SEA-DOO®

BRP

2011

Sea-Doo Boats
Shop Manual

150, 180, 200, 210, 230 Series

219 100 540

2011
Sea-Doo® Boats
Shop Manual

150, 180, 200, 210 and 230 SERIES

SEA-DOO

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Valcourt (Quebec) Canada

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SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2011 Sea-Doo® Boats as described in the model list in the *INTRODUCTION*.

This edition was primarily published to be used by technicians who are already familiar with all service procedures relating to BRP products. Technicians should attend training courses given by BRPTI.

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

The contents of this manual depicts parts and procedures applicable to the particular product at the time of writing. Service and warranty bulletins may be published to update the content of this manual. Dealer modifications that were carried out after manufacturing of the product, whether or not authorized by BRP, are not included.

It is understood that certain modifications may render use of the boat illegal under existing federal, provincial and state regulations.

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

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

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

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

⚠ WARNING

Indicates a potential hazard that, if not avoided, could result in serious injury or death.

⚠ CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates an instruction which, if not followed, could result in severe damage to vehicle components or other property.

NOTE: Indicates supplementary information required 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.

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

BRP disclaims liability for all damages and/or injuries resulting from the improper use of the contents. We strongly recommend that any services be carried out and/or verified by a highly skilled professional mechanic.

INTRODUCTION

This manual covers the following BRP made 2011 Sea-Doo Boats models.

MODEL	ENGINE	MODEL NUMBER
150 Speedster	155	97BA, 97BB, 97BC, 97BD
	255	99BA, 99BB, 99BC, 99BD
180 Challenger	215	86BE, 86BF
180 Challenger SE	215	86BA, 86BB, 86BC 86BD, 86BG, 86BH
	255	87BA, 87BB, 87BC 87BD, 87BE, 87BF
200 Speedster	2 x 255	68BA, 68BB, 68BU
210 Challenger	2 x 155	58BE, 58BF
210 Challenger SE	2 x 155	58BA, 58BB, 58BC, 58BD, 58BG, 58BH
	2 x 215	59BA, 59BB, 59BC, 59BD, 59BG, 59BH, 59BU
210 SP	2 x 155	58BN
210 Wake	2 x 155	58BW
	2 x 215	59BW
230 Challenger	2 x 155	77BA, 77BB
230 Challenger SE	2 x 155	77BC, 77BD, 77BE, 77BF, 77BG, 77BH
	2 x 215	78BA, 78BB, 78BE, 78BF, 78BJ, 78BK
	2 x 255	79BA, 79BB, 79BE, 79BF, 79BJ, 79BK, 79BU
230 SP	2 x 215	78BN
230 Wake	2 x 215	78BW
	2 x 255	79BW, 79BY

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

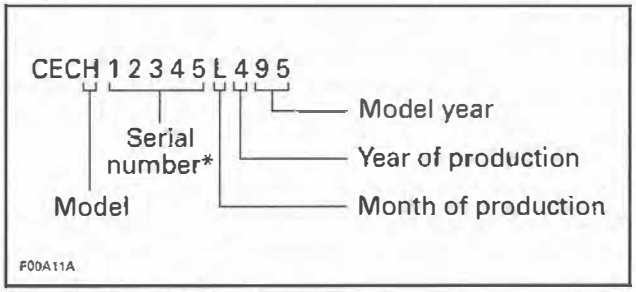
Due to late changes, there may be some differences between the manufactured product and the description and/or specifications in this document.

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

BOAT INFORMATION

HULL IDENTIFICATION NUMBER (H.I.N.)

The Hull Identification Number is composed of 13 digits:



*A letter may also be used as a digit.

It is located at right hand rear side of hull.

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

ENGINE IDENTIFICATION NUMBER (E.I.N.)

The Engine Identification Number is located on front end of the engine.

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

ENGINE EMISSIONS INFORMATION

Manufacturer's Responsibility

Since production of the 1999 model year engines, manufacturers of marine engines are required to 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 servicing all 1999 and more recent Sea-Doo Boats 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.

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 else 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 Boats manufactured by BRP are certified to the EPA standards as conforming to the requirements of the regulations for the control of air pollution emitted from new engines. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

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

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

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

INTERNET: http://www.epa.gov/otaq/

E-MAIL: otaqpublicweb@epa.gov

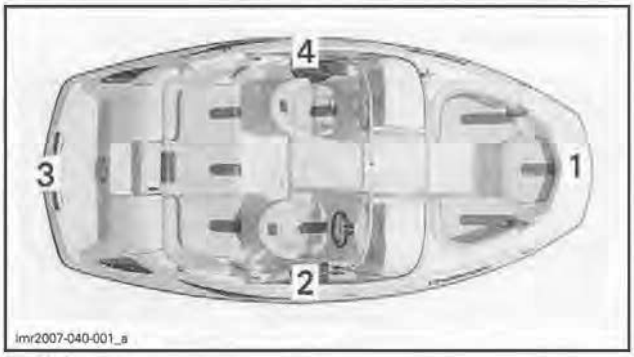
MANUAL INFORMATION

MANUAL PROCEDURES

Many of the procedures in this manual are interrelated. Before undertaking any task, you should 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 commencing any procedure, be sure that you have on hand all the tools required, or their approved equivalents.

In the marine industry, FRONT is called BOW, REAR is called STERN, RIGHT is called STARBOARD and LEFT is called PORT. They always refer to the operator's position sitting in boat.



TYPICAL
1. *BOW (front)*
2. *STARBOARD (right side)*
3. *STERN (rear)*
4. *PORT (left side)*

Other common terms used in the marine industry are the BOW (front of the boat), and the STERN (rear of the boat).

This manual uses technical terms which may be different from the ones in the *PARTS CATALOGS*.

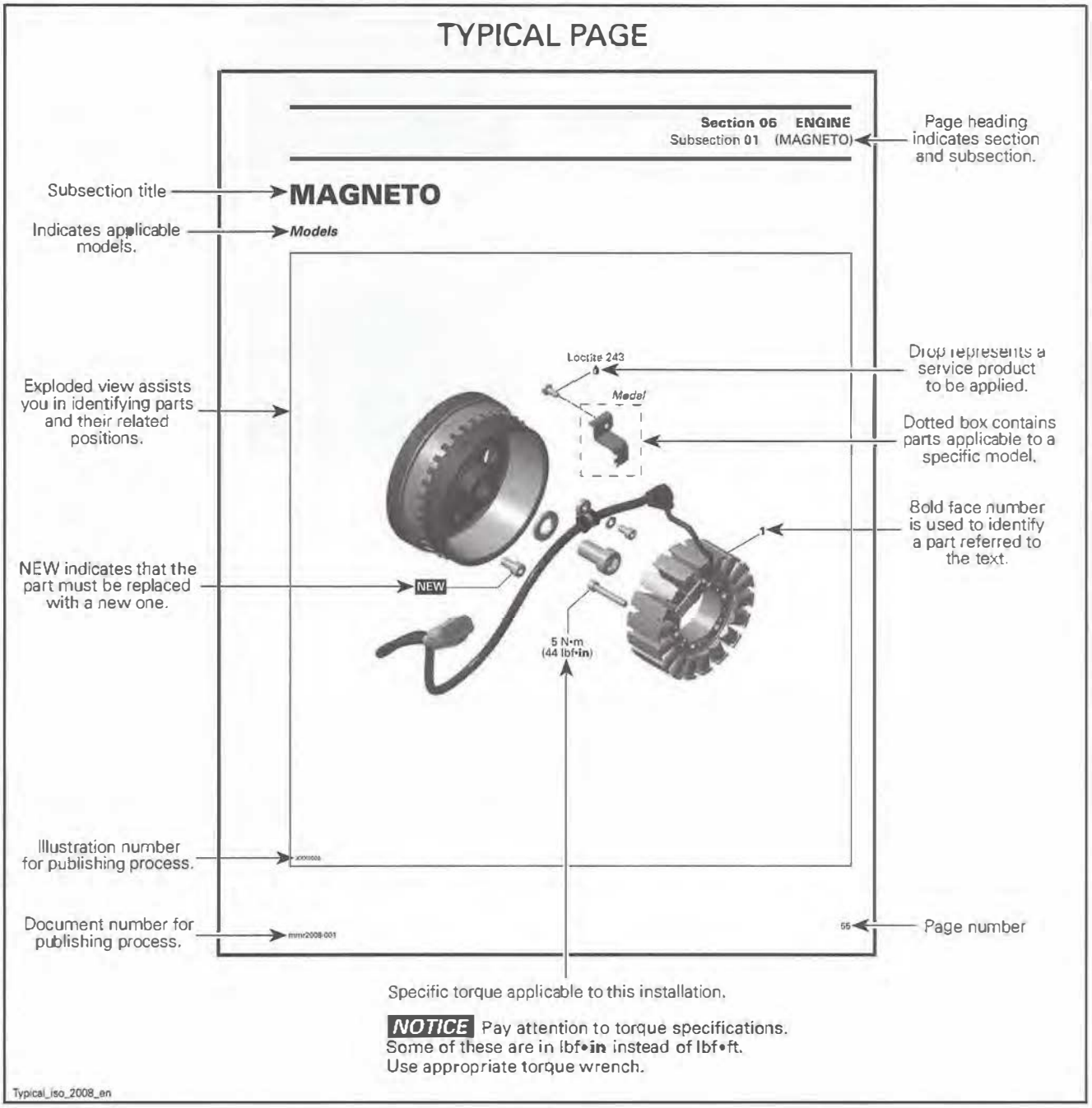
When ordering parts always refer to the specific model *PARTS CATALOGS*.

MANUAL LAYOUT

This manual is divided into many major sections as can be seen in the main table of contents at the beginning of the manual.

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

Illustrations and photos show the typical construction of various assemblies and, in all cases, may not reproduce the full detail or exact shape of the parts used in a particular model vehicle. However, they represent parts which have the same or a similar function.



TYPICAL PAGE

Tittle in bold indicates category of information to be carried out.

GENERAL

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

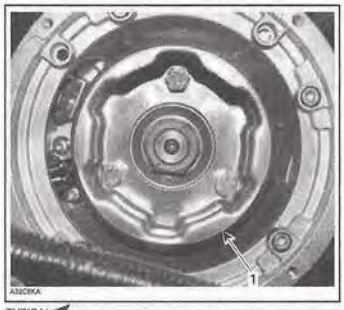
During assembly/installation, use the torque values and service products as in the exploded views.

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

Reference to a specific section or subsection.

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be replaced with new ones.



TYPICAL
1. Starting pulley

"TYPICAL" indicates a general view which may not represent exact details.

Call-outs pertaining to above illustration.

PROCEDURES

Indicates component procedures apply to.

MAGNETO FLYWHEEL

Magneto Flywheel Cleaning

Clean all metal components in a non-ferrous metal cleaner.

CAUTION: Clean magneto flywheel using only a clean cloth.

Indicates specific procedure to be carried out.

Magneto Flywheel Removal

Remove muffler, refer to the *EXHAUST SYSTEM* section.

Remove acoustic panel.

Remove rewind starter.

Remove starting pulley no. 2.

NOTE: To remove starting pulley bolts, hold magneto flywheel with a socket as shown.

TYPICAL

Illustration always follows text to which it applies.

Models

Italic bold face typesetting indicates a procedure applicable to a specific model(s).

Remove the connecting flange retaining the rewind starter to the engine housing.

Bold face number following part name refers to exploded view at beginning of subsection.

mmr2008-001 57

typical_txt_2008_en

TIGHTENING TORQUE

Tighten fasteners to the torque specified in the exploded view(s) and/or in the written procedure. When a torque is not specified, the torque normally recommended for a specific fastener should be used. Refer to the following table.

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices must be replaced when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.).

In order to avoid a poor assembly, tighten screws, bolts, or nuts in accordance with the following procedure:

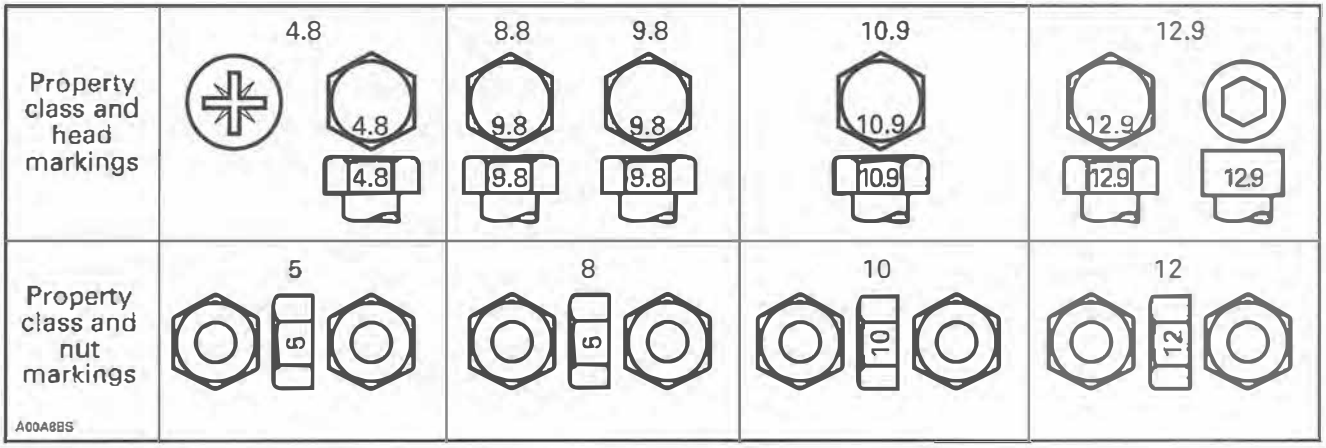
1. Manually screw all screws, bolts and/or nuts.
2. Apply half the recommended torque value.

NOTICE **Be sure to use the recommended tightening torque for the specified fastener used.**

NOTE: When possible, always apply torque on the nut.

3. Tighten fastener to the recommended torque value.

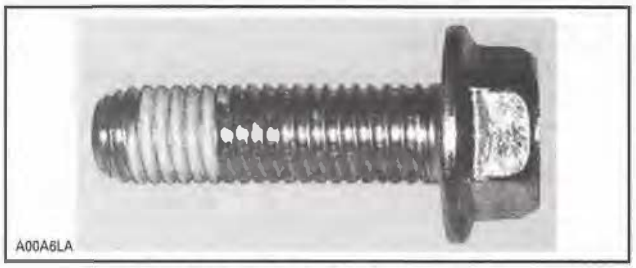
NOTE: Always torque screws, bolts and/or nuts using a crisscross pattern when multiple fasteners are used to secure a part (eg. a cylinder head). Some parts must be torqued according to a specific sequence and torque pattern as detailed in the installation procedure.



FASTENER SIZE	FASTENER GRADE/TORQUE			
	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 – 2 N•m (13 – 18 lbf•**in**)	2.5 – 3 N•m (22 – 27 lbf•**in**)	3.5 – 4 N•m (31 – 35 lbf•ft)	4 – 5 N•m (35 – 44 lbf•ft)
M5	3 – 3.5 N•m (27 – 31 lbf•ft)	4.5 – 5.5 N•m (40 – 47 lbf•ft)	7 – 8.5 N•m (62 – 75 lbf•ft)	8 – 10 N•m (71 – 89 lbf•ft)
M6	6.5 – 8.5 N•m (58 – 75 lbf•ft)	8 – 12 N•m (71 – 106 lbf•ft)	10.5 – 15 N•m (93 – 133 lbf•**in**)	16 N•m (142 lbf•**in**)
M8	15 N•m (133 lbf•**in**)	25 N•m (18 lbf•ft)	32 N•m (24 lbf•ft)	40 N•m (30 lbf•ft)
M10	29 N•m (21 lbf•ft)	48 N•m (35 lbf•ft)	61 N•m (45 lbf•ft)	73 N•m (54 lbf•ft)
M12	52 N•m (38 lbf•ft)	85 N•m (63 lbf•ft)	105 N•m (77 lbf•ft)	128 N•m (94 lbf•ft)
M14	85 N•m (63 lbf•ft)	135 N•m (100 lbf•ft)	170 N•m (125 lbf•ft)	200 N•m (148 lbf•ft)

FASTENER INFORMATION

SELF-LOCKING FASTENERS PROCEDURE



TYPICAL — SELF-LOCKING FASTENER

The following describes common procedures used when working with self-locking fasteners.

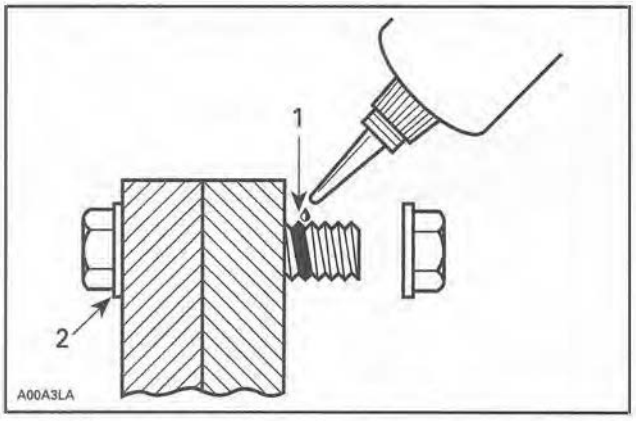
Use a metal brush or a tap to clean the hole properly then use a solvent. Allow the solvent time to act, approximately 30 minutes, then wipe off. Solvent utilization is to ensure proper adhesion of the product used for locking the fastener.

LOCTITE® APPLICATION PROCEDURE

The following describes common procedures used when working with Loctite products.

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

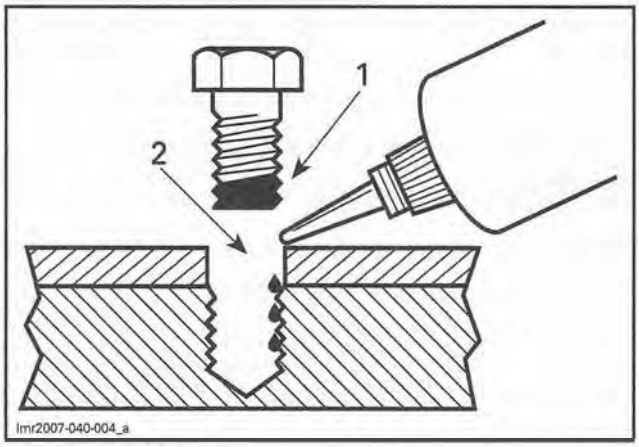
Threadlocker Application for Uncovered Holes (Bolts and Nuts)



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.

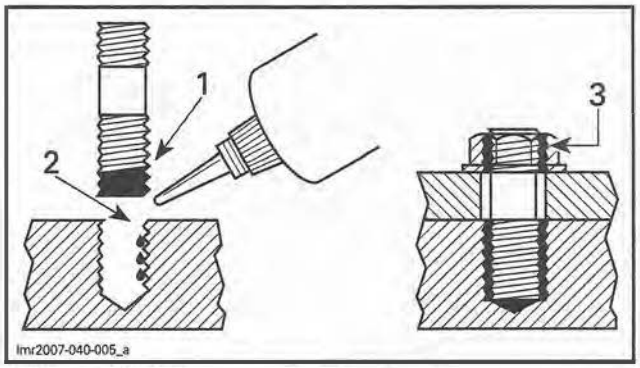
Threadlocker Application for Blind Holes



1. On fastener 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.

Threadlocker Application for Stud Installation in Blind Holes



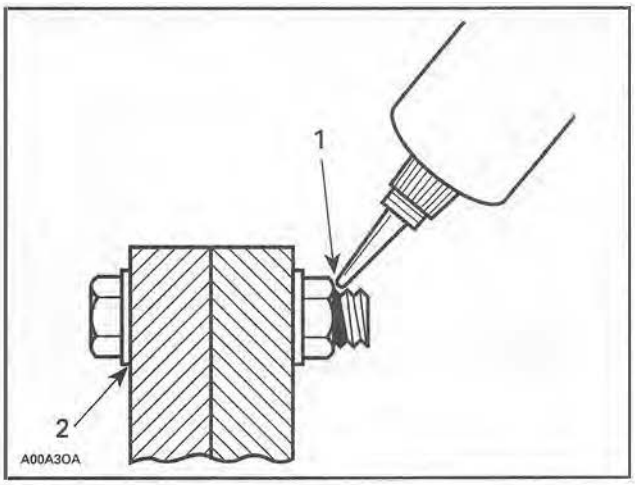
1. On stud threads
2. On threads and in the hole
3. On retaining nut threads

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 2 or 3 drops of proper strength Loctite threadlocker on female threads and in hole.

NOTE: To avoid a hydro lock situation, do not apply too much Loctite.

4. Apply several drops of proper strength Loctite on stud threads.
5. Install stud.
6. Install cover, part, etc.
7. Apply a few drops of proper strength Loctite on uncovered stud threads.
8. Install and tighten retaining nut(s) as required.

Threadlocker Application for Pre-Assembled Parts

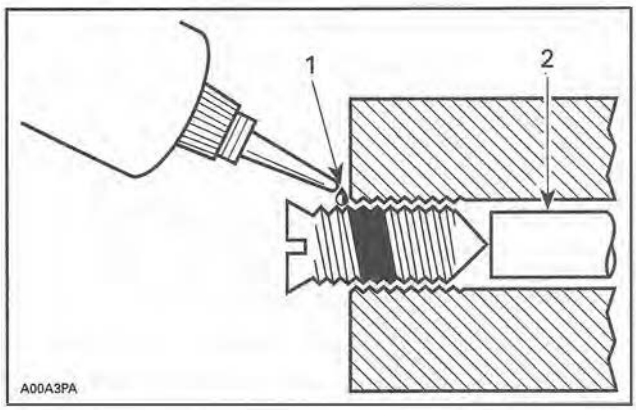


1. Apply here
2. Do not apply

1. Clean bolts and nuts with solvent.
2. Assemble components.
3. Tighten nuts.
4. Apply a few 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.

Threadlocker Application for an Adjustment Screw

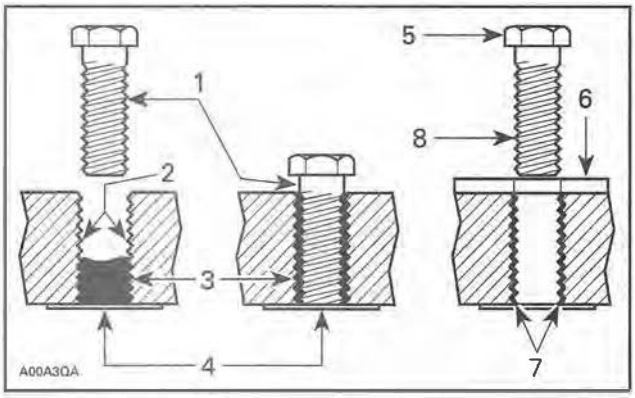


1. Apply here
2. Plunger

1. Adjust screw to proper setting.
2. Apply a few 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)).

Application for Stripped Thread Repair



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

Standard Thread Repair

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

If a plate is used to align bolt:

1. Apply release agent on mating surfaces.
2. 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

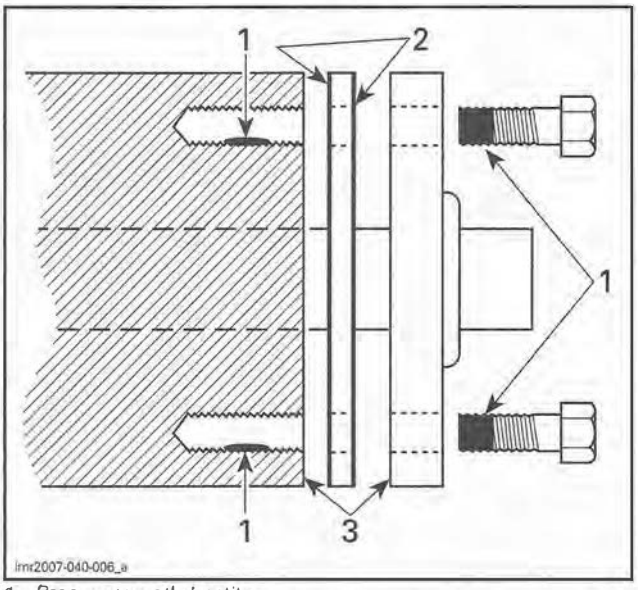
Option 1: Enlarge damaged hole, then follow *STANDARD THREAD REPAIR* procedure.

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

Permanent Stud Installation (Light Duty)

1. Use a stud of the desired thread length.
2. DO NOT apply release agent on stud.
3. Follow Standard Thread Repair procedure.
4. Allow 30 minutes for Loctite FORM-A-THREAD to cure.
5. Complete part assembly.

Gasket Compound Application



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 using LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500). Use a mechanical means only 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 and allow to dry 1 or 2 minutes.
4. Apply LOCTITE 518 (P/N 293 800 038) on both sides of gasket, using a clean applicator.
5. Place gasket on mating surfaces and assemble parts immediately.

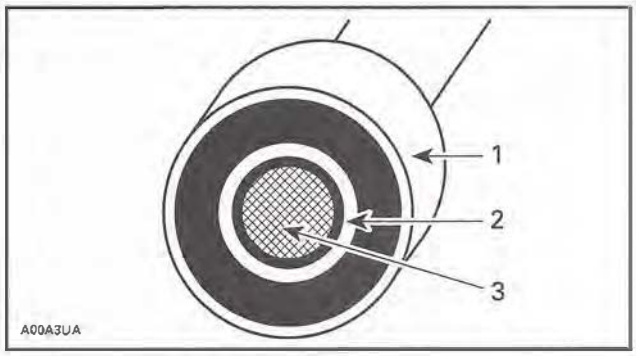
NOTE: If the cover is bolted to blind holes, apply proper strength Loctite in the hole and on threads. Tighten fastener.

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

6. Tighten as usual.

Threadlocker Application for Mounting on a Shaft

Mounting with a Press



1. Bearing
2. Proper strength Loctite
3. Shaft

1. Clean shaft external contact surface.
2. Clean internal contact surface of part to be installed on shaft.
3. Apply a strip of proper strength Loctite on circumference of shaft contact surface at insertion or engagement point.

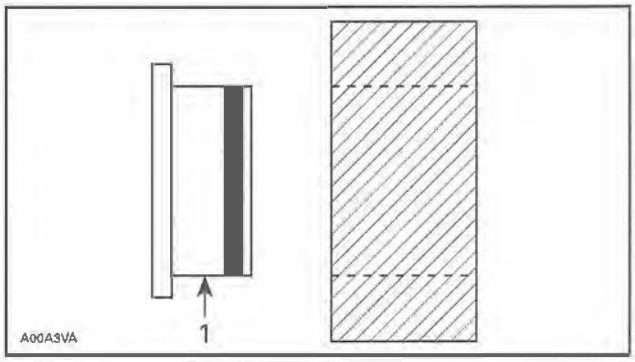
NOTE: Retaining compound is always forced out when applied on shaft.

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

Mounting in Tandem

1. Apply retaining compound on internal contact surface (bore) of parts to be installed.
2. Continue parts assembly as per previous illustration.

Threadlocker Application for 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 excess product.
6. Allow 30 minutes for product to cure.

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.

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(P/N 529 036 174)

ENGINE ALIGNMENT PLATE
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ENGINE LEAK DOWN TEST KIT
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FLOATING RING TOOL (TYPE I)
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FLOATING RING TOOL (TYPE III)
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KOSTAL DIE
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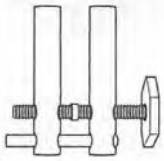
LARGE HOSE PINCHER
(P/N 529 032 500)



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MPI-2 DIAGNOSTIC CABLE
(P/N 710 000 851)

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MPI-2 INTERFACE CARD
(P/N 529 036 018)

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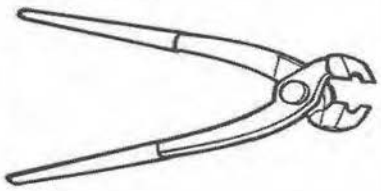
OETIKER PLIERS
(P/N 295 000 070)



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OIL SEAL GUIDE
(P/N 529 035 822)

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PISTON CIRCLIP INSTALLER
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PRESSURE CAP
(P/N 529 036 172)

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PRESSURE GAUGE
(P/N 529 035 709)

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PTO SUPPORT TOOL
(P/N 529 035 842)

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SERVICE TOOLS INDEX

SEAL/BEARING PUSHER
(P/N 529 035 819)

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SPRING INSTALLER/REMOVER (SMALL)
(P/N 529 035 989)

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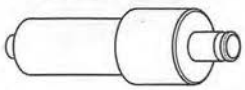
STARTER DRIVE SEAL PUSHER
(P/N 420 876 502)



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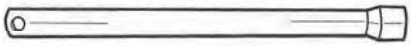
STEERING CABLE TOOL
(P/N 295 000 145)



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STRAIGHT FITTING
(P/N 293 710 037)

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SUCTION PUMP
(P/N 529 035 880)

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SUPERCHARGER GEAR HOLDER
(P/N 529 036 025)

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SUPERCHARGER OIL SPRAY NOZZLE TOOL
(P/N 529 036 134)

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SUPERCHARGER RETAINING KEY
(P/N 529 036 027)

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SUPERTANIUM DRILL BIT 3/16"
(P/N 529 031 800)

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SUPPORT PLATE
(P/N 529 035 947)

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TEST CAP
(P/N 529 035 991)

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TORX ADAPTER
(P/N 529 035 938)

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VACUUM/PRESSURE PUMP
(P/N 529 021 800)

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VALVE GUIDE PUSHER (6 MM)
(P/N 529 036 087)

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VALVE GUIDE REMOVER (6 MM)
(P/N 529 036 086)

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VALVE SPRING COMPRESSOR CUP
(P/N 529 036 073)

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VALVE SPRING COMPRESSOR
(P/N 529 035 724)

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WATER PUMP SEAL PUSHER
(P/N 529 035 823)

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BREAK-IN INSPECTION

BRP recommends that the maintenance or inspection items listed in the following table be carried out immediately after the first 10 hours of operation (break-in period).

NOTE: Some maintenance or inspection items listed in the following maintenance schedule may not be applicable to every boat model (e.g.: supercharger components). Follow maintenance schedule as applicable to boat model.

BREAK-IN INSPECTION CHART	INSPECT	CLEAN	LUBRICATE	ADJUST	REPLACE
ENGINE					
Engine oil and filter					X
Rubber mounts	X				
Corrosion protection			X		
Supercharger clutch	X				
EXHAUST SYSTEM					
Exhaust system fasteners, hoses and components condition. Also inspect for leaks	X				
COOLING SYSTEM					
Hose and fasteners	X				
Coolant	X				
FUEL SYSTEM					
Fuel lines, connections and pressure relief valve	X				
Fuel system leak test	X				
Throttle body	X				
Throttle cable	X				
Fuel tank straps	X				
ELECTRONIC MANAGEMENT SYSTEM					
EMS sensors	X				
Fault codes	X				
ELECTRICAL SYSTEM					
Spark plugs	X				
Electrical connections and fastening (ignition system, starting system, fuel injectors, fuse boxes etc.)	X				
Engine cut-off switch	X				
Main battery cut-off switch	X				
Battery support	X				
STEERING SYSTEM					
Steering cable and connections	X				
Steering nozzle bushings	X				

BREAK-IN INSPECTION CHART	INSPECT	CLEAN	LUBRICATE	ADJUST	REPLACE
PROPULSION SYSTEM					
Shifter system, cable and connections	X				
Carbon ring and rubber boot (drive shaft)	X				
Impeller boot	X				
Impeller and impeller wear ring clearance	X				
HULL and BODY					
Storage compartment cover(s), locks, latch(es) and hinge(s)	X		X		
Windscreen and fasteners	X				
Drain plug (inside bilge). Check for obstruction	X				
Bilge pump. Check for debris around bilge pump area.	X	X			
Ski/wakeboard attachment (tower, ski pole or tow hook) and fasteners	X				

PERIODIC MAINTENANCE SCHEDULE

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

NOTE: The schedule provides an equivalence between number of hours and months/year. Maintenance operations should be carried out following whichever time frame comes due first.

IMPORTANT: Boat rental operations or intensive use of boat, will require greater frequency of inspection and maintenance.

A: ADJUST **C: CLEAN** **I: INSPECT** **L: LUBRICATE** **R: REPLACE** **D: DEALER** **O: OPERATOR** PART/TASK	**EVERY 25 HOURS** **EVERY 50 HOURS** **EVERY 100 HOURS OR PRESEASON** **EVERY 200 HOURS OR 2 YEARS** **TO BE PERFORMED BY**					LEGEND
ENGINE						
Engine oil and filter			R (1)		D	(1) At storage period or after 100 hours of use whichever comes first. (2) Inspect slipping moment. (3) Every 10 hours in salt water use.
Rubber mounts		I			D	
Supercharger clutch (215 and 255 engines)				I (2)	D	
Corrosion protection			L (3)		O	
EXHAUST SYSTEM						
Exhaust system fasteners, hoses and components condition	I		I (4)		D	(1) At storage period or after 100 hours of use whichever comes first. (4) Also inspect for leaks. (5) Daily flushing in salt water or foul water use.
Exhaust system flushing	(1) (5)				O	
COOLING SYSTEM						
Hose and fasteners			I		D	—
Coolant				R	D	
FUEL SYSTEM						
Throttle cable (150, 180 and 200 Series)			I (3)		D	(3) Every 10 hours in salt water use.
Throttle body (150, 180 and 200 Series)			I, L (3)		O/D	
Throttle body (210 and 230 Series)			I (3)		O/D	
Fuel lines, connections, pressure relief valve and fuel system leak test			I		D	
Fuel tank straps			I		D	

A: ADJUST **C: CLEAN** **I: INSPECT** **L: LUBRICATE** **R: REPLACE** **D: DEALER** **O: OPERATOR**	**EVERY 25 HOURS**	**EVERY 50 HOURS**	**EVERY 100 HOURS OR PRESEASON**	**EVERY 200 HOURS OR 2 YEARS**	**TO BE PERFORMED BY**	
PART/TASK						LEGEND
ENGINE MANAGEMENT SYSTEM (EMS)						
EMS sensors			I		D	—
EMS fault codes			I		D	
AIR INTAKE SYSTEM						
Air filter			I (6)		D	(6) Replace if required
ELECTRICAL SYSTEM						
Spark plugs			I	R	D	
Ignition coils			I, L (3)		D	
Electrical connections (ignition system, starting system, fuel injectors etc.)			I		D	
ECM and VCM connectors (visual inspection without disconnecting)			I (3)		O	
Digitally Encoded Security System (D.E.S.S.) (150, 180 and 200 Series)			I		D	(3) Every 10 hours in salt water use.
Emergency Engine Stop Switch (210 and 230 Series)			I		D	
Main battery cut-off switch			I		D	
Battery support			I		D	
Battery			I		D	
Battery posts			L		D	
Stern light connectors			L		O	
STEERING SYSTEM						
Steering cable and connections			I		D	—
Steering nozzle bushings			I		D	

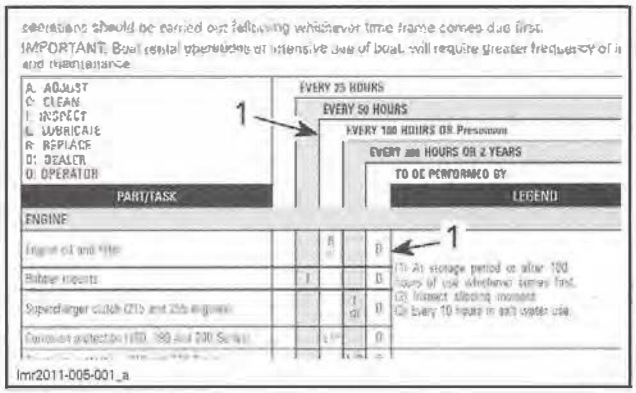
A: ADJUST **C: CLEAN** **I: INSPECT** **L: LUBRICATE** **R: REPLACE** **D: DEALER** **O: OPERATOR**	**EVERY 25 HOURS** **EVERY 50 HOURS** **EVERY 100 HOURS OR PRESEASON** **EVERY 200 HOURS OR 2 YEARS** **TO BE PERFORMED BY**					
PART/TASK						LEGEND
PROPULSION SYSTEM						
Drive shaft			L (3) (7)		D	(3) Every 10 hours in salt water use. (7) Lubricate for corrosion protection (8) Inspect each month (every two weeks in salt water) and change when necessary.
Carbon ring and rubber boot (drive shaft)		I			D	
Shifter system, cable and connections			I		D	
Reverse gate		L (3)			O	
Drive shaft/impeller splines			I, L		D	
Impeller boot			I		D	
Impeller shaft seal, sleeve and O-ring			I (3)		D	
Impeller and wear ring clearance		I			D	
Sacrificial anode	(8)				O	
HULL/BODY						
Storage compartment(s) cover lock(s), latch(es) and hinge(s)			I, L (3)		O	(3) Every 10 hours in salt water use. (9) Check for obstructions.
Windscreen and fasteners (180, 210 and 230 Series)	I		I		O	
Ride shoes condition (150 and 180 Series)			I		O	
Deck drains/scupper valve			I		O	
Drain plug (inside bilge)			I (9)		O	
Ski/wakeboard attachment (tower, ski pole or tow hook) and fasteners		I, L (3)			O	

PRESEASON PREPARATION

Proper boat preparation is necessary after the winter months or when a boat has not been used during 4 months.

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

Referring to the maintenance schedule, carry out the maintenance procedures for every item specified in the columns 100 HOURS OR 1 YEAR, and TO BE PERFORMED BY.



1. Use these columns

Perform a fuel system leak test and a fuel pump pressure test as described in the *FUEL TANK AND FUEL PUMP* subsection.

NOTE: It is of the utmost importance to inspect the fuel system.

Furthermore, proceed with the following:

Boat Prepared as per Storage Procedure

- Ensure battery is fully charged.
- Reinstall the battery.
- Test ride boat to confirm proper operation.

Boat Not Prepared as per Storage Procedure

- Ensure battery is fully charged.
- Replace engine oil and filter.
- Reinstall the battery.
- Test ride boat to confirm proper operation.

STORAGE PROCEDURE

SERVICE PRODUCTS

Description	Part Number	Page
XPS FUEL STABILIZER	413 408 601	15
XPS LUBE	293 600 016	15, 17
XPS WASH AND WAX (BOAT/PWC)	219 701 711	17

PROCEDURES

PROPULSION SYSTEM

Jet Pump Cleaning

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

⚠ WARNING

Always remove tether cord from the engine cut-off switch to prevent unexpected engine starting before cleaning the jet pump area. Engine must not be running for this operation.

Jet Pump Inspection

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

FUEL SYSTEM

Fuel System Inspection

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

Fuel System Protection

The XPS FUEL STABILIZER (P/N 413 408 601) or equivalent should be added in fuel tank to prevent fuel deterioration and fuel system gumming. Follow manufacturer's instructions for proper use.

NOTICE **Fuel stabilizer should be added prior to engine lubrication to ensure fuel system component protection against varnish deposits.**

Fill up fuel tank.

⚠ WARNING

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

ENGINE

Engine Oil and Filter Replacement

Change engine oil and filter. Refer to *LUBRICATION SYSTEM* subsection.

Intercooler Draining (255 Engine)

It is important to expel any trapped water that may have accumulated from condensation in the external intercooler.

Proceed as follows:

1. Remove the intake hose from throttle body.

TYPICAL
1. *Intake hose (from intercooler)*
2. *Throttle body*

2. Start and rev up the engine to 4000 RPMs several times.

WATER EXPELLED FROM INTERCOOLER

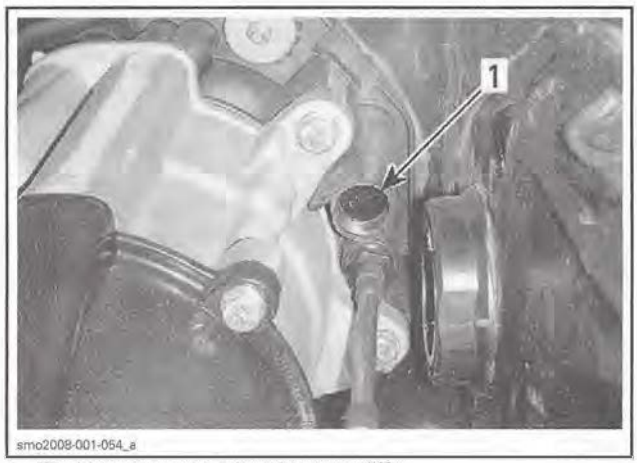
3. Stop engine.
4. Liberally lubricate throttle body inside and out.
5. Clean off any lubrication on the throttle body intake hose flange.
6. Install air intake hose to the throttle body.

Exhaust System Protection

The exhaust system is self draining, but the exhaust manifold needs to be drained to avoid damages should the boat be stored in an area where the temperature attains the freezing point of water.

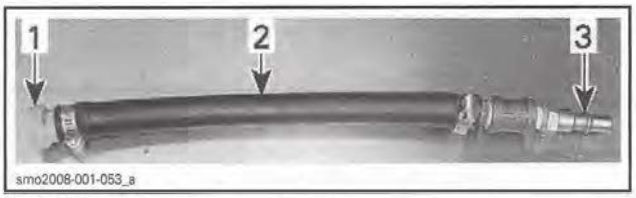
NOTE: On 215 engine, it also protects the intercooler.

Using the flushing connector located at the rear of boat, inject pressurized air (at 380 kPa (55 PSI)) in the system until there is no more water flowing from jet pump.



1. Flushing connector - location may differ

The following hose can be fabricated to ease draining procedure.



TYPICAL
1. Flushing adaptor (P/N 295 500 473)
2. Hose 13 mm (1/2 in)
3. Air hose male adapter

NOTICE **Failure to drain the exhaust manifold may cause severe damage to components.**

Engine Coolant Replacement

Antifreeze should be replaced every 200 hours or every two years to prevent antifreeze deterioration.

NOTICE **Failure to replace the antifreeze as recommended may allow its degradation that could result in poor engine cooling.**

If coolant is not replaced, test the coolant density using an antifreeze hydrometer.

Replace coolant if necessary. For the coolant replacement procedure, refer to *COOLING SYSTEM* subsection.

NOTICE **Improper antifreeze density may result in coolant freezing should the vehicle be stored in area where the freezing point is attained. This could seriously damage the engine.**

Engine Internal Lubrication

Engine must be lubricated to prevent corrosion on internal parts.

Lubrication of the engine is recommended at the end of the season and before any extended storage period to provide additional corrosion protection. This will lubricate the engine intake valves, the cylinders and the exhaust valves.

To lubricate the engine, proceed as follows:

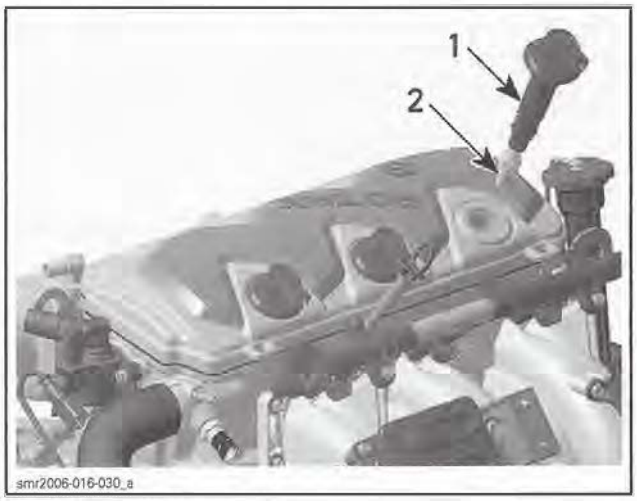
1. Disconnect ignition coil connectors.

⚠ WARNING

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

NOTICE Never cut the locking ties of ignition coil connectors. This would allow mixing of the wires between cylinders.

2. Clean the area around the ignition coils to avoid dirt falling into a cylinder.
3. Remove ignition coils.
4. Unscrew spark plugs.
5. Using an ignition coil as a puller, remove spark plugs.



1. *Ignition coil*
2. *Spark plug*

6. Spray XPS LUBE (P/N 293 600 016) into each spark plug hole.
7. Crank the engine a few turns to distribute the oil on cylinder wall.

NOTE: To crank engine, use the drowned mode to avoid injecting fuel. Refer to *DROWNED MODE* in *ENGINE MANAGEMENT SYSTEM* subsection for proper procedure.

8. Reinstall spark plugs and ignition coils.

NOTE: Refer to *IGNITION SYSTEM* subsection for details on installing the spark plugs and ignition coils.

9. Reconnect ignition coil connectors.
10. Install all other removed parts.

ELECTRICAL SYSTEM

Battery Removal

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

ENGINE COMPARTMENT

Engine Compartment Cleaning

1. Clean the bilge with hot water and a mild detergent, or using bilge cleaner.
2. Rinse thoroughly.
3. Lift front end of boat to completely drain bilge.

Anticorrosion Treatment

Wipe off any residual water in the engine compartment.

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

BODY AND HULL

Body and Hull Cleaning

Wash body and hull using the XPS WASH AND WAX (BOAT/PWC) (P/N 219 701 711) or with a soap and water solution (only use a mild detergent). Rinse thoroughly with fresh water. Remove marine organisms from the hull.

NOTICE Never clean body parts or hull with strong detergent, degreasing agent, paint thinner, acetone, etc.

Dry the boat and upholstery thoroughly before storing.

Replace damaged labels/decals.

Body and Hull Repair

If any repair is required, refer to *HULL* subsection.

Body and Hull Protection

Apply a good quality marine wax on body and hull.

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

NOTICE The boat should never be left in water for storage or stored in direct sunlight.

SPECIAL PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
LARGE HOSE PINCHER	529 032 500	19, 21–22
SUCTION PUMP	529 035 880	20

GENERAL

Refer to the following special procedures according to the specific event.

PROCEDURES

TOWING THE BOAT IN WATER

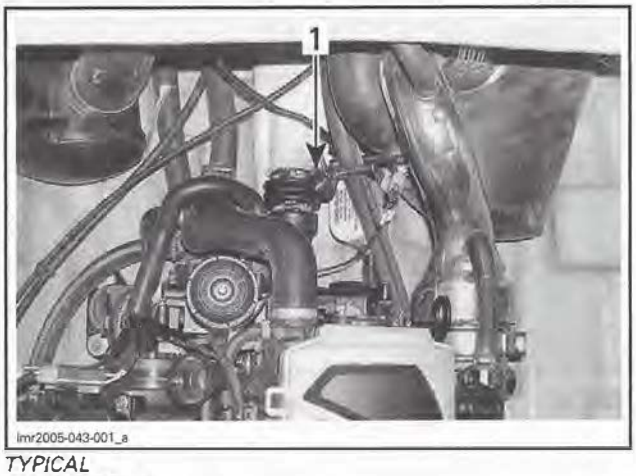
Special precautions should be taken when towing a Sea-Doo boat in water.

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

NOTE: This procedure must be followed for both engines.

When towing a Sea-Doo boat in water, pinch the water supply hose cooling the intercooler (if applicable) and exhaust system.

REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 529 032 500)	



TYPICAL
1. Hose pincher

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

NOTICE Failure to do this may result in damage to the engine. If you must tow a stranded sport boat 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).

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

SUBMERGED BOAT

NOTICE Never try to crank or start engine. Water trapped in the intake manifold would flow towards the engine and possible cause severe engine damage.

Drain bilge.

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

Check for water in the intake system. If water found in the intake system, refer to *WATER-FLOODED ENGINE* in this subsection.

Engine Lubrication

Refer to *WATER-FLOODED ENGINE* in this subsection.

Fuel Inspection

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

WATER-FLOODED ENGINE

NOTE: This procedure must be followed for both engines.

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

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

NOTICE

- **Never try to crank or start the engine. Water trapped in the intake manifold would enter the combustion chambers through the intake valves and may cause damage to the engine.**
- **A water-flooded engine must be properly drained, lubricant replaced (oil change), operated (boil out procedure), then lubricant replaced again, otherwise parts will be seriously damaged.**

If water is suspected to be in the intake and the exhaust system, it must be drained as follows:

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

Exhaust System Draining

If water is suspected to be in the exhaust system, remove the exhaust pipe and muffler. Drain them or siphon the water out of them. Refer to *EXHAUST SYSTEM*.

Intake System Draining

If water is suspected to be in the intake silencer, empty it. Refer to *AIR INTAKE SYSTEM* subsection.

On **215 and 255 engines**, check for water intrusion in the supercharger inlet hose. Remove hose to empty it.

Remove the water from blow-by valve hose.

If water is suspected in the intake manifold, remove the intake manifold and drain it. Then siphon the water out from the intake valve ports. Refer to *INTAKE MANIFOLD* subsection.

Throttle Body Lubrication

Throttle body should be lubricated flush out any water infiltration and to to prevent corrosion. Refer to *STORAGE PROCEDURE*.

Supercharger Servicing

215 and 255 Engines

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

Engine Oil and Filter Replacement

If the engine oil is contaminated with water (oil will be milky), change the engine oil and filter as per following procedure.

1. Siphon the contaminated oil from the engine reservoir through dipstick hole.

REQUIRED TOOL	
SUCTION PUMP (P/N 529 035 880)	

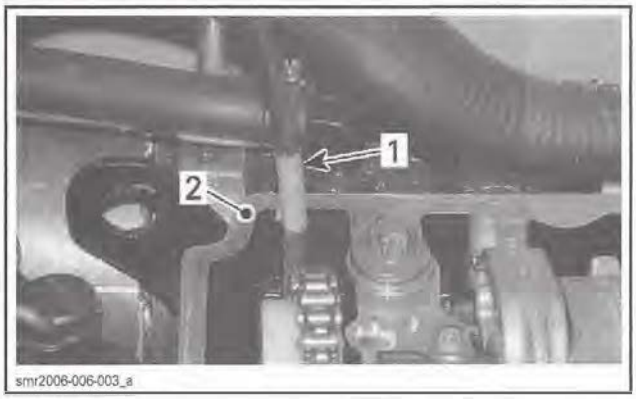
NOTICE Never crank or start engine when siphon tube is in dipstick hole. Never start engine when there is no oil in engine.

2. Remove the pump from the dipstick hole.
3. While in drowned engine mode, crank the engine for 5 seconds. Refer to *ENGINE MANAGEMENT SYSTEM* subsection for drowned mode details.
4. Remove the oil filter cap and the oil filter. Refer to *LUBRICATION SYSTEM* subsection.
5. Again, siphon the contaminated oil from the reservoir.
6. Remove cylinder head cover. Refer to *CYLINDER HEAD* subsection.

1. Cylinder head cover

7. The contaminated oil in the PTO area of the engine is siphoned using the same pump as above.
8. Put a tape at 400 mm (16 in) from the end of the pump tube.

9. Insert the tube in the PTO area until the tape reach the cylinder-block edge. Then, siphon contaminated oil out.



TYPICAL
1. Pump tube with tape
2. Edge of cylinder-block

10. Remove the pump tube.
11. Reinstall cylinder head cover.
12. Install a NEW oil filter and reinstall the oil filter cap.
13. Replenish the engine with appropriate amount of the recommended engine oil. Refer to *LUBRICATION SYSTEM* subsection.
14. Proceed with the boil out procedure below.

Boil Out Procedure

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

Procedure with Boat on Trailer in a Water Ramp

1. Connect the vehicle to B.U.D.S. to monitor the coolant temperature. It must exceed 100°C (212°F) in order for the water boil out. Once the boiling point is reached, it won't take long to evaporate the water.
2. Run the engine for 5 minutes at 3500 RPM.

⚠ WARNING

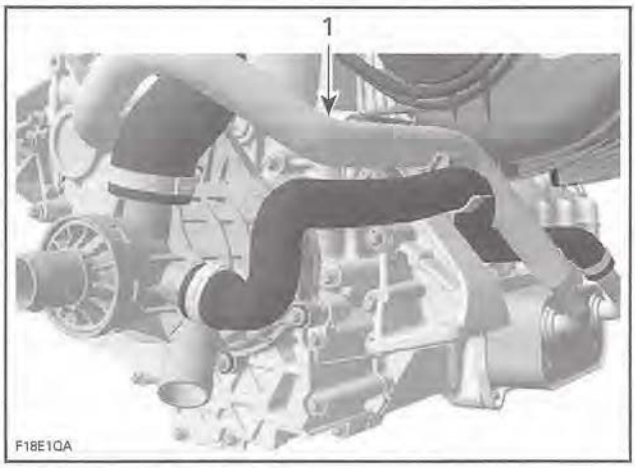
Make sure to safely secure the boat.

3. With the engine still running at 3500 RPM, pinch the coolant line going to the oil cooler.

REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 529 032 500)	

⚠ WARNING

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



1. Oil cooler coolant inlet hose

4. Continue to run the engine at 3500 RPM for 15 more minutes (20 minutes total run time).
5. Shut the engine off.
6. Remove the hose pincher from the coolant line.

NOTICE **Hose pincher must be removed prior to operating the boat. Failure to do this will result in damage to the engine.**

7. Change the oil and filter again.

Procedure is now complete.

Procedure with Boat on Trailer Connected to a Flush Kit

1. On drive shaft, remove the C-clip then move forward the ring seal carrier. Refer to *DRIVE SYSTEM* section.

NOTICE **Make sure that the ring seal carrier is not in contact with the PTO seal assembly, neither with the carbon ring.**

2. Connect the vehicle to B.U.D.S. to monitor the coolant temperature. It must exceed 100°C (212°F) in order for the water boil out. Once the boiling point is reached, it won't take long to evaporate the water.
3. Connect a flush kit to the coolant line.

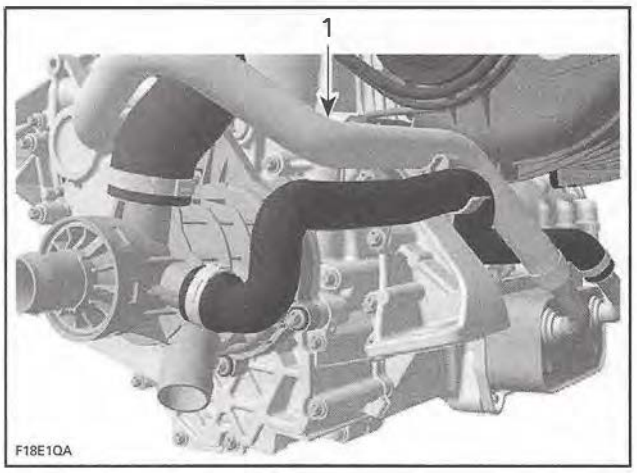
NOTICE Never run engine without supplying water to the exhaust cooling system when boat is out of water.

4. Run the engine for 5 minutes at 3000 RPM.
5. With the engine still running at 3000 RPM, pinch the coolant line going to the oil cooler.

REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 529 032 500)	

⚠ WARNING

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



1. Oil cooler coolant inlet hose

6. Continue to run the engine at 3000 RPM for 15 more minutes (20 minutes total run time).
7. Shut off the engine.
8. Remove the hose pincher from the coolant line.

NOTICE Hose pincher must be removed prior to operating the boat. Failure to do this will result in damage to the engine.

9. Change the oil and filter again.
10. Move rearward the ring seal carrier and reinstall the C-clip. Refer to *DRIVE SYSTEM* section.

Procedure is now complete.

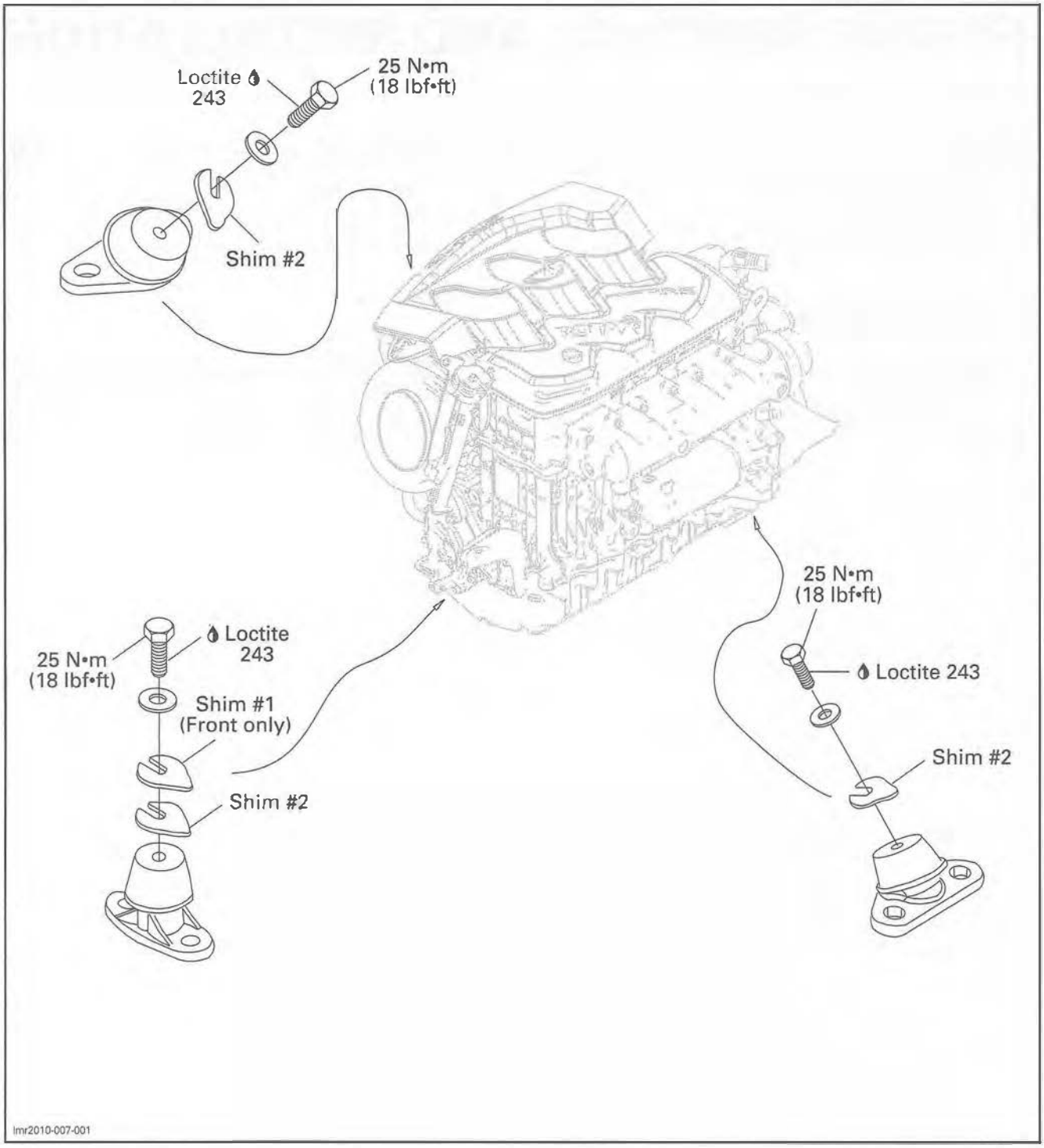
ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ALIGNMENT SHAFT ADAPTER	529 035 719	27
ALIGNMENT SHAFT SUPPORT	529 035 506	27
ALIGNMENT SHAFT	295 000 141	27
ENGINE ALIGNMENT PLATE	529 035 507	27

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	26, 28
PULLEY FLANGE CLEANER	413 711 809	26
XPS LUBE	293 600 016	27


Loctite 243
25 N•m
(18 lbf•ft)
Shim #2
25 N•m
(18 lbf•ft)
Loctite 243
Shim #1
(Front only)
Shim #2
25 N•m
(18 lbf•ft)
Loctite 243
Shim #2
lmr2010-007-001

GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must strictly be adhered to.
Locking devices must be replaced when removed (e.g.: locking tabs, elastic stop nuts, cotter pin, etc.).

NOTICE Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

ENGINE ACCESS

NOTE: Before removing the engine compartment cover, mark the position of the hinges and the retaining bolts for reinstallation.

NOTICE Always ask for help to hold engine compartment cover in order to avoid personal injuries.

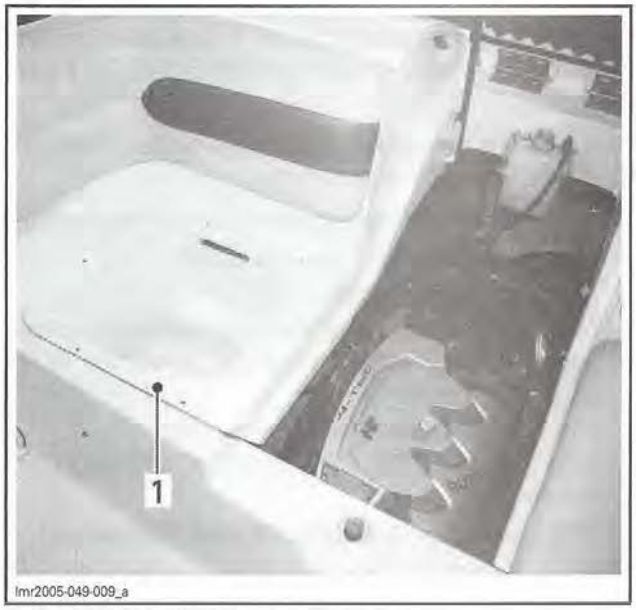
150, 200 and 210 Series

Remove the engine compartment cover and the storage tray.

180 Series

Remove the engine compartment cover and the storage tray.

Remove rear seat cushions and storage compartment baskets.

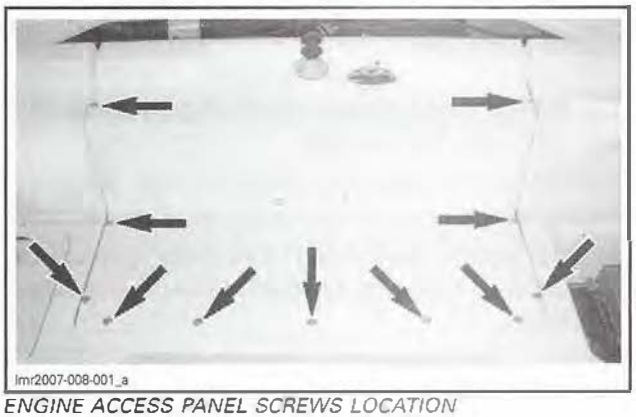


1. Starboard storage compartment basket

230 Series

Remove rear seat and backrest cushions.

Remove the engine access panel.



ENGINE ACCESS PANEL SCREWS LOCATION

NOTE: 2 more screws are located behind the top lip, inside engine compartment.

PROCEDURES

ENGINE

Engine Removal

Turn main cut-off switch to OFF and disconnect the battery.

Unplug fuel hose from fuel rail. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Drain coolant. Refer to *COOLING SYSTEM* subsection.

Detach the expansion tank from its support and temporarily tie it to engine.

On 210 series, remove the air intake silencer and its support. Refer to *AIR INTAKE SYSTEM* subsection.

Remove the supercharger (if applicable). Refer to *SUPERCHARGER* subsection.

Disconnect the following electrical components:
- The "B" connector from the ECM
- The engine connector
- The knock sensor and the magneto connectors (remove connector housings from the ECM support)
- The EGTS sensor from the muffler
- Fuel injector, CTS, CPS, TOPS, CAPS and OPS connectors
- TPS connector (**except 210 and 230 series**).

Unplug the following hoses from the engine:
- Air intake hose or air intake tube from the throttle body
- Exhaust hose from the muffler
- Blow-by valve hose
- Both hoses from the intercooler (**215 engine**
- Water hoses from the exhaust manifold
- Heat exchanger hoses from water pump housing.

Disconnect throttle cable from throttle body (**except 210 and 230 series**).

Disconnect the 3 ground cables on the front end of engine.

On 230 series, disconnect the other ground cable located on cylinder corner, behind the exhaust manifold.

Move muffler backward. Refer to *EXHAUST SYSTEM* subsection.

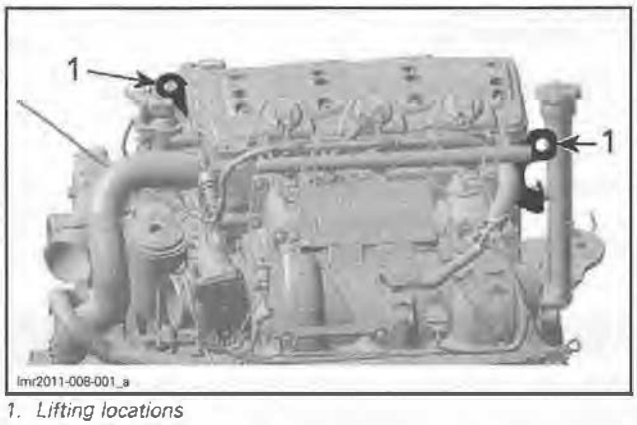
Remove the intake manifold. Refer to *INTAKE MANIFOLD* subsection.

Remove the drive shaft. Refer to *DRIVE SHAFT* subsection.

Remove the engine mounting screws.

Cut any locking ties from hoses or wiring harness that prevent engine removal.

Slightly lift the engine using a suitable lifting device.



1. Lifting locations

NOTE: Be careful when lifting the engine, shims could have been installed. Shims control engine alignment. Always note position of shims for reinstallation.

Disconnect the following cables:
- The starter cable from the starter.
- The engine ground cable located under the exhaust manifold.

Carry on engine lifting to remove it from the body opening.

NOTICE **Be careful not to scratch body or to hit any engine component.**

Wipe off any spillage in bilge. Clean with the PULLEY FLANGE CLEANER (P/N 413 711 809).

Engine Installation

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

NOTICE **Whenever engine is removed from boat, engine alignment must be performed at reinstallation.**

Check tightness and condition of rubber mounts. Refer to *ENGINE RUBBER MOUNTS* further in this subsection.

Before completely lowering engine, install ground cable, starter cable and cooling hoses on exhaust manifold. Follow these guide lines.
- Ensure contact surface is perfectly clean then reconnect grounds cable to engine.
- Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of ground cable screw or use a new screw with self-locking product.
- Tighten ground cable screw:
  - 230 series, 10 N•m (89 lbf•**in**)
  - All other models, 23 N•m (17 lbf•ft).
- Torque starter cable nut to 7 N•m (62 lbf•**in**).

– Install protective cap over the starter cable end.
– Connect exhaust manifold water inlet and outlet hoses. Tighten clamps to 1.7 N•m (15 lbf•**in**).

Place engine into boat.

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

Align engine. Refer to *ENGINE ALIGNMENT* in this subsection for complete procedure.

NOTICE **The engine alignment must be completed before finalizing the engine installation.**

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

Reinstall all removed parts and connect all connectors.

Ensure contact surface is perfectly clean then reconnect the 3 grounds wires to the front end of engine.

All Models except 210 and 230 Series

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

After its installation, properly adjust throttle cable. Refer to *THROTTLE/SHIFTER CONTROL* subsection.

All Models

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

⚠ WARNING

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

Verify all electrical connections (ground wires and battery).

Run engine and ensure there is no leakage.

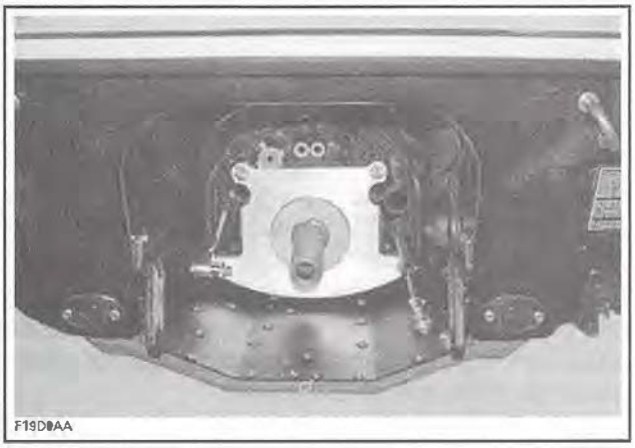
NOTICE **If boat is out of water, exhaust system must be cooled using the flush kit.**

Engine Alignment

REQUIRED TOOLS	
ENGINE ALIGNMENT PLATE (P/N 529 035 507)	
ALIGNMENT SHAFT SUPPORT (P/N 529 035 506)	
ALIGNMENT SHAFT ADAPTER (P/N 529 035 719)	
ALIGNMENT SHAFT (P/N 295 000 141)	

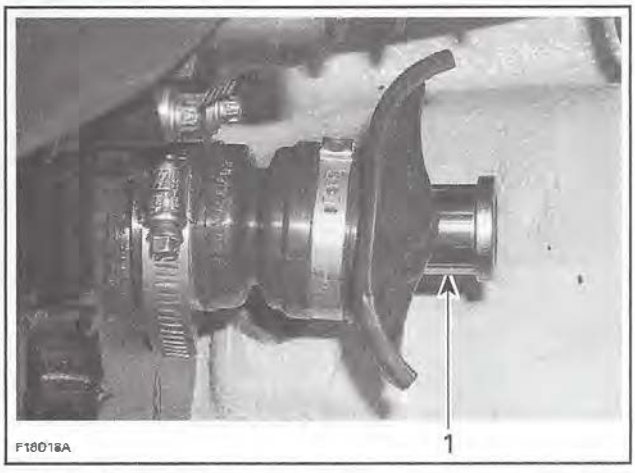
To verify alignment proceed as follows:

1. Remove jet pump and drive shaft. Refer to *STEERING AND PROPULSION* section.
2. Secure plate and support to hull with four nuts or screws.



TYPICAL

3. Install the ALIGNMENT SHAFT ADAPTER (P/N 529 035 719) in engine PTO housing.

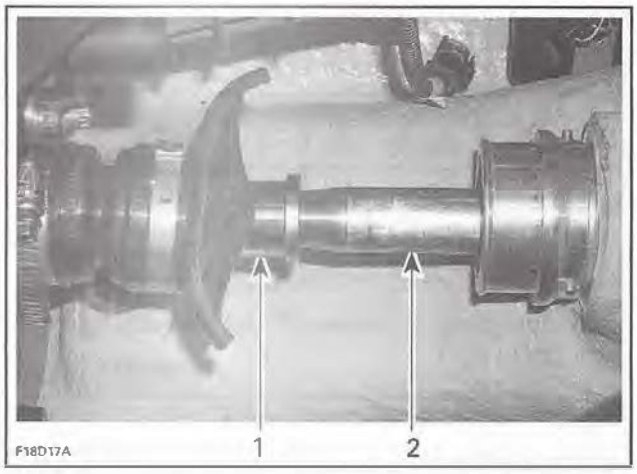


1. Engine alignment adapter

4. Carefully slide shaft through support.

5. Insert shaft end into engine alignment adapter.

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



TYPICAL
1. Engine alignment adapter
2. Alignment shaft

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

Install shim(s) between engine supports and rubber mounts to correct the alignment. Refer to the exploded view and the following table for shims position, thickness and quantity.

TYPICAL
1. Shim

MODELS	SHIM	SHIM THICKNESS	QTY (MAX.)
155 engine except 210 series	Shim #1 (P/N 270 000 025)	1.3 mm	1
	Shim #2 (P/N 270 000 061)	0.3 mm	1
215/255 engine except 210 series	Shim #1 (P/N 270 000 446)	1.3 mm	1
	Shim #2 (P/N 270 000 445)	0.3 mm	1
210 series	Shim #1 (P/N 270 000 025)	1.3 mm	2
	Shim #2 (P/N 270 000 024)	0.4 mm	2

NOTE: Shim #1 used ONLY to front engine mount.

Remove engine support screws and apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw threads.

Torque engine support screws as per following table when procedure is completed.

PART	TORQUE
Engine support screw	25 N•m (18 lbf•ft)

Remove alignment tools.

ENGINE RUBBER MOUNTS

Engine Rubber Mount Inspection

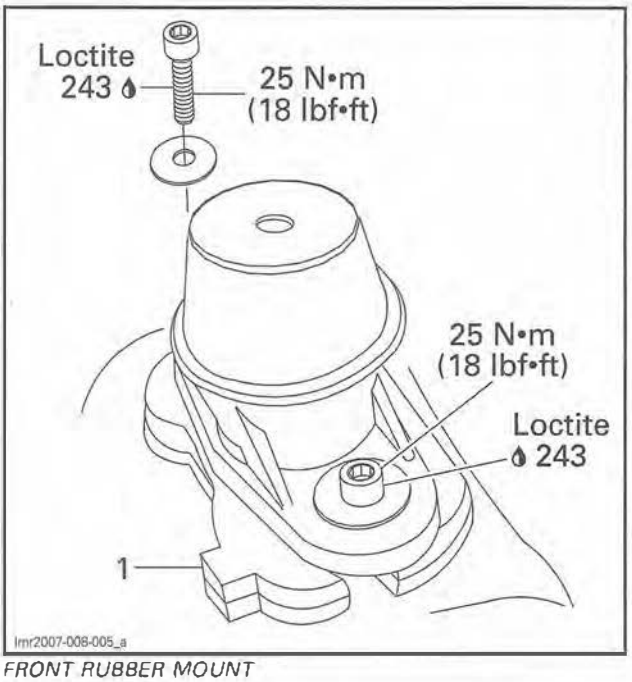
Check tightness and condition of rubber mounts.

Engine Rubber Mount Replacement

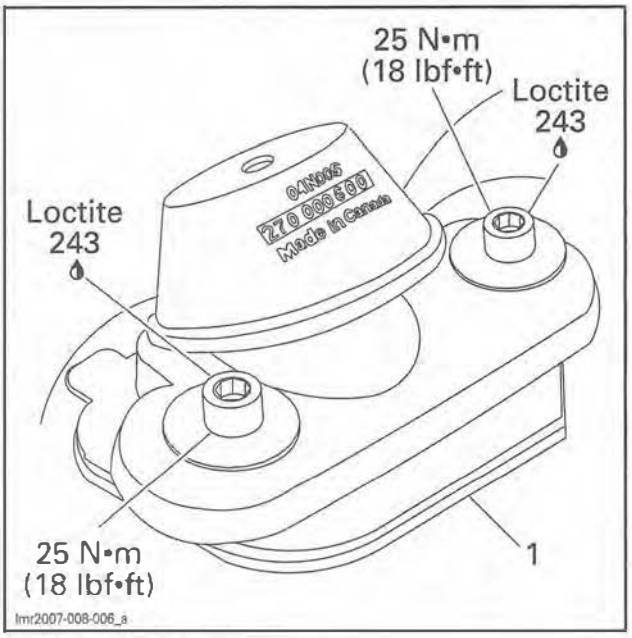
NOTE: The engine removal is not necessary to replace a rubber mount. Hold engine using lifting brackets.

Be careful when removing screws from rubber mount adapters, shims could have been installed underneath. Shims control engine alignment. Always note position of shims for reinstallation, to avoid altering engine alignment.

Check tightness and condition of rubber mounts. If they have been removed, apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw threads. Torque screws to 25 N•m (18 lbf•ft).



FRONT RUBBER MOUNT
1. Shims



REAR RUBBER MOUNT
1. Shims

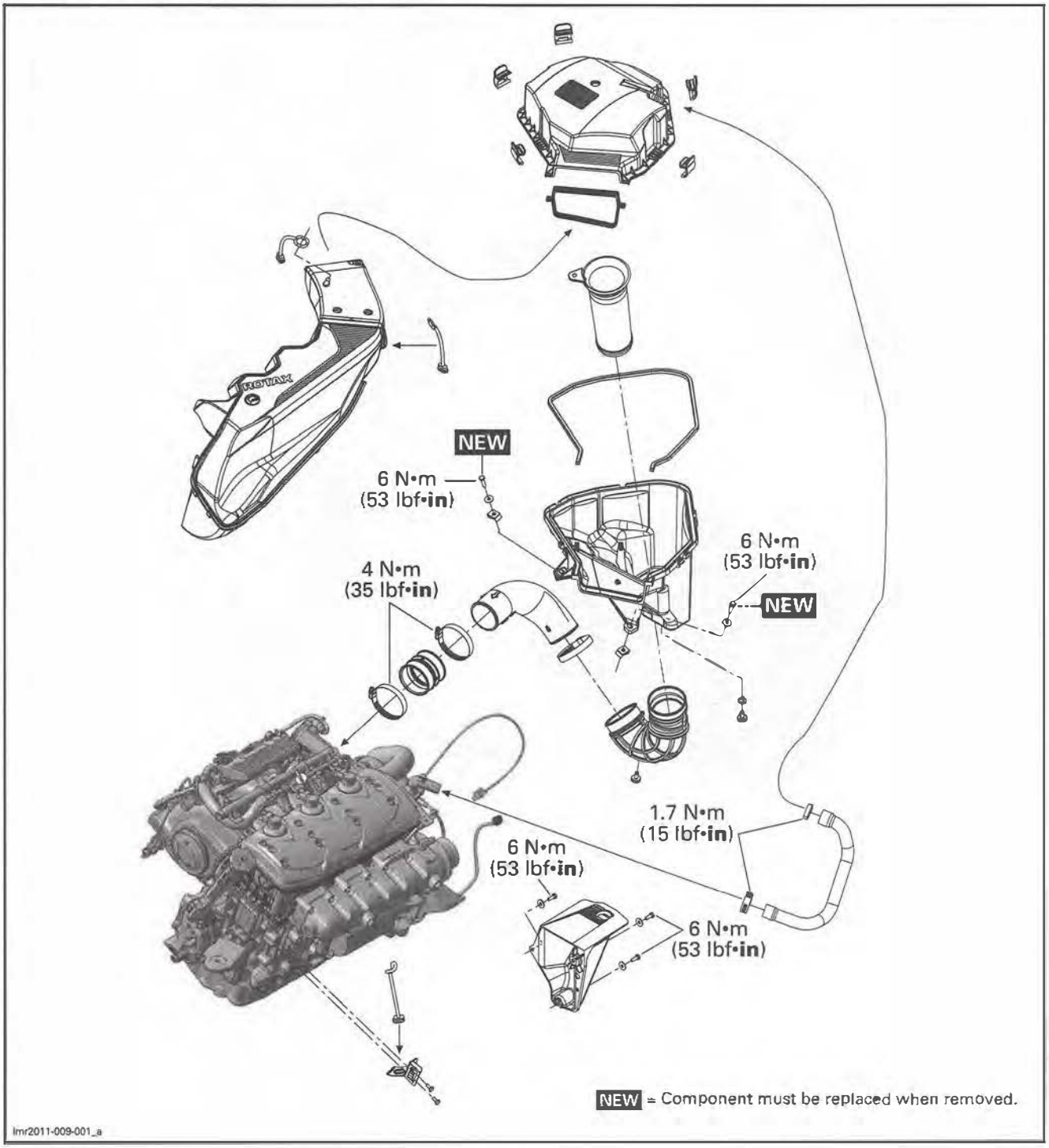
NOTICE Strict adherence to this torque is important to avoid damaging threads of hull aluminum inserts.

AIR INTAKE SYSTEM

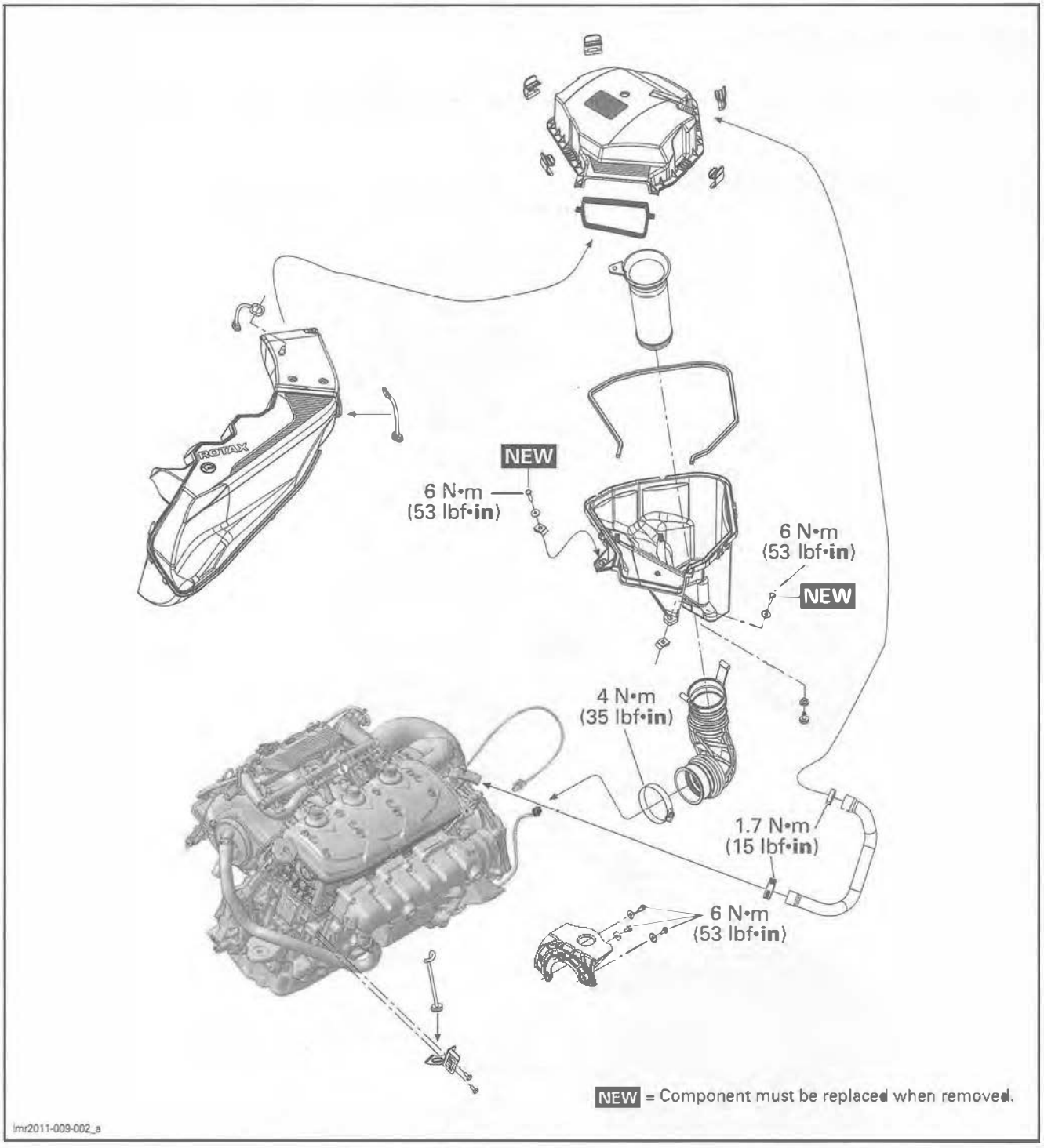
SERVICE PRODUCTS

Description	Part Number	Page
AIR FILTER OIL	219 700 340	36

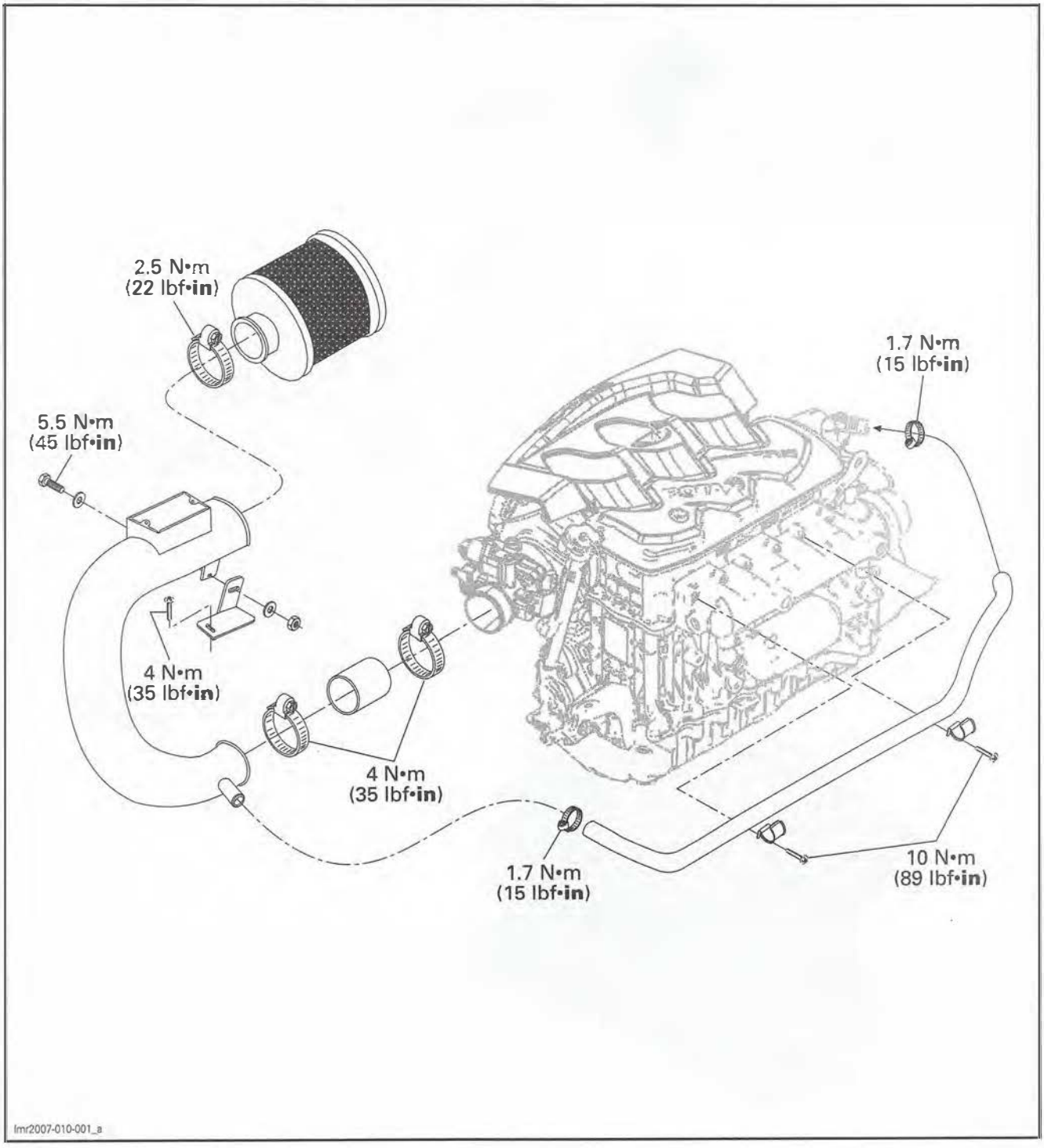
210 Series (Naturally-Aspirated Engine)



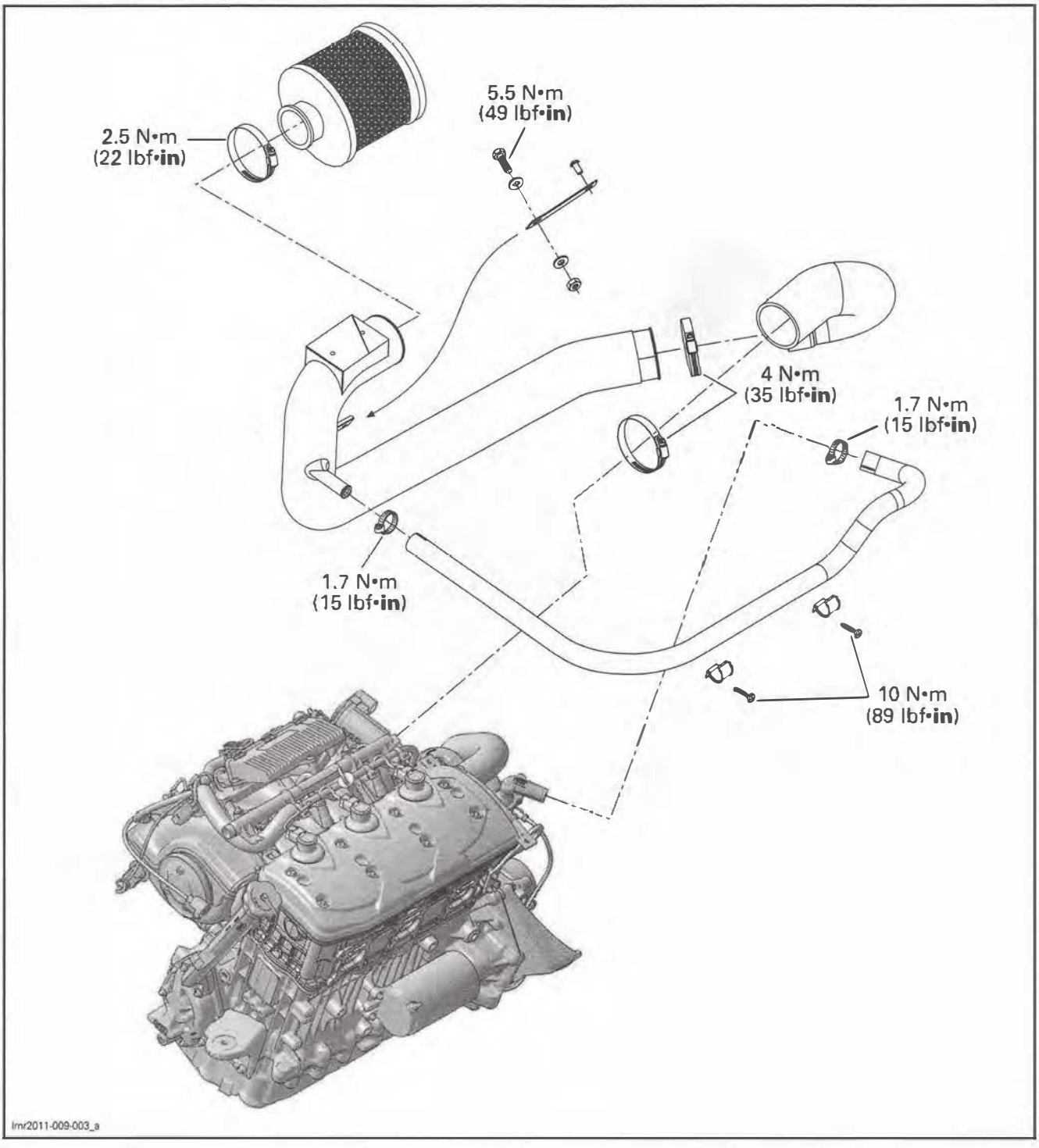
210 Series (Supercharged Intercooled Engine)



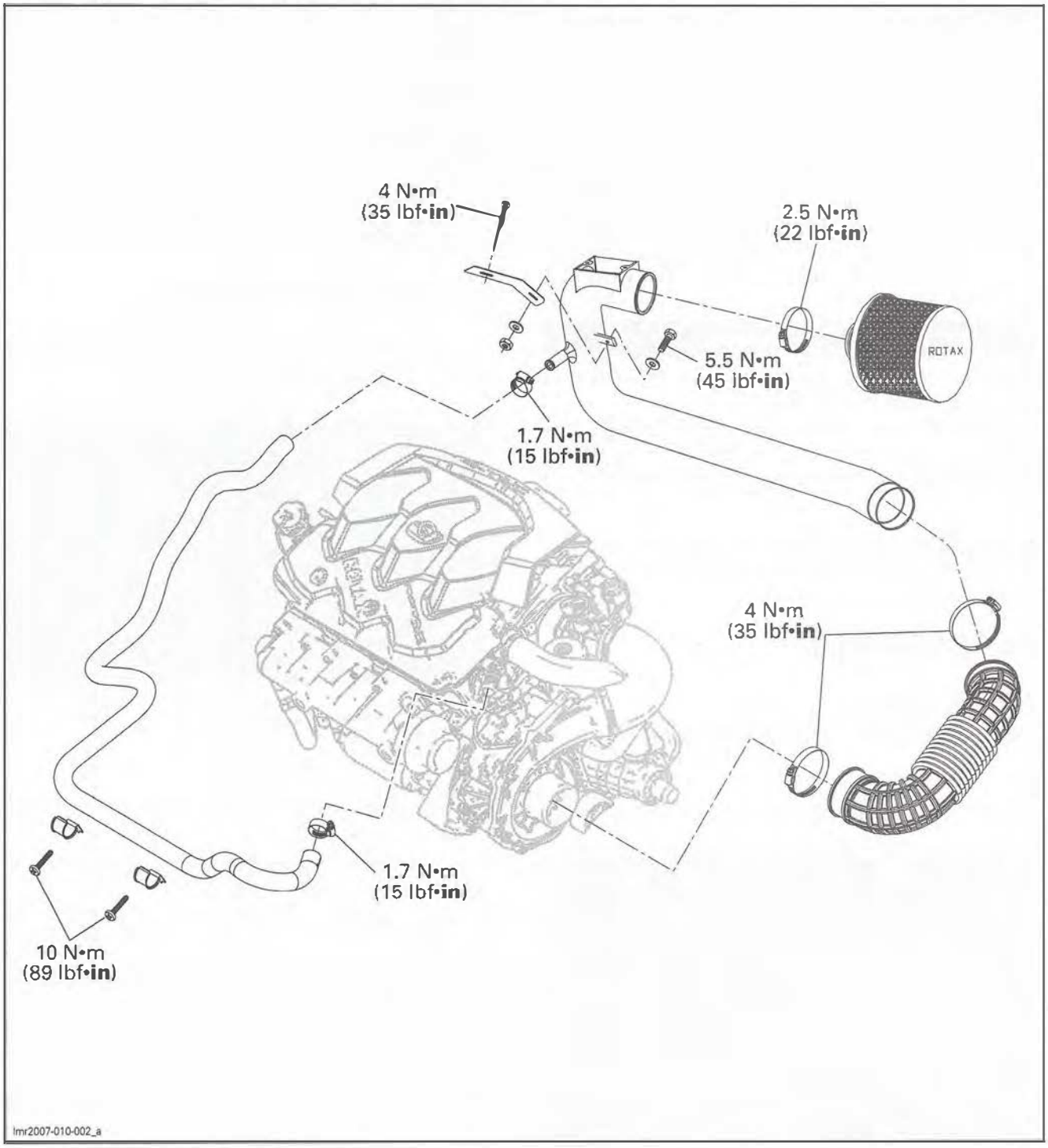
150, 180 and 200 Series (Naturally Aspirated Engine)



230 Series (Naturally-Aspirated Engine)



150, 180, 200 and 230 Series (Supercharged Intercooled Engine)



GENERAL

NOTICE Never remove or modify any component from the air intake system. Otherwise, engine performance degradation or damage can occur. The engine carburetion is calibrated to operate specifically with these components.

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices must be replaced when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.).

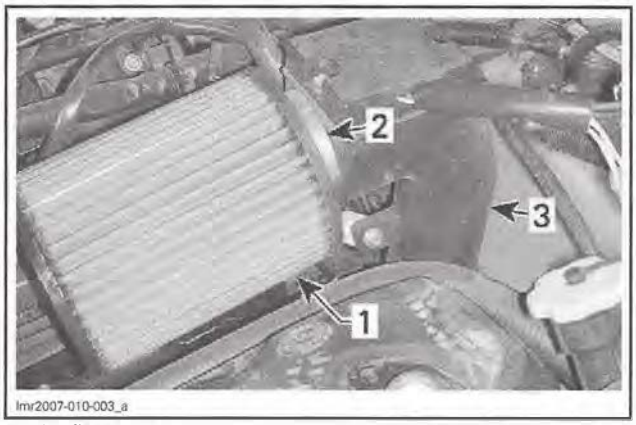
NOTICE Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

PROCEDURES

AIR FILTER (ALL EXCEPT 210 SERIES)

Air Filter Removal

Loosen clamp securing air filter to air intake tube.



1. *Air filter*
2. *Clamp*
3. *Air intake tube*

Pull air filter to remove it.

Air Filter Cleaning

This air filter should never need to be cleaned.

However, if the filter is dirty, it can be washed in soapy water, dried, and re oiled. To re oil the filter use the AIR FILTER OIL (P/N 219 700 340) or use K&N filter oil.

Air Filter Installation

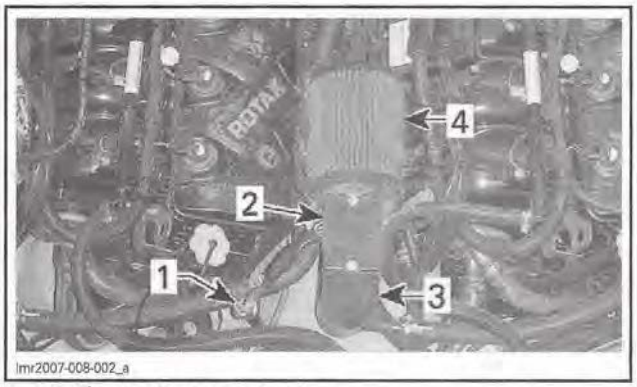
The installation is the reverse of the removal procedure.

AIR INTAKE TUBE (ALL EXCEPT 210 SERIES)

Air Intake Tube Removal

Remove air filter.

Unplug rectifier/regulator connectors or remove rectifier/regulator from air intake tube.



1. *Rectifier/regulator connectors*
2. *Rectifier/regulator*
3. *Air intake tube*
4. *Air filter*

Unplug the blow-by valve hose from the air intake tube.

Remove clamp securing air intake tube adapter to throttle body.

Unscrew bolt that attach air intake tube to its bracket.

Remove clamp securing air intake tube to supercharger inlet hose.

Unscrew bolt that attach air intake tube to its bracket.

Remove remaining clamp securing the air intake tube.

Remove the air intake tube.

Air Intake Tube Installation

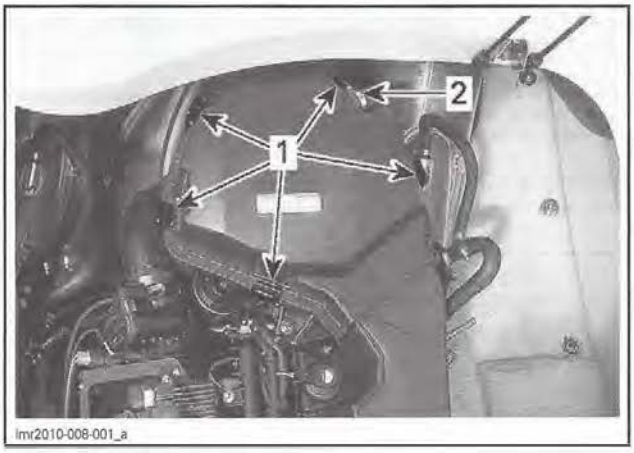
The installation is the reverse of the removal procedure.

AIR INTAKE SILENCER COVER (210 SERIES)

Air Intake Silencer Cover Removal

Release retaining clips.

Loosen clamp securing blow-by hose to cover.



1. *Retaining clips*
2. *blow-by hose clamp*

Remove the cover.

Air Intake Silencer Cover Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Check the condition of the cover seal. Replace seal as required.

Tighten blow-by hose clamp.

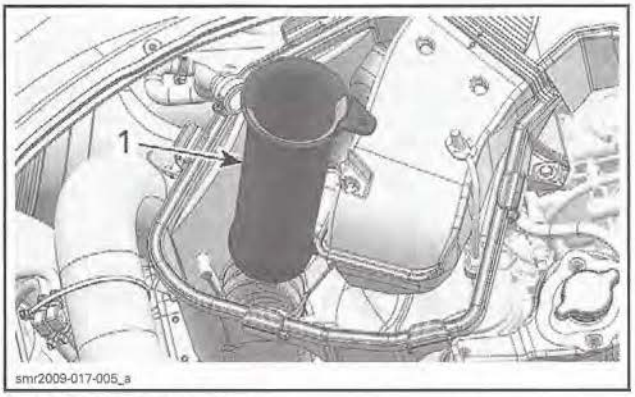
TORQUE	
Blow-by hose clamp	1.7 N•m (15 lbf•in)

AIR INTAKE SILENCER BAFFLE (210 SERIES)

Air Intake Silencer Baffle Removal

Remove *AIR INTAKE SILENCER COVER*, see procedure in this subsection.

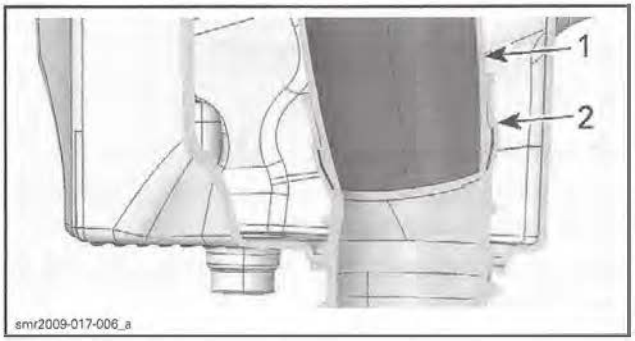
Pull the baffle out of the air intake silencer.



1. *Air intake silencer baffle*

Air Intake Silencer Baffle Installation

Insert the end of the baffle into supercharger air inlet hose. Using hose ears to retain hose, push the baffle into supercharger air inlet hose.



1. *Baffle*
2. *Air intake hose*

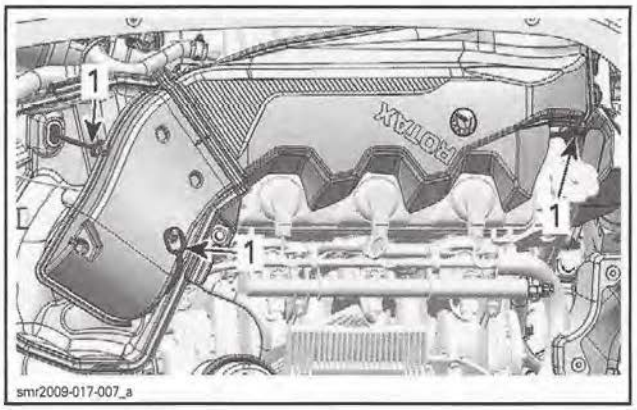
Install air intake silencer cover and all other removed parts.

AIR INTAKE TUBE (210 SERIES)

Air Intake Tube Removal

Remove the *AIR INTAKE SILENCER COVER* and the *AIR INTAKE SILENCER BAFFLE*, see procedure in this subsection.

Release the three rubber latches securing the air intake tube.



1. Rubber latches

Remove air intake tube.

Air Intake Tube Installation

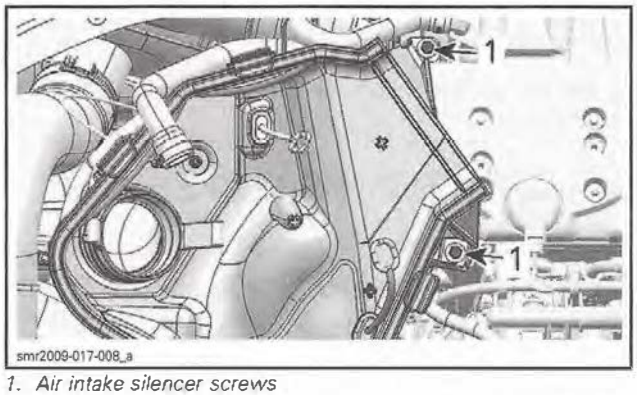
The installation is the reverse of the removal procedure.

AIR INTAKE SILENCER (210 SERIES)

Air Intake Silencer Removal

Remove air intake cover and air intake tube, see procedures in this subsection.

Remove and discard both screws securing air intake silencer.



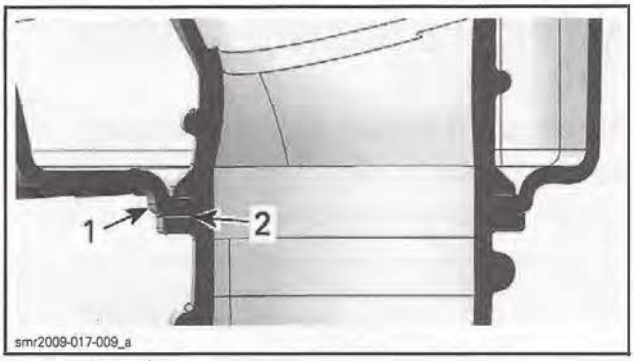
1. Air intake silencer screws

Inside air intake silencer, squeeze the top of the outlet hose and move hose out of air intake silencer.

Air Intake Silencer Installation

Squeeze the top of the air intake silencer outlet hose and move it in the air intake silencer.

Install the air intake silencer into hose groove.



1. Air intake silencer
2. Outlet hose groove

Secure air intake silencer using NEW screws.

TORQUE	
Air intake silencer screw	6 N•m (53 lbf•in)

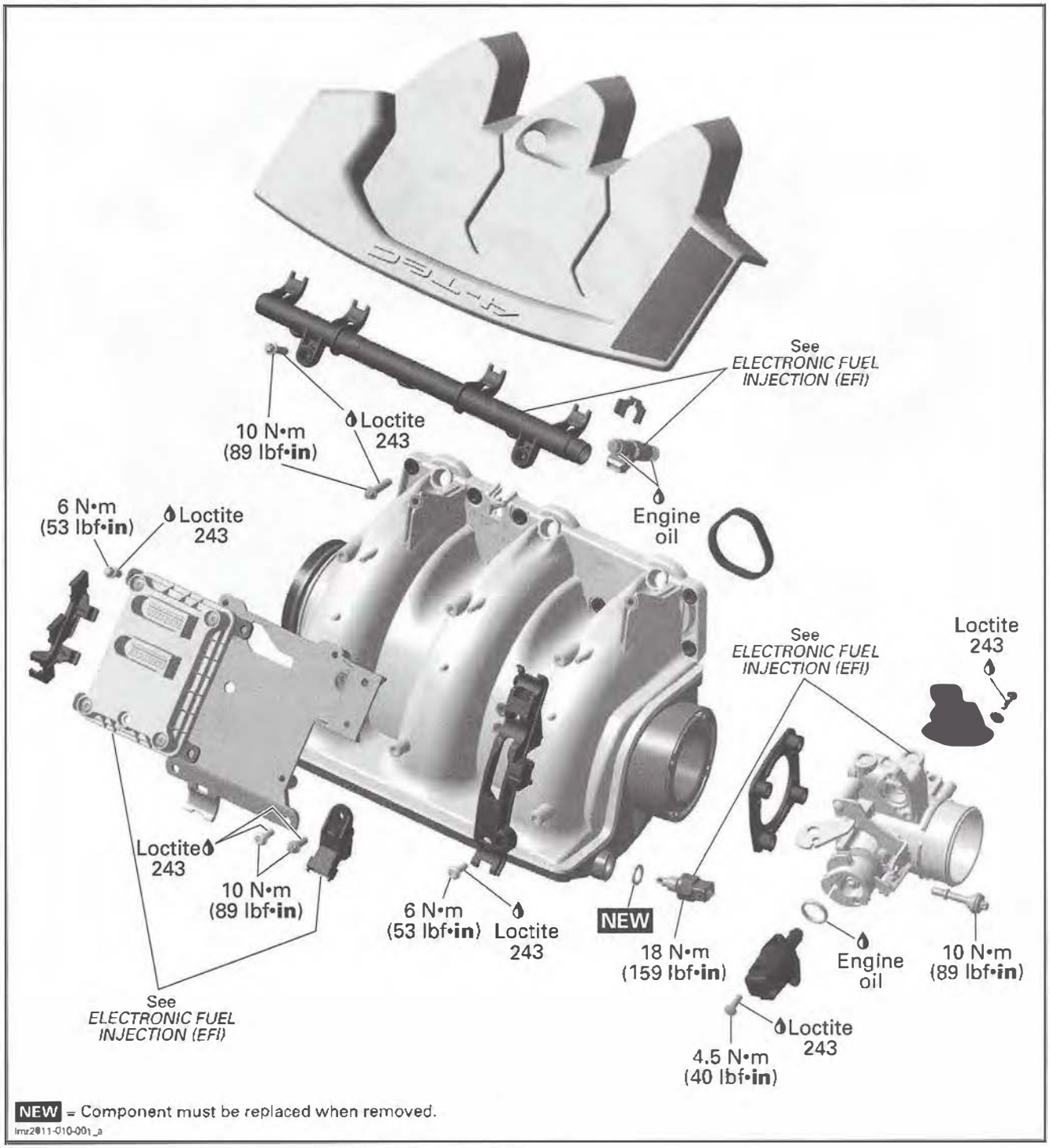
Install all other removed parts.

INTAKE MANIFOLD

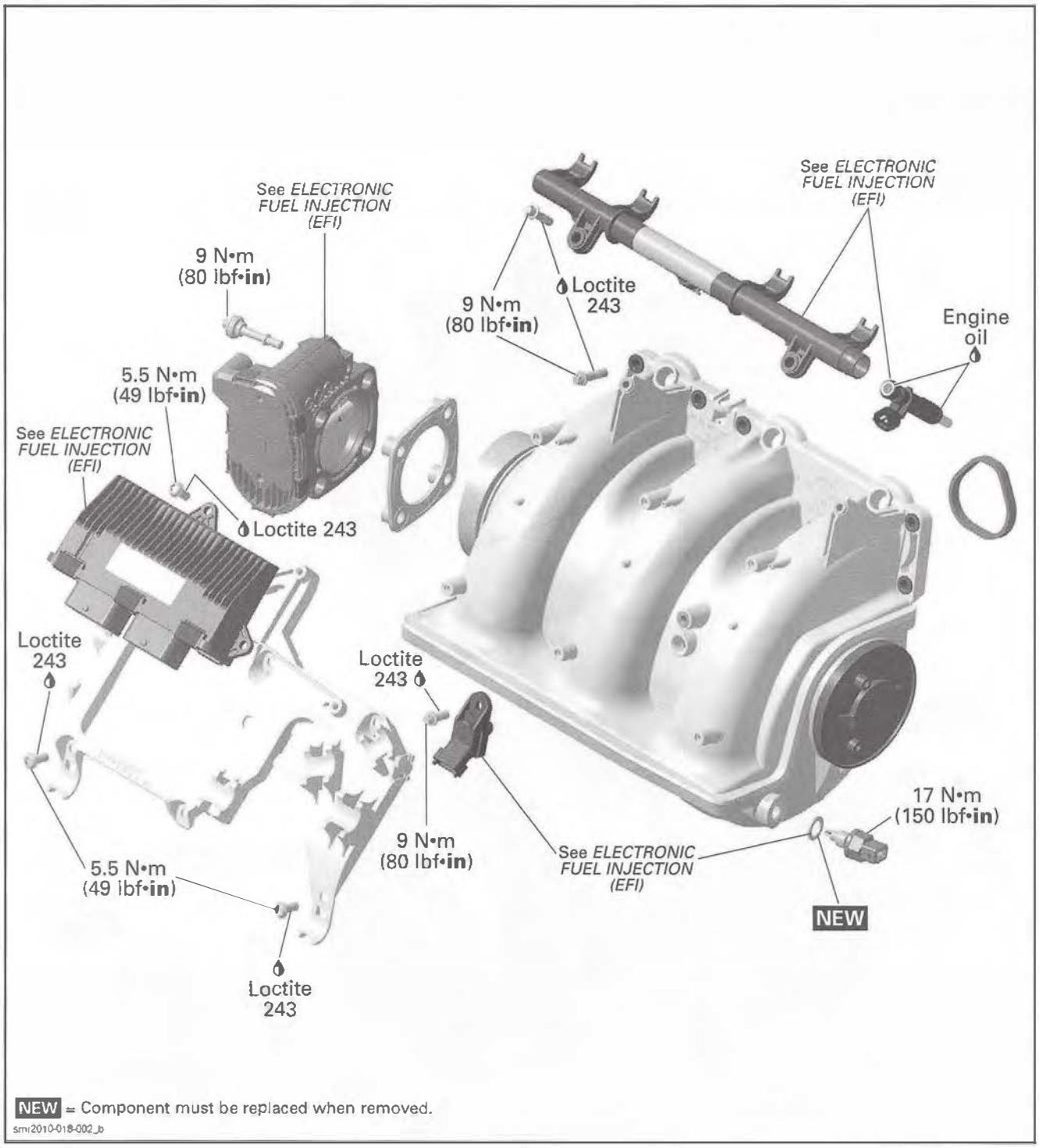
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	45–46

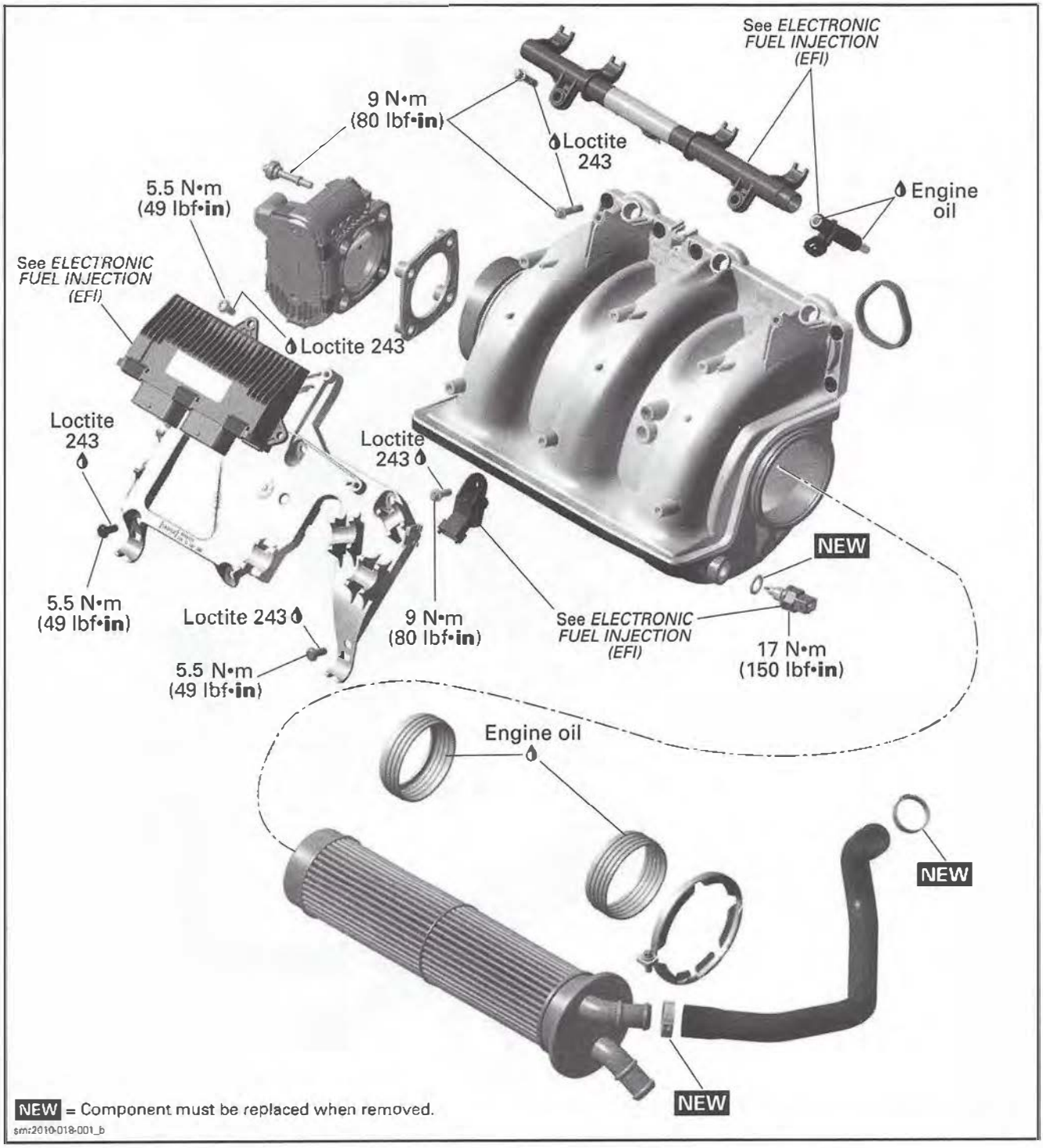
155 Engine without ETC



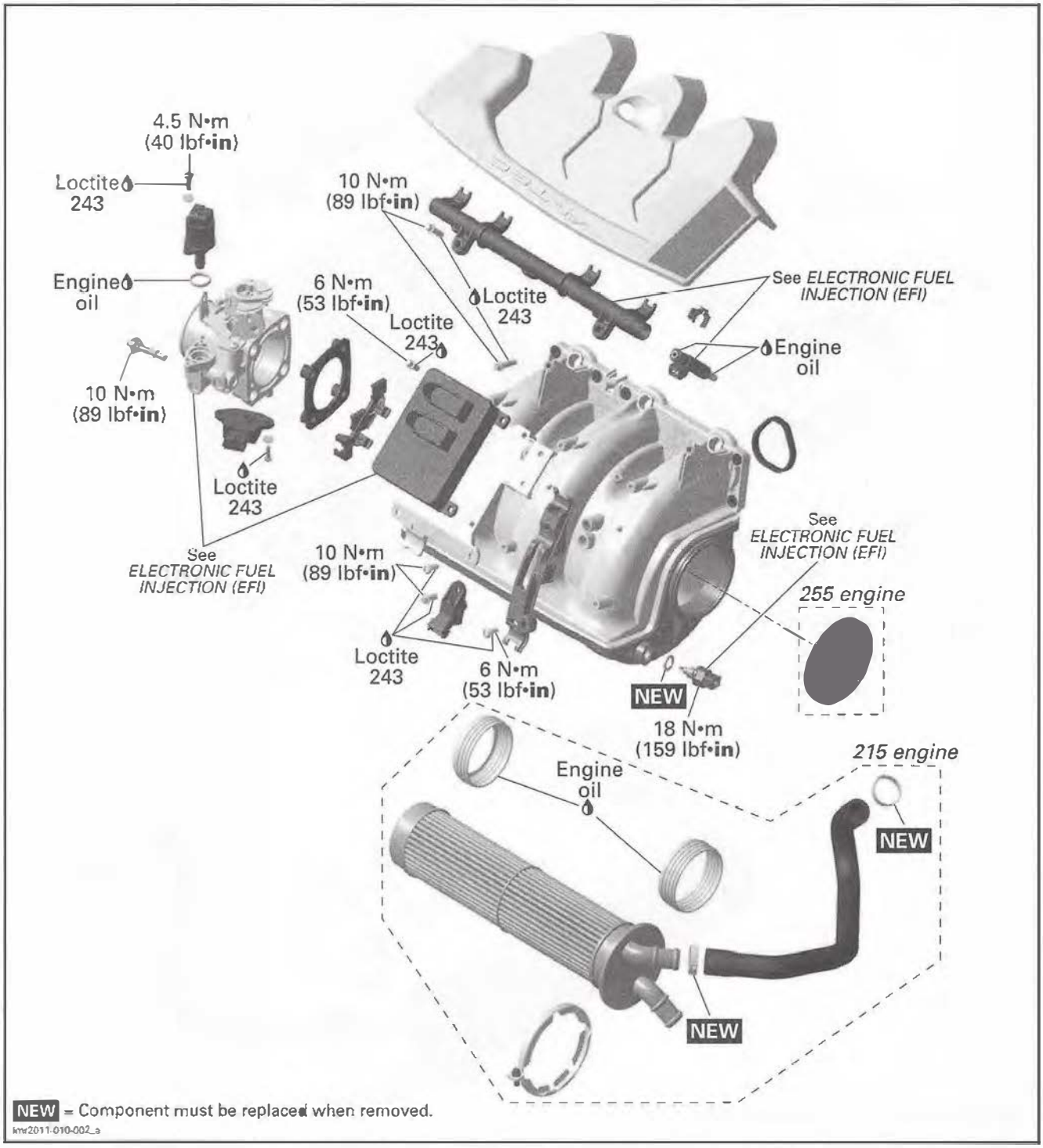
155 and 260 Engines with ETC



215 Engine with ETC



215 and 255 Engines without ETC



GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

PROCEDURES

INTAKE MANIFOLD

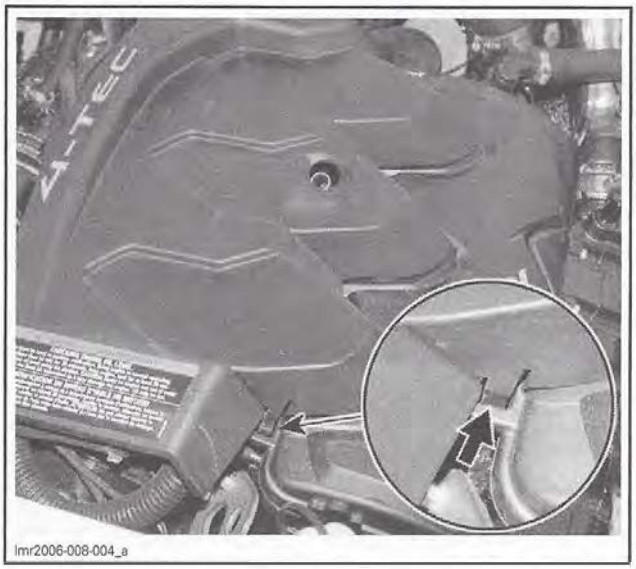
Intake Manifold Removal

To access engine(s), refer to *ENGINE ACCESS* in *ENGINE REMOVAL AND INSTALLATION*.

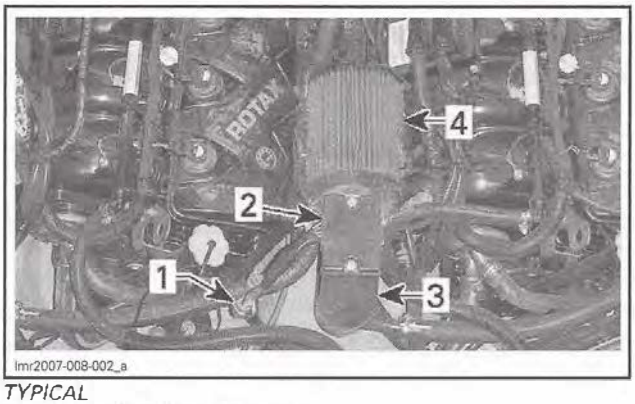
Turn main battery cut-off switch to OFF position.

150, 180 and 200 Series

1. Remove the oil dipstick.
2. Remove the engine cover. Press tabs on both sides to remove the cover.



3. Disconnect fuel hose connector from fuel rail. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
4. Remove the air filter.
5. Unplug rectifier/regulator connectors or remove rectifier/regulator from air intake tube.



TYPICAL
1. *Rectifier/regulator connectors*
2. *Rectifier/regulator*
3. *Air intake tube*
4. *Air filter*

6. Disconnect the blow-by valve hose from air intake tube.
7. Disconnect the air intake tube or the supercharger inlet hose from the throttle body.
8. Unscrew bolt that attach air intake tube to its bracket and remove the tube.
9. Unscrew throttle cable lock nut and remove cable from the bracket.
10. Detach throttle cable end from throttle body cam.

SUPERCHARGED INTERCOOLED ENGINE SHOWN
1. Lock nut
2. Cable barrel in cam

210 Series

1. Remove the air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove oil dipstick.
3. Disconnect the blow-by valve hose from the air intake silencer cover.
4. Disconnect the supercharger inlet hose from the throttle body.

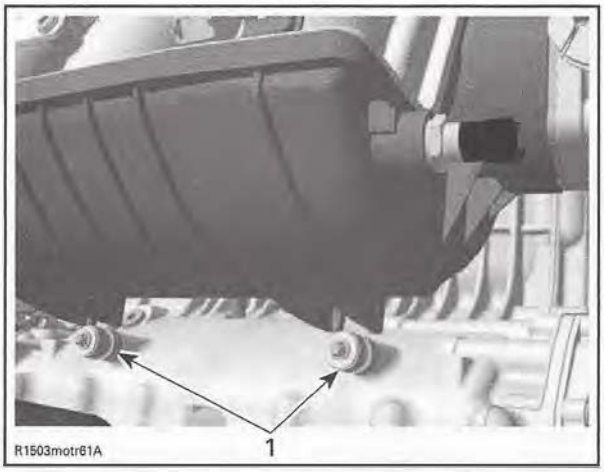
230 Series

1. Remove oil dipstick.
2. Disconnect the blow-by valve hose from the air intake tube.
3. Disconnect the air intake tube from the throttle body.
4. Unscrew bolt that attach air intake tube to its bracket and remove the tube.

All Models

1. Unplug intercooler hoses at the front end of the intercooler (**215 engine**).
2. Cut all locking ties securing the engine wiring harness to the intake manifold.
3. Unplug the following connectors, refer to *CONNECTOR INFORMATION* subsection for procedure:
   - Ignition connectors
   - Fuel injector connectors
   - "B" connector from the ECM
   - MAPS connector
   - Engine connector
   - MATS connector
   - KS connector
   - Magneto connector
   - TAS connector (**ETC engines**)
   - OPS connector.
4. Detach the following connector housing from the ECM support:
   - Engine connector
   - KS connector
   - Magneto connector.
5. Remove the ECM from its support.
6. Move the engine wiring harness, along with the ECM, away from intake manifold.
7. Remove manifold retaining screws and push the oil dipstick tube out of the manifold slot.

8. Lift intake manifold up to pull it out of the mounting brackets.



1. Mounting brackets

9. Pull intake manifold out.

Intake Manifold Inspection

Check intake manifold for cracks, warping at flanges or any other visible damage.

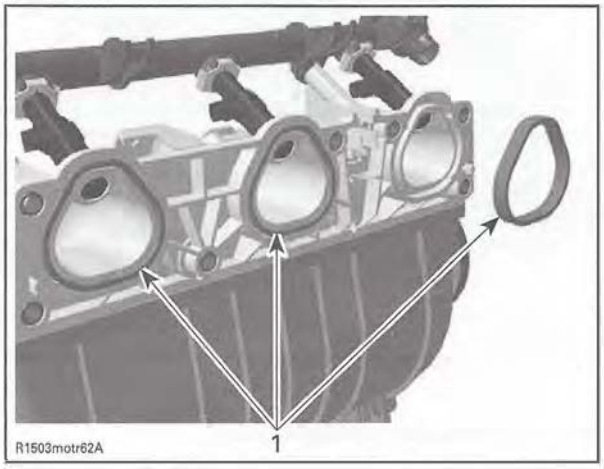
Check if intake manifold gaskets are cracked, brittle or otherwise damaged.

Replace damaged parts as necessary.

Intake Manifold Installation

For installation, reverse the removal procedure. Refer to exploded views at the beginning of this subsection for service products and tightening torque values. However, pay attention to following details.

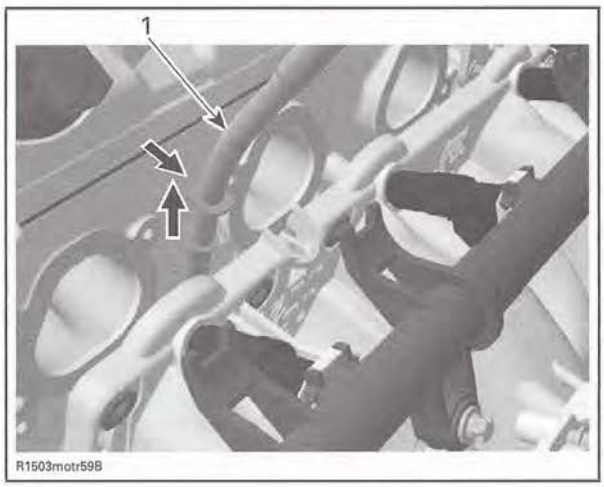
Ensure that all gaskets are properly installed and in a good condition.



INTAKE MANIFOLD
1. Gaskets

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

When installing the intake manifold, lift up the oil dipstick tube a little bit and insert it in the manifold slot.

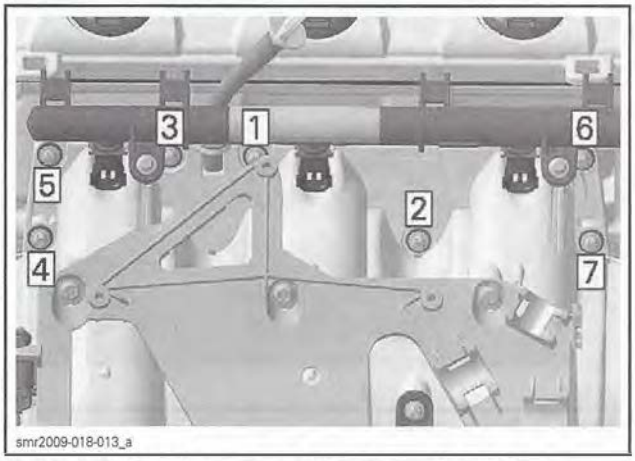


1. Oil dipstick tube

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the intake manifold screws.

Tighten intake manifold to specification using the following sequence.

TORQUE	
Intake manifold screws	9 N•m (80 lbf•in)



TIGHTENING SEQUENCE - INTAKE MANIFOLD SCREWS

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

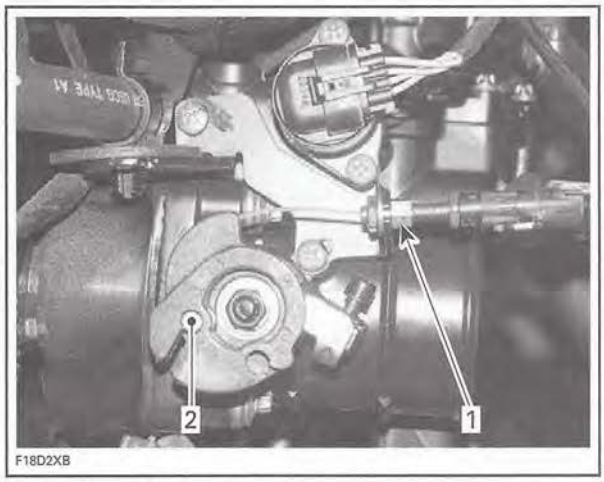
⚠ WARNING

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

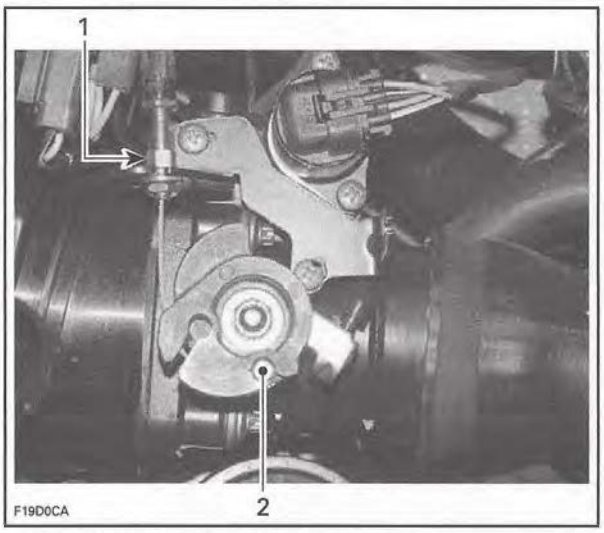
Throttle Cable

Engines without ETC

When installing throttle cable, ensure cable is in the proper position of bracket and that cable barrel is in the proper position of throttle cam.



NATURALLY ASPIRATED ENGINES
1. Cable position in bracket
2. Cable barrel position in cam



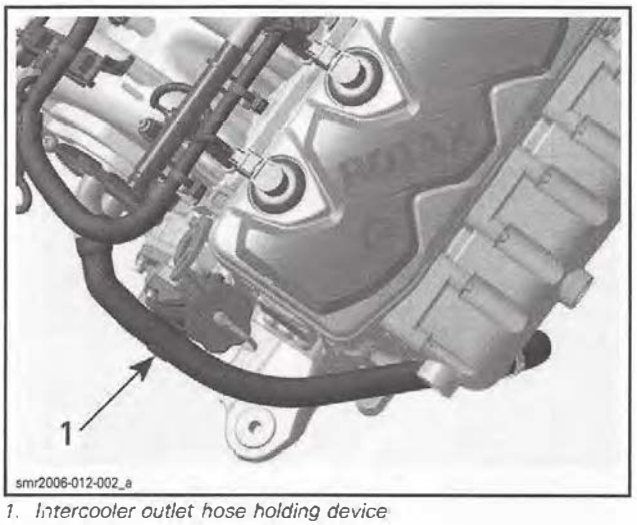
SUPERCHARGED INTERCOOLED ENGINES
1. *Cable position in bracket*
2. *Cable barrel position in cam*

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

Intercooler Hose

215 Engine

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



1. *Intercooler outlet hose holding device*

Engine Control Module

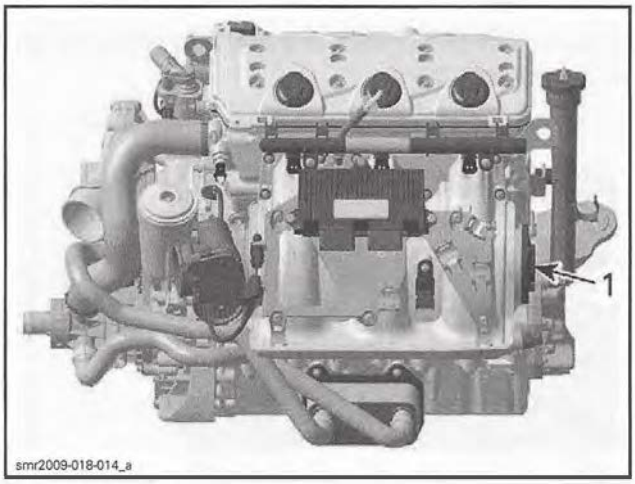
All Models

ECM RETAINING SCREWS	
PRODUCT	LOCTITE 243 (BLUE) (P/N 293 800 060)
TORQUE	9 N•m (80 lbf•in)

FLAME ARRESTER

Flame Arrester Location

The flame arrester is integrated in the intake manifold.



1. *Flame arrester*

Flame Arrester Inspection

The flame arrester in the intake manifold is maintenance free.

Flame Arrester Replacement

NOTE: The flame arrester can not be removed from the intake manifold.

Replace intake manifold if necessary. Refer to *INTAKE MANIFOLD* in this subsection.

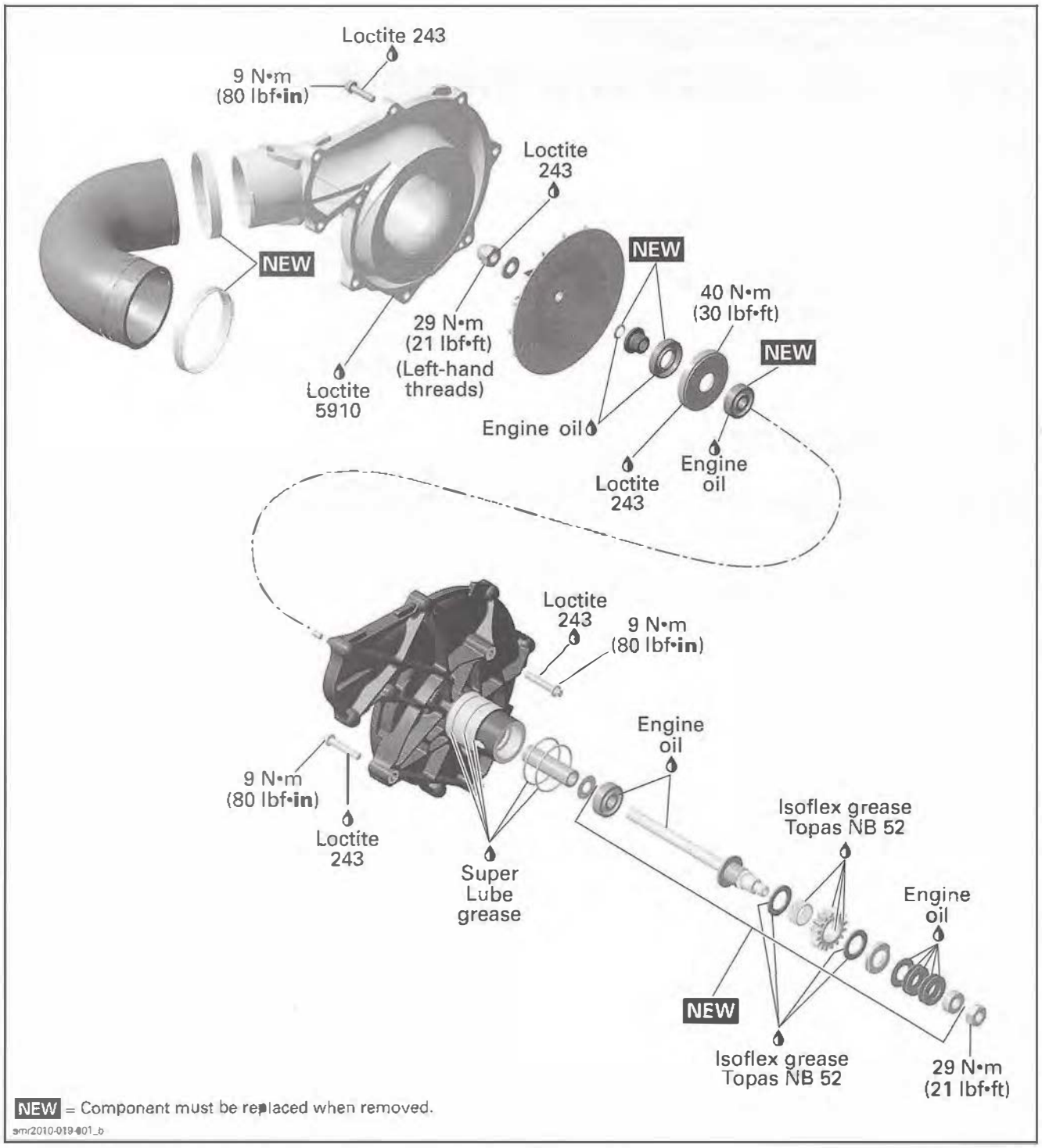
SUPERCHARGER (215, 255 AND 260 ENGINES)

SERVICE TOOLS

Description	Part Number	Page
4-PIN SOCKET	529 035 948	54, 57
BEARING SUPPORT/PUSHER	529 035 950	56–57
CAMSHAFT LOCKING TOOL	529 035 839	50
SUPERCHARGER GEAR HOLDER	529 036 025	50
SUPERCHARGER RETAINING KEY	529 036 027	53–54, 59
SUPPORT PLATE	529 035 947	50, 53, 56–57
TORX ADAPTER	529 035 938	52, 60

SERVICE PRODUCTS

Description	Part Number	Page
ISOFLEX GREASE TOPAS NB 52	293 550 021	58
LOCTITE 243 (BLUE)	293 800 060	57–60
LOCTITE 5910	293 800 081	59
SUPER LUBE GREASE	293 550 030	59



NEW = Component must be replaced when removed.

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GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

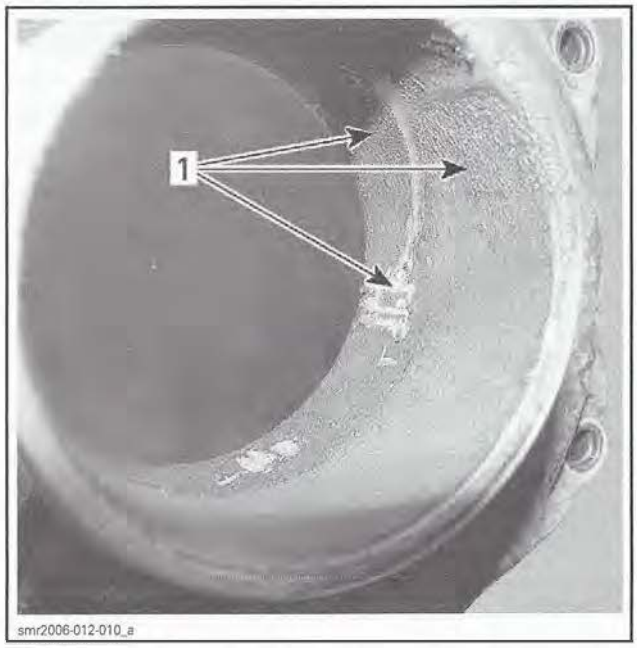
INSPECTION

SUPERCHARGER INLET CLEANLINESS

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

To access supercharger. Refer to *SUPERCHARGER ACCESS* in this subsection.

Visually inspect supercharger inlet side for oil, salt or any other deposits.



1. Dirt here

If dirt is found, proceed as follows.

1. Remove supercharger and perform the clutch slipping moment test. Inspect bearings and friction clutch. Replace bearings and clutch components as necessary.
2. Separate supercharger housing.

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

3. Clean internal housing and turbine using a brush and cleaning solvent to get rid of oil deposits.
4. Blow dry with compressed air.

NOTICE Do not let turbine spin when using compressed air.

5. Complete usual assembly procedures as described in this subsection.

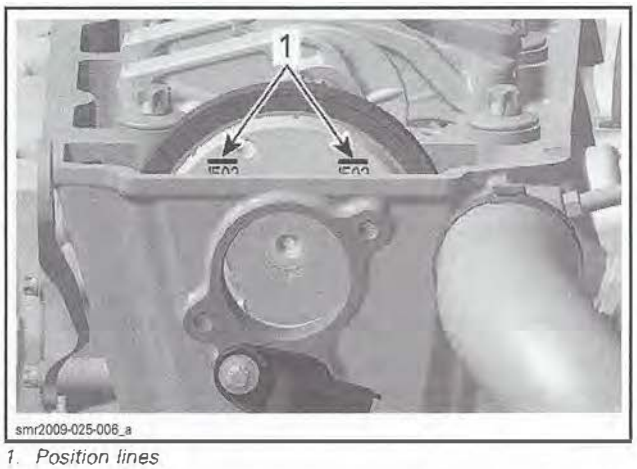
SUPERCHARGER CLUTCH SLIPPING MOMENT (ON ENGINE)

To access supercharger. Refer to *SUPERCHARGER ACCESS* in this subsection.

Remove cylinder head cover, refer to *CYLINDER HEAD* subsection.

Remove spark plugs.

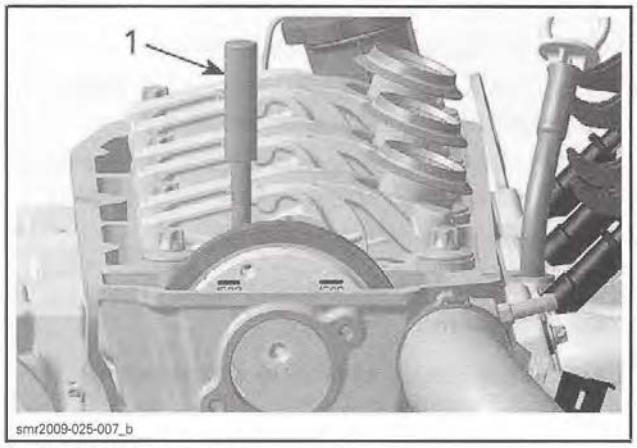
Turn engine by rotating the supercharger nut counterclockwise until the position lines on oil separator cover are lined up as shown in the following illustration.



1. Position lines

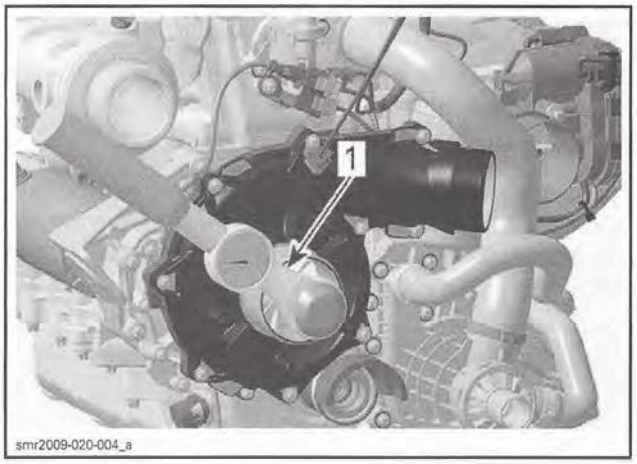
Lock camshaft to prevent camshaft rotation while checking slipping moment of supercharger.

REQUIRED TOOL
CAMSHAFT LOCKING TOOL (P/N 529 035 839)



1. Camshaft locking tool

Check slipping moment counterclockwise by using a torque wrench with actual torque viewer. A mirror is useful to see the viewer.



1. Torque wrench

NOTE: Before checking the supercharger slipping moment on a new or rebuilt supercharger, it is recommended to turn the clutch for a minimum of 3 complete revolutions. This will dissipate grease or oil on the friction shims for a precise reading.

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

SLIPPING MOMENT (NEW SUPERCHARGER)
9 N•m to 14 N•m (80 lbf•**in** to 124 lbf•**in**)

SLIPPING MOMENT (BREAK-IN SUPERCHARGER)
8 N•m to 12 N•m (71 lbf•**in** to 106 lbf•**in**)

If the torque is not within specifications, repair supercharger clutch. Verify supercharger clutch components as per *SUPERCHARGER INSPECTION* in this subsection.

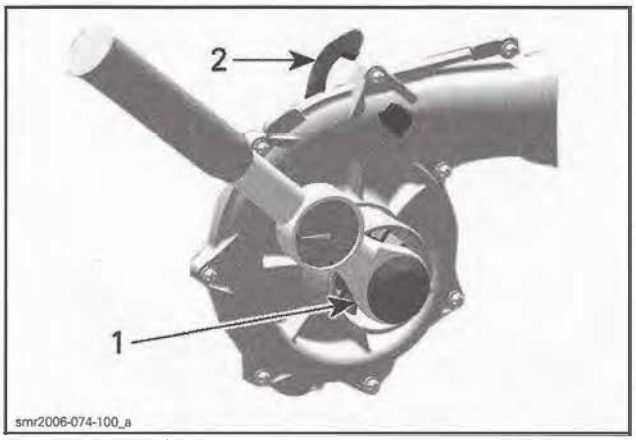
SUPERCHARGER CLUTCH SLIPPING MOMENT (BENCH TEST)

Mount supercharger on support plate.

Hold supercharger gear with supercharger gear holder.

REQUIRED TOOLS
SUPPORT PLATE (P/N 529 035 947)
SUPERCHARGER GEAR HOLDER (P/N 529 036 025)

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



1. Torque wrench
2. Gear holder

NOTE: Before checking the supercharger slipping moment on a new or rebuilt supercharger, it is recommended to turn the clutch for a minimum of 3 complete revolutions. This will dissipate grease or oil on the friction shims for a proper reading.

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

SLIPPING MOMENT (NEW SUPERCHARGER)
9 N•m to 14 N•m (80 lbf•**in** to 124 lbf•**in**)

SLIPPING MOMENT (BREAK-IN SUPERCHARGER)
8 N•m to 12 N•m (71 lbf•**in** to 106 lbf•**in**)

If the torque is not within specification, repair supercharger clutch. Verify supercharger clutch components as per *SUPERCHARGER INSPECTION* in this subsection.

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

ENGINE WILL NOT START (ENGINE DOES NOT TURN OVER)

1. **Supercharger seized or obstructed.**
   - *Inspect and repair supercharger.*

ENGINE LACKS ACCELERATION OR POWER (DOES NOT REACH MAXIMUM RPM)

1. **Supercharger inlet is dirty.**
   - *Check and clean supercharger inlet.*
   - *Check engine oil. Siphon excess of oil.*
2. **Supercharger slipping clutch defective.**
   - *Check slipping clutch moment.*
   - *Repair supercharger if out of specification.*

PROCEDURES

SUPERCHARGER

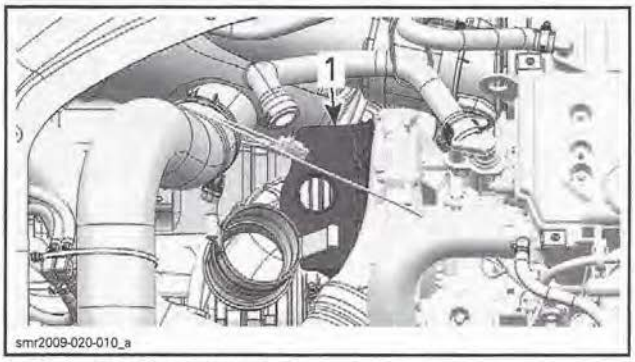
Supercharger Access

Open the engine compartment cover and remove the storage tray when required.

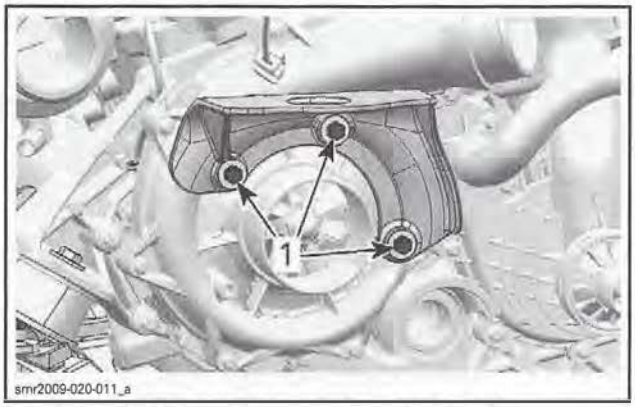
210 Series

Remove the air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.

Remove the air intake silencer support.



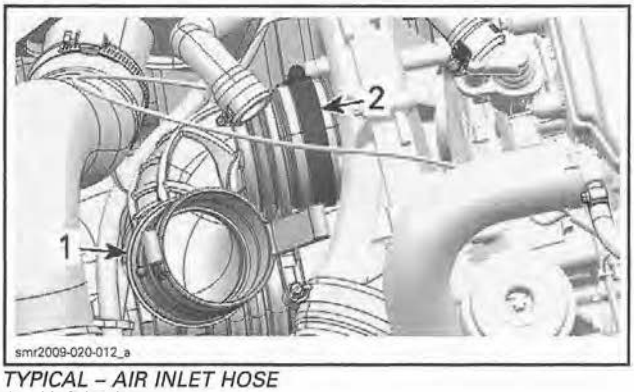
1. Air intake silencer support



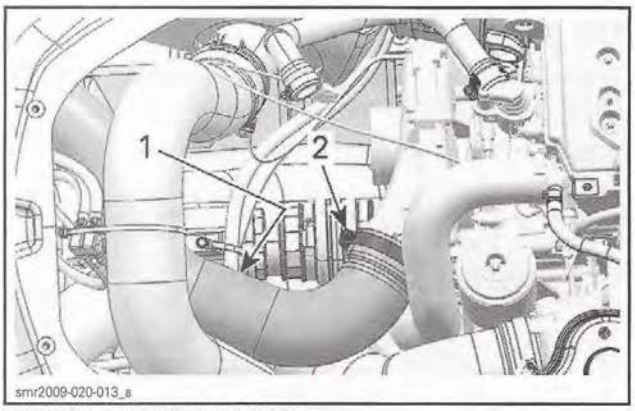
MANY PARTS REMOVED FOR C ARITY PURPOSE
1. Support screws

Supercharger Removal

Remove air inlet and outlet hoses from supercharger.

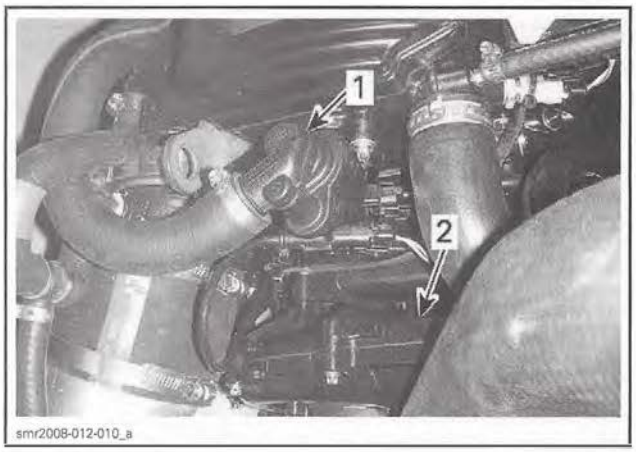


TYPICAL – AIR INLET HOSE
1. Air inlet hose
2. Hose clamp



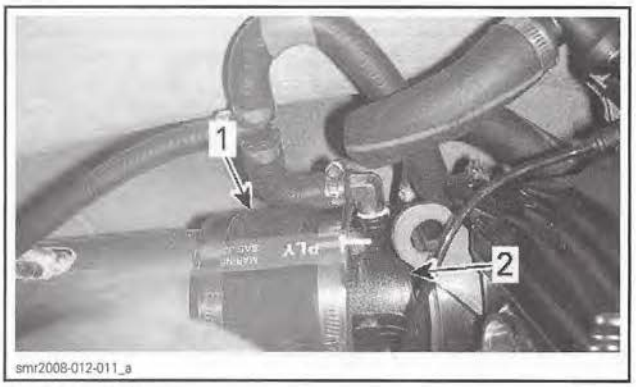
TYPICAL – AIR OUTLET HOSE
1. *Air outlet hose*
2. *Hose clamp*

Unscrew blow-by valve screws and move it aside to make room.



1. *Blow-by valve*
2. *Supercharger*

Using a marker, trace a mark on rubber adapter and exhaust pipe.



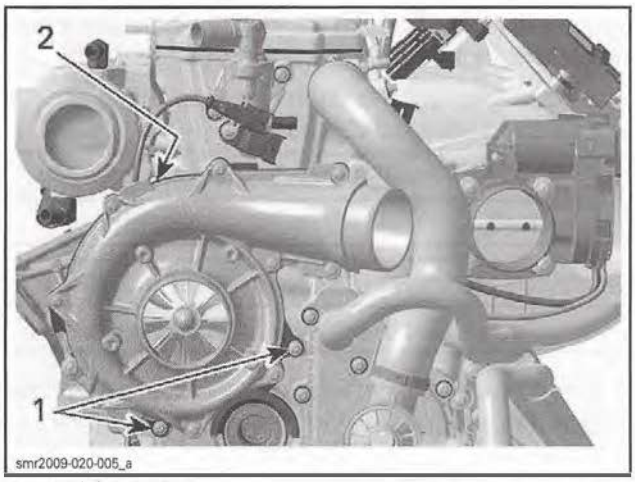
1. *Rubber adapter*
2. *Exhaust pipe*

Loosen clamp securing rubber adapter to exhaust pipe.

Detach muffler strap.

Move muffler back (± 5 cm (2 in)).

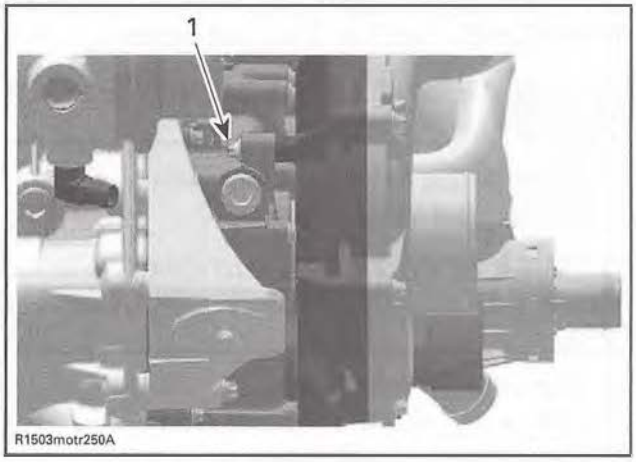
Remove retaining screws and pull out the supercharger.



1. *Retaining screws*
2. *Upper retaining screw (hidden behind the supercharger)*

NOTE: Use the following tool to remove the upper retaining screw.

REQUIRED TOOL	
TORX ADAPTER (P/N 529 035 938)	



1. *Upper retaining screw*

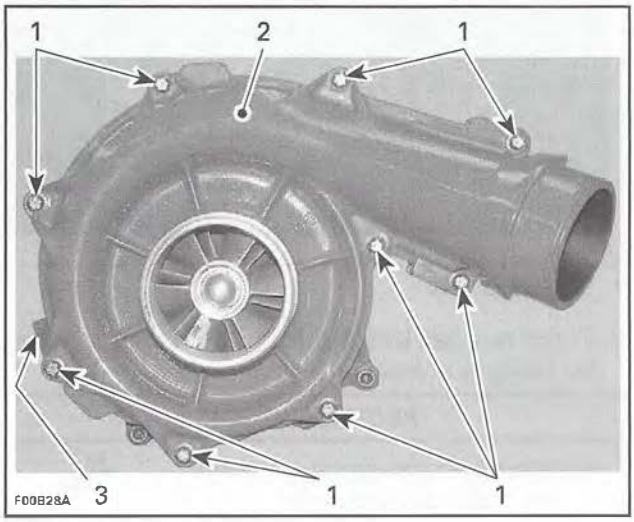
Supercharger Disassembly

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

1. Secure the supercharger on its support plate.

REQUIRED TOOL
SUPPORT PLATE (P/N 529 035 947) 

2. Take apart supercharger housing.

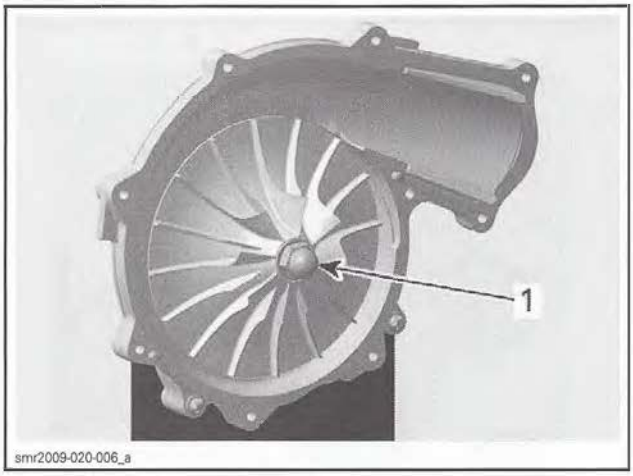


1. *Retaining screws*
2. *Housing half (intake side)*
3. *Housing half (engine side)*

PLASTIC HAMMER

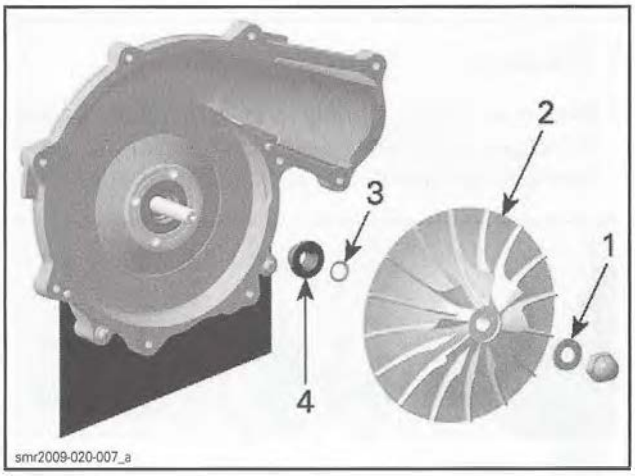
3. Loosen cap nut (turn **clockwise**) on supercharger shaft turbine side.

REQUIRED TOOL
SUPERCHARGER RETAINING KEY (P/N 529 036 027) 



1. *Cap nut (left-hand thread)*

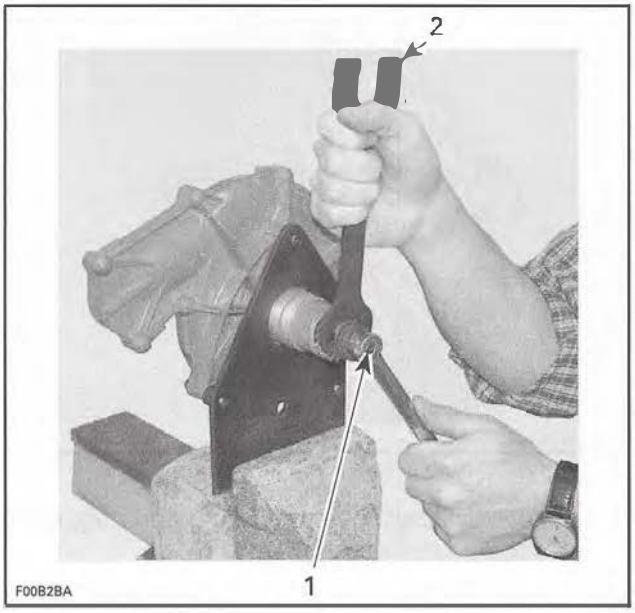
4. Remove washer, turbine, O-ring and step collar from supercharger shaft.



1. *Washer*
2. *Turbine*
3. *O-ring*
4. *Step collar*

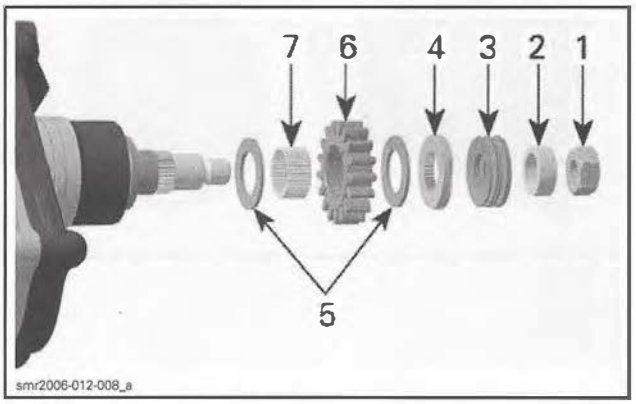
5. Loosen nut on supercharger shaft engine side (turn **counterclockwise**).

REQUIRED TOOL
SUPERCHARGER RETAINING KEY (P/N 529 036 027) 



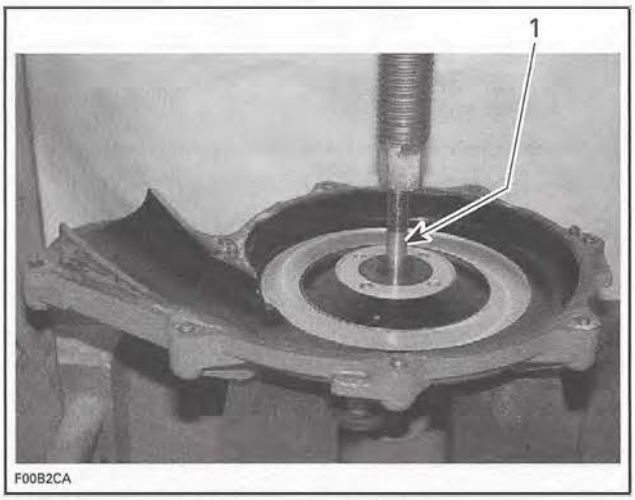
1. *Nut*
2. *Retaining key*

6. Remove L-ring, spring washers, lock washer, drive gear and needle pins by turning the supercharger upside down. Discard all needle pins.



1. *Nut*
2. *L-ring*
3. *Spring washers (5x)*
4. *Lock washer*
5. *Friction shims*
6. *Drive gear*
7. *Needle pins (discard all)*

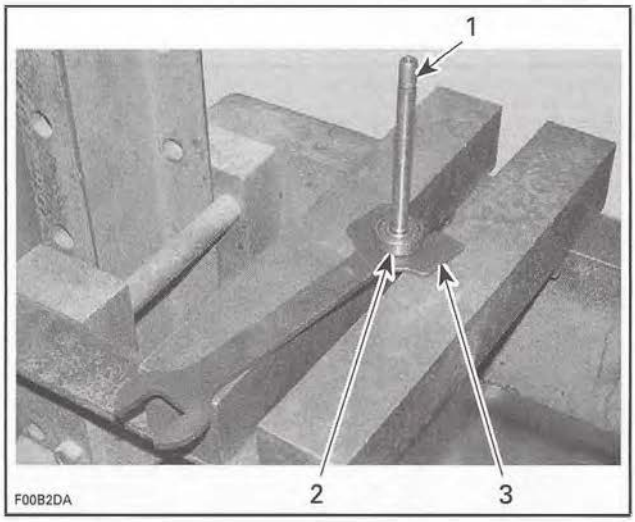
7. Carefully push out supercharger shaft towards engine side by using a press.



1. *Supercharger shaft*

8. Press out ball bearing from supercharger shaft by using a press.

REQUIRED TOOL	
SUPERCHARGER RETAINING KEY (P/N 529 036 027)	

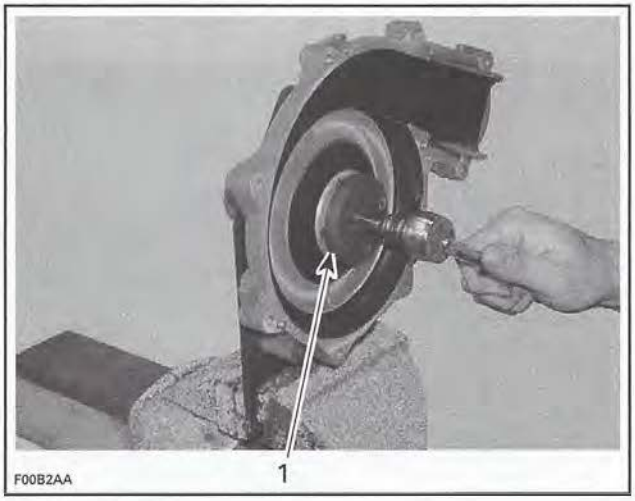


1. *Supercharger shaft*
2. *Ball bearing*
3. *Retaining key*

9. Remove retaining disc with seal from housing half (engine side).

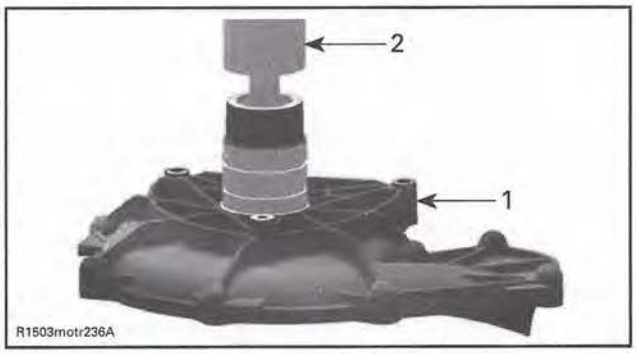
REQUIRED TOOL	
4-PIN SOCKET (P/N 529 035 948)	

NOTE: It may be necessary to heat the housing with a heat gun to release the retaining disc.



1. 4-pin socket

10. Discard the oil seal.
11. Remove and discard ball bearing from supercharger housing half (engine side) by using a press and a suitable bearing pusher.



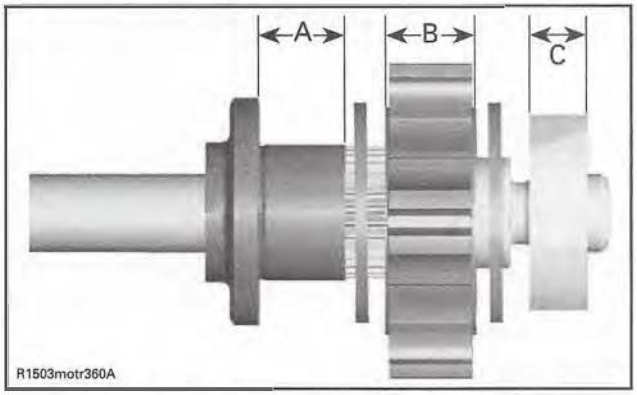
1. Supercharger housing half (engine side)
2. Bearing pusher

Supercharger Inspection

Supercharger Clutch Components and Gear

Check the wear limit on drive gear, lock washer and driven plate on supercharger shaft. Check drive gear for cracks.

NOTE: If parts are worn out or damaged, repair supercharger only by using supercharger repair kit.



A. Driven plate journal depth
B. Drive gear thickness
C. Lock washer thickness

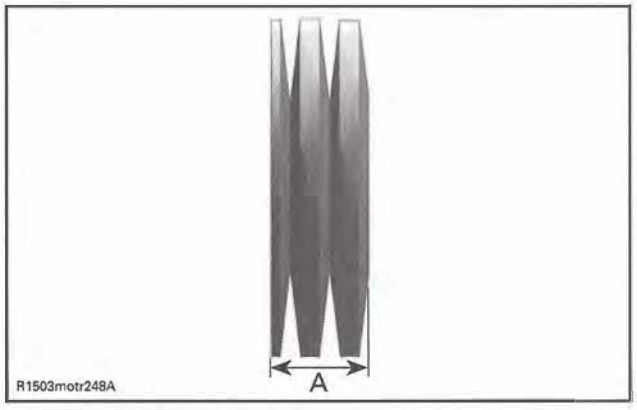
DRIVEN PLATE JOURNAL DEPTH	
NEW	14.460 mm to 14.500 mm (.5693 in to .5709 in)
SERVICE LIMIT	14.600 mm (.5748 in)

DRIVE GEAR THICKNESS	
NEW	11.000 mm to 11.050 mm (.4331 in to .435 in)
SERVICE LIMIT	10.900 mm (.4291 in)

LOCK WASHER THICKNESS	
NEW	4.050 mm to 4.150 mm (.1594 in to .1634 in)
SERVICE LIMIT	3.950 mm (.1555 in)

Spring Washer

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



A. Spring washer package height

SPRING WASHER PACKAGE HEIGHT	
NEW	10.7 mm to 10.9 mm (.4213 in to .4291 in)
SERVICE LIMIT	10.2 mm (.4016 in)

Supercharger Assembly

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

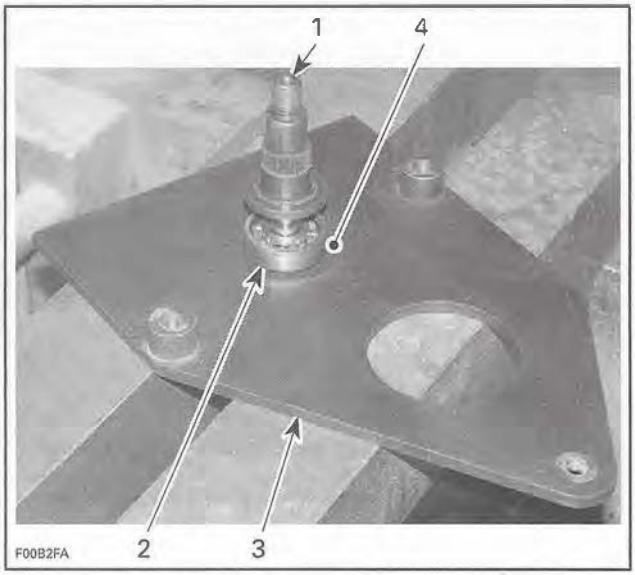
NOTICE Both ball bearings have to be installed with cages facing turbine side.

1. Install ball bearing on supercharger shaft. Hold bearing using the following tool.
   1.1 Apply enough engine oil on NEW ball bearing.
   1.2 Press the bearing. Use the following tool to hold the bearing.

REQUIRED TOOL	
SUPPORT PLATE (P/N 529 035 947)	

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

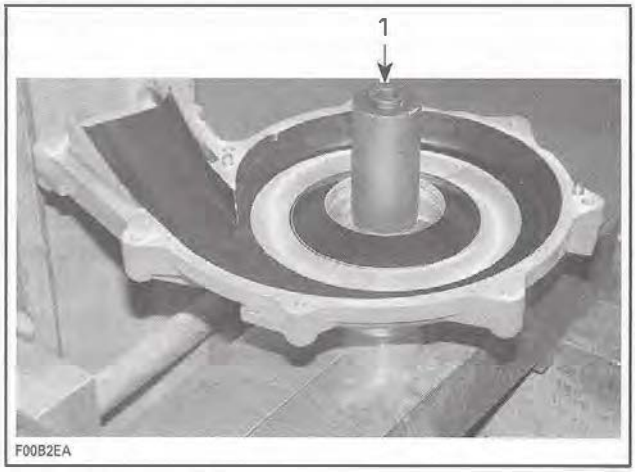
NOTICE To install ball bearings and supercharger shaft always use a press, never use any beating force like a hammer.



1. Supercharger shaft
2. Ball bearing
3. Bearing support plate
4. Protrusion of support plate on this side (underneath inner race)

2. Press in the ball bearing in supercharger housing half (engine side).
   2.1 Apply enough engine oil on NEW ball bearing.
   2.2 Press the bearing using the following tool.

REQUIRED TOOL	
BEARING SUPPORT/PUSHER (P/N 529 035 950)	

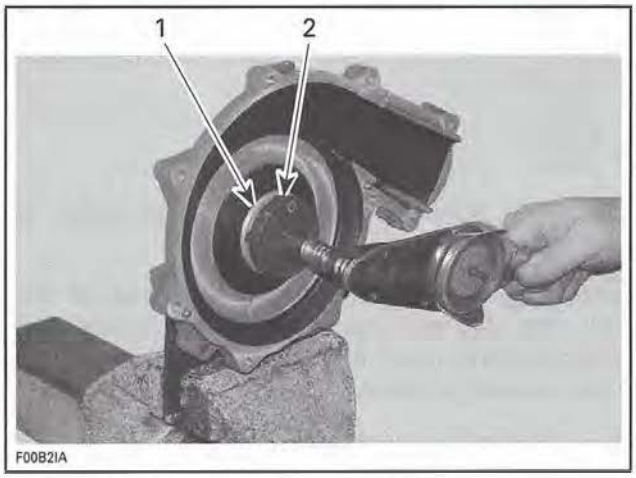


1. Bearing support/pusher

3. Secure the supercharger housing plate (engine side) in a vice.

REQUIRED TOOL	
SUPPORT PLATE (P/N 529 035 947)	

4. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on retaining disc. If a new retaining disc is used, the threads are coated with a self-locking product.
5. Install the retaining disc in supercharger housing half.



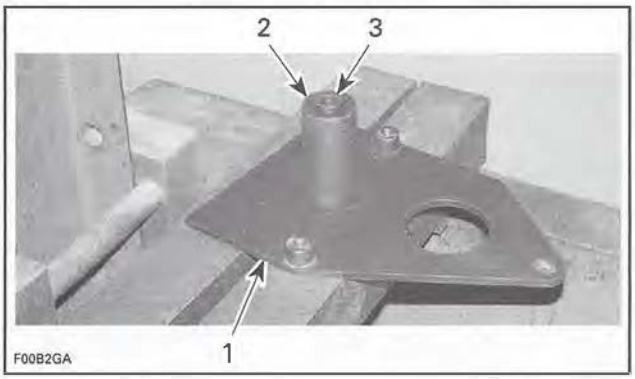
1. Retaining disc
2. 4-pin socket

REQUIRED TOOL	
4-PIN SOCKET (P/N 529 035 948)	

TORQUE	
Retaining disc	40 N•m (30 lbf•ft)

6. Press supercharger shaft in housing half (engine side).
   6.1 Properly support bearing using the following tools under supercharger housing half.

REQUIRED TOOLS	
SUPPORT PLATE (P/N 529 035 947)	
BEARING SUPPORT/PUSHER (P/N 529 035 950)	

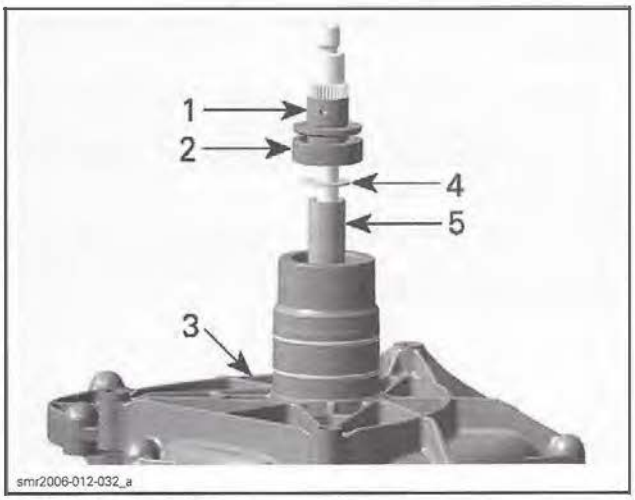


1. Support plate
2. Bearing support/pusher
3. Protrusion here

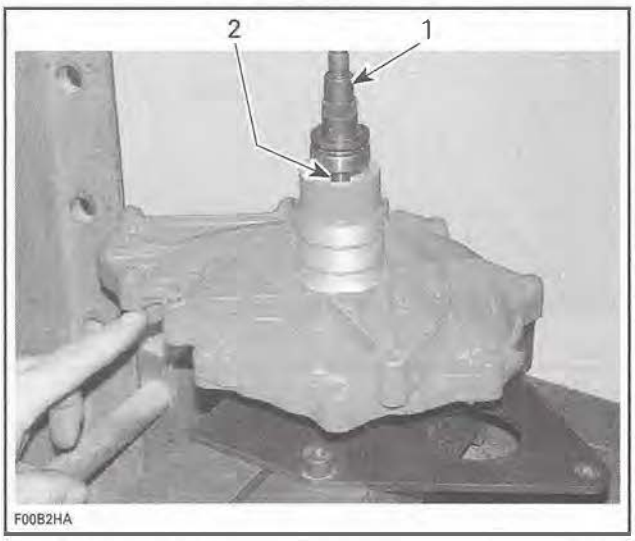
NOTICE Before pressing in the supercharger shaft, be sure to properly support the inner race of ball bearing in supercharger housing half with the recommended tool. This way, the installation pressure will be applied to the inner race and will not be transmitted to the bearing balls which would otherwise shorten the bearing life.

6.2 Apply heat outside of the housing with a heat gun to expand its diameter prior to inserting the shaft. Ensure there is no O-ring on the housing half prior to heating.

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



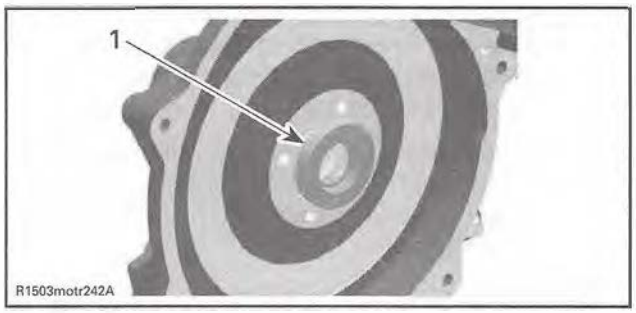
1. Compressor shaft
2. Ball bearing
3. Supercharger housing half
4. Thrust washer
5. Distance sleeve



1. Supercharger shaft
2. Distance sleeve

7. Apply engine oil on seal and push into retaining disc by hand.

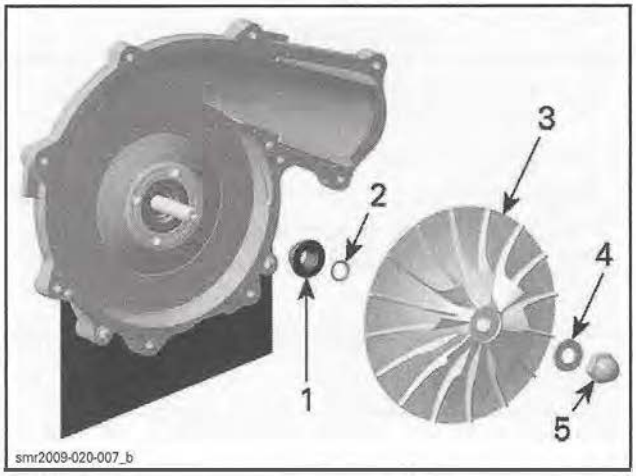
NOTE: Always use a NEW oil seal when assembling the supercharger.



1. Oil seal

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

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



1. Step collar
2. O-ring
3. Turbine
4. Washer
5. Cap nut

Complete installation of supercharger shaft, engine side as follows:

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

9. Install the first friction shim.

NOTE: The friction shims have the same inner diameter.

NOTICE Manipulate friction shims with care, those parts are sensitive.

10. IMPORTANT: Apply ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021) to the inner diameter of the gear thrust surface on the shaft, friction shims, needle bearing, shaft surface and lock washer.

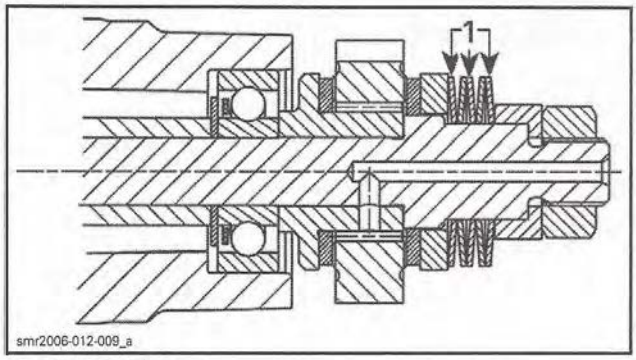
NOTICE No other grease can be used, otherwise damage to bearings will occur.

11. Install the NEW needle bearing on the compressor shaft.

NOTE: The new needle bearing contains 40 needle pins trapped in a wax strip with an adhesive backing.

12. Remove the adhesive backing.
13. Install the drive gear over the needle bearing.
14. Install the second friction shim.
15. Install the lock washer.
16. Apply engine oil to the spring washers.
17. Position the spring washers as per illustration.

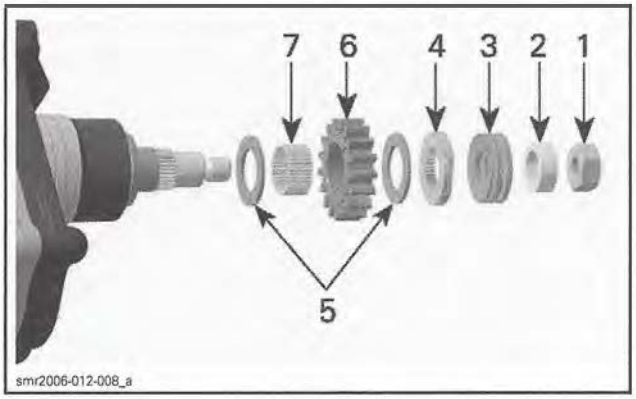
NOTICE When installing the spring washers, take care of the exact installation direction of the washers.



1. Spring washers

18. Install the L-ring on the compressor shaft.
19. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the hexagonal nut threads before tightening it.

TORQUE	
Hexagonal nut	29 N•m (21 lbf•ft)



1. Nut
2. L-ring
3. Spring washers
4. Lock washer
5. Friction shims
6. Drive gear
7. Needle bearing

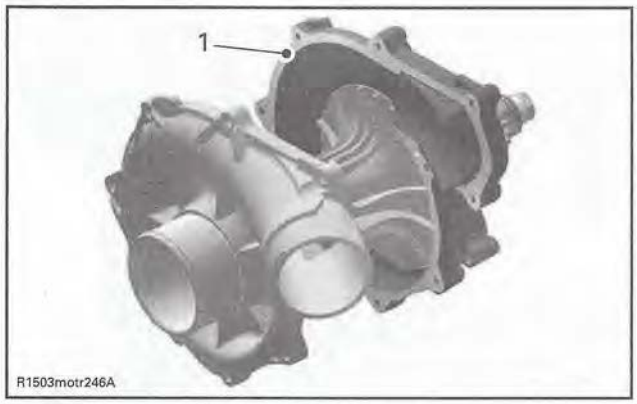
NOTE: The L-ring will preload the spring washers.

20. Hold the lock washer of the supercharger shaft (engine side) and tighten the cap nut.

REQUIRED TOOL
SUPERCHARGER RETAINING KEY (P/N 529 036 027)

TORQUE	
Cap nut	29 N•m (21 lbf•ft)

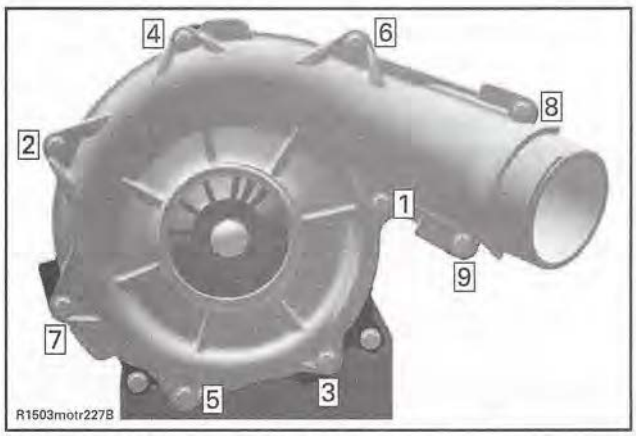
21. Apply LOCTITE 5910 (P/N 293 800 081) on supercharger housing sealing surface.



1. Apply Loctite 5910 on sealing surface

22. Assemble supercharger housing halves.
    22.1 Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on retaining screws.
    22.2 Tighten supercharger housing halves screws according to the following sequence.

TORQUE	
Supercharger housing halves screws	9 N•m (80 lbf•in)



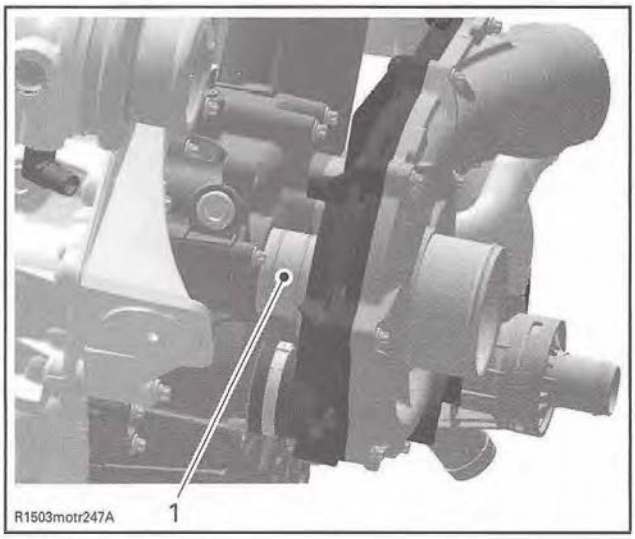
SUPERCHARGER TIGHTENING SEQUENCE

23. Verify the clutch slipping moment. Refer to *SUPERCHARGER CLUTCH SLIPPING MOMENT (BENCH TEST)* in this subsection.

Supercharger Installation

1. Grease sealing surface between supercharger and PTO housing with SUPER LUBE GREASE (P/N 293 550 030).

NOTE: Ensure O-rings are installed.



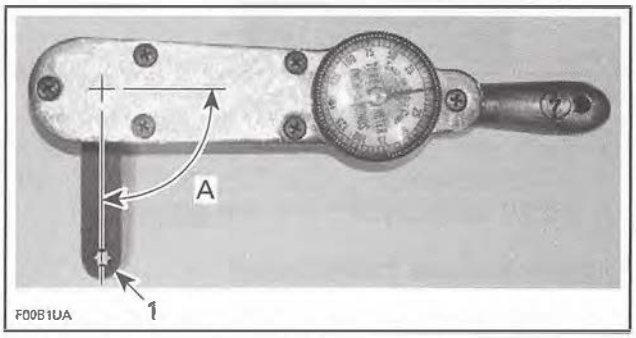
1. Super Lube grease

2. Install supercharger on PTO housing.
3. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the retaining screws.
4. Tighten supercharger retaining screws to specifications.

TORQUE	
Supercharger retaining screws	9 N•m (80 lbf•in)

NOTE: For the upper retaining screw the following tool must be used mounted 90° to torque wrench.

REQUIRED TOOL	
TORX ADAPTER (P/N 529 035 938)	



1. Torx adapter perpendicular to torque wrench
A. 90°

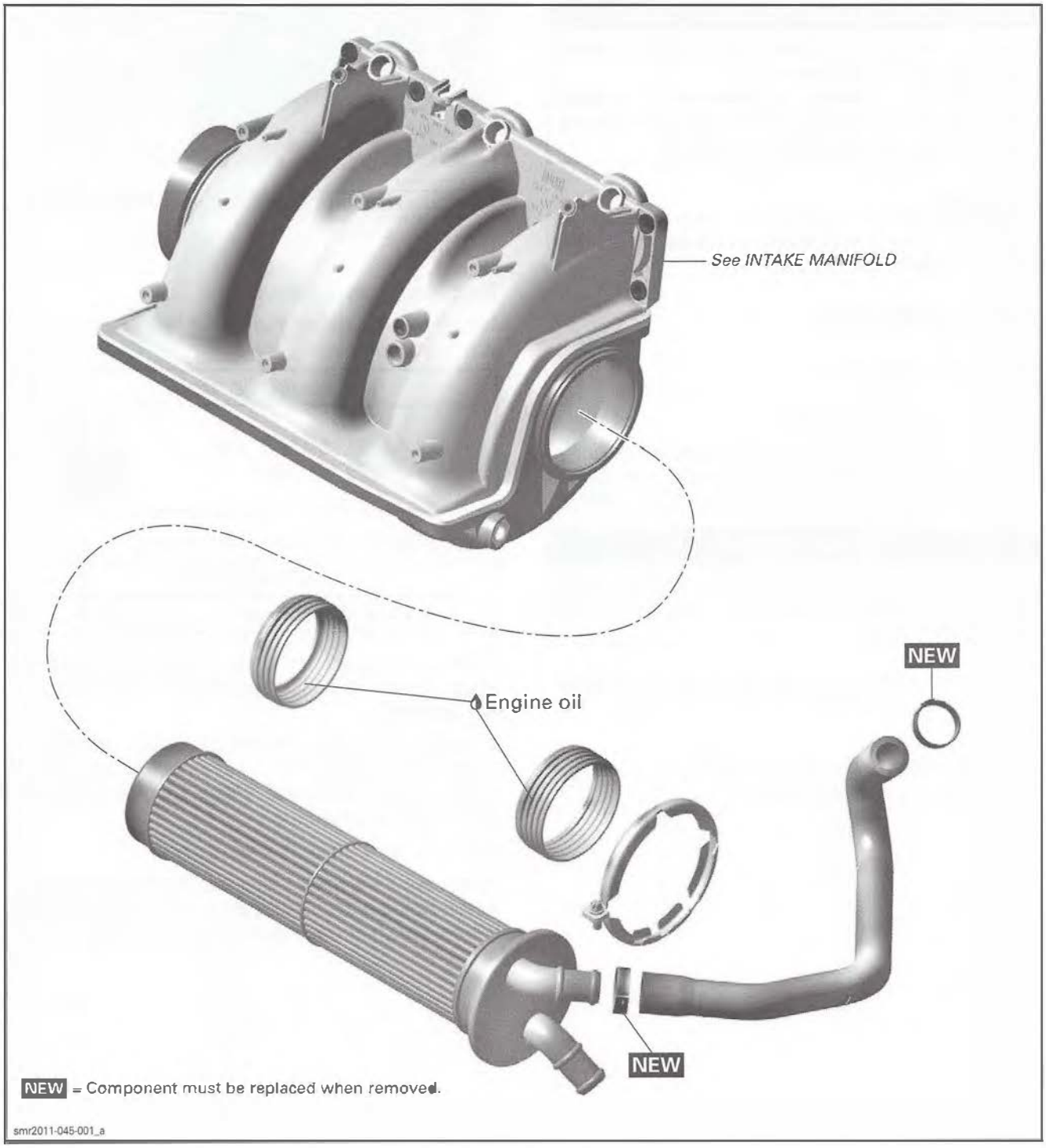
NOTICE Not installing the tool as shown will change the torque applied to the screw.

5. After complete installation of the supercharger, the slipping moment has to be rechecked. Refer to *SUPERCHARGER CLUTCH SLIPPING MOMENT (ON ENGINE)* at the beginning of this subsection.

INTERCOOLER (215 ENGINE)

SERVICE TOOLS

Description	Part Number	Page
VACUUM/PRESSURE PUMP	529 021 800	62



GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

PROCEDURES

INTERCOOLER

Intercooler Leak Test

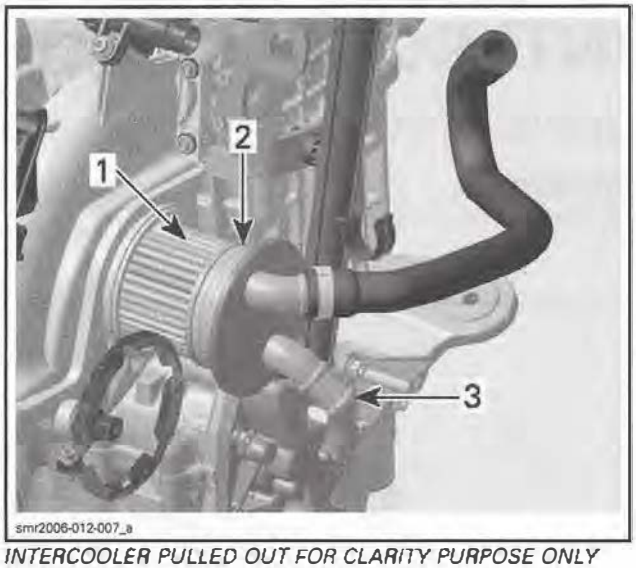
Perform intercooler leak test when engine looses performance, when there is white exhaust smoke or when temperature in exhaust system is to high.

⚠ WARNING

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

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

Remove:
- Outlet hose from exhaust manifold
- Inlet hose from intercooler.



INTERCOOLER PULLED OUT FOR CLARITY PURPOSE ONLY
1. *Intercooler*
2. *Outlet hose*
3. *Inlet nipple*

Plug intercooler inlet nipple.

Install an adapter on the outlet hose to connect a pressure pump.

REQUIRED TOOL	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

Pressurize the intercooler as follows:

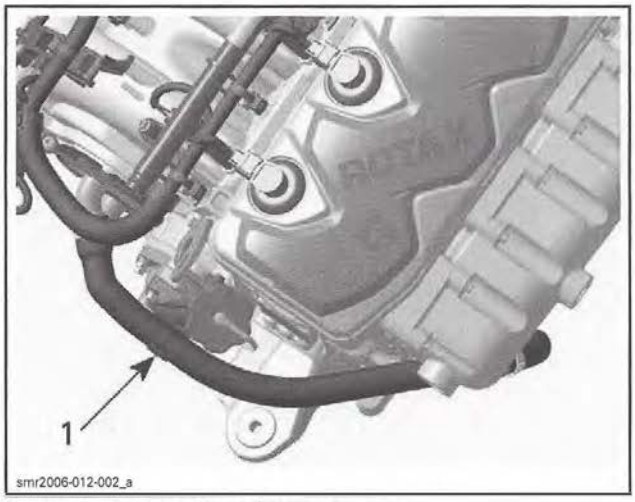
PRESSURE TEST
69 kPa (10 PSI) for 10 minutes minimum

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

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

Properly reinstall removed parts.

Make sure the intercooler outlet hose is installed in the holding device (located on the oil filler tube) otherwise the hose will scuff on the engine block.

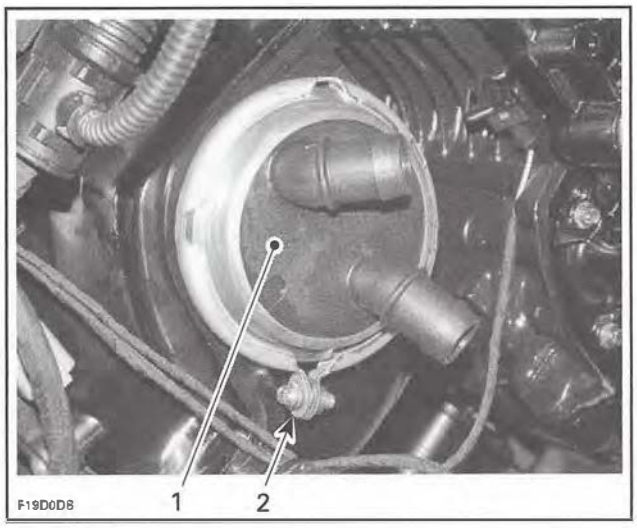


1. Intercooler outlet hose holding device

Intercooler Removal

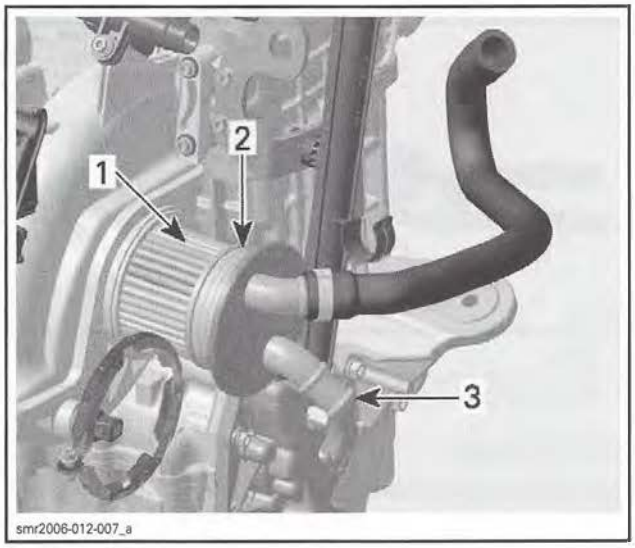
Remove intake manifold. Refer to *INTAKE MANIFOLD* subsection.

Remove collar from intercooler.



TYPICAL
1. Intercooler
2. Collar

Carefully pull intercooler out of intake manifold.



1. Intercooler
2. Profile ring
3. Collar

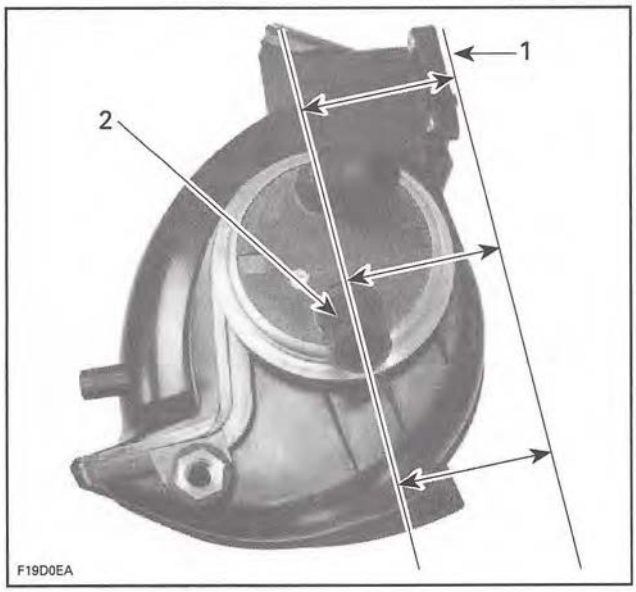
Intercooler Installation

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

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

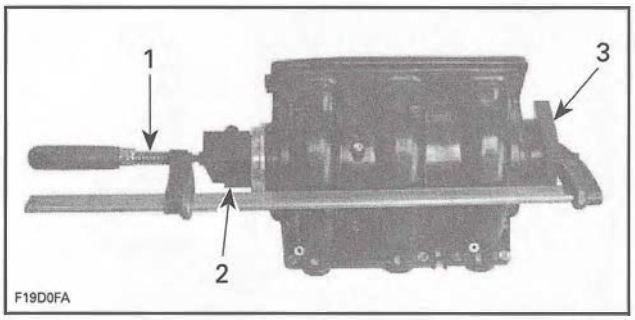
While properly aligning the inner end of intercooler in intake manifold, gently push intercooler until it bottoms.

Rotate intercooler to position nipples as shown.



1. Intake manifold flange
2. Nipple parallel with manifold flange

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



1. Clamp
2. Plastic block between nipples
3. Plastic block

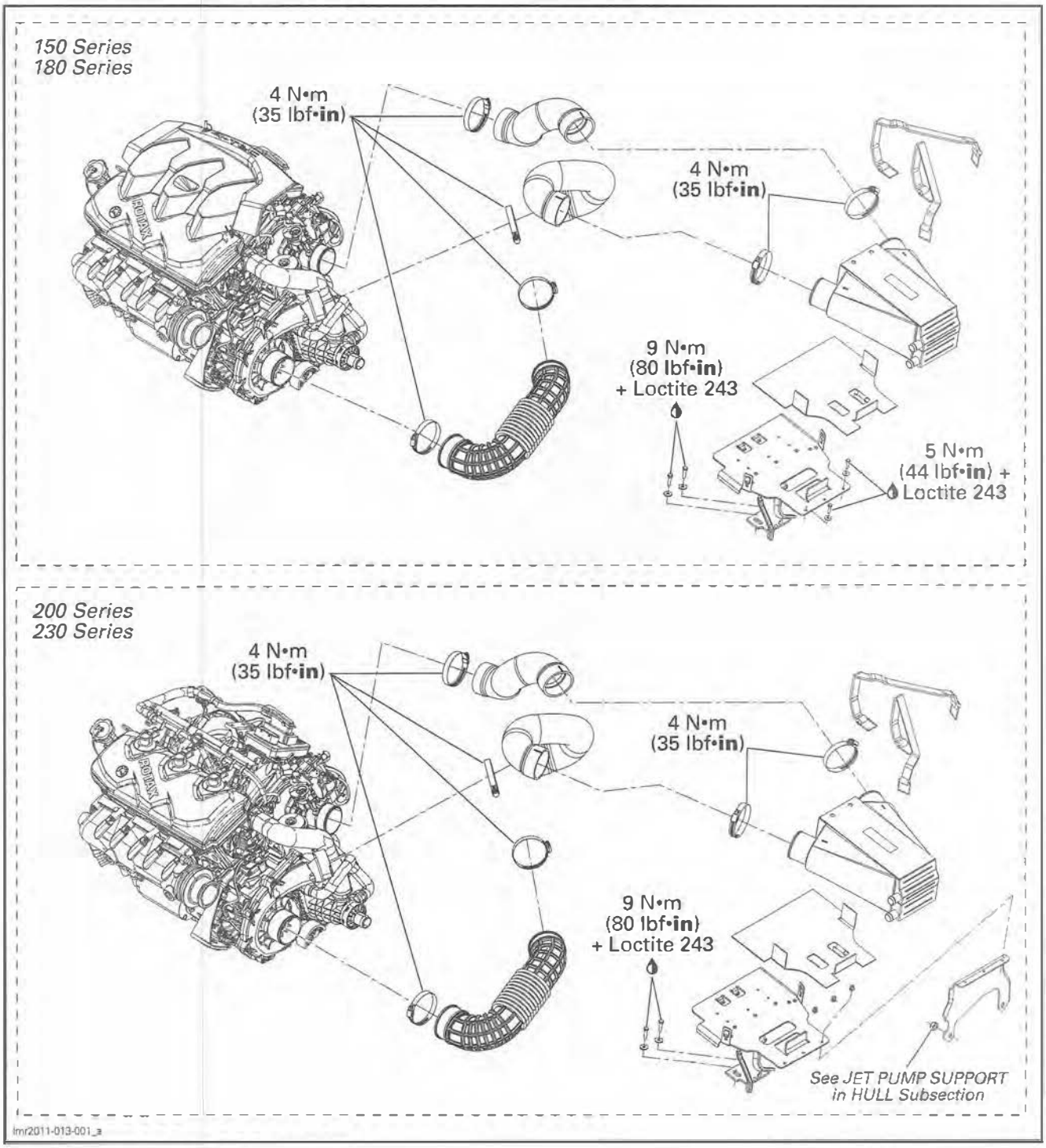
Reinstall collar.

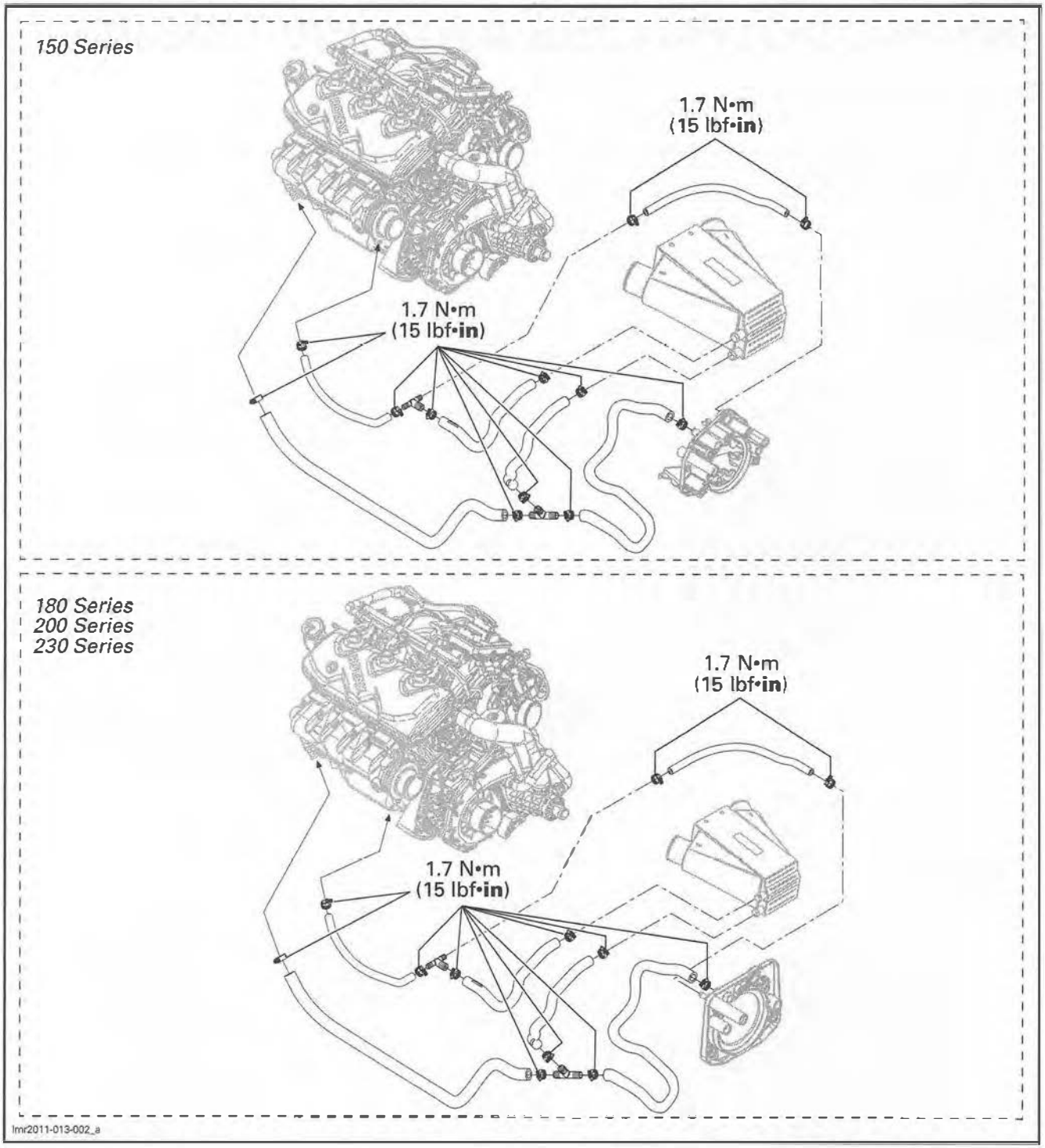
Reinstall intake manifold.

INTERCOOLER (255 AND 260 ENGINES)

SERVICE TOOLS

Description	Part Number	Page
LARGE HOSE PINCHER	529 032 500	68
VACUUM/PRESSURE PUMP	529 021 800	68




150 Series
1.7 N•m
(15 lbf•in)
1.7 N•m
(15 lbf•in)
180 Series
200 Series
230 Series
1.7 N•m
(15 lbf•in)
1.7 N•m
(15 lbf•in)
lmr2011-013-002_a

GENERAL

During assembly or installation, use torque values and service products as in the exploded view.

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

NOTICE **Torque wrench tightening specifications must be strictly adhered to.**

⚠ WARNING

Locking devices must be replaced when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.).

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

MAINTENANCE

INTERCOOLER FLUSHING

Flushing the intercooler 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 intercooler.

NOTE: Intercooler is flushed with the exhaust system, as they are on the same circuit.

Exhaust system and intercooler should be flushed each time:

- Boat is used in salt water and is not expected to be used further the same day.
- Boat is used in foul water.
- Boat is stored for any extended time.

Refer to *EXHAUST SYSTEM* subsection for flushing procedure.

NOTICE **Failure to flush the system, when necessary, will severely damage engine intercooler or exhaust system.**

PROCEDURES

INTERCOOLER

⚠ CAUTION **Let engine cool down prior to work on intercooler.**

Intercooler Cleaning

If temperature in intake manifold gets too high or if engine is down in performance, intercooler may require to be cleaned.

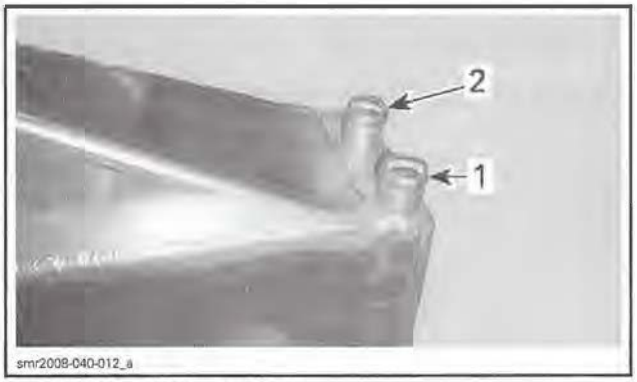
The exhaust system should be flushed first, as it may unclogged the intercooler. If not, then proceed with the intercooler cleaning procedure as detailed here.

NOTE: The exhaust temperature will decrease when the intercooler is clogged because more water is rerouted through the exhaust system.

To clean the intercooler, do the following:

NOTICE **Never try to clean the intercooler with chemical products. Only use fresh water. Chemical products will permanently damage the internal parts of intercooler.**

1. Remove the *INTERCOOLER* from the boat. See procedure further in this subsection.
2. Poor fresh water into the water outlet fitting.



1. *Intercooler water inlet fitting*
2. *Intercooler water outlet fitting*

3. Let water into intercooler for many hours. Occasionally, shake the intercooler to soak off deposits.
4. Rinse the intercooler using a garden hose installed on water outlet.
5. Let water flows out of intercooler a few minutes to evacuate internal deposits.
6. Check water flow.

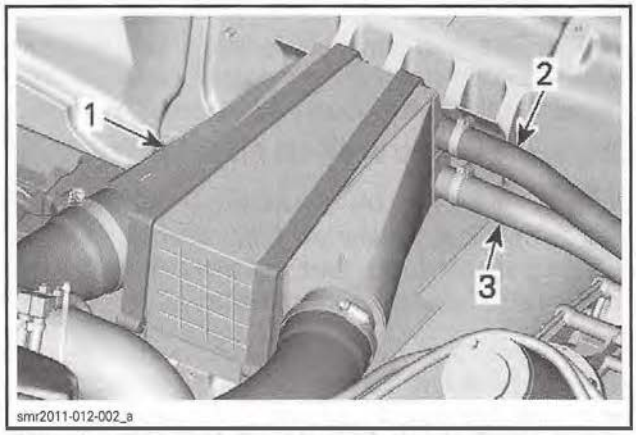
WATER FLOW	
LOW OR ERRATIC	1. Repeat cleaning procedure. 2. Replace the intercooler.
HIGH AND REGULAR	Intercooler is not clogged.

7. Perform a leak test before installing the intercooler in the boat.

Intercooler Leak Test

Block intercooler water inlet and outlet hoses.

REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 529 032 500)	



TYPICAL - SOME PARTS REMOVED FOR CLARITY PURPOSE
1. *Intercooler*
2. *Intercooler water outlet hose*
3. *Intercooler water inlet hose*

Unplug the intercooler water inlet hose from the intercooler.

Install the VACUUM/PRESSURE PUMP (P/N 529 021 800) on intercooler water inlet fitting.

Pressurize the intercooler.

PRESSURE TEST
69 kPa (10 PSI) for 10 minutes min.

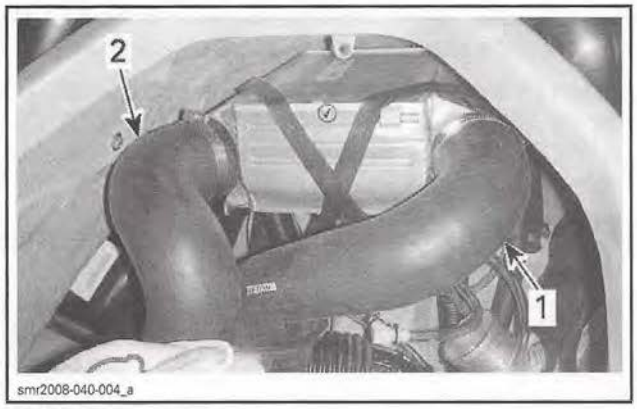
If there is a pressure drop, first spray tool, hoses and adapters with a soapy water solution to ensure they are not leaking.

Otherwise, replace the intercooler.

Intercooler Removal

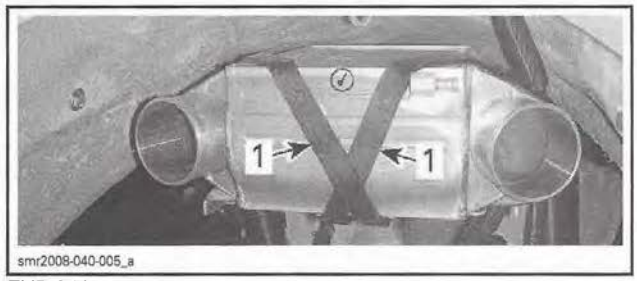
Access the engine compartment.

Disconnect both air hoses.



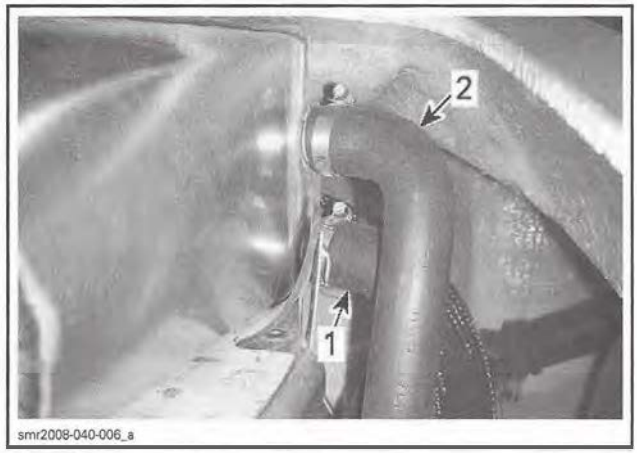
TYPICAL
1. *Intercooler air inlet hose*
2. *Intercooler air outlet hose*

Detach intercooler retaining straps.



TYPICAL
1. *Intercooler straps*

Disconnect water hoses from the rear left side of intercooler.



TYPICAL
1. *Intercooler water inlet hose*
2. *Intercooler water outlet hose*

Remove the intercooler.

Intercooler Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Ensure hoses are routed correctly and locking ties are positioned at proper locations.

Run engine above 4000 RPM for 30 seconds to push air out and allow intercooler to fill completely.

EXHAUST SYSTEM

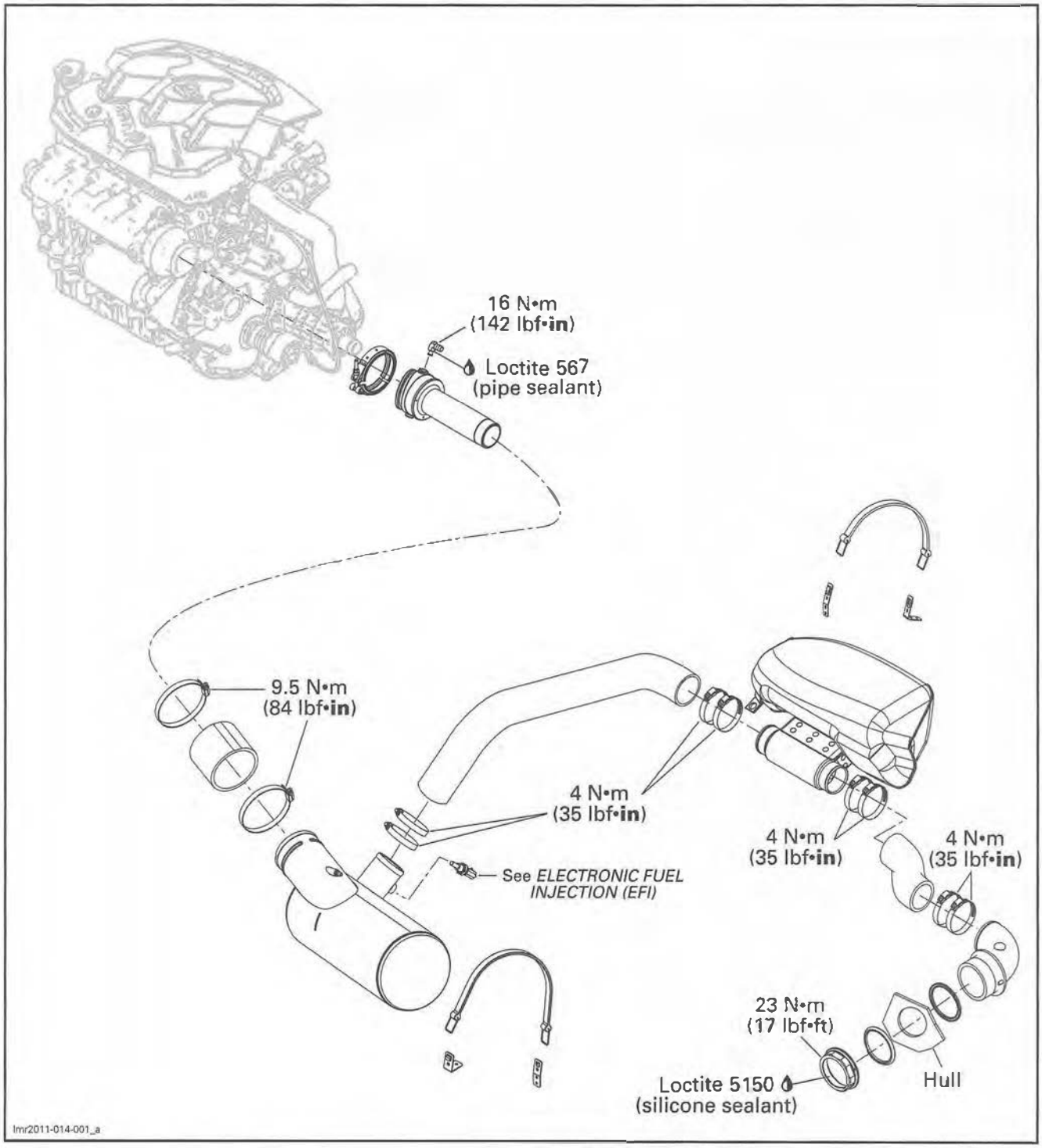
SERVICE TOOLS

Description	Part Number	Page
FLUSHING CONNECTOR ADAPTER	295 500 473	78
SPRING INSTALLER/REMOVER (SMALL)	529 035 989	80

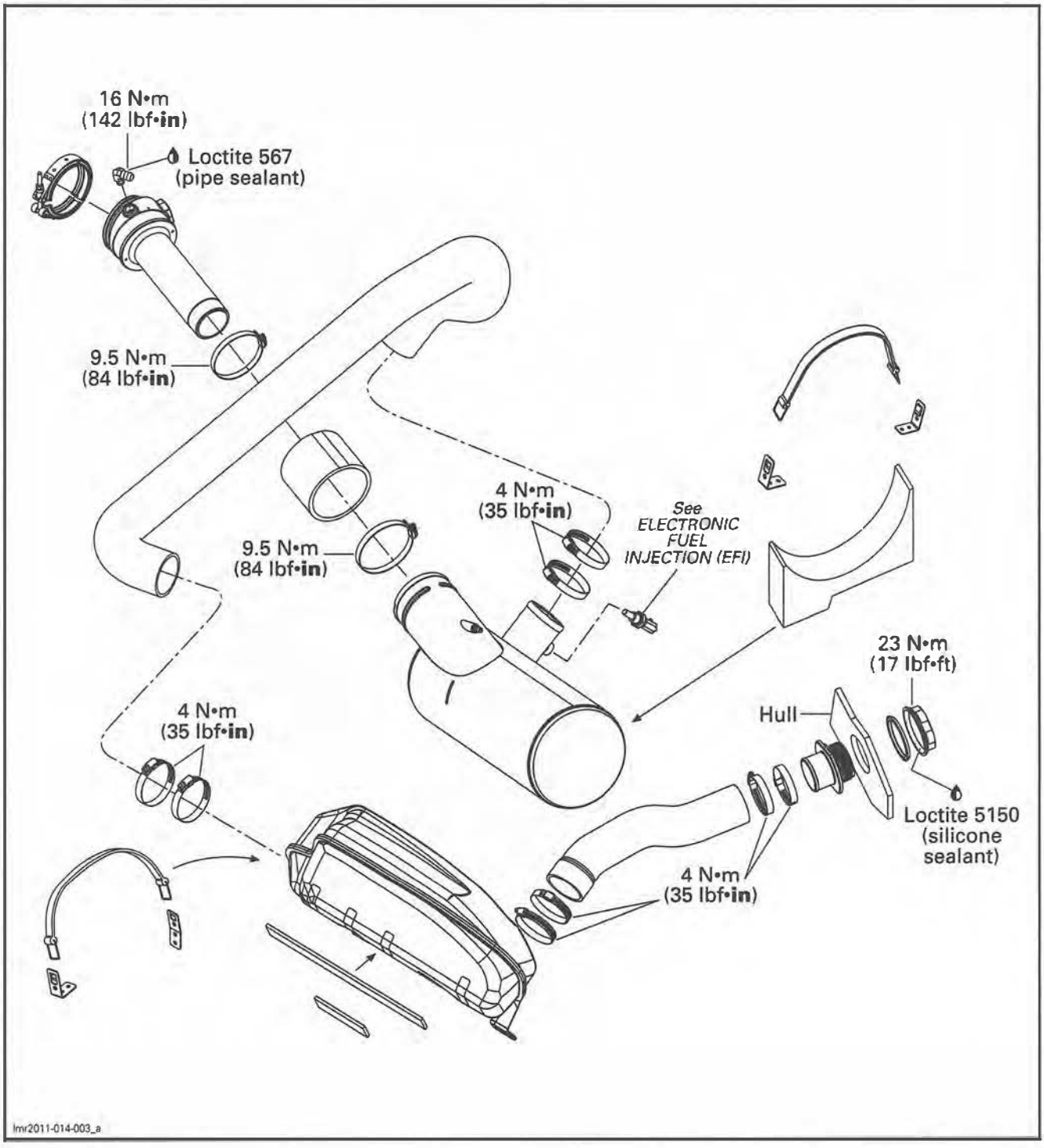
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	83

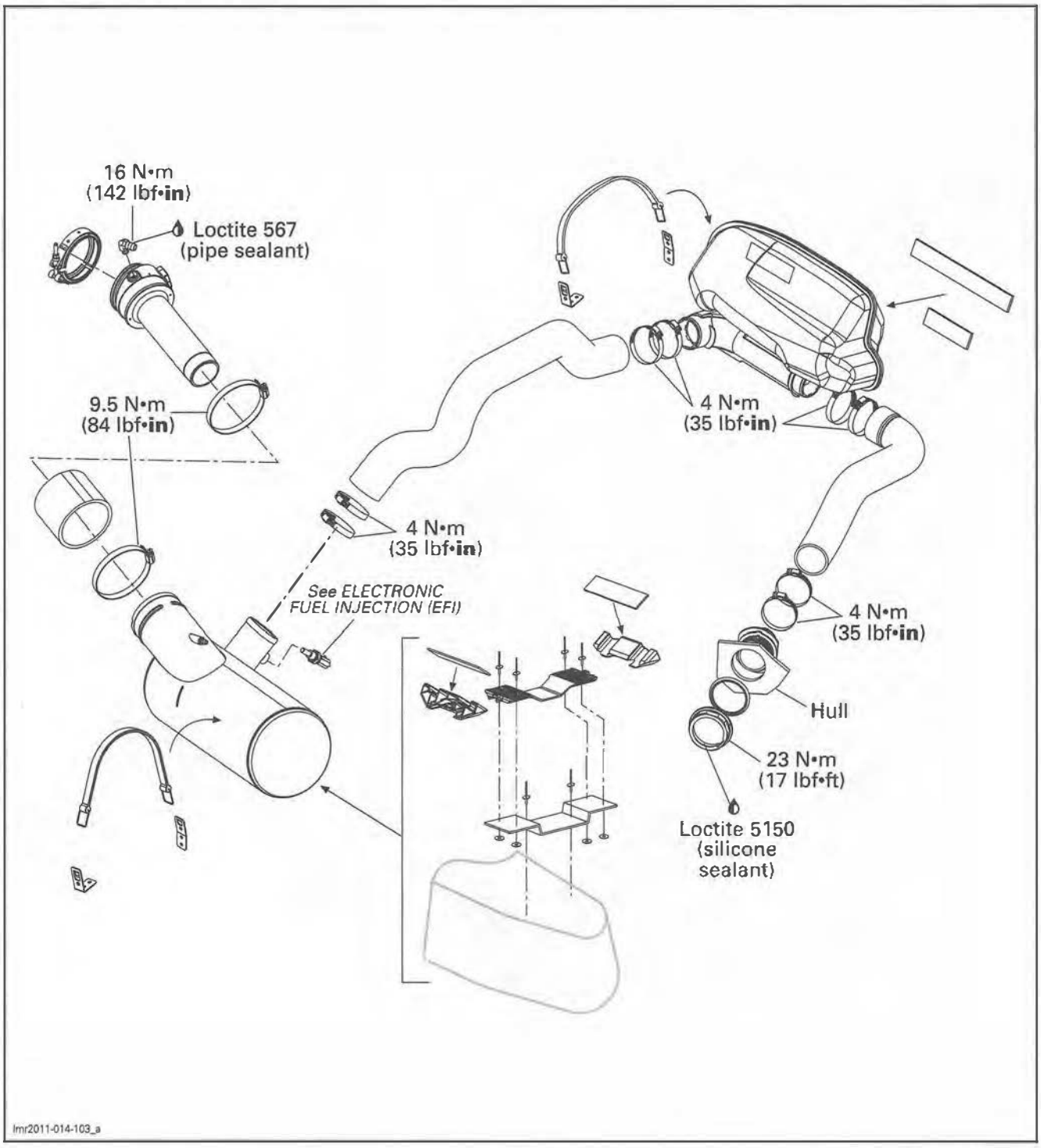
150 and 180 Series



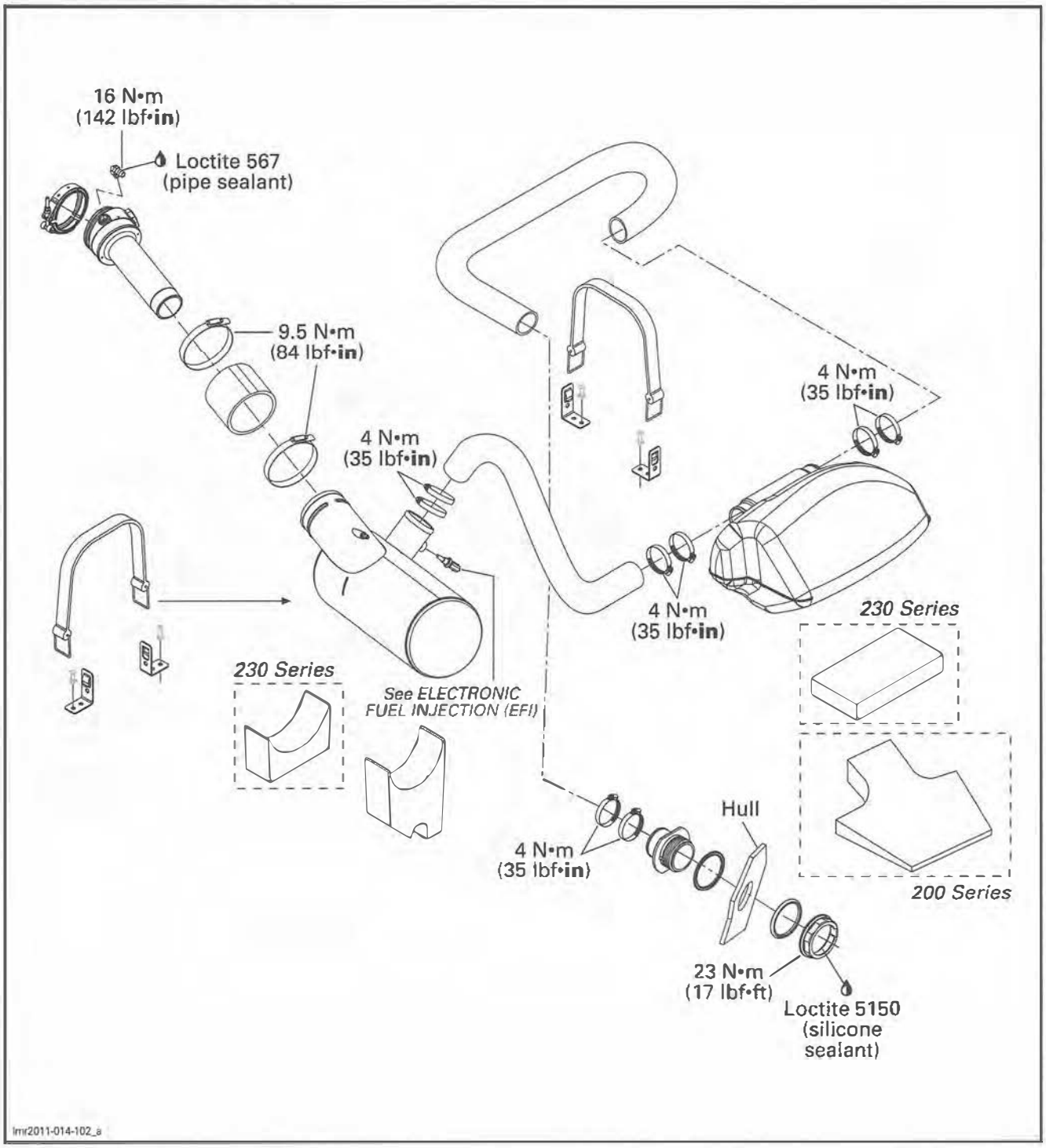
210 Series (Port Side)



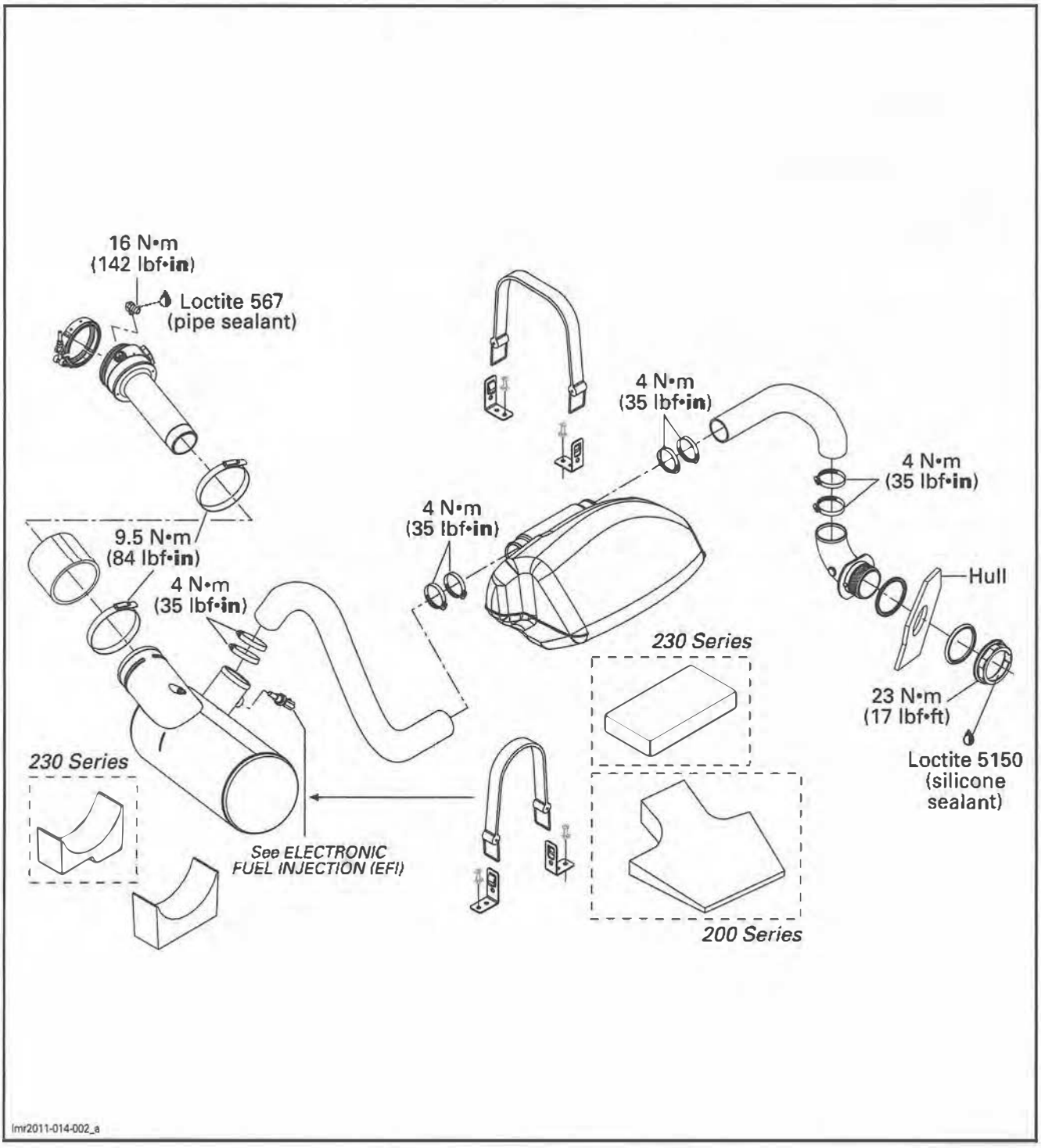
210 Series (Starboard Side)



200 and 230 Series (Port Side)



200 and 230 Series (Starboard Side)



GENERAL

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

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

NOTICE **When installing exhaust hoses (muffler or resonator), ensure exhaust hose clamps are located after the exhaust spud bulge and they must not overlap each other.**

NOTICE **Torque wrench tightening specifications must be strictly adhered to.**

⚠ WARNING

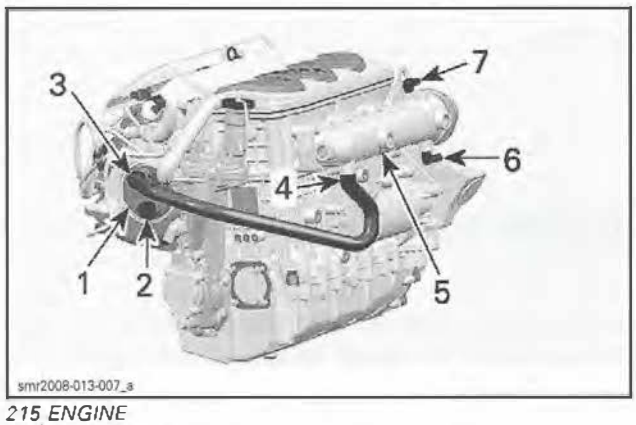
Locking devices must be replaced when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.).

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

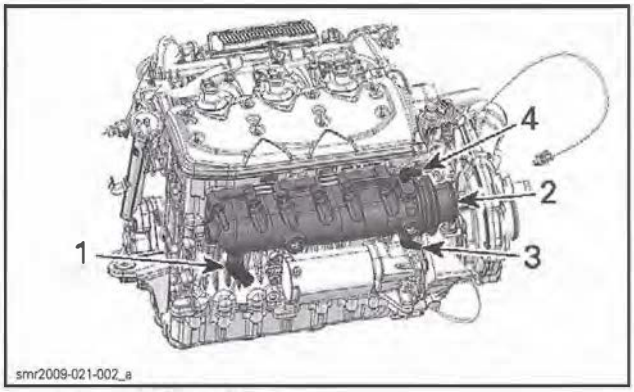
SYSTEM DESCRIPTION

The exhaust system is cooled by water provided by a pressurized area in the jet pump (open loop system).

The same water is also used to cool the intercooler (supercharged engines).

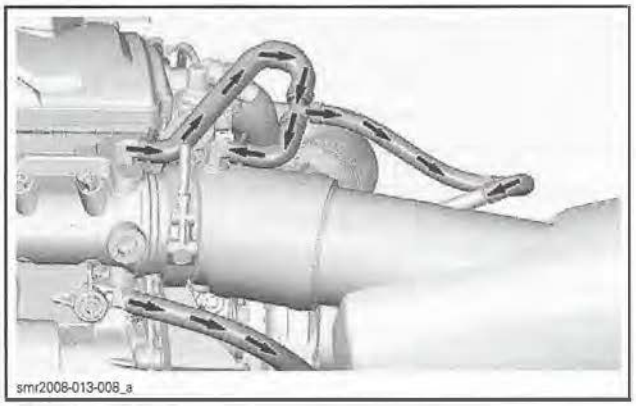


215 ENGINE
1. *Intercooler*
2. *Intercooler water inlet*
3. *Intercooler water outlet*
4. *Exhaust manifold water inlet*
5. *Exhaust manifold*
6. *Exhaust manifold water outlet (to pump support)*
7. *Exhaust manifold water outlet (to exhaust pipe and muffler)*



155, 255 AND 260 ENGINES
1. *Exhaust manifold water inlet*
2. *Exhaust manifold*
3. *Exhaust manifold water outlet (to pump support)*
4. *Exhaust manifold water outlet (to exhaust pipe and muffler)*

Water from the exhaust manifold jacket is directed to the exhaust pipe via 2 hoses.



TYPICAL

Water exits the exhaust pipe water jacket through holes to inject water in the muffler and resonator.

TYPICAL
1. *Water jacket holes*

The water is evacuated through the exhaust outlet in the transom area.

Exhaust System Technical Specifications

TYPE	Total Loss Cooling System (TLCS)
WATER FLOW	Flow from jet pump (no water pump)
TEMPERATURE CONTROL	Calibrated outlet fittings (no thermostat)
SYSTEM BLEEDING	Self-bleed type
SYSTEM DRAINING	Self-drain type

MAINTENANCE

EXHAUST SYSTEM FLUSHING

Flushing the exhaust system with fresh water is essential to neutralize corroding effects of salt or other chemical products present in water. It will help to remove sand, salt, shells or other particles in water jackets, exhaust system, intercooler (supercharged engines) and hoses.

Exhaust system flushing should be performed when the boat is not expected to be used further the same day or when the boat is stored for any extended time.

NOTICE **Failure to flush the system, when necessary, will severely damage intercooler and exhaust system. Make sure engine operates during entire procedure.**

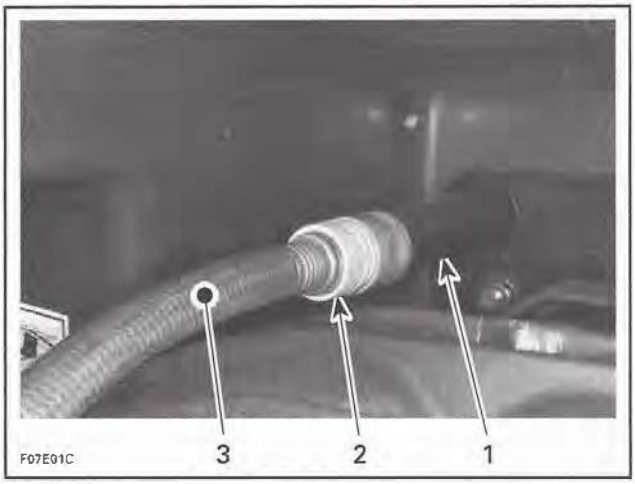
⚠ WARNING

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

⚠ WARNING

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

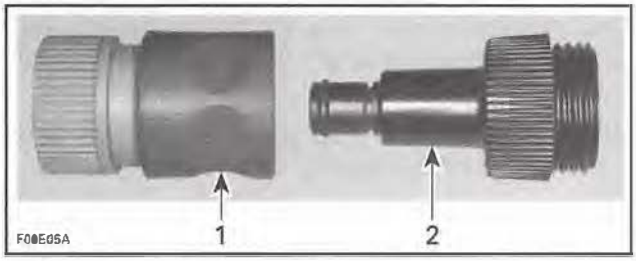
1. Connect a garden hose to connector located at the rear of boat on jet pump support. Do not open water tap yet.



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

NOTE: The following tool is recommended when a quick connect adapter is used to ease garden hose installation.

RECOMMENDED TOOL	
FLUSHING CONNECTOR ADAPTER (P/N 295 500 473)	



1. *Quick connect adapter*
2. *Flushing connector adapter*

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

NOTICE **Always start the engine before opening the water tap. Open water tap immediately after engine is started to prevent overheating. Never run engine without supplying water to the exhaust system when boat is out of water.**

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

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

4. Ensure water flows out of jet pump while flushing.

5. Close the water tap, then stop the engine.

NOTICE **Always close the water tap before stopping the engine.**

6. Disconnect the garden hose.

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

PROCEDURES

MUFFLER

⚠ CAUTION **Certain components in the engine compartment may be very hot. Let exhaust system cool down prior to removing parts.**

Muffler Access

To access engine compartment, refer to *ENGINE ACCESS* in *ENGINE REMOVAL AND INSTALLATION* subsection.

210 Series

Remove air intake system, refer to *AIR INTAKE SYSTEM* subsection.

Muffler Removal

1. Disconnect exhaust hose from muffler outlet.

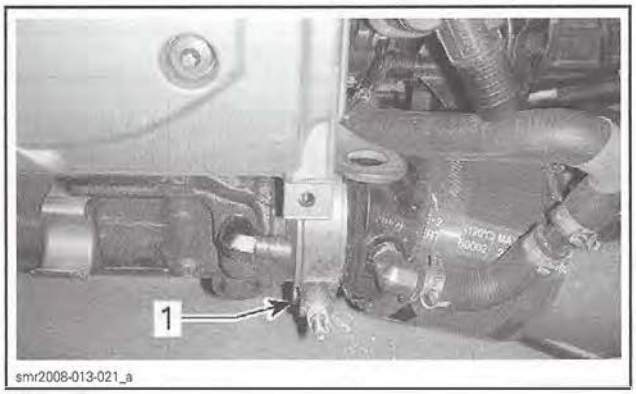
TYPICAL
1. *Exhaust hose*
2. *Muffler*

2. Cut locking tie securing water outlet hose (exhaust system) and blow-by hose.
3. Disconnect the upper water outlet hose from the exhaust manifold.

TYPICAL
1. *Exhaust manifold water outlet hose*
2. *Exhaust manifold fitting*

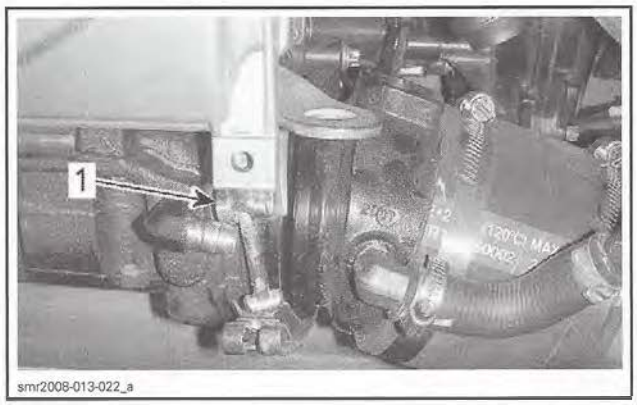
4. Gently disconnect the hose from blow-by valve.
5. Unscrew exhaust clamp.

NOTICE **Do not use pneumatic or electric tools as seizure of the fastener may occur.**



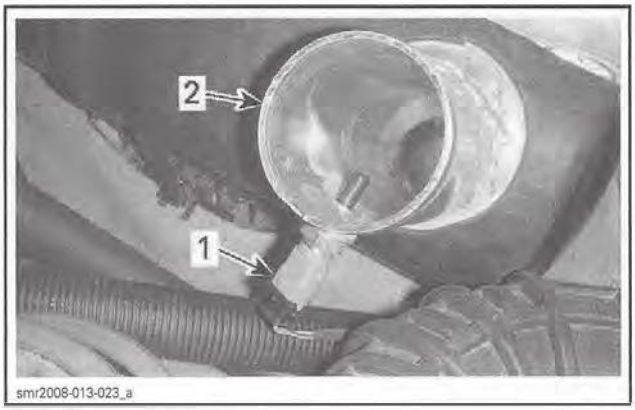
TYPICAL
1. *Exhaust clamp*

6. Move exhaust clamp onto exhaust manifold.



TYPICAL
1. *Opened exhaust clamp on exhaust manifold*

7. Disconnect the exhaust gas temperature sensor (EGTS) from muffler.



TYPICAL
1. *Exhaust gas temperature sensor*
2. *Muffler*

8. Cut locking ties and move or remove other hoses as required to permit removal of muffler. Note the position of locking ties and hoses for reinstallation.
9. Detach muffler strap.

RECOMMENDED TOOL	
SPRING INSTALLER/REMOVER (SMALL) (P/N 529 035 989)	

10. Move muffler backward to extract exhaust manifold from exhaust pipe.
11. Remove the muffler from boat.

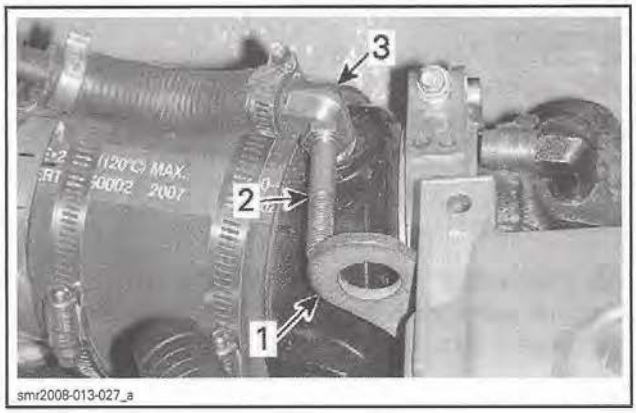
Muffler Inspection

1. Check muffler for:
   - Cracks
   - Corrosion
   - Other damages.
2. Check if exhaust hose is:
   - Brittle
   - Hard
   - Cracked
   - Otherwise damaged.
3. Replace any defective part.

Muffler Installation

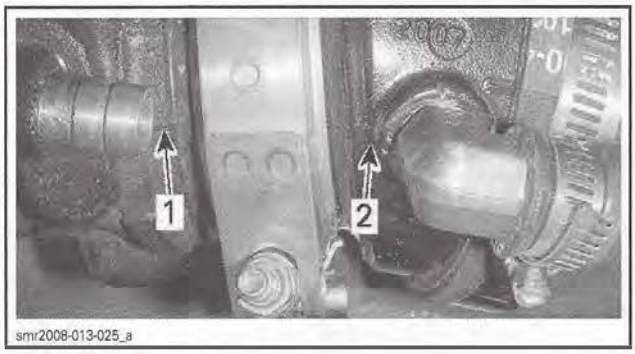
With a new muffler, install the EGTS sensor. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

1. Place the muffler in hull.
2. Align the exhaust pipe flange to the exhaust manifold. Rotate and move muffler so that the exhaust pipe flange makes perfect contact with exhaust manifold.
3. Install exhaust clamp with the nut upward.
4. Tighten clamp loosely.
5. Using a 50 mm (2 in) spacer (in this case a bolt), position the exhaust pipe. See following illustration.



TYPICAL
1. *Engine lifting ring*
2. *Spacer*
3. *Exhaust pipe fitting*

6. Confirm that the index mark on the exhaust pipe is aligned with the index mark on the exhaust manifold.



TYPICAL
1. *Exhaust manifold index mark*
2. *Exhaust pipe index mark*

7. Tighten exhaust clamp.

TORQUE	
Exhaust clamp	11 N•m (97 lbf•in)

NOTICE **Do not use pneumatic or electric tools as seizure of the fastener may occur.**

8. Install the muffler strap.

NOTICE **Do not rotate muffler during strap installation. The use of a soapy water solution on inner side of muffler strap is recommended.**

9. Install all other removed parts.

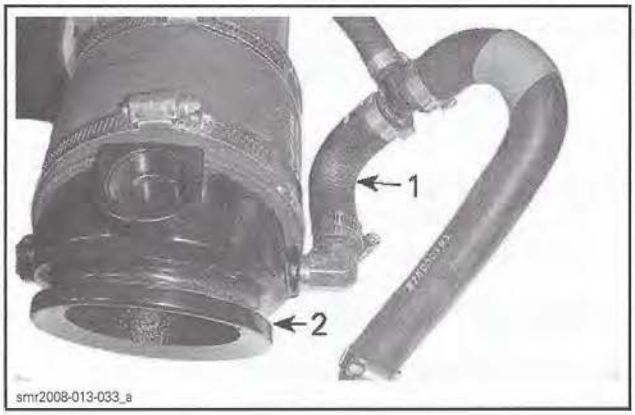
10. After installation, test run the engine while supplying water to the exhaust system. Ensure there is no water or exhaust gas leakage when engine is running.

NOTICE **Never run engine without supplying water to the exhaust system when the boat is out of water.**

EXHAUST PIPE

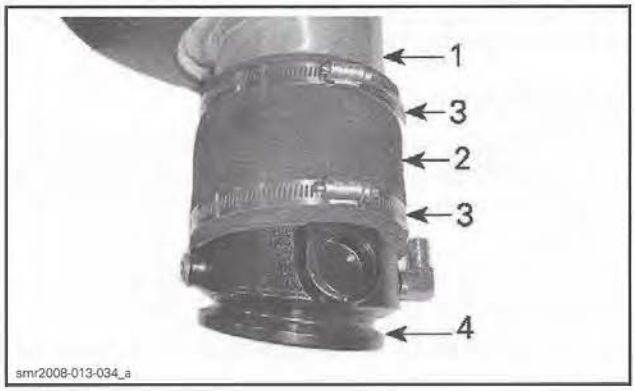
Exhaust Pipe Removal

1. Remove *MUFFLER*, see procedure in this subsection.
2. Disconnect water inlet hose from exhaust pipe fitting.



TYPICAL
1. Water inlet hose
2. Exhaust pipe

3. Loosen rubber adapter clamps.



TYPICAL
1. Muffler
2. Rubber adapter
3. Clamps
4. Exhaust pipe

4. Remove exhaust pipe and the rubber adapter.

Exhaust Pipe Inspection

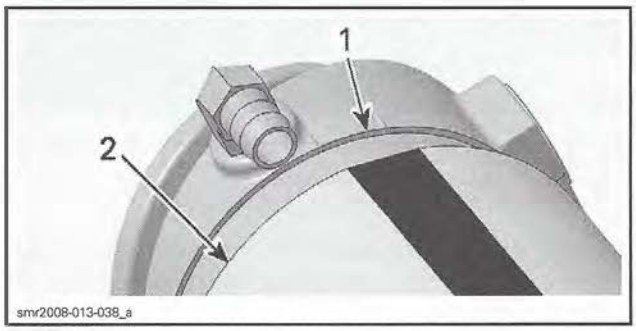
1. Inspect exhaust pipe for:
   - Cracks
   - Flange damages
   - Other damages.
2. Replace exhaust pipe as required.
3. Check if the rubber adapter is:
   - Brittle
   - Hard
   - Otherwise damaged.
4. Replace rubber adapter if necessary.

Exhaust Pipe Installation

1. Trace an index mark to locate the middle of the bulge opening on the muffler.

TYPICAL
1. Bulge
2. Middle of the opening

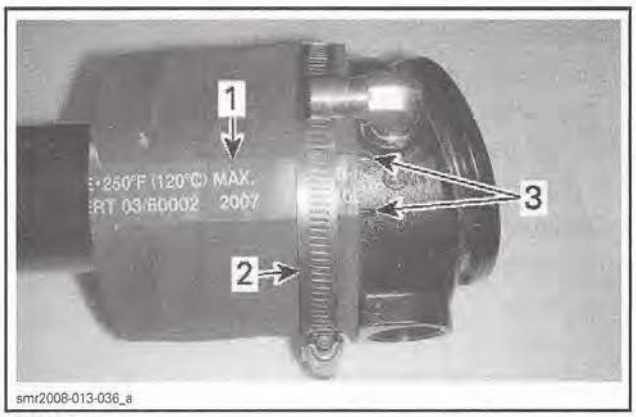
2. Install the rubber adapter on exhaust pipe. Ensure rubber adapter is properly seated against exhaust pipe shoulder.



TYPICAL
1. Exhaust pipe shoulder
2. Rubber adapter

NOTE: Do not use soap or lubricant to install hose.

3. Center the identification band on the rubber adapter between both exhaust pipe marks.



TYPICAL
1. *Identification band on rubber adapter*
2. *Retaining clamp*
3. *Exhaust pipe index marks*

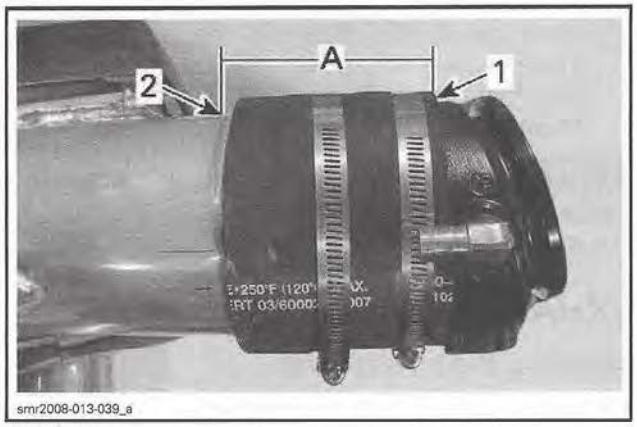
4. Tighten retaining clamp.

TORQUE	
Rubber adapter retaining clamp	9 N•m (80 lbf•**in**)

5. Slide the other clamp on the rubber adapter.
6. Insert the exhaust pipe into the muffler.
7. Align the center of the identification band on the rubber adapter with the index mark previously traced on the muffler.

TYPICAL
1. *Middle of rubber identification band*
2. *Center index mark of the muffler bulge opening*

8. Using a caliper, measure the distance between the exhaust pipe shoulder and the outside of the muffler bulge.
9. Position the muffler to 95 mm ± 2 mm (3.74 in ± .079 in). Check the distance in several places.



TYPICAL
1. *Rubber adapter end*
2. *Outside of the muffler bulge*

A. 95 mm ± 2 mm (3.74 in ± .079 in)

10. Tighten retaining clamp.

TORQUE	
Rubber adapter retaining clamp	9 N•m (80 lbf•**in**)

11. Install muffler in vehicle. Refer to *MUFFLER INSTALLATION* in this subsection for complete procedure.

EXHAUST MANIFOLD

Exhaust Manifold Access

To access engine compartment, refer to *ENGINE ACCESS* in *ENGINE REMOVAL AND INSTALLATION* subsection.

210 Series

Remove the air intake tube, refer to *AIR INTAKE SYSTEM* subsection.

Exhaust Manifold Removal

1. Move muffler rearwards to make room. Refer to *MUFFLER REMOVAL* in this subsection to know how separate muffler from exhaust manifold.
2. Disconnect the lower water outlet hose from the aft end of the exhaust manifold.
3. Disconnect the cooling system supply hose underneath the front part of the exhaust manifold.
4. Unscrew the exhaust manifold starting with the lower screws. This will help to secure the manifold as you remove the screws.
5. Remove the exhaust manifold from the boat.

Exhaust Manifold Inspection

1. Inspect exhaust manifold condition, pay attention for cracks or other damages.

2. Check contact surfaces and hose. Replace any defective part.
3. Inspect plane surfaces, ensure they are not warped.

NOTE: Small deformations can be corrected by grinding the surface with a fine sand paper. Lay the sand paper on a plane surface and rub part against oiled sand paper.

4. Clean all metal components in a solvent.

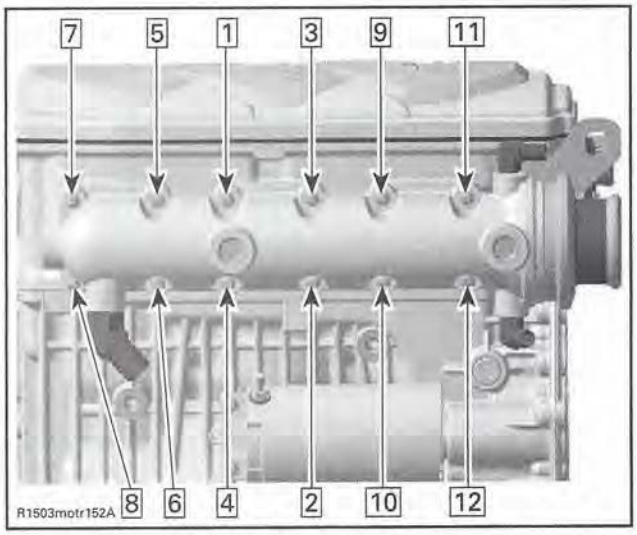
Exhaust Manifold Installation

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

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

1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of screws.
2. To help hold the exhaust manifold while installing screws, first insert the manifold into the exhaust pipe then, install the upper front screw. Continue with the remaining screws.
3. Torque screws to specification as per sequence illustrated.

TORQUE	
Exhaust manifold screws	9 N•m (80 lbf•in)



TYPICAL - MANIFOLD TORQUE SEQUENCE

4. Install all other removed parts, refer to applicable exploded view for service products and torques.
5. After installation, test run the engine while supplying water to the flushing connector. Ensure there is no water or exhaust gas leakage when the engine is running.

NOTICE **Never run engine without supplying water to the exhaust cooling system when boat is out of water.**

RESONATOR

Resonator Access

To access engine compartment, refer to *ENGINE ACCESS* in *ENGINE REMOVAL AND INSTALLATION* subsection.

210 Series

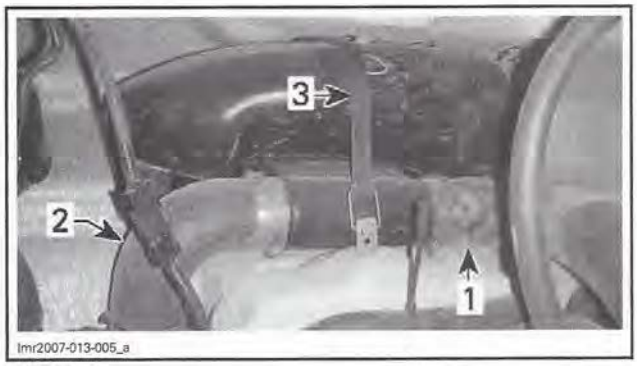
Remove air inlet system for increased access to the resonator.

200 and 230 Series

When equipped with a 255 engine, remove the intercooler. Refer to *INTERCOOLER (255 ENGINE)* subsection.

Resonator Removal

1. Disconnect both hoses from resonator.
2. Remove strap(s) retaining resonator.



TYPICAL
1. *Hose from muffler*
2. *Resonator outlet hose*
3. *Resonator strap*

3. Carefully pull out the resonator.

Resonator Inspection

1. Inspect parts condition paying attention for:
   - Deformation
   - Cracks
   - Other damages.
2. Check hoses and retaining straps.
3. Replace any defective part.

Resonator Installation

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

1. Remove outlet hose from exhaust outlet.
2. Install outlet hose on resonator.
3. Install resonator in position while inserting outlet hose on exhaust outlet.
4. Install all other removed parts.
5. After installation, test run the engine while supplying water to the exhaust system. Ensure there is no water or exhaust gas leakage when the engine is running.

NOTICE **Never run engine without supplying water to the exhaust system when boat is out of water.**

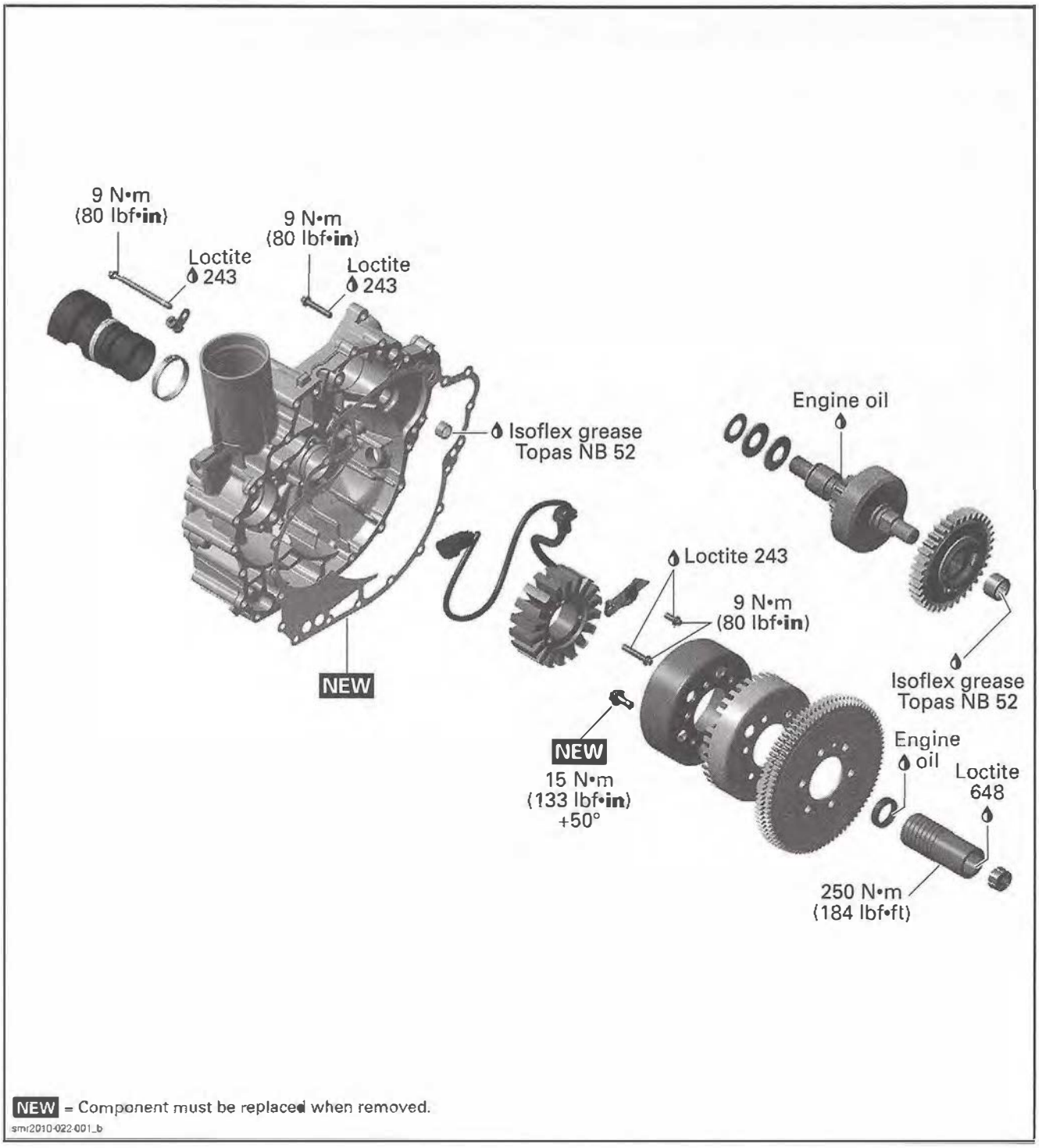
PTO HOUSING AND MAGNETO

SERVICE TOOLS

Description	Part Number	Page
3-PIN MAGNETO HARNESS ADAPTER	529 036 016	94–95
BLIND HOLE BEARING PULLER SET	529 036 117	93
HANDLE	420 877 650	93
IMPELLER REMOVER/INSTALLER	529 035 820	92
OETIKER PLIERS	295 000 070	92
STARTER DRIVE SEAL PUSHER	420 876 502	93
SUCTION PUMP	529 035 880	87

SERVICE PRODUCTS

Description	Part Number	Page
ISOFLEX GREASE TOPAS NB 52	293 550 021	93, 99
LOCTITE 243 (BLUE)	293 800 060	91, 96
LOCTITE 648 (GREEN)	413 711 400	93
PULLEY FLANGE CLEANER	413 711 809	88, 91



NEW = Component must be replaced when removed.

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GENERAL

NOTE: It is good practice to check for fault codes using the B.U.D.S. software as a first troubleshooting step. Refer to the *DIAGNOSTIC AND FAULT CODES* subsection.

Always carry out electrical tests on components before removing or installing them.

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

⚠ WARNING

Before carrying out any inspection or maintenance procedure on the vehicle, wait until the engine and exhaust have cooled down to avoid potential burns.

PROCEDURES

PTO HOUSING

PTO Housing Access

1. Remove parts as required to access engine, refer to *ENGINE ACCESS* in *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Turn the main battery cut-off switch to OFF when working on the engine.

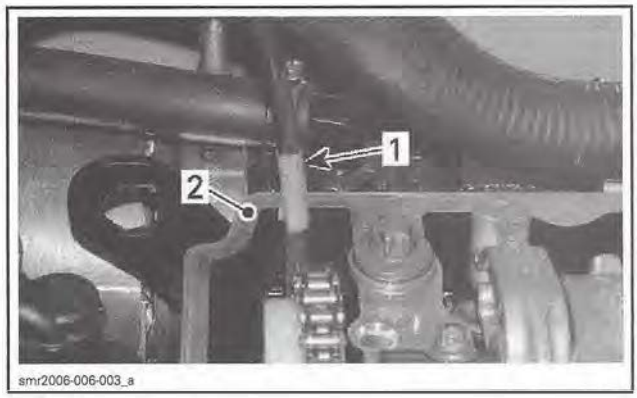
1. ON position

3. On **210 series**, remove air intake system, refer to *AIR INTAKE SYSTEM* subsection.
4. Move muffler rearwards. Refer to *EXHAUST SYSTEM* subsection.
5. Refer to *PROPULSION* subsection and remove the following:
   - Jet pump
   - Drive shaft
   - Drive shaft boot.

PTO Housing Removal

1. Drain the engine oil. Refer to *LUBRICATION SYSTEM* subsection.
2. Remove the cylinder head cover. Refer to *CYLINDER HEAD* subsection.
3. Insert the tube of the suction pump in the lower area of the timing chain.

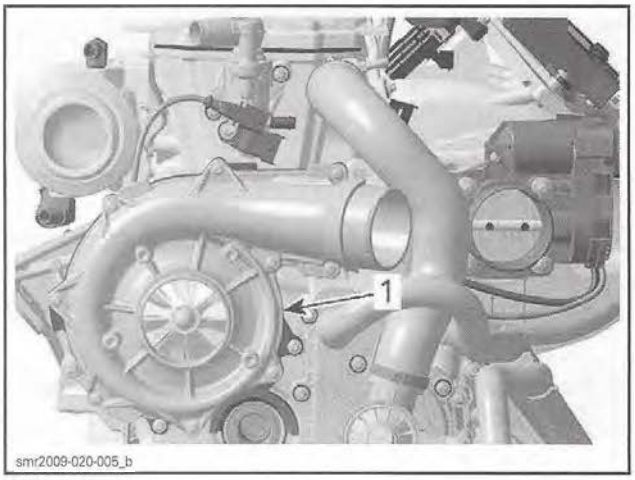
REQUIRED TOOL	
SUCTION PUMP (P/N 529 035 880)	



TYPICAL
1. Suction pump tube
2. Edge of cylinder block

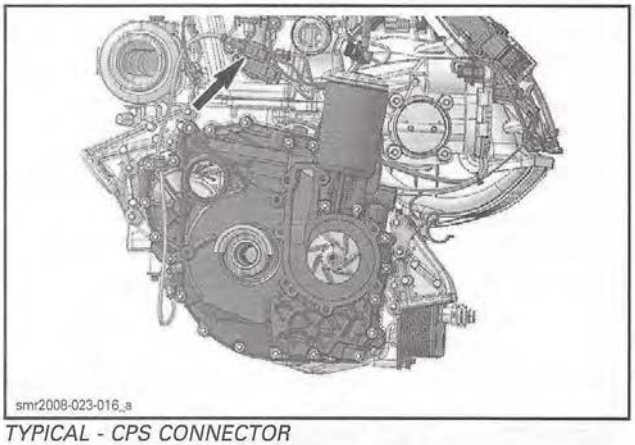
4. Syphon remaining oil out of the lower timing chain case.

5. Drain engine coolant, refer to the *COOLING SYSTEM* subsection.
6. Disconnect at throttle body the air intake hose.
7. On **supercharged models**, remove the supercharger, refer to the *SUPERCHARGER* subsection.



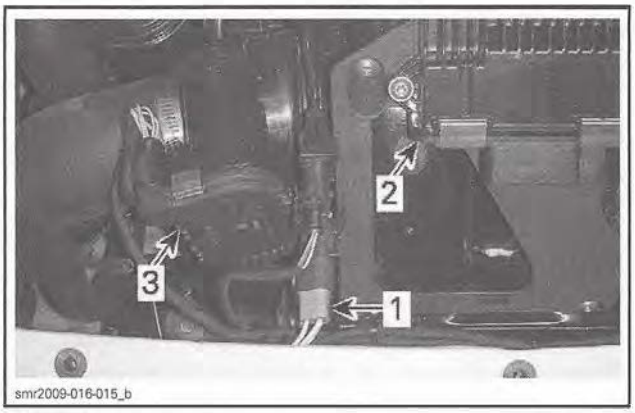
TYPICAL
1. Supercharger

8. Disconnect CPS connector.



TYPICAL - CPS CONNECTOR

9. Disconnect the magneto connector.



TYPICAL
1. Magneto connector
2. ECM
3. Throttle body

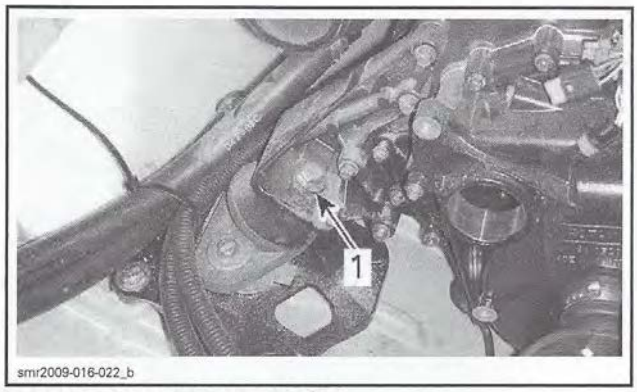
10. Place rags under PTO housing to prevent oil spillage.

NOTE: Up to 250 ml (8 U.S. oz) of oil could flow out when removing PTO housing. If spillage occurs, clean immediately with PULLEY FLANGE CLEANER (P/N 413 711 809) to prevent oil stains.

11. Remove both rear engine support screws.

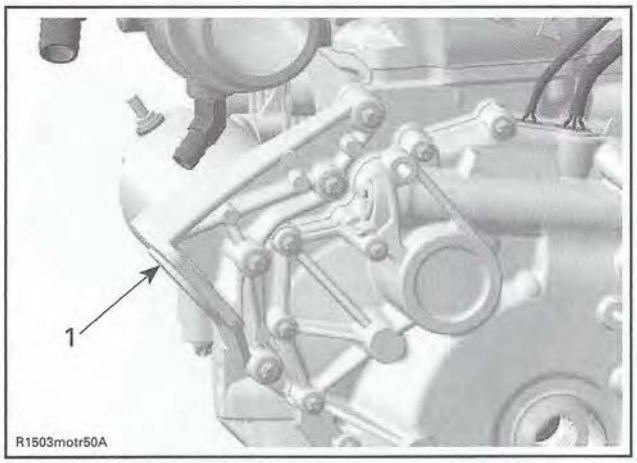
TYPICAL - RIGHT SIDE OF VEHICLE
1. Rear engine support screw

NOTE: When removing the rear engine support screws, secure the shims from each mount (as applicable) in a separate bag, identified to the mount position (LH or RH side).



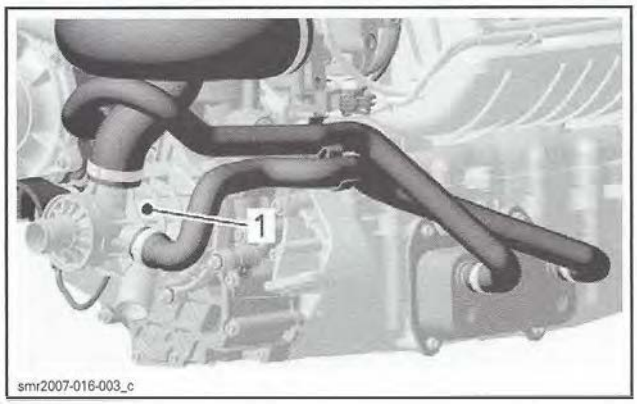
TYPICAL - LEFT SIDE OF VEHICLE
1. Rear engine support screw

12. Slightly lift aft end of engine and insert a safely block under the engine to secure it in this position.
13. Remove LH rear engine support.



TYPICAL
1. Engine support

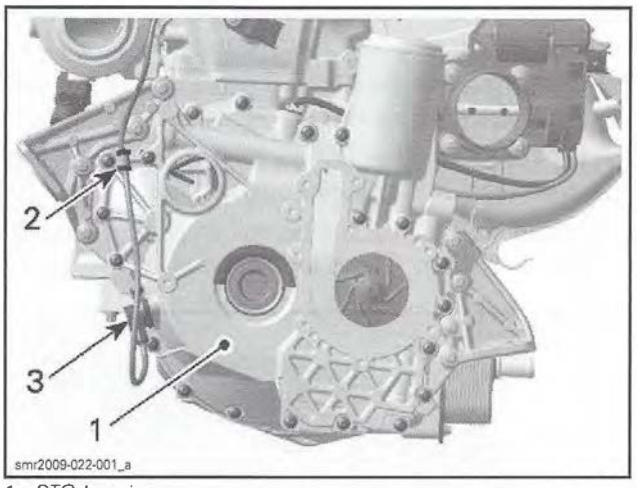
14. Remove water pump housing, refer to *COOLING SYSTEM* subsection.



TYPICAL
1. Water pump housing

15. Remove PTO housing retaining screws.

NOTE: Note position of the CPS harness retaining clamp position as indicated in the following illustration for reinstallation.

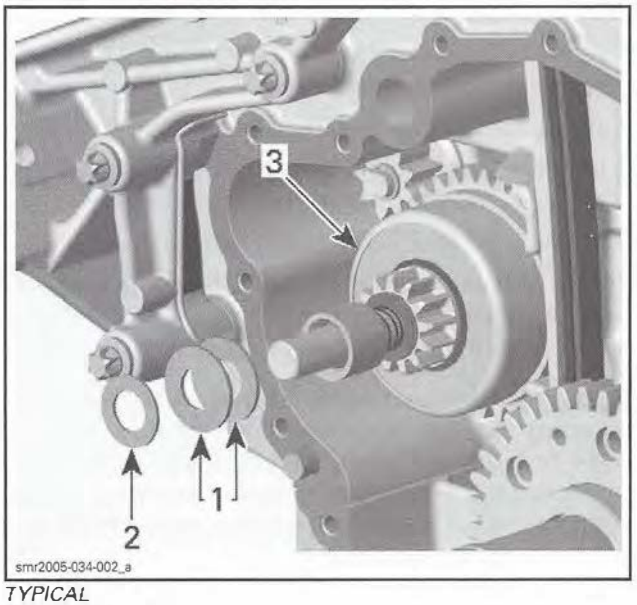


1. PTO housing
2. CPS harness retaining clamp
3. CPS

16. Remove PTO housing from engine.

NOTICE To prevent damaging contact surfaces, be sure to use prying lugs to separate PTO housing from engine.

NOTE: Carefully separate PTO housing from engine using two flat screwdrivers prying equally on opposite sides of the housing and at the same time. Proceed slowly to prevent starter drive spring discs and thrust washer from falling down into bilge area.



TYPICAL
1. Spring discs
2. Thrust washer
3. Starter drive

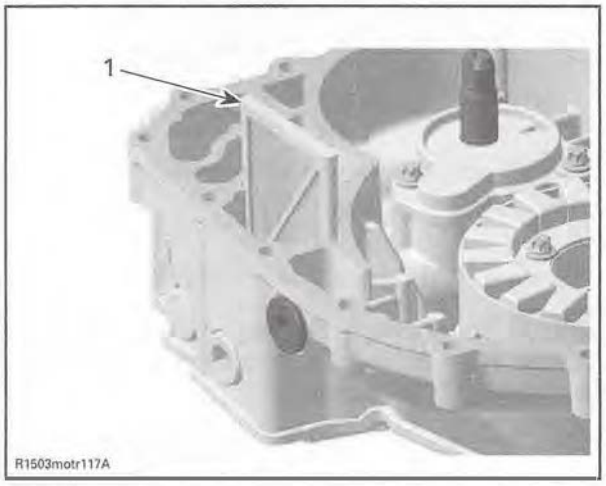
17. Remove PTO housing gasket and discard it.

PTO Housing Inspection

1. Inspect PTO housing for cracks or any other damages. Replace if necessary.
2. Inspect the needle bearing used to support the starter drive shaft in the PTO housing.

NOTE: Clean all disassembled metal components in a non-ferrous metal cleaner.

3. Inspect oil strainer for contaminants, debris or other particles. Clean as required.



TYPICAL
1. PTO oil strainer

PTO Housing Installation

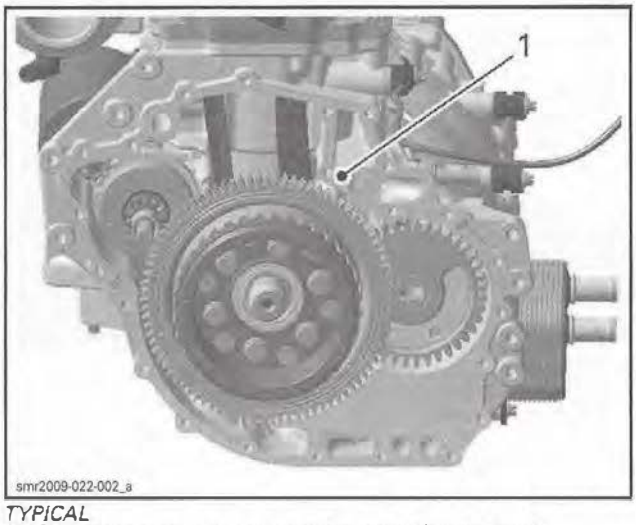
For installation, reverse the removal procedure. However, pay attention to the following.

1. Apply lubricants, sealers or threadlocker as specified in exploded view.
2. Apply torques as specified in exploded view.
3. Install starter drive, see *STARTER DRIVE INSTALLATION* further in this subsection.
4. Install a **NEW** PTO housing gasket.

NOTE: When installing the PTO housing, you will need to rotate the oil/water pump shaft slightly to align it with the balance shaft for proper insertion.

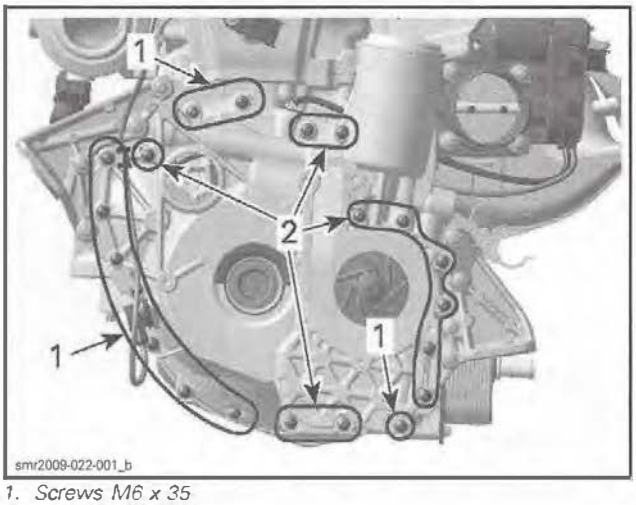
NOTICE Pay particular attention to the PTO housing gasket alignment to ensure that it does not get pinched, or slide out of its surface contact area. Never force housing when installing it. If there is a strong resistance, remove housing and check oil/water pump shaft alignment and starter drive gear alignment.

NOTICE Ensure the starter drive shaft is well aligned when engaging it in the PTO housing needle bearing.



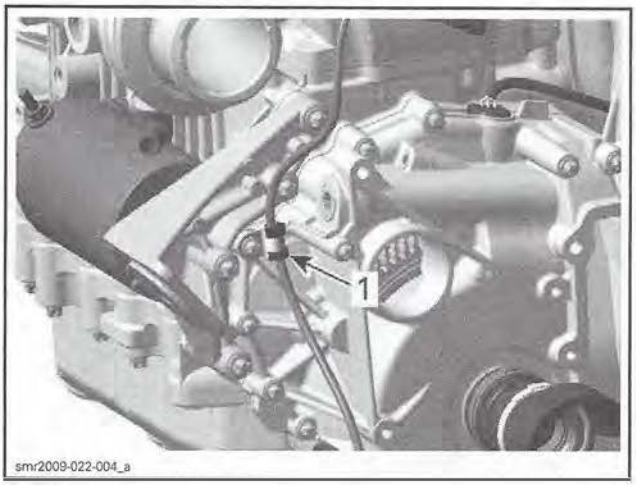
TYPICAL
1. Pay attention that gasket remains properly positioned on this surface

5. Refer to the following illustration to identify the locations of the various housing screws.



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

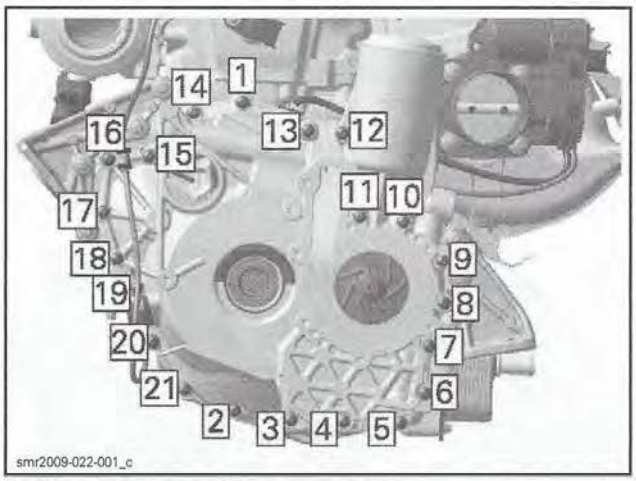
NOTE: Install the CPS harness retaining clamp at the position noted during the PTO housing removal.



TYPICAL
1. CPS harness retaining clamp

6. Install the PTO housing screws finger tight, then torque them as per following table and sequence numbered in the illustration.

PTO HOUSING INSTALLATION		
GASKET	**PRODUCT**	**SCREW TORQUE**
NEW	LOCTITE 243 (BLUE) (P/N 293 800 060)	9 N•m (80 lbf•in)



PTO HOUSING TORQUE SEQUENCE

7. Reinstall LH engine support as per following table.

LH ENGINE SUPPORT INSTALLATION	
PRODUCT	TORQUE
LOCTITE 243 (BLUE) (P/N 293 800 060)	23 N•m (17 lbf•ft)

8. Remove safety block from under engine.
9. Install both rear engine support screws loosely.
10. Carry out an engine alignment, refer to the *ENGINE REMOVAL AND INSTALLATION* subsection.

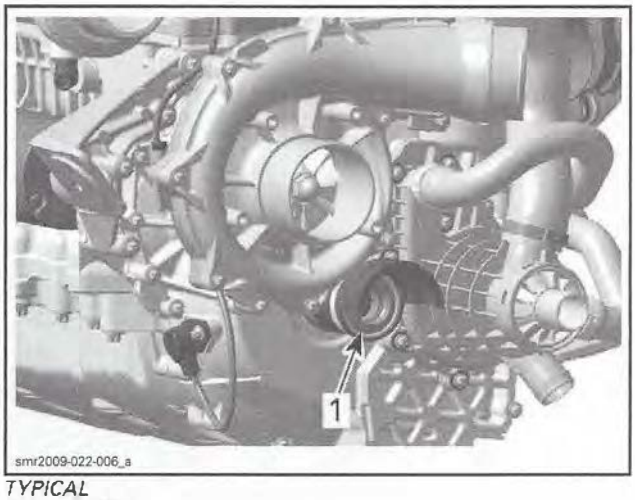
NOTICE **An engine alignment procedure must be carried out to ensure proper engine alignment or severe component damage may occur.**

11. Install all remaining parts, reconnect hoses and electrical connectors. Refer to applicable subsections for procedures and specific details (torques, service products or instructions).
12. Refill engine with oil and cooling system with coolant. Refer to *LUBRICATION SYSTEM* and *COOLING SYSTEM* subsections.

PTO SEAL

PTO Seal Inspection

1. Inspect the PTO seal on the PTO housing. If brittle, hard or damaged, or if you see a sign of oil leakage, replace it.
2. Inspect ball bearing within PTO seal for excessive play and smooth operation.
3. Replace PTO seal if oil seal or ball bearing is damaged.



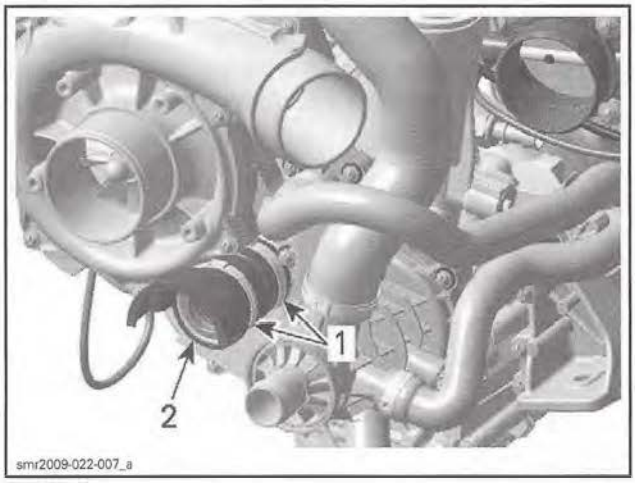
TYPICAL
1. PTO seal

PTO Seal Removal

1. Place rags under PTO housing to prevent spillage. If spillage occurs, clean immediately with PULLEY FLANGE CLEANER (P/N 413 711 809) to prevent oil stains.

NOTE: Take note of seal position and orientation of Oetiker clamp for installation.

2. Remove the Oetiker clamp retaining the seal to the PTO housing.



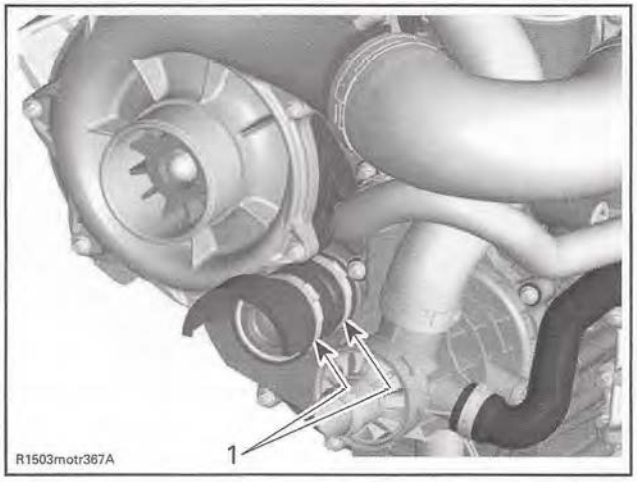
TYPICAL
1. Oetiker clamps
2. PTO seal

3. Pull seal from PTO housing.

PTO Seal Installation

1. Insert a NEW Oetiker clamp over the seal.
2. Push seal onto PTO housing. Be sure to align seal and clamp as noted at removal.

NOTICE **When installing PTO seal on supercharged engines, make sure to position the Oetiker clamps as illustrated.**

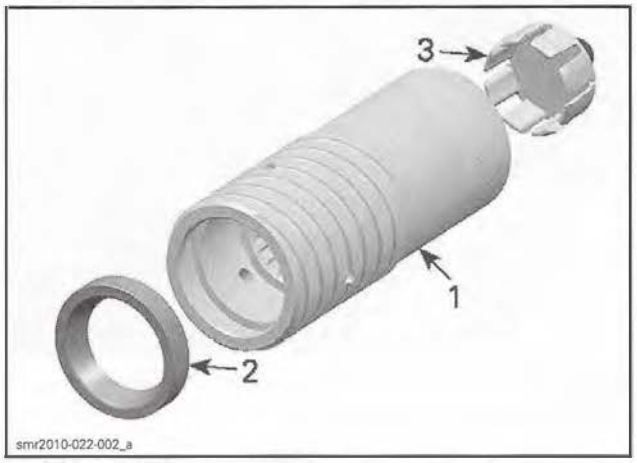


TYPICAL
1. Oetiker clamps

3. Crimp Oetiker clamp.

REQUIRED TOOL	
OETIKER PLIERS (P/N 295 000 070)	

PTO COUPLING



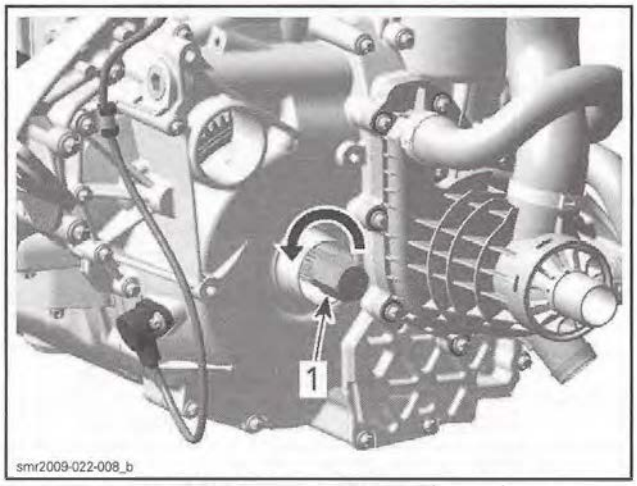
1. PTO coupling
2. Seal
3. Stop sleeve

PTO Coupling Removal

1. Lock crankshaft. Refer to *CYLINDER BLOCK* subsection for the procedure.
2. Remove PTO seal as described in previous procedure.
3. Unscrew coupling from crankshaft.

REQUIRED TOOL	
IMPELLER REMOVER/INSTALLER (P/N 529 035 820)	

NOTICE **Apply engine oil to the removal tool to protect the seal located within the PTO coupling.**



TYPICAL – TURN COUNTERCLOCKWISE TO REMOVE
1. Impeller removal tool

PTO Coupling Inspection

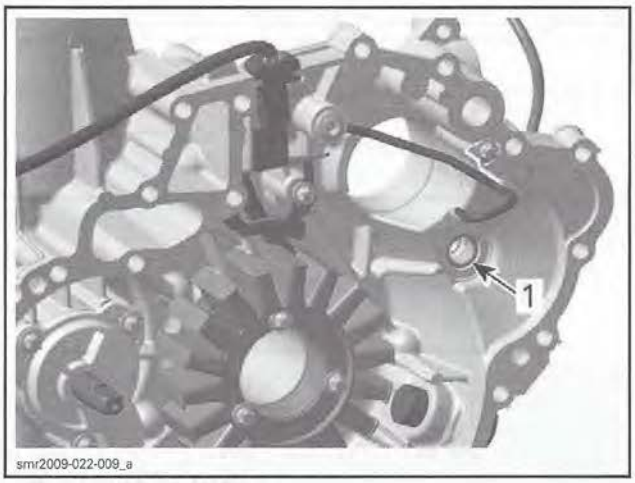
1. Inspect seal within coupling, if it is brittle, cracked or hard, replace it.
2. Check coupling for worn or damaged splines. Replace as required.

PTO Coupling Installation

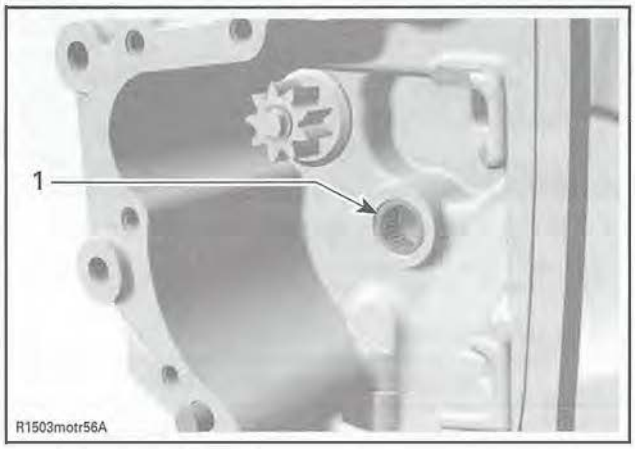
For installation, reverse the removal procedure. However, pay attention to the following.

PTO COUPLING INSTALLATION	
PRODUCT	TORQUE
LOCTITE 648 (GREEN) (P/N 413 711 400)	250 N•m (184 lbf•ft)

STARTER DRIVE BEARINGS



TYPICAL - PTO HOUSING
1. Starter drive bearing



TYPICAL - CYLINDER BLOCK
1. Starter drive bearing

Starter Drive Bearing Removal

1. Remove PTO housing, see procedure in this subsection.
2. Remove starter drive bearing from PTO housing or cylinder block.

REQUIRED TOOL	
BLIND HOLE BEARING PULLER SET (P/N 529 036 117)	

Starter Drive Bearing Installation

1. Prior to assembly, grease starter drive bearing.

STARTER DRIVE BEARING INSTALLATION
PRODUCT
ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021)

2. Install starter drive bearing in the PTO housing or in the cylinder block.

REQUIRED TOOLS	
STARTER DRIVE SEAL PUSHER (P/N 420 876 502)	
HANDLE (P/N 420 877 650)	

STATOR

Stator Output Voltage Test

1. Disconnect the magneto connector.

TYPICAL
1. Magneto connector
2. ECM
3. Throttle body

2. Install the following harness adapter onto the magneto connector.

NOTE: Do not connect the magneto harness adapter to the vehicle harness connector.

REQUIRED TOOL	
3-PIN MAGNETO HARNESS ADAPTER (P/N 529 036 016)	

3. Set multimeter to Vac scale.
4. Start engine.
5. Connect multimeter between each pair of YELLOW wires as per following table. Measure voltage between each pair of wires.

TYPICAL - STATOR OUTPUT VOLTAGE TEST
1. *Connect adapter to magneto connector*
2. *Leave vehicle harness disconnected*

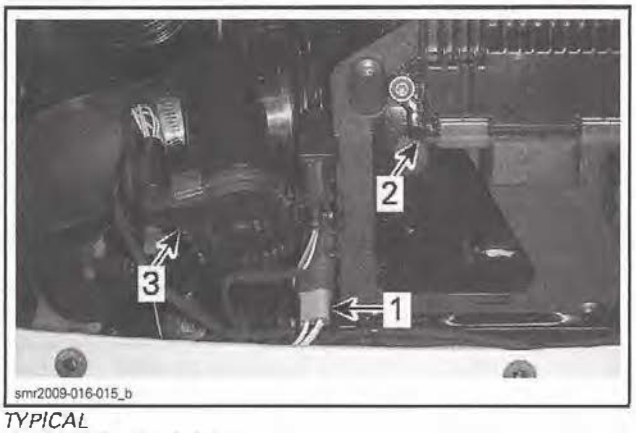
6. Read voltage as per following table.

STATOR OUTPUT VOLTAGE TEST		
TEST ENGINE SPEED	TERMINAL	VOLTAGE (AC)
4000 RPM	1 and 2	Approx. 50 Vac
	1 and 3	
	2 and 3	

If voltage is lower than specification, carry out a *STATOR CONTINUITY TEST* and a *STATOR INSULATION TEST*. See procedures in this subsection.

Stator Continuity Test

1. Disconnect the magneto connector.



TYPICAL
1. *Magneto connector*
2. *ECM*
3. *Throttle body*

2. Install the following harness adapter onto the magneto connector.

NOTE: Do not connect the magneto harness adapter to the vehicle harness connector.

REQUIRED TOOL	
3-PIN MAGNETO HARNESS ADAPTER (P/N 529 036 016)	

3. Set multimeter to Ω.
4. Connect multimeter between each pair of YELLOW wires.

TYPICAL - STATOR CONTINUITY TEST
1. *Connect adapter to magneto connector*
2. *Leave vehicle harness disconnected*

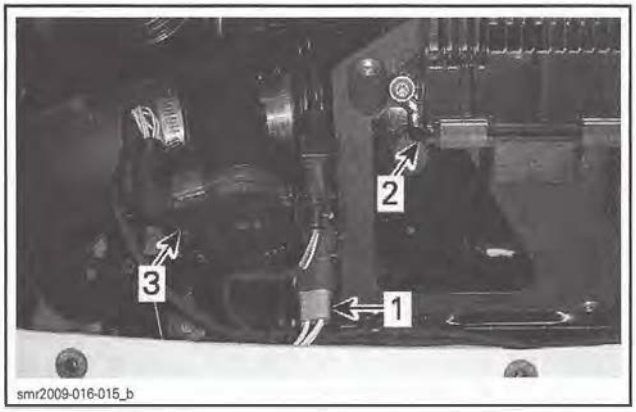
5. Read resistance.

STATOR CONTINUITY TEST	
TERMINAL	RESISTANCE @ 20°C (68°F)
1 and 2	0.1 - 1 Ω
1 and 3	
2 and 3	

If any result is out of specification, replace stator.

Stator Insulation Test

1. Disconnect the magneto connector.



1. Magneto connector
2. ECM
3. Throttle body

2. Install the following harness adapter onto the magneto connector.

NOTE: Do not connect the magneto harness adapter to the vehicle harness connector.

REQUIRED TOOL	
3-PIN MAGNETO HARNESS ADAPTER (P/N 529 036 016)	

3. Set multimeter to Ω.
4. Connect multimeter between any YELLOW wire and engine ground.

STATOR INSULATION TEST
1. Connect adapter to magneto connector
2. Leave vehicle harness disconnected

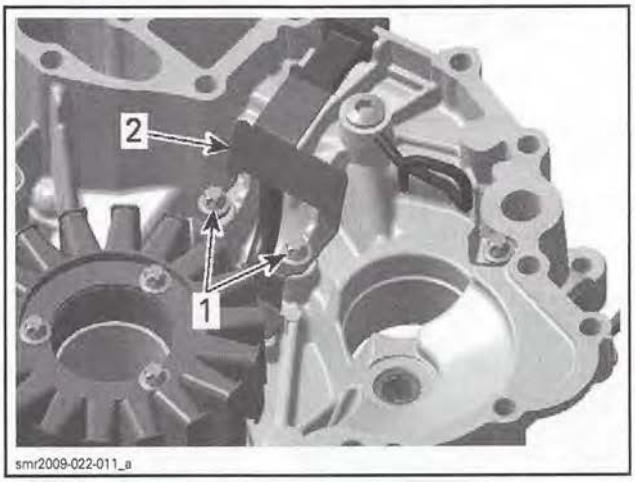
Read resistance.

STATOR INSULATION TEST	
TERMINAL	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and engine ground	Infinity (open circuit)

If there is a resistance or continuity to engine ground, the stator coils and/or the wiring is grounded and need to be repaired or replaced.

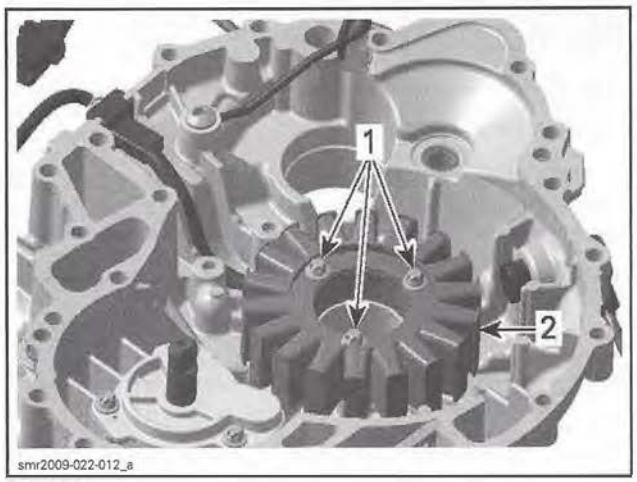
Stator Removal

1. Remove PTO housing, see procedure in this subsection.
2. Remove stator cable holding plate from PTO housing.



TYPICAL
1. Screws
2. Holding plate

3. Remove stator retaining screws.
4. Remove stator from PTO housing.

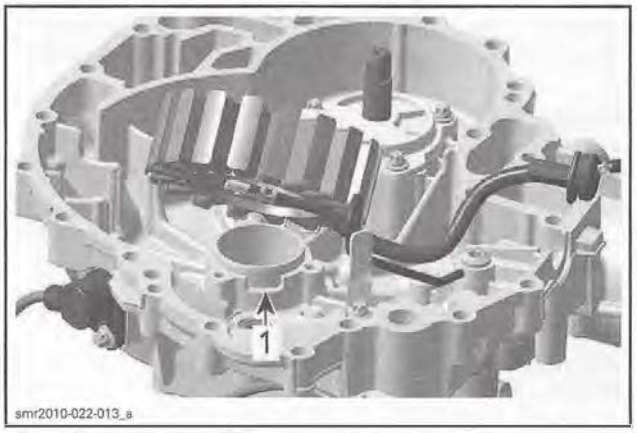


TYPICAL
1. Stator screws
2. Stator

Stator Installation

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

NOTE: The position of the stator in the PTO housing is determined by a key on the stator and a notch in the magneto housing.



TYPICAL
1. Notch for stator

2. Place the stator cable rubber grommet in the notch provided in the PTO housing.

TYPICAL
1. Stator cable grommet

3. Apply threadlocker and torque stator and cable holding plate screws as per following table.

STATOR INSTALLATION	
PRODUCT	TORQUE (STATOR AND CABLE HOLDING PLATE)
LOCTITE 243 (BLUE) (P/N 293 800 060)	9 N•m (80 lbf•in)

4. Install PTO housing as per procedures in this subsection.

ROTOR AND TRIGGER WHEEL

Rotor and Trigger Wheel Inspection

Inspect rotor and trigger wheel condition. Pay particular attention to the inside of the rotor for:
- Cracks
- Rub marks
- Discoloration.

If damaged, replace faulty part.

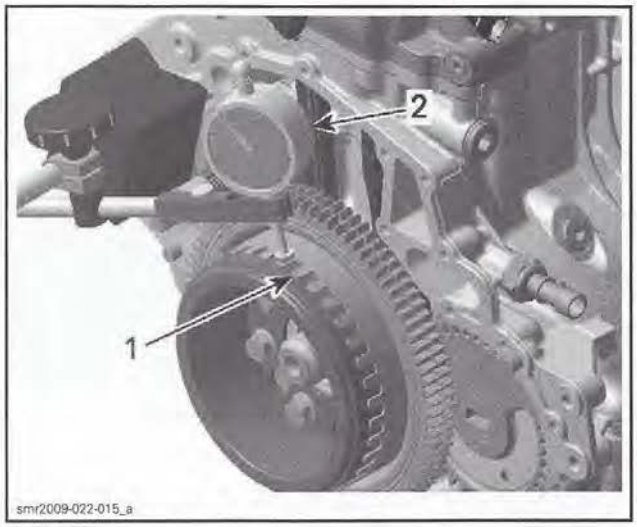
Check the trigger wheel for bent teeth using the following procedure.

1. Install a dial indicator on crankcase casting.
2. Position the gauge on a tooth and set it to zero (0). Be sure to lock the indicator dial to prevent movement of the dial during the remainder of the procedure.
3. Draw a line on the tooth to indicate it as the first tooth measured (reference tooth).
4. Gently lift the gauge contact point off the tooth and rotate the rotor to the next tooth.

NOTE: When lifting contact point off the tooth for rotor rotation, be careful not to move gauge position or test readings taken on next tooth will not be accurate with reference to the reference tooth.

5. Gently set the gauge contact point on the next tooth and read the dial indicator.
6. Repeat this procedure taking a reading at each tooth.
7. Recheck reading on reference tooth to ensure gauge has not changed position (gauge should still read zero).

TRIGGER WHEEL TEETH INSPECTION
MAXIMUM ALLOWABLE DIFFERENCE
0.15 mm (.006 in)



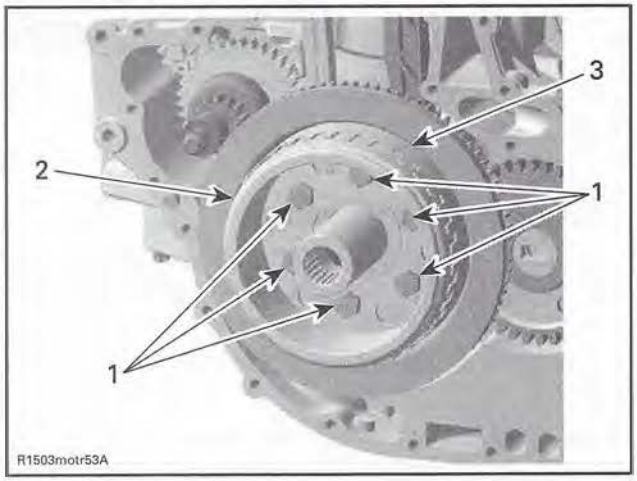
TYPICAL
1. *Trigger wheel*
2. *Dial indicator*

NOTE: If the reading exceeds the maximum allowable difference, straighten the tooth or replace the trigger wheel.

8. Properly reinstall PTO housing.

Rotor and Trigger Wheel Removal

1. Lock crankshaft, refer to *CYLINDER BLOCK* subsection.
2. Remove PTO housing, see procedure in this subsection.
3. Remove and discard the magneto rotor retaining screws.
4. Pull rotor and trigger wheel off crankshaft end.



TYPICAL
1. *Rotor retaining screws*
2. *Rotor*
3. *Trigger wheel*

Rotor and Trigger Wheel Installation

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

1. Align the trigger wheel to the crankshaft using the location pin on the crankshaft end.
2. Install **NEW** OEM rotor screws and torque them as per following table.

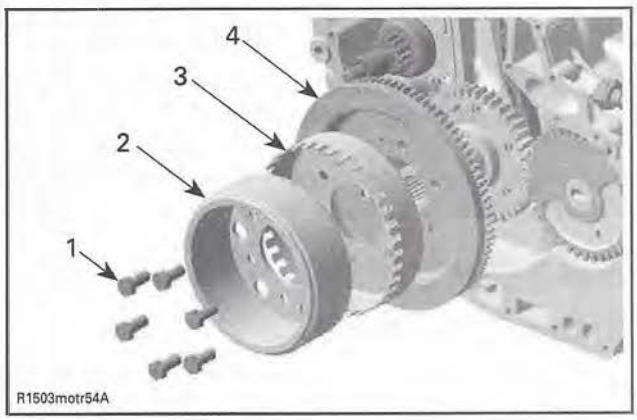
ROTOR AND TRIGGER WHEEL INSTALLATION		
PARTS	TORQUE (CRISSCROSS PATTERN)	FINAL TORQUE
NEW OEM rotor screws	15 N•m (133 lbf•in)	Additional 50° rotation with a torque angle gauge

NOTICE Always install NEW OEM screws with pre-applied threadlocker. These are stretch screws that are one time use only. Not replacing rotor screws may lead to engine damage and failure.

RING GEAR

Ring Gear Removal

1. Lock crankshaft. Refer to *CRANKSHAFT LOCKING PROCEDURE* in *CYLINDER BLOCK* subsection.
2. Remove the PTO housing, see procedure in this subsection.
3. Remove and discard the magneto rotor retaining screws.
4. Pull rotor, trigger wheel, and ring gear off crankshaft end.



TYPICAL
1. *Magneto rotor retaining screws*
2. *Rotor*
3. *Trigger wheel*
4. *Ring gear*

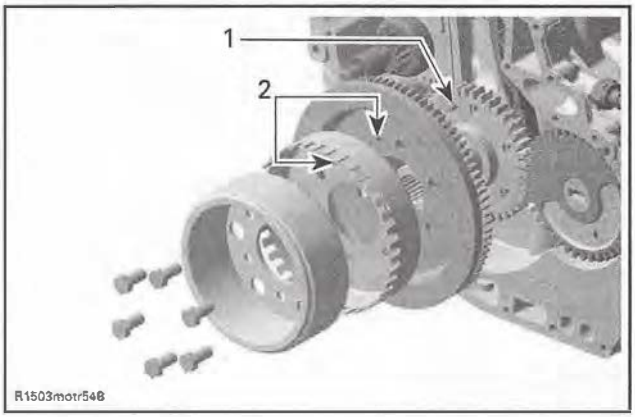
Ring Gear Inspection

Inspect ring gear for damages. Pay particular attention to teeth condition. If badly worn, cracked, or broken teeth are found, replace ring gear.

Ring Gear Installation

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

Align the ring gear and trigger wheel to the crankshaft using the location pin on the crankshaft end.



TYPICAL
1. Location pin
2. Location pin holes

Install NEW OEM rotor screws and torque them as per following table.

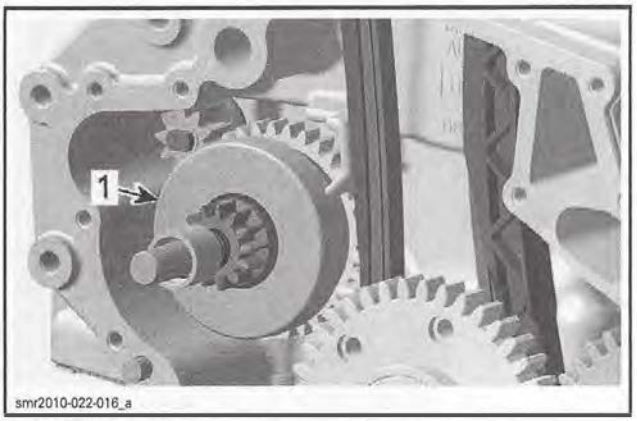
RING GEAR INSTALLATION		
PARTS	TORQUE (CRISSCROSS PATTERN)	FINAL TORQUE
NEW OEM rotor screws	15 N•m (133 lbf•in)	Additional 50° rotation with a torque angle gauge

NOTICE **Always install NEW OEM screws with pre-applied threadlocker. These are stretch screws that are one time use only. Not replacing rotor screws may lead to engine damage and failure.**

STARTER DRIVE

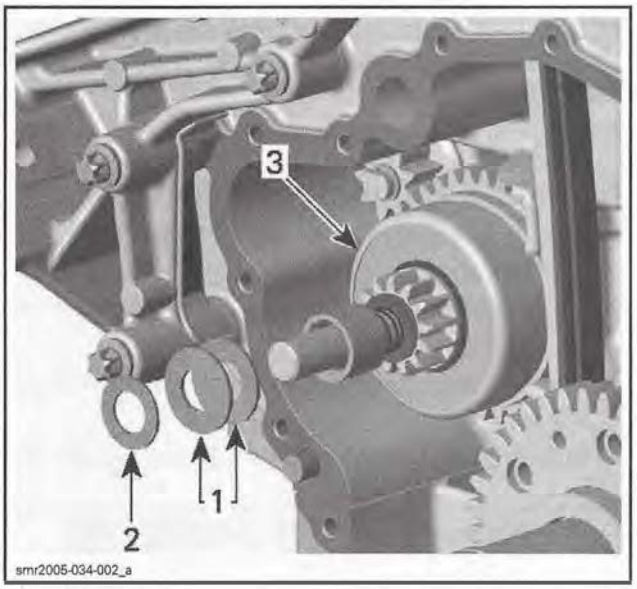
Starter Drive Removal

1. Remove the PTO housing and ring gear as described in this subsection.
2. Remove starter drive.



TYPICAL
1. Starter drive

NOTICE **Be careful not to lose the spring discs and thrust washer located on the starter drive shaft.**



TYPICAL
1. Spring discs
2. Thrust washer
3. Starter drive

Starter Drive Inspection

Inspect all starter drive parts for excessive wear, cracks and other defects. Pay attention to the condition of the drive gear teeth.

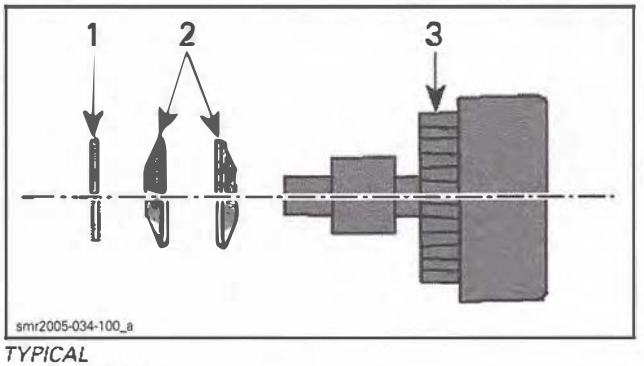
Ensure proper operation of the starter drive sprag clutch.

If any part of the assembly shows signs of abnormal wear, cracks, broken teeth or malfunction (sprag clutch), replace the faulty part.

Starter Drive Installation

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

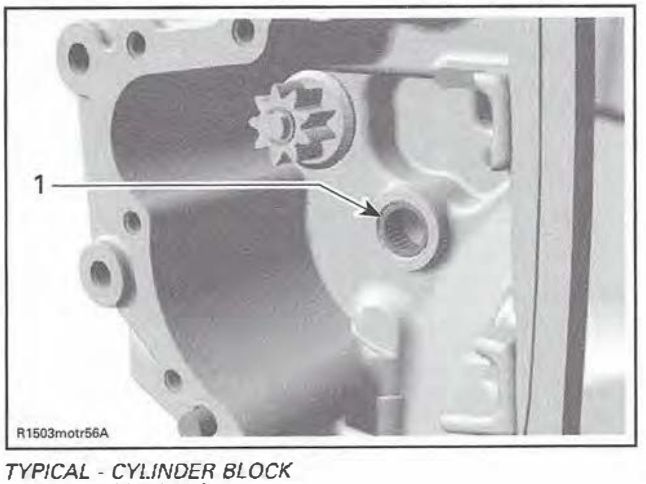
Position the spring discs and thrust washer onto the starter drive shaft as per following illustration.



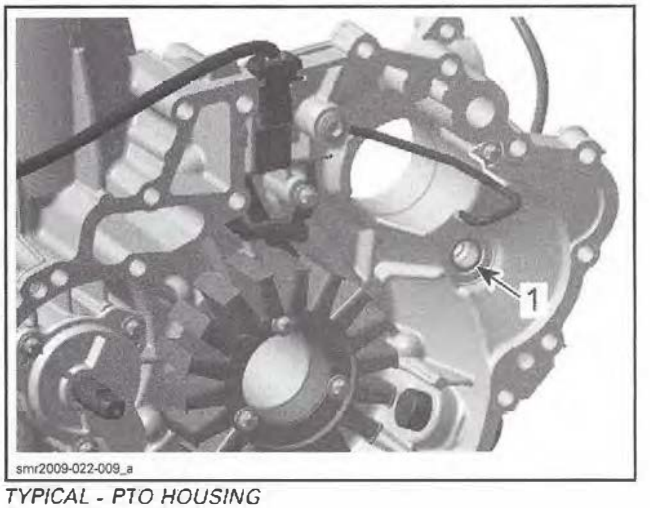
TYPICAL
1. *Thrust washer*
2. *Spring discs*
3. *Starter drive*

When installing a new starter drive, oil the shaft, gear teeth and splines with engine oil.

Apply ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021) on the starter drive bearings located in the cylinder block and in the PTO housing.



TYPICAL - CYLINDER BLOCK
1. *Starter drive bearing*



TYPICAL - PTO HOUSING
1. *Starter drive bearing*

NOTICE **Be sure not to forget the spring discs and thrust washer on the starter drive shaft when reassembling.**

LUBRICATION SYSTEM

SERVICE TOOLS

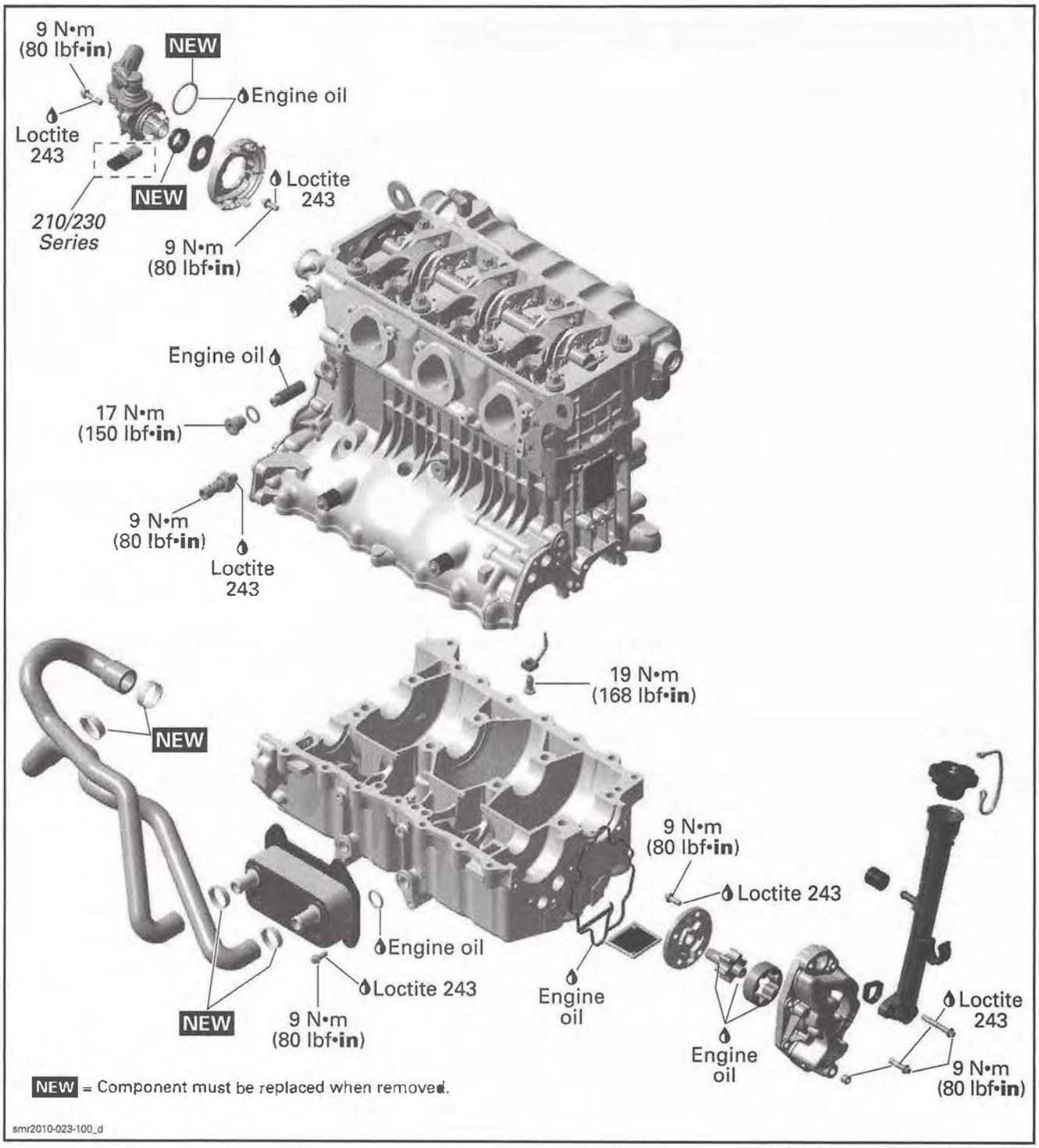
Description	Part Number	Page
ADAPTER HOSE	529 035 652	108
ECM ADAPTER TOOL	420 277 010	111
ECM ADAPTER TOOL	529 036 166	111, 126
FLUKE 115 MULTIMETER	529 035 868	111, 126
OIL SEAL GUIDE	529 035 822	116
PRESSURE GAUGE	529 035 709	108
SUCTION PUMP	529 035 880	107
SUPERCHARGER OIL SPRAY NOZZLE TOOL	529 036 134	120
WATER PUMP SEAL PUSHER	529 035 823	116–117

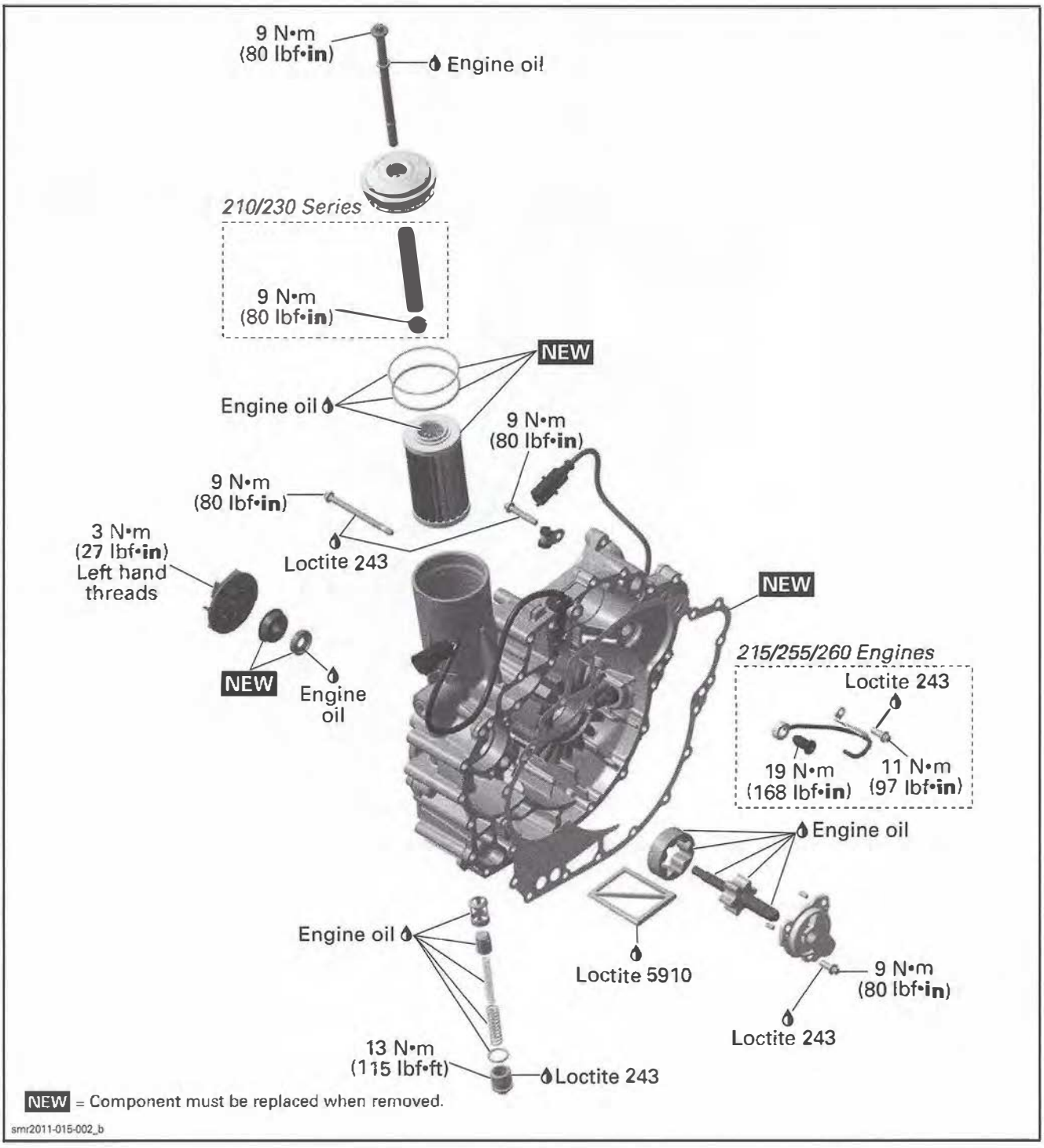
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	tp88	126

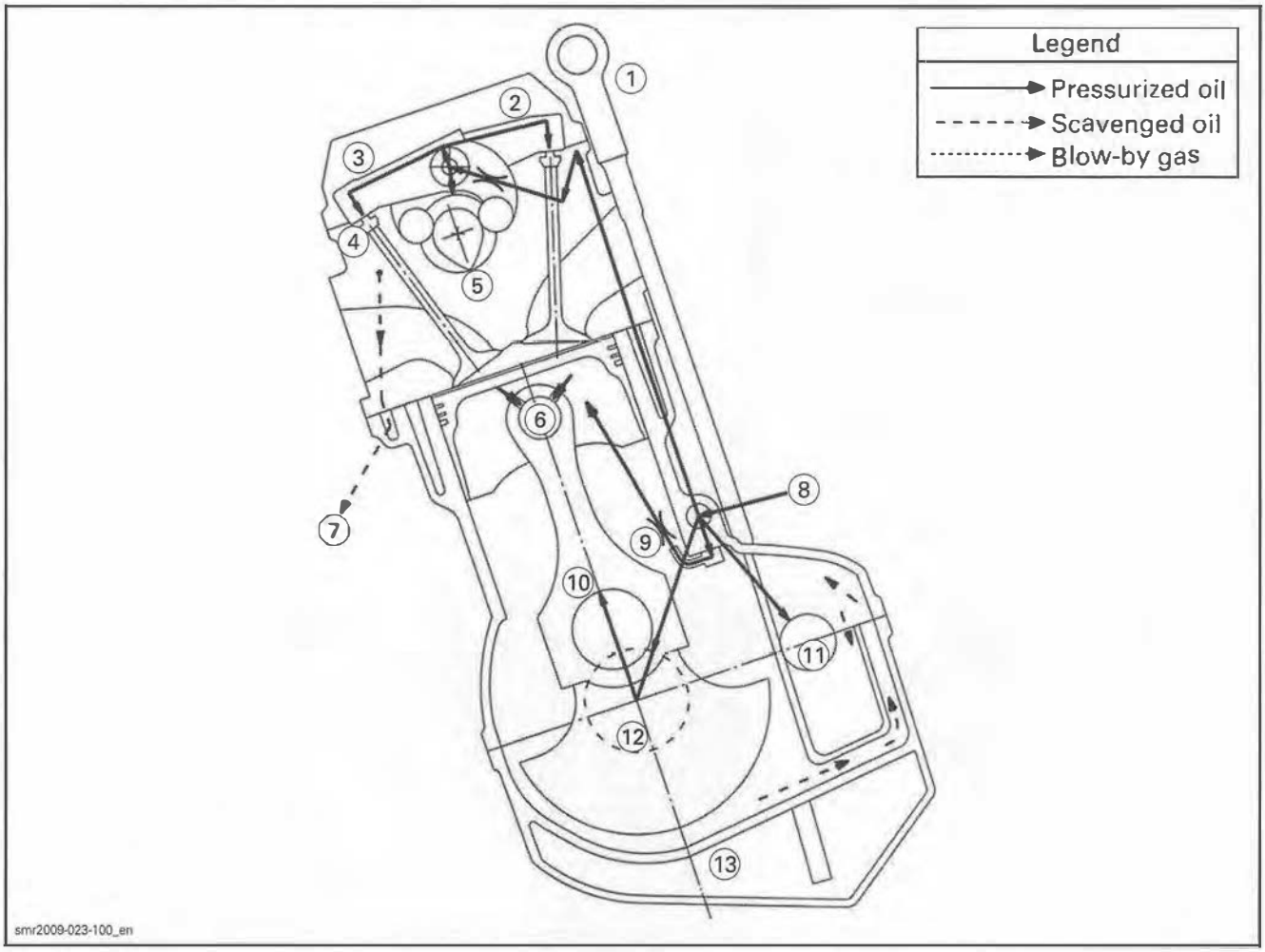
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	111, 113–114, 116, 119–120, 125, 128
LOCTITE 5910	293 800 081	112
PULLEY FLANGE CLEANER	413 711 809	107, 118
SUPER LUBE GREASE	293 550 030	108
XPS 4-STROKE BLEND OIL (SUMMER GRADE)	293 600 121	106


9 N•m
(80 lbf•in)
NEW
Engine oil
Loctite
243
NEW
Loctite
243
210/230
Series
9 N•m
(80 lbf•in)
Engine oil
17 N•m
(150 lbf•in)
9 N•m
(80 lbf•in)
Loctite
243
19 N•m
(168 lbf•in)
NEW
9 N•m
(80 lbf•in)
Loctite 243
Engine oil
Loctite 243
NEW
9 N•m
(80 lbf•in)
Engine
oil
Engine
oil
Loctite
243
9 N•m
(80 lbf•in)
NEW = Component must be replaced when removed.
smr2010-023-100_d

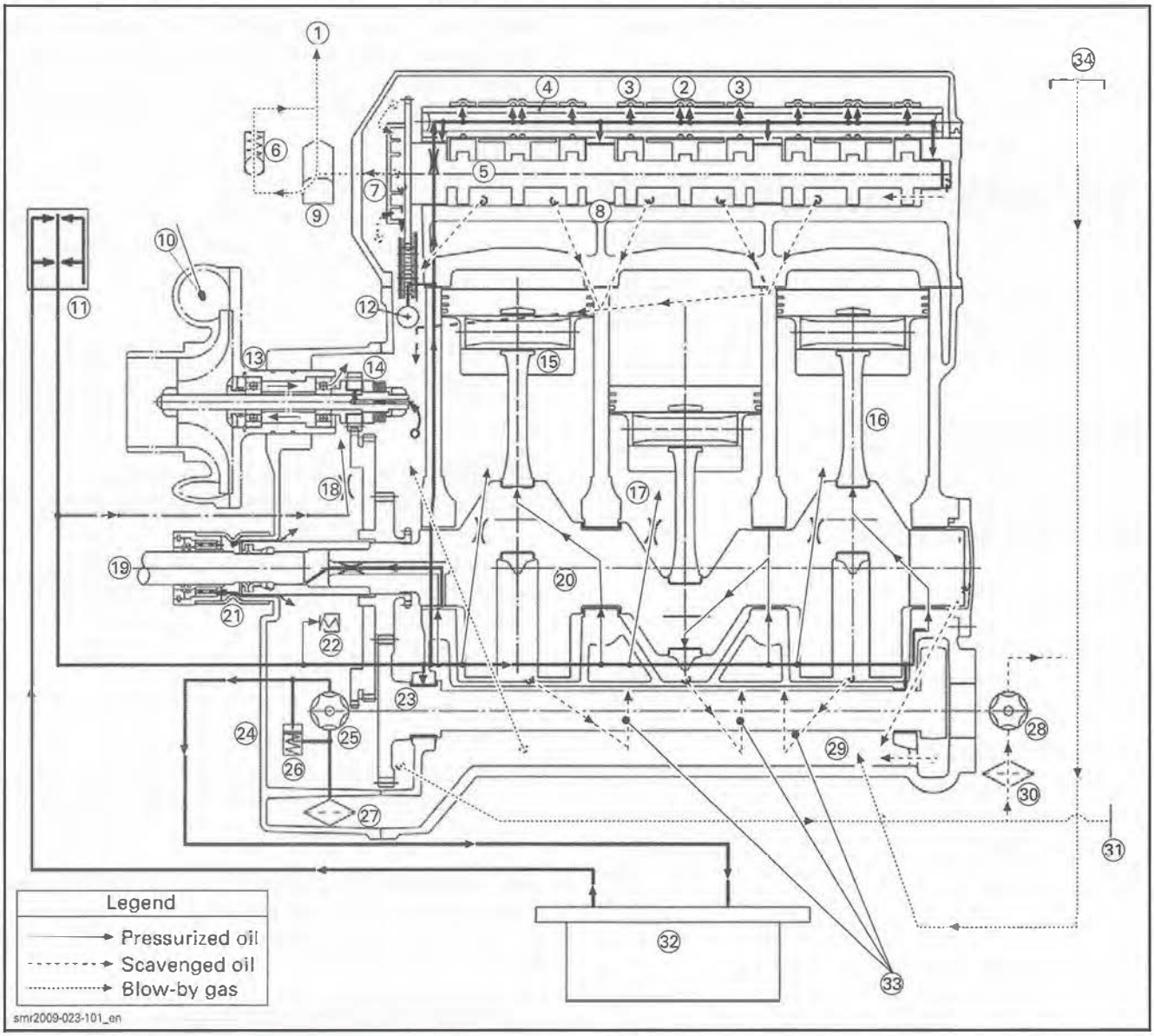

9 N•m
(80 lbf•in)
Engine oil
210/230 Series
9 N•m
(80 lbf•in)
NEW
Engine oil
9 N•m
(80 lbf•in)
9 N•m
(80 lbf•in)
3 N•m
(27 lbf•in)
Left hand
threads
Loctite 243
NEW
NEW
Engine
oil
215/255/260 Engines
Loctite 243
19 N•m
(168 lbf•in)
11 N•m
(97 lbf•in)
Engine oil
Engine oil
Loctite 5910
9 N•m
(80 lbf•in)
Loctite 243
13 N•m
(115 lbf•ft)
Loctite 243
NEW = Component must be replaced when removed.
smr2011-015-002_b

ENGINE LUBRICATION CIRCUIT



1. *Oil dipstick*
2. *Rocker arm (intake)*
3. *Rocker arm (exhaust)*
4. *Hydraulic valve lifter*
5. *Camshaft*
6. *Piston pin*
7. *Into PTO housing*
8. *From oil filter*
9. *Piston cooling*
10. *Connecting rod*
11. *Balance shaft*
12. *Crankshaft*
13. *Oil tank*

ENGINE LUBRICATION CIRCUIT (CONT'D)



1. To air intake silencer
2. Rocker arm (intake)
3. Rocker arm (exhaust)
4. Rocker arm axle
5. Camshaft
6. Pressure relief valve
7. Oil separator
8. Cylinder head
9. Blow-by valve
10. Supercharger (if so equipped)
11. Oil filter
12. Hydraulic chain tensioner
13. Supercharger bearing (if so equipped)
14. Friction clutch
15. Piston pin
16. Connecting rod
17. Piston cooling
18. Oil spray nozzle
19. Drive shaft
20. Crankshaft
21. PTO seal
22. Oil pressure switch
23. Balance shaft
24. PTO housing
25. Pressure pump
26. Pressure relief valve
27. Oil strainer (pressure pump)
28. Scavenge pump
29. Oil tank
30. Oil strainer (scavenge pump)
31. Oil drainage (PTO housing)
32. Oil cooler
33. Scavenge of oil and blow-by gas
34. Oil filler cap

GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

MAINTENANCE

ENGINE OIL

Recommended Oil

Use XPS 4-STROKE BLEND OIL (SUMMER GRADE) (P/N 293 600 121).

Naturally-aspirated Engine

If the recommended XPS™ engine oil is not available, use a 5W40 or 10W40 engine oil meeting the requirements for API service classification SM, SL or SJ. Always check the API service label certification on the oil container, it must contain at least one of the above standards.

Supercharged Intercooled Engine

If XPS™ engine oil is not available, use a 10W40 mineral engine oil compatible with wet clutches.

NOTE: The XPS engine oil has been thoroughly tested to be free of any additives that could impair the functionality of the supercharger clutch.

NOTICE **NEVER use synthetic oil. This would impair the proper operation of the supercharger clutch. Do not add any additives to the recommended oil. Mineral oils not recommended by BRP may also contain additives (friction modifiers) that may cause inappropriate slippage of the supercharger and eventually lead to premature wear. For this reason, XPS Synthetic Blend oil (Summer Grade) or a BRP approved equivalent are the only recommended oils. Use of any oil not recommended by BRP may void BRP's limited warranty.**

Oil Level Verification

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

Check the oil level as follows:

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

1. Start and warm-up engine.

NOTE: If the boat is out of water, link a garden hose to the hose adapter. Refer to *EXHAUST SYSTEM FLUSHING* in the *EXHAUST SYSTEM* subsection.

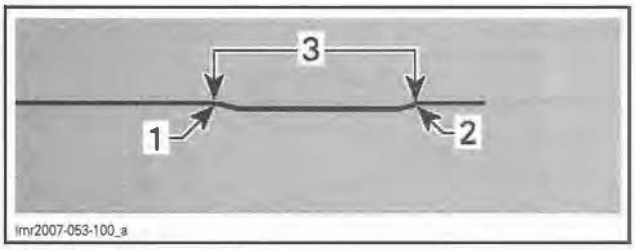
NOTICE **When boat is out of water:**
- **Never run engine without supplying water to the exhaust system.**
- **Never run engine longer than 2 minutes. Drive line seal has no cooling when boat is out of water.**

2. Let idle for 30 seconds.
3. Stop engine.
4. Access the engine compartment.
5. Wait at least 30 seconds for the oil to settle in the engine, then pull dipstick out and wipe clean.

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

TYPICAL – 210 CHALLENGER SHOWN
1. Dipstick
2. Oil cap

6. Reinstall dipstick, push in completely.
7. Remove dipstick and read oil level. It should be between the FULL and ADD marks.



1. *Full*
2. *Add*
3. *Operating range*

Otherwise, add oil until its level is between marks as required.

To add oil, unscrew oil cap. Place a funnel into the oil filler neck opening and add the recommended oil to the proper level. Do not overfill.

Oil Change

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

Bring engine to its normal operating temperature.

NOTICE When boat is out of water:

- **Never run engine without supplying water to the exhaust system.**
- **Never run engine longer than 2 minutes. Drive line seal has no cooling when boat is out of water.**

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

Remove oil filler cap and dipstick.

⚠ WARNING

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

Siphon oil through the dipstick tube.

REQUIRED TOOL	
SUCTION PUMP (P/N 529 035 880)	

NOTICE Never crank or start engine when suction pump hose is in the dipstick tube. Never start engine when there is no oil in engine.

NOTE: To properly position the suction pump hose is located at the proper height to siphon oil, it is suggested to put some electrical tape on hose at 475 mm (18-11/16 in) from its end. Then, insert the hose until you reach the tape.

Pull suction pump hose out of dipstick tube

Fully depress the throttle lever and HOLD it while cranking engine for 10 seconds. Siphon oil again. Repeat the crank-siphon cycle 2 - 3 times.

Refill engine with the recommended oil, see *RECOMMENDED OIL* in this subsection.

Reinstall oil filler cap and dipstick.

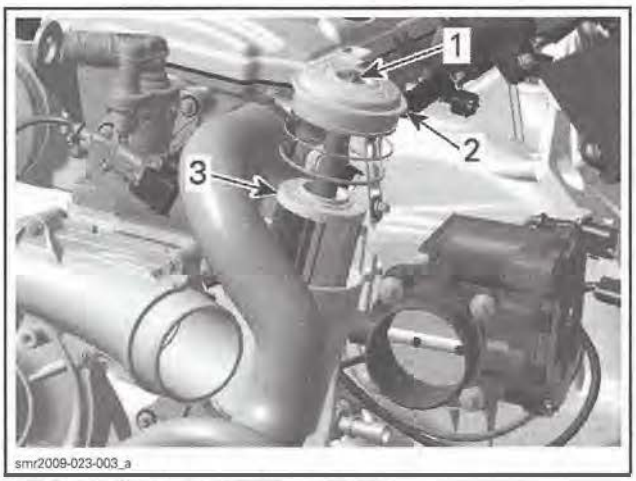
Replace *OIL FILTER*, see procedure in this subsection.

OIL FILTER

Oil Filter Removal

Remove:

- Oil filter screw
- Oil filter cover
- Oil filter.



TYPICAL – 210 CHALLENGER SHOWN

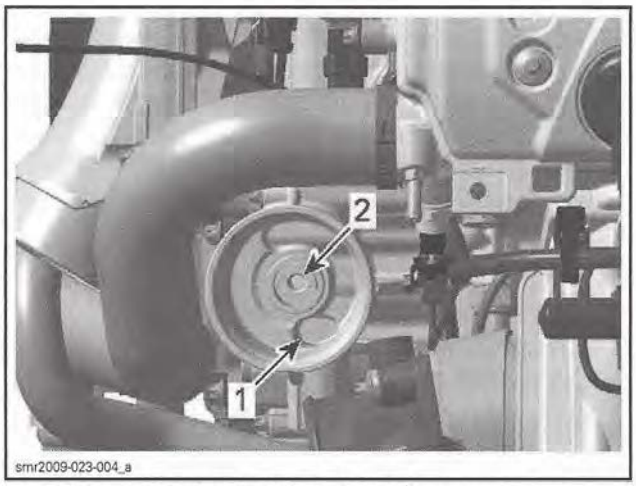
1. *Oil filter screw*
2. *Oil filter cover*
3. *Oil filter*

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

Oil Filter Inspection

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

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



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

Oil Filter Installation

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

Install a **NEW** oil filter.

Install O-ring on oil filter cover.

Apply engine oil on filter ring, filter cover O-rings and on oil filter screw O-ring.

NOTE: In salt water area, it is recommended to coat mating surface of cover with SUPER LUBE GREASE (P/N 293 550 030).

Torque oil filter screw to specification.

TORQUE	
Oil filter screw	9 N•m (80 lbf•**in**)

INSPECTION

ENGINE OIL PRESSURE

Oil Pressure Test Requirement

Bring engine to its normal operating temperature.

⚠ WARNING

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

NOTICE When watercraft is out of water:

- Never run engine without supplying water to the exhaust system.
- Never run engine longer than 2 minutes. Drive line seal has no cooling when watercraft is out of water.

Required Tools for Oil Pressure Test

REQUIRED TOOLS	
PRESSURE GAUGE (P/N 529 035 709)	
ADAPTER HOSE (P/N 529 035 652)	

NOTE: A 1/8 NPT pipe extension may ease the installation.

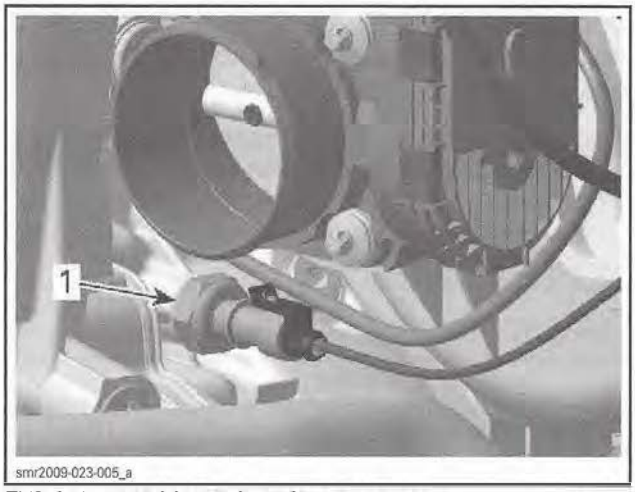
Oil Pressure Specifications

Use the following table to compare the oil pressure at different RPM.

OIL PRESSURE	
Idle (cold)	448 kPa - 648 kPa (65 PSI - 94 PSI) for a very short time
Idle (at 80°C (176°F))	Min. 228 kPa (33 PSI)
4000 - 7500	400 kPa - 496 kPa (58 PSI - 72 PSI)

Test at the Oil Pressure Switch Location

Remove oil pressure switch and install gauge.



TYPICAL – PRESSURE SWITCH LOCATION
1. Remove oil pressure switch and install gauge here

To prevent the EMS to go in limp home mode (at 2500 RPM) or to generate a fault code, do the following:

1. Ground OPS to engine.
2. Plug OPS to harness.
3. Start engine.

4. While engine is running, unplug OPS from harness.

Read oil pressure at different RPM as per table above.

Reinstall oil pressure switch.

Test at the Cylinder Head Location

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

Remove plug located on cylinder head and install gauge.

INSTALLATION AT CYLINDER HEAD
1. Remove plug and install gauge here

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

Reinstall plug.

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *ENGINE MANAGEMENT* section.

LOW OR NO ENGINE OIL PRESSURE

1. **Oil level too low.**
   - *Refill engine oil.*
   - *Check for high oil consumption. See below.*
   - *Check for oil leaks (oil leaking out of leak indicator hole, gaskets, oil seal or O-rings). Repair or replace.*
2. **Oil pressure switch defective.**
   - *Check and replace if necessary.*
3. **Oil filter clogged.**
   - *Replace engine oil and oil filter at the same time.*
4. **Oil pressure regulator valve sticks open, or spring load is too small.**
   - *Clean oil regulator piston and its bore. Replace if necessary.*
   - *Measure spring free length. Replace if too small.*
5. **Oil pump(s) worn or damaged.**
   - *Check oil pump rotors and its bore for wear limits. Replace if out of specification.*
6. **Engine oil strainers are clogged.**
   - *Remove and clean engine oil strainers.*
7. **Heavy wear on plain bearings.**
   - *Check radial clearance of plain bearings. Replace if out of specification.*

HIGH OIL CONSUMPTION

1. **Oil in breathing system.**
   - *Check if breather V-ring is brittle, hard or damaged. Replace V-ring.*
2. **Valve stem seals worn or damaged.**
   - *Replace valve stem seals.*
3. **Piston rings worn out (blue colored exhaust smoke).**
   - *Replace piston rings.*

OIL CONTAMINATION (WHITE APPEARANCE)

1. **Water ingestion through drive shaft and floating ring.**
   - *Check if water is leaking between drive shaft and floating ring. Repair or replace defective parts. Refer to PTO HOUSING AND MAGNETO subsection.*
   - *Change engine oil and filter.*
2. **Oil seal and rotary seal on water pump shaft leaking.**
   - *Replace oil seal and water pump shaft assembly.*
   - *Change engine oil and oil filter.*
3. **Cylinder head gasket leaking.**
   - *Replace cylinder head gasket and tighten cylinder head with recommended torque.*
   - *Change engine oil and oil filter.*
4. **Cylinder head screws not properly tightened.**
   - *Retighten screws with recommended torque.*
   - *Change engine oil.*
5. **Oil cooler O-rings are leaking.**
   - *Replace O-rings.*
   - *Change engine oil and oil filter.*

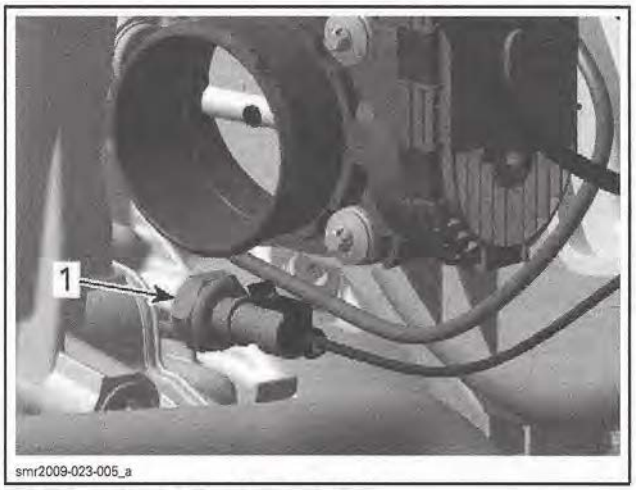
6. Cylinder block or cylinder head casting is leaking.
   - *Check for internal cracks in casting. Replace damaged components.*
   - *Change engine oil and oil filter.*

PROCEDURES

OIL PRESSURE SWITCH (OPS)

Oil Pressure Switch Operation

The switch threshold value to send a signal of low oil pressure may vary from a minimum of 180 kPa (26 PSI) to a maximum of 220 kPa (32 PSI).



TYPICAL - 210 CHALLENGER SHOWN
1. OPS

Oil Pressure Switch Inspection

First, carefully check the condition of the connector terminals. Clean to remove dirt and corrosion that could affect proper operation of the OPS.

IMPORTANT: Do not apply dielectric grease on terminal.

Before checking the function of the OPS, an oil pressure test has to be performed to be sure the oil pressure is not in fault. Refer to *INSPECTION* in this subsection.

When the engine oil pressure tests good but the OIL message in the information center is present and the beeper sounds:

- Ensure OPS connector is plugged to the switch.
- Check the resistance of the OPS while engine is off and while engine is running.

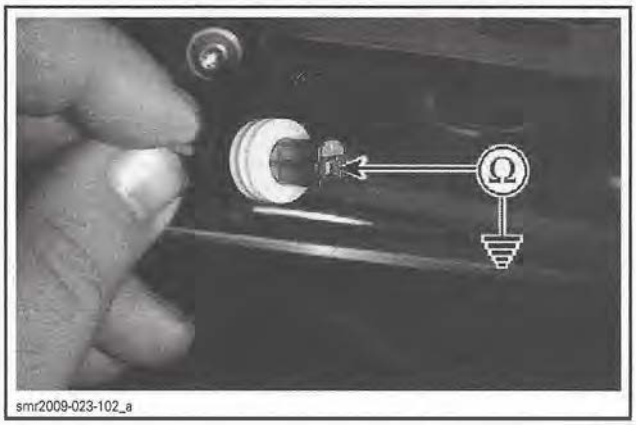
Oil Pressure Switch Resistance Test

Disconnect the connector from the OPS.

Use a multimeter to check the resistance as shown.

ENGINE NOT RUNNING		
TEST PROBES		RESISTANCE (Ω)
OPS connector (pin 1)	Engine ground	Close to 0 (normally closed switch)

ENGINE RUNNING		
TEST PROBES		RESISTANCE (Ω)
OPS connector (pin 1)	Engine ground	Infinitely high (OL) when pressure reaches 180 kPa (26 PSI) and 220 kPa (32 PSI)



If resistance values are incorrect, replace OPS.

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

Oil Pressure Switch Circuit Continuity Test

Disconnect the ECM connector A from the ECM.

Install the ECM connector on the applicable ECM adapter tool and test for continuity of circuit as per model.

150, 180 and 200 Series

REQUIRED TOOL	
ECM ADAPTER TOOL (P/N 420 277 010)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

OPS CONNECTOR	ECM ADAPTER	RESISTANCE @ 20°C (68°F)
Pin 1	A-6	Close to 0 Ω (continuity)

210 and 230 Series

REQUIRED TOOL	
ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

OPS CONNECTOR	ECM ADAPTER	RESISTANCE @ 20°C (68°F)
Pin 1	A-E3	Close to 0 Ω (continuity)

If continuity test failed, repair or replace the connector and wiring between ECM connector and OPS.

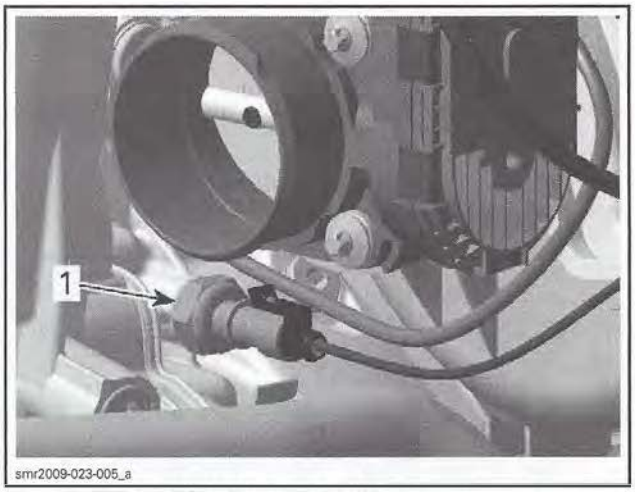
If continuity test succeeded, check the ECM. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Oil Pressure Switch Removal

Remove the throttle body. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Unplug the OPS connector.

Unscrew and remove the oil pressure switch.



TYPICAL – 210 CHALLENGER SHOWN
1. OPS

Oil Pressure Switch Installation

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of oil pressure switch.

Torque oil pressure switch to specification.

TORQUE	
Oil pressure switch	9 N•m (80 lbf•in)

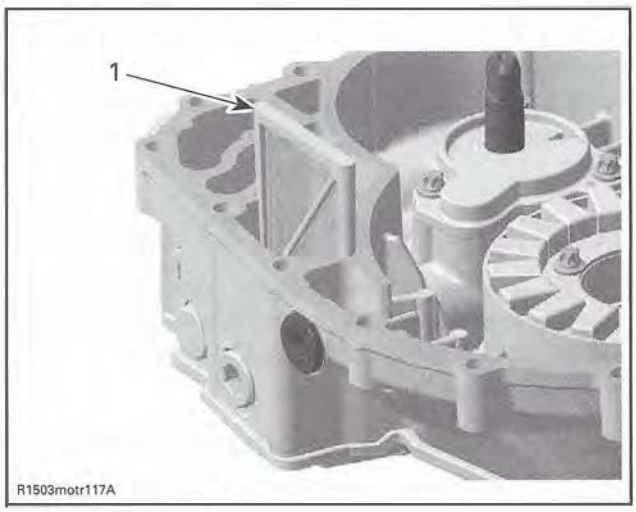
PTO OIL STRAINER

PTO Oil Strainer Removal

Remove engine oil. See procedure in *OIL CHANGE* in this subsection.

Remove the PTO housing. Refer to *PTO HOUSING AND MAGNETO* subsection.

Remove the oil strainer.

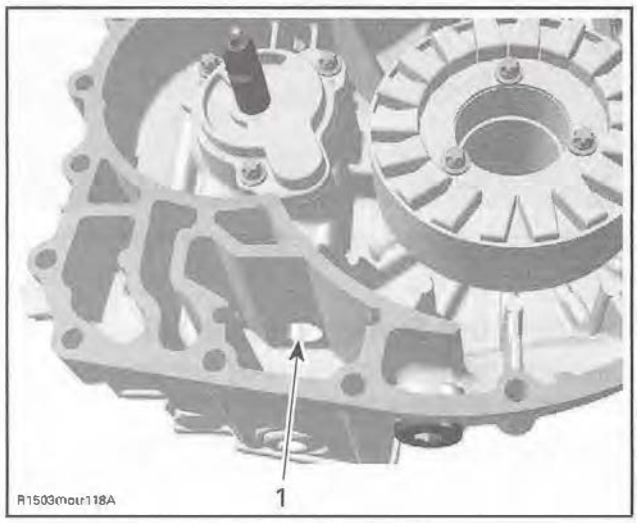


1. PTO oil strainer

PTO Oil Strainer Cleaning and Inspection

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

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



1. Oil inlet to the oil pump

PTO Oil Strainer Installation

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

Clean cylinder block to remove all remaining silicone residues in oil strainer area.

Apply a thin layer of LOCTITE 5910 (P/N 293 800 081) on oil strainer side.

Install it in the PTO housing.

Install the PTO housing using the procedure described in the *PTO HOUSING AND MAGNETO* subsection.

Refill engine at the proper level with the recommended oil. Refer to *ENGINE OIL* for the procedure.

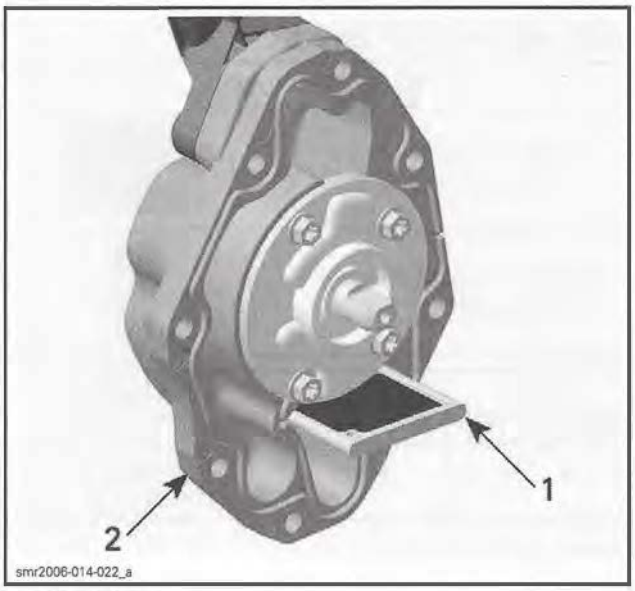
SUCTION PUMP OIL STRAINER

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

Suction Pump Oil Strainer Removal

Remove oil filler tube and suction pump cover, refer to *OIL SUCTION PUMP* in this subsection.

Remove oil strainer from the suction pump cover.

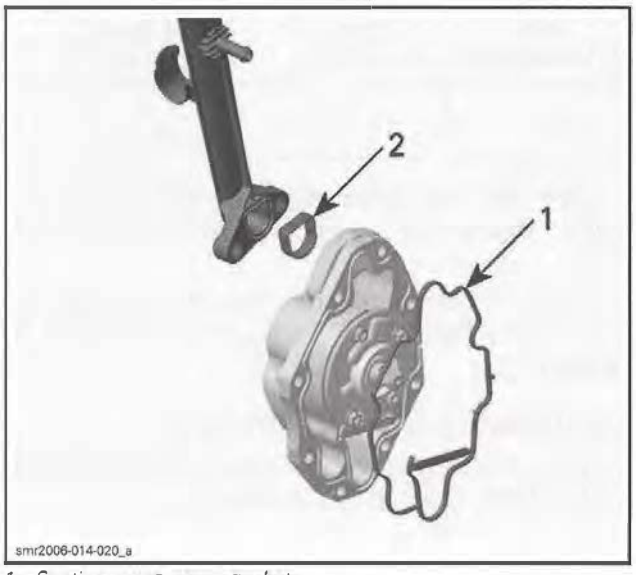


1. Oil strainer
2. Suction pump cover

Suction Pump Oil Strainer Cleaning and Inspection

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

Inspect rubber ring gaskets.

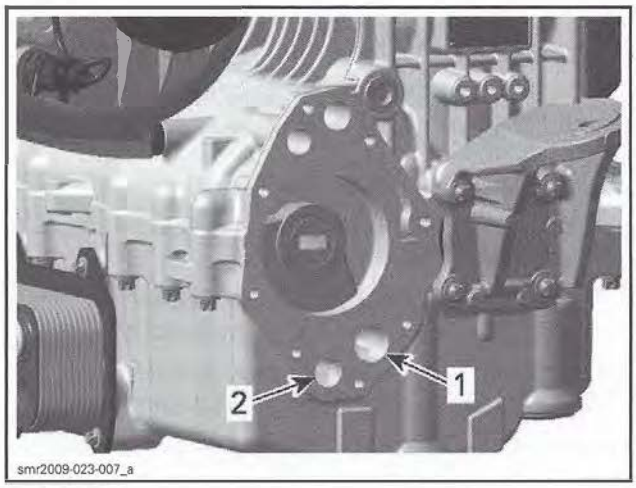


1. Suction pump cover gasket
2. Oil filler tube gasket

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

Clean both contact surfaces of oil suction pump cover.

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



1. *Oil inlet*
2. *Oil outlet*

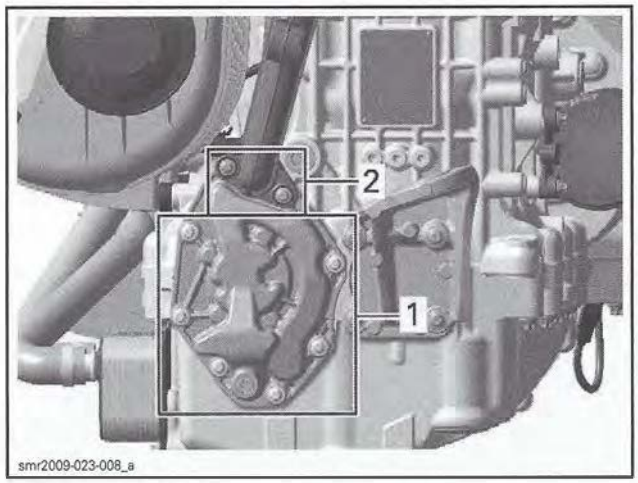
Suction Pump Oil Strainer Installation

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

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of the suction pump cover screws and tighten them to specification.

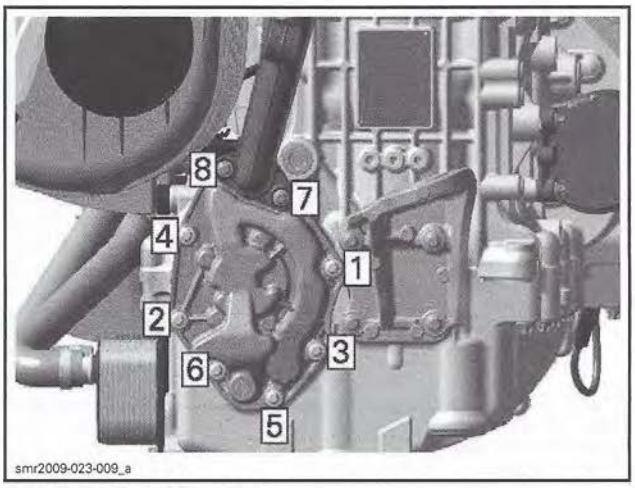
TORQUE	
Suction pump cover screws	9 N•m (80 lbf•**in**)

Position screws according to their length as shown.



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

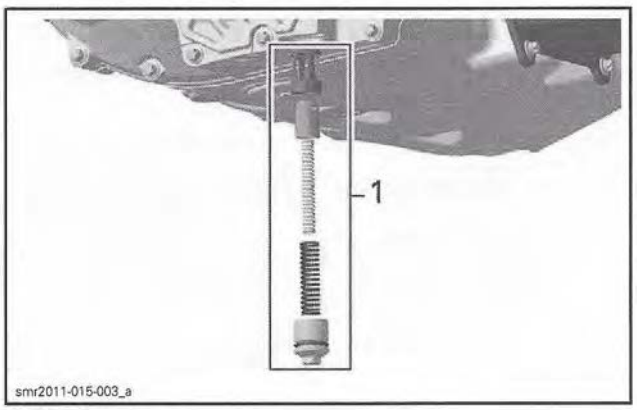
Torque suction pump cover screws as per sequence illustrated below.



TIGHTENING SEQUENCE

ENGINE OIL PRESSURE REGULATOR

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



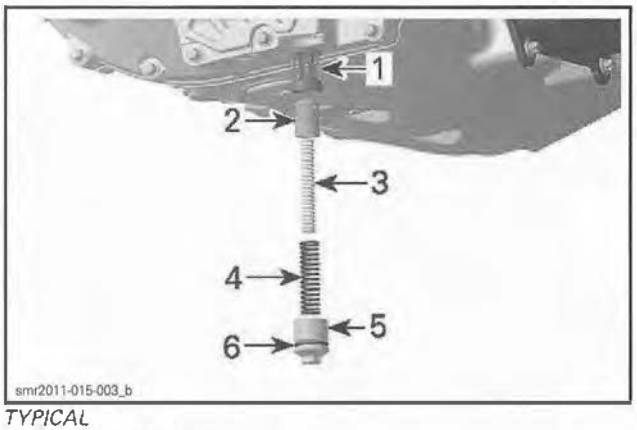
TYPICAL
1. *Oil pressure regulator*

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

Oil Pressure Regulator Removal

Remove engine oil. See procedure in *OIL CHANGE* in this subsection.

Remove:
- Oil pressure regulator plug
- Compression springs
- Valve piston
- Valve piston guide.



TYPICAL
1. *Valve piston guide*
2. *Valve piston*
3. *Inner compression spring*
4. *Outer compression spring*
5. *Oil pressure regulator plug*
6. *O-ring*

⚠ WARNING

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

Oil Pressure Regulator Inspection

Inspect valve piston and valve piston guide for scoring or other damages.

Check free length of outer compression spring.

OUTER COMPRESSION SPRING FREE LENGTH	
NEW NOMINAL	60 mm (2.362 in)
SERVICE LIMIT	50.3 mm (1.98 in)

Replace inner and outer compression spring as an assembly.

Replace parts if important wear or damage are present.

Clean bore and threads in the PTO housing from metal shavings and other contaminations.

Oil Pressure Regulator Installation

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

Be careful that the O-ring on plug screw is in place.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of the oil pressure regulator plug.

Torque plug screw to specification.

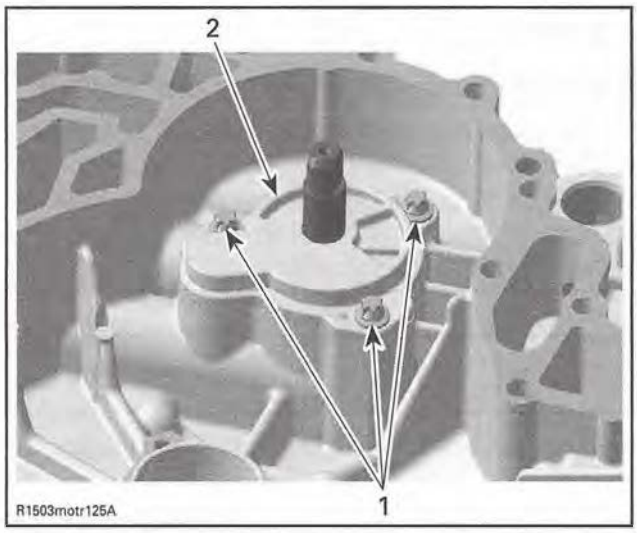
TORQUE	
Oil pressure regulator plug	13 N•m (115 lbf•in)

OIL PRESSURE PUMP

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

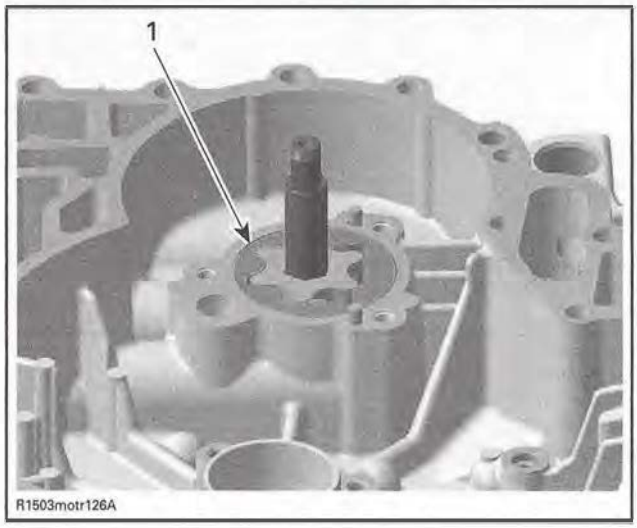
Oil Pressure Pump Removal

1. Remove engine oil. See procedure in *OIL CHANGE* in this subsection.
2. Remove the PTO housing. Refer to *PTO HOUSING AND MAGNETO* subsection.
3. Remove water pump housing and the impeller. Refer to *COOLING SYSTEM* subsection.
4. Remove screws securing the oil pump cover.



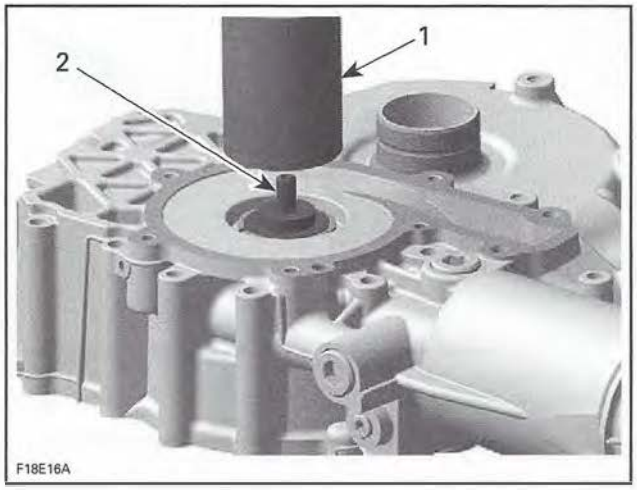
1. *Screws*
2. *Oil pump cover*

5. Pull and remove the outer oil pump rotor.



1. *Outer oil pump rotor*

6. Extract the coolant/oil pump shaft from outside PTO housing cover with a pusher.



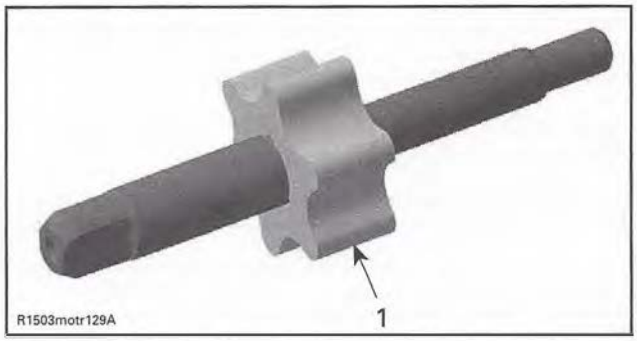
1. Pusher
2. Coolant/oil pump shaft

7. Remove rotary seal and oil seal. Refer to *ROTARY SEAL* further in this subsection.

Oil Pressure Pump Inspection

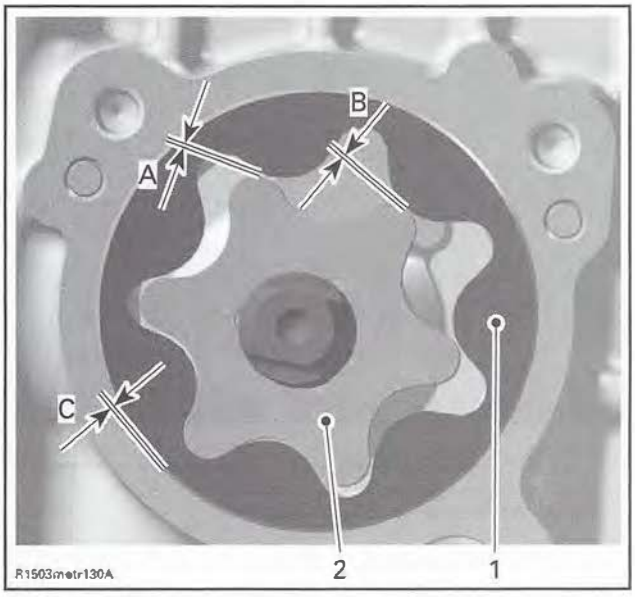
Inspect coolant/oil pump shaft, housing and cover for marks or other damages.

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



1. Pittings on the teeth

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



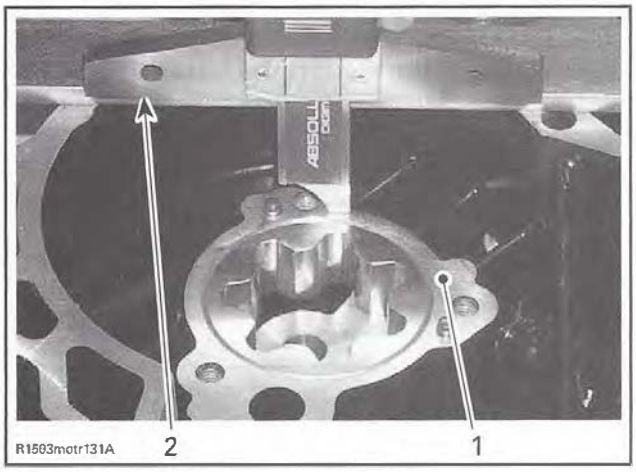
1. Outer rotor
2. Inner rotor

OUTER AND INNER ROTOR CLEARANCE	
SERVICE LIMIT	
A	0.25 mm (.0098 in)
B	
C	

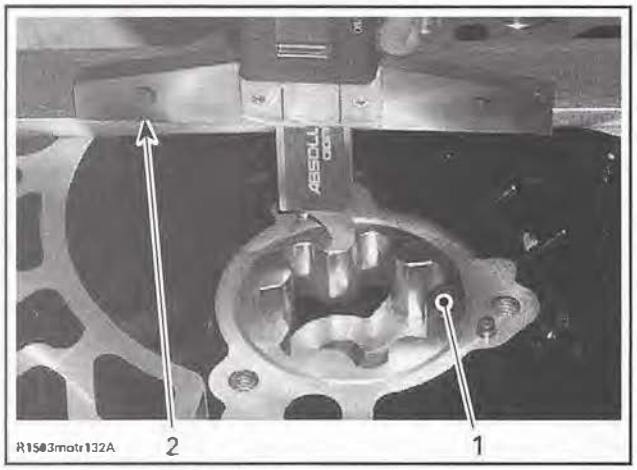
If clearance between inner and outer rotors exceeds the tolerance, replace coolant/oil pump shaft. Ensure to also check oil pump housing and cover and replace if damaged.

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

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



1. PTO housing surface
2. Vernier depth gauge



1. *Oil pump outer rotor surface*
2. *Vernier depth gage*

Clearance between pump housing and outer rotor should not exceed the following specification. If so, replace the complete oil pump assembly.

CLEARANCE BETWEEN PUMP HOUSING AND OUTER ROTOR	
SERVICE LIMIT	0.1 mm (.004 in)

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

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

Oil Pressure Pump Installation

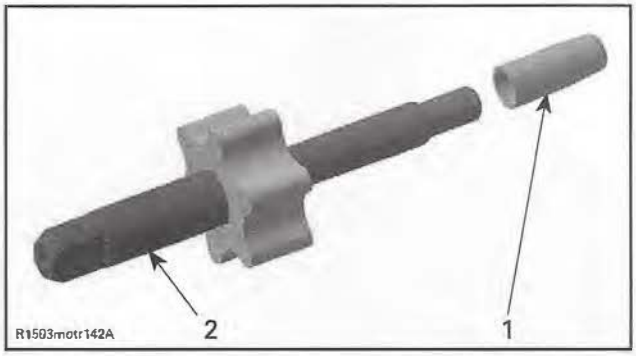
For installation, reverse the removal procedure. Pay attention to the following details.

Install a NEW rotary seal and a NEW oil seal. Refer to *ROTARY SEAL* in this subsection.

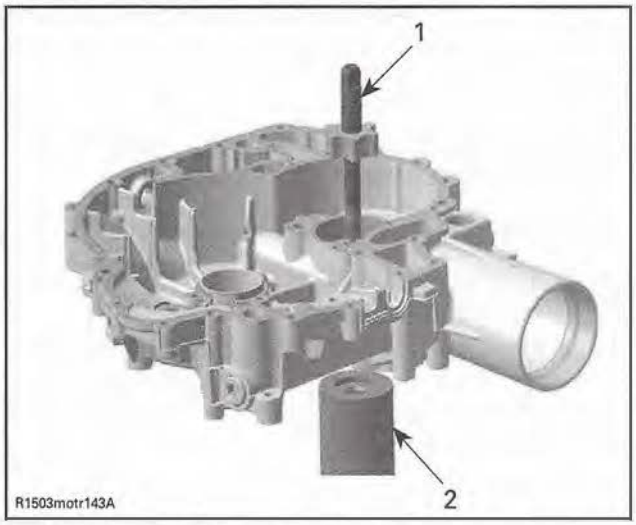
Install the coolant/oil pump shaft.

NOTICE **Never use a hammer for the coolant/oil pump shaft installation. Only use a press to avoid damaging the ceramic component of the rotary seal.**

REQUIRED TOOL	
OIL SEAL GUIDE (P/N 529 035 822)	
WATER PUMP SEAL PUSHER (P/N 529 035 823)	



1. *Oil seal guide*
2. *Coolant/oil pump shaft*



1. *Coolant/oil pump shaft with oil seal guide*
2. *Rotary seal pusher to support PTO housing*

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of oil pump cover screws.

Tighten oil pump cover screws to specification.

TORQUE	
Oil pump cover screws	9 N•m (80 lbf•in)

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

ROTARY SEAL

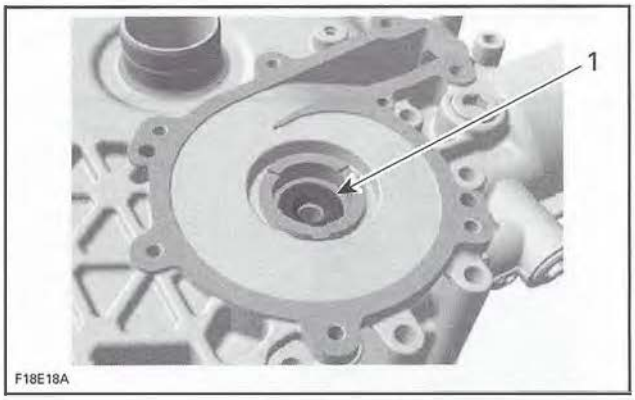
Rotary Seal Removal

Remove the coolant/oil pump shaft. Refer to *OIL PRESSURE PUMP* in this subsection.

Carefully remove rotary seal with a screwdriver.

NOTICE Be careful not to damage the surface of the rotary seal bore in PTO housing.

Remove also the oil seal behind the rotary seal.



1. Oil seal

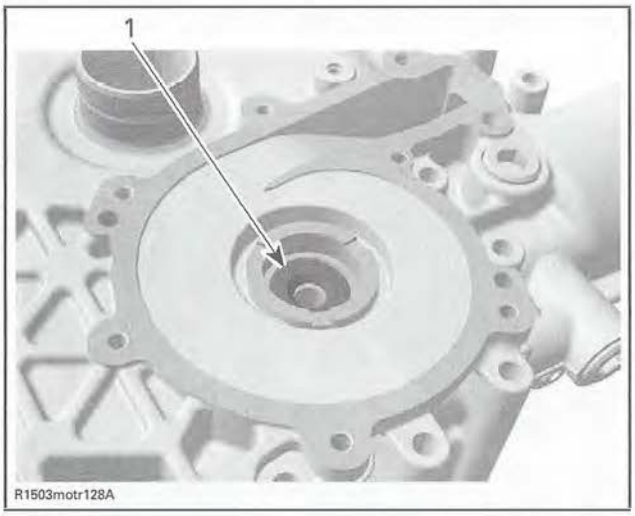
Discard rotary seal and oil seal.

Rotary Seal Installation

The installation is the opposite of the removal procedure. Pay attention to the following details.

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

Push the NEW oil seal in place by using thumb.

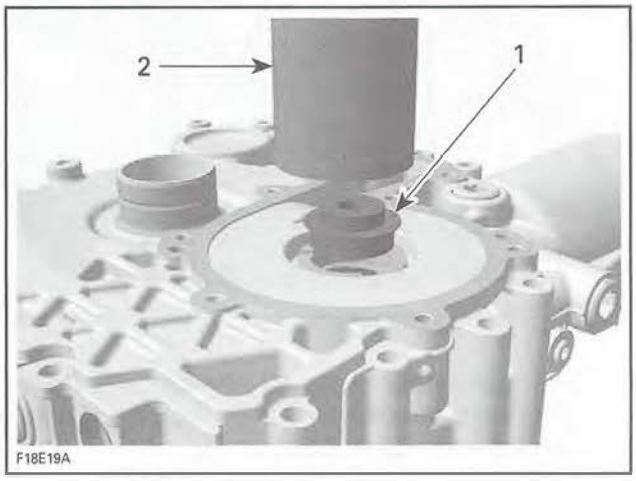


1. Oil seal

Install the NEW rotary seal.

REQUIRED TOOL	
WATER PUMP SEAL PUSHER (P/N 529 035 823)	

NOTICE Never use a hammer for the rotary seal installation. Only use a press to avoid damaging the ceramic component.



1. Rotary seal
2. Rotary seal installer

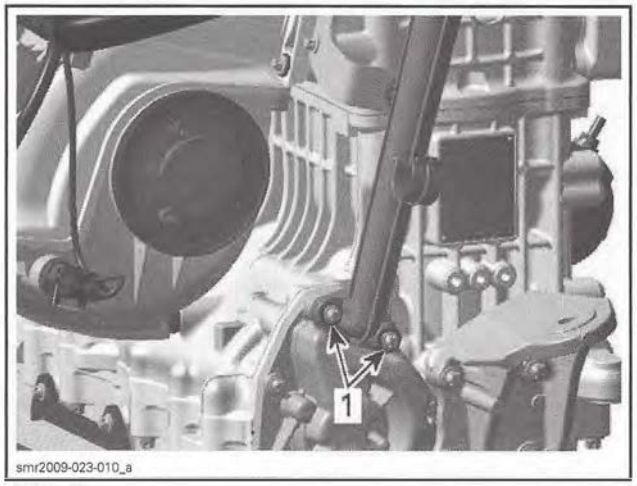
Install the coolant/oil pump shaft. Refer to *OIL PRESSURE PUMP* in this subsection.

OIL SUCTION PUMP

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

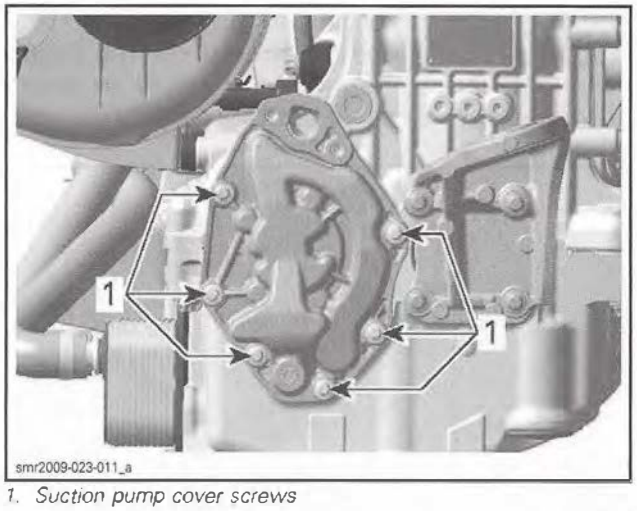
Oil Suction Pump Removal

1. Remove retaining screws from oil filler tube.



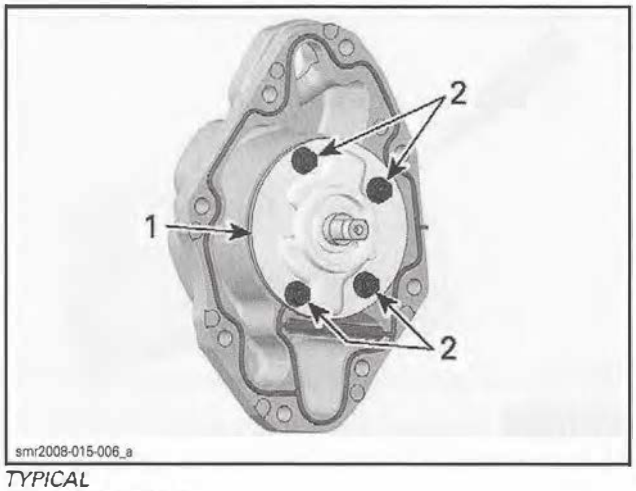
TYPICAL
1. Oil filler tube screws

2. Remove oil filler tube.
3. Remove retaining screws.



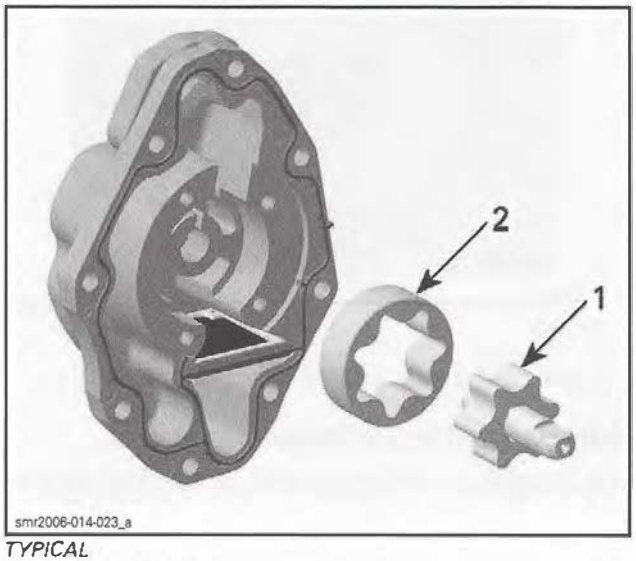
1. Suction pump cover screws

4. Place rags under cover to prevent spillage. If spillage occurs, clean with the PULLEY FLANGE CLEANER (P/N 413 711 809).
5. Remove the oil suction pump housing.
6. Remove oil pump screws and cover.



TYPICAL
1. Oil pump cover
2. Oil pump screws

7. Remove oil pump shaft.
8. Remove outer rotor.

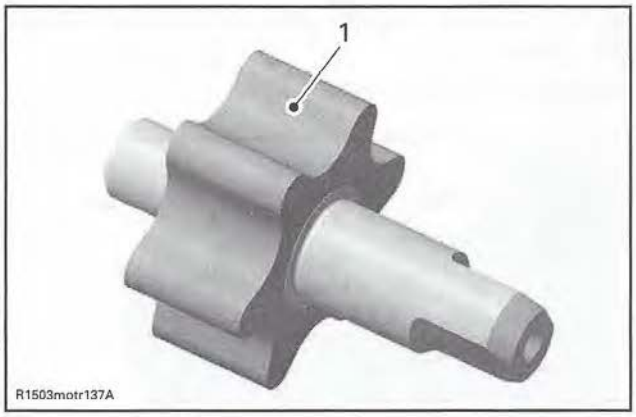


TYPICAL
1. Oil pump shaft
2. Outer rotor

Oil Suction Pump Inspection

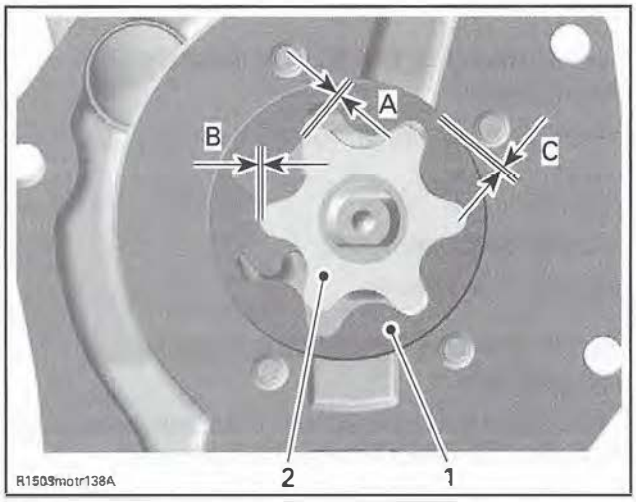
Inspect oil pump shaft, housing and cover for marks or other damages.

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



1. Pittings on the teeth

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



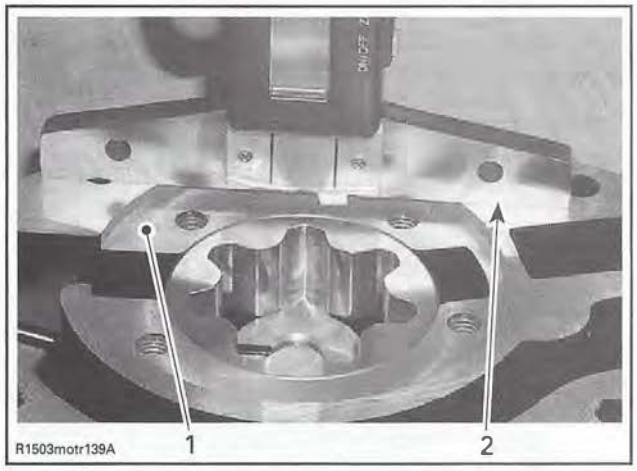
1. Outer rotor
2. Inner rotor

OUTER AND INNER ROTOR CLEARANCE	
SERVICE LIMIT	
A	0.25 mm (.0098 in)
B	
C	

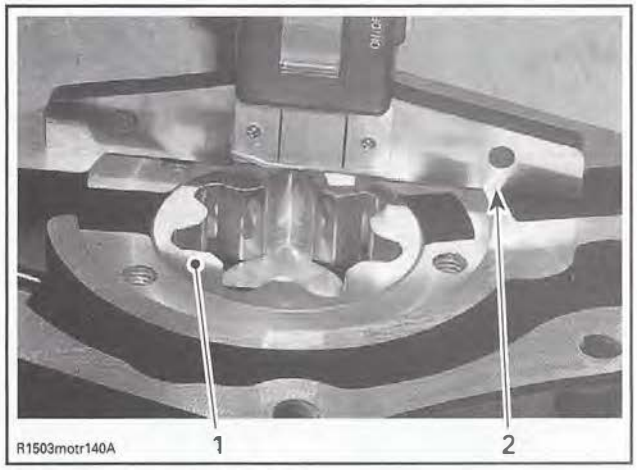
If clearance between inner and outer rotors exceeds the tolerance, replace oil pump shaft. Ensure to also check oil pump housing and cover and replace if damaged.

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

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



1. Oil pump housing surface
2. Vernier depth gage



1. Oil pump outer rotor surface
2. Vernier depth gage

Clearance between pump housing and outer rotor should not exceed specification. If so, replace the complete oil pump assembly.

CLEARANCE BETWEEN PUMP HOUSING AND OUTER ROTOR	
SERVICE LIMIT	0.1 mm (.004 in)

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

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

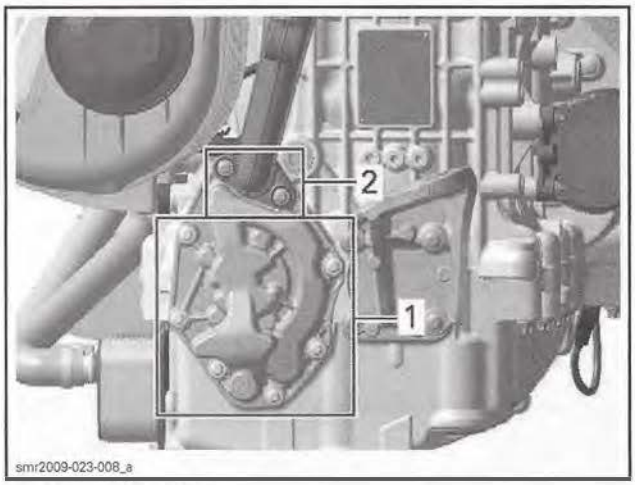
Oil Suction Pump Installation

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

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of the suction pump cover screws and tighten them to specification.

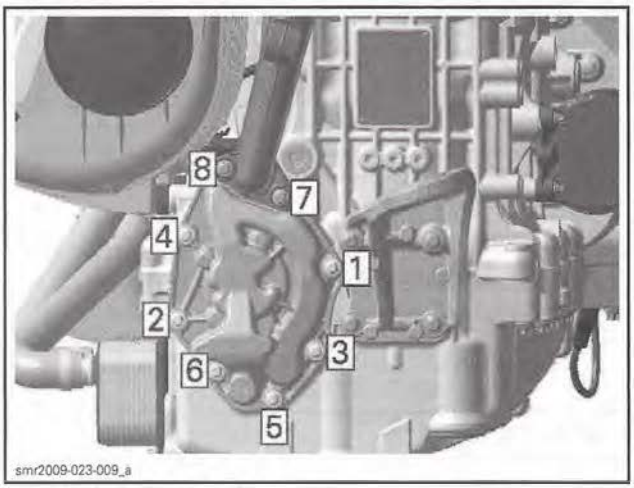
TORQUE	
Suction pump cover screws	9 N•m (80 lbf•**in**)

Position screws according to their length as shown.



1. *Screws M6 x 25*
2. *Screws M6 x 45*

Tighten suction pump cover screws as per following sequence.



TIGHTENING SEQUENCE

Refer to the appropriate procedures and install all other removed parts.

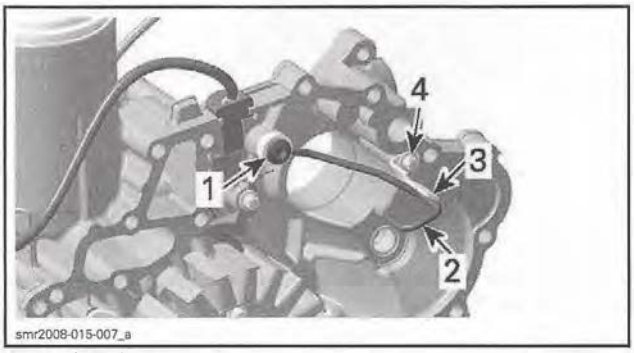
SUPERCHARGER OIL SPRAY NOZZLE

Supercharger Oil Spray Nozzle Removal

Remove the PTO housing. Refer to *PTO HOUSING AND MAGNETO* subsection.

Remove the Torx screw securing the oil spray nozzle support.

Unscrew the Banjo bolt.



1. *Banjo bolt*
2. *Supercharger oil spray nozzle*
3. *Oil spray nozzle support*
4. *Torx screw*

Supercharger Oil Spray Nozzle Inspection

Check oil spray nozzle for:

- Dirt
- Bend
- Other damages.

Replace if necessary.

Supercharger Oil Spray Nozzle Installation

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

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of Torx screw.

Install the oil spray nozzle support.

TORQUE	
Oil spray nozzle support screw (Torx screw)	11 N•m (97 lbf•**in**)

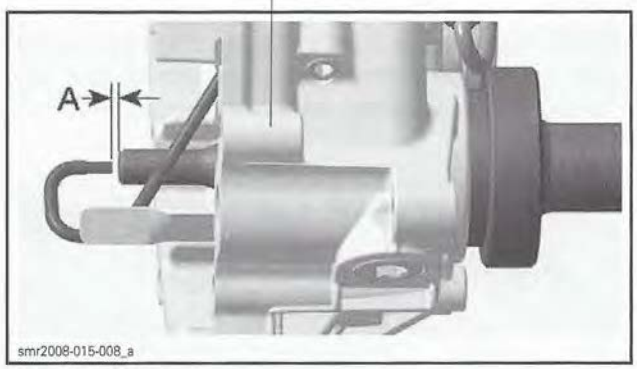
Install oil spray nozzle with Banjo bolt.

TORQUE	
Oil spray nozzle Banjo bolt	19 N•m (168 lbf•**in**)

Adjust the position of the oil spray nozzle.

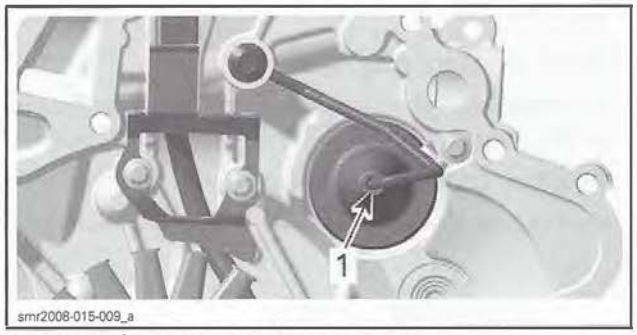
REQUIRED TOOL	
SUPERCHARGER OIL SPRAY NOZZLE TOOL (P/N 529 036 134)	

The distance between the adjustment tool and oil spray nozzle must be within 1 mm (.039 in).



A. 1 mm (.039 in)

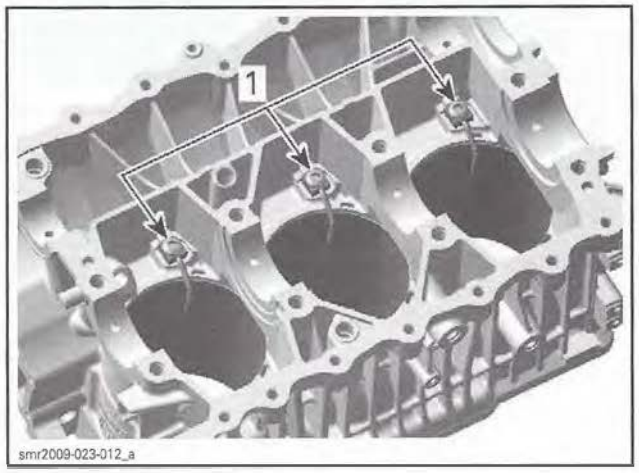
NOTE: Make sure that the oil spray nozzle is facing to the center of the tool. Not following this procedure will lead to an insufficient oiling of the supercharger and a supercharger failure can occurs. Adjust the oil spray nozzle if necessary by slightly bending it, take care not to over bend the oil spray nozzle.



1. Center of supercharger oil spray nozzle tool

PISTON OIL SPRAY NOZZLES

The piston oil spray nozzles are located on the upper half of cylinder block.



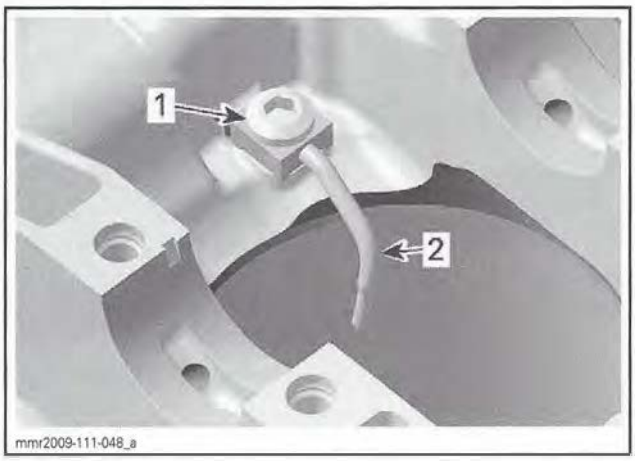
1. Piston oil spray nozzles

NOTE: When the scope of repair work obligates you to split the cylinder block, take this opportunity to clean the oil spray nozzles.

Piston Oil Spray Nozzle Removal

Remove cylinder block lower half. Refer to *CYLINDER BLOCK* subsection.

Remove oil spray nozzle and Banjo fitting from cylinder block upper half.

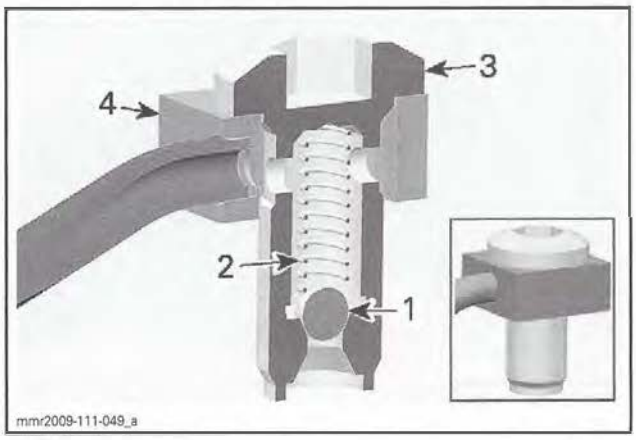


1. Banjo fitting
2. Oil spray nozzle

Piston Oil Spray Nozzle Cleaning and Inspection

Clean oil spray nozzle and Banjo fitting from dirt and debris. Use a part cleaner, then compressed air and dry the parts.

Check if ball inside Banjo fitting moves freely.

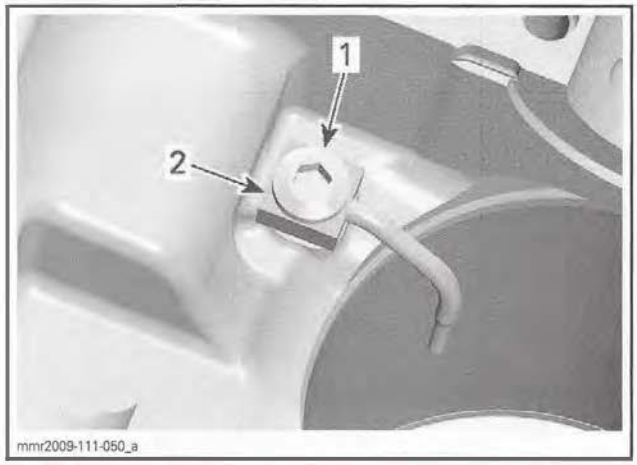


1. Ball
2. Spring
3. Banjo fitting
4. Oil spray nozzle

NOTE: If the oil spray nozzle is damaged or bent during work in the cylinder block, it must be replaced immediately.

Piston Oil Spray Nozzle Installation

NOTICE At assembly make sure the contact surface of the oil spray nozzle is well fitted onto the cylinder block. If this is not ensured, the oil spray direction will change, causing potential engine damage.

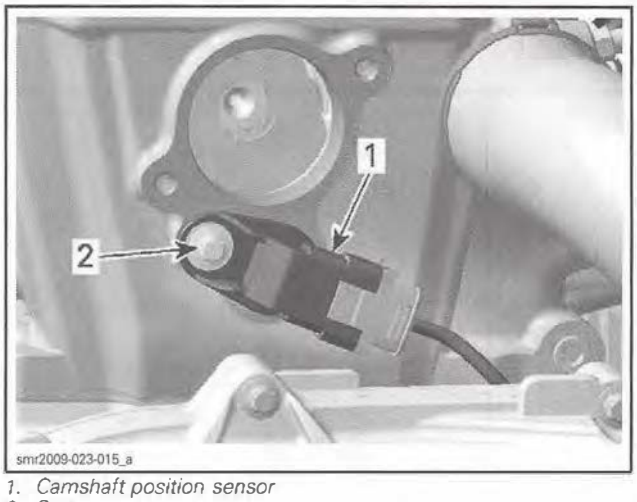


1. Oil spray nozzle
2. Contact surface

OIL SEPARATOR COVER

Oil Separator Cover Removal

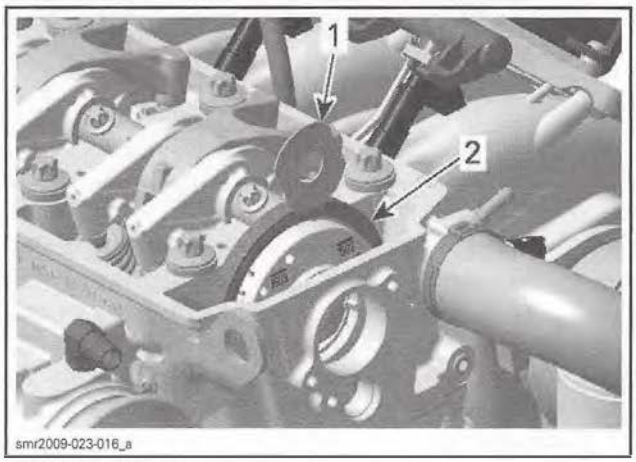
1. Remove the blow-by valve. See procedure in this subsection.
2. Remove camshaft position sensor.



1. Camshaft position sensor
2. Screw

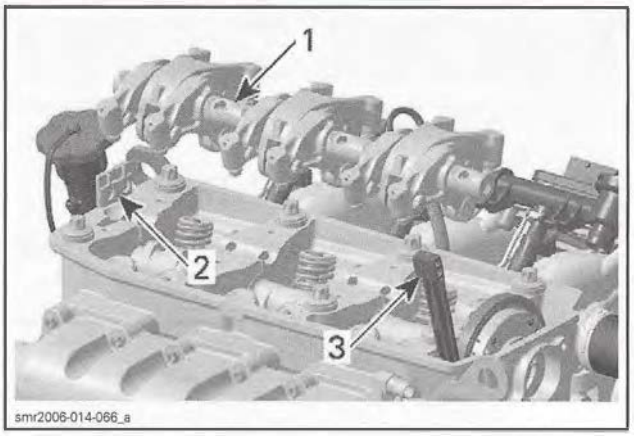
3. Remove cylinder head cover, refer to *CYLINDER HEAD* subsection.
4. Remove thrust washer from oil separator cover.

NOTE: Make sure not to loose thrust washer when removing it from oil separator cover, otherwise thrust washer would fall into the PTO housing.



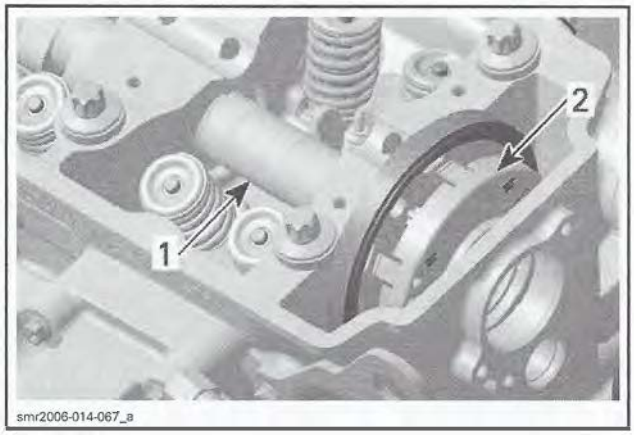
1. Thrust washer
2. Oil separator cover

5. Remove spark plug tube.
6. Remove rocker arm shaft together with rocker arms, refer to *CYLINDER HEAD* subsection.
7. Remove chain guide and camshaft guide.



1. Rocker arm
2. Camshaft guide
3. Chain guide

8. Move camshaft backwards as far as possible.
9. Remove oil separator cover from timing gear by releasing the holding clips.

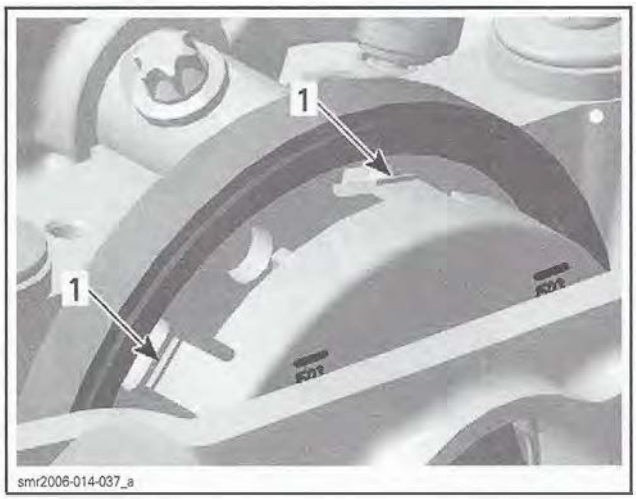


1. *Camshaft*
2. *Oil separator cover*

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

Oil Separator Cover Inspection

Inspect oil separator cover for marks or other damages. Ensure to check also the holding clips of oil separator cover and for thrust washer. If any damage is visible replace oil separator cover.



1. *Holding clips*

Oil Separator Cover Installation

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

Properly install oil separator cover and thrust washer. They need to be in a perfect even position with timing gear.

NOTE: Make sure not to lose thrust washer when installed on oil separator cover.

For installation of rocker arm shaft with rocker arms, follow the procedure as it is described in *CYLINDER HEAD* subsection.

Install all other removed parts.

BLOW-BY VALVE

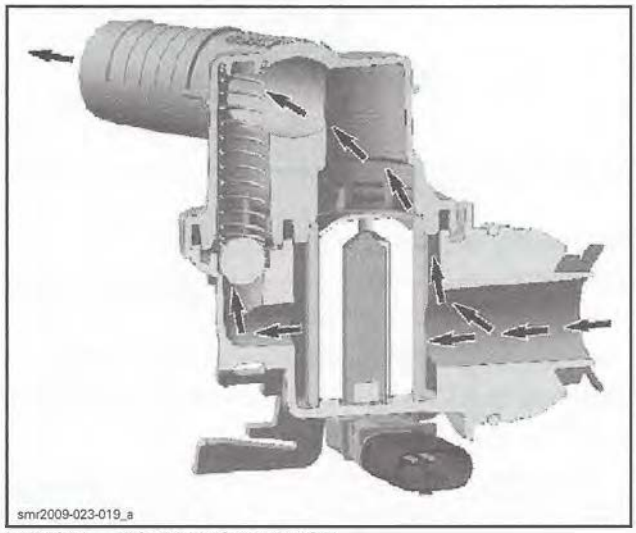
Blow-By Valve Description

The function of the blow-by valve is the circulation of the oil vapors.

Blow-By Valve Operation

Normal Operation

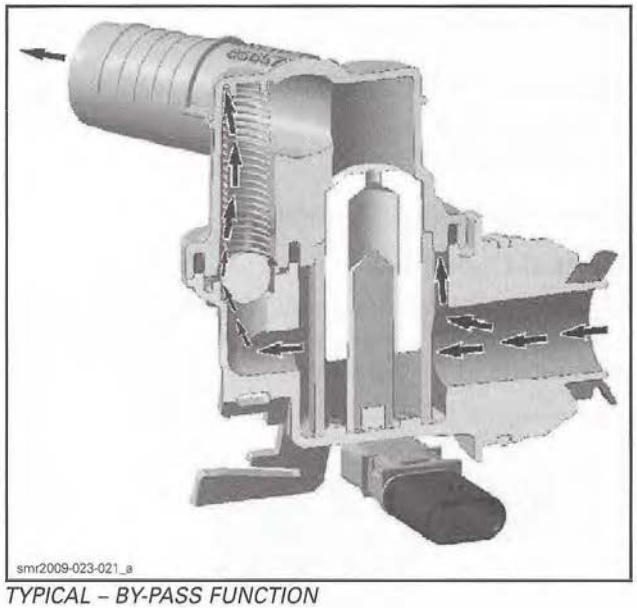
During its normal operation, the blow-by valve allows crankcase vapors to return in the intake system where they are harmlessly burned.



TYPICAL – NORMAL OPERATION

By-Pass Function

If, for any reason, the valve piston gets stuck at normal operation and the crankcase pressure exceeds 40 kPa (6 PSI), the pressure unseats a check ball and crankcase vapors can bypass the valve piston.



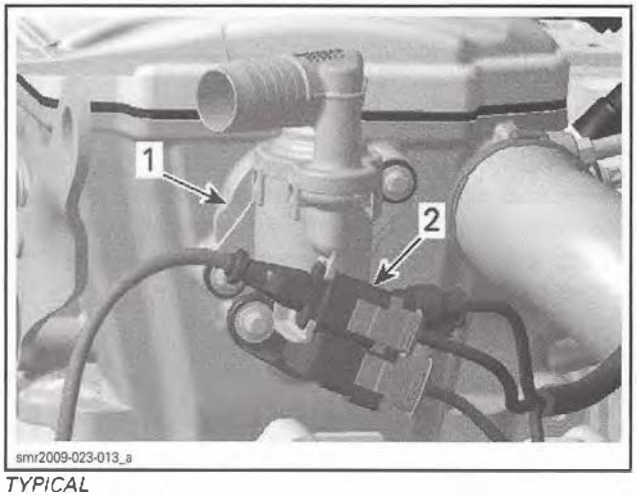
TYPICAL – BY-PASS FUNCTION

Blow-By Valve Removal

On **210 Series**, remove air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.

Remove ventilation hose from blow-by valve.

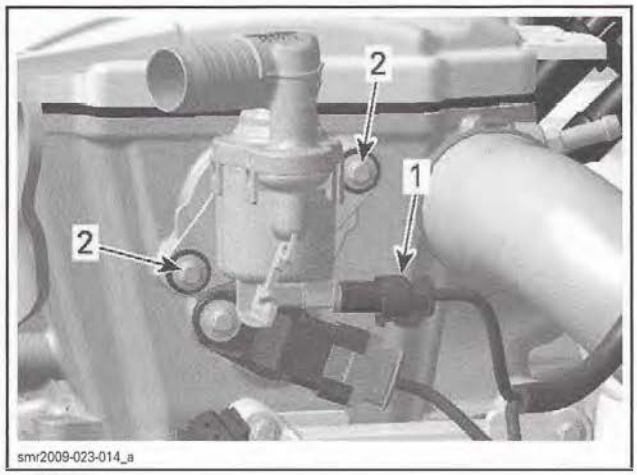
Remove the CPS connector from its support on blow-by valve.



TYPICAL
1. Blow-by valve
2. CPS connector

On **210 and 230 Series**, disconnect the TOPS switch connector of the blow-by valve.

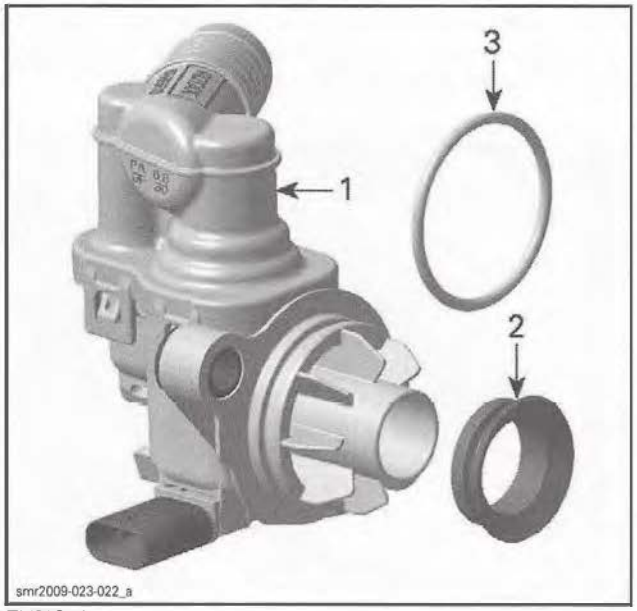
Unscrew and remove the blow-by valve.



TYPICAL
1. TOPS switch connector
2. Retaining screws

Remove and discard O-ring and V-ring.

NOTE: The blow-by valve can not be disassembled.



TYPICAL
1. Blow-by valve
2. V-ring
3. O-ring

Blow-By Valve Inspection

If blow-by valve is damaged, replace it.

Clean all contact surfaces of blow-by valve.

Place a clean rag on valve inlet.

Blow air through inlet port. Air must flow freely to the outlet port.

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

If test fails, replace blow-by valve.

Blow-By Valve Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Install the blow-by valve with NEW O-ring and V-ring.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of blow-by valve screws.

Tighten blow-by valve screws to specification.

TORQUE	
Blow-by valve screws	9 N•m (80 lbf•in)

Reinstall remaining removed parts.

TOPS SWITCH (210 AND 230 SERIES)

Tip Over Protection Switch (TOPS Switch) Function

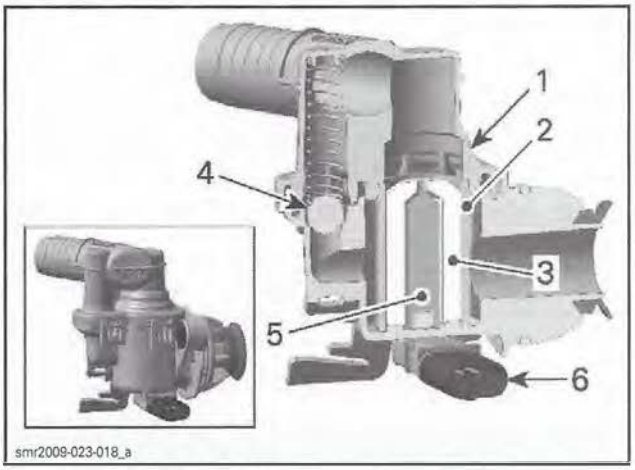
The function of the TOPS switch is the engine protection in the event the boat tip over.

During normal operation the TOPS switch state is OFF, no signal to the ECM.

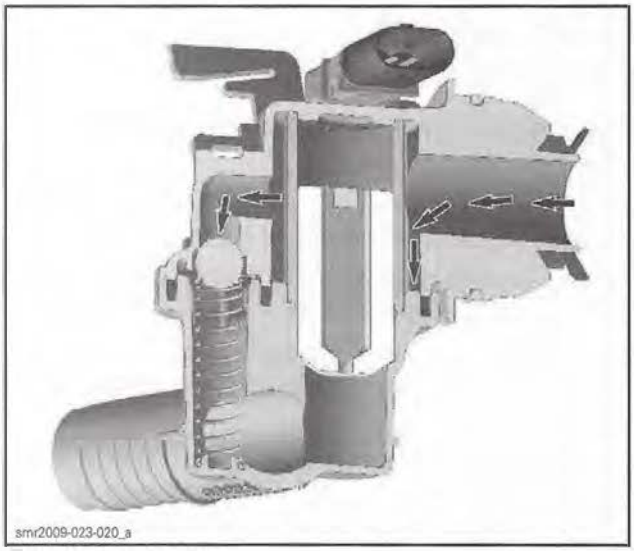
If the boat tips over, gravity causes a valve piston to close and no engine oil will leak out of the blow-by valve.

In this event, a pin (with magnet) opens a gap to the TOPS switch (Hall effect sensor) and the TOPS changes its state to ON and sends a signal to the ECM.

The ECM will shut down the engine by cutting the ignition and the fuel injection.



BLOW-BY VALVE CUT-AWAY
1. *Valve housing*
2. *Valve sleeve*
3. *Valve piston*
4. *Check ball*
5. *Valve pin (with magnet)*
6. *TOPS switch of the blow-by valve*



TIP OVER FUNCTION

TOPS Switch Input Voltage Test

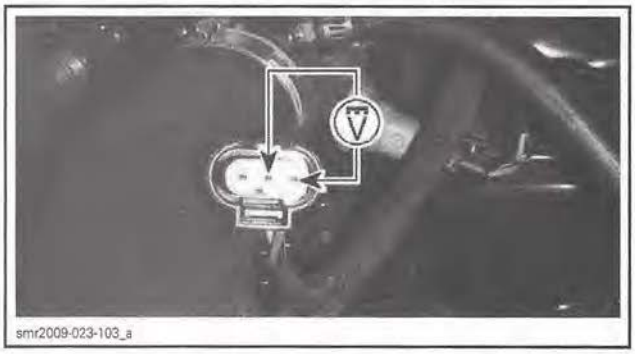
On 210 Series, remove air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.

Disconnect the TOPS switch connector of the blow-by valve.

Install the tether cord on the engine cut-off switch and turn ignition key to ON position.

Probe terminals as shown to check the voltage output from the ECM.

TOPS SWITCH CONNECTOR	VOLTAGE
Pins 2 and 3	Approximately 5 Vdc



If voltage test is good, check the TOPS switch output voltage.

If voltage test is not good, check the continuity of the blow-by valve TOPS switch circuit.

NOTE: After voltage test, clear the fault codes in the ECM using the B.U.D.S. software.

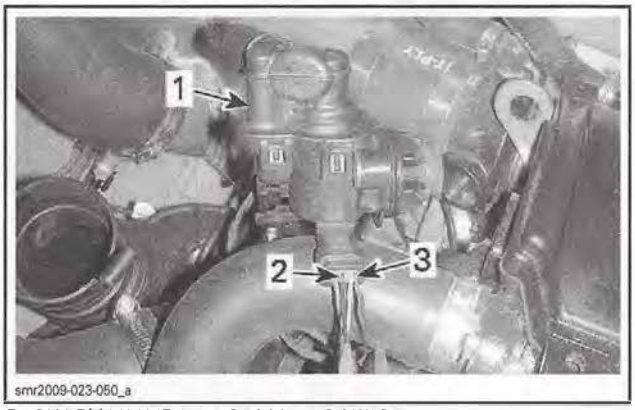
TOPS Switch Output Voltage Test

Remove the blow-by valve.

Back-probe TOPS connector and check voltage.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

NOTE: To easily probe wire terminals through the back of the connector, use the FLUKE RIGID BACK PROBES (P/N TP88) or an equivalent.



BLOW-BY VALVE IN NORMAL POSITION
1. *Blow-by valve*
2. *RED probe into pin 2*
3. *BLACK probe into pin 1*

TOPS SWITCH CONNECTOR	BLOW-BY VALVE POSITION	VOLTAGE
Pin 1 and pin 2	Normal position	0.4 ± 0.1 Vdc
Pin 1 and pin 2	Upside down	4.4 ± 0.2 Vdc
Pin 2 and pin 3	Normal position or upside down	Approximately 5 Vdc

Replace TOPS switch if not within specification.

TOPS Switch Circuit Continuity Test

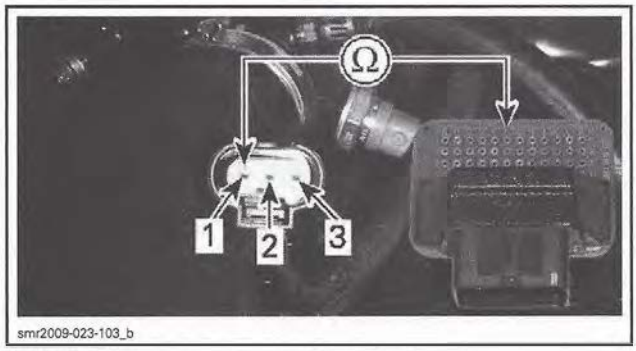
Disconnect the TOPS switch connector of the blow-by valve.

Disconnect the connector A from the ECM.

Check continuity of the blow-by valve TOPS switch circuit as per following table.

REQUIRED TOOL	
ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

TOPS SWITCH CONNECTOR	ECM ADAPTER	RESISTANCE
Pin 1	Pin F4	Close to 0 Ω (continuity)
Pin 2	Pin G1	
Pin 3	Pin C4	



1. Pin 1
2. Pin 2
3. Pin 3

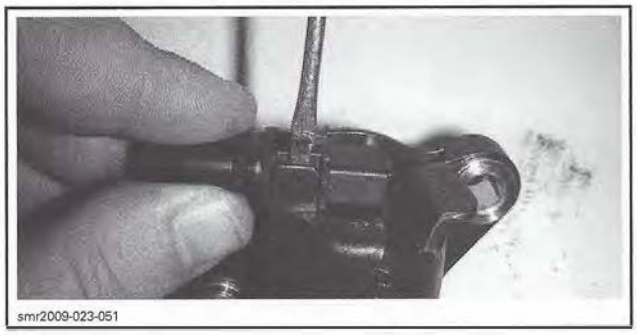
If continuity test is good, check ECM. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

If continuity test is not good, repair or replace defective wires or connectors.

TOPS Switch Replacement

Remove blow-by valve and turn it upside down.

Insert a small screwdriver between TOPS switch and its retaining tab. Twist and hold the TOPS switch then release the other retaining tab.

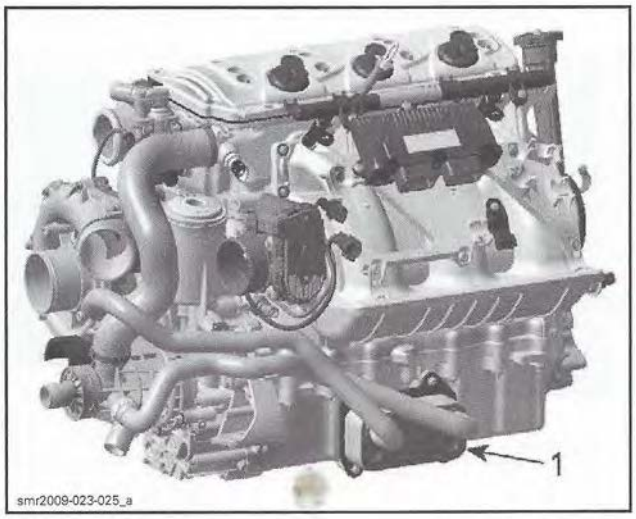


When installing the TOPS switch, make sure printed information is visible.

1. TOPS valve inscriptions

OIL COOLER

The oil cooler is located below the air intake manifold.



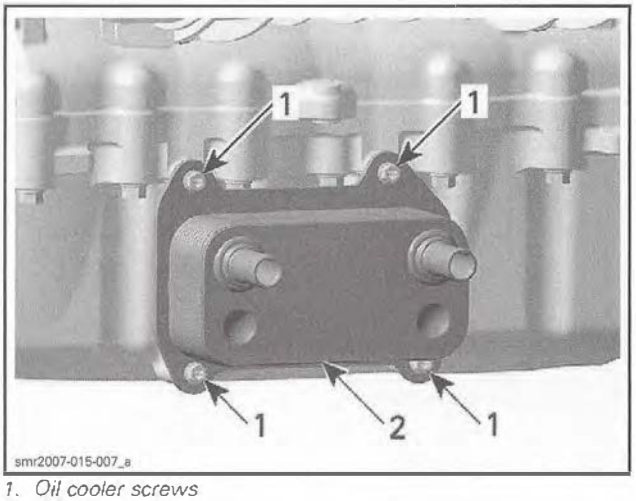
1. Oil cooler

Oil Cooler Removal

Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

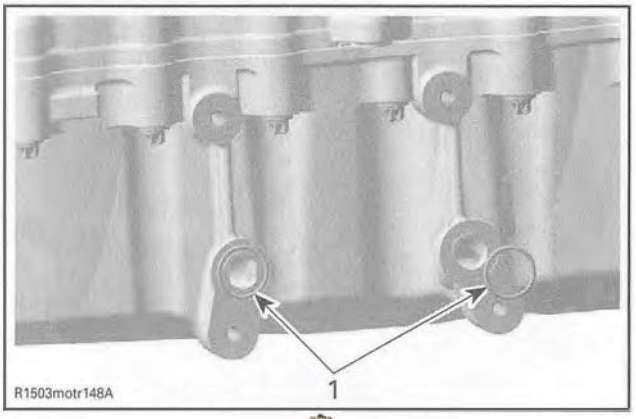
Disconnect cooling hoses from oil cooler.

Remove screws securing oil cooler.



1. Oil cooler screws
2. Oil cooler

Remove oil cooler from engine. Ensure not to lose O-rings located between oil cooler and engine.



1. O-rings

Oil Cooler Inspection

If O-rings are brittle, cracked or hard, replace them.

Clean both contact surfaces of oil cooler.

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

Oil Cooler Installation

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

Apply engine oil on O-rings.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of oil cooler screws.

Tighten oil cooler screws to specification.

TORQUE	
Oil cooler screws	9 N•m (80 lbf•in)

COOLING SYSTEM

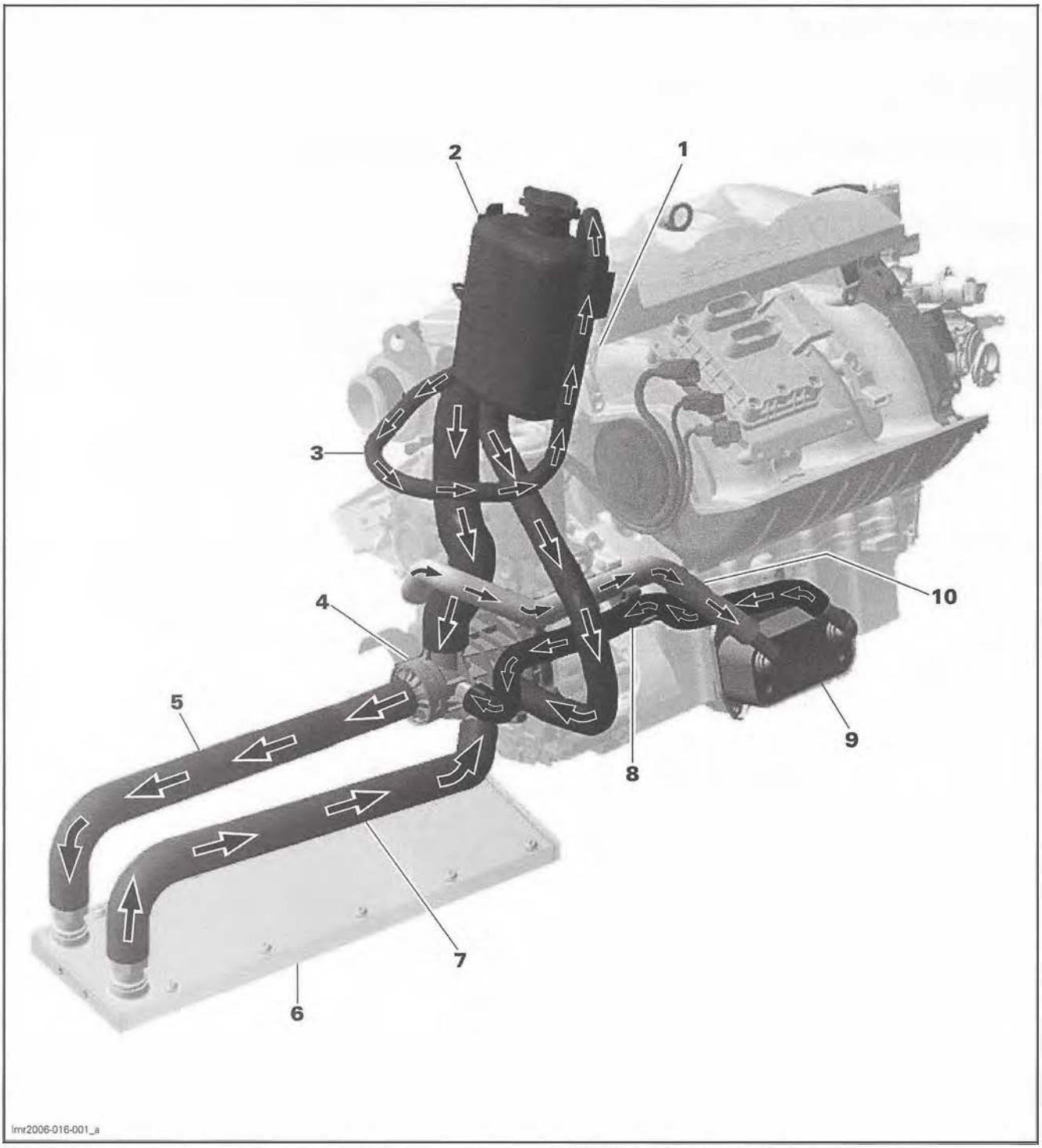
SERVICE TOOLS

Description	Part Number	Page
OETIKER PLIERS	295 000 070	138
TEST CAP	529 035 991	137
VACUUM/PRESSURE PUMP	529 021 800	137

SERVICE PRODUCTS

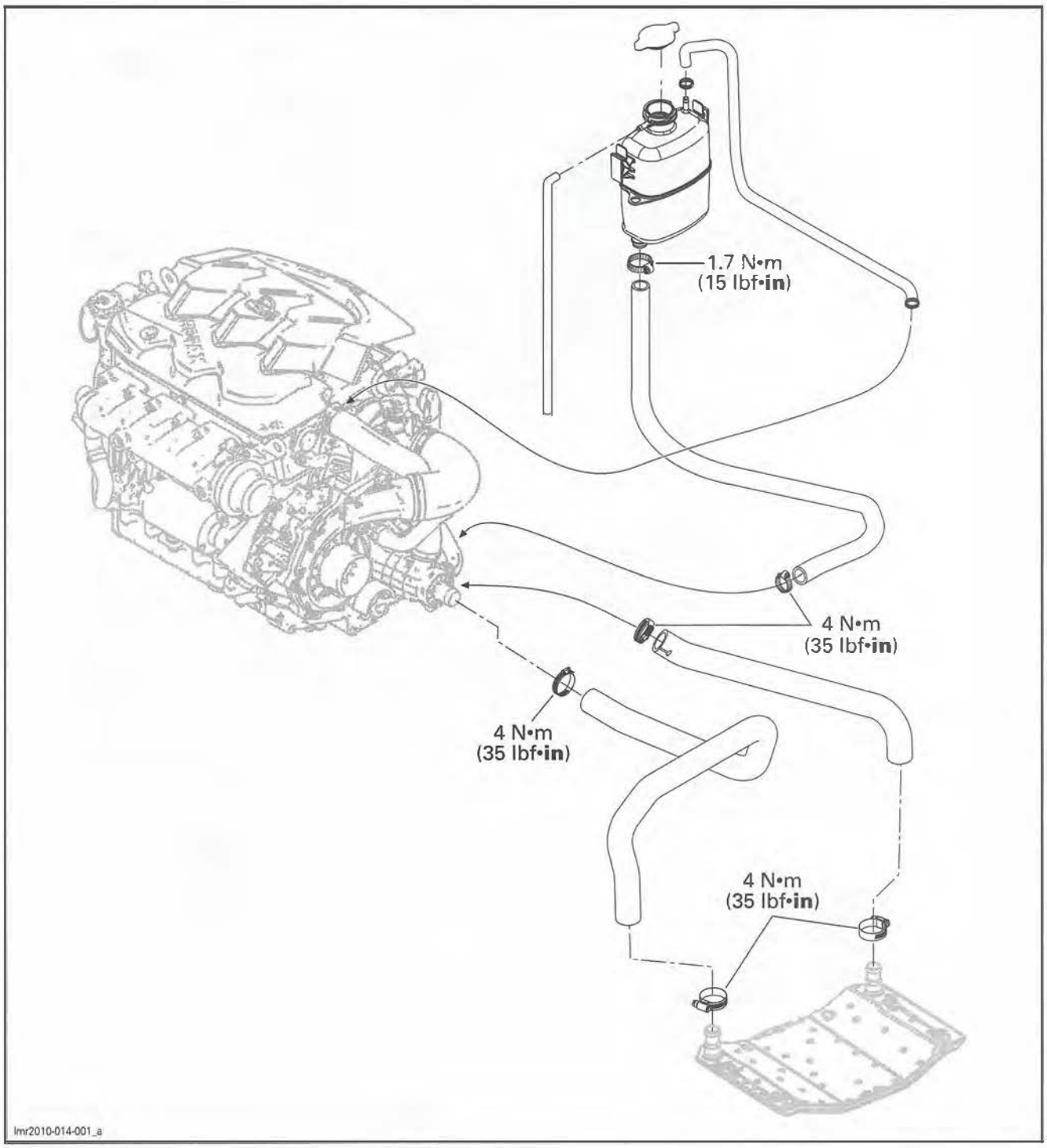
Description	Part Number	Page
BRP PREMIXED COOLANT	219 700 362	135
LOCTITE 243 (BLUE)	293 800 060	140, 142
LOCTITE 567 (PIPE SEALANT)	293 800 013	136
LOCTITE INSTANT GASKET	219 701 421	142

COOLING SYSTEM (CLOSED LOOP)

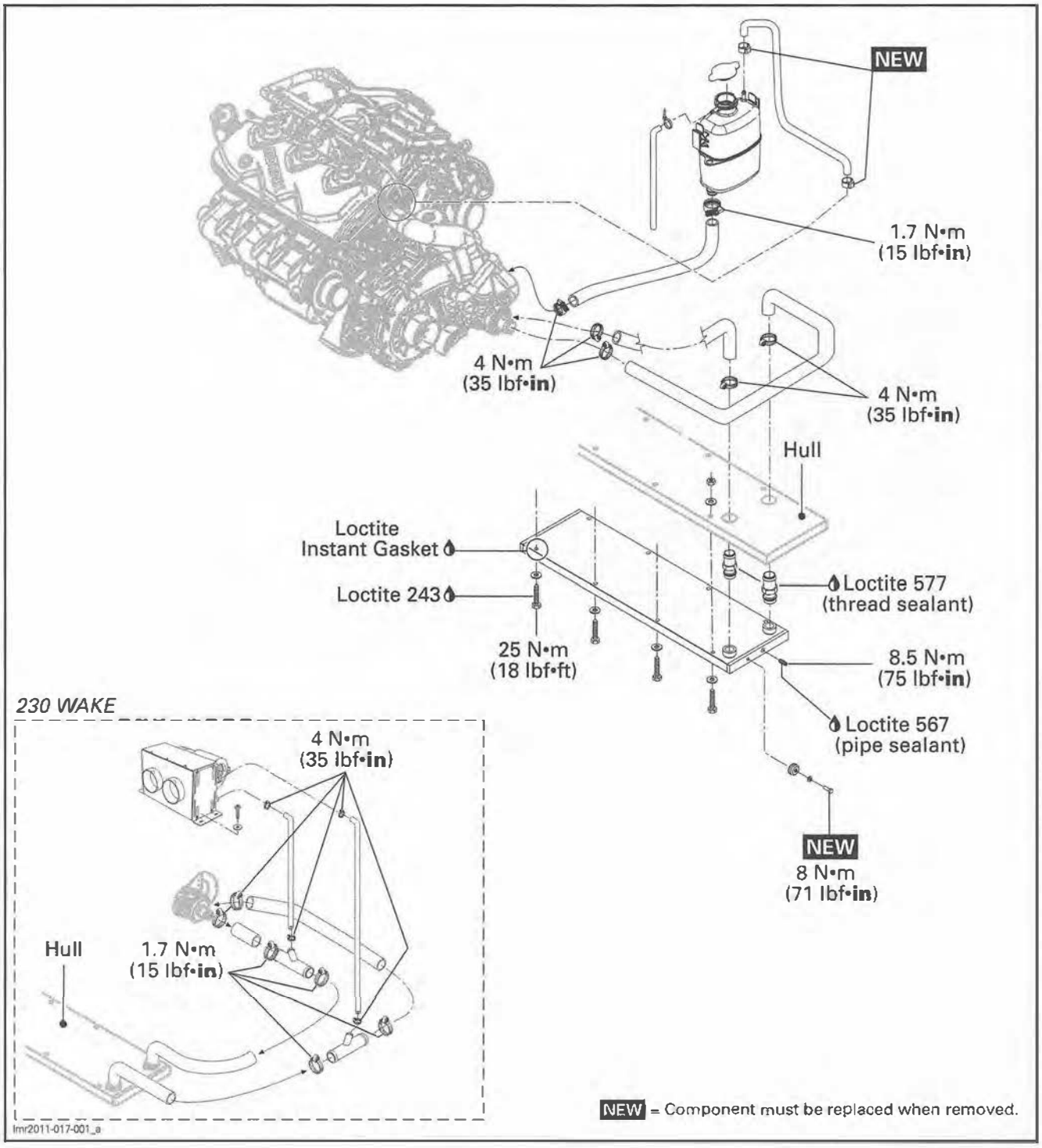


1. *Coolant temperature sensor (CTS) activates when temperature exceeds 100°C (212°F)*
2. *Expansion coolant tank*
3. *Bleed hose from cylinder head to expansion coolant tank*
4. *Water pump housing including thermostat that opens at 87°C (188°F)*
5. *Coolant flows to heat exchanger*
6. *Heat exchanger*
7. *Coolant returns from heat exchanger*
8. *Coolant returns from oil cooler*
9. *Oil cooler*
10. *Coolant flows to oil cooler*

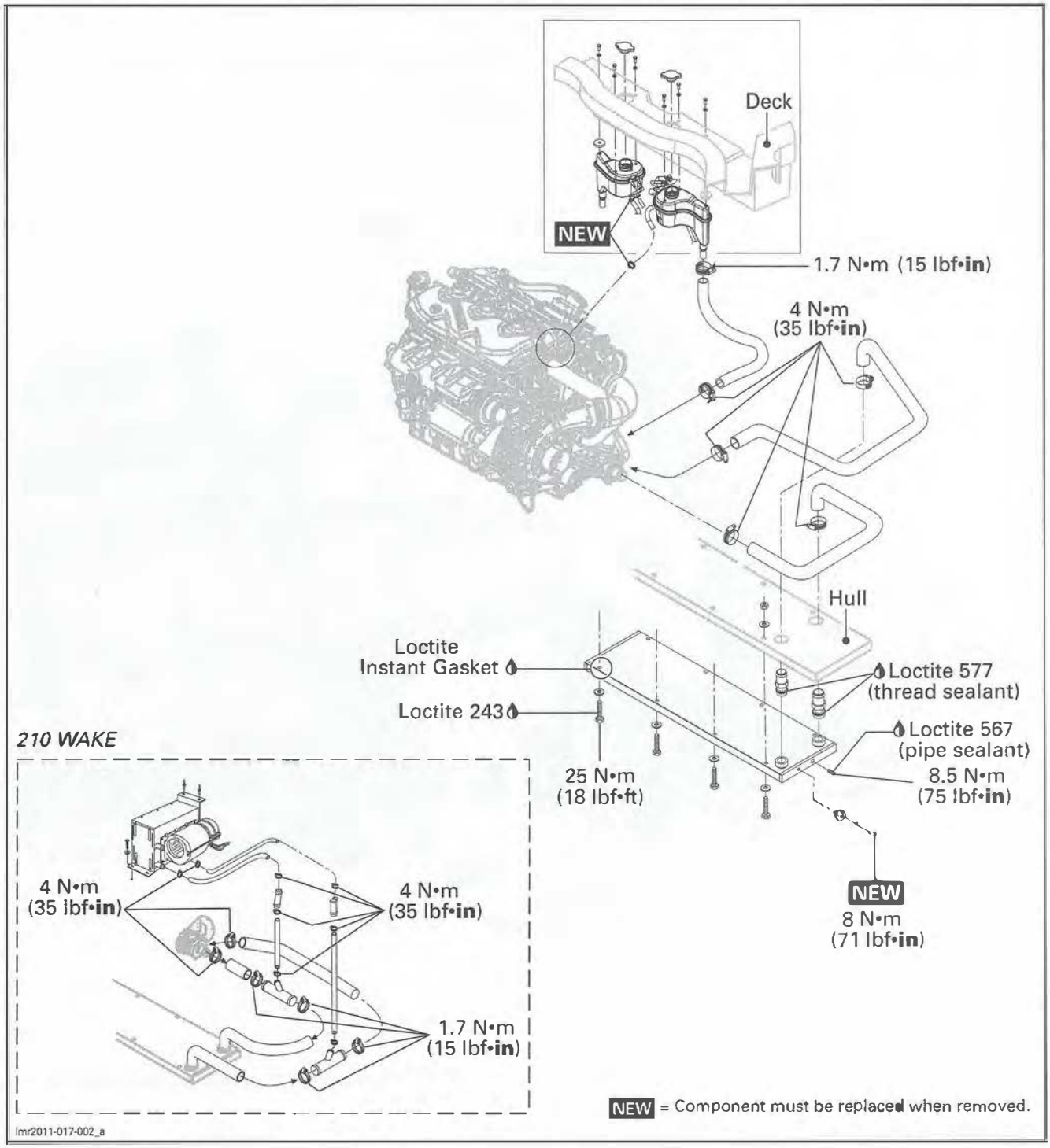
COOLING SYSTEM COMPONENTS (150 AND 180 SERIES)



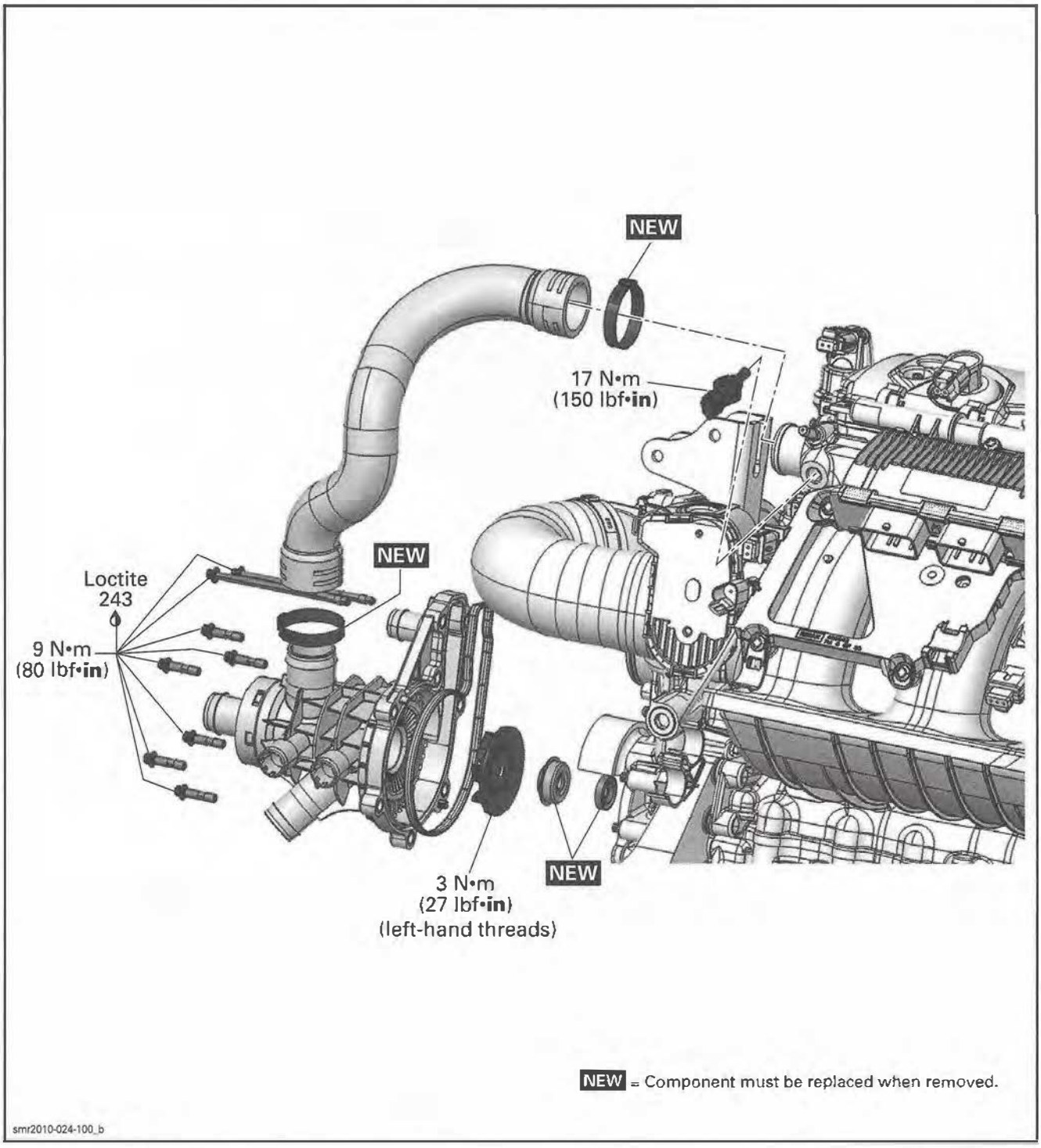
COOLING SYSTEM COMPONENTS (200 AND 230 SERIES)



COOLING SYSTEM COMPONENTS (210 SERIES)



COOLING SYSTEM COMPONENTS (ENGINE)



GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

SYSTEM DESCRIPTION

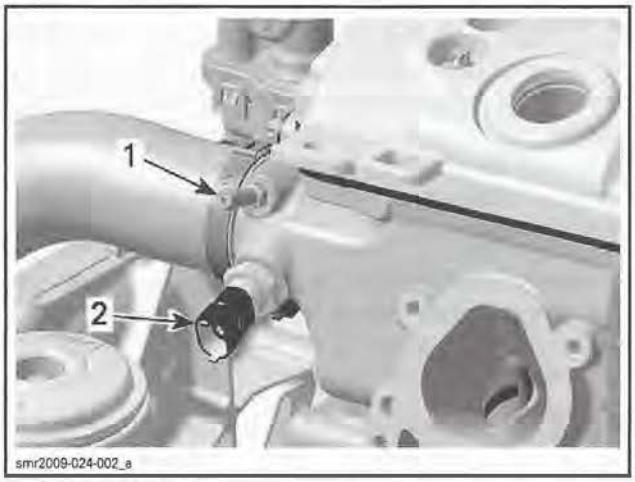
A closed loop cooling system is utilized on the 1503 4-TEC engines, which offers an efficient engine cooling while keeping dirt and salt water out of the cooling system. This system keeps the temperature constant and prevents internal engine corrosion.

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

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

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

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



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

NOTICE **Never modify cooling system arrangement, otherwise serious engine damage could occur.**

Technical Specifications

TYPE	Closed loop cooling system.
COOLANT FLOW	Flow from water pump.
TEMPERATURE CONTROL	Thermostat.
SYSTEM BLEEDING	Self-bleed type through coolant tank (hose at uppermost point of circuit).
MONITORING BEEPER	Turns on at 100°C (212°F) on naturally aspirated engines. Turns on at 110°C (230°F) on supercharged engines.

MAINTENANCE

ENGINE COOLANT

⚠ WARNING

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

Recommended Coolant

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

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

NOTICE A blend of 40% antifreeze with 60% demineralized water will improve the cooling efficiency. Using tap water instead of demineralized water, would contribute to make deposits in cooling system and to reduce antifreeze efficiency. This could lead to engine overheating.

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

NOTICE To prevent rust formation or freezing condition in cold areas, always replenish the system with 50% antifreeze and 50% demineralized water. Pure antifreeze will freeze at a higher temperature than the optimal water/antifreeze mix. Always use ethylene glycol antifreeze containing corrosion inhibitors specifically recommended for aluminum engines.

Draining the System

⚠ WARNING

Never drain or refill cooling system when engine is hot.

Remove the coolant tank cap.

Install a drain pan underneath the ride plate or heat exchanger.

Unscrew the drain plug located at rear of ride plate or heat exchanger.

NOTE: Raising the front of the boat will contribute to drain the cooling system.

Dispose coolant as per local regulations.

Do not reinstall drain plug at this time.

Cleaning the System

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

Drain the cooling system.

Add a cleaning product such as the Zerex® Super Cleaner by Valvoline (or an equivalent) in coolant tank then fill cooling system with demineralized water.

Reinstall cap on coolant tank.

Ride boat on a stretch of water. Start engine and run for approximately 15 minutes.

IMPORTANT: Ensure thermostat opens so that the cleaning product flows in ride plate or heat exchanger properly.

Stop engine and let the cleaning product work for 12 to 16 hours.

Thereafter, engine can be operated one last time to soak off deposits.

Drain and thoroughly rinse the cooling system with clean fresh water.

Refill cooling system as described below.

Refilling the System

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

Place a container under drain plug to collect antifreeze.

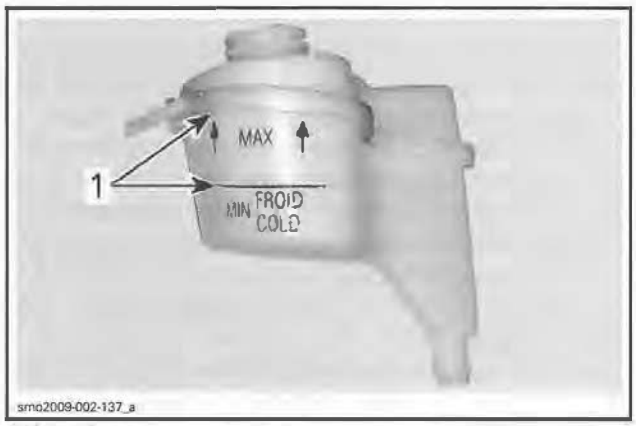
Apply LOCTITE 567 (PIPE SEALANT) (P/N 293 800 013) on drain plug threads.

Ask someone to pour recommended antifreeze in coolant tank.

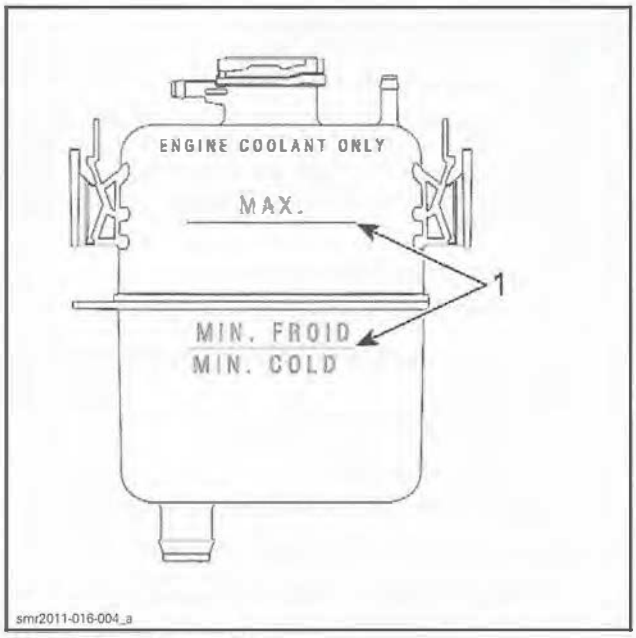
When antifreeze flows out from the ride plate or heat exchanger drain hole, reinstall drain plug.

TORQUE	
Drain plug	8 N•m (71 lbf•in)

Continue to pour and fill coolant tank between marks.



210 SERIES
1. Level between marks when engine is cold



ALL EXCEPT 210 SERIES
1. Level between marks when engine is cold

Do not install pressure cap at this time.

Link a garden hose to the hose adapter at the back of the boat. Refer to *EXHAUST SYSTEM FLUSHING* in the *EXHAUST SYSTEM* subsection.

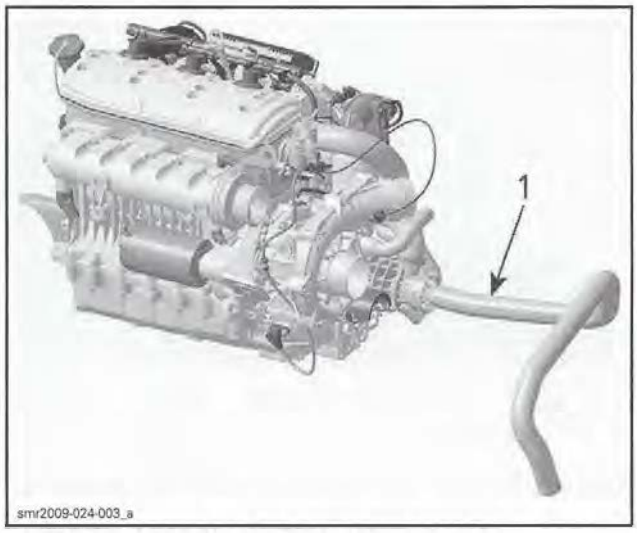
NOTICE **Never run engine without supplying water to the exhaust system.**

Start engine and let run for a maximum of 2 minutes. Stop engine and wait 15 minutes to let it cool down. Refill coolant tank as necessary.

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

NOTE: Properly cool exhaust system by installing a garden hose. Refer to *EXHAUST SYSTEM* subsection.

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



1. This hose becomes hot when thermostat opens

Last, refill coolant tank and install pressure cap.

When engine has completely cooled down, recheck coolant level in coolant tank and top up if necessary.

INSPECTION

COOLING SYSTEM LEAK TEST

⚠ WARNING

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

Pressurize system through coolant tank to 90 kPa (13 PSI).

NOTE: It is not necessary to install a hose pincher on overflow hose.

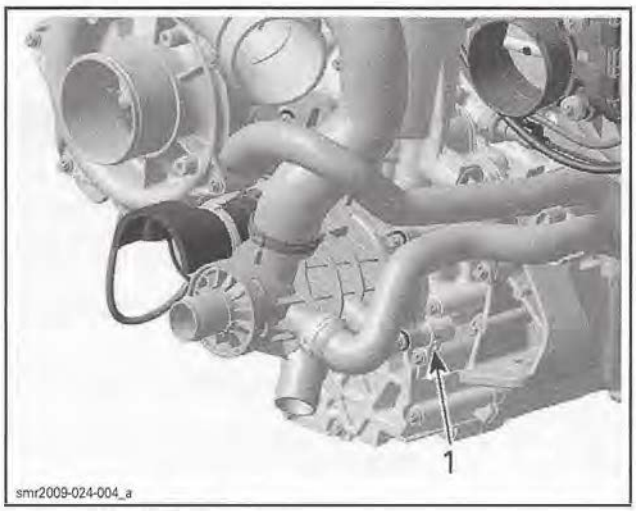
REQUIRED TOOLS	
TEST CAP (P/N 529 035 991)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

TYPICAL
1. Vacuum/pressure pump

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

On WAKE models, check the heating unit and its hoses.

Check the leak indicator hole if there is oil or coolant. If so, replace appropriate water pump shaft seal.



1. Leak indicator hole

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

ENGINE OVERHEATING

1. Low coolant level.
   - *Refill and check for leaks (coolant leaking out of engine leak indicator hole, hoses or clamps missing/defective, cylinder head gaskets leaks, ride plate or heat exchanger leaking, etc.). Repair or replace.*
2. Air in cooling system.
   - *Refill and bleed cooling system.*
3. Thermostat defective (does not open when engine gets hot).
   - *Replace thermostat housing.*
4. Water pump failure.
   - *Inspect and replace defective components.*
5. Water temperature sensor defective.
   - *Check or replace. Refer to ELECTRONIC FUEL INJECTION (EFI).*
6. Ride plate or heat exchanger or hoses damaged.
   - *Check or replace damaged components.*
7. Exhaust system clogged.
   - *Flush exhaust system.*
8. Internal passage blocked in cooling system.
   - *Inspect and clean.*

PROCEDURES

PRESSURE CAP

Pressure Cap Inspection

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

CLAMPS

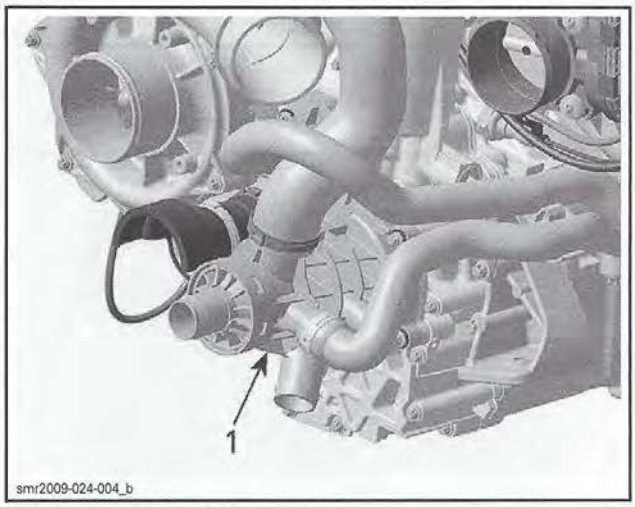
Clamp Replacement

To cut or secure Oetiker clamps of cooling system hoses, use special pliers.

REQUIRED TOOL	
OETIKER PLIERS (P/N 295 000 070)	

NOTE: Always check general condition of hoses and clamp tightness.

WATER PUMP HOUSING



1. Water pump housing

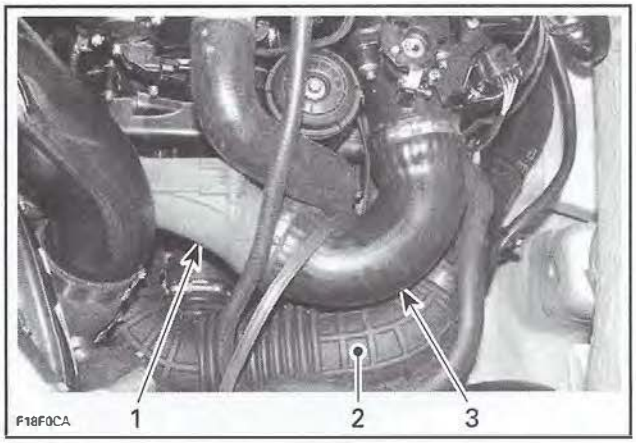
Water Pump Access

210 Series

Remove air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.

All Models with Supercharged Intercooled Engines

Remove supercharger inlet and outlet hoses to make room.



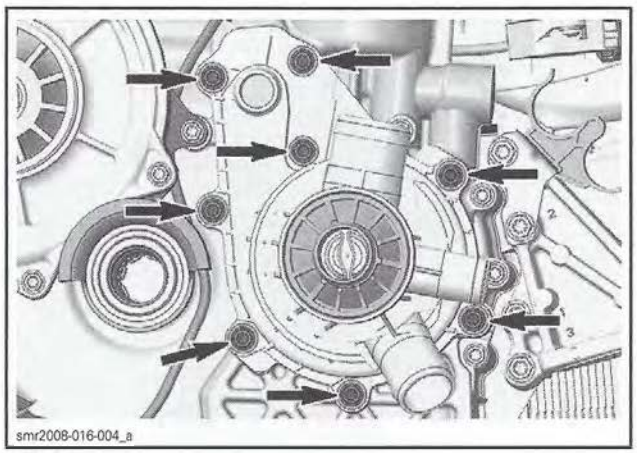
TYPICAL
1. Supercharger
2. Inlet hose
3. Outlet hose

Water Pump Housing Removal

Drain cooling system.

Disconnect all coolant hoses from water pump housing.

Remove water pump housing retaining screws.

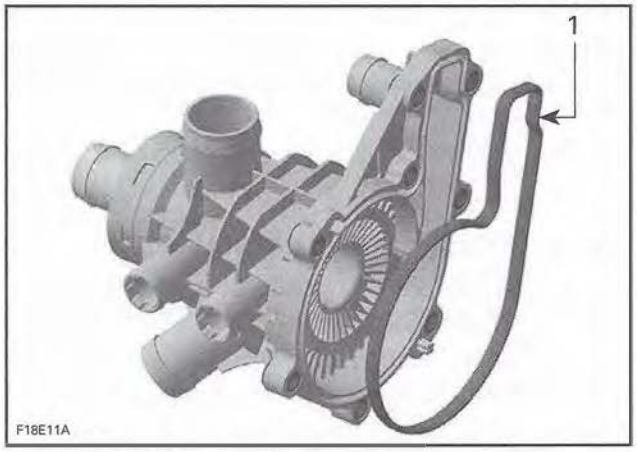


TYPICAL

Pull the water pump housing to remove it.

Water Pump Housing Inspection

Check if gasket is brittle, hard or damaged and replace as necessary.

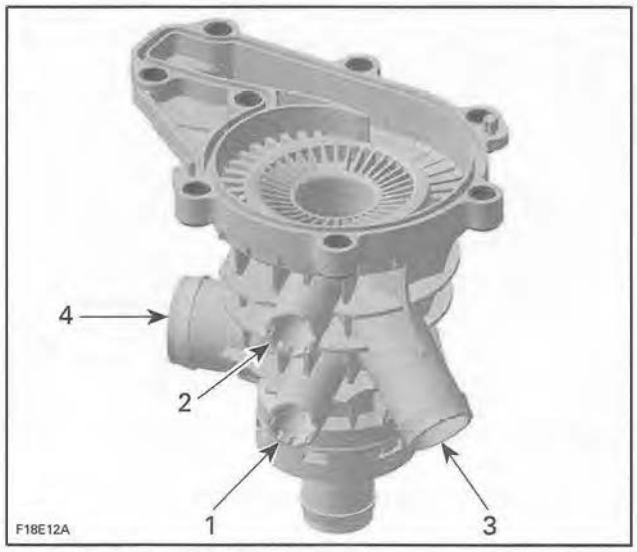


1. Water pump housing gasket

Check if thermostat is in good condition. Refer to *THERMOSTAT* in this subsection.

Water Pump Housing Leak Test

Plug the connections of the oil cooler return hose, coolant tank hose, ride plate or heat exchanger return hose and cylinder head return hose with a rag.



1. *Oil cooler return connection*
2. *Coolant tank hose connection*
3. *Ride plate or heat exchanger return hose connection*
4. *Cylinder head return hose connection*

Fill the water pump housing with water.

If a bigger quantity of coolant leaks out at the ride plate or heat exchanger outlet connection, replace the water pump housing.

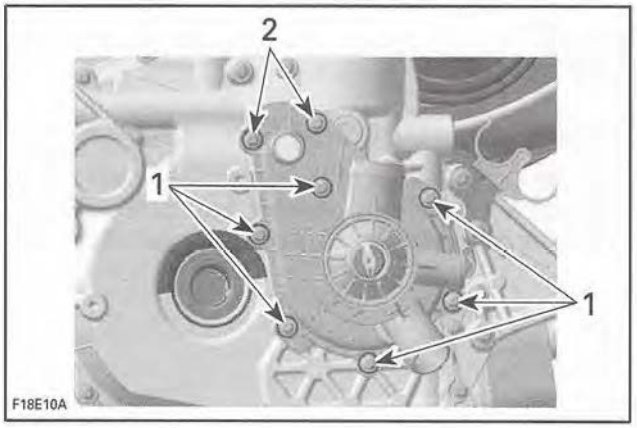
If there is no leak, check the operation of the thermostat.

Water Pump Housing Installation

The installation is the opposite of the removal procedure. However, pay attention to the following.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of water pump housing screws.

Install screws as per the following illustration.

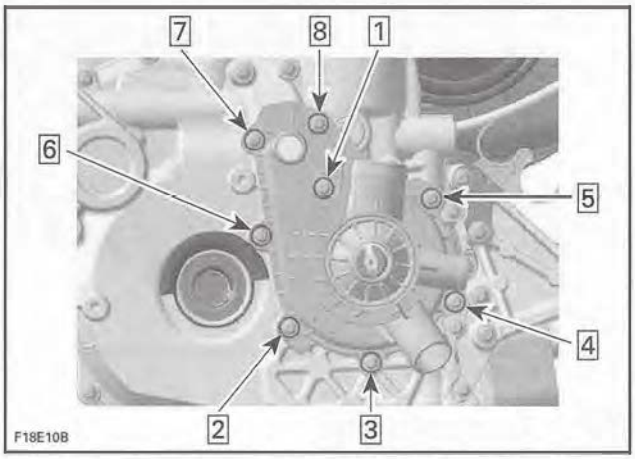


1. *Screws M6 x 25*
2. *Screws M6 x 105*

NOTICE To prevent leaking, take care that the gaskets are exactly in groove when you reinstall the water pump housing.

Tighten screws to specification using the illustrated sequence.

TORQUE	
Water pump housing retaining screws	9 N•m (80 lbf•in)



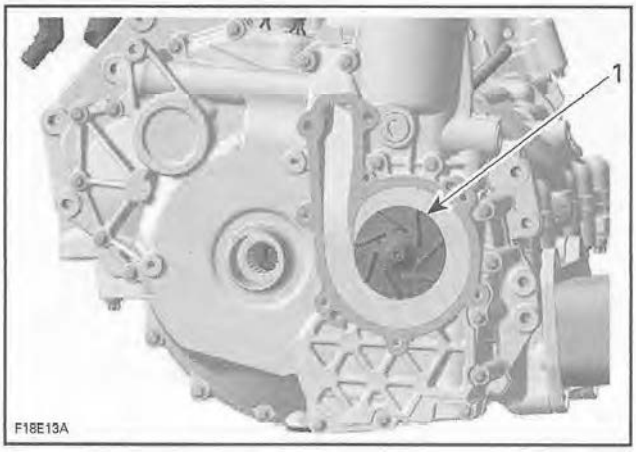
WATER PUMP HOUSING TIGHTENING SEQUENCE

WATER PUMP IMPELLER

Water Pump Impeller Removal

Remove the *WATER PUMP HOUSING*, see procedure in this subsection.

Unscrew the impeller clockwise.



1. *Impeller*

NOTICE Coolant/oil pump shaft and impeller have left-hand threads. Remove by turning clockwise and install by turning counterclockwise.

Water Pump Impeller Inspection

Check impeller for cracks or other damage. Replace impeller if damaged.

Water Pump Impeller Installation

The installation is the opposite of the removal procedure. Pay attention to the following details.

NOTICE Be careful not to damage impeller wings during installation.

Tighten impeller to specification.

TORQUE	
Water pump impeller (left-hand threads)	3 N•m (27 lbf•in)

THERMOSTAT

The thermostat is a single action type.

Thermostat Removal

Remove the *WATER PUMP HOUSING*, see procedure in this subsection.

NOTE: The thermostat is located inside the water pump housing.

Thermostat Test

To check the operation of the thermostat, put it in water and heat water.

Look inside the cylinder head return hose connection to see the movement of the thermostat. Thermostat should open when water temperature reaches 87°C (189°F).

If there is no operation, replace the water pump housing.

Thermostat Installation

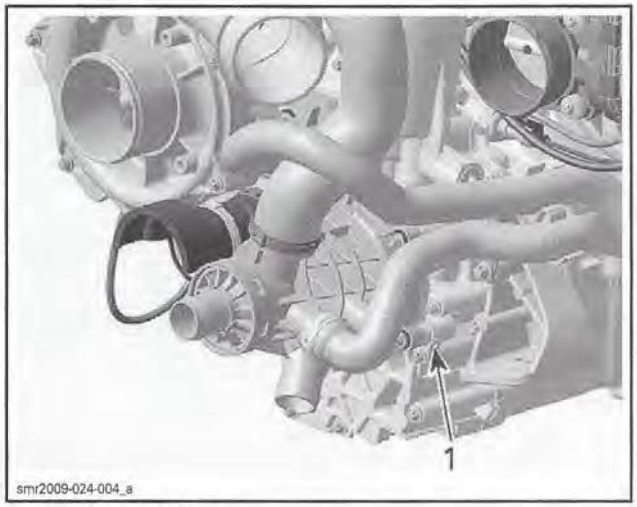
For installation, reverse the removal procedure, paying attention to the following details.

Refer to *WATER PUMP HOUSING* in this subsection.

ROTARY SEAL

Rotary Seal Inspection

Check leak indicator hole for oil or coolant leak.



1. Leak indicator hole

Coolant leaking out of the hole indicates a defective rotary seal. Leaking oil indicates a faulty oil seal.

Rotary seal and oil seal must be replaced together.

Rotary Seal Replacement

Refer to *LUBRICATION SYSTEM* subsection.

HEAT EXCHANGER (200, 210 AND 230 SERIES)

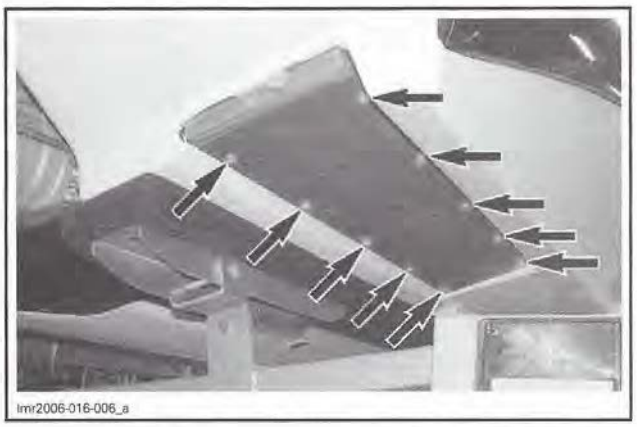
NOTE: On 150 and 180 series, the heat exchanger is integrated in the ride plate. Refer to *HULL* subsection.

Heat Exchanger Removal

Drain cooling system.

Inside hull, disconnect both heat exchanger hoses.

Remove all bolts securing heat exchanger to hull.



Push on heat exchanger fittings to force heat exchanger out of hull recess.

NOTE: When a sufficient gap is obtained, grab heat exchanger from outside hull and pull strongly to remove it.

Clean all residues from hull.

Heat Exchanger Installation

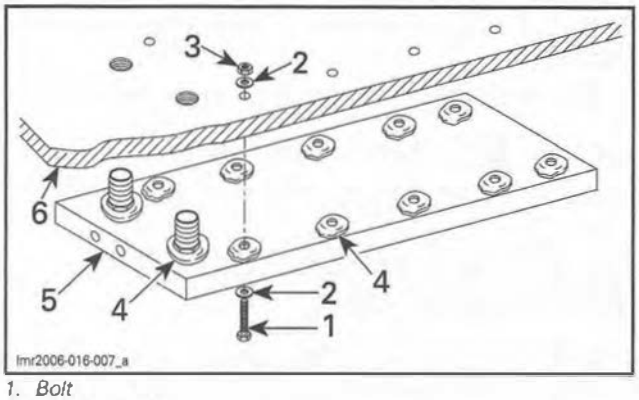
Apply LOCTITE INSTANT GASKET (P/N 219 701 421) around all holes and both hose fittings.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of heat exchanger bolts.

Position heat exchanger.

Install and tighten all bolts.

TORQUE	
Heat exchanger bolts	25 N•m (18 lbf•ft)



1. *Bolt*
2. *Flat washers*
3. *Nut*
4. *Loctite Instant Gasket*
5. *Heat exchanger*
6. *Hull*

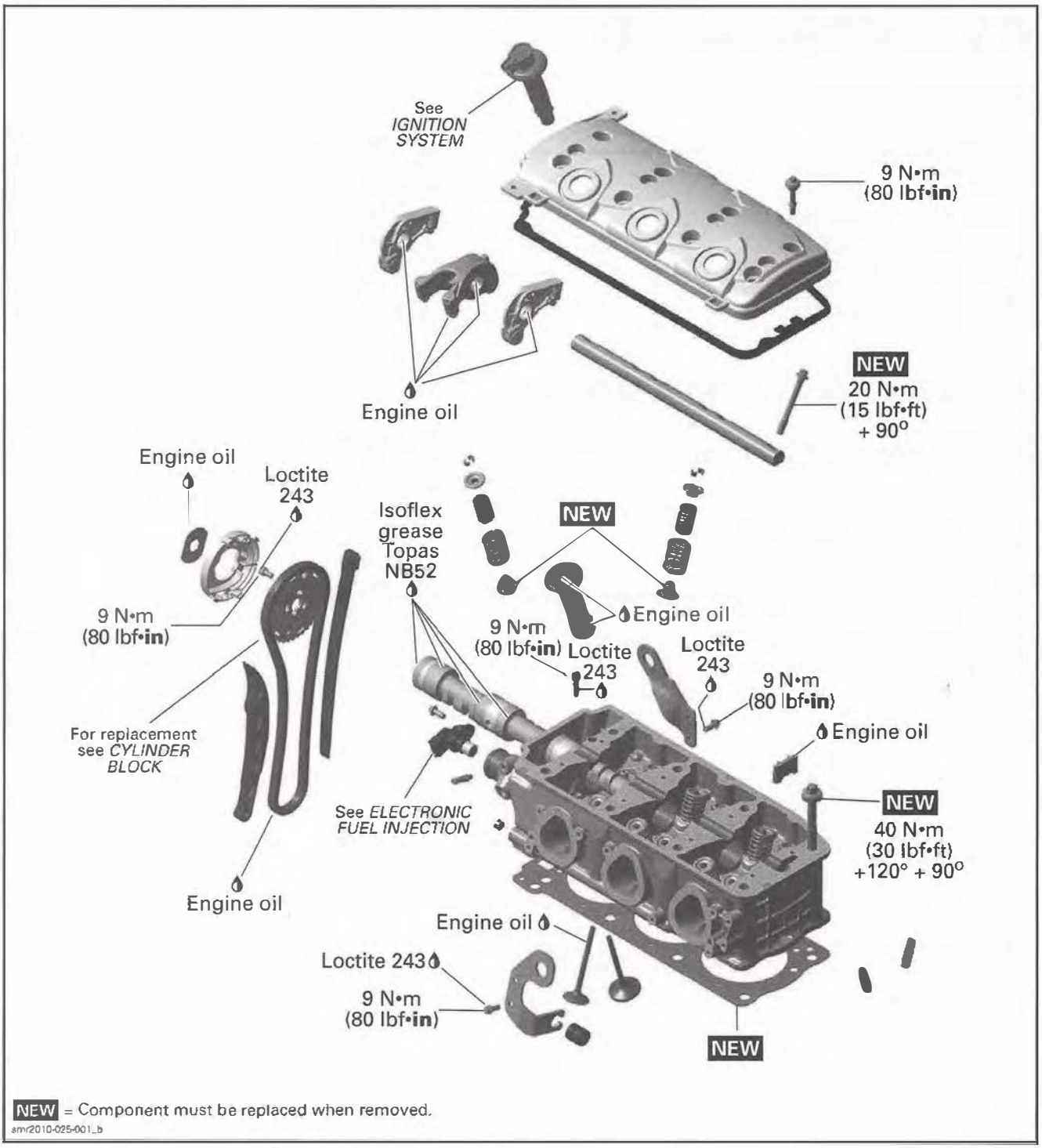
Connect heat exchanger hoses and refill the system. Refer to *REFILLING THE SYSTEM* in this subsection.

CYLINDER HEAD

SERVICE TOOLS

SERVICE TOOLS – OTHER SUPPLIER

SERVICE PRODUCTS



NEW = Component must be replaced when removed.

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GENERAL

NOTE: When diagnosing an engine problem, always perform an engine leak test. This will help pin-point a problem. Refer to *ENGINE LEAK TEST* in this subsection for procedures.

Always turn off the main battery cut-off switch before working on the engine.

All removed parts must be reinstalled in their original positions.

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cable or locking ties removed during the removal must be reinstalled as per factory standards.**

INSPECTION

ENGINE LEAK TEST

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

⚠ WARNING

Beware of burns when working on a hot engine.

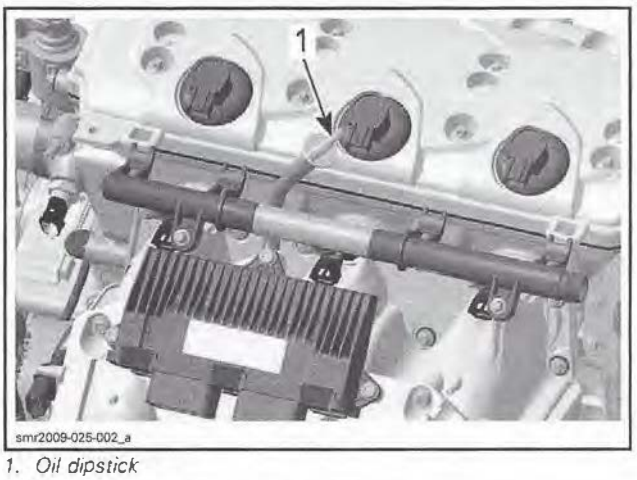
Preparation

1. Remove any required parts to give access to engine.
2. Remove jet pump (refer to *JET PUMP* subsection).
3. Remove coolant pressure cap.

⚠ WARNING

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

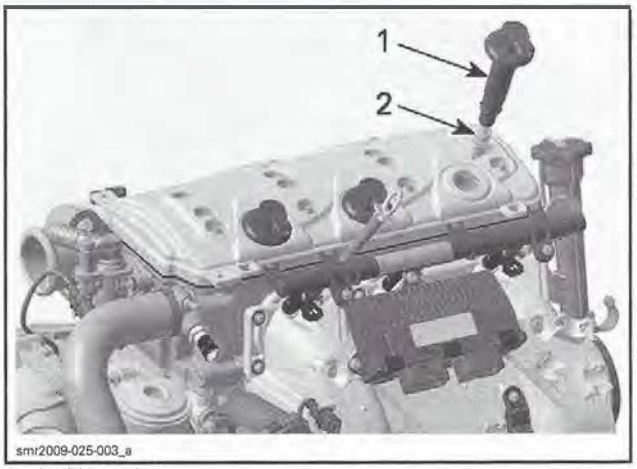
4. Remove oil dipstick.



1. Oil dipstick

5. Unplug and remove ignition coils.
6. Remove spark plugs.

NOTE: Ignition coil may be used as an extractor.



1. Ignition coil
2. Spark plug

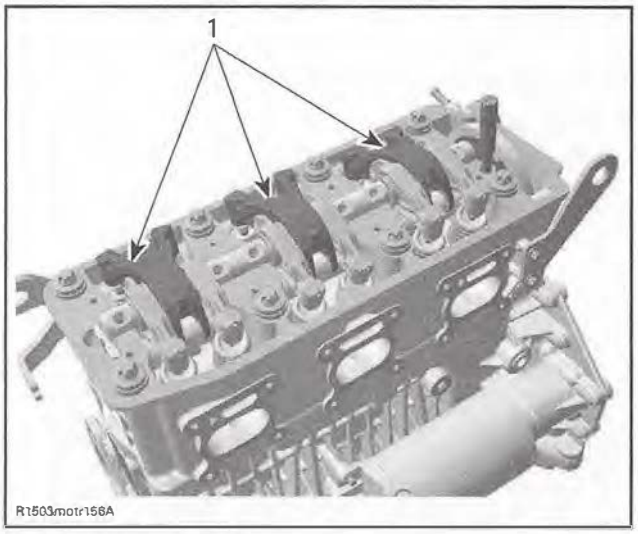
7. Remove *CYLINDER HEAD COVER*, see procedure in this subsection.
8. Install the drive shaft adapter and an appropriate wrench lever on drive shaft end.

REQUIRED TOOL	
DRIVE SHAFT ADAPTER (P/N 529 035 985)	

Leak Test Procedure

NOTE: Cylinder numbers are molded on cylinder head cover.

1. Rotate engine crankshaft counterclockwise until the cylinder 1 is at Top Dead Center (TDC) compression stroke.
   1.1 As the engine crankshaft is turned over, observe the movement of intake rocker arm of the cylinder to be checked.
   1.2 After piston completes its cycle and the intake valve closes, observe the piston.
   1.3 When it reaches its uppermost position **this is TDC compression stroke.**



1. Intake rocker arms

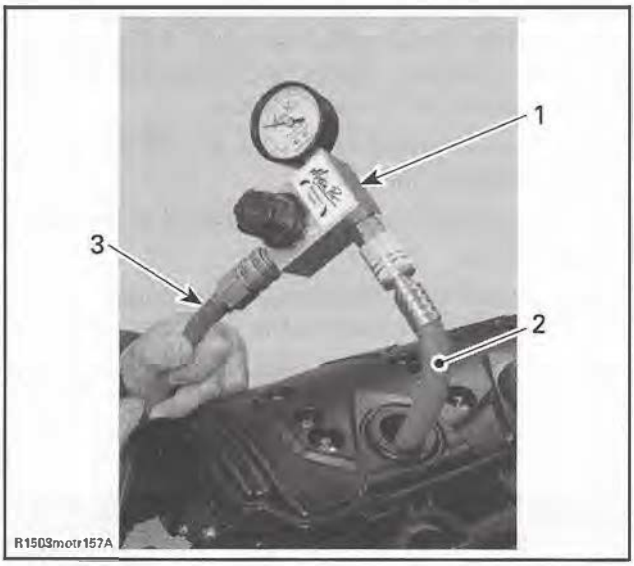
2. Secure the wrench lever, at the end of the drive shaft, against hull to prevent further crankshaft rotation.
3. Install the leak down test tool.

REQUIRED TOOL	
ENGINE LEAK DOWN TEST KIT (P/N 529 035 661)	

   3.1 Install the appropriate gauge adapter into spark plug hole.
   3.2 Connect the leak down tester gauge to the gauge adapter.
   3.3 Connect to an adequate pressurized air supply.
   3.4 Set needle of measuring gauge to zero (0).

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

4. Supply combustion chamber with air.



TYPICAL
1. Leak down tester gauge
2. Gauge adapter
3. Air supply hose

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

LEAKAGE PERCENTAGE	ENGINE CONDITION
Up to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; engine will run and performance might be not be optimal in some cases
41% and higher	Poor condition, diagnose and repair engine

6. Proceed the same way with remaining cylinders.

Diagnostic

Pressurize area to be tested, spray soap/water solution at the indicated location and look and/or listen for air bubbles.

OBSERVATION	CAUSE
Air escaping on intake port	Leaking intake valve(s)
Air escaping on exhaust port	Leaking exhaust valve(s)
Air escaping into crankcase	Excessively worn and/or broken piston rings
Air bubbles out of coolant tank	Leaking cylinder head gasket
Air/water escaping from cylinder-block/head	Damaged gasket and/or loosened screws
Coolant escaping from water pump housing	Damaged gasket and/or loosened screws (refer to *COOLING SYSTEM*)
Coolant escaping from leak indicator hole	Damaged rotary seal on water pump shaft (refer to *COOLING SYSTEM*)
Oily contamination on leak indicator hole	Damaged oil seal on water pump shaft

Reassembly

For reassembly, reverse the preparation procedure. Use torque values and service products from the exploded views (refer to proper *ENGINE* subsections).

Properly install ignition coils. Refer to *IGNITION SYSTEM* subsection.

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of problems. It is a guideline and it should not be assumed to list all possible problems.

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. Incorrect camshaft timing adjustment.
   - *Replace damaged components and readjust camshaft timing.*
2. Camshaft timing gear screws got loose.
   - *Retighten screws with the recommended torque.*
3. Rocker arm(s) hydraulic element is broken or worn out (improper valve adjustment).
   - *Replace faulty rocker arm(s).*
4. Rocker arm screw not properly tightened.
   - *Retighten screws with recommended torquing procedure.*
5. Faulty chain tensioner.
   - *Replace chain tensioner.*
6. Chain guide is worn out.
   - *Replace chain guide.*
7. Stretched timing chain or worn out sprocket.
   - *Replace timing chain and sprocket.*
8. Camshaft is worn out.
   - *Check if camshaft radial clearance is out of specification.*

OIL LEAKAGE FROM CYLINDER HEAD

1. Cylinder head cover gasket is leaking.
   - *Replace cylinder head cover gasket and retighten screws with recommended torque.*
   - *Check cylinder head cover for cracks or other damage. Replace if necessary.*
2. Cylinder head cover screws are leaking.
   - *Replace cylinder head cover screws.*
3. Spark plug tube gasket is leaking.
   - *Remove cylinder head cover and replace spark plug tube gasket.*
   - *Clean spark plug area from oil spillage.*
4. Blow by valve is leaking.
   - *Replace blow by valve O-ring.*
5. Camshaft sensor O-ring is leaking.
   - *Replace camshaft sensor O-ring.*
6. Cylinder head gasket is leaking.
   - *Remove cylinder head and check for damage.*
   - *Replace cylinder head gasket and retighten screws with recommended torquing procedure.*

ENGINE LACKS ACCELERATION OR POWER

1. Incorrect camshaft timing adjustment.
   - *Replace damaged components and readjust camshaft timing.*
2. Intake or exhaust valves are leaking.
   - *Perform ENGINE LEAK TEST.*
   - *Check if valve seats properly in valve seat.*
   - *Repair or replace damaged components.*
3. Broken valve spring(s).
   - *Replace defective parts.*
4. Broken rocker arm(s).
   - *Replace defective parts.*

PROCEDURES

CYLINDER HEAD COVER

Cylinder Head Cover Access

To access engine, refer to *ENGINE ACCESS* in *ENGINE REMOVAL* subsection.

210 Series

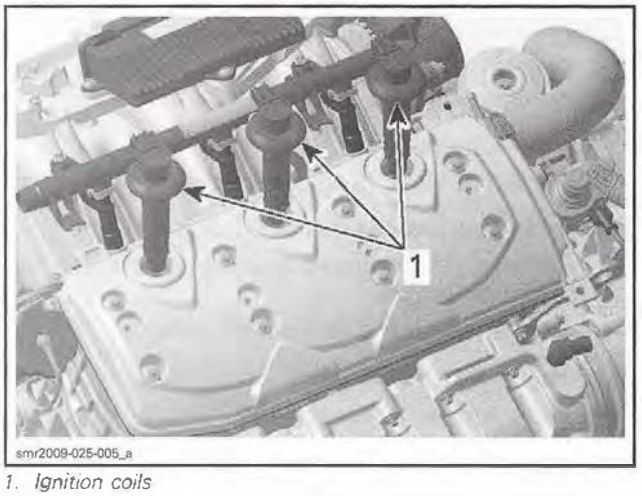
Remove air intake tube, refer to *AIR INTAKE SYSTEM* subsection.

All Models except 210 Series

Remove cylinder head cover cowl.

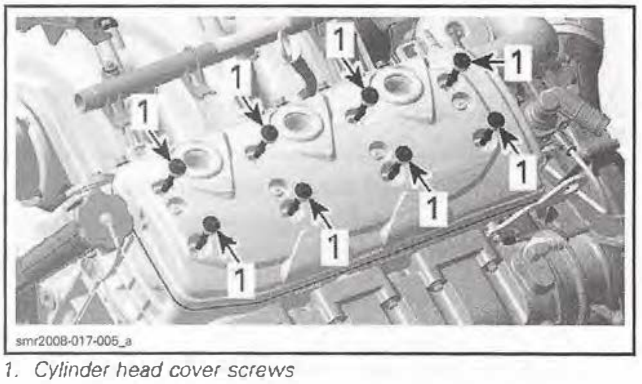
Cylinder Head Cover Removal

1. Unplug and remove ignition coils.



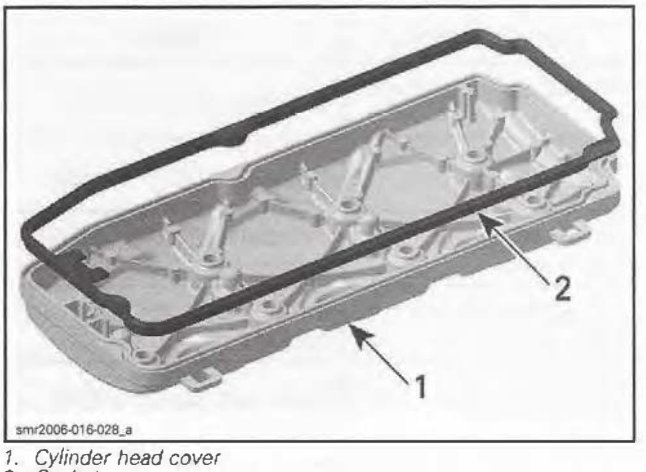
1. Ignition coils

2. Remove screws securing the cylinder head cover.



1. Cylinder head cover screws

3. Remove the cylinder head cover and its gasket.



1. Cylinder head cover
2. Gasket

Cylinder Head Cover Inspection

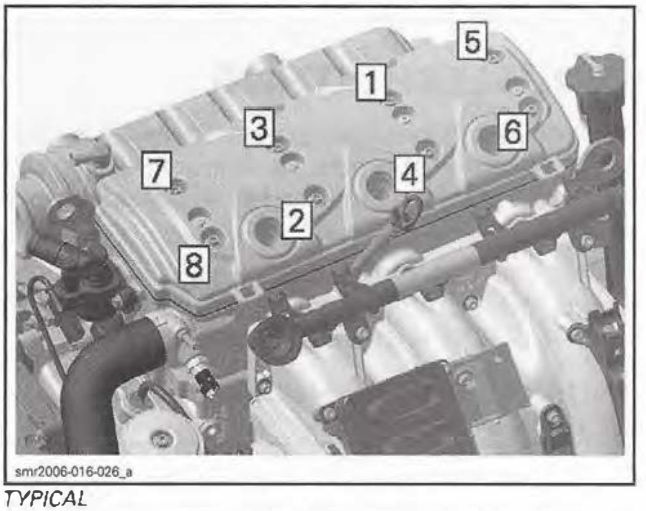
Check if the gasket on the cylinder head cover and the rubber bushing on the cylinder head cover screws are brittle, cracked or hard. If so, replace the gasket or the cylinder head cover screw accordingly.

Cylinder Head Cover Installation

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

Properly seat the gasket in the cover groove.

Install and tighten the cylinder head cover screws according to following sequence.



TYPICAL

TORQUE	
Cylinder head cover screws	9 N•m (80 lbf•in)

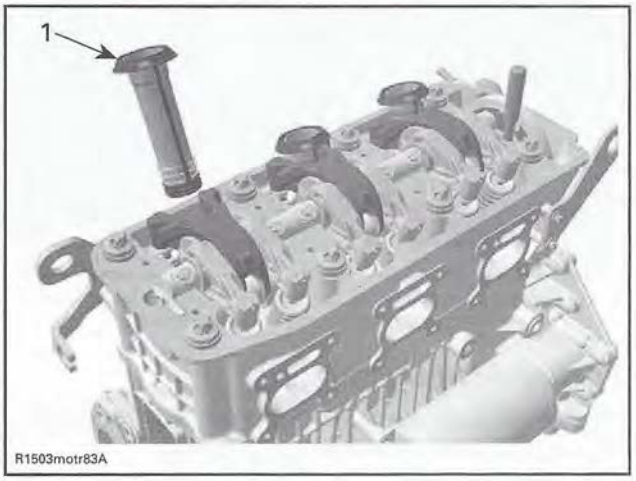
Install all other removed parts. Refer to proper subsection for procedure.

SPARK PLUG TUBES

Spark Plug Tube Removal

Remove the *CYLINDER HEAD COVER*, see procedure in this subsection.

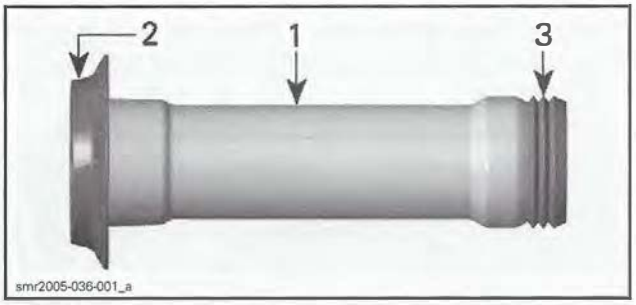
Pull spark plug tubes to remove them.



1. Spark plug tube

Spark Plug Tube Inspection

Check seals on spark plug tube. If seals are brittle, cracked or hard, replace spark plug tube.



TYPICAL
1. Spark plug tube
2. Seal to the cylinder head cover
3. Seal to the cylinder head

Spark Plug Tube Installation

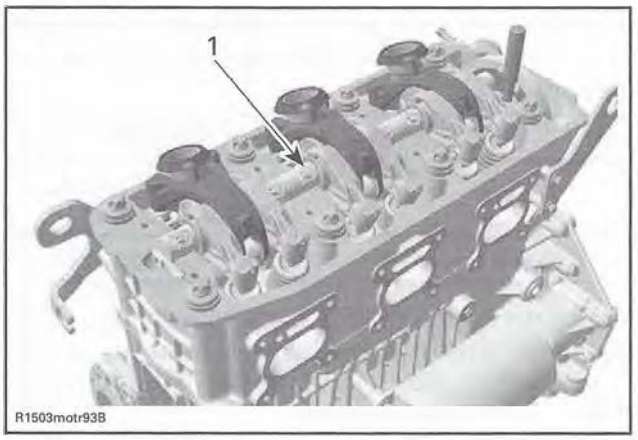
For installation, reverse the removal procedure. Pay attention to the following detail.

Apply engine oil on seals.

ROCKER ARMS

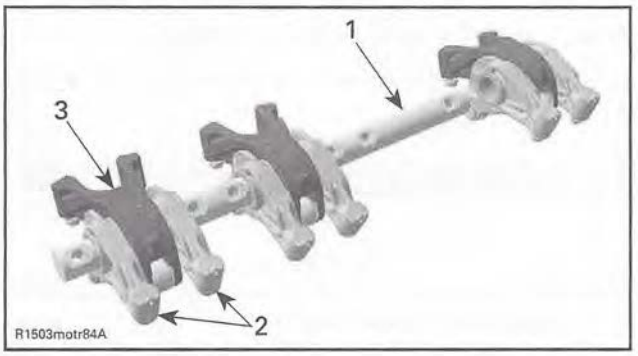
Rocker Arm Removal

1. Remove the *CYLINDER HEAD COVER*, see procedure in this subsection.
2. Remove spark plug tubes.
3. Remove and discard rocker arm shaft screws.



1. Rocker arm shaft screw

4. Remove rocker arm shaft with rocker arms.

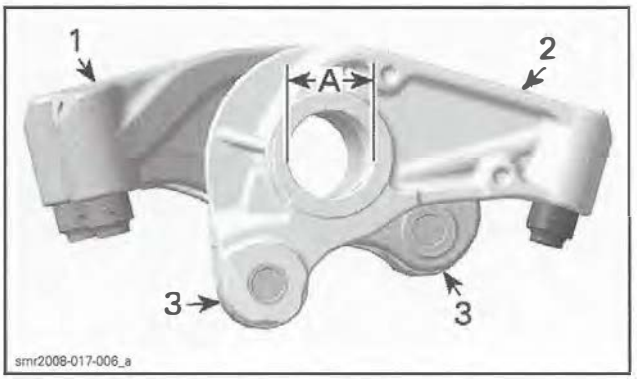


1. Rocker arm shaft
2. Rocker arms (exhaust side)
3. Rocker arm (intake side)

Rocker Arm Inspection

Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly.

Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly as necessary.



1. Rocker arm (intake side)
2. Rocker arm (exhaust side)
3. Rollers
A. Rocker arm inside diameter

Measure rocker arm inside diameter. If diameter is out of specification, change the rocker arm assembly.

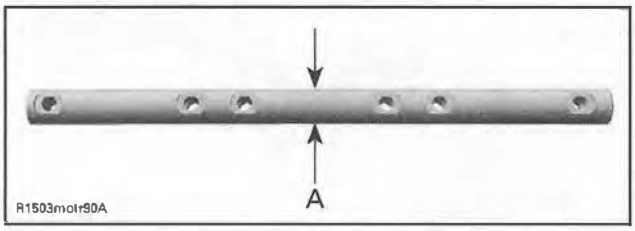
ROCKER ARM INSIDE DIAMETER	
NEW	20.007 mm - 20.020 mm (.7877 in - .7882 in)
SERVICE LIMIT	20.050 mm (.7894 in)

Press the hydraulic lifter with your thumb. If the hydraulic lifter can be fully pressed in, replace rocker arm. Lifter must turn freely in rocker arm bore. Otherwise, replace.

Rocker Arm Shaft

Check for scored friction surfaces, if so, replace parts.

Measure rocker arm shaft diameter.

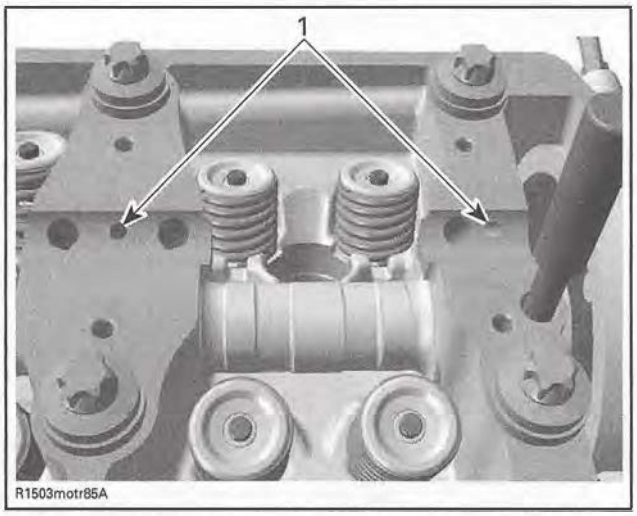


A. Measure rocker arm shaft diameter here

ROCKER ARM SHAFT DIAMETER	
NEW	19.980 mm - 19.993 mm (.7866 in - .7871 in)
SERVICE LIMIT	19.970 mm (.7862 in)

Any area worn excessively will require parts replacement.

Verify and clean oil orifices to ensure a good rocker arm shaft lubrication.



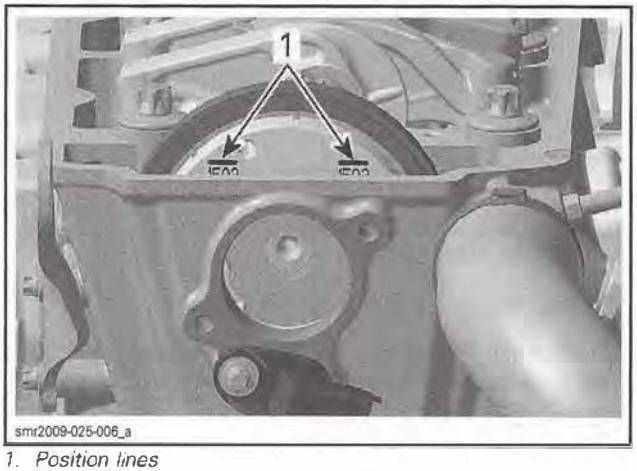
1. Oil orifices from the camshaft to the rocker arm shaft, then to the rocker arms and finally to the valve adjustment

Rocker Arm Installation

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

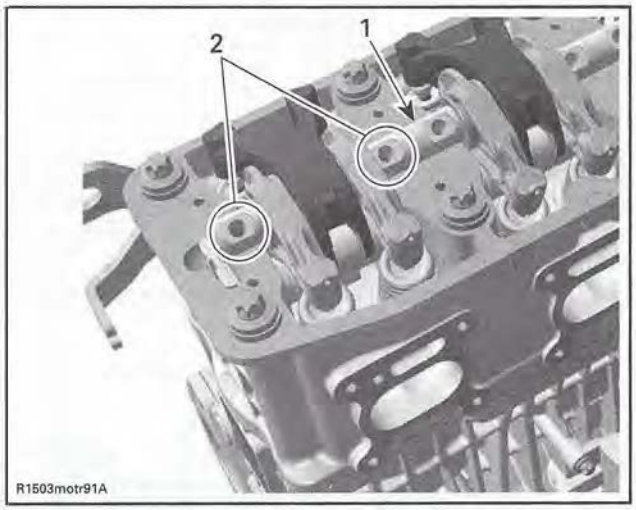
NOTE: The rocker arm shaft can only be installed in one specific position. Therefore the camshaft has to be positioned with its locking pin when the piston of cylinder 3 is on ignition TDC.

1. Lock camshaft. Refer to *CAMSHAFT* in this subsection.
2. Make sure the position lines on oil separator cover are lined up as shown in the following illustration.



1. Position lines

3. Apply engine oil on rocker arm shaft.
4. Position the rocker arm shaft with the notches on top.



1. *Rocker arm shaft*
2. *Rocker arm shaft notches*

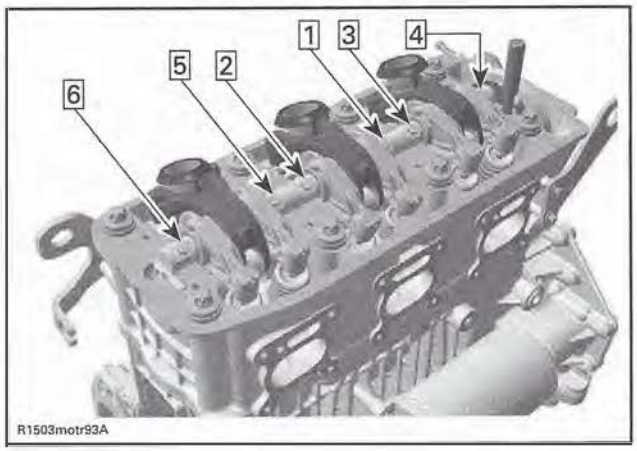
5. Install **NEW** rocker arm shaft screws.

NOTICE This assembly uses stretch screws. As the screws have been stretched from the previous installation, it is very important to use new screws at assembly. Failure to replace screws and to strictly follow the torque procedure may cause screws to loosen and lead to engine damage.

6. Tighten rocker arm shaft screws according to the following sequence.

NOTE: Always perform a step on **ALL** rocker arm shaft screws before going to the next step.

TORQUE		
Rocker arm shaft screws	Step 1	10 N•m (89 lbf•**in**)
	Step 2	20 N•m (15 lbf•ft)
	Step 3	Apply an additional 90° rotation



TIGHTENING SEQUENCE

CAMSHAFT TIMING GEAR

NOTE: Although it is not necessary to position crankshaft to TDC for disassembly, it is a good practice to do it, as a troubleshooting step, to know before disassembly if valve timing was appropriate.

Camshaft Timing Gear Removal

Lock crankshaft, refer to *CYLINDER BLOCK* subsection.

Remove *CYLINDER HEAD COVER*, see procedure above in this subsection.

Lock camshaft. Refer to *CAMSHAFT* in this subsection.

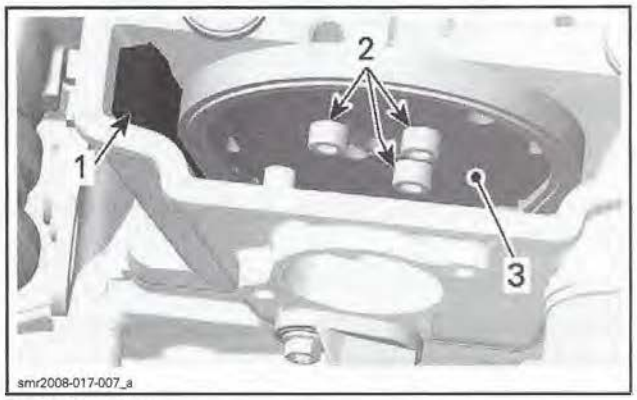
Remove the oil separator cover. Refer to *LUBRICATION SYSTEM* subsection.

Remove the chain tensioner. Refer to *CYLINDER BLOCK* subsection.

Remove the chain guide.

Remove camshaft timing gear screws.

Remove the camshaft timing gear.



1. *Chain guide*
2. *Camshaft timing gear screws*
3. *Camshaft timing gear*

NOTE: Secure timing chain with a retaining wire.

Camshaft Timing Gear Inspection

Check camshaft timing gear for wear or deterioration.

If gear is worn or damaged, replace it as a set (camshaft timing gear and timing chain).

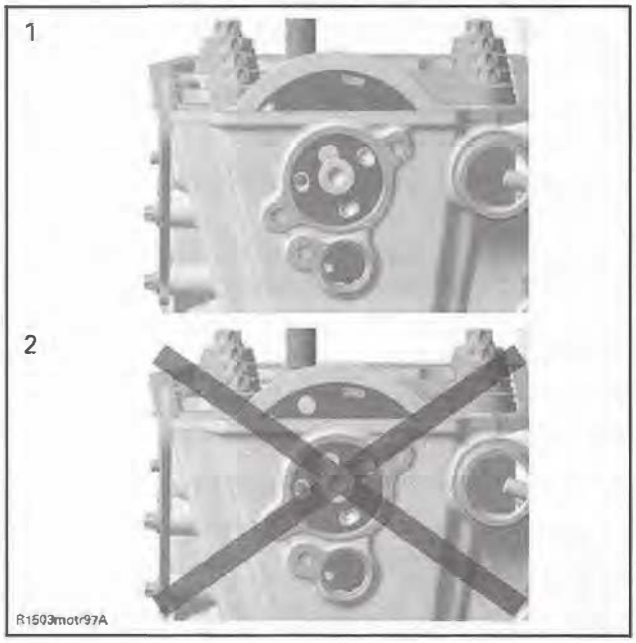
NOTE: For crankshaft timing gear replacement, refer to *CYLINDER BLOCK* subsection.

Camshaft Timing Gear Installation

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

NOTICE **Improper camshaft timing will damage engine components. Make sure camshaft and crankshaft are still locked. If not, lock them before beginning this procedure.**

Install the camshaft timing gear with the writing visible, i.e. to be able to see the position lines when looking from outside of engine.



1. Good (with 1503 aligned)
2. Never

Install timing chain. Refer to *CYLINDER BLOCK* subsection.

Ensure chain guides are properly installed.

Loosely install camshaft timing gear screws.

Install chain tensioner.

NOTE: There can be 2 different positions to install the timing gear on the camshaft. Basically both positions are working well, since the camshaft and crankshaft are locked in their proper position. Due to some tolerances, there could be one position which fits better than the other one. To check this, perform the following test.

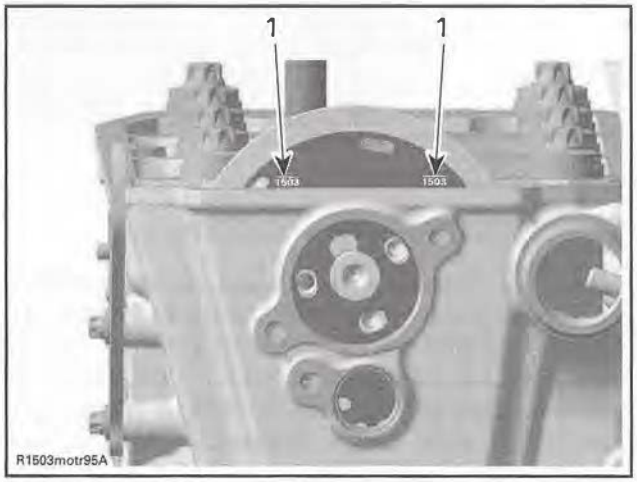
Check if camshaft timing gear screws are still loose. If screws are squeezed by the timing gear, remove the chain tensioner again and rotate timing gear by one tooth clockwise. Then install the chain tensioner again.

One at a time, remove camshaft timing gear screws and apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads.

Tighten camshaft timing gear screws to specification.

TORQUE	
Camshaft timing gear screws	9 N•m (80 lbf•in)

NOTICE **Crankshaft and camshaft must be locked on TDC position to place camshaft timing gear and timing chain in the proper position. To double check, take a look at the timing gear lines. They must be parallel to the cylinder head surface.**



1. Position lines

NOTICE **Ensure to remove crankshaft and camshaft locking tools when finished.**

Install all other removed parts.

CAMSHAFT

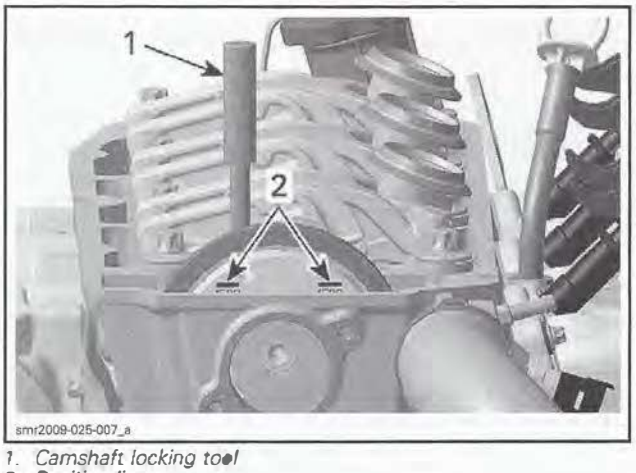
Camshaft Locking Procedure

1. Remove *CYLINDER HEAD COVER*, see procedure in this subsection.
2. Lock crankshaft, refer to procedure in *CYLINDER BLOCK* subsection.
3. Lock camshaft.

REQUIRED TOOL	
CAMSHAFT LOCKING TOOL (P/N 529 035 839)	———

3.1 Insert the camshaft locking tool into the hole behind the camshaft timing gear.

3.2 Make sure the position lines on oil separator cover are lined up as shown in the following illustration.



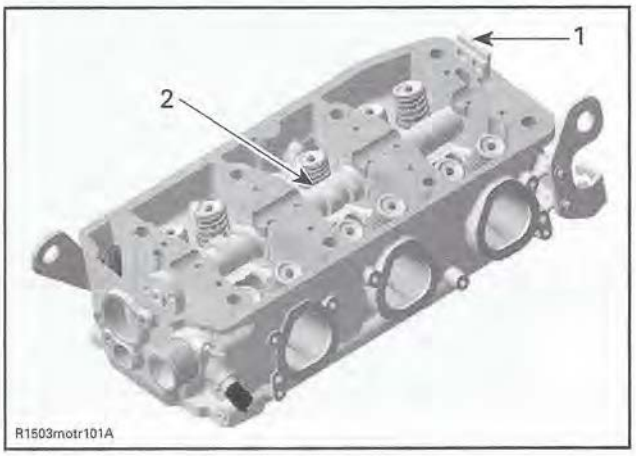
1. Camshaft locking tool
2. Position lines

Camshaft Removal

Remove the *CAMSHAFT TIMING GEAR*, see procedure in this subsection.

Remove the *ROCKER ARM*, see procedure in this subsection.

Remove the camshaft lock to remove the camshaft.



1. Camshaft lock
2. Camshaft

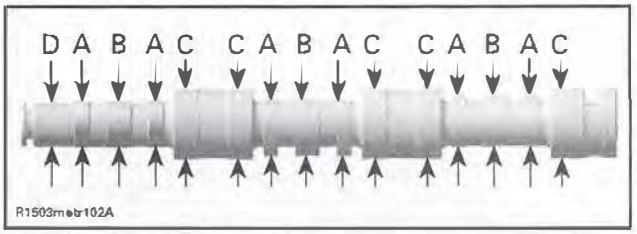
Camshaft Inspection

Check each lobe and bearing journal of camshaft for:

- Scoring
- Scuffing
- Cracks
- Other signs of wear.

Measure camshaft bearing journal and lobe height using a micrometer.

Measure clearance between both ends of camshaft and cylinder head.



A. Camshaft lobe (exhaust valves)
B. Camshaft lobe (intake valves)
C. Camshaft bearing journal
D. Camshaft bearing journal (engine front)

CAMSHAFT LOBE HEIGHT — EXHAUST VALVE	
NEW	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)
SERVICE LIMIT	31.380 mm (1.2354 in)
CAMSHAFT LOBE HEIGHT — INTAKE VALVE	
NEW	31.540 mm - 31.740 mm (1.2417 in - 1.2496 in)
SERVICE LIMIT	31.50 mm (1.2402 in)
CAMSHAFT BEARING JOURNAL	
NEW	39.892 mm - 39.905 mm (1.5706 in - 1.5711 in)
SERVICE LIMIT	39.880 mm (1.5701 in)
CAMSHAFT BEARING JOURNAL (ENGINE FRONT)	
NEW	24.939 mm - 24.960 mm (.9819 in - .9827 in)
SERVICE LIMIT	24.910 mm (.9807 in)
CAMSHAFT BEARING INNER DIAMETER	
NEW	40.000 mm - 40.020 mm (1.5748 in - 1.5756 in)
SERVICE LIMIT	40.050 mm (1.5768 in)
CAMSHAFT BEARING INNER DIAMETER (ENGINE FRONT)	
NEW	25.000 mm - 25.013 mm (.9843 in - .9848 in)
SERVICE LIMIT	25.050 mm (.9862 in)

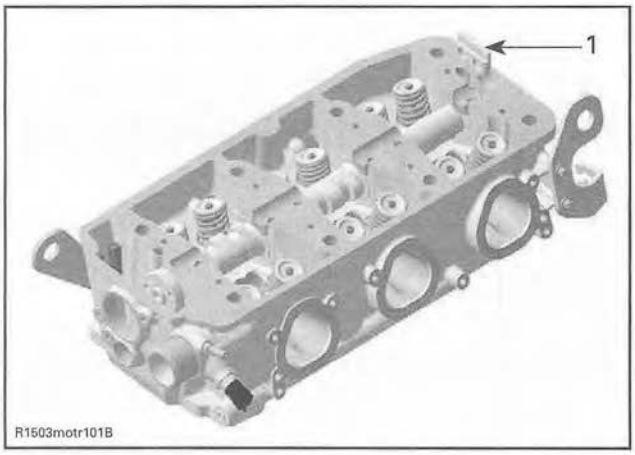
Replace parts that are not within specifications.

Camshaft Installation

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

Grease the camshaft bearing journals well by using the ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021) or a similar product.

Install camshaft then place the camshaft lock in its slot.



1. Camshaft lock

For other parts, refer to the proper installation procedures in this subsection.

CYLINDER HEAD

Cylinder Head Removal

Lock crankshaft, refer to *CYLINDER BLOCK* subsection.

Drain coolant, refer to *COOLING SYSTEM* subsection.

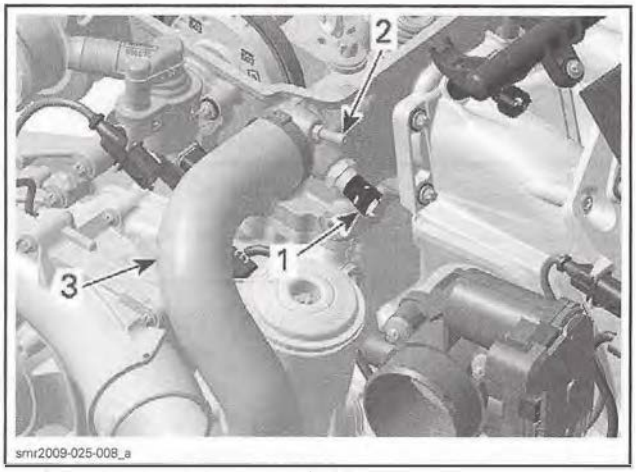
Remove blow-by valve from cylinder head. Refer to *LUBRICATION SYSTEM* subsection.

Unplug the camshaft position sensors (CAPS).

Unplug the coolant temperature sensor (CTS).

Disconnect bleeding hose.

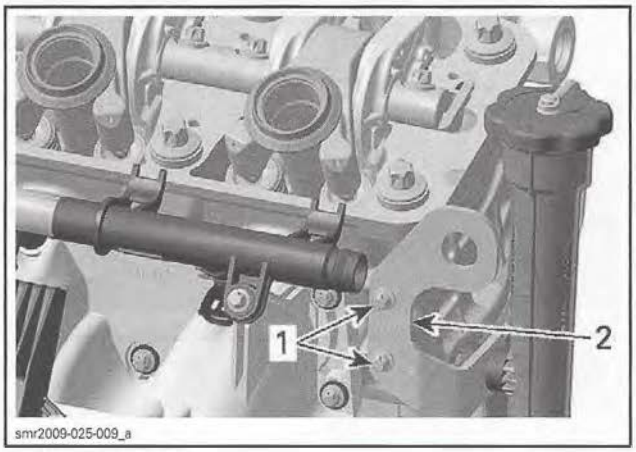
Disconnect the cylinder head outlet hose.



1. Coolant temperature sensor (CTS)
2. Bleeding nipple
3. Cylinder head outlet hose

Remove the exhaust manifold. Refer to *EXHAUST SYSTEM* subsection.

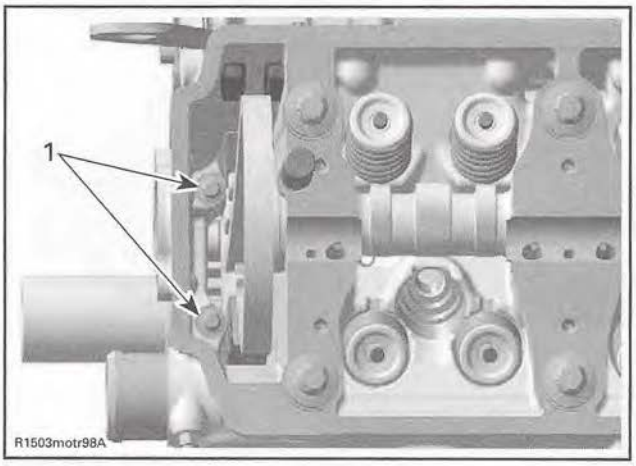
Unscrew the oil filler tube support from cylinder head.



1. Retaining screws
2. Oil filler tube support

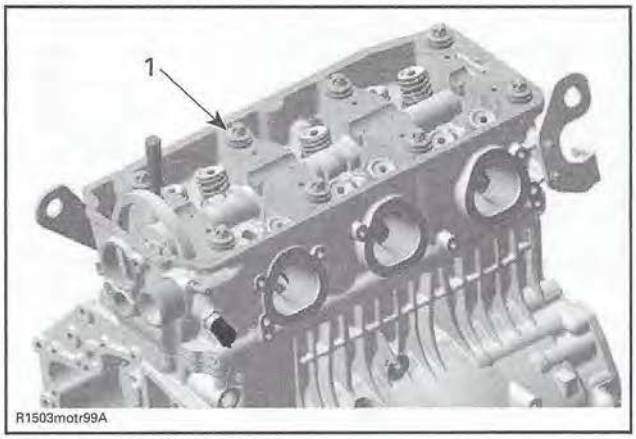
Remove the *CAMSHAFT TIMING GEAR*, see procedure in this subsection.

Remove the M6 cylinder head screws.



1. M6 cylinder head screws

Remove and discard the M11 cylinder head screws securing cylinder head to cylinder block.



1. M11 cylinder head screws

Pull up cylinder head.

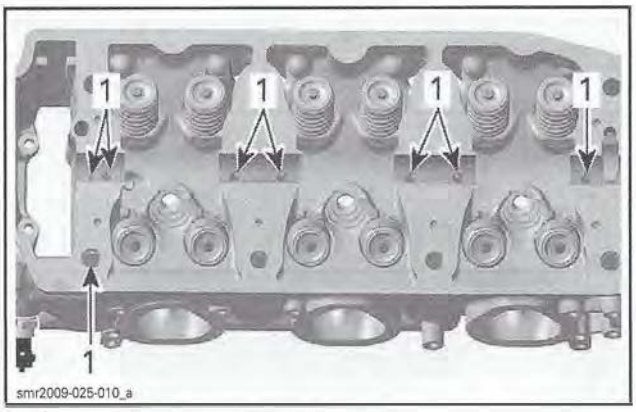
Remove and discard gasket.

Cylinder Head Cleaning

Remove carbon deposits from combustion chamber, exhaust port and piston top.

Clean cylinder head, especially cylinder head screw surface from oil spillage.

Blow out the oil orifices and check if they are not clogged.

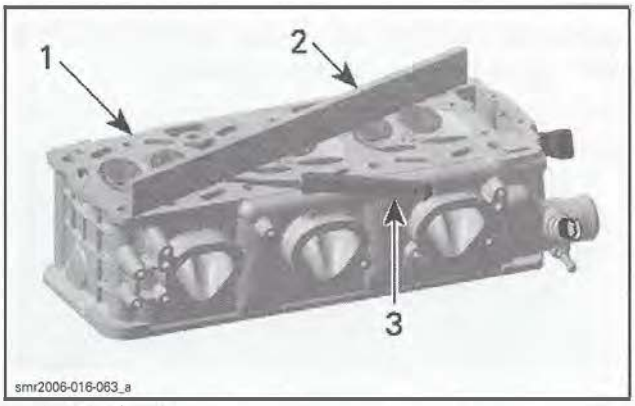


1. Oil orifices

Cylinder Head Inspection

Check for cracks between valve seats or other damages, if so, replace cylinder head.

Check cylinder head mating surface for flatness, using a straight edge.



1. Cylinder head
2. Flat bar
3. Feeler gauge

Check cylinder head warpage.

CYLINDER HEAD WARPAGE	
Maximum	0.15 mm (.006 in)

If warpage exceeds specification, resurface the cylinder head as follows.

Use a 400 - 600 grit wet sandpaper on a surface plate and gently grind off the mating surface.

NOTE: To ensure an even surface, rotate cylinder head several times during resurfacing.

Replace cylinder head, if resurfacing fails.

Cylinder Head Installation

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

Ensure dowel pins are in place.

Install NEW cylinder head gasket.

NOTICE Each installation of the cylinder head requires a new cylinder head gasket. Using a gasket twice will cause engine damage, even if the engine had not run.

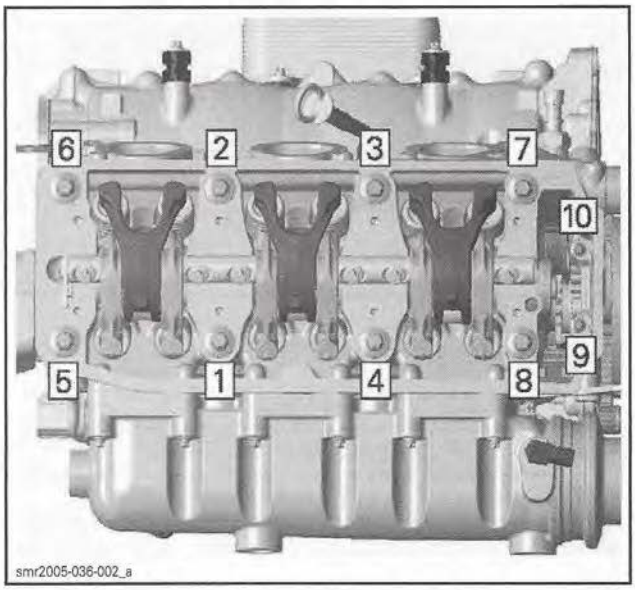
Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of M6 cylinder head screws.

Install M6 screws and manually tighten them.

Install NEW M11 cylinder head screws and tighten them manually.

NOTICE This assembly uses stretch screws. As the M11 cylinder head screws have been stretched from the previous installation, it is very important to replace the old screws by new ones at assembly. Failure to replace screws and to strictly follow the torque procedure may cause screws to loosen and lead to engine damage.

Using the following sequence, tighten M11 cylinder head screws as described below.



NOTE: Always perform a step on ALL M11 cylinder head screws before going to the next step.

TORQUE		
M11 cylinder head screws	Step 1	40 N•m (30 lbf•ft)
	Step 2	Apply an additional 120° rotation
	Step 3	Apply an additional 90° rotation

Tighten M6 cylinder head screws to specification.

TORQUE	
M6 cylinder head screws	9 N•m (80 lbf•**in**)

Remove crankshaft and camshaft locking tools.

Install all removed parts.

VALVE SPRINGS

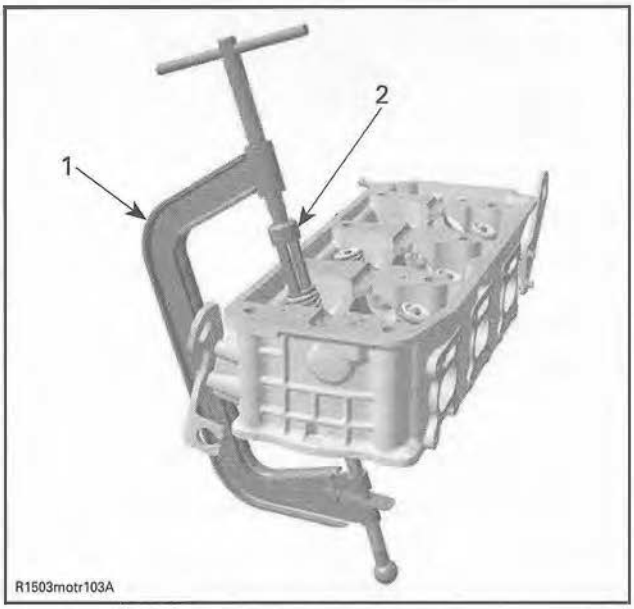
Valve Spring Removal

Remove rocker arm shaft. Refer to *ROCKER ARM* procedure in this subsection.

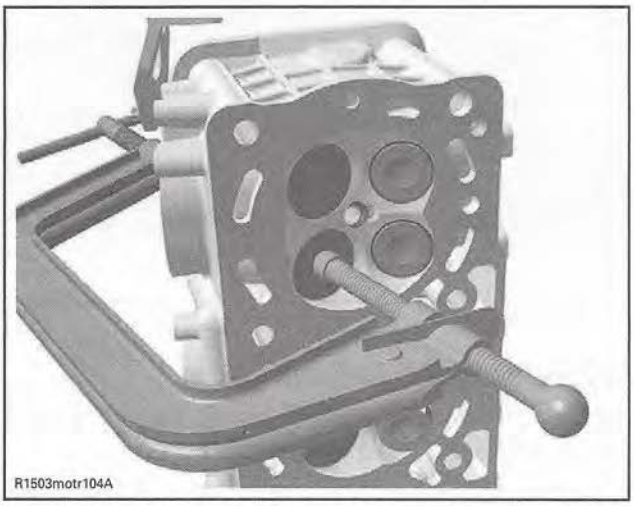
Remove *CYLINDER HEAD*, see procedure in this subsection.

Compress valve springs.

REQUIRED TOOL	
VALVE SPRING COMPRESSOR (P/N 529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N 529 036 073)	



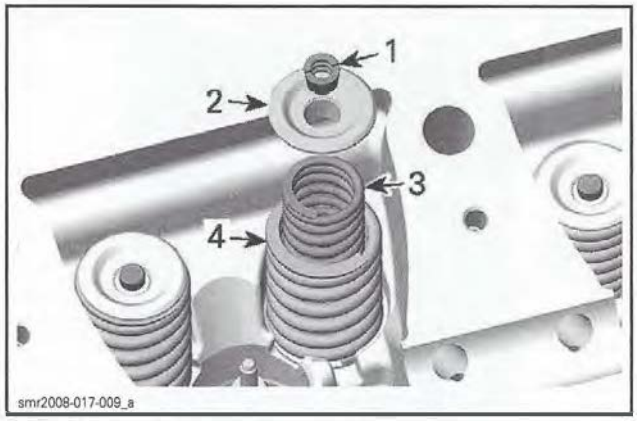
1. *Valve spring compressor clamp*
2. *Valve spring compressor cup*



LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve cotters.

Withdraw valve spring compressor, valve spring retainer and valve springs.



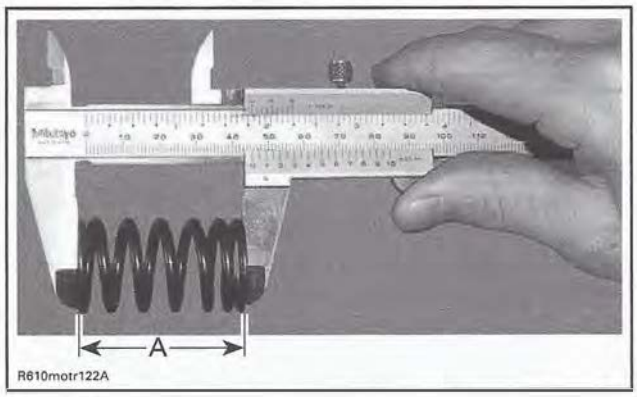
1. *Valve cotters*
2. *Valve spring retainer*
3. *Inner valve spring*
4. *Outer valve spring*

Valve Spring Inspection

Check valve springs for rust, corrosion or other visible damages. If so, replace faulty valve springs.

Check valve springs for free length and straightness.

Replace valve springs if not within specifications.



A. Valve spring length

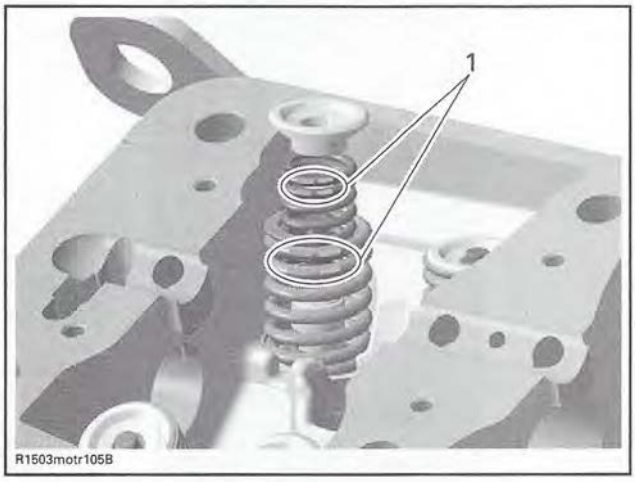
OUTER VALVE SPRING FREE LENGTH	
NEW NOMINAL	45.45 mm (1.789 in)
SERVICE LIMIT	43.00 mm (1.693 in)
INNER VALVE SPRING FREE LENGTH	
NEW NOMINAL	41.02 mm (1.615 in)
SERVICE LIMIT	38.8 mm (1.528 in)

Valve Spring Installation

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

Colored area of the valve spring must be placed on top.

NOTE: Valve cotters must be properly engaged in valve stem grooves.



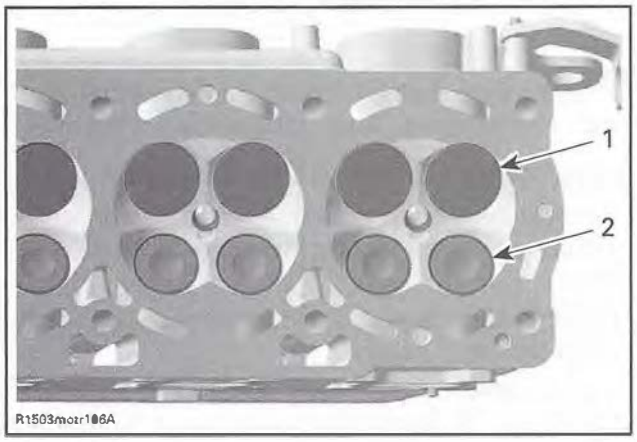
1. *Position of the valve spring*

VALVES

Valve Removal

Remove valve spring.

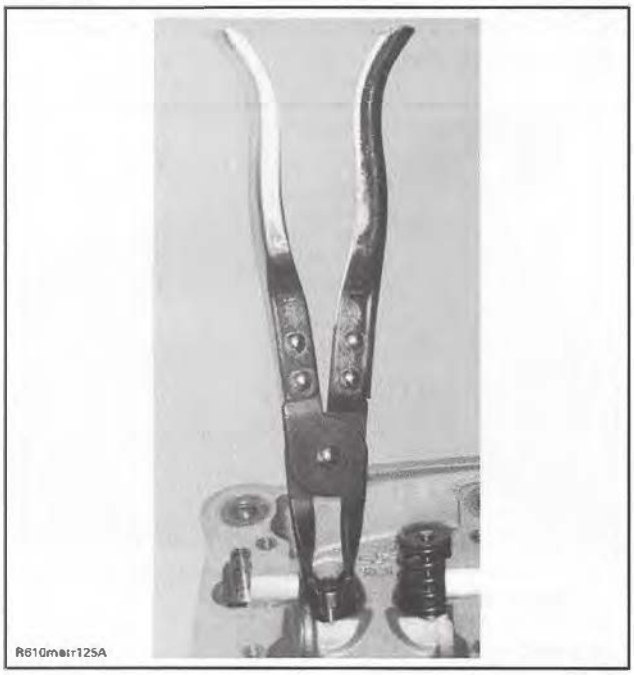
Push valve stem then pull valves out of valve guides.



1. *Intake valve 38 mm*
2. *Exhaust valve 31 mm*

Remove valve stem seal with a valve stem seal pliers.

RECOMMENDED TOOL
SNAP-ON VALVE STEM SEAL PLIERS (P/N YA8230)



Valve Inspection

Valve Stem Seal

Inspection of valve stem seals is not needed because NEW seals should always be installed whenever cylinder head is removed.

Valve

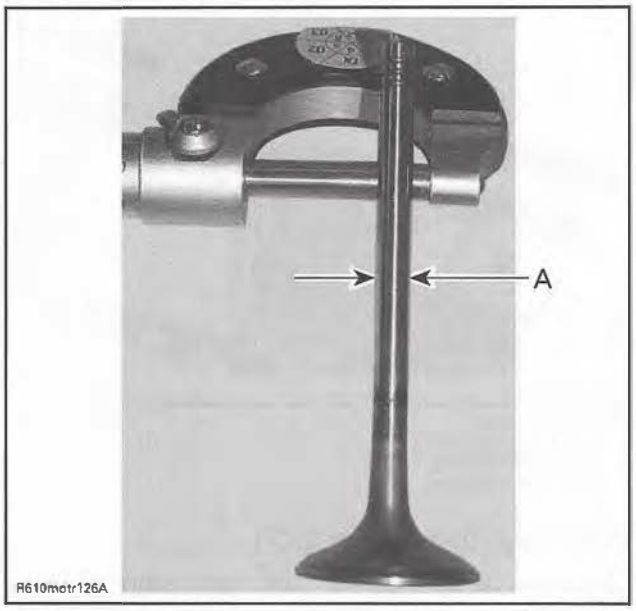
Inspect valve surface, check for abnormal stem wear and bending. If so, replace by a new one.

Valve Stem and Valve Guide Clearance

Measure valve stem and valve guide in three places, using a micrometer and a small bore gauge.

NOTE: Clean valve guide to remove carbon deposits before measuring.

Change valve if valve stem is out of specification or has other damages such as wear or friction surface.



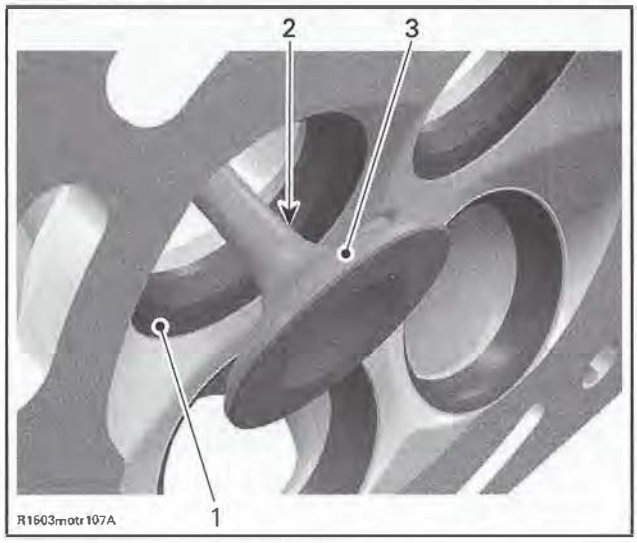
A. Valve stem diameter

VALVE STEM DIAMETER	
NEW	
EXHAUST	5.946 mm - 5.960 mm (.2341 in - .2346 in)
INTAKE	5.961 mm - 5.975 mm (.2347 in - .2352 in)
SERVICE LIMIT	
EXHAUST	5.93 mm (.233 in)
INTAKE	

Replace valve guide if it is out of specification or has other damages such as wear or friction surface. Refer to valve guide replacement below.

VALVE GUIDE INNER DIAMETER	
NEW	
EXHAUST	5.994 mm - 6.018 mm (.236 in - .2369 in)
INTAKE	
SERVICE LIMIT	
EXHAUST	6.060 mm (.2386 in)
INTAKE	

Valve Face and Seat



1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

Check valve face and seat for burning or pittings and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

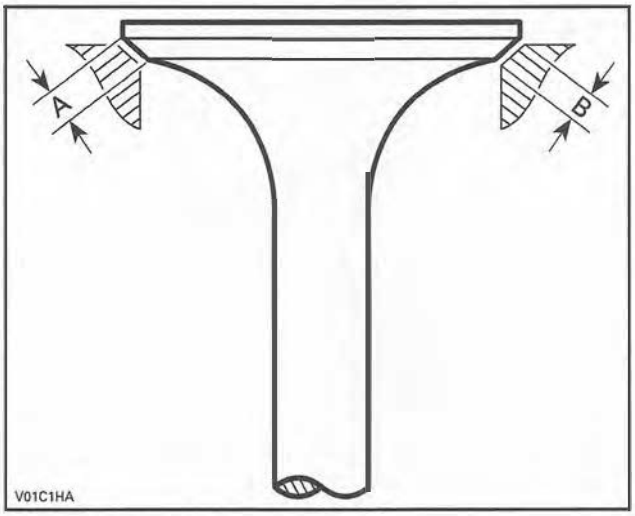
Measure valve face contact width.

NOTE: The location of contact area should be in center of valve seat.

Measure valve seat width, using a caliper.

VALVE SEAT CONTACT WIDTH	
NEW	
EXHAUST	1.25 mm - 1.55 mm (.049 in - .061 in)
INTAKE	1.10 mm - 1.30 mm (.043 in - .051 in)
SERVICE LIMIT	
EXHAUST	1.8 mm (.071 in)
INTAKE	1.6 mm (.063 in)

If valve seat contact width is too wide or has dark spots, replace the cylinder head.

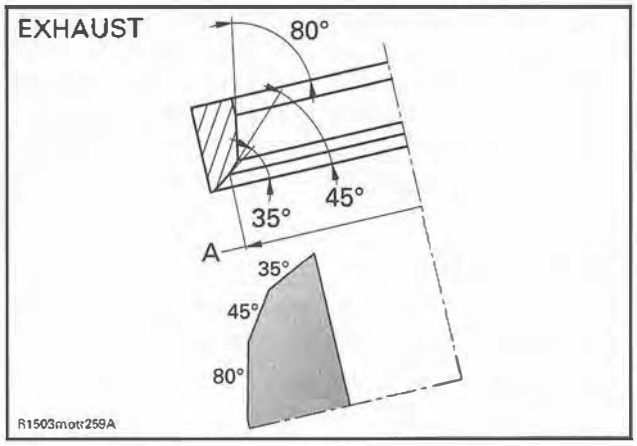


A. Valve face contact width
B. Valve seat contact width

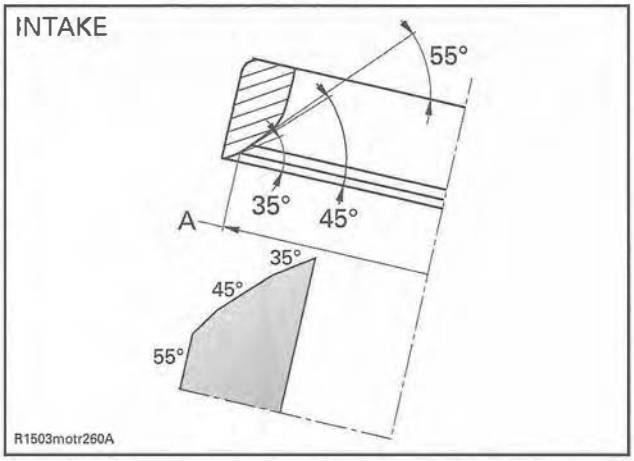
Valve Seat Grinding

NOTE: The valve seats may be reground with a valve seat grinder which centers on the valve guide.

1. Grind the valve seat at 45°. Remove no more material than absolutely necessary to clean the seat up.
2. Using a 35° stone, narrow the valve seat until the appropriate outer diameter is obtained.



A. Valve seat outer diameter EXHAUST



A. Valve seat outer diameter INTAKE

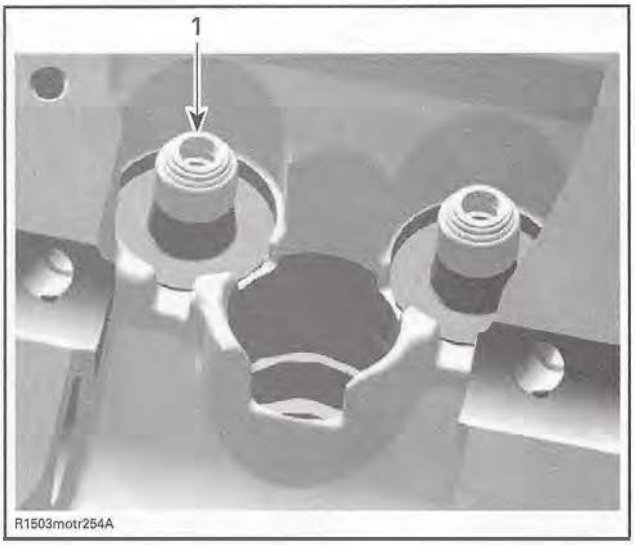
VALVE SEAT OUTER DIAMETER	
INTAKE	37.35 mm (1.4705 in)
EXHAUST	30.3 mm (1.1929 in)

3. Using a 55° stone for the intake and an 80° stone for the exhaust valve, reduce the valve seat contact width to the appropriate value mentioned above.
4. Finally, coat the valve seating surface with a fine paste of valve grinding compound using a manual valve grinding mandrel. Lightly grind the valves until a smooth, even, uniform sealing surface of the appropriate inside and outside diameter is obtained on both the valve and the seat. Use only a hand held valve grinding mandrel with a suction cup, rotating the valve back and forth through about 45°, and then advancing the valve 45° before repeating this operation.

Valve Installation

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

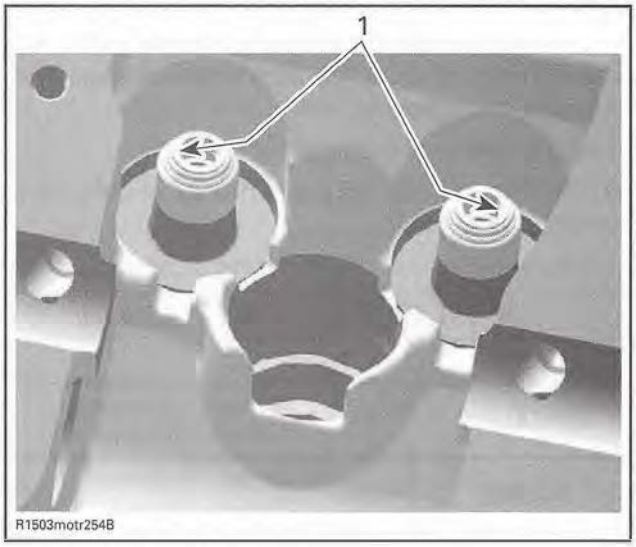
Install **NEW** valve stem seal.



1. Valve stem seal

Apply engine oil on valve stem and install valve.

NOTICE **Be careful when valve stem is passed through sealing lips of valve stem seal.**



1. Sealing lips of valve stem seal

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After springs are installed, ensure valve springs and valve spring retainer are properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE **An improperly locked valve spring will cause engine damage.**

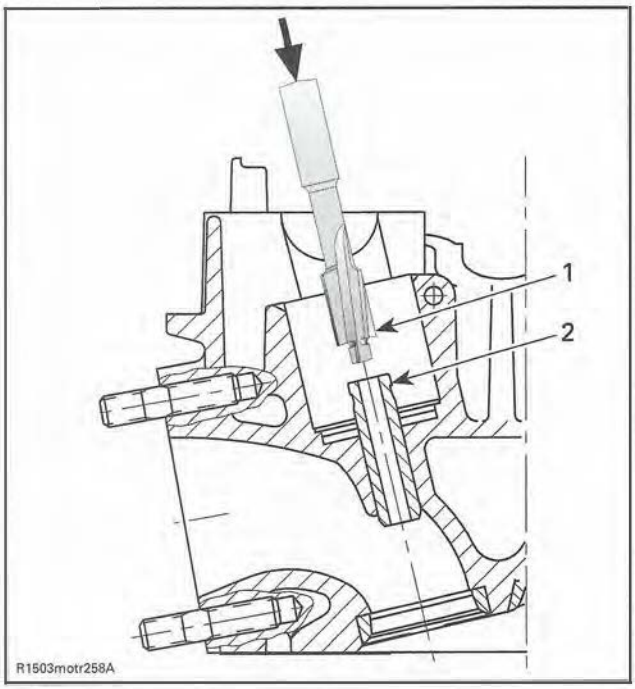
VALVE GUIDE

Valve Guide Replacement

NOTICE Do not heat cylinder head for this procedure.

NOTICE The sharp edge near the top of the valve guide must be machined away. Otherwise it will foul the valve guide hole in the cylinder head and destroy the cylinder head, as the valve guide is removed.

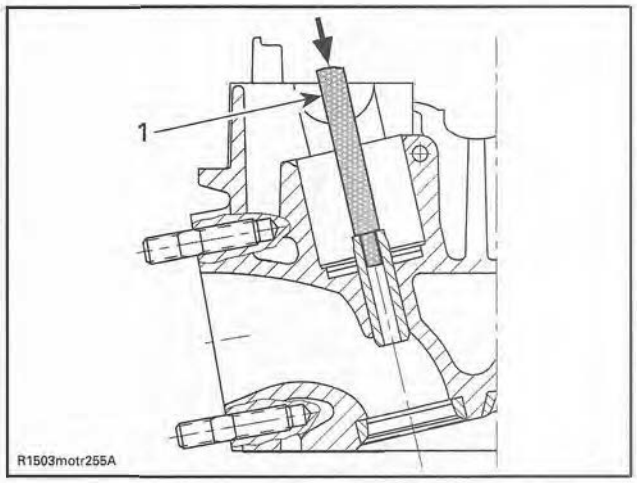
Use a special reamer as far as the top of the notch.



TYPICAL
1. Special reamer
2. Notch

Chase valve guide out of the cylinder head towards combustion chamber.

REQUIRED TOOL	
VALVE GUIDE REMOVER (6 MM) (P/N 529 036 086)	



TYPICAL
1. Punch

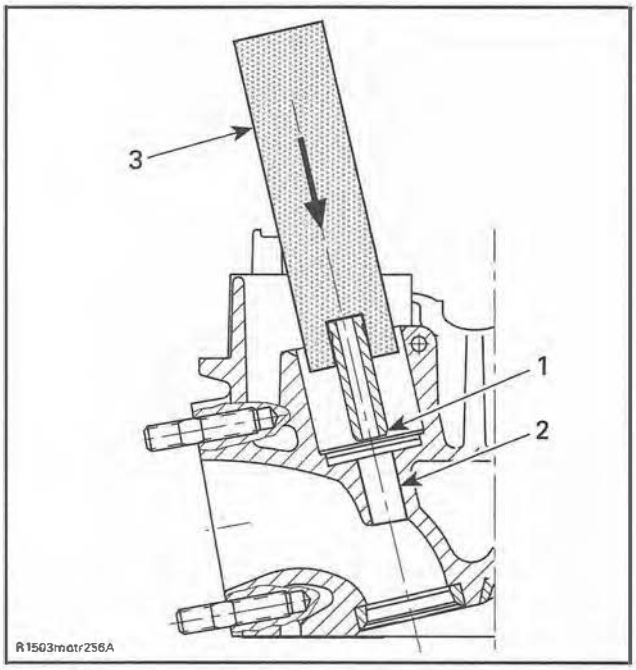
Check valve guide bore for abreased material. The inlet and exhaust valve guides have the same length and are interchangeable.

NOTE: If valve guide has caused scoring during extraction, replace the cylinder head.

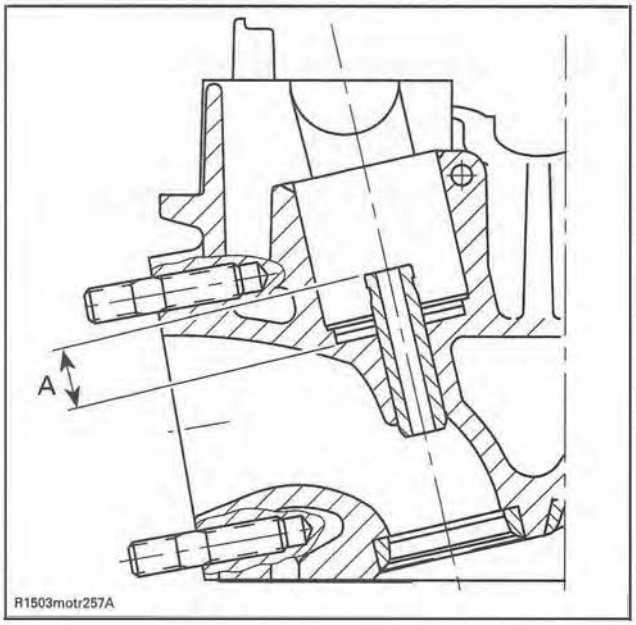
Grease the bore in cylinder head and the leading end of valve guide with MOLYKOTE G-N (P/N 420 297 433).

Press the valve guide into the **COLD** cylinder head as shown.

REQUIRED TOOL	
VALVE GUIDE PUSHER (6 MM) (P/N 529 036 087)	



TYPICAL
1. *Valve guide leading end*
2. *Cylinder head bore*
3. *Valve guide pusher (6 mm)*



TYPICAL
A. Protrusion

VALVE GUIDE PROTRUSION	
Minimum	12.4 mm (.4882 in)
Maximum	12.8 mm (.5039 in)

NOTE: After installing new guides, they must be reamed with a standard 6 mm reamer tool. These are available from various tool suppliers.

Clean cylinder head carefully. Check that the valve seat is concentric with the new guide axis (check contact surface with engineer's blue).

CYLINDER BLOCK

SERVICE TOOLS

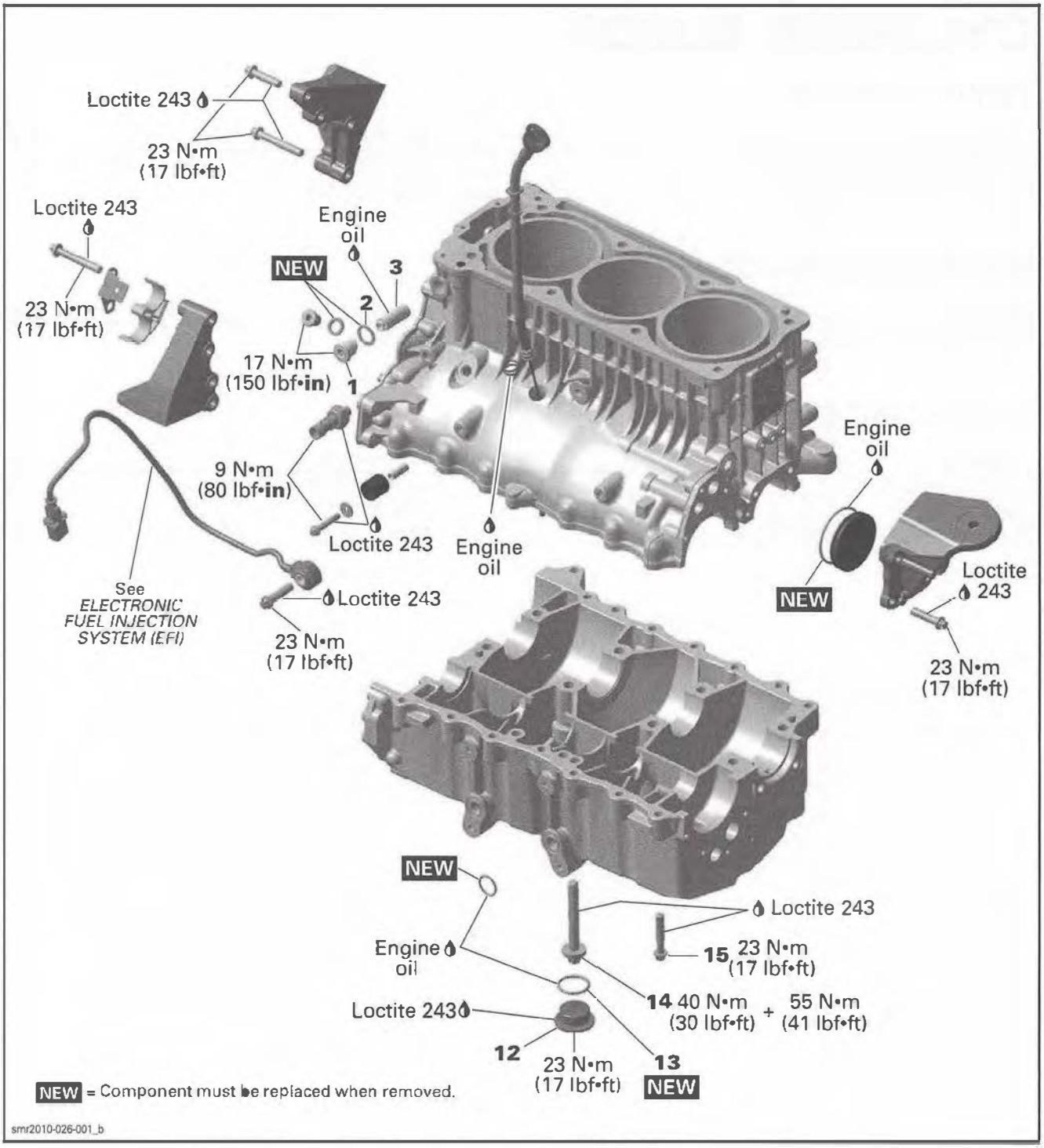
Description	Part Number	Page
CRANKSHAFT LOCKING TOOL	529 035 821	174, 178, 180, 185
PISTON CIRCLIP INSTALLER	529 035 765	171

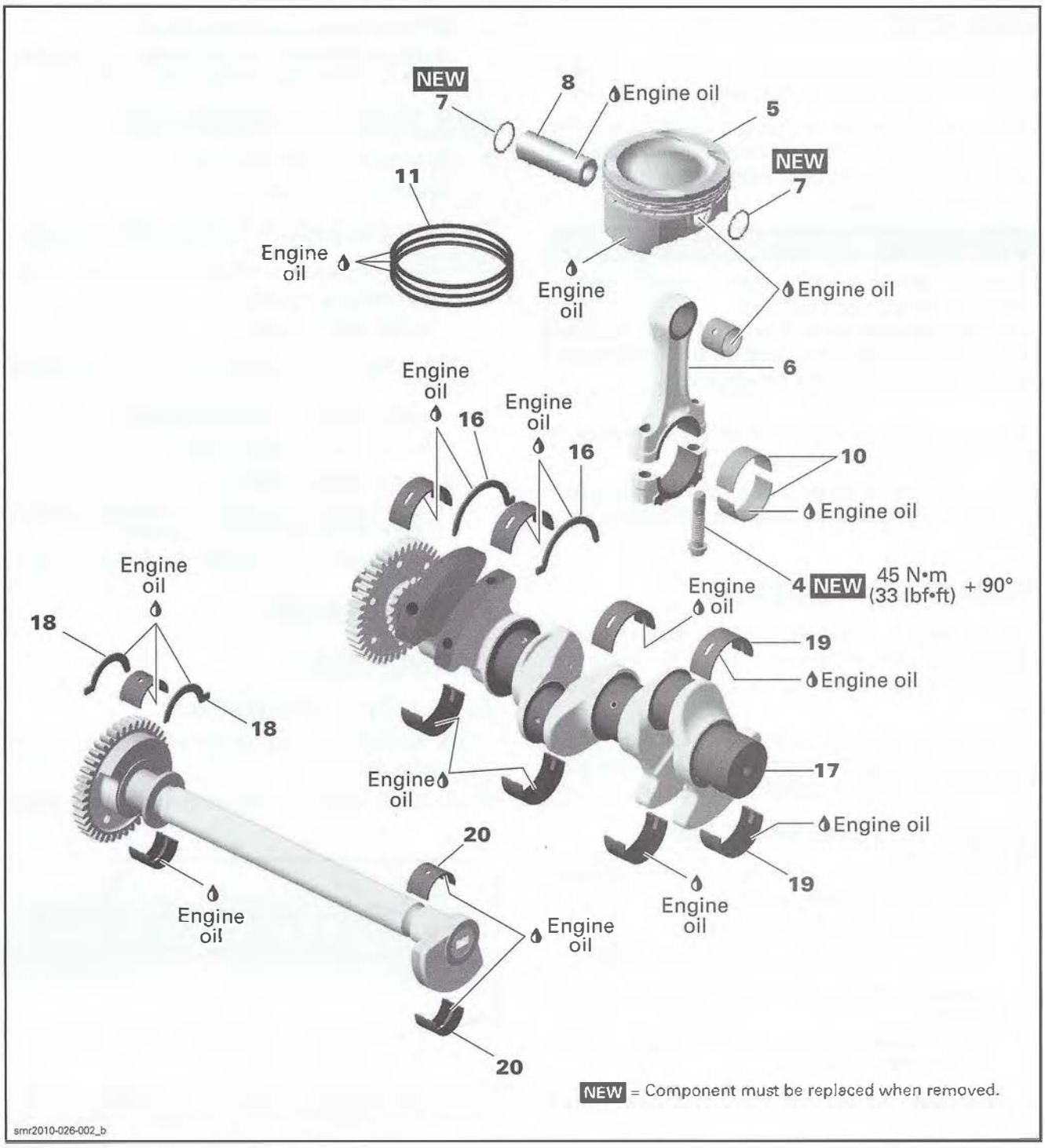
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON PISTON RING COMPRESSOR PLIERS	RC980	171

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	184
LOCTITE 5910	293 800 081	183
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	183


Loctite 243
23 N•m
(17 lbf•ft)
Loctite 243
23 N•m
(17 lbf•ft)
Engine
oil
NEW
3
2
17 N•m
(150 lbf•in)
1
9 N•m
(80 lbf•in)
Loctite 243
Engine
oil
See
ELECTRONIC
FUEL INJECTION
SYSTEM (EFI)
Loctite 243
23 N•m
(17 lbf•ft)
Engine
oil
NEW
Loctite
243
23 N•m
(17 lbf•ft)
NEW
Loctite 243
Engine
oil
15 23 N•m
(17 lbf•ft)
14 40 N•m
(30 lbf•ft)
+ 55 N•m
(41 lbf•ft)
Loctite 243
12
23 N•m
(17 lbf•ft)
13
NEW
NEW = Component must be replaced when removed.
smr2010-026-001_b


NEW
7
8
Engine oil
5
NEW
7
11
Engine oil
Engine oil
Engine oil
6
Engine oil
16
Engine oil
16
10
Engine oil
4 NEW 45 N•m (33 lbf•ft) + 90°
Engine oil
18
Engine oil
18
19
Engine oil
Engine oil
17
Engine oil
19
20
Engine oil
Engine oil
Engine oil
20
NEW = Component must be replaced when removed.
smr2010-026-002_b

GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

All engine parts removed must be reinstalled in their original positions.

Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Heavy wear on plain bearings.**
   - *Check radial play of plain bearings.*
   - *Replace plain bearings if out of specification.*
2. **Crankshaft and balancer shaft are not properly aligned.**
   - *Disassemble cylinder block and check if marks are properly aligned.*
3. **Crankshaft or balancer shaft axial play out of specification.**
   - *Measure crankshaft and balancer shaft axial play.*
   - *If axial play is out of specification, replace thrust washers.*
4. **Connecting rod axial play out of specification.**
   - *Measure connecting rod axial play on crankshaft.*
   - *Replace connecting rod or crankshaft if out of specification.*
5. **Connecting rod screws got loose.**
   - *Replace damaged components and retighten screws with the recommended torque.*

BLUE SMOKE IN THE EXHAUST

1. **Oil scrapper rings worn out.**
   - *Replace piston rings.*

ENGINE SUDDENLY TURNS OFF (POOR IDLING)

1. **Piston rings worn out.**
   - *Replace piston rings.*
2. **Piston/cylinder wall clearance out of specification.**
   - *Check piston/cylinder wall clearance.*
   - *Replace if out of specification.*
3. **Melted or broken piston.**
   - *Check if oil spray nozzle is not clogged. Refer to LUBRICATION SYSTEM subsection.*
   - *Replace piston and cylinder block if necessary.*

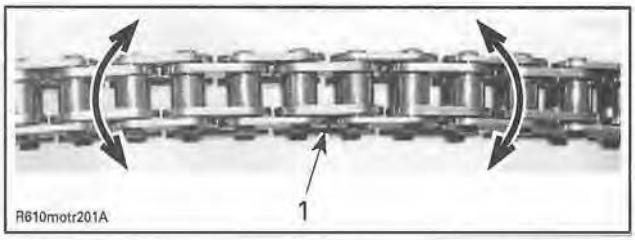
PROCEDURES

TIMING CHAIN

Timing Chain Inspection

Check timing chain on camshaft gear for excessive radial play.

Check chain condition for wear and rollers condition.



1. Timing chain

If chain is excessively worn or damaged, replace it as a set (camshaft timing gear and timing chain).

Timing Chain Removal

Remove:
- Engine oil (refer *LUBRICATION SYSTEM* subsection)
- Engine from vehicle (refer to *ENGINE REMOVAL AND INSTALLATION* subsection)
- Cylinder head (refer to *CYLINDER HEAD* subsection)

- PTO housing (refer to *PTO HOUSING AND MAGNETO* subsection)
- Crankshaft (refer to *CRANKSHAFT* in this subsection)
- Timing chain.

Timing Chain Installation

The installation is essentially the reverse of the removal procedure. However, pay attention to the following details.

Ensure to perform proper valve timing.

NOTICE Improper valve timing will damage engine components.

Lock crankshaft and camshaft at TDC (refer to *CYLINDER HEAD* subsection for the camshaft locking procedure).

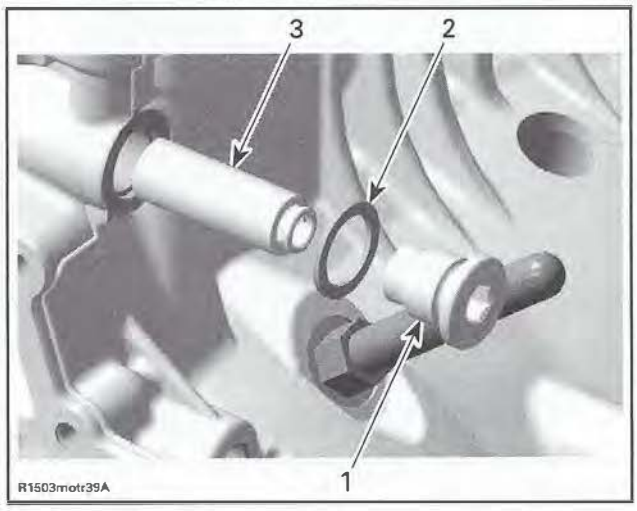
Install chain, then install chain tensioner.

CHAIN TENSIONER

Chain Tensioner Removal

NOTE: Removal of the intake manifold allows easier access to the chain tensioner, but is not necessary. Refer to *INTAKE MANIFOLD* subsection.

Remove:
- Chain tensioner plug screw **no. 1**
- Gasket ring **no. 2** (discard it)
- Chain tensioner **no. 3**.



1. Plug screw
2. Gasket ring
3. Chain tensioner

Chain Tensioner Inspection

Check chain tensioner for excessive wear or cracks. Also check free movement of the chain tensioner piston.

Chain Tensioner Installation

The installation is essentially the reverse of the removal procedure but, pay attention to the following details.

Use a **NEW** gasket ring when installing the chain tensioner plug screw.

Torque chain tensioner plug screw to 17 N•m (150 lbf•**in**).

Tighten the chain tensioner plug screw to specification.

TORQUE	
Chain tensioner plug screw	17 N•m (150 lbf•**in**)

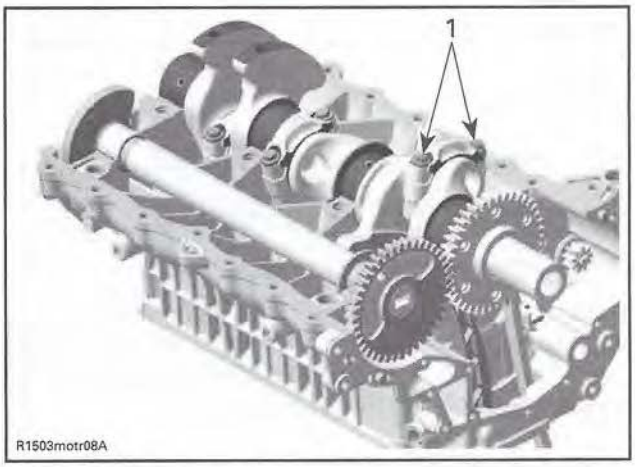
PISTONS AND CONNECTING RODS

Piston and Connecting Rod Removal

1. Disassemble *CYLINDER BLOCK* as per procedure in this subsection.

NOTE: It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to *INSPECTION* below.

2. Remove connecting rod cap screws **no. 4**.

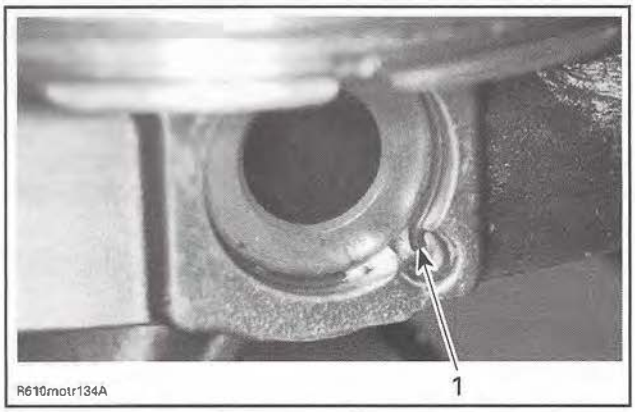


1. Connecting rod screws

NOTE: Before removing the connecting rod caps, mark them to remember the right position when reassembling.

3. Pull piston **no. 5** with connecting rod **no. 6** out of the cylinders.

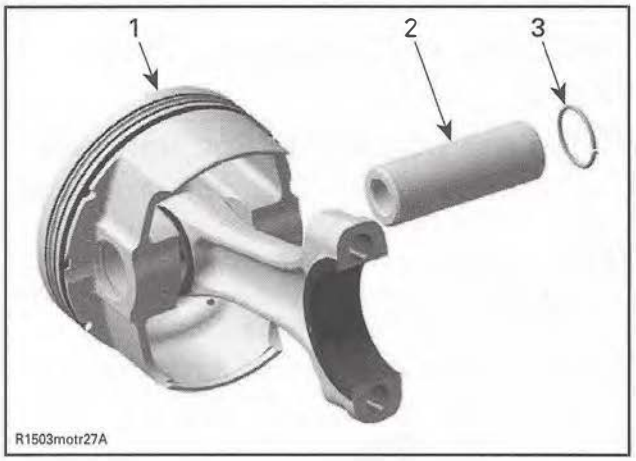
4. Remove one piston circlip **no. 7** and discard it.



1. Piston circlip

NOTE: The removal of both piston circlips is not necessary to remove piston pin.

5. Push piston pin **no. 8** out of piston.



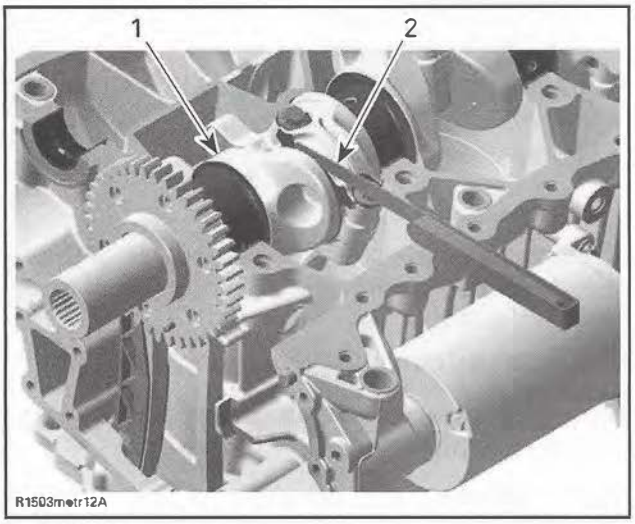
1. Piston
2. Piston pin
3. Circlip

6. Detach piston from connecting rod.

Connecting Rod Inspection

Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between butting face of connecting rod and crankshaft counterweight. If the distance exceeds specified tolerance, replace the worn part.

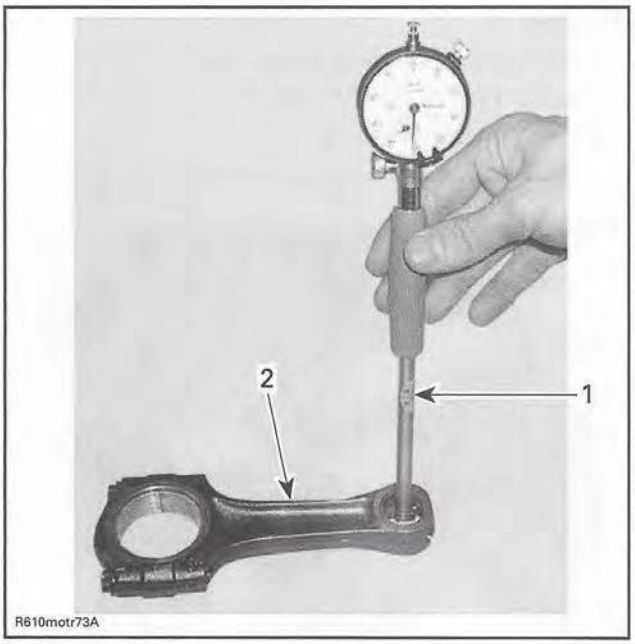


1. Crankshaft
2. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY	
NEW	0.100 mm - 0.352 mm (.004 in - .014 in)
SERVICE LIMIT	0.500 mm (.02 in)

Connecting Rod Small End Radial Play

Measure connecting rod small end.



1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER	
NEW	23.01 mm - 23.02 mm (.9059 in - .9063 in)
SERVICE LIMIT	23.07 mm (.908 in)

If the connecting rod small end diameter is out of specification, replace small end bearing sleeve no. 9.

NOTE: For small end bearing sleeve replacement contact a machine shop. After installing a NEW small end bearing sleeve on the connecting rod, the inner diameter and the oil holes need to be machined to specification.

Measure piston pins (refer to *PISTON PIN INSPECTION* in this subsection). Compare to inside diameter of connecting rod to obtain connecting rod small end radial play.

CONNECTING ROD SMALL END RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.003 in)

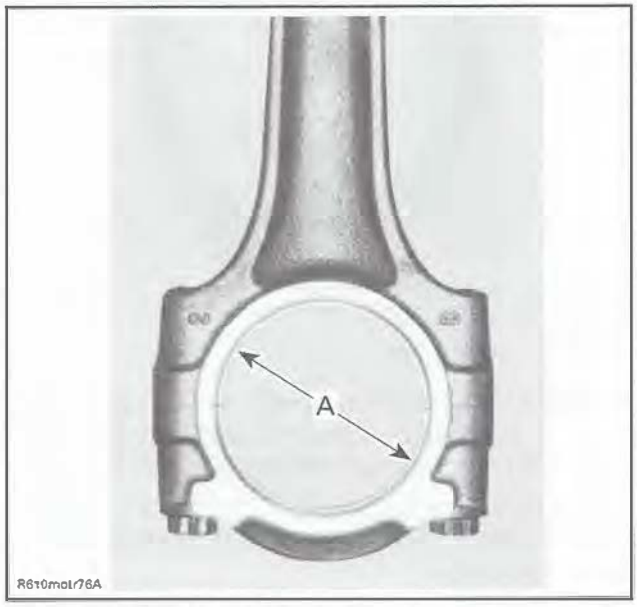
Connecting Rod Big End Radial Play

Measure inside diameter of connecting rod big end. Compare to crankshaft pin.

To measure the connecting rod big end diameter, use the OLD screws no. 4.

Install the OLD bearings no. 10 as they were mounted initially.

Do the torque procedure as described below.



A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	45.080 mm (1.775 in)

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.09 mm (.0035 in)

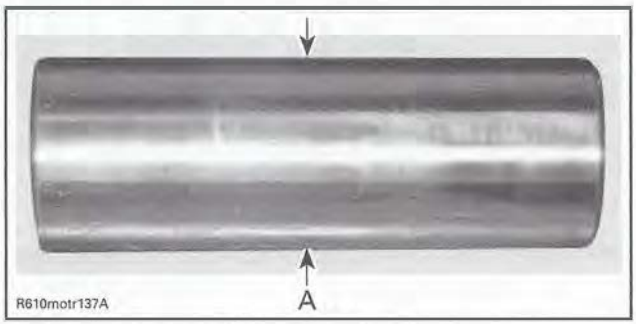
Use NEW bearings, when connecting rod big end diameter is out of specification.

Piston Pin Inspection

Using synthetic abrasive woven, clean piston pin from deposits.

Inspect piston pin for scoring, cracking or other damages.

Measure piston pin. See the following illustration for the proper measurement position.



A. Piston pin diameter in the area of the bushing

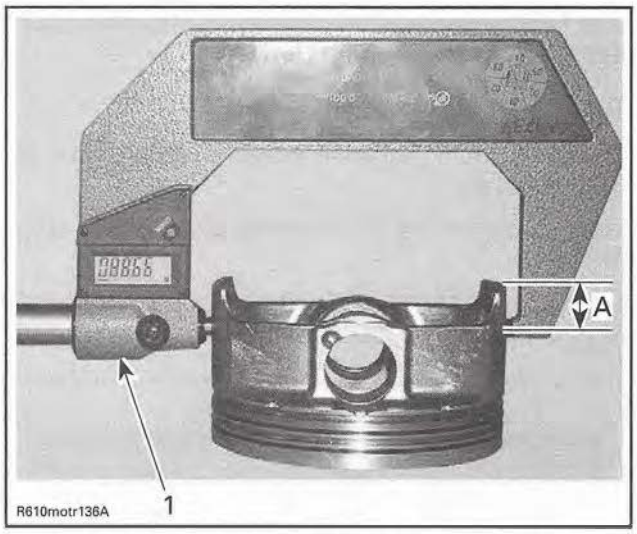
PISTON PIN DIAMETER	
NEW	22.996 mm - 23.000 mm (.905 in - .906 in)
SERVICE LIMIT	22.990 mm (.905 in)

Measure connecting rod small end diameter (refer to *CONNECTING RODS INSPECTION* above) to check connecting rod small end radial play.

Piston Inspection

Inspect piston for scoring, cracking or other damages. Replace piston and piston rings if necessary.

Using a micrometer, measure piston at 18 mm (.709 in) perpendicularly (90°) to piston pin axis.



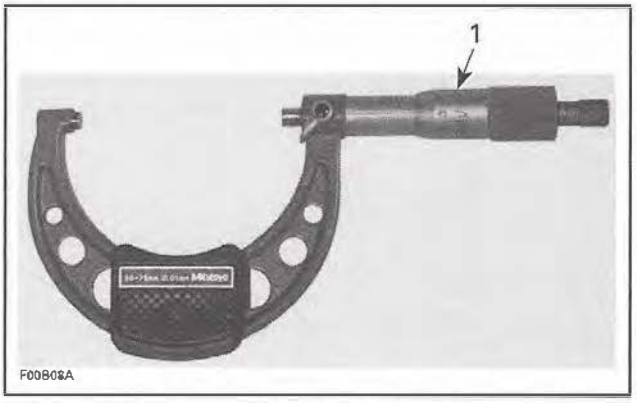
1. Measuring perpendicularly (90°) to piston pin axis
A. 18 mm (.709 in)

The measured dimension should be as described in the subsequent table. If not, replace piston.

PISTON MEASUREMENT	
155 ENGINE	
NEW NOMINAL	99.951 mm - 99.969 mm (3.935 in - 3.936 in)
SERVICE LIMIT	99.90 mm (3.933 in)
215, 255 AND 260 ENGINES	
NEW NOMINAL	99.931 mm - 99.949 mm (3.934 in - 3.935 in)
SERVICE LIMIT	99.90 mm (3.933 in)

Piston/Cylinder Wall Clearance

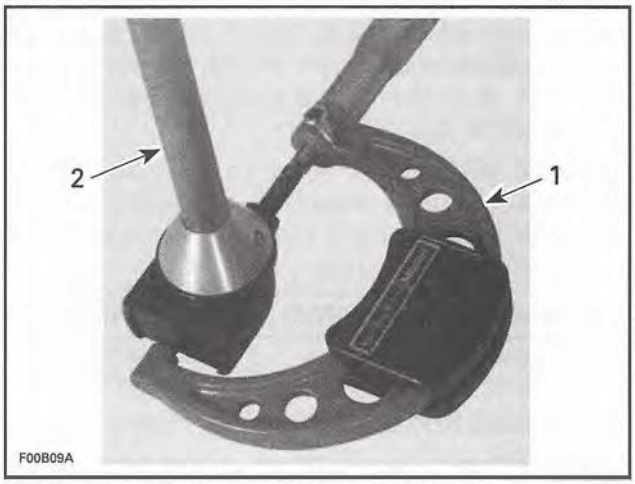
Adjust and lock a micrometer to the piston dimension.



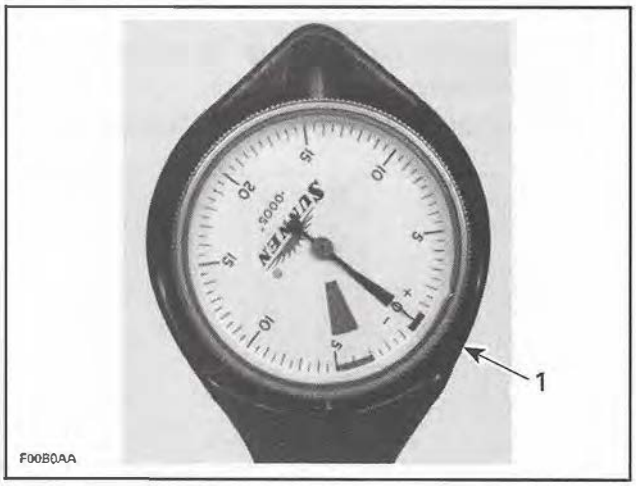
1. Micrometer set to the piston dimension

NOTE: Make sure used piston is not worn.

With the micrometer set to the dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).



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



TYPICAL
1. Indicator set to 0 (zero)

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.

Position the dial bore gauge 62 mm (2.44 in) above cylinder base, measuring perpendicularly (90°) to piston pin axis.

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

PISTON/CYLINDER CLEARANCE	
155 ENGINE	
NEW NOMINAL	0.024 mm - 0.056 mm (.001 in - .002 in)
SERVICE LIMIT	0.100 mm (.004 in)
215, 255 AND 260 ENGINES	
NEW NOMINAL	0.044 mm - 0.076 mm (.0017 in - .003 in)
SERVICE LIMIT	0.100 mm (.004 in)

If clearance exceeds specified tolerance, re-hone cylinder sleeve and replace piston by an oversize one.

NOTE: It is not necessary to have all pistons replaced with an oversize if they are not all out of specification. Mixed standard size and oversize piston are allowed.

Piston and Connecting Rod Assembly

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

Apply engine oil on the piston pin.

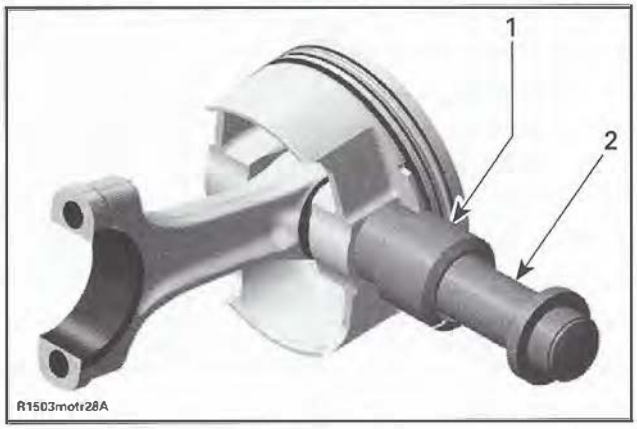
Insert piston pin into piston and connecting rod.

Install the piston circlip.

REQUIRED TOOL
PISTON CIRCLIP INSTALLER (P/N 529 035 765)

NOTICE **Secure piston pin with new piston circlips.**

NOTE: Take care that the hook of the piston circlip is positioned properly.



1. Sleeve with piston circlip inside
2. Assembly jig from piston clip installer

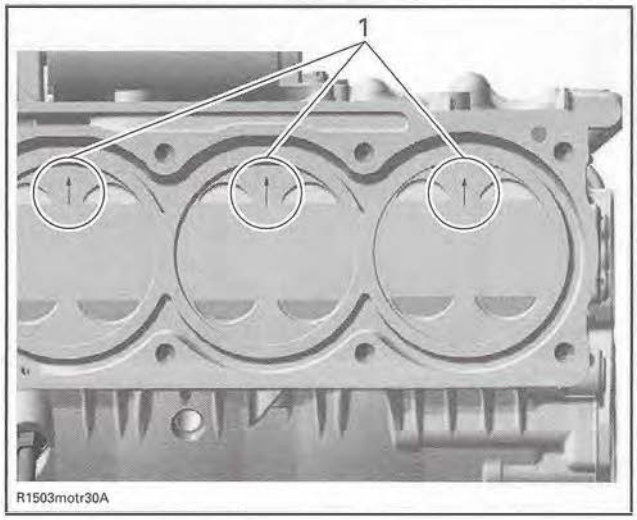
CORRECT POSITION OF THE PISTON CIRCLIP

Piston and Connecting Rod Installation

1. Using a piston ring compressor, slide piston into cylinder.

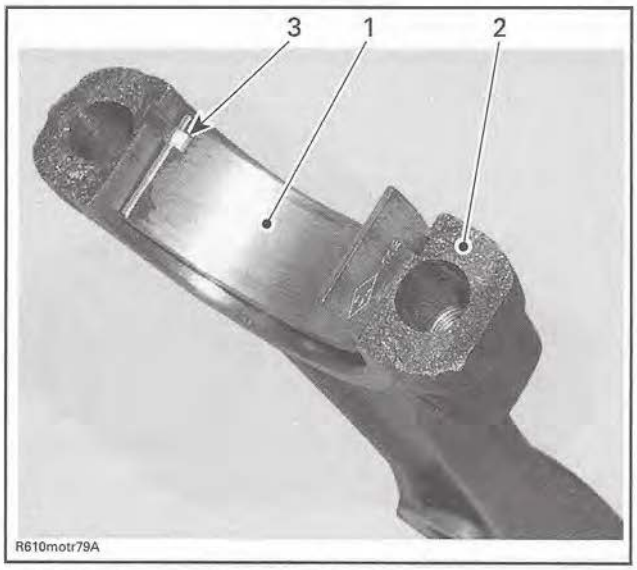
RECOMMENDED TOOL
SNAP-ON PISTON RING COMPRESSOR PLIERS (P/N RC980)

NOTICE **Install piston with punched arrow toward exhaust side.**



1. Arrows toward exhaust side

2. Correctly install bearings and carefully clean split surface on both sides (cracked area).



1. Half bearing of connecting rod big end
2. Split surface of the connecting rod
3. Protrusion of bearing in line with connecting rod groove

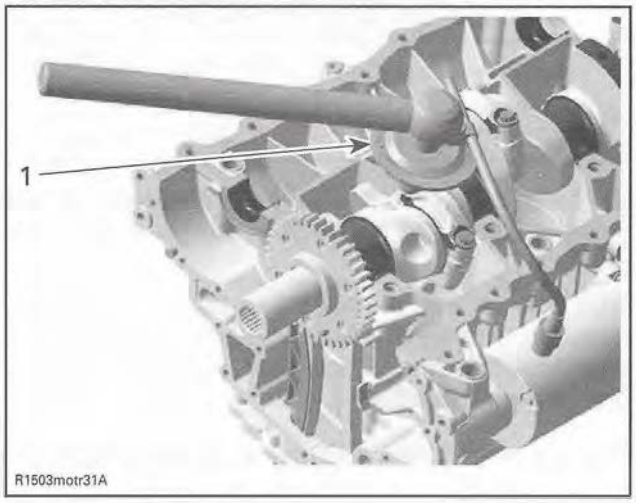
3. Torque NEW connecting rod screws as per following procedure:

NOTE: Do not apply any threadlocker product on threads of connecting rod screws.

NOTICE Connecting rod screws must be torque FIRST according to step 1.

TORQUE		
Connecting rod screws	Step 1	45 N•m (33 lbf•ft)
	Step 2	+ 90°

NOTICE Failure to strictly follow this procedure may cause screw to loosen and lead to engine damage. Knowing that the screws have been stretched from the previous installation, it is very important to use new screws at assembly.



1. Angle torque wrench

PISTON RINGS

Piston Ring Removal

Remove piston as described above.

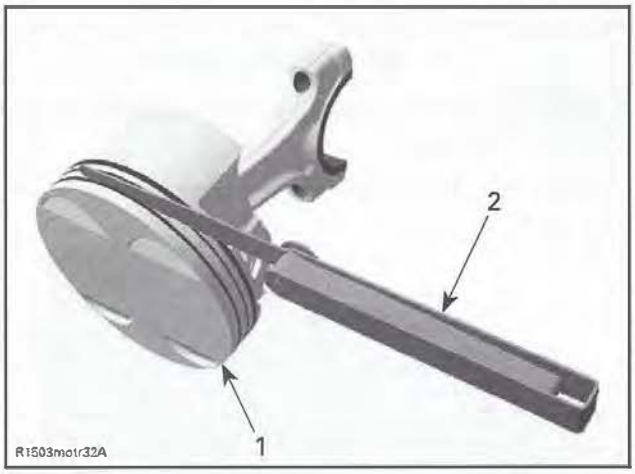
Remove rings no. 11.

Piston Ring Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance. If the clearance is too large, the piston and the piston rings should be replaced.

RING/PISTON GROOVE CLEARANCE	
NEW	
RECTANGULAR	0.025 mm - 0.070 mm (.001 in - .0028 in)
TAPER-FACE	0.015 mm - 0.060 mm (.0006 in - .0024 in)
OIL SCRAPER RING	0.020 mm - 0.055 mm (.0008 in - .0022 in)
SERVICE LIMIT	
ALL	0.15 mm (.006 in)



1. Piston
2. Filler gauge

Ring End Gap

RING END GAP	
NEW	
RECTANGULAR	0.30 mm - 0.50 mm (.012 in - .02 in)
TAPER-FACE	0.35 mm - 0.55 mm (.014 in - .022 in)
OIL SCRAPER RING	0.35 mm - 0.50 mm (.014 in - .02 in)
SERVICE LIMIT	
ALL	1.50 mm (.0591 in)

Measure position for ring end gap in the area of 8 mm to 16 mm (.315 in to .63 in) from top of cylinder.

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

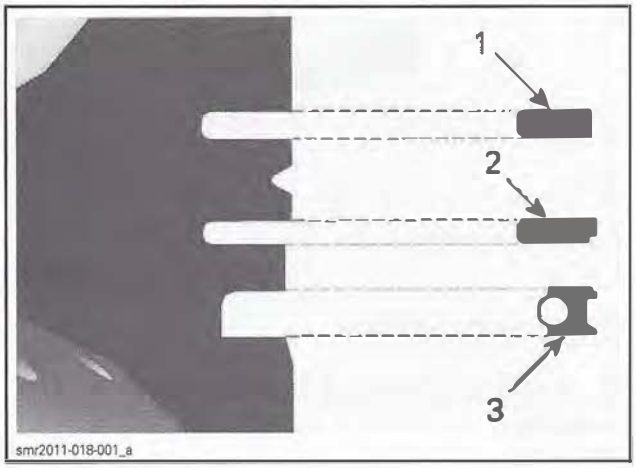
Using a feeler gauge, check ring end gap. Replace ring if gap exceeds above described specified tolerance.

Piston Ring Installation

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

Install rings in the following order and layout:

PISTON RING INSTALLATION		
ORDER	RING	POSITION
First step	Oil scraper ring	Stamped dot facing UP
Second step	Taper-face ring	Stamped "E" and "TOP" facing UP
Third step	Rectangular ring	Stamped "E" and "TOP" facing UP



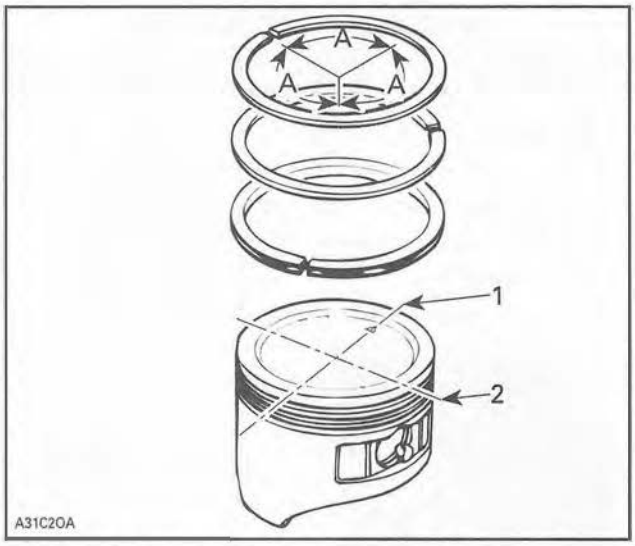
1. Rectangular ring
2. Taper-face ring
3. Oil scraper ring

NOTICE Ensure that top and second rings are not interchanged.

NOTE: Use a ring expander to prevent breakage during installation. The oil ring must be installed by hand.

Check that rings rotate smoothly after installation.

Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.



1. *DO NOT align ring gap with piston trust side axis*
2. *DO NOT align ring gap with piston pin bore axis*

A. 120°

CRANKSHAFT

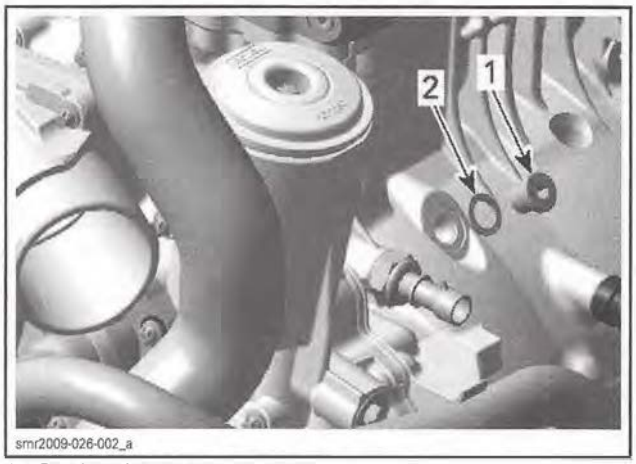
Crankshaft Locking Procedure

NOTICE **The crankshaft must be locked at TDC for removal and installation of crankshaft, balancer shaft and camshaft.**

NOTE: When the crankshaft is locked, the piston of cylinder 3 is at ignition TDC.

Remove:

- Intake manifold (refer to *INTAKE MANIFOLD* subsection)
- Spark plugs
- Cylinder head cover (refer to *CYLINDER HEAD* subsection
- Crankshaft access plug screw.

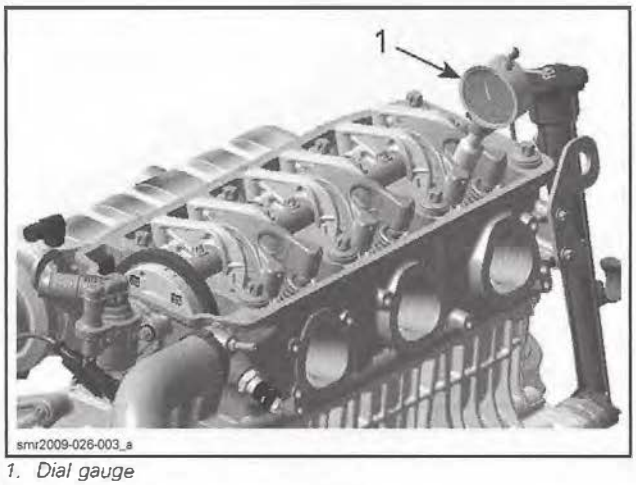


1. *Crankshaft access plug screw*
2. *Gasket ring*

Turn engine counterclockwise.

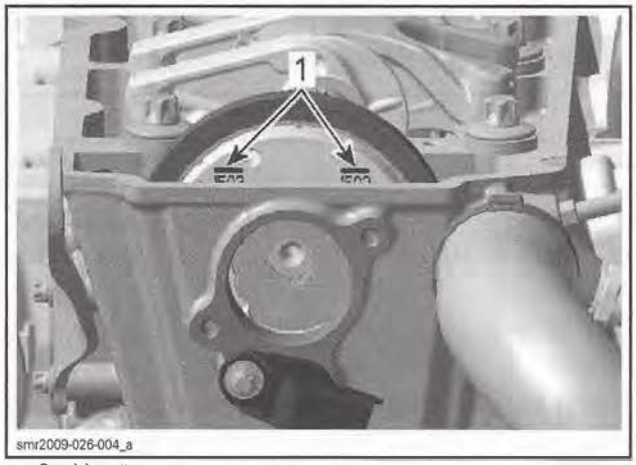
Bring piston of cylinder 3 to ignition TDC, using a dial gauge or another similarly suitable tool.

NOTICE **Do not scratch or damage piston and cylinder surface.**



1. *Dial gauge*

NOTE: When the piston of cylinder 3 is at ignition TDC, the position lines on oil separator cover must be lined up as shown in the following illustration.



1. *Position lines*

Use a small screwdriver to check if the groove in the crankshaft is aligned with the hole.

In this position, lock the crankshaft.

REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)	

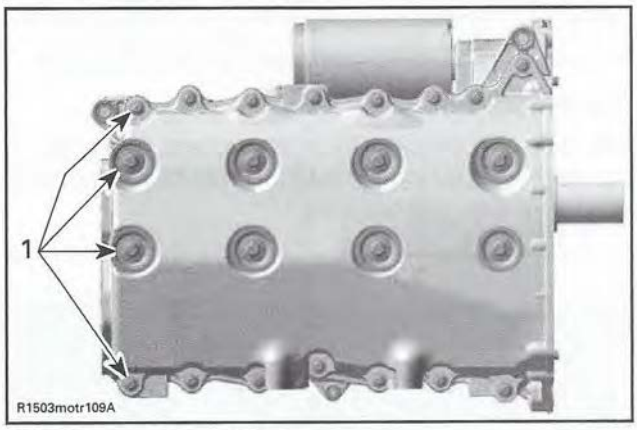
Crankshaft Removal

1. Drain engine oil (refer to *LUBRICATION SYSTEM* subsection).
2. Remove engine from vehicle (refer to *ENGINE REMOVAL AND INSTALLATION* subsection).

3. Remove cylinder head (refer to *CYLINDER HEAD* subsection).
4. Remove PTO housing, starter gear and starter drive (refer to *PTO HOUSING AND MAGNETO* subsection).
5. Remove oil suction pump (refer to *LUBRICATION SYSTEM* subsection).
6. Remove engine mounting brackets.
7. Remove oil reservoir plug screws no. 12 with O-ring no. 13.

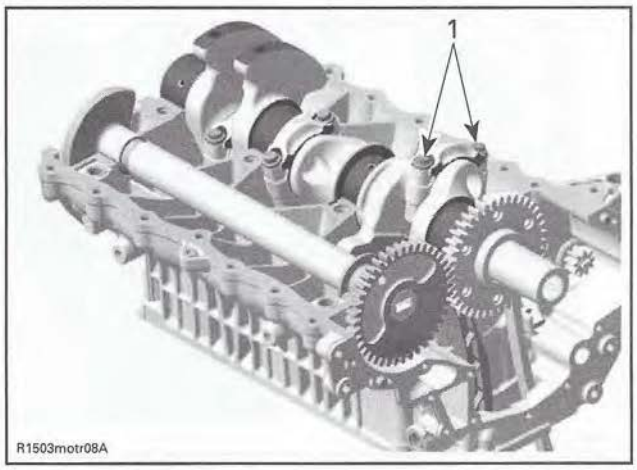
ENGINE UPSIDE DOWN
1. Oil reservoir plug screw with O-ring

8. Remove cylinder block screws no. 14 and no. 15.



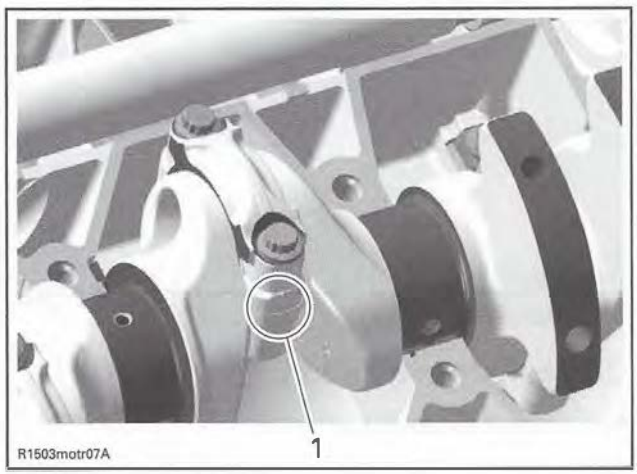
BOTTOM VIEW OF ENGINE
1. Screws

9. Remove cylinder block lower half.
10. Remove connecting rod screws.



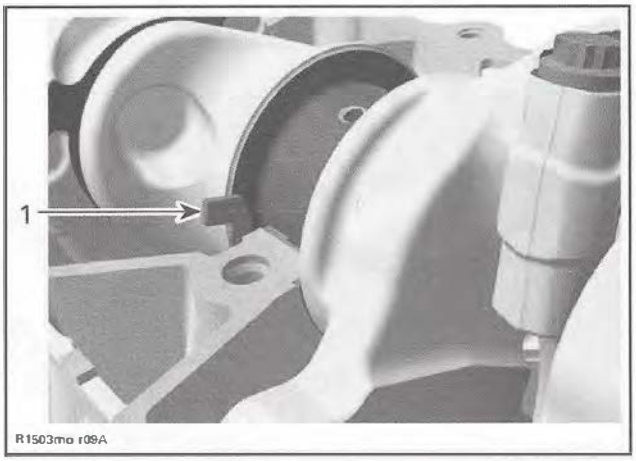
1. Connecting rod screws

NOTE: Before removing the connecting rod caps, mark them to remember the right position when reassembling. It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to *PISTONS AND CONNECTING RODS* in this subsection for the procedure.



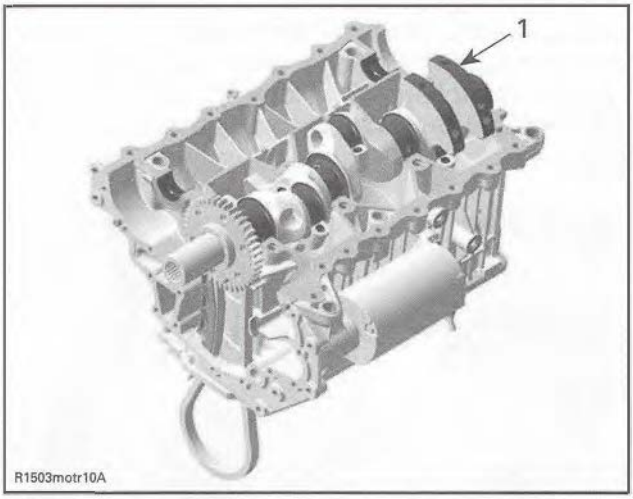
1. Mark on connecting rod

11. Remove thrust washers no. 16.



1. Thrust washer

12. Remove crankshaft no. 17.

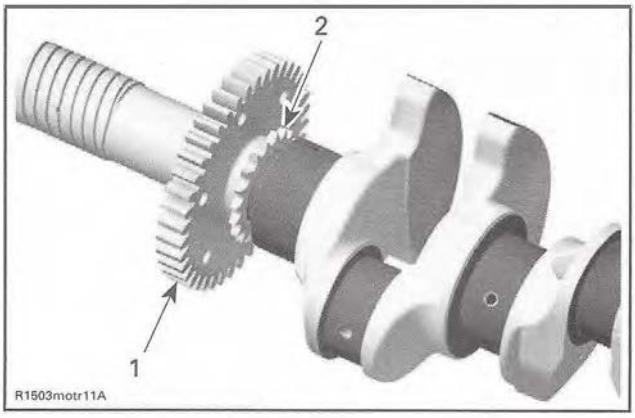


1. Crankshaft

Crankshaft Inspection

Crankshaft Gear Inspection

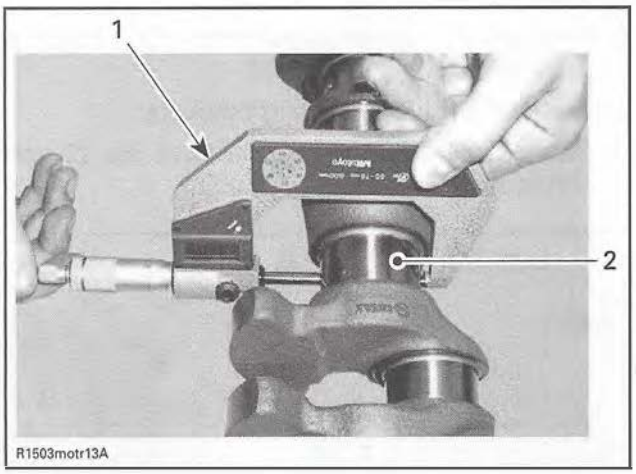
Replace crankshaft if the gears are worn or otherwise damaged.



1. Balancer gear
2. Crankshaft timing gear

Crankshaft Radial Play

Measure all crankshaft journals. Compare to inside diameter of crankshaft bearings (elsewhere in this subsection).



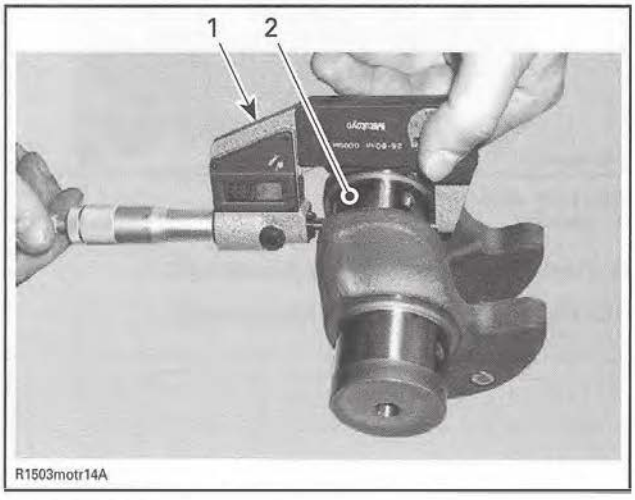
1. Micrometer
2. Crankshaft area for bearing

CRANKSHAFT JOURNAL DIAMETER	
NEW	49.991 mm - 50.01 mm (1.9681 in - 1.9689 in)
SERVICE LIMIT	49.95 mm (1.9665 in)

CRANKSHAFT JOURNAL RADIAL CLEARANCE	
SERVICE LIMIT	0.07 mm (.0028 in)

Crankshaft Pin

Measure all crankshaft pin diameters. Compare to inside diameter of connecting rod bearings (elsewhere in this subsection).



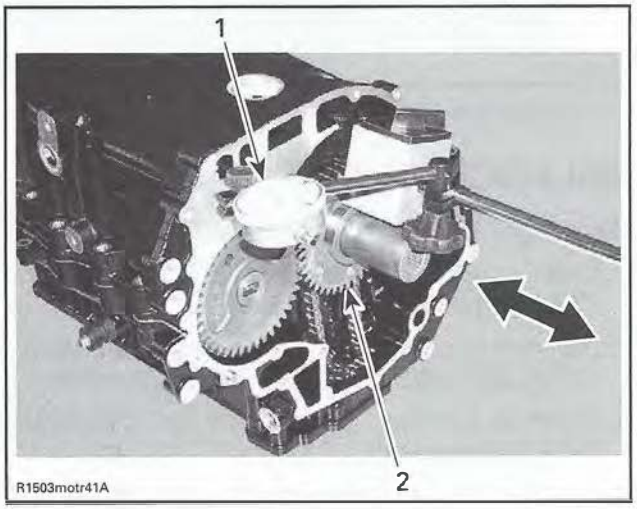
1. Micrometer
2. Crankshaft pin area for bearing

CRANKSHAFT PIN DIAMETER	
NEW	45.032 mm - 45.048 mm (1.7729 in - 1.7735 in)
SERVICE LIMIT	45.029 mm (1.7728 in)

CRANKSHAFT PIN RADIAL CLEARANCE	
SERVICE LIMIT	0.09 mm (.0035 in)

Crankshaft Axial Clearance

When assembling the cylinder-block, measure the crankshaft axial clearance.



1. Dial gauge
2. Crankshaft

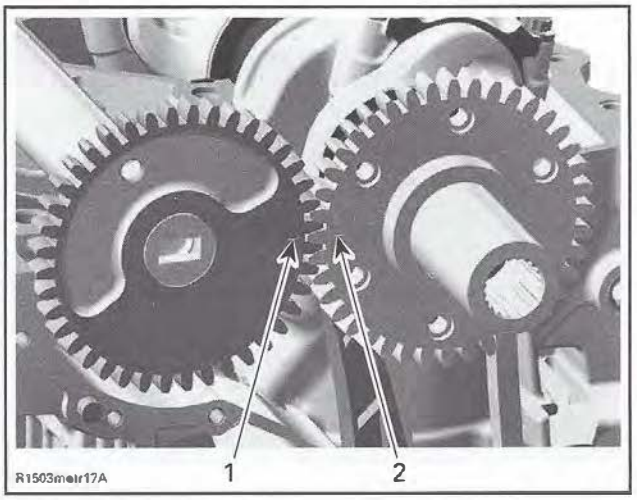
CRANKSHAFT AXIAL CLEARANCE	
NEW	0.08 mm - 0.22 mm (.003 in - .009 in)
SERVICE LIMIT	0.35 mm (.014 in)

Crankshaft Installation

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

NOTE: Before installing the crankshaft, make sure that the timing chain is on the crankshaft and the chain guide has been installed first. Those parts cannot be installed when the crankshaft is in place.

NOTICE **Crankshaft and balancer shaft marks have to be aligned.**



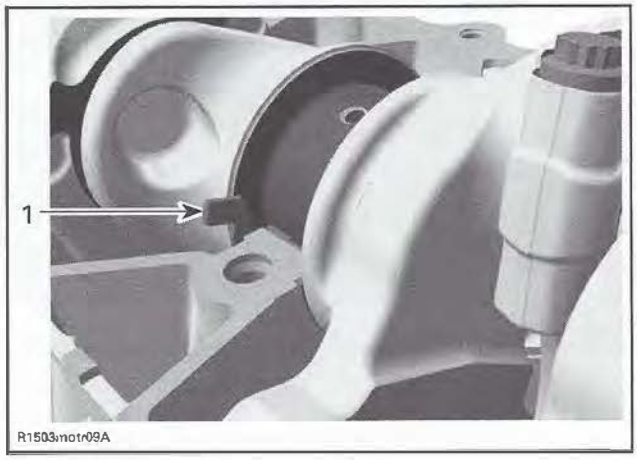
1. Mark on balancer shaft
2. Mark on crankshaft

For correct installation of the connecting rods, refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTICE **It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.**

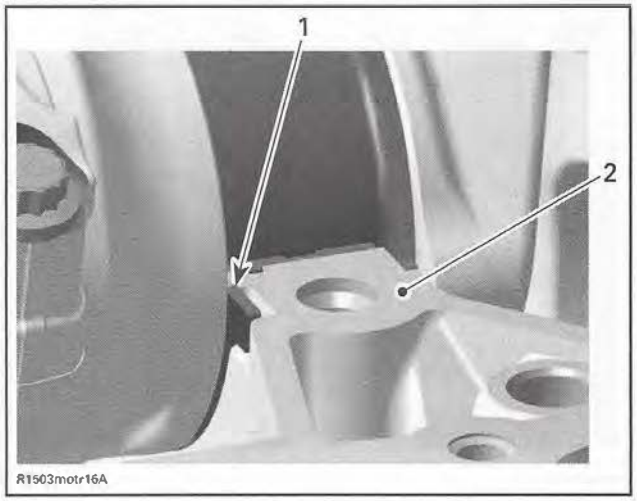
Insert thrust washers **no. 16** as soon as crankshaft is in place as per following illustration.

NOTICE **Never forget thrust washers on center of crankshaft to control axial adjustment.**



THRUST WASHER INSERT DIRECTION
1. Thrust washer

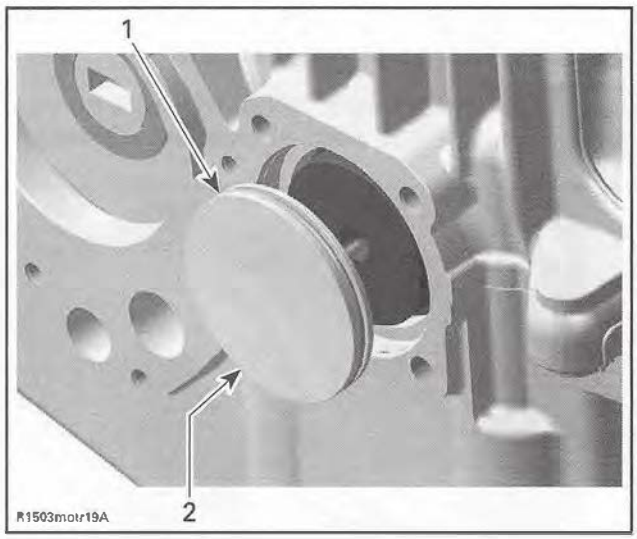
NOTICE **Thrust washers have to be flush with the cylinder block sealing surface.**



1. Thrust washer
2. Sealing surface

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

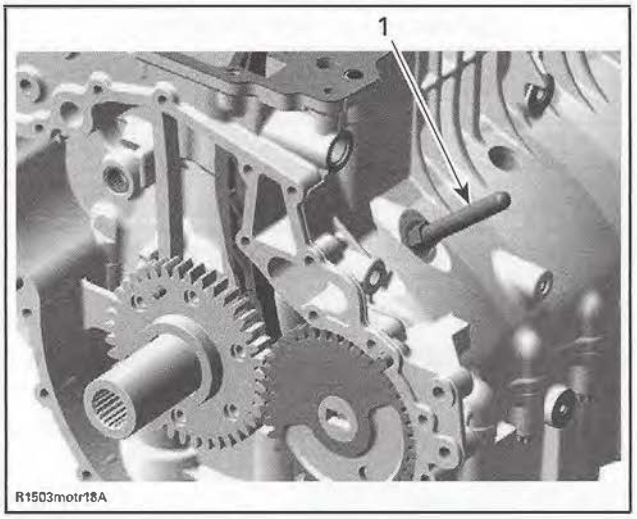
Install the crankshaft cover before mounting the engine bracket. Apply engine oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.



1. O-ring
2. Crankshaft cover

Position crankshaft at TDC before installing the camshaft and the rocker arms (refer to *CYLINDER HEAD* subsection).

REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)	

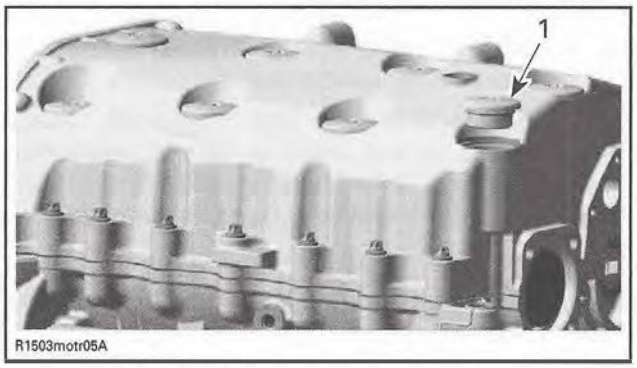


1. Crankshaft locking tool

BALANCER SHAFT

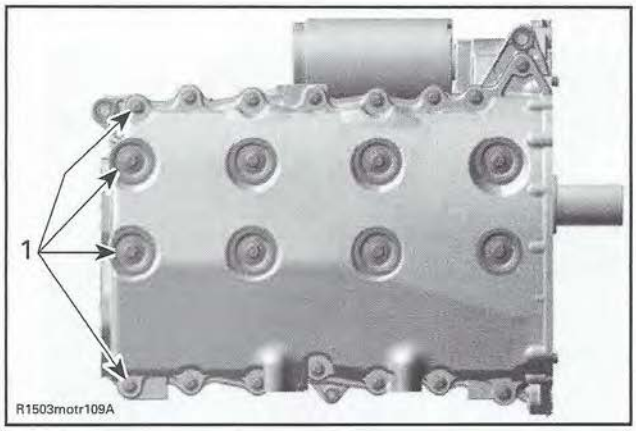
Balancer Shaft Removal

1. Drain engine oil (refer to *LUBRICATION SYSTEM* subsection).
2. Remove engine from vehicle (refer to *ENGINE REMOVAL AND INSTALLATION* subsection).
3. Remove cylinder head (refer to *CYLINDER HEAD* subsection).
4. Remove PTO housing, starter gear and starter drive (refer to *PTO HOUSING AND MAGNETO* subsection).
5. Remove oil suction pump (refer to *LUBRICATION SYSTEM* subsection).
6. Remove engine mounting brackets.
7. Remove oil reservoir plug screws **no. 12** with O-ring **no. 13**.



ENGINE UPSIDE DOWN
1. Oil reservoir plug screw with O-ring

8. Remove cylinder block screws **no. 14** and **no. 15**.



1. Screws

9. Remove cylinder block lower half.
10. Remove thrust washers no. 18.

1. Thrust washer

11. Remove balancer shaft.

Balancer Shaft Inspection

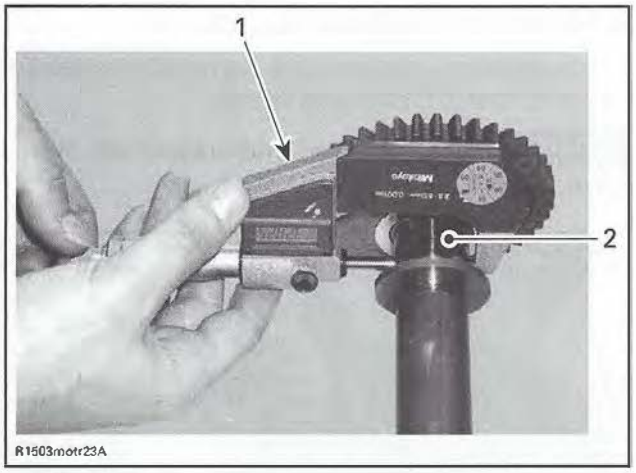
Check balancer shaft and replace if damaged.

If the gear on the balancer shaft is damaged, replace balancer shaft.

Check gear on the crankshaft at the same time and replace crankshaft if necessary (refer to *CRANKSHAFT* above).

Balancer Shaft Bearing Seat Play

Measure all balancer shaft bearing seats. Compare to inside diameter of balancer shaft bearings (see *CYLINDER BLOCK INSPECTION* in this subsection).



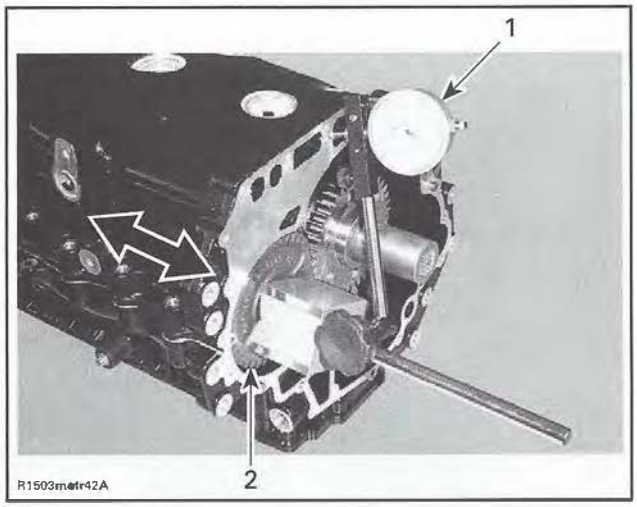
1. Micrometer
2. Balancer shaft area for bearing

BALANCER SHAFT SEAT DIAMETER	
NEW	31.984 mm - 32.000 mm (1.2592 in - 1.2598 in)
SERVICE LIMIT	31.950 mm (1.2579 in)

BALANCER SHAFT SEAT RADIAL CLEARANCE	
SERVICE LIMIT	0.07 mm (.0028 in)

Balancer Shaft Axial Clearance

When assembling the cylinder-block, measure the balance shaft axial play.



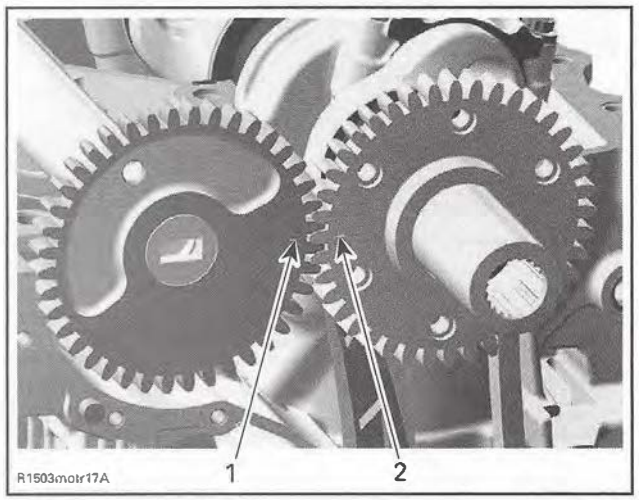
1. Dial gauge
2. Balancer shaft

BALANCER SHAFT AXIAL CLEARANCE	
NEW	0.02 mm - 0.25 mm (.001 in - .01 in)
SERVICE LIMIT	0.35 mm (.014 in)

Balancer Shaft Installation

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

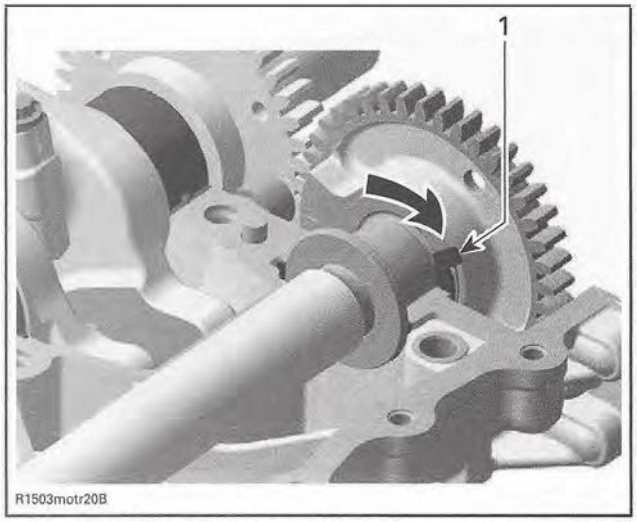
NOTICE **Balancer shaft and crankshaft marks have to be aligned.**



1. Mark on balancer shaft
2. Mark on crankshaft

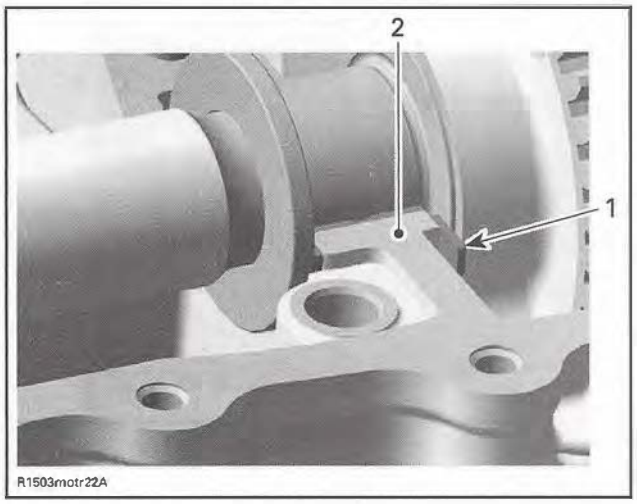
NOTICE **Never forget thrust washers no. 18 on PTO side to control axial adjustment on balancer.**

Insert thrust washers as soon as balancer shaft is in place as per following illustration.



THRUST WASHER INSERT DIRECTION
1. Thrust washer

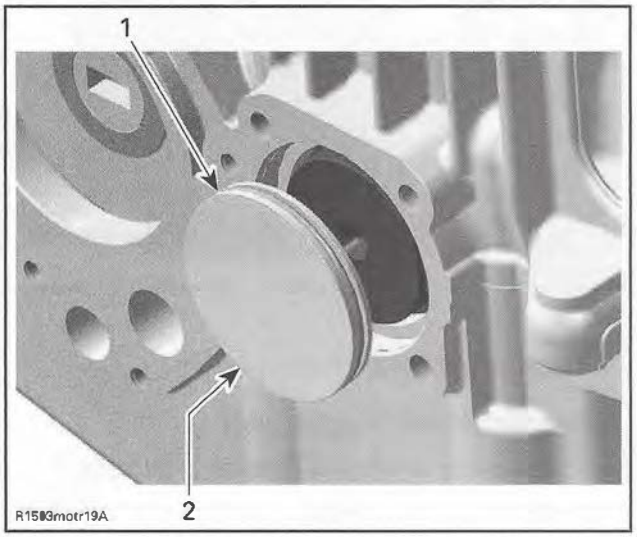
NOTICE **Thrust washers have to be flush with the cylinder block sealing surface.**



1. Thrust washer
2. Sealing surface

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

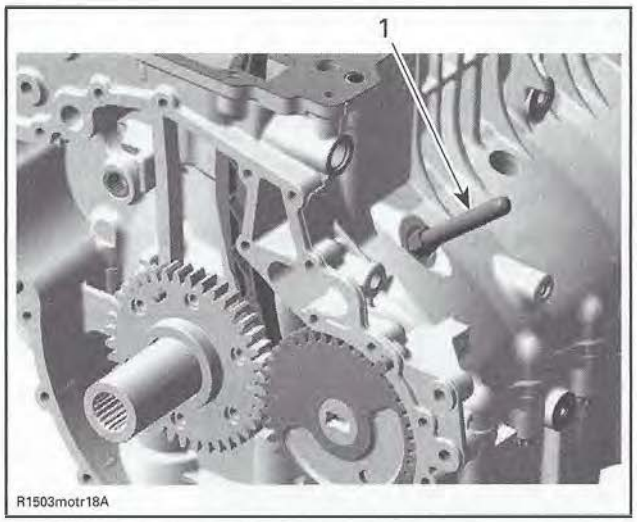
Install the crankshaft cover before mounting the engine bracket. Apply engine oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.



1. O-ring
2. Crankshaft cover

Position crankshaft at TDC before installing the camshaft and the rocker arms (refer to *CYLINDER HEAD* subsection).

REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)	



1. Crankshaft locking tool

CYLINDER BLOCK

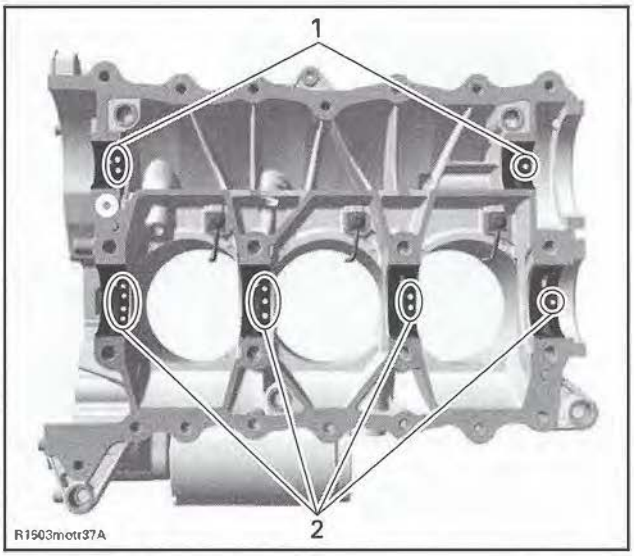
Cylinder Block Disassembly

Remove:

- Engine oil (refer to *LUBRICATION SYSTEM* subsection)
- Engine from vehicle (refer to *ENGINE REMOVAL AND INSTALLATION* subsection)
- Cylinder head (refer to *CYLINDER HEAD* subsection)
- PTO housing, starter gear and starter drive (refer to *PTO HOUSING AND MAGNETO* subsection)
- Oil suction pump (refer to *LUBRICATION SYSTEM* subsection)
- Balancer shaft (refer to *BALANCER SHAFT* elsewhere in this subsection)
- Crankshaft (refer to *CRANKSHAFT* elsewhere in this subsection)
- Piston with connecting rod (refer to *PISTONS AND CONNECTING RODS* elsewhere in this subsection).

Bearings

When bearings **no. 19** and **no. 20** need to be removed from the cylinder block, mark them to identify the correct position at installation. See the following illustration for an example:



1. Marks on balancer shaft bearings
2. Marks on crankshaft bearings

Cylinder Block Inspection

Cylinder

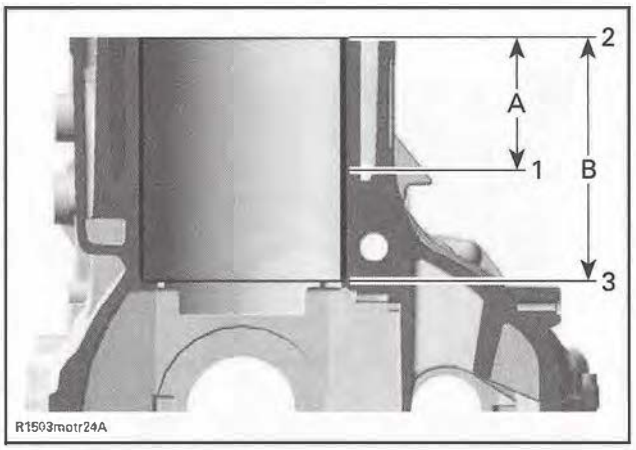
Check cylinder for cracks, scoring and wear ridges on the top and bottom of the cylinder. If so, replace cylinder.

Cylinder Taper

Measure cylinder bore and if it is out of specifications, re-hone cylinder sleeve and replace piston with first oversize.

NOTE: It is not necessary to have all cylinders re-honed if they are not all out of specification. Mixed standard size and oversize cylinders are allowed.

Measure cylinder bore at 3 recommended positions. See the following illustration.



1. First measuring diameter
2. Second measuring diameter
3. Third measuring diameter
A. 60 mm (2.362 in)
B. 110 mm (4.331 in)

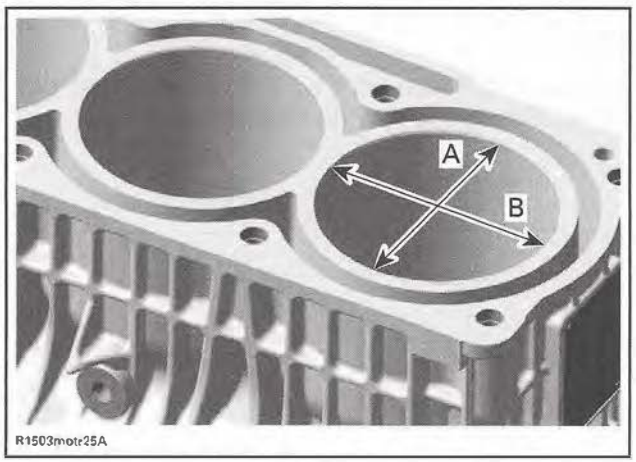
CYLINDER TAPER IN DIAMETER	
NEW MAXIMUM	0.038 mm (.001 in)
SERVICE LIMIT	0.100 mm (.004 in)

Distance between measurements should not exceed the service limit mentioned above.

Cylinder Out of Round

Measure cylinder diameter in piston axis direction from top of cylinder. Take an other measurement 90° from first one and compare.

NOTE: Take the same measuring points as described in *CYLINDER TAPER* above.



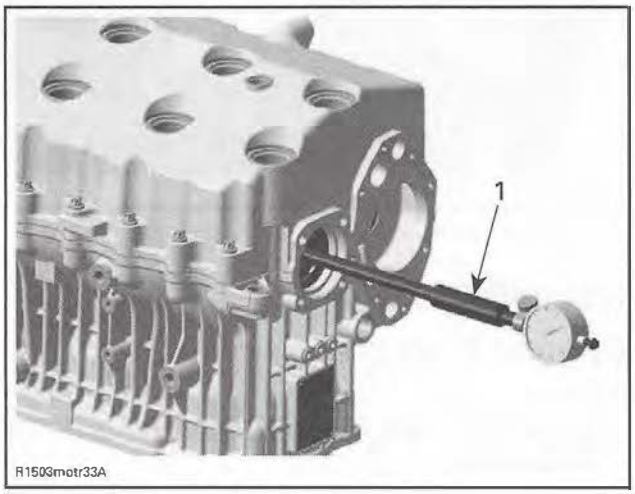
A. Perpendicular to crankshaft axis
B. Parallel to crankshaft axis

CYLINDER OUT OF ROUND	
NEW MAXIMUM	0.008 mm (.0003 in)
SERVICE LIMIT	0.015 mm (.0006 in)

Bearings

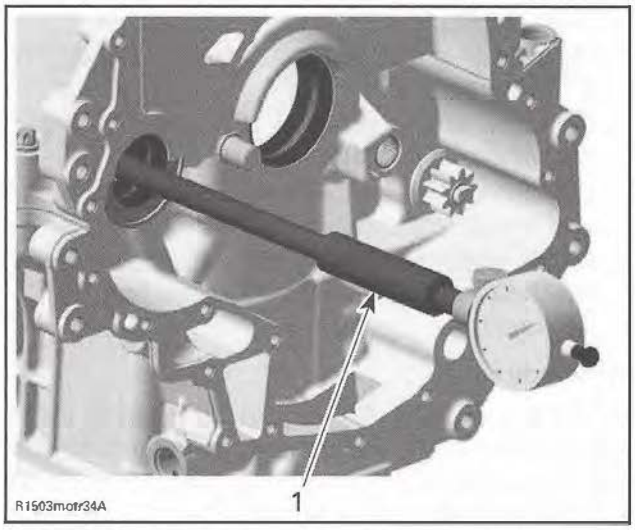
To measure the wear of the crankshaft bearings **no. 19** and balancer shaft bearings **no. 20**, both cylinder block halves with **OLD** bearings have to be screwed together as per tightening procedure described below.

Measure the inside diameter of the bearings with a bore gauge.



ENGINE UPSIDE DOWN
1. Bore gauge

CRANKSHAFT BEARING INSIDE DIAMETER	
SERVICE LIMIT	50.1 mm (1.9724 in)



ENGINE UPSIDE DOWN
1. Bore gauge

BALANCER SHAFT BEARING INSIDE DIAMETER	
SERVICE LIMIT	32.11 mm (1.2642 in)

Replace bearings if they are out of specifications.

Cylinder Block Assembly

For assembly, reverse the disassembly procedure. Pay attention to the following details.

Tighten Banjo screw to specification.

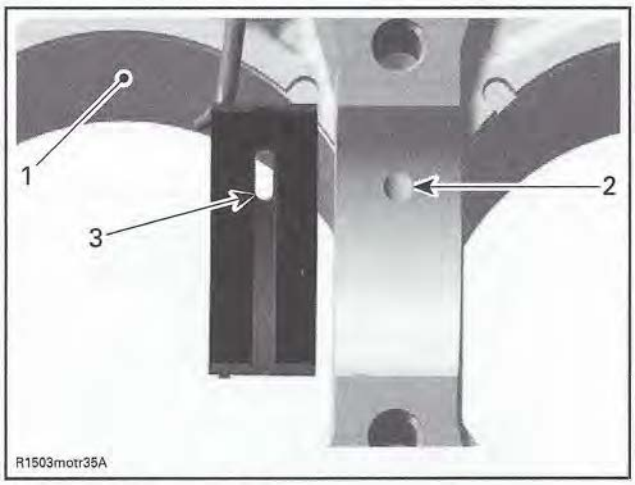
TORQUE	
Banjo screw	19 N•m (168 lbf•in)

Install starter drive bearing **no. 21**, refer to *PTO HOUSING AND MAGNETO* subsection.

Use **NEW** bearings when diameters are out of specification.

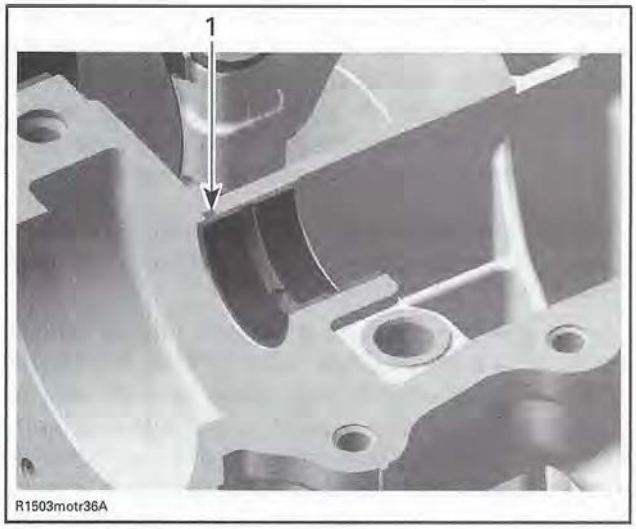
If **OLD** bearings can be used again, make sure they are at the same position as they were before.

Correctly install bearings. Top crankshaft bearing halves have a bore which has to be placed in the upper cylinder block.



1. *Cylinder block upper half*
2. *Oil bore in cylinder block*
3. *Oil bore in bearing*

Bearings have to be flush with the cylinder block split surface and their protrusions have to fit in the notched areas in the cylinder block seat.



1. *Bearing protrusion in cylinder block notch*

Apply engine oil on all bearings, in the bottom area of the cylinder bore and also on the band of the piston ring compressor tool.

For proper installation of pistons, refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTE: Before installing the crankshaft, make sure that the timing chain is on the crankshaft and the chain guide has been installed first. Those parts cannot be installed after as the crankshaft is in place.

Clean oil passages and make sure they are not clogged.

Clean all metal components in a solvent.

Cylinder block mating surfaces are best cleaned using a combination of the LOCTITE 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).

NOTICE **Do not wipe with rags. Use a new clean hand towel only.**

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

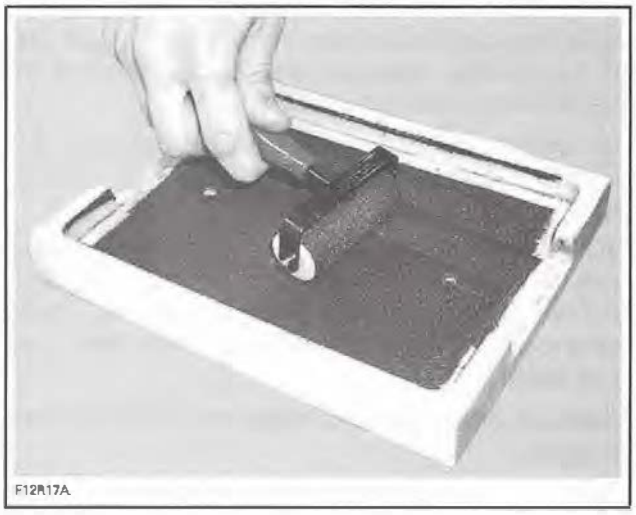
NOTE: It is recommended to apply this specific sealant as described here to get an uniform application without lumps. If you do not use the roller method, you may use your finger to uniformly distribute this sealant.

Apply LOCTITE 5910 (P/N 293 800 081) on mating surfaces.

NOTICE Do not use other products to seal crankcase. Do not use an activator with the Loctite 5910. Using other products or non silicone-based sealant over a previously sealed crankcase with Loctite 5910 will lead to poor adhesion and possibly a leaking crankcase.

NOTE: Refer to the product label for the sealant curing time. Respect the manufacturer's recommendations prior to start engine.

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

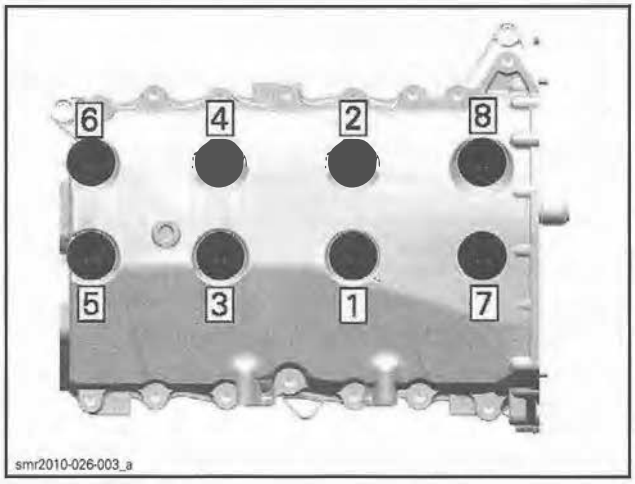

F12R17A

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

Tighten cylinder block screws as per following procedure:

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw threads.

Tighten M10 cylinder block screws no. 14 using the following sequence.



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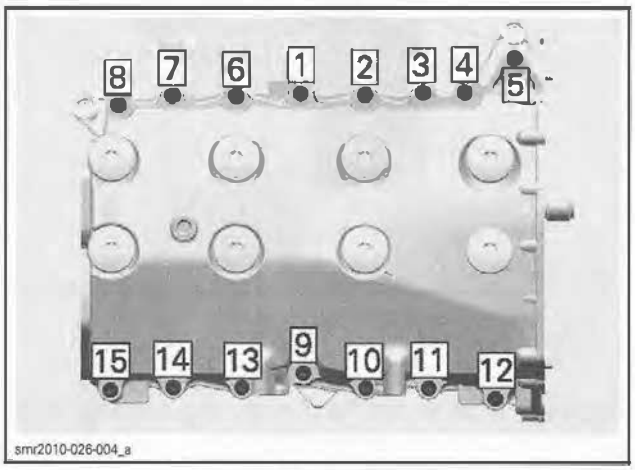
NOTICE M10 cylinder block screws must be torque FIRST according to step 1.

TORQUE		
M10 cylinder block screws	Step 1	40 N•m (30 lbf•ft)
	Step 2	55 N•m (41 lbf•ft)

Tighten M8 cylinder block screws no. 15 using the following sequence.



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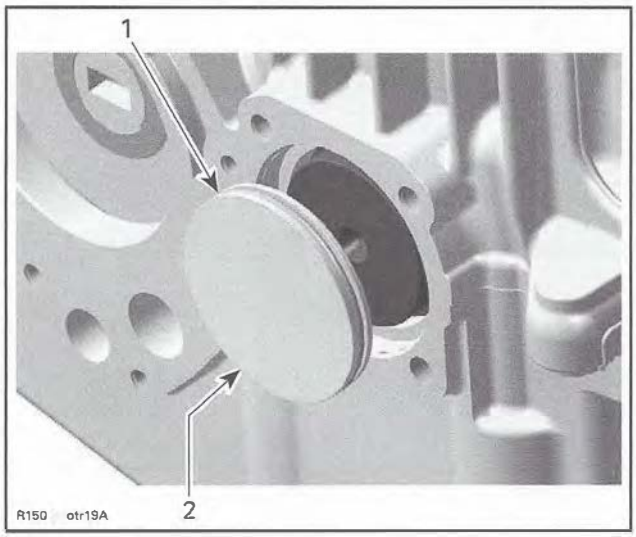
TORQUE	
M8 cylinder block screws	23 N•m (17 lbf•ft)

NOTE: Before continuing the assembly process, the axial clearance of balancer shaft and crankshaft has to be checked. Refer to *CRANKSHAFT* and *BALANCER SHAFT* in this subsection for the procedure.

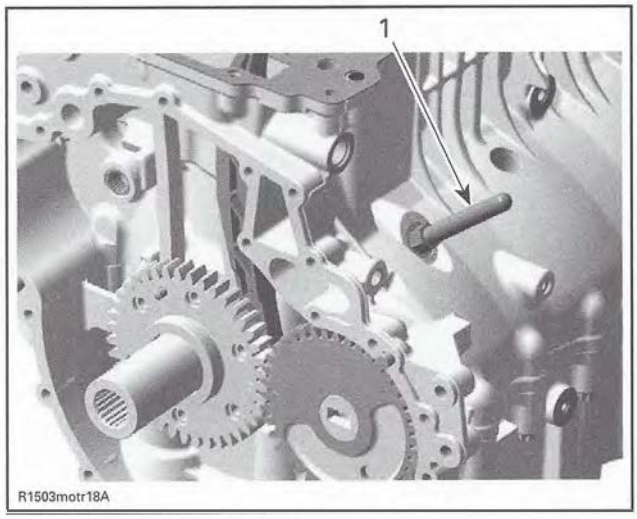
Install the crankshaft cover before mounting the engine bracket. Apply engine oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.



1. O-ring
2. Crankshaft cover

Position crankshaft at TDC before installing the camshaft and the rocker arms (refer to *CYLINDER HEAD* subsection).

REQUIRED TOOL
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)



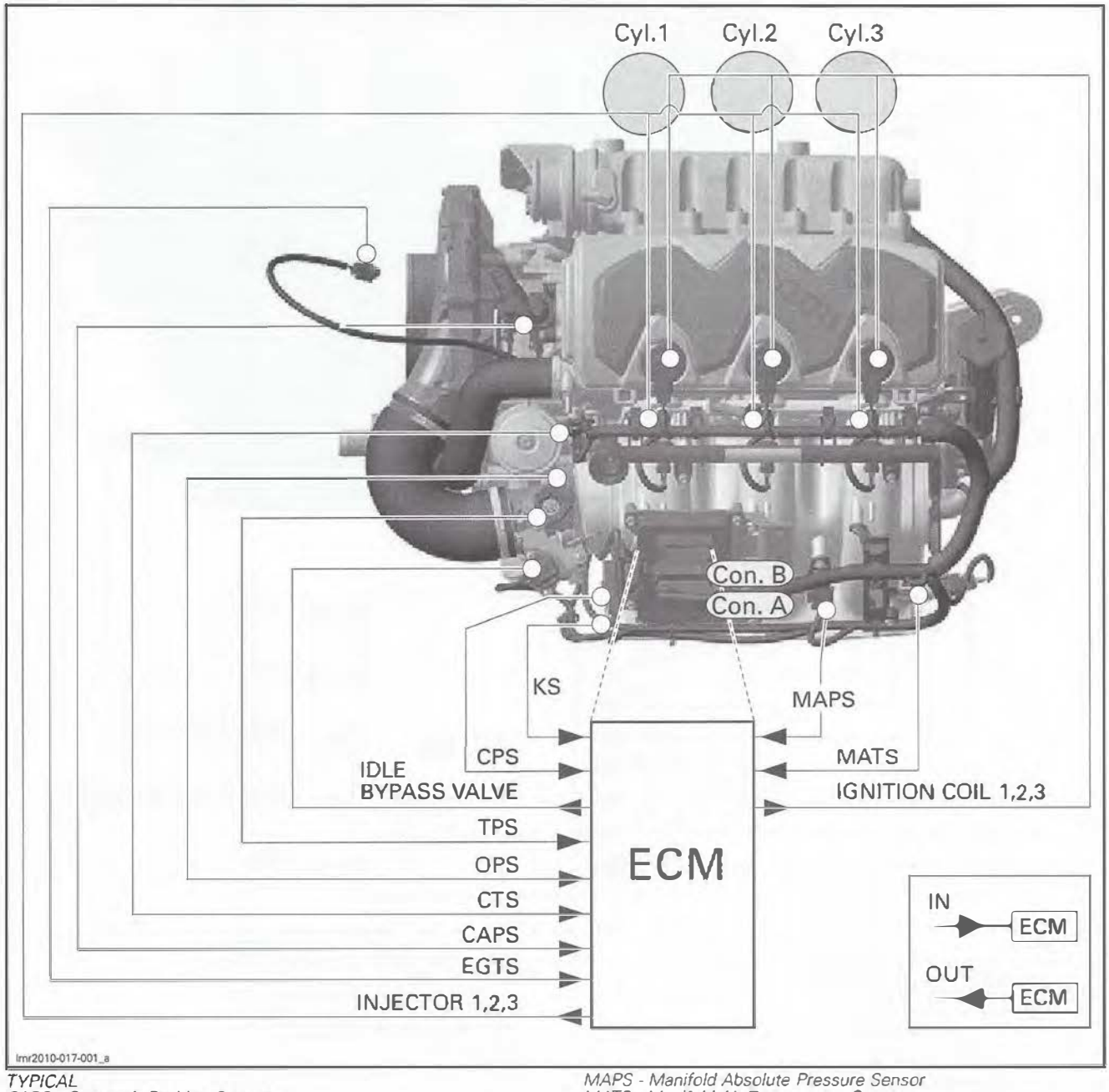
1. Crankshaft locking tool

Install cylinder head, PTO housing and the other parts in accordance with the proper assembly procedures.

ENGINE MANAGEMENT SYSTEM

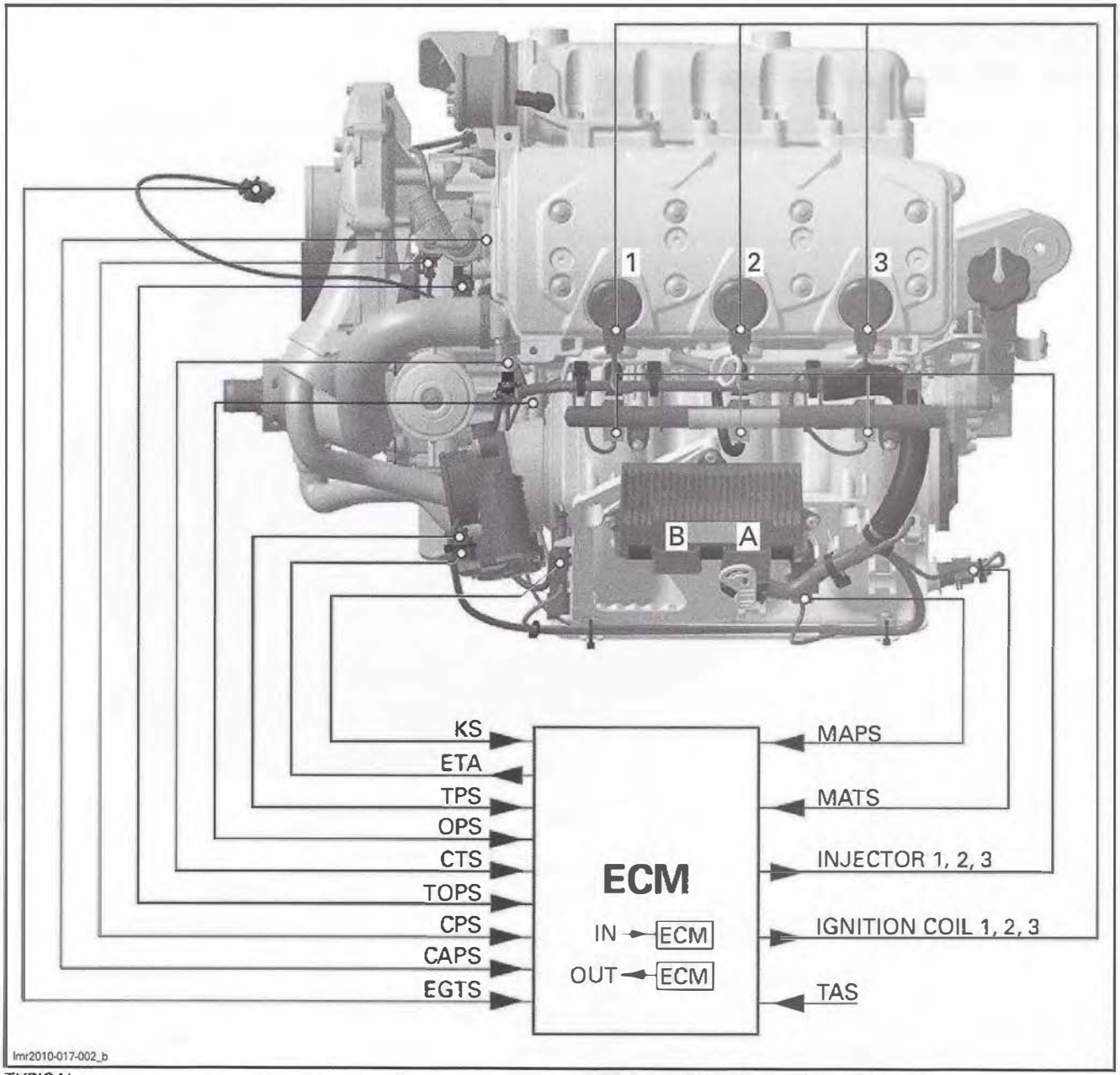
GENERAL

ENGINE MANAGEMENT SCHEMATIC (150, 180 AND 200 SERIES)



TYPICAL
CAPS - Camshaft Position Sensor
CPS - Crankshaft Position Sensor
Con. A - Engine Wiring Harness Connector
Con. B - Vehicle Wiring Harness Connector
CTS - Coolant Temperature Sensor
ECM - Engine Control Module
EGTS - Exhaust Gas Temperature Sensor
KS - Knock Sensor
MAPS - Manifold Absolute Pressure Sensor
MATS - Manifold Air Temperature Sensor
OPS - Oil Pressure Sensor
TPS - Throttle Position Sensor
Idle bypass valve
Ignition coil
Injector
In
Out

ENGINE MANAGEMENT SCHEMATIC (210 AND 230 SERIES)



TYPICAL
A - Engine Wiring Harness Connector
B - Vehicle Wiring Harness Connector
CAPS - Camshaft Position Sensor
CPS - Crankshaft Position Sensor
CTS - Coolant Temperature Sensor
ECM - Engine Control Module
EGTS - Exhaust Gas Temperature Sensor
ETA - Electric Throttle Actuator
KS - Knock Sensor
MAPS - Manifold Absolute Pressure Sensor
MATS - Manifold Air Temperature Sensor
OPS - Oil Pressure Sensor
TAS - Throttle Accelerator Sensor
TOPS - Tip-Over Protection System
TPS - Throttle Position Sensor
Ignition coil
Injector
In
Out

SYSTEM DESCRIPTION

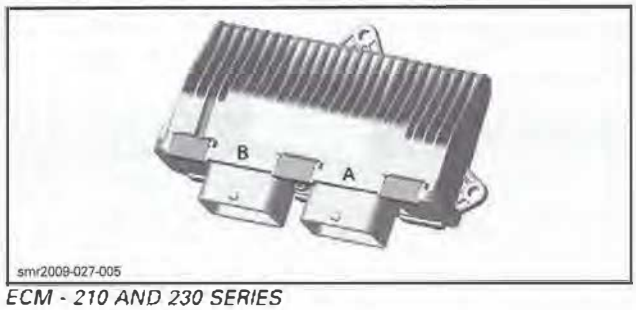
A highly advanced engine management system (EMS) is used to ensure a high power output with cleaner combustion. To accomplish this, other systems must interact with the EMS.

The main systems that interact with the engine management system are:

1. Electronic fuel injection
2. D.E.S.S. system (except 210 and 230 Series)
3. Ignition system
4. Starting system
5. T.O.P.S. (Tip-Over Protection System on 210 and 230 series)
6. iTC (intelligent Throttle Control system on 210 and 230 series).

Engine Control Module (ECM)

ECM - 150, 180 AND 200 SERIES



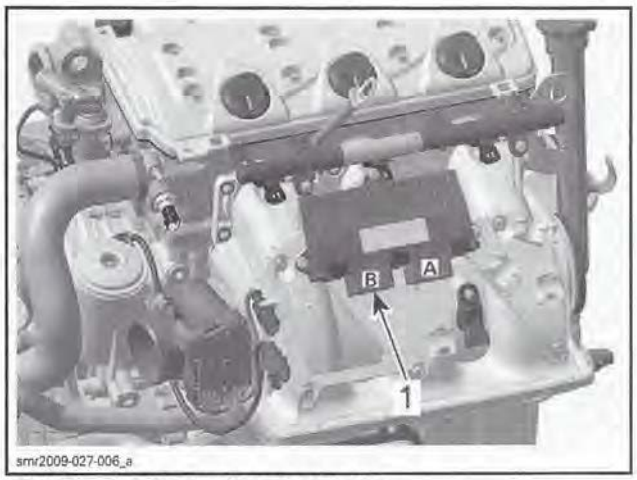
ECM - 210 AND 230 SERIES

The ECM is mounted on the intake manifold.

The ECM is the main component of the engine management system. It controls the electrical system and the engine management functions by processing the information obtained from various switches, controls and sensors that it compares to predetermined parameters stored in the ECM.

It also interacts with other electronic systems through the CAN bus (information center) for various functions that affect engine management.

On iTC equipped models, the ECMs (one on each engine) also communicate with each other for functions, such as engine synchronization.



TYPICAL - iTC ENGINE ILLUSTRATED
1. ECM on intake manifold

The ECM features a permanent memory that will store fault codes, customer information and other engine information, even when the battery is removed from the vehicle.

The ECM controls the following engine management functions:

Engine RPM Limiter

The ECM limits maximum engine speed. It monitors engine RPM through the CPS.

Models Without iTC

When maximum engine RPM is attained, ignition is cut off to prevent an engine overspeed.

Models With iTC

The ECM varies fuel injection, ignition and throttle plate opening as necessary to limit engine RPM.

Engine Speed Control

Idle speed is not adjustable. The ECM controls the engine idle RPM.

Models Without iTC

When the throttle lever is advanced, it mechanically opens the throttle plate allowing the engine to draw in more air. The ECM will then adjust fuel injection and ignition timing accordingly to provide the desired change in engine speed and power.

Models With iTC

The throttle/shift lever is connected to the TAS (Throttle Accelerator Sensor) actuator lever via a cable. When the throttle lever is advanced, it acts upon the TAS located in the helm, which sends signals to the ECM that are proportional to the change in speed or power desired. The ECM then varies the engine speed by commanding the electric throttle actuator (ETA) towards open or close based on throttle position and various other

inputs. The ETA also allows for other functions of the iTC system such as cruise and ski modes. Refer to *INTELLIGENT THROTTLE CONTROL (ITC)* subsection.

Engine Synchronization

Engine synchronization is used to synchronize the RPM of both engines. It is active by default and indicated by a SYNC indicator light in the RH tachometer, and may be selected OFF or ON through the multifunction gauge.

Engine synchronization is a function of the multifunction gauge and both ECMs. The gauge tells the ECMs that the function is active, and the engine that tends to produce a higher RPM will synchronize itself to the engine with the lower RPM. This is possible as the ECMs compare their operating parameters with each other through the CAN bus system.

If the difference in RPM between the two engines is too great such as when manoeuvring or if an engine goes into limp mode, synchronization may be automatically disabled. If the condition is momentary such as during a manoeuvre, the SYNC indicator light will go off.

Drowned Mode

If an engine is flooded and does not start, this special mode can be activated to prevent fuel injection and ignition while cranking in order to ventilate the engine to dry the cylinder walls.

Proceed as follows to activate drowned mode.

Models Without iTC

1. Ensure engine is OFF.

⚠ WARNING

Engine(s) must be stopped when using drowned mode to vent a flooded engine.

2. Set throttle lever to idle position.
3. Set shift lever to neutral position.
4. Install tether cord on the engine cut-off switch.
5. Open the engine access cover.
6. Manually rotate the throttle plate on the drowned engine to wide open position (WOT) and HOLD.

TYPICAL
1. Wide open position

7. Have someone press and hold the start/stop switch to crank engine while still HOLDING the throttle plate at WOT.

NOTE: The ECM will allow engine cranking while inhibiting fuel injection and ignition. Do not crank engine for more than 10 seconds.

Releasing the throttle plate will return the engine to its normal mode of operation.

If the engine does not start, it may be necessary to remove spark plugs and crank engine with rags over spark plug holes. Refer to *IGNITION SYSTEM* subsection.

Models With iTC

To activate DROWNED MODE, proceed as per following steps.

1. Ensure **both engines are OFF.**

⚠ WARNING

Both engines must be stopped when using drowned mode to vent a flooded engine.

2. Install the tether cord on the engine cut-off switch.
3. Ensure the throttle/shift lever is in the NEUTRAL position.
4. Move the throttle accelerator sensor (TAS) to the wide open throttle position (WOT).

NOTE: For TAS access and identification, refer to *INTELLIGENT THROTTLE CONTROL (ITC)* (210 and 230 Series) subsection.

1. Throttle accelerator sensors (TAS)
2. Wide open throttle position (WOT)

5. Have someone to perform the following:
   - Turn ignition switch to ON
   - Press and hold the START/STOP button.

NOTE: The ECM will allow engine cranking while inhibiting fuel injection and ignition. Do not crank engine for more than 10 seconds.

Releasing the TAS will allow the ECM to revert back to normal mode.

If the engine does not start, it may be necessary to remove the spark plugs and crank the engine with rags over the spark plug holes. Refer to *IGNITION SYSTEM* subsection.

Monitoring System

The ECM monitors electrical and electronic components of the engine system, the information center (gauge), some components of the electrical system as well as signals from other electronic modules.

For more information, refer to *DIAGNOSTIC AND FAULT CODES*.

Limp Home Mode

The ECM may automatically put the engine in LIMP HOME MODE using default parameters when certain major faults are detected. For more information, refer to *DIAGNOSTIC AND FAULT CODES*.

210 and 230 Series

If a fault is detected that triggers the activation of LIMP HOME MODE, both engines will be in limp home mode.

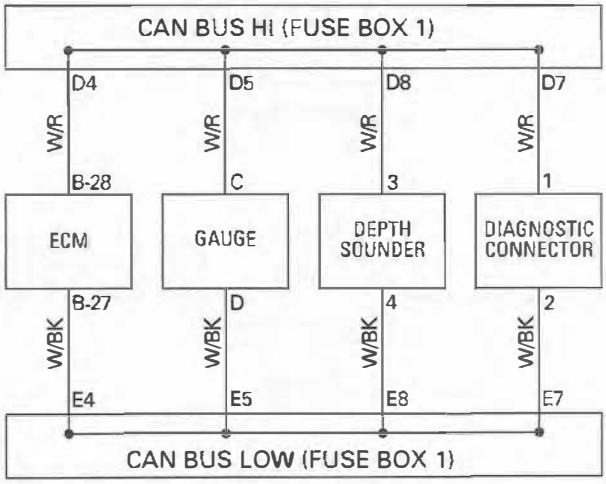
Diagnostic Mode

The ECM features a self-diagnostic mode that is initiated on system power up for certain systems and components (when pressing the START button), and when the engine is running for others. Refer to *DIAGNOSTIC AND FAULT CODES* subsection for more information.

CONTROLLER AREA NETWORK (CAN)

CAN DIAGRAM

150 and 180 Series



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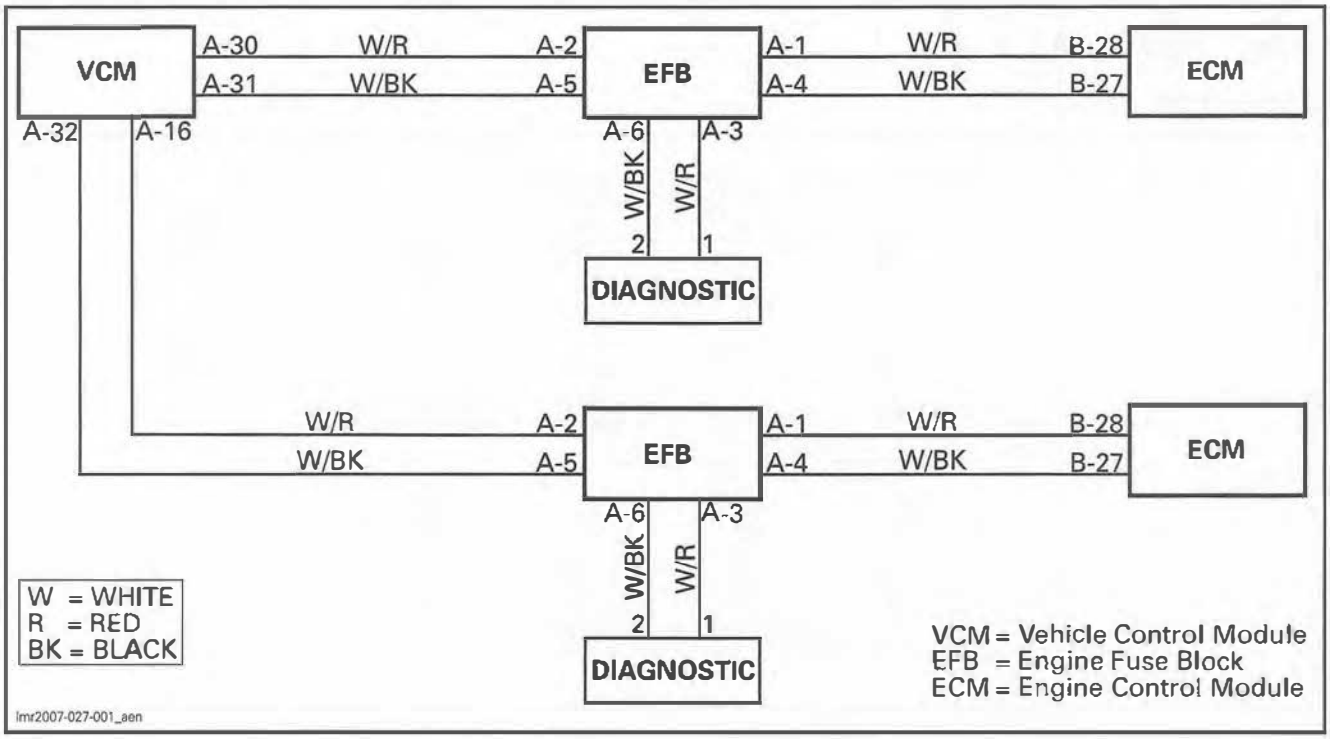
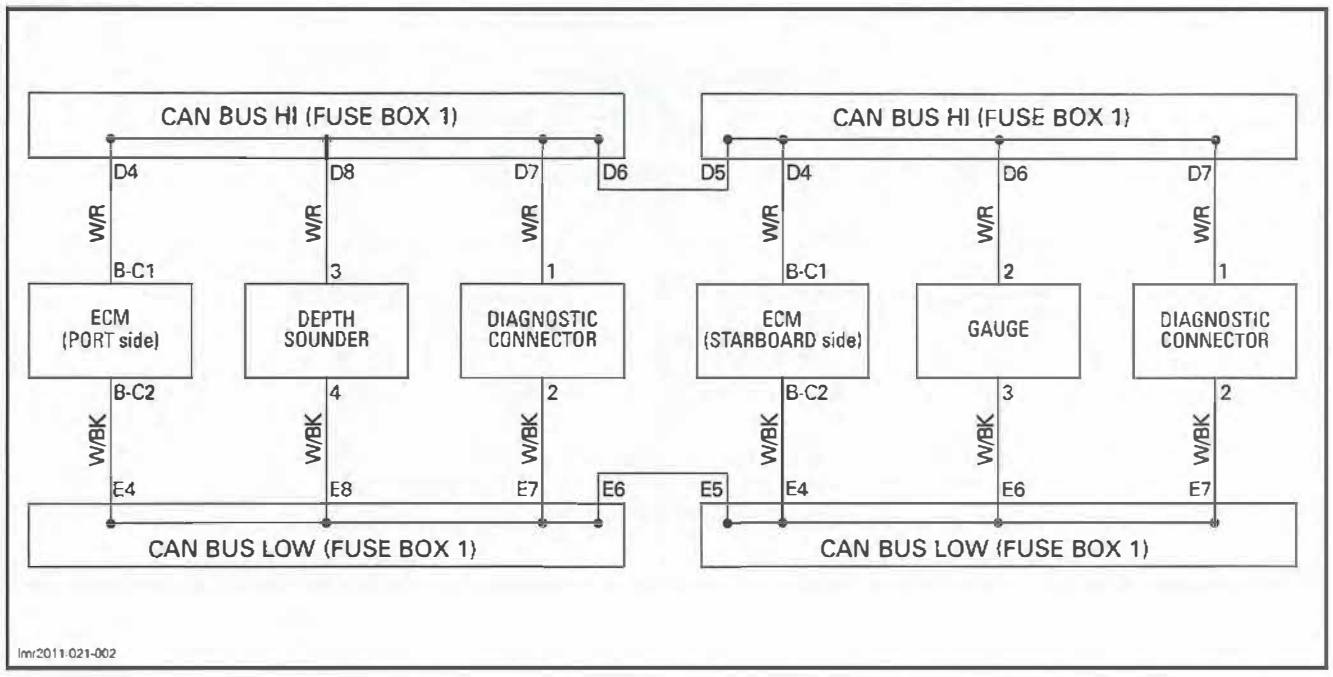
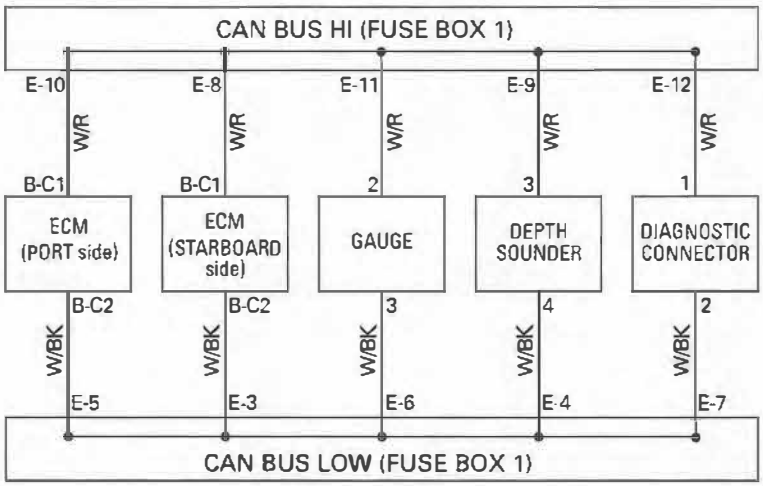
200 Series


VCM
A-30
A-31
W/R
W/BK
A-2
A-5
EFB
A-1
A-4
W/R
W/BK
B-28
B-27
ECM
A-32
A-16
A-6
A-3
W/BK
W/R
2
1
DIAGNOSTIC
W/R
W/BK
A-2
A-5
EFB
A-1
A-4
W/R
W/BK
B-28
B-27
ECM
A-6
A-3
W/BK
W/R
2
1
DIAGNOSTIC
W = WHITE
R = RED
BK = BLACK
VCM = Vehicle Control Module
EFB = Engine Fuse Block
ECM = Engine Control Module
lmr2007-027-001_aen

210 Series


CAN BUS HI (FUSE BOX 1)
CAN BUS HI (FUSE BOX 1)
D4
D8
D7
D6
D5
D4
D6
D7
W/R
W/R
W/R
W/R
W/R
W/R
B-C1
3
1
B-C1
2
1
ECM (PORT side)
DEPTH SOUNDER
DIAGNOSTIC CONNECTOR
ECM (STARBOARD side)
GAUGE
DIAGNOSTIC CONNECTOR
B-C2
4
2
B-C2
3
2
W/BK
W/BK
W/BK
W/BK
W/BK
W/BK
E4
E8
E7
E6
E5
E4
E6
E7
CAN BUS LOW (FUSE BOX 1)
CAN BUS LOW (FUSE BOX 1)
lmr2011-021-002

230 Series



lmr2011-021-001

GENERAL

SYSTEM DESCRIPTION

The CAN (Controller Area Network) protocol is an ISO standard for serial data communication.

The CAN bus links the electronic modules (ECUs) together so that they communicate to interact as required.

The communication link is also used to communicate with the B.U.D.S. software (Bombardier Utility and Diagnostic System).

CAN lines consist of a pair of twisted wires (WHITE/BLACK and WHITE/RED).

All modules monitor each other. If a component or system malfunction is detected, a module may generate a fault code, which it transmits through the CAN bus as a signal. The fault signal may be used for various functions such as triggering the display of an error message in the gauge, turning on a fault indicator light, limiting or inhibiting vehicle or engine operation, or viewed using the B.U.D.S. software for troubleshooting.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Check the fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* section.

CAN Communication Problems

The following chart gives some symptoms and behaviors relative to the CAN component in cause. The list is not exhaustive or specific to a model, only the most significant items are given to help in troubleshooting.

CAN FAULTY WIRES (NO COMMUNICATION)	BOAT BEHAVIOR OR OBSERVATION IN GAUGE	OBSERVATION IN B.U.D.S.
Short circuit in CAN wires	– Engine is set to limp home mode. – Check engine light is ON.	– B.U.D.S. will not be able to communicate with any electronic module. – "No vehicle detected" message will be displayed in B.U.D.S.
Gauge	– Check engine light is ON. – Some functions not displayed such as: Engine hours and RPM.	– Missing modules. – "Cluster" tab and its data will not be available in B.U.D.S. – ECM will report a cluster CAN problem.
ECM (Engine Control Module)	– Engine is set to limp home mode. – Check engine light is ON. – Some functions not displayed such as: Engine hours and RPM.	– Missing modules. – ECM tab and its data will not be available in B.U.D.S.
Diagnostic connector	– No symptom.	– B.U.D.S. will not be able to communicate with any electronic module. – "No vehicle detected" message will be displayed in B.U.D.S.

CAN Continuity Tests

If a communication problem is present, perform the appropriate continuity test relating to the component reported by, or not available in B.U.D.S., before assuming the component is at fault.

For circuit details, refer to the applicable CAN DIAGRAM in this subsection and to the corresponding *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547).*

COMMUNICATION TOOLS AND B.U.D.S.

SERVICE TOOLS

GENERAL

Refer to *PROCEDURES* for instructions on the communication tools.

If communication problems occur, refer to *TROUBLESHOOTING* in this subsection.

REQUIRED TOOLS

MANDATORY TOOLS	
A personal computer (laptop or desktop)	
MPI-2 INTERFACE CARD (P/N 529 036 018)	
MPI-2 DIAGNOSTIC CABLE (P/N 710 000 851)	
FOR 150, 180 and 200 Series D.E.S.S. POST INTERFACE (P/N 529 036 019)	
OPTIONAL TOOL	
Extension cable available at electronic retail outlets. Do not exceed 7.5 m (25 ft)	

DIAGNOSTIC CONNECTOR LOCATION

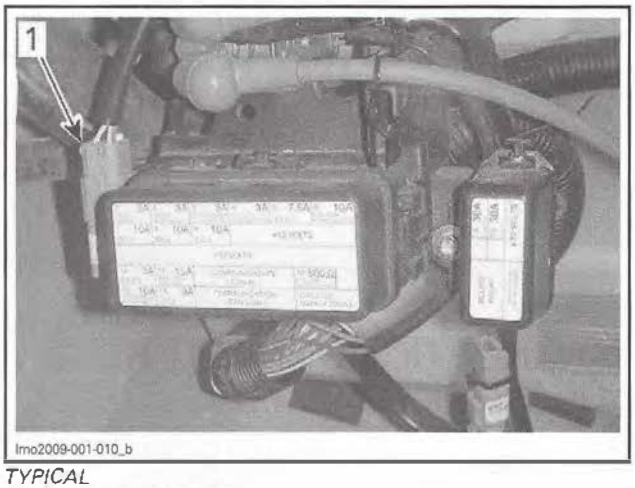
MODEL	B.U.D.S CONNECTOR LOCATION
150 Speedster	Engine compartment, in port side next to fuse box.
180 Challenger	Port side, under the rear storage cover
200 Speedster	Underneath rear seat, in storage compartment (1)
210 Series	Engine compartment, next to fuse box (2)
230 Series	Engine compartment, next to fuse box support on starboard side (3)

(1) The 200 series have two diagnostic connectors, one for each engine. The port diagnostic connector allows communication with the port ECM (only), and the starboard connector with the starboard ECM (only).

(2) The 210 series have two diagnostic connectors. Port or starboard connector may be used to communicate with the cluster and the both ECMs through CAN bus.

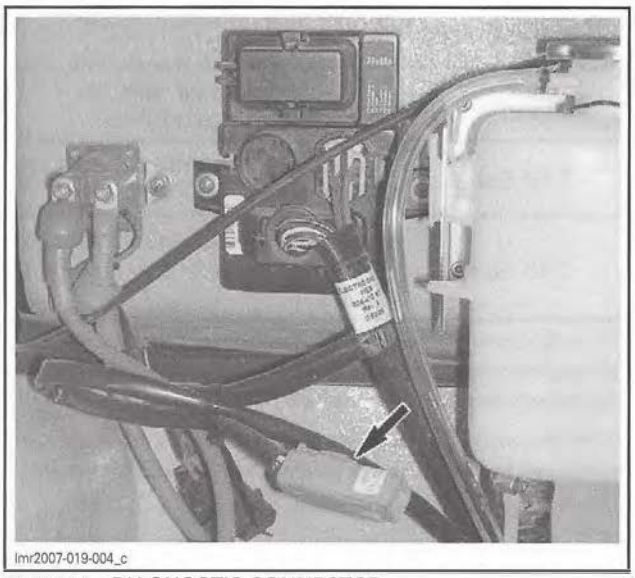
(3) The 230 series used one diagnostic connector to communicate with cluster and both ECMs through the CAN bus.

150 and 180 Series



TYPICAL
1. Diagnostic connector

200 Series



TYPICAL - DIAGNOSTIC CONNECTOR

210 and 230 Series

T PICAL
1. Diagnostic connector

TROUBLESHOOTING

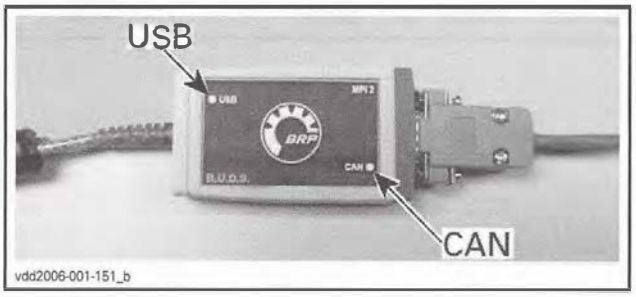
DIAGNOSTIC TIPS

IMPORTANT: Make sure all connections are made and vehicle is powered up before starting B.U.D.S. to allow proper communication between the vehicle and B.U.D.S. software.

MPI-2 Connection Troubleshooting

MPI-2 Status Lights

The MPI-2 includes 2 status lights that indicate the connection condition: USB and CAN. Both lights must be GREEN for the MPI-2 to function properly. Otherwise, refer to the following charts.



Prerequisite for USB communication:

1. PC Computer turned on
2. MPI-2 connected to PC computer.

USB LIGHT	
STATUS	WHAT TO DO
Light is OFF	– Check USB connection between MPI-2 and PC computer. – Check USB operation on PC computer (hardware or Windows drivers).
Light is GREEN	– Connections are GOOD. Communication can take place on USB side.

Prerequisite for CAN communication:

1. MPI-2 connected to boat diagnostic connector.
2. ECM turned on (electrical system powered up without engine started).
3. Tether cord installed on the engine cut-off switch.
4. B.U.D.S. started and logged on.

CAN LIGHT	
STATUS	WHAT TO DO
Light is OFF	– Check connection between MPI-2 and diagnostic connector on vehicle.
Light is RED	– Check CAN wires/connectors on vehicle.
Light is GREEN	– Connections are GOOD. Communication can take place on CAN side.

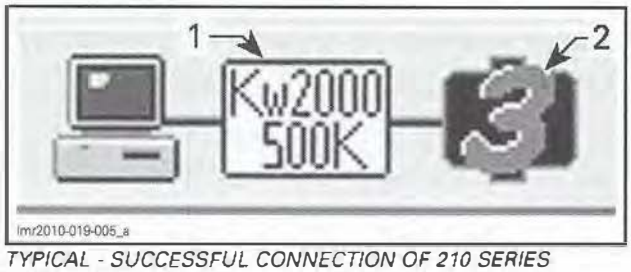
Communication Problems when Using B.U.D.S.

Missing Module

The following table indicates the number of module.

MODEL	NUMBER OF MODULES	MODULES
150 and 180 Series	2	ECM and cluster
200 Series	1	ECM
210 and 230 Series	3	ECM (2x) and cluster

The number of modules is shown at the bottom RH side of B.U.D.S. screen.

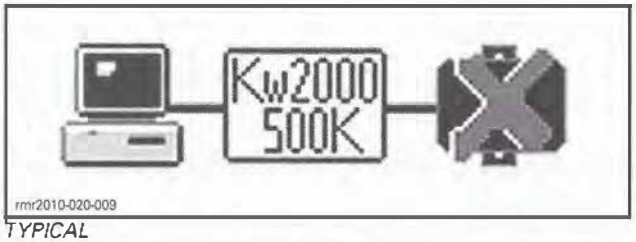


TYPICAL - SUCCESSFUL CONNECTION OF 210 SERIES
1. Connection protocol
2. Number of modules read

If one or more ECU is not communicating with the MPI, refer to *DIAGNOSTIC AND FAULT CODES* subsection.

No Vehicle Detected

If an "X" is shown in the status bar and the protocol tool is blinking between Kw2000 500K and Kw2000, it means that no "ECU" is communicating with the MPI.

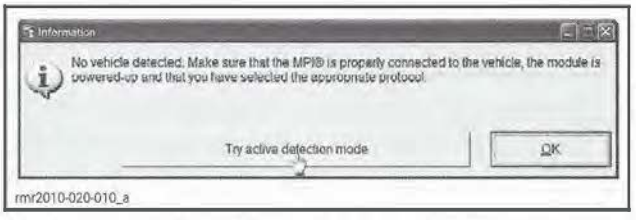


TYPICAL

1. Check connections between the PC computer and the vehicle.
2. Activate the boat electrical system without starting the engine. Refer to *POWER DISTRIBUTION SYSTEM* subsection.

NOTE: The tether cord must be installed on the engine cut-off switch.

3. Ensure both USB and CAN lights on the MPI-2 are GREEN. Refer to *MPI-2 CONNECTION TROUBLESHOOTING* subsection.
4. If B.U.D.S. does not automatically exit the following message box, click the **Try active detection mode** button. This will manually establish the communication with the ECUs.



Message Box: "Some of the Information Normally Displayed..."

If the following message box is displayed in B.U.D.S.:

smr2009-028-016

1. Click on the **OK** button in the box.
2. Ensure the tether cord is properly installed.
3. Click on the **Read Data** button in B.U.D.S.

PROCEDURES

MPI-2

The MPI-2 (Multi-Purpose Interface-2) in conjunction with the MPI-2 diagnostic cable is used with B.U.D.S. software to communicate with the ECM (engine control module) and other modules.

MPI-2 Power

The MPI-2 interface card uses the power from the PC computer's USB port.

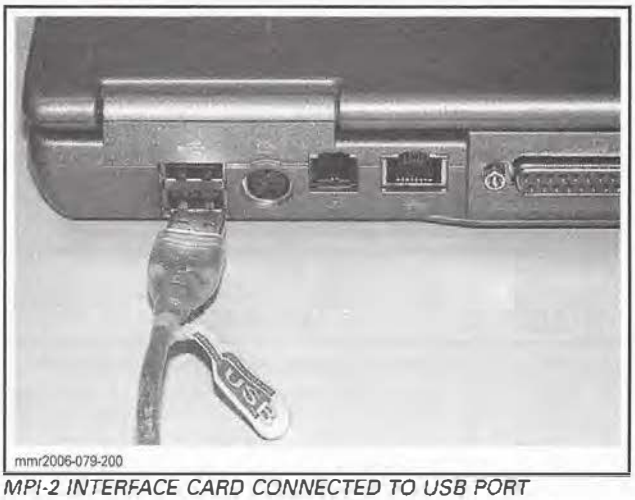
Connecting the PC to the Boat for Diagnostics

REQUIRED TOOLS	
A personal computer (laptop or desktop)	
MPI-2 INTERFACE CARD (P/N 529 036 018)	
MPI-2 DIAGNOSTIC CABLE (P/N 710 000 851)	
OPTIONAL TOOL	
Extension cable available at electronic retail outlets. Do not exceed 7.5 m (25 ft)	

1. Locate the 6-pin diagnostic connector, refer to *DIAGNOSTIC CONNECTOR LOCATION* in this subsection.
2. Disconnect the 6-pin diagnostic connector from it's holder (protective cap).
3. Connect one end of the MPI-2 DIAGNOSTIC CABLE (P/N 710 000 851) to the vehicle connector.
4. Connect the other end of diagnostic cable to the MPI-2 INTERFACE CARD (P/N 529 036 018).


vdd2006-001-151
DIAGNOSTIC CABLE CONNECTED TO MPI-2 INTERFACE CARD

5. Connect the MPI-2 INTERFACE CARD (P/N 529 036 018) to the USB port of a PC (personal computer).


mmr2006-079-200
MPI-2 INTERFACE CARD CONNECTED TO USB PORT

⚠ CAUTION If the computer you are using is connected to a power outlet, there is a potential risk of electric shock when working in contact with water. Be careful not to touch water while working with the computer.

6. Use B.U.D.S. software as described further in *B.U.D.S. SOFTWARE*.

Connecting the PC to the Boat for Programming D.E.S.S. Keys

All Models except 210 and 230 Series

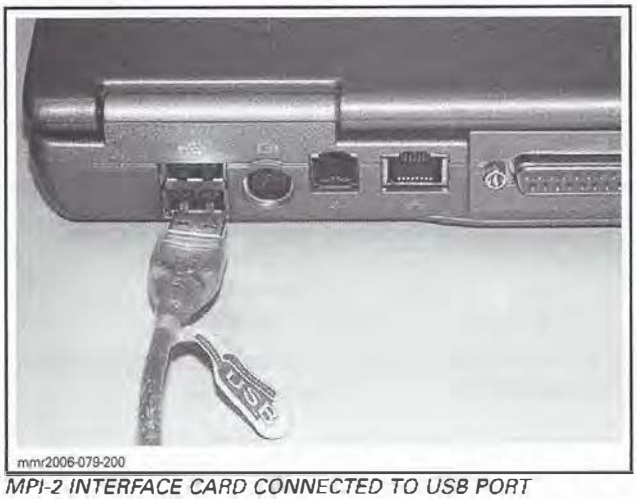
MANDATORY TOOLS	
A personal computer (laptop or desktop)	
MPI-2 INTERFACE CARD (P/N 529 036 018)	

MANDATORY TOOLS	
D.E.S.S. POST INTERFACE (P/N 529 036 019)	
OPTIONAL TOOL	
Extension cable available at electronic retail outlets. Do not exceed 7.5 m (25 ft)	

1. Locate the 6-pin diagnostic connector, refer to *DIAGNOSTIC CONNECTOR LOCATION* in this subsection.
2. Disconnect the 6-pin diagnostic connector from it's holder (protective cap).
3. Connect one end of the D.E.S.S. POST INTERFACE (P/N 529 036 019) to the 6-pin diagnostic connector.
4. Connect the other end of the D.E.S.S. post interface to the MPI-2 INTERFACE CARD (P/N 529 036 018).

D.E.S.S. POST INTERFACE CONNECTED TO MPI-2 INTERFACE CARD

5. Connect the MPI-2 INTERFACE CARD (P/N 529 036 018) to the USB port of a PC (personal computer).



MPI-2 INTERFACE CARD CONNECTED TO USB PORT

⚠ CAUTION **If the computer you are using is connected to a power outlet, there is a potential risk of electric shock when working in contact with water. Be careful not to touch water while working with the computer.**

6. Use B.U.D.S. software as described further in *B.U.D.S. SOFTWARE*.
7. Refer to *DIGITALLY ENCODED SECURITY SYSTEM* subsection for key programming.

B.U.D.S. SOFTWARE

B.U.D.S. (Bombardier Utility and Diagnostic Software) is designed to allow programming key(s) to the vehicle, allow electrical and electronic component monitoring, activation of certain components for diagnostic purposes, and to carry out settings changes.

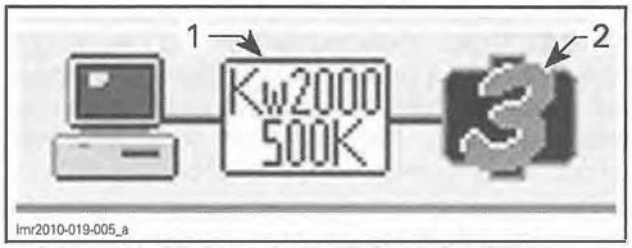
For more information pertaining to the use of the B.U.D.S. software, use its help which contains detailed information on its functions.

Always use the latest applicable B.U.D.S. version available on BOSSWeb.

How to Read the Electronic Control Units Using B.U.D.S. Software

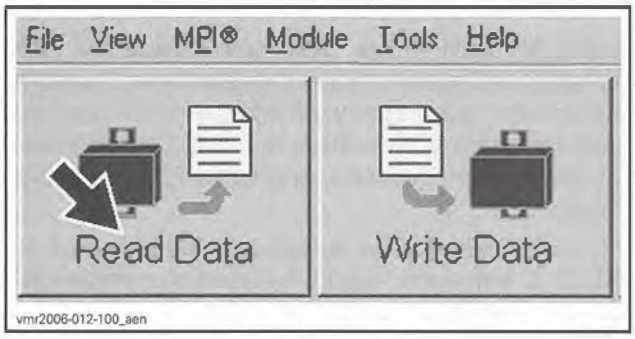
1. Connect the PC to the boat. Refer to *CONNECTING THE PC TO THE BOAT FOR DIAGNOSTICS* in this subsection
2. Ensure the tether cord is properly installed on the engine cut-off switch.
3. Energize the electrical system without starting the engine.
4. Start B.U.D.S. and logon.
5. Ensure the status bar shows the proper Kw2000 protocol and the appropriate number of modules to its right according to the vehicle model. Otherwise, refer to *MPI-2 CONNECTION TROUBLESHOOTING* in this subsection.

BOAT MODEL	PROTOCOL	NUMBER OF MODULES
200 Series	Kw2000	1 (each engine)
150 and 180 Series	Kw2000	2
210 and 230 Series	Kw2000 (500K)	3



TYPICAL - SUCCESSFUL CONNECTION OF 210 SERIES
1. Connection protocol
2. Number of modules read

6. Read ECM by clicking the **Read Data** button.

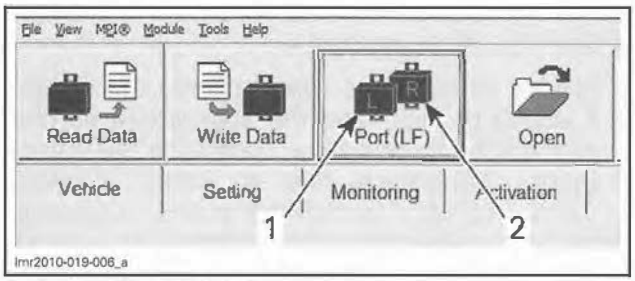


B.U.D.S. is now ready to use.

210 and 230 Series

When clicking on the **Read Data** button, B.U.D.S. will read the cluster module and the ECM on both engines through CAN bus.

However, to view the information from a specific ECM or to change settings in a specific ECM, click on the**Starboard (R)** or **Port (L)** button icon to choose the ECM you wish to communicate with **(R)** or **(L)**.



1. Port (L) ECM selected
2. Starboard (R) ECM available

NOTE: The L or R icon selected will be highlighted in red and move to the forefront of the button.

Electronic Modules ("ECU") Update

NOTICE **Failure to strictly follow a procedure to update a module may permanently damage the module.**

NOTE: On twin engine models, this procedure must be carried out for each ECM.

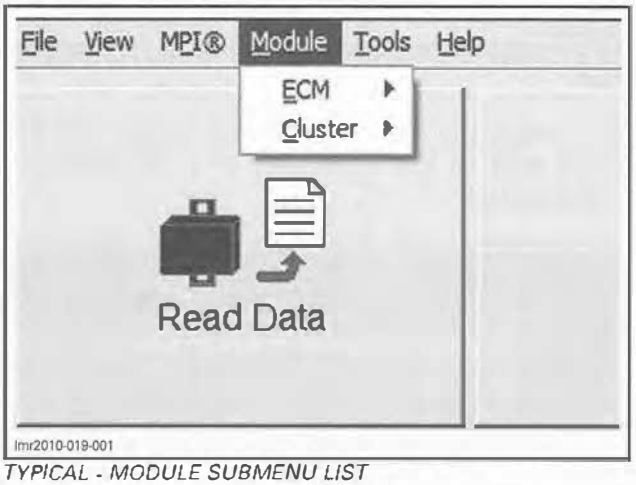
Whenever B.U.D.S. is started, check for an update icon in the B.U.D.S. status bar.

TYPICAL

If the icon is visible, it indicates that a file is available in B.U.D.S. to update at least one of the electronic modules:

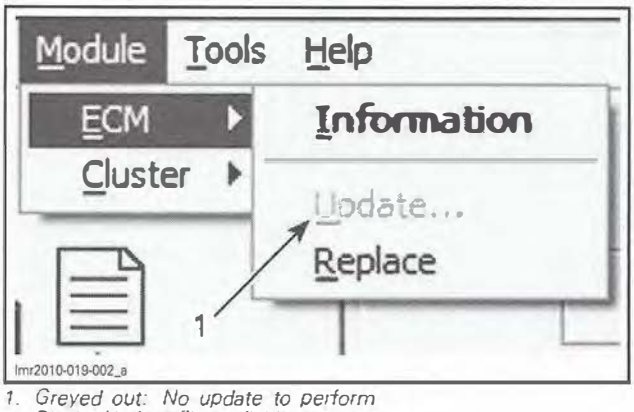
NOTE: If an update file is available on BOSSWeb but the B.U.D.S. software being used is not up to date, the update icon will not appear. Refer to the service bulletins to see if there is an update available.

Use the **Module** submenu and check all modules one at a time to see which module(s) can be updated.



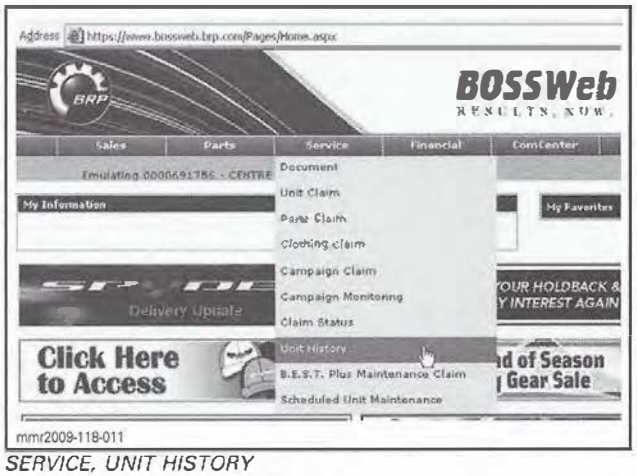
TYPICAL - MODULE SUBMENU LIST

1. If the **Update** option is **greyed out**, no update file is available for this module.
2. If the **Update** option is **black**, an update file is available for this module.



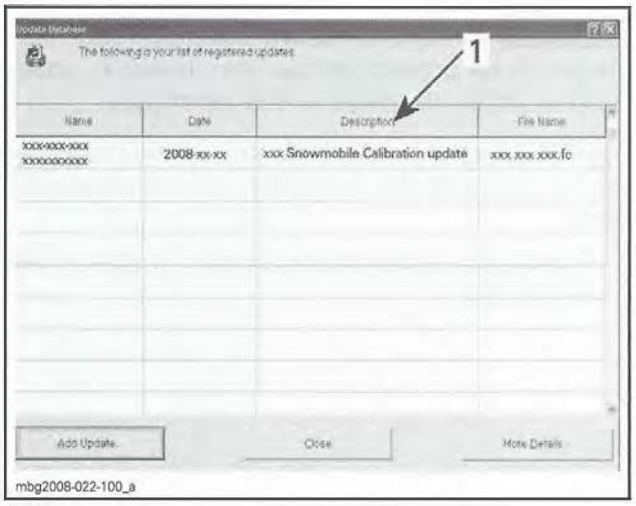
1. *Greyed out: No update to perform*
   Black: Update file available

Before applying an update, log in BOSSWeb and look in **Service** for the **Unit history** to find out if any information or publication related to the vehicle is available. If so, carefully follow the given instructions.



SERVICE, UNIT HISTORY

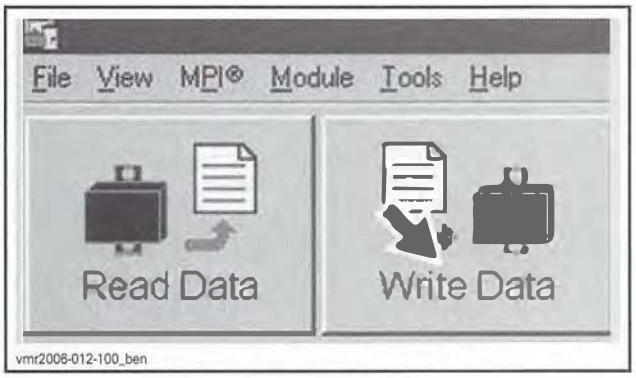
NOTE: When selecting the update menu in B.U.D.S., a dialog box will appear and the update file description may give some clue to finding the vehicle-related information in BOSSWeb.



TYPICAL
1. *File description*

Writing Changes in an ECU

1. When making a data or setting change in an ECU using B.U.D.S., save the new data (or setting) in the ECU by clicking the **Write Data** button.



NOTE: If the word **Modified** appears in the vehicle file identification number at the top of the B.U.D.S. page, then a change has been made that requires selecting the **Write Data** for the change to be saved.

1. *Indicate setting or data modified; Write Data to save*

2. After the write data operation, remove tether cord from the engine cut-off switch.

Disconnect MPI connections and store the vehicle diagnostic connector in its protective cap.

NOTICE **Failure to secure the diagnostic connector in its protective cap may result in corrosion or other damage to the terminals.**

NOTE: There is a 120 Ω resistor in the protective cap to minimize the possibility of communication error.

3. Reinstall all removed parts, refer to appropriate subsections.

DIAGNOSTIC AND FAULT CODES

GENERAL

MONITORING SYSTEM

This system monitors the electronic components of the EMS (engine management system) the information center and other components of the electrical system to detect if they are faulty or defective. The monitoring system becomes active when the electrical system is energized and the ECM is powered up.

NOTE: Some components need the engine to be running for them to be monitored (fuel injectors for example).

The following tables provide lists of components or functions that may be monitored, and are not specific to a particular model.

EMS MONITORING
Battery voltage
EMS sensors (TAS, TPS, CPS, CAPS, MAPS, MATS, CTS, OPS, EGTS, TOPS, knock sensor). Throttle actuator, ignition coils and fuel injectors
ECM
Engine RPM
CAN
D.E.S.S. system
START switch and starter solenoid
Fuel pump
Idle bypass valve
Information center (cluster)
Speed/temp sensor

All Models Except 200 Series

INFORMATION CENTER MONITORING
Information center
CAN
GPS (210 and 230 Series)
Fuel level sensor

When a malfunction is currently detected, the related electronic module:

- Sets an active fault code.
- Adapts the proper protection strategy according to the failure.
- Sends out warning signals to the information center/beeper codes to inform the rider of a particular condition.

When a minor or transient fault occurs, the fault message and beeper will cease automatically if the condition that caused the fault does not exist anymore.

If a minor fault is active, the engine will operate without a noticeable loss of performance.

Releasing the throttle and letting the engine return to idle speed may allow normal operation to resume. If this does not work, try the following:

- Remove tether cord from the engine cut-off switch.
- Turn off electrical system and wait for the ECM to shut down.
- Start engine.
- Check if the fault code is still active.

The electronic system will react differently depending on the fault type. If a severe failure occurs, the engine may not be allowed to be started. In other cases, the engine may operate in limp home mode (reduced speed) or not be affected at all.

These strategies are used to protect the engine system from damage and to maintain safe operation of the vehicle.

Limp Home Mode

When a major component of the EMS is not operating properly, limp home mode will be set. Engine speed will be limited and therefore vehicle speed.

This mode allows the rider to return home which would otherwise not be possible without this advanced system.

When this mode is active, the **CHECK ENGINE** light will come on.

All Models Except 200 Series

In conjunction with the **CHECK ENGINE** light coming on, a **LIMP HOME MODE** message will be displayed in the information center.

Indicator Lights and Message Display Information

Indicator lights (pilot lamps) inform the rider of a selected function, a normal condition, a system anomaly, or a serious malfunction.

150 and 180 Series

The following table provides a list of indicator lights and messages that may be displayed.

PILOT LAMPS (ON)	MESSAGE DISPLAY	DESCRIPTION
	OIL	Low oil pressure
	CHK ENG	Check engine
	H-TEMP	Engine or exhaust system overheating
	FUEL-LOW	Low fuel level
	12 V LOW/HI	Low/high battery voltage
	MAINT	Maintenance reminder

200 Series

These models are equipped with the following indicator lights, no message display.

PILOT LAMPS (ON)	DESCRIPTION
	Low oil pressure
	Check engine
	Engine or exhaust system overheating
	Low/high battery voltage

210 and 230 Series

An indicator light may be accompanied by a scrolling message in the multifunction display.

PILOT LAMPS (ON)	MESSAGE DISPLAY	DESCRIPTION
	MAINTENANCE REMINDER	Maintenance required
	LOW or HIGH BATTERY VOLTAGE	Low/high battery voltage
	LOW-FUEL	Low fuel level or fuel level sensor disconnected
	HIGH TEMPERATURE	Engine or exhaust system overheating
	CHECK ENGINE or LIMP HOME MODE	Check engine (minor fault req. maint.) or LIMP HOME MODE (major eng. fault)
	LOW OIL PRESSURE	Low oil pressure
	–	CRUISE mode engaged
	–	Good GPS uplink
	Scrolling SKI MODE messages	When turned ON: SKI MODE is engaged. When blinking: SKI MODE is selected but not engaged
–	CALIBRATION CHECKSUM ERROR	Information center programming corrupted

Beeper Signals

When one of the conditions listed in the following tables occurs, the monitoring system emits beep signals.

150, 180 and 200 Series

NOTES FOR PROBLEMS THAT GENERATE BEEP CODES ON TWIN ENGINE MODELS.

If both engines are in trouble, the first beep(s) that are heard come from the LH engine. Then, the RH engine will follow with its beep(s).

Beep codes can be different on each engine if a different problem is present.

If only one engine is in trouble, only this engine will beep. The check engine light of the faulty engine may be lit or blinking. This would help to identify which engine is in trouble.

BEEPER SIGNALS	POSSIBLE CAUSE	ACTION
No beep signal when installing tether cord.	– Main battery cut-off switch is turned OFF.	– Verify and turn ON.
	– Battery is discharged or missing.	– Charge or install battery.
	– EFB is not powered.	– Refer to *POWER DISTRIBUTION.*
	– Faulty ECM fuse.	– Refer to *ENGINE MANAGEMENT.*
	– Faulty D.E.S.S. system.	– Refer to *DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.).*
2 short beeps when installing tether cord.	– Confirms D.E.S.S. key signal operation.	– Engine can be started.
	– D.E.S.S. key is recognized by the ECM.	
	– Good contact between D.E.S.S. key and engine cut-off switch.	
1 long beep when installing tether cord.	– Bad D.E.S.S. system connection.	– Reinstall tether cord.
	– Wrong D.E.S.S. key.	– Use a tether cord that has been programmed for the boat. If it does not work, check key with B.U.D.S. Replace key if defective.
	– Defective D.E.S.S. key.	– Use another tether cord with a programmed key.
	– Dried salt water or dirt in tether cord cap.	– Clean key to remove salt water.
	– Defective engine cut-off switch.	– Refer to *IGNITION SYSTEM* subsection.
	– Improper operation of ECM or defective wiring harness.	– Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
4 short beeps every 3 second interval.	– Tether cord has been left on engine cut-off switch without starting engine or after engine was stopped.	– To prevent battery discharge, remove tether cord.

BEEPER SIGNALS	POSSIBLE CAUSE	ACTION
2 second beep every 15 minute interval.	– Battery voltage too low.	– Refer to *CHARGING SYSTEM* subsection.
	– Engine coolant temperature sensor or circuit malfunction.	– Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
	– Exhaust temperature sensor or circuit malfunction.	– Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
	– Engine oil pressure sensor or circuit malfunction.	– Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
	– MAP, CPS, TPS, or knock sensor or circuit malfunction.	– Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
	– Fuel injector or circuit malfunction.	– Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
	– Ignition coil or circuit malfunction.	– Refer to *IGNITION SYSTEM* subsection.
	– Fuel pump or circuit malfunction.	– Refer to *FUEL TANK AND FUEL PUMP* subsection.
	– Starter solenoid circuit malfunction.	– Refer to *STARTING SYSTEM* subsection.
Continuously beeps.	– High engine coolant temperature.	– Refer to *COOLING SYSTEM* subsection.
	– High exhaust temperature.	– Refer to *EXHAUST SYSTEM* subsection.
	– Low engine oil pressure.	– Refer to *LUBRICATION SYSTEM* subsection.

210 and 230 Series

BEEPER SIGNALS	DESCRIPTION	ACTION
A 2 second beep when crossing the low fuel threshold.	Low fuel level.	Refuel. If problem persists, check fuel level sensor. Refer to *FUEL TANK AND FUEL PUMP* subsection.
Continuous beep.	High engine coolant temperature.	Refer to *COOLING SYSTEM* subsection.
	High exhaust temperature.	Refer to *EXHAUST SYSTEM* subsection.
	Low or high engine oil pressure.	Refer to *LUBRICATION SYSTEM* subsection.

FAULT CODES

A fault code is an indication that a glitch or malfunction is detected by the monitoring system of the vehicle.

A fault code consists of a letter followed by 4 digits that are a combination of numbers and letters. The first letter defines the type of fault code while the remaining digits refer to a unique fault.

Verify if the check engine light is ON. If so, look for fault codes to diagnose the trouble. The fault codes recorded in the related module can be checked on the information center (210 and 230 Series) or by using the B.U.D.S. software.

NOTE: If many fault codes become active at the same time, it is likely to be caused by a burnt fuse(s) or a bad bus bar connection in one of the fuse box(es).

For more information pertaining to the fault codes (state, count, first, etc.) and report, refer to B.U.D.S. online help.

When a fault is no longer active, its status is changed from **active** to **occurred** and it is stored in the related module. Stored fault codes are kept in the module even if the battery is disconnected.

When using the service action suggested in the Fault section of B.U.D.S., the system circuits may be referred to as A-M4 for instance. It means ECM connector "A" and the circuit wire M4 as found in the *WIRING DIAGRAM*.

IMPORTANT: After a problem has been solved, be sure to clear the fault(s) in the related module. Refer to *CLEARING FAULT CODES USING B.U.D.S. SOFTWARE* in this subsection.

Fault Code Types

There are 4 types of fault codes that can be used:
- "B" for body, which include information center and switch faults (Bxxxx)
- "C" for chassis system faults (Cxxxx)
- "P" for power train and related system faults, which include the ECM (Pxxxx)
- "U" for CAN communication faults (Uxxxx).

The modules that store the fault codes are:
- ECM (Engine Control Module)
- Cluster (Information Center).

The ECM stores mainly "P" codes and some "U" codes.

The Cluster stores "B" and "P" codes.

Fault Code States

The various electronic control units (ECUs) used in the vehicle generate a variety of fault codes depending on the level of monitoring they are capable of. Fault codes have 3 possible states:
- Active state
- Occurred state
- Inactive state.

All types of fault codes may be viewed in the **Faults** page of B.U.D.S. **Only** fault codes in an **active state** may be viewed in the cluster (as applicable).

Active Fault Codes

An active fault code is an indication of a fault that is presently active. The active fault may or may not compromise normal operation of the system(s) in question as indicated by the fault code(s). Service action should be taken to correct the problem that caused the fault code.

Once the cause of the active fault is corrected, the fault code must be cleared using B.U.D.S. to prevent it from being retained in memory.

Occurred Fault Codes

An occurred fault code indicates a fault that was active, but no longer is. The occurred fault does not presently affect system or component operation but is retained as a history of the faults that were detected.

The fault may have been generated due to a system or component that was momentarily operating outside normal parameters. Repeated occurred faults of this type should be considered when troubleshooting a problem, and may require that maintenance action be taken.

An occurred fault may also be generated when disconnecting and reconnecting a component, replacing a burnt fuse, or may be due to a momentary high or low voltage.

Inactive Fault Codes

An inactive fault code represents a fault code that is neither active, nor occurred. It is simply part of a list of all possible faults which may be monitored by the various ECUs., which may become active or occurred if the monitoring system detects an applicable fault. These codes can be viewed in B.U.D.S.

Reading Fault Codes Using the Information Center

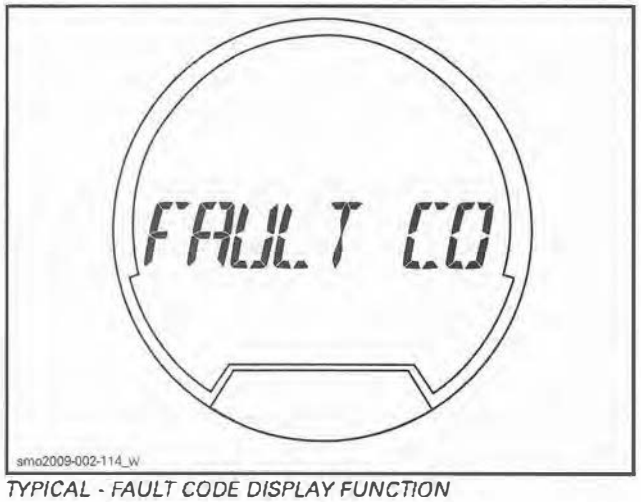
210 and 230 Series

NOTE: Only active faults will be displayed.

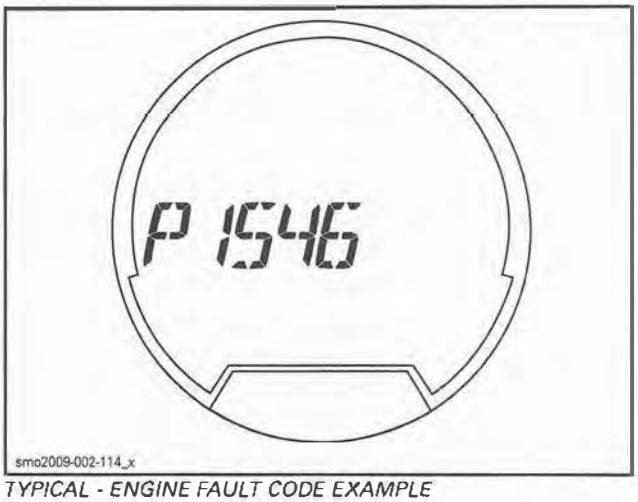
1. Press the MODE button repeatedly until the FAULT CODE function is visible in the multi-function display.
2. Press the SET button or the UP or DOWN arrow button to enter the function and display the first fault code.
3. Press the UP or DOWN arrow button repeatedly to display each subsequent code.

NOTE: When the last fault code has been displayed and the button is pressed again, the system loops back to the first fault code displayed, and all fault codes can again be displayed. If there was one active fault code when entering FAULT CODE mode, and it becomes occurred (no longer active), a NO ACTIVE FAULT CODE message will scroll in the display.

4. To exit the FAULT CODE display function, the MODE or SET button must be pressed once. There is no time out on this function.



TYPICAL - FAULT CODE DISPLAY FUNCTION



TYPICAL - ENGINE FAULT CODE EXAMPLE

Reading Fault Codes Using B.U.D.S. Software

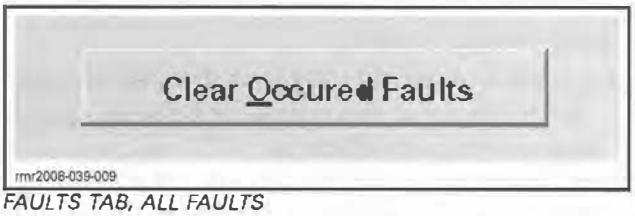
1. Connect vehicle to the latest B.U.D.S. software, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Click on the **Read Data** button.
3. Select the **Faults** page tab.

200 Series

NOTE: Connect to each engine diagnostic connector to read the faults codes stored in each ECM.

Clearing Fault Codes Using B.U.D.S. Software

The fault(s) (occurred state) can be cleared by pressing the **Clear Occurred Faults** button in B.U.D.S.



FAULTS TAB, ALL FAULTS

This will reset the appropriate counter(s) and will also record that the problem has been fixed in the related module memory.

NOTE: An active fault code cannot be cleared. In other words, the problem must be repaired before the fault code can be cleared.

200 Series

Be sure to connect to each engine ECM to clear the faults in both ECMs.

SPECIFIC FAULT CODES

Several Fault Codes Are Active Simultaneously

If this occurs, check the following:

- Check fuses.
- Check the bus bar condition and connections in the fuse box(es).
- Check the diagnostic connector for the presence of water or corrosion.
- Check the CAN wires.

Fault Code P0562

Battery voltage too low. It occurs when both battery voltage and engine RPM conditions are met. See following chart. Refer to *CHARGING SYSTEM* subsection.

BATTERY VOLTAGE	ENGINE SPEED
Lower than 6.5 Vdc	Lower than 1280 RPM
Lower than 11.8 Vdc	Greater than 1280 RPM

Fault Code P0563

Battery voltage too high. It occurs when battery voltage is above 16 Vdc when engine is running. Refer to *CHARGING SYSTEM*.

Fault Code U016A

Loss of vehicle speed. This fault may occasionally appear as occurred. Normal operation is not affected. If the count is high, check the related components.

Fault Code U0300

Incorrect ECM or information center for the engine. Installed part is not appropriate for the vehicle. Using B.U.D.S., check if the security coding of the cluster is matched with the ECM security coding. **Engine will crank but will not start**. Refer to *PARTS CATALOGS* for proper part according to vehicle.

Fault Code U16A1, U16A2, U16A3

Cluster CAN time-out error-missing CAN ID xxxh. This fault may occasionally appear as occurred. Normal operation is not affected. If the count is high, check the related components.

FAULT CODE TABLE

The following table provides a general list of fault codes that may be set by an ECU of a sport boat. The fault codes listed may not be applicable to every sport boat model.

NOTE: Always refer to the fault code list available in the latest applicable version of B.U.D.S. software.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
B2200	Cluster	GPS lost of signal fault	GPS lost signal satelite because of an obstacle. The GPS/Cluster must be in direct sight with the sky to work properly	If the "GPS locked" green lamp doesn't come active after 2 minutes with open sky above the cluster with no obstacle near around and the fault still active, replace the cluster
P0106	ECM	Intake pressure sensor out of range	Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of housing or leaking inlet. Verify air intake hose if disconnected or air leak.	Check system circuits A-B4, A-G4, A-H2. Make sure that the sensor housing is correctly inserted into the manifold. Check sensor connector for: a) 5 volts on pin 1. b) 0 volt on pin 2. c) 0 volt on pin 3. Refer to the Shop Manual for more details.
P0107	ECM	Manifold absolute pressure sensor shorted to ground or not connected	Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of housing or leaking inlet. Connector disconnected.	Check system circuits A-B4, A-G4, A-H2. Make sure that the sensor housing is correctly inserted into the manifold. Check sensor connector for: a) 5 volts on pin 1. b) 0 volt on pin 2. c) 0 volt on pin 3. Refer to the Shop Manual for more details.
P0108	ECM	Manifold absolute pressure sensor open circuit or shorted to battery	Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of housing or leaking inlet	Check system circuits A-B4, A-G4, A-H2. Make sure that the sensor housing is correctly inserted into the manifold. Check sensor connector for: a) 5 volts on pin 1. b) 0 volt on pin 2. c) 0 volt on pin 3. Refer to the Shop Manual for more details.
P0111	ECM	Intake manifold temperature sensor functional problem.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins. Fault detected when the engine is running.	Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-7 and A-21.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0112	ECM	Intake manifold temperature sensor shorted to ground	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-H3 and A-J3. Refer to the Shop Manual for more details.
P0113	ECM	Intake manifold temperature sensor open circuit or shorted to battery	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-H3 and A-J3. Refer to the Shop Manual for more details.
P0116	ECM	Engine coolant temperature signal not plausible	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-A1 and A-J2. Refer to the Shop Manual for more details.
P0117	ECM	Engine coolant temperature sensor fault. Short to GND.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-A1 and A-J2. Refer to the Shop Manual for more details.
P0118	ECM	Engine coolant temperature sensor fault. Short circuit to V+ or connector disconnected	Engine overheated or damaged sensor. Connector disconnected	Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-A1 and A-J2. Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0122	ECM	TAS (Throttle Accelerator sensor) 1 fault (short circuit to GND or open circuit)	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins. Connector disconnected.	Check system circuits B-E1, B-K1, B-K3. Check for 0 volt on sensor connector pin 5. Check for 5 volts on sensor connector pin 4. Check for 0.5 to 3 volts on sensor connector pin 6. Refer to the Shop Manual for more details.
P0123	ECM	TAS (Throttle Accelerator sensor) 1 fault (short circuit to battery)	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins.	Check system circuits B-E1, B-K1, B-K3. Check for 0 volt on sensor connector pin 5. Check for 5 volts on sensor connector pin 4. Check for 0.5 to 3 volts on sensor connector pin 6. Refer to the Shop Manual for more details.
P0127	ECM	Intercooler system fault	High air intake temperature detected. Fault detected when the engine is running and stopped. Blocked intercooler water circuit	Clean intercooler water circuit system. Refer to the Shop Manual for more details.
P0201	ECM	Injection Power Stage fault - open line/Cylinder 1	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 1 and ECM connector pin A-B3. Check for 12 volts on pin 2 of injector connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0202	ECM	Injection Power Stage fault - open line/Cylinder 2	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 2 and ECM connector pin A-K1. Check for 12 volts on pin 2 of injector connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0203	ECM	Injection Power Stage fault - open line/Cylinder 3	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 3 and ECM connector pin A-J1. Check for 12 volts on pin 2 of injector connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0217	ECM	High engine coolant temperature detected	Engine overheated or damaged sensor	Check for debris or blockage in cooling system. Check the sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F) between ECM connector pins A-A1 and A-J2. Refer to the Shop Manual for more details.
P0222	ECM	TAS (Throttle Accelerator sensor) 2 fault (short circuit to GND or open)	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins. Connector disconnected.	Check system circuits B-A3, B-B3, B-J3. Check for 0 volt on pin 3 of 24 pin sensor connector. Check for 5 volts on pin 9 of 24 pin sensor connector. Check for 0.25 to 1.5 volts on pin 6 of 24 pin sensor connector. Refer to the Shop Manual for more details.
P0223	ECM	TAS (Throttle Accelerator sensor) 2 fault (short circuit to battery)	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check system circuits B-A3, B-B3, B-J3. Check for 0 volt on pin 3 of 24 pin sensor connector. Check for 5 volts on pin 9 of 24 pin sensor connector. Check for 0.25 to 1.5 volts on pin 6 of 24 pin sensor connector. Refer to the Shop Manual for more details.
P0231	ECM	Fuel pump open circuit or short to ground	Damaged pump, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 1 ohm between pins A and D of the fuel pump connector. Check fuse 6 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Check for damaged connector, damaged ECM output pins or ECM failure. Refer to the Shop Manual for more details.
P0232	ECM	Fuel pump short circuit to battery	Damaged pump, damaged circuit wires, damaged connector or damaged ECM output pins	Check for approximately 1 ohm between pins A and D of the fuel pump connector. Check fuse 6 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Check for damaged connector, damaged ECM output pins or ECM failure. Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0261	ECM	Injector 1 open circuit or shorted to ground	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 1 and ECM connector pin A-B3. Check for 12 volts on pin 2 of injector connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0262	ECM	Injector 1 shorted to battery	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 1 and ECM connector pin A-B3. Check for 12 volts on pin 2 of injector connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0264	ECM	Injector 2 open circuit or shorted to ground	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 2 and ECM connector pin A-K1. Check for 12 volts on pin 2 of injector connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0265	ECM	Injector 2 shorted to battery	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 2 and ECM connector pin A-K1. Check for 12 volts on pin 2 of injector connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0267	ECM	Injector 3 open circuit or shorted to ground	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 3 and ECM connector pin A-J1. Check for 12 volts on pin 2 of injector connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0268	ECM	Injector 3 shorted to battery	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 11.4 to 12.6 ohms between engine connector pin 3 and ECM connector pin A-J1. Check for 12 volts on pin 2 of injector connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Check for damaged circuit wires. Refer to the Shop Manual for more details.
P0300	ECM	Multiple misfire detected		
P0301	ECM	Misfire cylinder 2 (physical cylinder 1)		
P0302	ECM	Misfire cylinder 0 (physical cylinder 2)		
P0303	ECM	Misfire cylinder 1 (physical cylinder 3)		
P0325	ECM	Knock sensor fault	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins. Open circuit.	Bring engine to 5000 RPM. If fault code appears then check for approximately 5 Mohms between system circuits A-C3 and A-G2. Engine must run over 5000 rpm to erase the corrected fault. Refer to the Shop Manual for more details.
P0326	ECM	Knock sensor out of range.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is running.	Bring engine to 5000 RPM. If fault code appears then check for approximately 5 Mohms between system circuits A-9 and A-23.
P0335	ECM	Crankshaft signal error.	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel. Connector disconnected.	For the CPS, check for 700 to 900 ohms between terminals A-H1 and A-K2 of ECM connector. Refer to the Shop Manual for more details.
P0336	ECM	Crank position sensor – Wrong engine RPM detected.	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.	For the CPS, check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. For the CAPS, refer to camshaft position sensor. Check continuity for circuits A-20, A-34 and terminal 4 on engine connector.
P0337	ECM	No CPS signal but CAPS signal detected.	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.	Check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. Check for 2 volts AC while cranking the engine.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0337	ECM	No CPS signal but CAPS signal detected.	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.	Check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector.
P0339	ECM	Crank signal not possible with cam signal.	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel.	For the CPS, check for 190 to 290 ohms between terminals A-5 and A-19 of ECM connector. For the CAPS, check for 12 volts on sensor connector pin 3. Check continuity for circuits A-20, A-34 and terminal 4 on engine connector. Check fuse #4 (refer to *WIRING DIAGRAM*).
P0340	ECM	Camshaft 1 signal error	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel Connector disconnected.	For the CAPS, check for 12 volts on sensor connector pin 3. Check continuity for circuits A-D4, A-E2 and terminal 4 on engine connector. Check fuse 2 (refer to *WIRING DIAGRAM*). Engine must run to erase the corrected fault. Refer to the Shop Manual for more details.
P0344	ECM	Cam phase sensor signal missing.	Damaged sensor, damaged circuit wires, damaged connector, damaged ECM pins or damaged tooth wheel. Fault detected when the engine is running.	For the CAPS, check for 12 volts on sensor connector pin 3. Check continuity for circuits A-20, A-34 and terminal 4 on engine connector. Check fuse #4 (refer to *WIRING DIAGRAM*).
P0351	ECM	Ignition coil 1 open circuit or shorted to ground or to battery	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 1 and ECM connector pin A-M4. Check for 12 volts on pin 2 of coil connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0352	ECM	Ignition coil 2 open circuit or shorted to ground or to battery	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 2 and ECM connector pin A-M2. Check for 12 volts on pin 2 of coil connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0353	ECM	Ignition coil 3 open circuit or shorted to ground or to battery	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 3 and ECM connector pin A-M1. Check for 12 volts on pin 2 of coil connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0354	ECM	Ignition Power Stage fault - short circuit to GND/Cylinder 1	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 1 and ECM connector pin A-M4. Check for 12 volts on pin 2 of coil connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0355	ECM	Ignition Power Stage fault - short circuit to GND/Cylinder 2	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 2 and ECM connector pin A-M2. Check for 12 volts on pin 2 of coil connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0356	ECM	Ignition Power Stage fault - short circuit to GND/Cylinder 3	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 3 and ECM connector pin A-M1. Check for 12 volts on pin 2 of coil connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0357	ECM	Ignition Power Stage fault - short circuit to V+/Cylinder 1	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 1 and ECM connector pin A-M4. Check for 12 volts on pin 2 of coil connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0358	ECM	Ignition Power Stage fault - short circuit to V+/Cylinder 2	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 2 and ECM connector pin A-M2. Check for 12 volts on pin 2 of coil connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0359	ECM	Ignition Power Stage fault - short circuit to V+/Cylinder 3	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	Check for 0.85 to 1.15 ohms between engine connector pin 3 and ECM connector pin A-M1. Check for 12 volts on pin 2 of coil connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0360	ECM	Ignition Power stage max error and false detection of low battery voltage/ Cylinder 1	Signal not plausible, verify battery voltage too low during ignition	Check for 0.85 to 1.15 ohms between engine connector pin 1 and ECM connector pin A-M4. Check for 12 volts on pin 2 of coil connector. Check fuse 7 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0361	ECM	Ignition Power stage max error and false detection of low battery voltage/ Cylinder 2	Signal not plausible, verify battery voltage too low during ignition	Check for 0.85 to 1.15 ohms between engine connector pin 2 and ECM connector pin A-M2. Check for 12 volts on pin 2 of coil connector. Check fuse 8 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0362	ECM	Ignition Power stage max error and false detection of low battery voltage/ Cylinder 3	Signal not plausible, verify battery voltage too low during ignition	Check for 0.85 to 1.15 ohms between engine connector pin 3 and ECM connector pin A-M1. Check for 12 volts on pin 2 of coil connector. Check fuse 9 (refer to *WIRING DIAGRAM*). Refer to the Shop Manual for more details.
P0461	ECM	Fuel level circuit out of range.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for 2.6 (full tank) to 93.6 ohms (empty tank) between pin B and pin C at the fuel pump connector. Verify the 500 ohms resistor (refer to *WIRING DIAGRAM*). Check fuse 4 (refer to *WIRING DIAGRAM*).
P0462	ECM	Fuel level circuit voltage low.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for 2.6 (full tank) to 93.6 ohms (empty tank) between pin B and pin C at the fuel pump connector. Verify the 500 ohms resistor (refer to *WIRING DIAGRAM*). Check fuse 4 (refer to *WIRING DIAGRAM*).
P0463	ECM	Fuel level circuit voltage high.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for 2.6 (full tank) to 93.6 ohms (empty tank) between pin B and pin C at the fuel pump connector. Verify the 500 ohms resistor (refer to *WIRING DIAGRAM*). Check fuse 4 (refer to *WIRING DIAGRAM*).

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0500	ECM	Vehicle speed signal fault	Cluster fault detected by ECM. CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuit wires. Replace instrument Cluster. Verify outside of the building if the GPS LED becomes active after 1 minute and stays steady. Refer to the Shop Manual for more details.
P0501	ECM	Vehicle speed not plausible	Cluster fault detected by ECM. CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuit wires. Replace instrument Cluster. Verify outside of the building if the GPS LED becomes active after 1 minute and stays steady. Refer to the Shop Manual for more details.
P0505	ECM	Idle bypass valve output stage cutoff memory difference.	Damaged actuator, damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is stopped.	Check for approximately 50 ohms between pins A and D and also between pins B and C of the idle bypass valve. Check for damaged circuit wires. Check for approximately 50 ohms between pins A-36 and A-35 and also between pins A-37 and A-38. Check for damaged connector, damaged ECM output pins or ECM failure.
P0512	ECM	Starter power stage detects high current	Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM	Verify 5 A fuse F4. Check for 12 volts on pin 2 of the starter relay. Refer to the Shop Manual for more details.
P0520	ECM	Oil pressure switch functional problem	Engine leak, oil pump failure, damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check resistance at 0 RPM and above 3500 RPM. Switch is normally closed. ECM connector pin A-E3. When blow-by pressure exceeds 40 kPa (6 PSI), the resistance is infinitely high. Refer to the Shop Manual for more details.
P0523	ECM	Oil pressure sensor fault	Engine leak, oil pump failure, damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins. Fault detected when the engine is running or stopped	Check resistance at 0 RPM and above 3500 RPM. When blow-by pressure exceeds 40 kPa (6 PSI), the resistance is infinitely high. Refer to the Shop Manual for more details.
P0524	ECM	Low oil pressure condition	Low oil level, engine leak, oil pump fault.	Check oil level. Check impedance of sensor. Engine must run over 3000rpm to erase the corrected fault. Refer to the Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0544	ECM	Exhaust gas temperature sensor functional problem	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins	Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-H4 and A-J4. Refer to the Shop Manual for more details.
P0545	ECM	Exhaust gas temperature sensor shorted to ground	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins	Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-H4 and A-J4. Refer to the Shop Manual for more details.
P0546	ECM	Exhaust gas temperature sensor open circuit or shorted to battery	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins	Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-H4 and A-J4. Refer to the Shop Manual for more details.
P0560	ECM	Battery voltage not plausible	Battery failure, rectifier failure, damaged circuit wires, battery terminal connection, damaged AC generator or damaged connectors	Check fuse F15 (refer to *WIRING DIAGRAM*). Check ground continuity to the engine block. Refer to the Shop Manual for more details.
P0562	ECM	Battery voltage too low	Battery failure, rectifier failure, damaged circuit wires, battery terminal connection, damaged AC generator or damaged connectors	Check fuse 15 (refer to *WIRING DIAGRAM*). Check ground continuity to the engine block. Refer to the Shop Manual for more details.
P0563	ECM	Battery voltage too high	Battery failure, rectifier failure or battery terminal connection	Check for regulator-rectifier failure. Refer to the Shop Manual for more details.
P0600	ECM	Communication problem detected by ECM.	Damaged circuit wires, damaged connector, damaged ECM output pins. Diagnostic connector cap not connected. Fault detected when the engine is stopped.	Connect diagnostic connector cap.
P0600	ECM	Communication problem – ECM message missing.	Damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is stopped.	Check system circuits B-10 and B-11.
P0601	ECM	TPS learns unlikely or check sum fault.	ECM not coded. Check cable adjustment. Damaged ECM or TPS not initialized.	Check cable adjustment. Check idle stop for wear. Check throttle angle at idle. Reset closed TPS. Refer to Shop Manual for more details.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0601	ECM	Module call monitoring.	Damaged ECM.	Key on and off. Reset closed TPS. Check battery voltage. Replace TPS.
P0602	ECM	ECM not coded.	ECM not coded or damaged ECM.	No service action available for fault P0602, symptom 142.
P0604	ECM	RAM fault.	Damaged ECM.	No service action available for fault P0604, symptom 136.
P0605	ECM	EEPROM fault.	Damaged ECM.	No service action available for fault P0605, symptom 137.
P0605	ECM	EEPROM checksum fault.	Damaged ECM.	No service action available for fault P0605, symptom 143.
P0605	ECM	Coding ID checksum fault.	Damaged ECM.	No service action available for fault P0605, symptom 144.
P0605	ECM	Coding checksum fault.	Damaged ECM.	No service action available for fault P0605, symptom 145.
P0605	ECM	Programming checksum fault.	Damaged ECM.	No service action available for fault P0605, symptom 146.
P0606	ECM	ECM ADC fault	Damaged ECM	Replace ECM.
P0608	ECM	Sensor's power supply voltage too low.	Intake pressure sensor or TPS failure. Sensors power line shorted to ground. Fault detected when the engine is stopped.	Check for MAPS or TPS failure. Check for MAPS or TPS circuit failure.
P0608	ECM	Sensor's power supply voltage too high.	Intake pressure sensor or TPS failure. Sensors power line shorted to battery. Fault detected when the engine is stopped.	Check for MAPS or TPS failure. Check for MAPS or TPS circuit failure.
P0616	ECM	Starter relay open circuit or shorted to ground.	Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is running.	Verify fuse #12 (refer to *WIRING DIAGRAM*). Check for 12 volts on pin A of the starter relay connector.
P0617	ECM	Starter relay shorted to battery.	Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is running.	Verify if system circuit B-31 is shorted to 12 V.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P060D	ECM	TAS (Throttle Accelerator sensor) synchronization error	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM pins	Check system circuits B-E1, B-K1, B-K3, B-A3, B-B3, B-J3. Check for 0 volt on steering connector pins 2 and 5. Check for 5 volts on sensor connector pins 1 and 4. Check for 0.5 to 3 volts on sensor connector pin 6, and 0.25 to 1.5 on 3. Refer to the Shop Manual for more details.
P060E	ECM	Throttle Actuator - Controller Fault-digital position control exceeds limit	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle reset with B.U.D.S. Replace throttle actuator, replace ECM
P0610	ECM	Variant coding fault		
P062C	ECM	Cluster CAN error - Loss of vehicule speed information from cluster	Cluster fault detected by ECM CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuits wires. Replace instrument Cluster. Verify outside of the building if the GPS LED becomes active after 1 minute and stays steady Refer to the Shop Manual for more details.
P062F	ECM	ECM EEPROM fault - exchange ECM	Damaged ECM.	Replace ECM.
P06B6	ECM	ECM Fast ADC fault (knock detection line)		
P1102	ECM	Throttle position sensor adaptation failure.	No initialization after throttle body or ECM replacement or throttle idle stop drifted.	Check cable adjustment. Check idle stop for wear. Make sure that the throttle plate is against the throttle stop. Check throttle angle at idle. Reset closed TPS.
P1104	ECM	Throttle position sensor adaptation cancelled.	No initialization after throttle body or ECM replacement or throttle idle stop drifted.	Check cable adjustment. Check idle stop for wear. Make sure that the throttle plate is against the throttle stop. Check throttle angle at idle. Reset closed TPS.
P1116	ECM	High engine temperature.	Engine overheat or damaged sensor.	Check cooling system for blockage. Check sensor impedance (should be at 2280-2736 ohms @19-21°C (66-70°F) between circuits 4-9 and 4-11 of system.
P1120	ECM	Throttle positions calculated from TPS 1 and TPS 2 not corresponding	Damaged throttle actuator, damaged circuit wires, damaged or disconnected connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1148	ECM	Fuel injector 1, 2 or 3 – safety fuel cut-off detected.	Idle bypass valve wrong reference, TPS adaptation failure, TPS failure or battery voltage out of range.	Key on and off. Reset closed TPS. Check battery voltage. Replace TPS. Replace idle bypass valve.
P1264	ECM	Ignition Power stage overload	Damaged coil, damaged circuit wires, damaged connector or damaged ECM output pins	N/A
P1502	ECM	TOPS functional problem	Boat or sensor upside down, damaged circuit wires, damaged connector or damaged ECM output pins	Check continuity of circuits A-C4, A-G1, A-F4. Refer to the Shop Manual for more details.
P1503	ECM	TOPS switch short circuit to 12 V	Boat or sensor upside down, damaged circuit wires, damaged connector or damaged ECM output pins	Check continuity for circuits A-C4, A-G1, A-F4. Refer to the Shop Manual for more details.
P1504	ECM	TOPS switch short circuit ground	Boat or sensor upside down, damaged circuit wires, damaged connector or damaged ECM output pins	Check continuity for circuits A-C4, A-G1, A-F4. Refer to the Shop Manual for more details.
P1505	ECM	TOPS switch fault non plausible state	Boat or sensor upside down, damaged circuit wires, damaged connector or damaged ECM output pin. Open circuit.	Check continuity for circuits A-C4, A-G1, A-F4. Refer to the Shop Manual for more details.
P1506	ECM	TOPS switch open circuit	Boat or sensor upside down, damaged circuit wires, damaged connector or damaged ECM output pins. Open circuit.	Check continuity for circuits A-C4, A-G1, A-F4. Refer to the Shop Manual for more details.
P1509	ECM	Lake water temperature sensor circuit out of range.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for 6528.3 to 25403.3 ohms between system circuits B-8 and B-20.
P1510	ECM	Lake water temperature sensor circuit voltage low.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for no continuity between system circuit and battery ground. Connect or disable lake water temperature sensor in setting page.
P1511	ECM	Lake water temperature sensor circuit voltage high.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for 6528.3 to 25403.3 ohms between system circuits B-8 and B-20. Connect or disable lake water temperature sensor in setting page.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1513	ECM	Wrong ECM.	ECM or Cluster is not compatible with the engine.	Use proper ECM or code the instrument cluster.
P1514	ECM	Exterior air temperature sensor circuit voltage high.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for 200 to 24000 ohms between pins 1 and 9 of the instrument cluster harness connector. Connect or disable exterior air temperature sensor in setting page.
P1517	ECM	Compass circuit out of range.	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins.	Check compass connection. Connect or disable compass in setting page.
P1520	ECM	Low oil pressure.	Low oil level, engine leak, oil pump fault.	Check oil level. Check impedance of sensor.
P1544	ECM	High exhaust temperature.	Exhaust overheat, damaged sensor or damaged circuit wires.	Check cooling system for blockage. Check if the exhaust injection valve is properly calibrated.
P160E	ECM	Throttle Actuator - Controller Fault - digital position control below limit	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1606	ECM	ECM ADC fault - exchange ECM	Damaged ECM	No service action available for fault P1606.
P1607	ECM	ECM fault.	Damaged ECM.	No service action available for fault P1607.
P1610	ECM	Throttle Actuator - Power Stage fault	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1611	ECM	P+ test of ISC output signal failed.	Intake pressure sensor or TPS failure. Sensors power line shorted to ground or to battery. Damaged ECM. Fault detected when the engine is stopped.	Key on and off. Reset closed TPS. Check battery voltage. Replace TPS. Replace idle bypass valve.
P1611	ECM	Throttle Actuator - Power Stage fault	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1612	ECM	Throttle Actuator - Power Stage fault	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1613	ECM	Throttle Actuator - Power Stage fault	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1614	ECM	Throttle Actuator - Return-Spring check not passed/Spring does not close	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1615	ECM	Throttle Actuator - Position monitoring fault	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1616	ECM	Throttle Actuator - Default position check or learning fault	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1619	ECM	Throttle Actuator - Adaptation of upper mechanical limit failed	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1620	ECM	Throttle Actuator - Adaptation of lower mechanical limit failed	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1621	ECM	Throttle Actuator - Abortion of adaptation	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1622	ECM	Throttle Actuator - Repeated abortion of adaptation	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P1655	ECM	D.E.S.S. line shorted to battery.	Damaged safety switch, damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is stopped.	Remove D.E.S.S. key and check for an open circuit on system circuit B-38.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1656	ECM	D.E.S.S. line shorted to ground.	Damaged safety switch, damaged circuit wires, damaged connector or damaged ECM output pins. Fault detected when the engine is stopped.	Remove D.E.S.S. key and check for an open circuit on system circuit B-38.
P1660	ECM	Bilge pump open circuit or shorted to ground.	Damaged bilge pump, damaged circuit wires, damaged connector or damaged ECM output pins.	Check system circuits 2-20 and 2-3. Connect or disable bilge pump in setting page.
P1661	ECM	Bilge pump circuit shorted to battery.	Damaged bilge pump, damaged circuit wires, damaged connector or damaged ECM output pins.	Check system circuits 2-20 and 2-3. Connect or disable bilge pump in setting page.
P1670	ECM	Bilge pump shorted to battery.	Damaged bilge pump, damaged circuit wires, damaged connector or damaged ECM output pins.	Check system circuits 2-20 and 2-3.
P1675	ECM	Buzzer shorted to battery.	Damaged connector or damaged ECM output pins.	Check system circuit 1-20.
P1676	ECM	Depth sounder shorted to battery.	Damaged component, damaged circuit wires, damaged connector or damaged ECM output pins.	Connect component or disable depth sounder in setting page.
P1678	ECM	Spare output 2 open circuit or shorted to ground.	Damaged component, damaged circuit wires, damaged connector or damaged ECM output pins.	Connect component or disable spare output 2 in setting page.
P1679	ECM	Spare output 2 shorted to battery.	Damaged component, damaged circuit wires, damaged connector or damaged ECM output pins.	Connect component or disable spare output 2 in setting page.
P1679	ECM	Main relay sticking	Permanent 12V is present on ECM Pin B-M4	ECU pin B-M4 is permanently supplied thru 15 amp fuse and it should be accessory 12 Vdc.
P1680	ECM	Communication problem detected by ECM.	Damaged circuit wires, damaged connector, damaged ECM output pins. Diagnostic connector cap not connected.	Connect diagnostic connector cap.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1681	ECM	Communication problem – instrument cluster message missing.	Damaged circuit wires, damaged connector, damaged ECM output pins. Instrument cluster not connected.	Check system circuits 1-10 and 1-11. Check for 12 volts between pins 7 and 8 on the instrument cluster harness connector. Check 1A fuse. Connect instrument cluster.
P1682	ECM	Communication problem – ECM message missing.	Damaged circuit wires, damaged connector, damaged ECM output pins. ECM not connected.	Check system circuits 2-10 and 2-11. Check for 12 volts between system circuit A-11 and ground. Check 5A fuses. Check connection.
P1683	ECM	Communication RAM fault.	Damaged ECM.	No service action available for fault P1683, symptom 88.
P16B6	ECM	ECU Fast ADC fault (knock detection line)		
P16B7	ECM	ECU Fast ADC fault (knock detection line)		
P16B8	ECM	ECU Fast ADC fault (knock detection line)		
P16C0	ECM	Fault of ECM ADC		
P16C1	ECM	Fault of ECM ADC		
P16C2	ECM	Fault of ECM monitoring module		
P16C3	ECM	Monitoring fault due to Accelerator Sensor check		
P16C4	ECM	Monitoring fault due to engine speed check		
P16C5	ECM	Safety fuel cut off activ - Monitoring level 1		
P16C6	ECM	Safety fuel cut off activ - Monitoring level 2		
P16C7	ECM	Monitoring fault due to throttle valve plausibility check	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P16C8	ECM	Monitoring fault due to exceeding permitted throttle valve position	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle reset with B.U.D.S. Replace throttle actuator, replace ECM.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P16C9	ECM	Monitoring detected non plausible D.E.S.S. key state	Damaged D.E.S.S. key switch, damaged circuit wires, damaged connector or damaged ECM output pins	Remove D.E.S.S. key and check system circuit B-B2. Refer to the Shop Manual for more details.
P16CA	ECM	ECU detected faulty watch dog line – ECU defect	Damaged ECM.	Replace ECM
P16CB	ECM	ECU switch off through watch dog line (hardware fault) – ECU defect	Damaged ECM.	Replace ECM
P2080	ECM	Exhaust temperature not plausible	Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins	Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-H4 and A-J4. Refer to the Shop Manual for more details.
P2081	ECM	Exhaust temperature sensor fault	Intermittent connection. Damaged sensor, damaged circuit wires, damaged connector or damaged ECM output pins	Check for approximately 2280 to 2736 ohms at temperature of 19 to 21°C (66 to 70°F) between system circuits A-H4 and A-J4. Refer to the Shop Manual for more details.
P212C	ECM	Electrical lower-range violation TPS 2	Damaged throttle actuator, damaged circuit wires, damaged or disconnected connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P212D	ECM	Electrical upper-range violation TPS 2	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P2279	ECM	Air intake manifold leak downstream of throttle	Air leak	
P2428	ECM	High exhaust temperature detected	Exhaust overheat, damaged sensor or damaged circuit wires.	Check cooling system for blockage. Check if the exhaust injection valve is properly calibrated. Refer to the Shop Manual for more details.
P2620	ECM	TPS value not plausible	Damaged throttle actuator, damaged circuit wires, damaged or disconnected connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P2621	ECM	Electrical lower-range violation TPS 1	Damaged throttle actuator, damaged circuit wires, damaged or disconnected connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.

FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P2622	ECM	Electrical upper-range violation TPS 1	Damaged throttle actuator, damaged circuit wires, damaged connector or damaged ECM	Check system circuit, perform closed throttle with B.U.D.S. Replace throttle actuator, replace ECM.
P3999	ECM	Dummy		
U016A	ECM	Loss of vehicle speed	Instrument cluster fault detected by ECM, CAN circuit failure, instrument Cluster or ECM failure	Check CAN circuits wires, replace instrument Cluster. Refer to the Shop Manual for more details.
U0300	ECM	Exchange security - Wrong ECM	Incorrect ECM or cluster for engine	Install proper recommended ECM or cluster for vehicle and select Module info, Cluster, Update security coding
U16A1	ECM	Cluster CAN Time out error-Missing CAN ID 514h	Cluster fault detected by ECM CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuits wires. Replace instrument Cluster. Refer to the Shop Manual for more details.
U16A2	ECM	Cluster CAN Time out error-Missing CAN ID 230h	Cluster fault detected by ECM CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuits wires. Replace instrument Cluster. Refer to the Shop Manual for more details.
U16A3	ECM	Cluster CAN Time out error-Missing CAN ID 408h	Cluster fault detected by ECM CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuits wires. Replace instrument Cluster. Refer to the Shop Manual for more details.
U16A6	ECM	Cluster check sum error - CAN ID230h	Cluster fault detected by ECM CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuits wires. Replace instrument Cluster. Refer to the Shop Manual for more details.
U16A7	ECM	Cluster check sum error - CAN ID408h	Cluster fault detected by ECM CAN circuit failure, Instrument cluster or ECM failure	Check CAN circuits wires. Replace instrument Cluster. Refer to the Shop Manual for more details.
U16AC	ECM	Starboard ECU – Check sum error - CAN ID 014h	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16AD	ECM	Port ECU – Check sum error - CAN ID 015h	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16AE	ECM	Starboard ECU – Check sum error - CAN ID 016h	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16AF	ECM	Port ECU – Check sum error - CAN ID 017h	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16B0	ECM	Starboard ECU – Check sum error - CAN ID 01Ah	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.

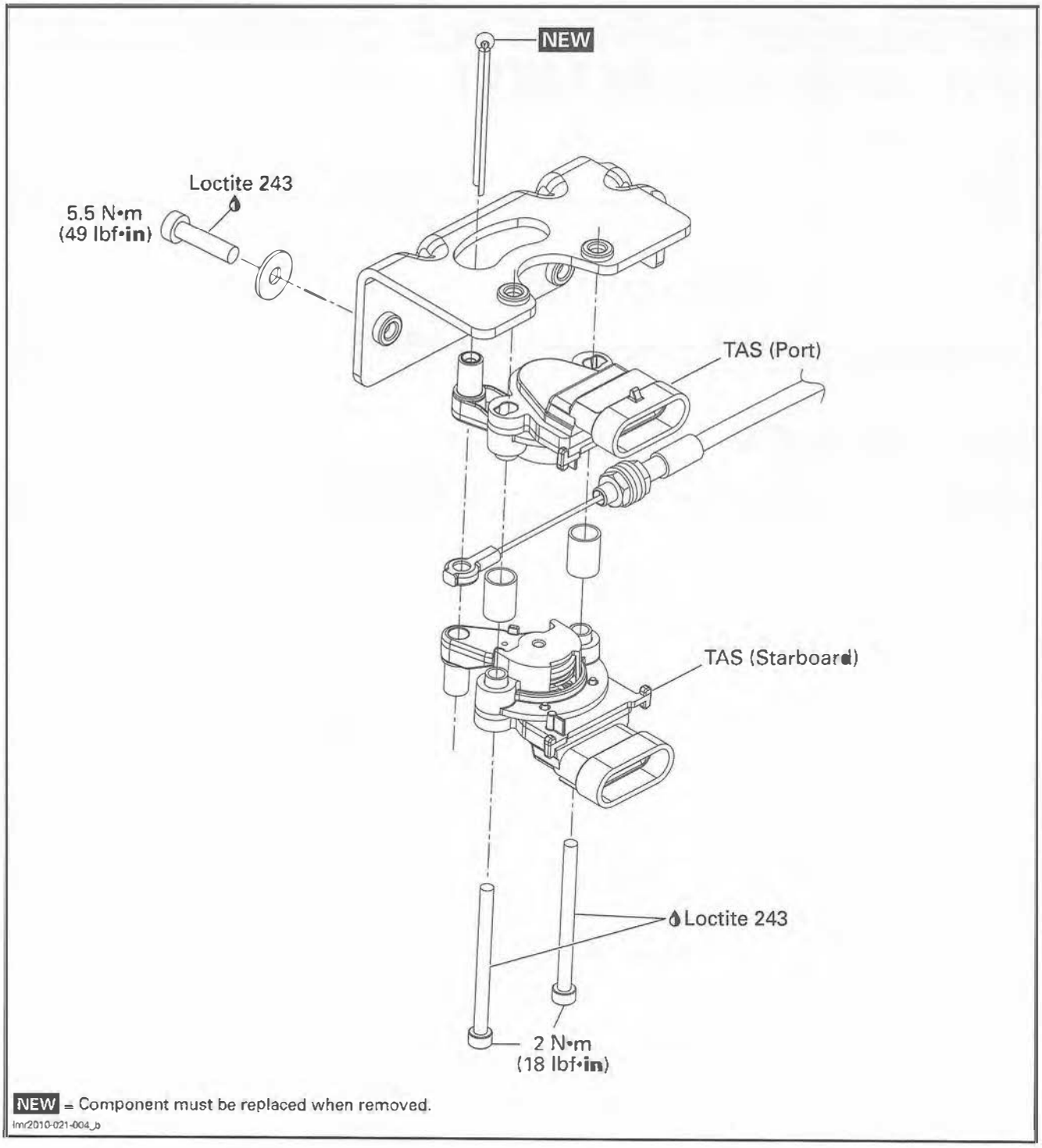
FAULT CODE	MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
U16B1	ECM	Port ECU – Check sum error - CAN ID 01Bh	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16B2	ECM	Starboard ECU – Check sum error - CAN ID 102h	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16B3	ECM	Port ECU – Check sum error - CAN ID 1A2h	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16B4	ECM	Starboard ECU – CAN Timeout error-Missing CAN ID 014h	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure, Port ECM software failure	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16B5	ECM	Port ECU – CAN Timeout error-Missing CAN ID 015h	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16B6	ECM	Starboard ECU – CAN Timeout error-Missing CAN ID 016h	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16B7	ECM	Port ECU – CAN Timeout error-Missing CAN ID 017h	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16B8	ECM	Starboard ECU – CAN Timeout error-Missing CAN ID 01Ah	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16B9	ECM	Port ECU – CAN Timeout error-Missing CAN ID 01Bh	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16BA	ECM	Starboard ECU – CAN Timeout error-Missing CAN ID 102h	Starboard ECM fault detected by Port ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Starboard ECM. Refer to the service manual for more details.
U16BB	ECM	Port ECU – CAN Timeout error-Missing CAN ID 1A2h	Port ECM fault detected by Starboard ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace Port ECM. Refer to the service manual for more details.
U16BB	ECM	Cluster CAN Timeout error-Missing CAN ID 5B4h	Cluster fault detected by ECU ECM. C.A.N. circuit failure.	Check C.A.N. circuits wires. Replace instrument Cluster. Refer to the service manual for more details.
U1700	ECM	ECU cannot detect its position	Port detection jumper missing.	Check port detection circuit. Refer to service manual for more details.
U1701	ECM	Partner ECU could not detect its position (starboard/port)	Port detection jumper missing.	Check port detection circuit. Refer to service manual for more details.
U1702	ECM	Both ECUs detected same installation position (starboard/port)	Port detection jumper missing.	Check port detection circuit. Refer to service manual for more details.

INTELLIGENT THROTTLE CONTROL (iTC) (210 AND 230 SERIES)

SERVICE TOOLS

SERVICE TOOLS – OTHER SUPPLIER

SERVICE PRODUCTS



NEW = Component must be replaced when removed.

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GENERAL

SYSTEM DESCRIPTION

The iTC is an electronic throttle control system that includes:

- A throttle accelerator sensor (TAS) controlled by the throttle/shift control via a cable.
- An electric throttle actuator (ETA) located on the throttle body.
- A throttle position sensor (TPS) located on the throttle body.

NOTE: The ETA and TPS are part of the throttle body and cannot be replaced separately.

The iTC is often referred to as a "throttle by wire" system.

1. TAS

TYPICAL - ETA
1. Throttle body
2. Throttle actuator

According to the driver's torque demand and many EMS inputs, the ECM powers the ETA motor using pulse width modulation (PWM), to open or close the throttle plate. When the ECM detects through the TPS that the throttle plate has reached the targeted opening, the ECM stops the throttle actuator.

The iTC allows the throttle actuator to be moved irrespective of the accelerator sensor position since it is not directly linked by a throttle cable.

The use of the iTC allows the following modes of operation.

Engine RPM Synchronization

On twin engines models, the EMS synchronizes engine rotation speed using the iTC.

Fuel Economy Mode

In the fuel economy mode, the engines are set at a suitable, steady RPM optimizing fuel economy.

Cruise Control

Cruise control allows the operator to set a desired cruising speed of the boat when operating at speeds above 10 km/h (6 MPH).

Ski Mode

Ski mode allows for a controlled launch and accurately maintained maximum towing speed when towing a skier or wake boarder.

Docking Mode

In the docking mode, the full throttle/shift lever stroke will only allow 3500 engine RPM. This helps performing smooth manoeuvres when docking.

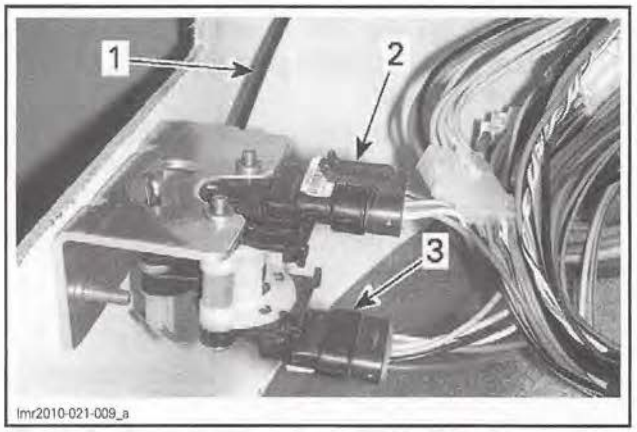
PROCEDURES

TAS (THROTTLE ACCELERATOR SENSOR)

TAS Description

The TAS (throttle accelerator sensors) are double hall effect sensors that sends a signal to the ECM which is proportional to the throttle/shift lever angle. The redundancy is used for security purposes.

There is one TAS per engine, controlled by the throttle/shift lever via a cable.



1. Cable
2. Port TAS
3. Starboard TAS

TAS Access

Open the bow seat backrest of the driver's console.

Unsnap the separating membrane.

TAS Signal Validation

Carry out steps 1 to 4 of *TAS ADJUSTMENT* to validate if the TAS signal reaches the ECM.

TAS Voltage Test

RECOMMENDED TOOLS	
FLUKE 115 MULTIMETER (P/N 529 035 868)	
FLUKE RIGID BACK-PROBE (P/N TP88)	

1. Enable electrical system.
2. Select Vdc on multimeter.
3. Back-probe the TAS connector using the following table information.

NOTICE Be careful not to damage the connector seals when back-probing.

TAS PINOUT			
TAS CONNECTOR		**IDLE POSITION**	**WIDE OPEN POSITION**
PIN		VOLTAGE (Vdc)	
1 (W)	2 (BL)	4.9 - 5.1	
2 (BL)	3 (Y)	0.15 - 0.35	1.4 - 1.6
4 (G)	5 (BK)	4.9 - 5.1	
5 (BK)	5 (R)	0.4 - 0.6	2.9 - 3.1

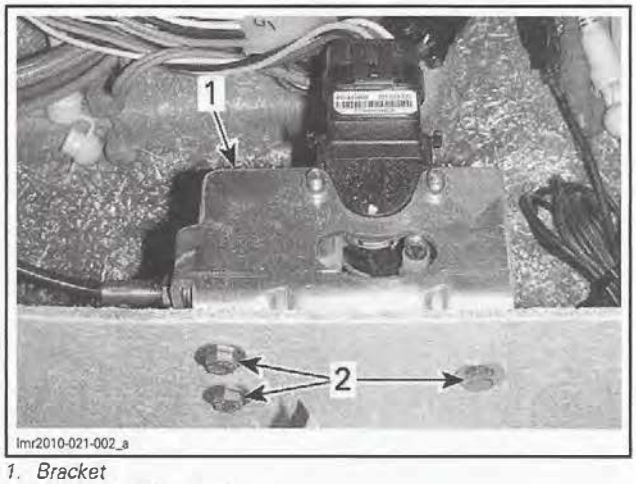
If voltage is as per specification, the TAS is functional.

If voltage is out of specification, check continuity of wires between the ECM and the sensor. If continuity is good, replace sensor.

4. Reinstall removed components.

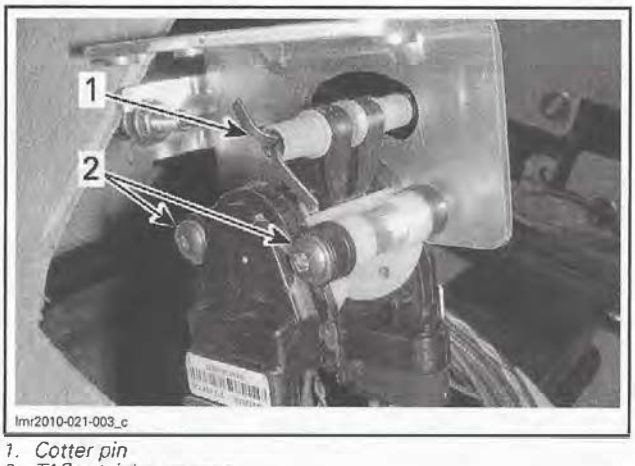
TAS Removal

1. Remove the bracket retaining screws.



1. Bracket
2. Bracket retaining screws

2. Disconnect the electrical connector(s).
3. Remove and discard the cotter pin.
4. Remove the TAS retaining screws.



1. Cotter pin
2. TAS retaining screws

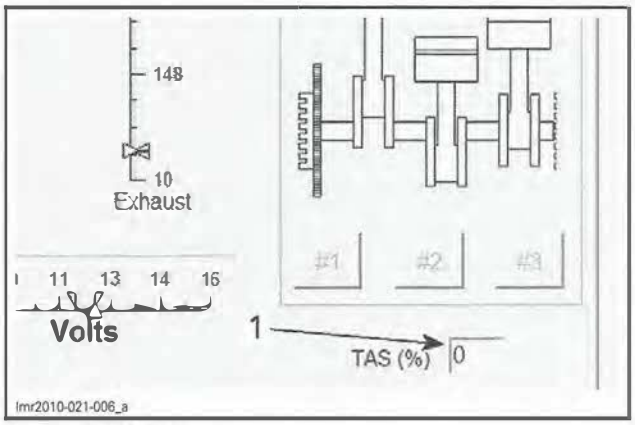
5. Remove TAS from bracket.

TAS Installation

Refer to the exploded view at the beginning of this subsection for parts layout, threadlocker and tightening torque information.

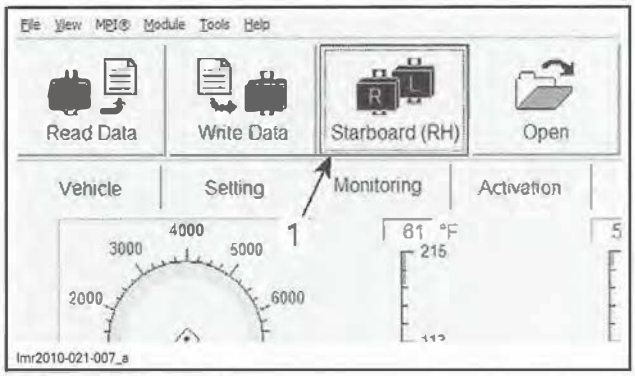
TAS Adjustment

1. Connect vehicle to the latest B.U.D.S. version.
2. Enable electrical system.
3. Select the Monitoring, then ECM tabs.
4. Read the TAS position showed in % for each TAS.



1. TAS % window

NOTE: On twin engines models, click on the Starboard/Port button to change between starboard and port ETA readings.



1. Starboard/Port button

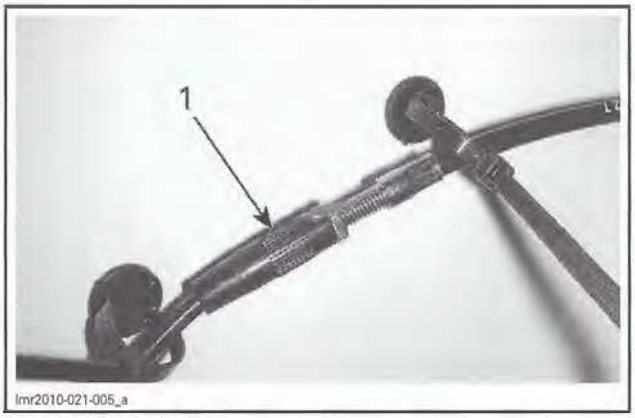
See the following table for correct adjustment.

CORRECT TAS ADJUSTMENT	
THROTTLE/SHIFT LEVER POSITION	READING
Neutral	0%
Wide open	100%

5. Loosen the TAS cable adjuster lock nut.

NOTE: The adjuster is located inside the starboard console.

6. Turn adjuster in order to get the specified readings.



1. TAS cable adjuster

NOTE: In neutral, the TAS arms should rest against the stoppers without any tension on the cable.

7. Tighten the TAS cable adjuster lock nut.

NOTE: If the cable adjuster does not allow correct adjustment, use the threaded end of the cable liner attached to the bracket. In such a case, apply LOCTITE 243 (BLUE) (P/N 293 800 060) to the cable liner threads.

8. After adjusting at WOT, recheck readings in neutral and make sure the TAS arms rest against the stoppers and that the cable is not tight.

ELECTRONIC FUEL INJECTION (EFI)

SERVICE TOOLS

Description	Part Number	Page
DIGITAL INDUCTION TACHOMETER	529 014 500	243
ECM ADAPTER TOOL	420 277 010	250, 257, 266, 268, 273–274, 276, 278–279
ECM ADAPTER TOOL	529 036 166	245, 257, 263, 268, 273–274, 276, 278–279
FLUKE 115 MULTIMETER	529 035 868	245, 250, 256–257, 263, 265–267, 269, 271, 273–275, 277, 279
FUEL HOSE DISCONNECT TOOL	529 036 037	252

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBE	TP88	271

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	247, 253, 266, 269, 272, 276, 279
LOCTITE 518	293 800 038	278
XPS LUBE	293 600 016	262

GENERAL

⚠ WARNING

Always activate bilge blower 5 minutes minimum before working in the engine compartment to allow proper evacuation of any potential fuel fumes.

⚠ WARNING

Fuel is flammable and explosive under certain conditions. Ensure work area is well ventilated. Do not smoke or allow open flames or sparks in the vicinity.

⚠ WARNING

Always turn the main battery cut-off switch to OFF prior to work 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 a pressurized fuel system. Proceed with care when removing/installing pressure test equipment or disconnecting fuel line connections.

⚠ WARNING

Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Wipe off any fuel spillage in the bilge area, if so, vent the bilge thoroughly.

NOTICE **Never use a hose pincher on injection system high pressure hoses.**

When the repair or test is completed, ensure that all hoses are connected and secured. Perform the *FUEL SYSTEM PRESSURE TEST* and the *FUEL SYSTEM LEAK TEST* as explained in *FUEL TANK AND FUEL PUMP* subsection.

⚠ WARNING

Always perform the fuel pressure test if any fuel line has been removed or disconnected. Replace any damage, leaking or deteriorated fuel lines or connections.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

SYSTEM DESCRIPTION

The electronic fuel injection system (EFI) is comprised of various sensors used for detecting ongoing operating conditions of the engine and boat, and includes all the actuators that perform the required adjustment to the engine.

Electrical System

ECM (Electronic Control Module)

From input signals, the ECM acknowledges driver demands and converts them to an engine torque requirement through calculation of several variables. Then, the ECM controls the iTC, the injection system and the ignition system to meet the torque requirement.

The ECM manages the engine torque requirements and controls engine operation to ensure it is delivering optimum performance, fuel economy and meeting emission regulations. The ECM also controls idle RPM and limits maximum engine speed.

EFI Sensors

The ECM reads the inputs from the sensors which it compares to predetermined parameters stored in the ECM, makes computations, and activates the outputs accordingly (injectors, ignition coils etc.).

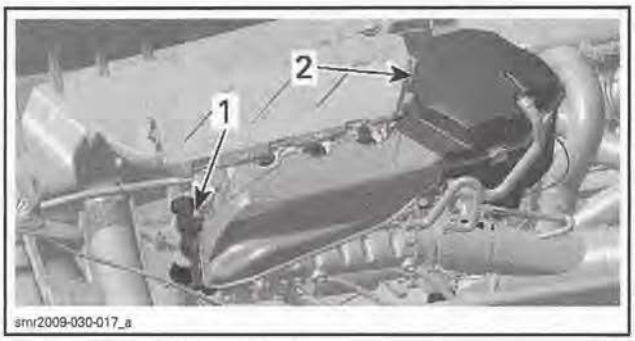
Signals from sensors are used by the ECM to determine the injection and ignition parameters (referenced to fuel maps) as required to maintain the optimum air-fuel ratio.

Air Intake System

Air Intake Silencer (210 Series)

Air is drawn in through the air intake silencer located above rear part of engine.

An air duct is used to channel the air to the throttle body (155 engine) or to the supercharger (215 engine).



1. Air entry behind rubber baffle
2. Air intake silencer

Air Filter (except 210 Series)

Air is drawn directly into a air filter.

An air duct is used to channel the air to the throttle body (155 engine) or to the supercharger (215, 255 and 260 engines).

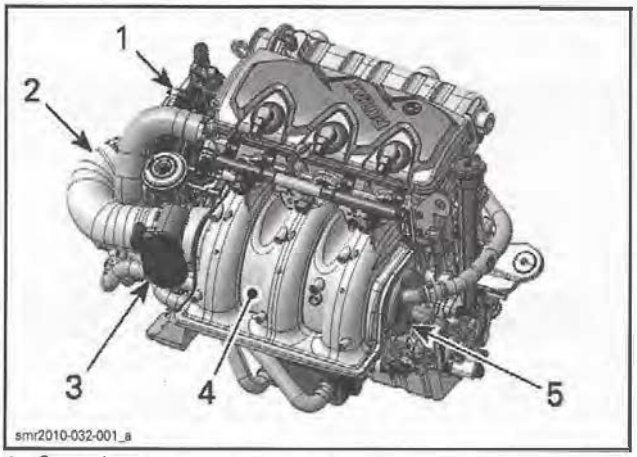
Intercooler (Supercharged Engines)

Air that exits the supercharger has been warmed up during the air compression process. The air that enters the intercooler is cooled down by circulating between small tubes in which cooling water flows. The cooling water is supplied by the jet pump. This increases the air density which augments the amount of air entering the engine.

215 Supercharged Engines

The intercooler used on a 215 engine is located inside the intake manifold. The intercooler is a cylindrical unit that is comprised of small interconnected tubes.

This intercooler configuration cools the air from the supercharger after it has passed through the throttle body.

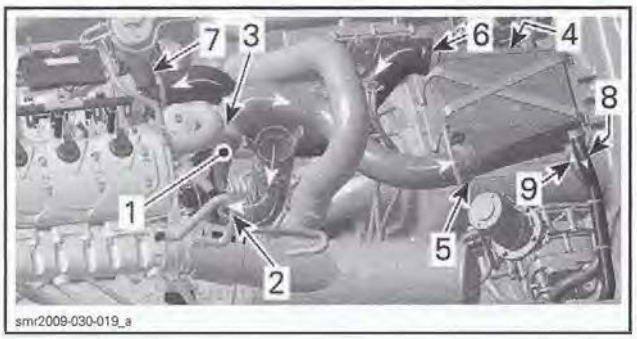


1. Supercharger
2. Supercharger outlet hose
3. Throttle body
4. Intake manifold
5. Intercooler

255 and 260 Supercharged Engines

The intercooler used on a 255 and 260 engines is a separate unit externally mounted.

This intercooler configuration is more efficient as it cools the air from the supercharger before it passes through the throttle body using a larger intercooler. It provides for better cooling, higher mass air flow and higher engine horsepower.



1. *Supercharger*
2. *Supercharger inlet*
3. *Supercharger outlet*
4. *Intercooler*
5. *Intercooler air inlet — warm air from supercharger*
6. *Intercooler air outlet — cooled air*
7. *Throttle body*
8. *Cooling water outlet — warmed water*
9. *Intercooler cooling water inlet — cold water*

Throttle Body

A throttle body is mounted on the intake manifold.

Air for combustion is drawn in by the engine or by a mechanically-driven supercharger. The air flows through the throttle body and is controlled by a throttle plate.

150, 180 and 200 Series

Fitted on the throttle body, the idle bypass valve allow the ECM to control the RPM while the throttle plate is closed.

210 and 230 Series

Fitted on the throttle body, an electric throttle actuator (ETA) allows the ECM to electronically control the throttle plate opening which regulates the amount of air that enters the engine, and therefore engine speed.

There is no idle air control valve (IACV).

Fuel System

Fuel Rail

A single fuel rail is mounted on the intake manifold. The fuel rail ensures that enough fuel can be delivered to the fuel injectors throughout the engine operating range.

The fuel rail is fed by the fuel pump. The fuel pressure applied to the fuel rail is regulated by the fuel pressure regulator located in the fuel pump module.

Fuel Injectors

Three fuel injectors are used to inject fuel into the intake ports of the cylinder head. One injector is used per cylinder.

Fuel Pump

An electric fuel pump with an integrated pressure regulator is used. For more details on the fuel pump unit, refer to *FUEL TANK AND FUEL PUMP* subsection.

ADJUSTMENT

IDLE SPEED

Idle speed is not adjustable. The ECM controls the idle speed of the engine.

If desired, the engine RPM can be measured following this procedure:

REQUIRED TOOL	
DIGITAL INDUCTION TACHOMETER (P/N 529 014 500)	

1. Wrap the tachometer's wire a few times around the protruding part of the ignition coil.

TYPICAL

2. Start engine, read the engine RPM on the induction tachometer.

IDLE SPEED
1800 ± 50 RPM

If idle speed is not within specifications, check if there is any occurred or active fault code(s). If not, proceed with the following:

- Check the throttle cable adjustment (except 210 and 230 Series).
- Perform the *CLOSED THROTTLE RESET*.
- If idle speed is still not adequate, there is probably a mechanical problem.

CLOSED THROTTLE RESET

General Information

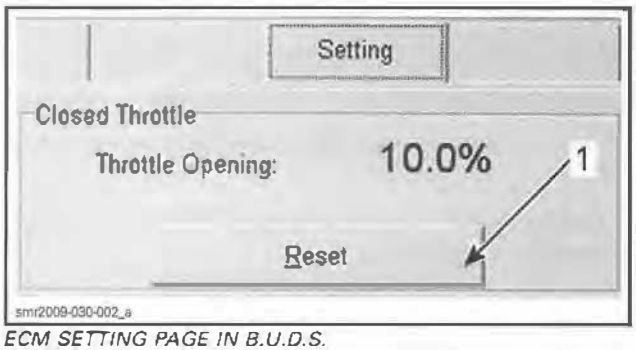
This operation performs a reset of the TPS values of the throttle body in the ECM.

Closed throttle reset must be carried out only when:

- Loosening, removing or replacing TPS (except 210 and 230 Series).
- Loosening, removing or replacing idle bypass valve (except 210 and 230 Series).
- Replacing the throttle body.
- Replacing the ECM.

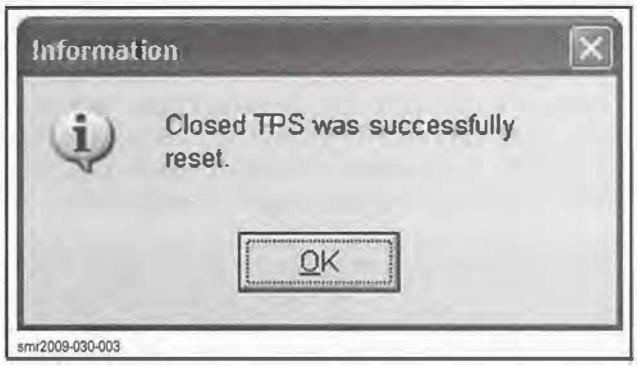
Closed Throttle Reset Procedure

1. Connect boat to latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Ensure throttle/shifter control is in NEUTRAL position.
3. Ensure tether cord is properly installed on engine cut-off switch.
4. Energize the electrical system without starting the engine.
5. Start B.U.D.S. and logon.
6. In B.U.D.S., select the ECM **Setting** page, then click on the **Reset** button.



ECM SETTING PAGE IN B.U.D.S.
1. Click Reset button

The following message will confirm the operation.



Reset is completed.

Exit B.U.D.S.. It is not necessary to click on the WRITE button before closing B.U.D.S.

NOTE: If the throttle valve was not within the allowed range when the **Closed Throttle reset** was carried out, no error message would be displayed. However, a fault code would be set when the engine is started.

7. Start engine and make sure it operates normally through its full engine RPM range.
8. Check for fault codes using B.U.D.S. If a fault code related to the throttle actuator appears, clear it, then carry out another **Closed Throttle reset** procedure. To clear faults, refer to *DIAGNOSTIC AND FAULT CODES* subsection.

TROUBLESHOOTING

DIAGNOSTIC TIPS

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

It is important to ensure that the engine and propulsion system, fuel delivery and electrical systems are functioning normally.

For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

After a problem has been solved, be sure to clear the fault(s) in the ECM using the B.U.D.S. software.

Never use a battery charger to temporarily substitute the battery as it may cause the ECM to function erratically, or not at all.

Check related-circuit fuse solidity and condition with an ohmmeter. A visual inspection could lead to a false diagnosis.

Electrical Related Problems

It is important to check the following in the electrical system:

- Battery voltage
- Fuses
- Bus bar condition in fuse boxes
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are genuine OEM. Any modification to the wiring harness may lead to poor system operation or generate fault codes.

Electrical Connections

Pay particular attention to ensure that terminals and pins are not out of their connectors, corroded, or out of shape.

When probing terminals, pay attention not to deform the terminals as this could cause a loose or intermittent connection that would be difficult to troubleshoot.

PROCEDURES

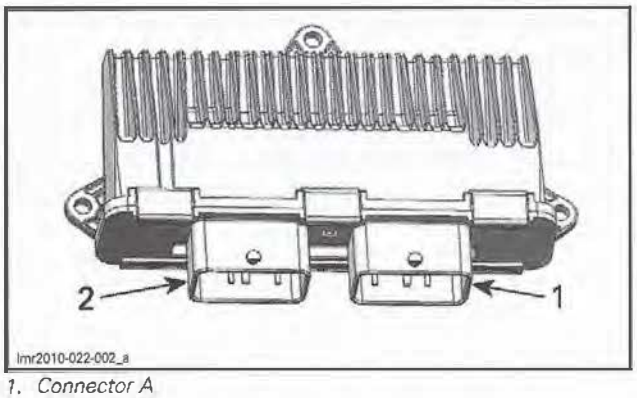
ECM (ENGINE CONTROL MODULE) (210 AND 230 SERIES)

ECM Connector Identification

There are 2 connectors connected to the ECM.

The engine harness female connector is connected to the ECM module male connector A.

The vehicle system control harness female connector is connected to the ECM module male connector B.



1. *Connector A*
2. *Connector B*

The ECM connectors have 48 pins.

NOTE: For connector information, cleaning and probing, refer to *CONNECTOR INFORMATION* subsection.

ECM Validation Tool

The most recommended and safest method to probe ECM connector terminals is to use the ECM ADAPTER TOOL (P/N 529 036 166).

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

ECM Power Supply Test

REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect connector "B" from the ECM.
2. Install the required ECM adapter tool on ECM connector.
3. Install a jumper wire between B-H2 and B-M2.
4. Activate the electrical system.
5. Select the Vdc position on the multimeter and check voltage as follows.

ECM ADAPTER	BATTERY	VOLTAGE
B-M4	Negative post	Battery voltage

If voltage is not measured, check the following:

- Main relay
- Diode
- Wiring and connections (refer to *ECM POWER CIRCUIT CONTINUITY TEST*.

ECM Power Circuit Continuity Test

1. Turn the main battery cut-off switch to OFF position.
2. With the adapter tool still connected, probe terminals as per following table.

210 SERIES		
FUSE BOX	ECM ADAPTER	RESISTANCE
Terminal C4	Pin B-M4	Close to 0 Ω

230 SERIES		
FUSE BOX	ECM ADAPTER	RESISTANCE
Terminal A1	Pin B-M4	Close to 0 Ω

If an open circuit is measured, repair or replace wiring and connectors.

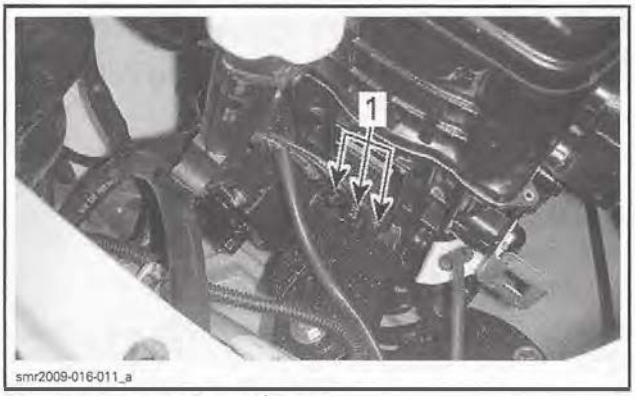
If the ECM power circuit tests good, test the ECM ground circuit.

ECM Ground Circuits Continuity Test

1. With the adapter tool still connected, probe terminals as per following table.

ECM ADAPTER	BATTERY POST	RESISTANCE
B-L1	Ground	Close to 0 Ω (continuity)
B-M2		
B-M3		

If measurement is out of specification, check grounds:
- Ground bus bar in fuse box
- Ground wires and connections
- Engine grounds
- Battery ground.



TYPICAL - FRONT OF ENGINE
1. Engine grounds

TYPICAL - LH SIDE OF ENGINE
1. Battery ground cable
2. Exhaust manifold water inlet fitting

ECM Removal

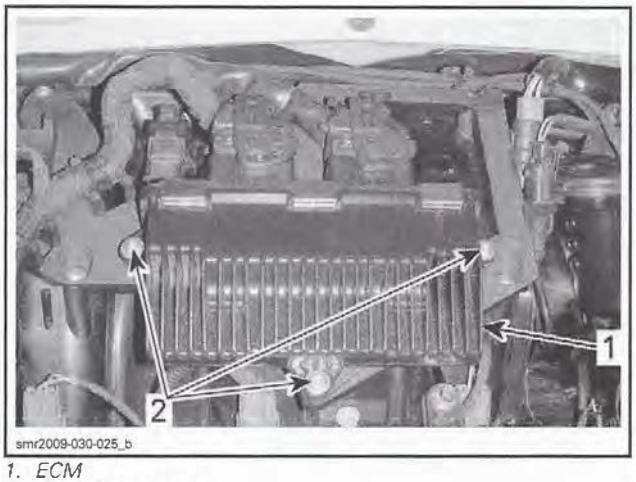
NOTE: If a new ECM is to be installed, first read the procedures in *ECM REPLACEMENT* in this subsection.

1. Disconnect battery cables.

⚠ WARNING

Always disconnect the BLACK negative (–) battery cable first, then disconnect RED positive (+) cable.

2. Disconnect both ECM connectors from ECM.
3. Unscrew all retaining screws and remove the engine ECM from its support on the intake manifold.



1. ECM
2. Retaining screws

ECM Installation

Reverse removal procedure however, pay attention to the following.

1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) to mounting screws.
2. Install and secure the ECM.

NOTICE **Always replace ECM by the same part number or by a BRP approved equivalent.**

TIGHTENING TORQUE	
ECM mounting screws	5.5 N•m (49 lbf•in)

3. Reconnect ECM connectors.
4. Reconnect battery cables.

⚠ WARNING

Always reconnect the RED positive (+) battery cable first, then reconnect BLACK negative (–) cable.

5. If a new ECM is installed, refer to *ECM REPLACEMENT* in this subsection.

ECM Replacement

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

When installing a new ECM, data must be entered and a reset is required.

To transfer/enter data to the new ECM, refer to *ECM MANUAL DATA ENTRY*.

ECM Manual Data Entry

There are 2 possible methods to collect the required information. The 1st being the easiest:

1. Use B.U.D.S. software and obtain the data from a saved **.mpem** file on your PC computer.
2. Collect the information from the vehicle and BOSSWeb.

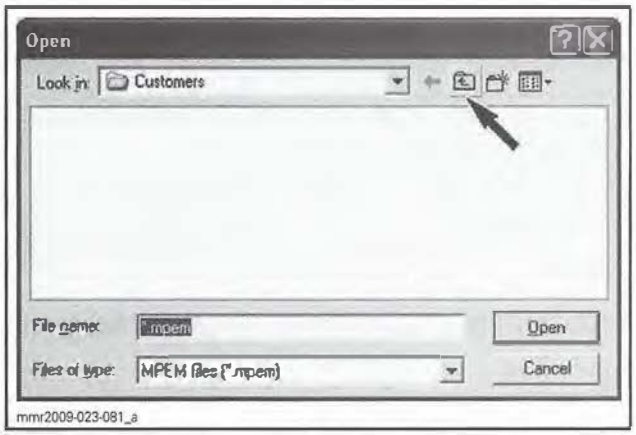
1st Collecting Method: Obtaining the Data from a Saved .mpem File

1. Use the B.U.D.S. software.

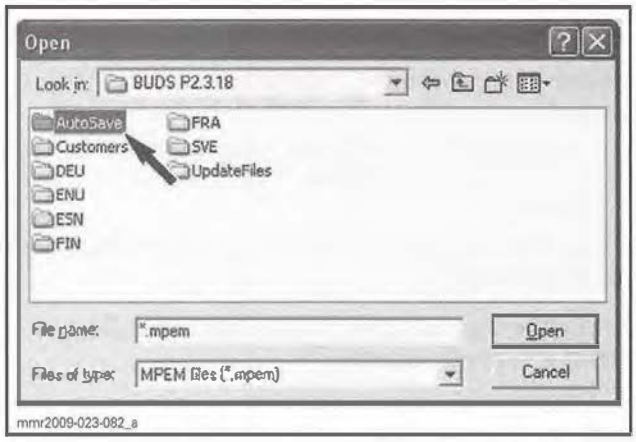
NOTE: It is not necessary to perform any connection. The PC computer can be used alone.

2. In B.U.D.S., click on the **Open** button.

3. Click once on the **Folder Up** button in the **Open** box.

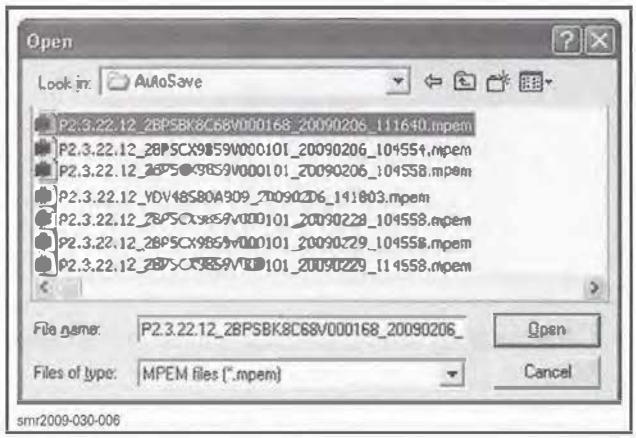


Double click on the **AutoSave** folder.



NOTE: You may have to go to another **AutoSave** folder from a previous version of B.U.D.S.

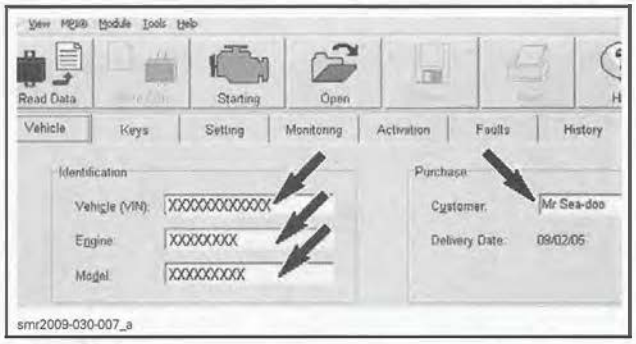
4. Choose the latest file saved for this specific vehicle.



IMPORTANT: Be sure to use the file that specifically matches the vehicle you are servicing.

NOTE: The file name structure is as follows:
BUDS version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem
Example: **P2.3.22.12_2BPSBK8C68V000168_20090206_111640.mpem** Therefore: B.U.D.S. version: P2.3.22.12 VIN: 2BPSBK8C68V000168 Date: 2009 02 06 Hour: 11h 16m 40s

5. Go in the **Vehicle** tab and record the following information.
   1. Vehicle serial number
   2. Engine serial number (without the leading "M")
   3. Vehicle model number
   4. Customer name.



VEHICLE TAB

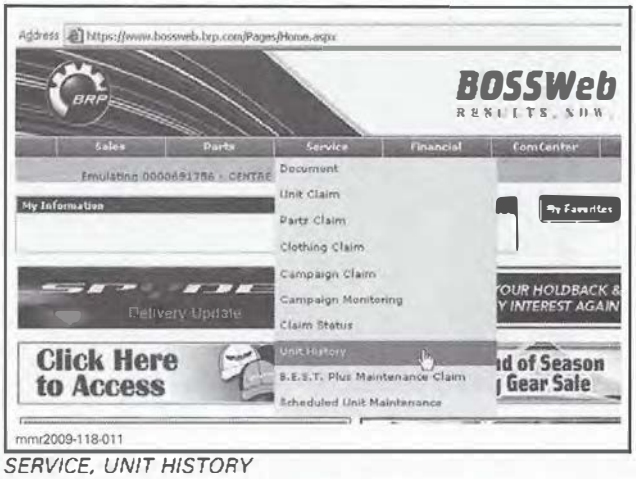
6. Enter recorded data in ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM.*

2nd Collecting Method: Collect the Information from the Vehicle and BOSSWeb

1. Record engine serial number.

1. Engine serial number

2. Record the following numbers using BOSSWeb. Look in **Service** menu and choose **Unit history**.
   1. Vehicle serial number
   2. Vehicle model number
   3. Customer name.

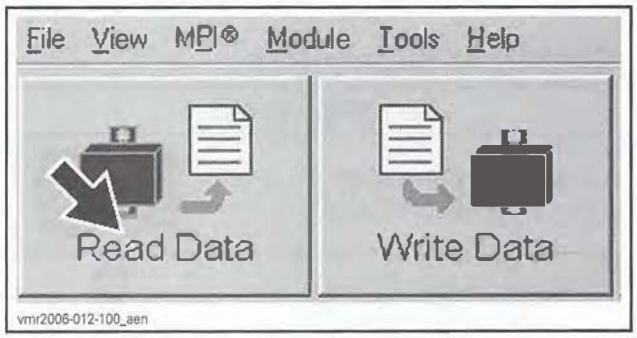


SERVICE, UNIT HISTORY

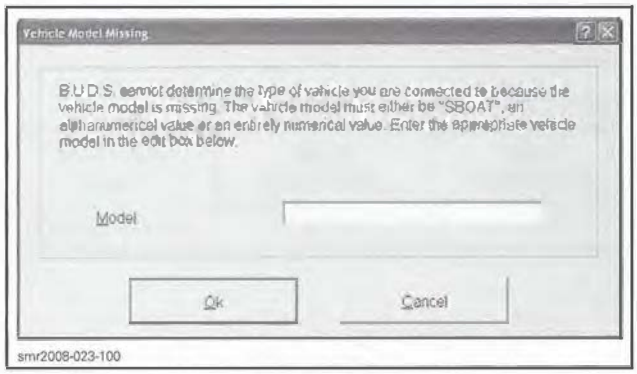
3. Enter the recorded data in the new ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM*.

Entering the Collected Information Into the ECM

1. Use the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND b.u.d.s.* subsection.
2. Install the tether cord on the engine cut-off switch and turn ignition key to ON position.
3. In B.U.D.S., click the **Read Data** button to read the new ECM.

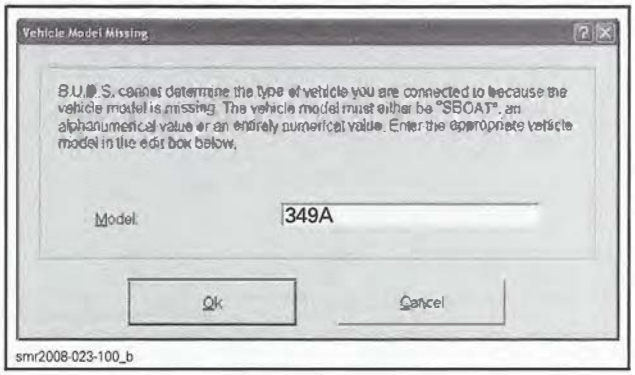


The following screen window will pop up.

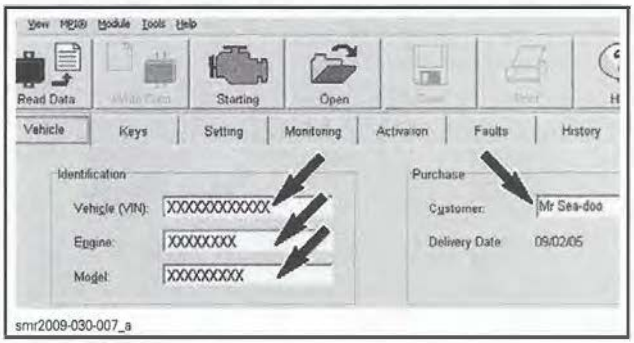


4. Enter the vehicle model number.

NOTICE Enter only the appropriate product model number as obtained when gathering the information.

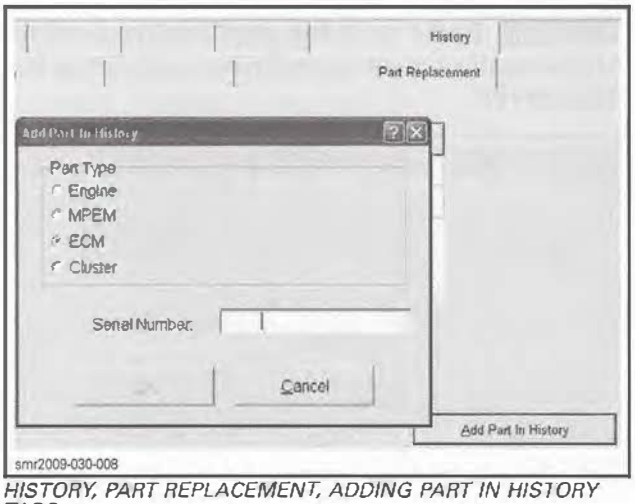


5. Select the **Vehicle** tab and enter the information you recorded previously.
   1. Vehicle serial number
   2. Engine number (**do not** enter the "M" at the beginning of the engine number)
   3. Customer name.



VEHICLE TAB

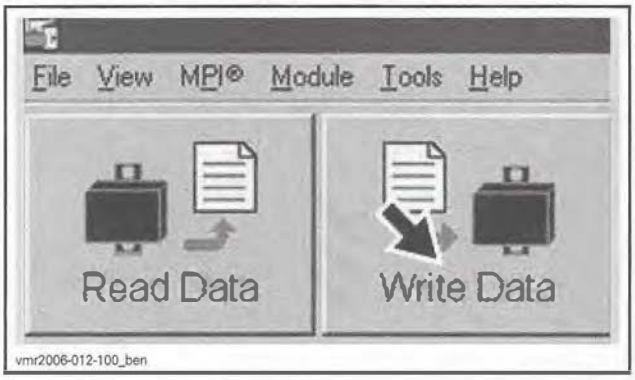
6. Click on the following tabs:
   - **History**
   - **Part Replacement**
   - **Add Part in History**.
7. Enter the **old** ECM serial number in the **Add Part In History** window.



HISTORY, PART REPLACEMENT, ADDING PART IN HISTORY TABS

NOTE: The ECM serial number can be found on the ECM sticker that also identifies the part number.

8. Click on the **Write Data** button.

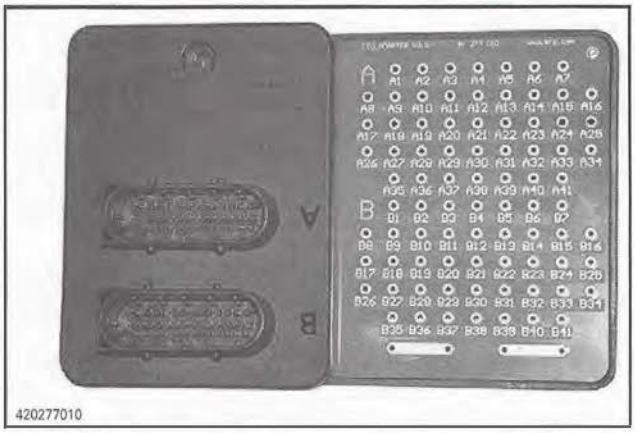


9. Perform the **Closed throttle** reset. Refer to **Closed Throttle Reset** in *ADJUSTMENTS* in this subsection.
10. Reinstall remaining removed parts.

ECM (ENGINE CONTROL MODULE) (150, 180 AND 200 SERIES)

ECM Validation Tool

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



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

Troubleshooting ECM

Install tether cord to engine cut-off switch.

QUICK INDICATION THAT ECM IS NOT POWERED (ASSUMING THE OBSERVED COMPONENT IS WORKING)
Fuel pump does not turn on for approx. 5 seconds.
D.E.S.S. key not validated by the ECM (no bip).
Engine cranking does not occur when pressing START button.

ECM Power Supply Test

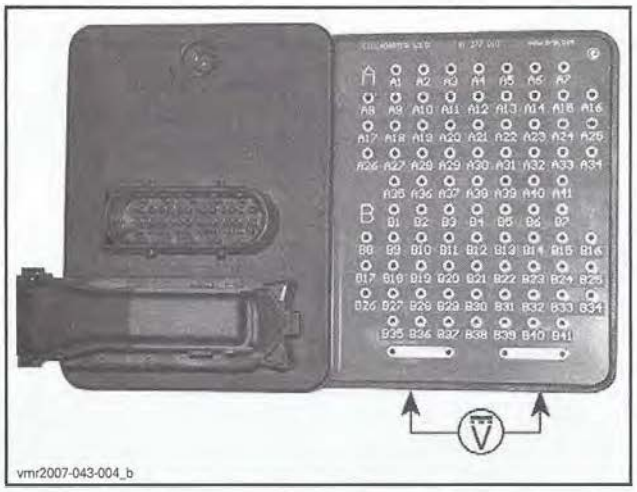
REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 420 277 010)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Disconnect connector "B" from ECM.

Install the required ECM adapter tool to ECM connector.

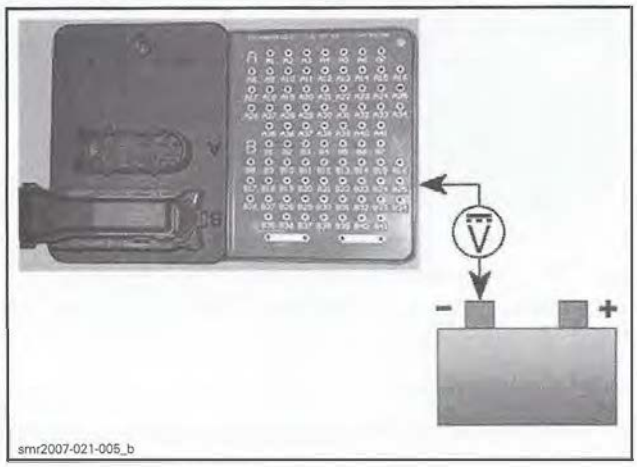
Probe circuit as per following table.

ECM ADAPTER	ECM ADAPTER	VOLTAGE (VDC)
Pin B-11	Pin B-1	Battery voltage



If voltage is inadequate, recheck as follows.

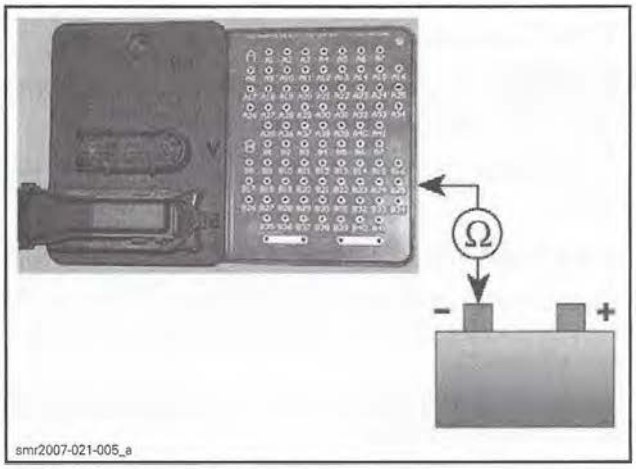
ECM ADAPTER	BATTERY	VOLTAGE (VDC)
Pin B-11	Ground post	Battery voltage



ECM Ground Circuits

Check ground circuits as follows.

ECM ADAPTER	BATTERY POST	RESISTANCE
B1	Ground	Close to 0 Ω (continuity)
B2		
B32		
B41		



If measurement is out of specification, check battery ground and engine grounds.

ECM Replacement

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

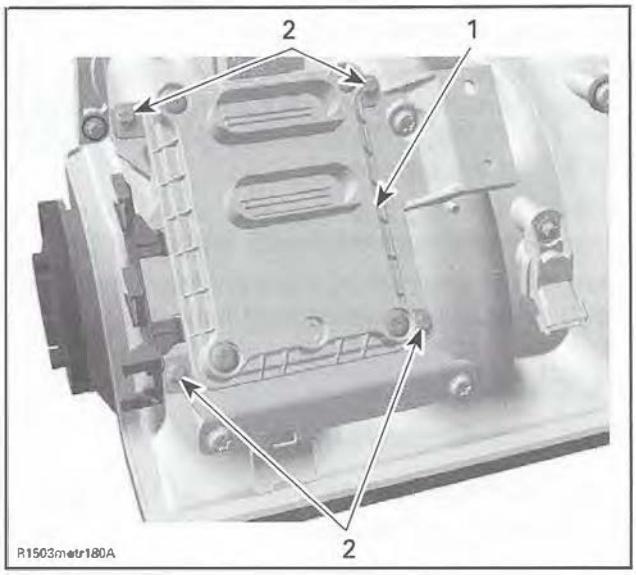
If the defective ECM can be read with B.U.D.S., it is possible to transfer the recorded information of this module to the new ECM. Use Replace ECM in the Module menu of B.U.D.S. Follows instructions in its help system.

If the defective ECM can not be read, do the following.

Turn main battery cut-off switch to OFF position.

Disconnect both ECM connectors from ECM.

Unscrew all retaining screws and remove the engine ECM from its support.



TYPICAL
1. ECM
2. Retaining screws

Install the new ECM.

NOTICE **Always replace ECM by the same part or by an approved equivalent.**

Reconnect ECM connectors to ECM then battery cables.

If the Previous ECM was Read with B.U.D.S.

Transfer the data from the previous ECM to the new one using B.U.D.S. then proceed with the required resets.

Continue procedure as per *FINALIZING ECM REPLACEMENT* below.

If the Previous ECM was NOT Read with B.U.D.S.

1. Enter the old ECM serial number in the **Part Replacement** under **History tab**. Click on **Add** part in History.

NOTE: The ECM serial number can be found on the ECM sticker that also shows the part number.

2. Enter the vehicle and engine serial numbers in the **Vehicle tab**.
3. Reprogram D.E.S.S. key(s).
4. Manually activate the options installed on vehicle under the **Setting tab**.

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

Continue procedure as per *FINALIZING ECM REPLACEMENT* below.

Finalizing ECM Replacement

IMPORTANT: When the ECM is replaced, the Closed Throttle and Idle Actuator must be reset. Refer to *CLOSED THROTTLE RESET* in *ADJUSTMENT* for the procedure.

After performing the required reset, ensure to clear all faults from the newly replaced ECM.

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

FUEL RAIL

Fuel Rail Removal

Fuel Rail Hose Disconnection

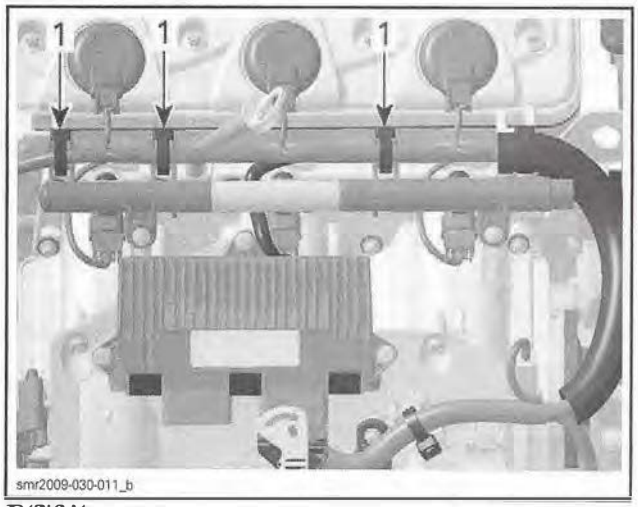
1. Release fuel pressure
   - 1.1 Disconnect fuel pump electrical connector.
   - 1.2 Crank engine.
2. Turn the main battery cut-off switch to OFF position.
3. Place an absorbent shop rag under the fuel supply hose fitting at the fuel rail to catch any fuel leakage.
4. Disconnect fuel hose from fuel rail.

REQUIRED TOOL
FUEL HOSE DISCONNECT TOOL (P/N 529 036 037)

NOTE: It may be necessary to rotate fuel hose fitting to align the tool ends with the openings of the locking mechanism.

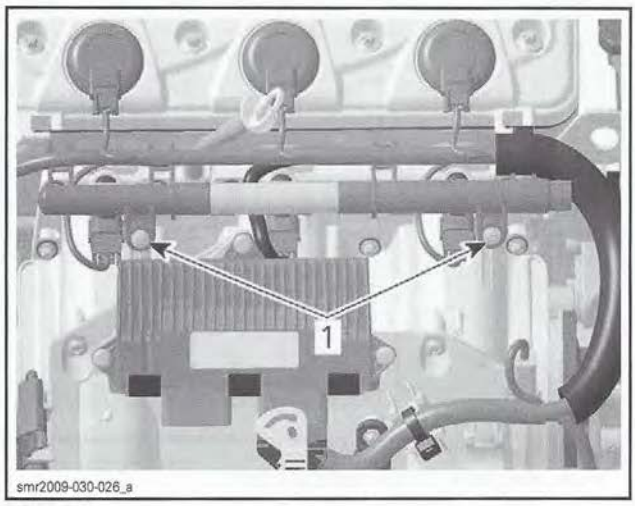
Fuel Rail Removal

1. Cut locking ties retaining engine harness to fuel rail.



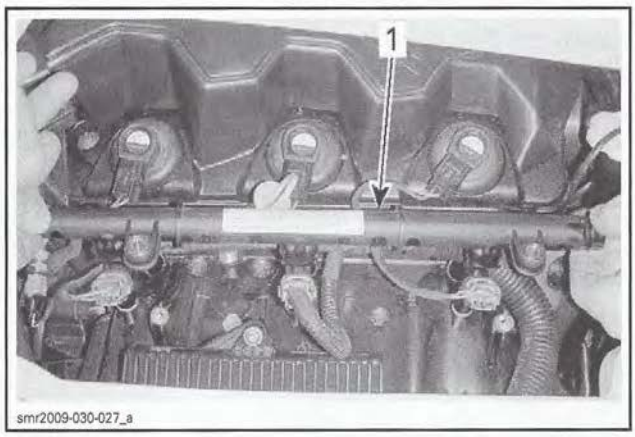
TYPICAL
1. Cut locking ties

2. Remove screws retaining the fuel rail.



TYPICAL
1. Retaining screws

3. Gently pull fuel rail side to side (wiggle).



TYPICAL
1. Fuel rail

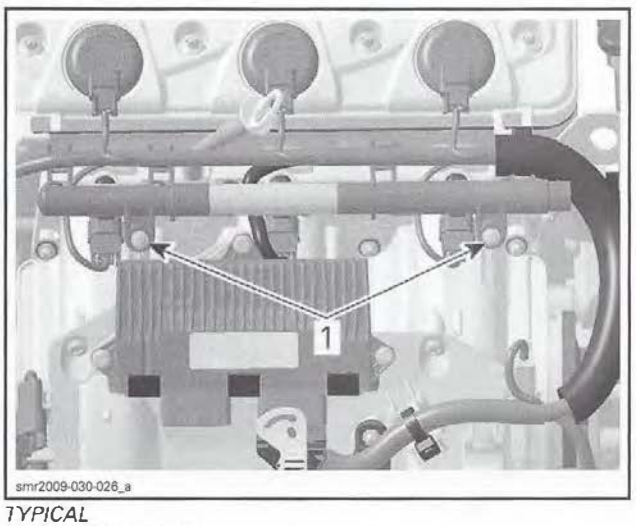
4. Disconnect all injector connectors.
5. Pull fuel rail out with fuel injectors.

Fuel Rail Installation

Reverse the removal procedure. However, pay attention to the following.

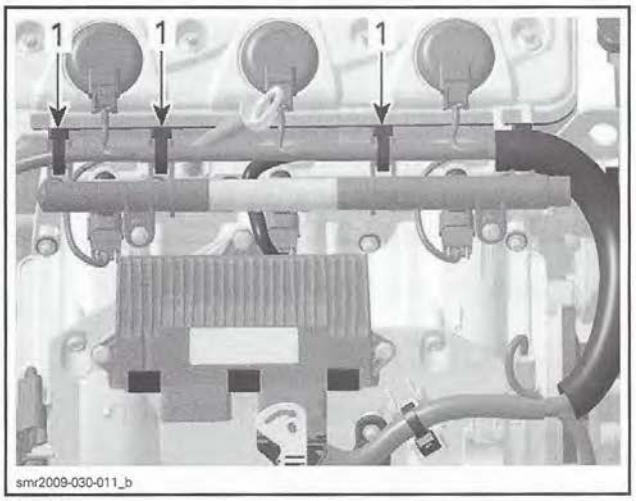
1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on fuel rail retaining screws.
2. Torque fuel rail retaining screws to specification.

TIGHTENING TORQUE	
Fuel rail retaining screws	9 N•m (80 lbf•in)



TYPICAL
1. Retaining screws

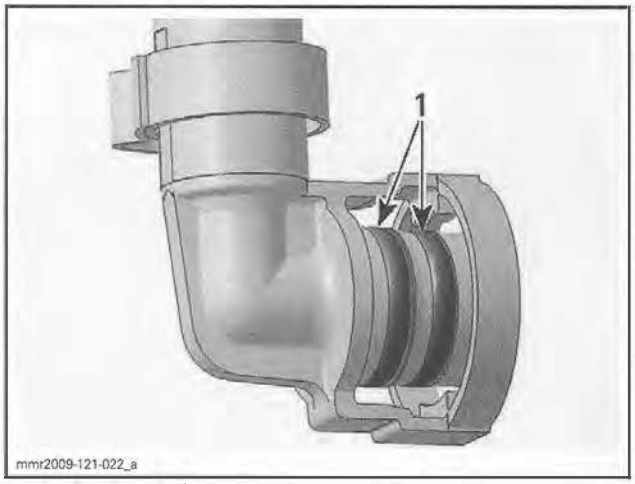
3. Properly install new locking ties to secure engine harness to fuel rail.



TYPICAL
1. New locking ties

Fuel Rail Hose Connection

1. Apply engine oil on O-rings of fitting.



1. Apply oil on O-rings

2. Push fuel hose fitting on fuel rail until its "clicks".

NOTE: Try pulling fuel hose off fuel rail to ensure fitting is properly locked.

3. Pressurize the fuel system and check for a fuel leak. Refer to *FUEL SYSTEM LEAK TEST* in *FUEL TANK AND FUEL PUMP* subsection.

⚠ WARNING

Failure to pressurize the fuel system may result in severe injury or a life threatening situation should a leak occur.

4. Reinstall all remaining removed parts.

FUEL INJECTOR

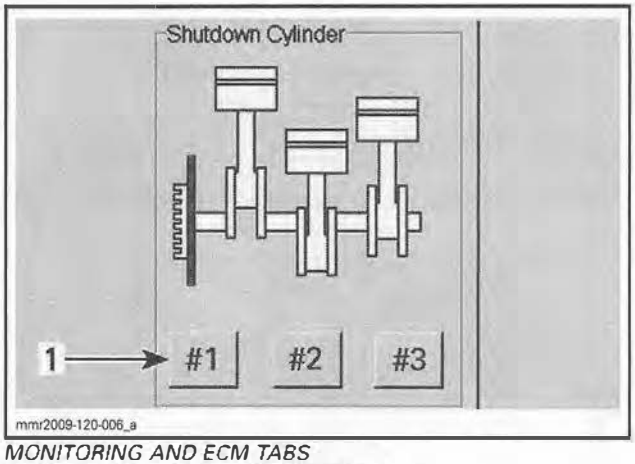
Fuel Injector Operation Test with B.U.D.S. (Dynamic)

1. Connect B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Start engine.

NOTE: If the boat is out of water, connect a garden hose to the hose adapter to cool exhaust system. Refer to *EXHAUST SYSTEM FLUSHING* in the *EXHAUST SYSTEM* subsection.

NOTICE Damages may occur to exhaust system if not cooled with water.

3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Monitoring** page tab.
4. Using the B.U.D.S. software, shut down each engine cylinder one at a time by clicking on the button under the applicable cylinder.



MONITORING AND ECM TABS
1. Click on cylinder number to be tested

If the engine RPM drops when clicking on a cylinder, the injector and the ignition of this cylinder are functioning normally.

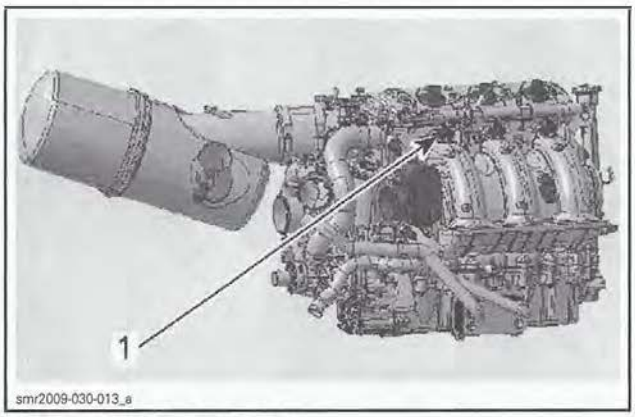
If the engine RPM does not drop when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to *FUEL INJECTOR OPERATION TEST WITH B.U.D.S. (STATIC).*
- Spark plug and ignition coil. Refer to *IGNITION SYSTEM.*
- Engine condition.

Fuel Injector Operation Test with B.U.D.S. (Static)

NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine and prevent a potential backfire due to fuel accumulation in the engine.

1. Connect B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Activate the electrical system.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** page tab.
4. On the ECM Activation page, energize the fuel injector to be tested by clicking on it in B.U.D.S.



ACTIVATION AND ECM TABS
1. Injector of cylinder no. 1 shown

5. Listen to the injector.

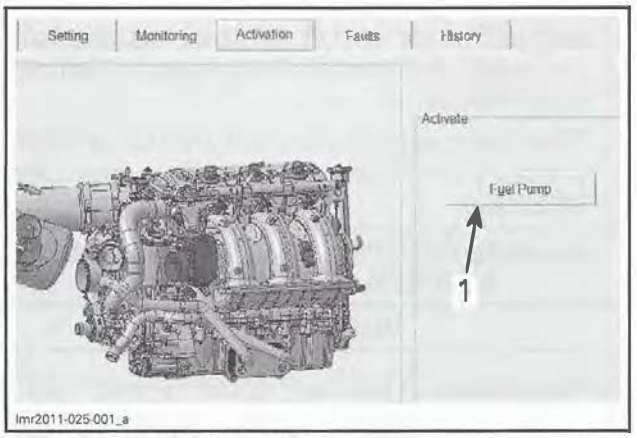
If you can hear the injector, it validates its operation. Carry out the *FUEL INJECTOR BALANCE TEST*.

If you do not hear the injector, carry out the *INJECTOR INPUT VOLTAGE TEST*.

Fuel Injector Balance Test with B.U.D.S.

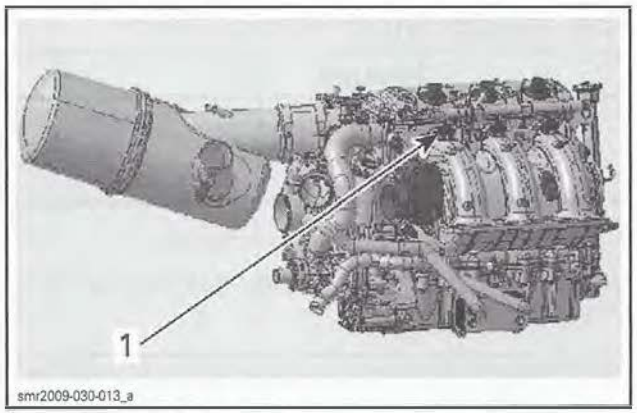
NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine and prevent a potential backfire due to fuel accumulation in engine.

1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* of *FUEL TANK AND FUEL PUMP* subsection.
2. Connect B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. Activate the electrical system.
4. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** page tab.
5. In B.U.D.S., click the **Fuel Pump** button to activate fuel pump.



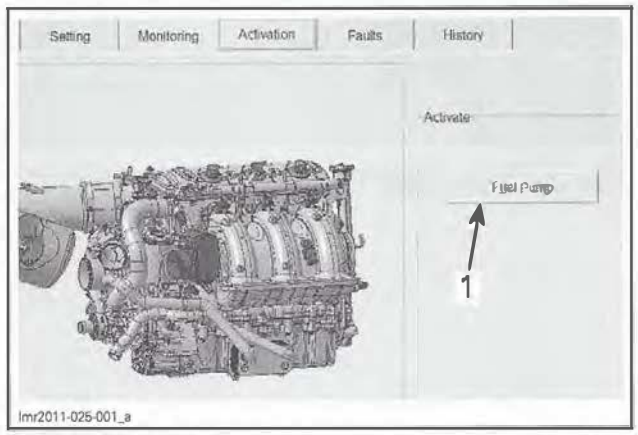
ACTIVATION AND ECM TABS
1. Fuel Pump activation button

6. Fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.
7. In B.U.D.S., energize fuel injector **no. 1**.



ACTIVATION AND ECM TABS
1. Injector of cylinder no. 1 shown

8. Record the fuel pressure drop for injector **no. 1**.
9. In B.U.D.S., click the **Fuel Pump** button to activate fuel pump.



ACTIVATION AND ECM TABS
1. Fuel pump

10. Repeat the procedure for fuel injectors no. 2 and no. 3 and record the pressure drop for each injector.
11. The maximum fuel pressure drop between injectors should not exceed the following specification:

MAXIMUM FUEL PRESSURE DROP ALLOWED BETWEEN FUEL INJECTORS
10 kPa (1.5 PSI)

If pressure drop of any fuel injector is greater than the specification, replace that injector then repeat the test.

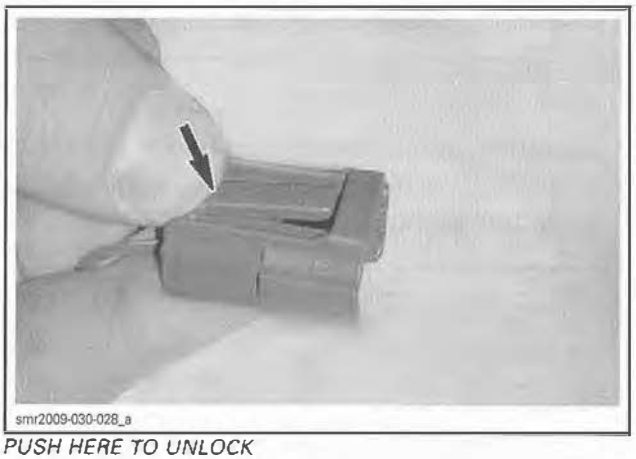
12. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
13. Remove fuel pressure gauge and reinstall removed parts.

Fuel Injector Input Voltage Test

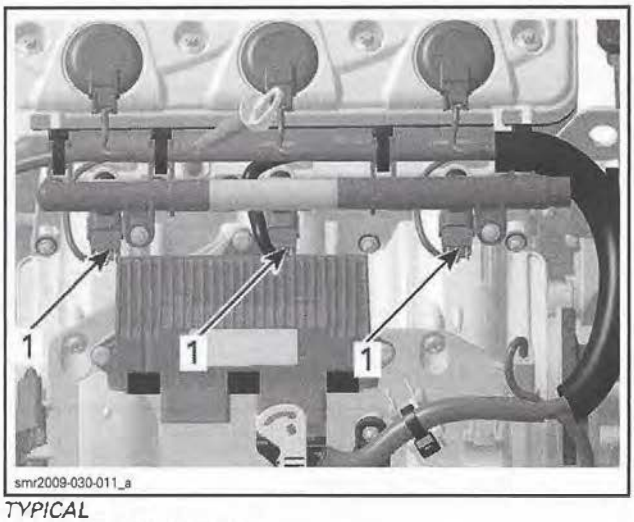
REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect fuel injector connectors.

NOTE: Push against tab underneath connector as illustrated to unlock it.



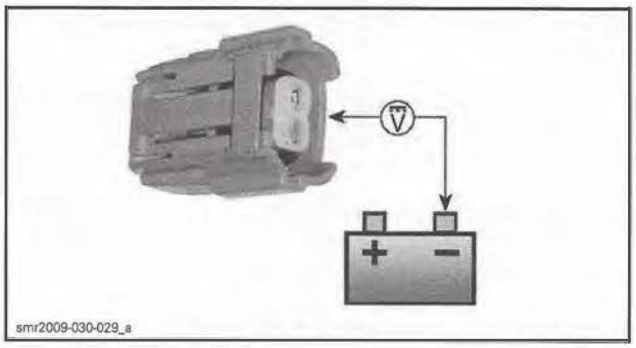
PUSH HERE TO UNLOCK



TYPICAL
1. Fuel injector connectors

2. Activate the electrical system.
3. On multimeter, select Vdc.
4. Read input voltage to the applicable injector as per following table.

PROBE INJECTOR CONNECTOR	MEASUREMENT
VIOLET wire with a tracer to battery ground	Battery voltage



If battery voltage is measured, carry out the *FUEL INJECTOR GROUND CIRCUIT TEST.*

If battery voltage is not measured, carry out the *FUEL INJECTOR POWER CIRCUIT CONTINUITY TEST.*

Fuel Injector Power Circuit Continuity Test

1. Remove or disconnect the following:

MODEL	REMOVE OR DISCONNECT
150, 180 and 210 series	Remove the long bus bar from fuse box #1
200 series	Disconnect the connector B from the EFB
230 Series	Remove the long bus bar from fuse boxes #1 and #2

2. On multimeter, select Ω.
3. Measure resistance value between terminals as follows.

150, 180 AND 210 SERIES		
FUSE BOX #1 TERMINAL	INJECTOR CONNECTOR PIN	RESISTANCE @ 20°C (68°F)
C12 (injector #1 - rear)	2	11.4 - 12.6 Ω
C8 (injector #2)		
C5 (injector #3)		

200 SERIES		
EFB CONNECTOR TERMINAL	INJECTOR CONNECTOR PIN	RESISTANCE @ 20°C (68°F)
B-C (injector #1 - rear)	2	11.4 - 12.6 Ω
B-D (injector #2)		
B-G (injector #3)		

230 SERIES		
FUSE BOX TERMINAL	INJECTOR CONNECTOR PIN	RESISTANCE @ 20°C (68°F)
C11 (injector #1 - rear)	2	11.4 - 12.6 Ω
C9 (injector #2)		
C7 (injector #3)		

If resistance value are not as specified:
- Check fuse
- Repair or replace wiring and connectors.

If resistance values are as specified, carry out the *FUEL INJECTOR GROUND CIRCUIT TEST.*

Fuel Injector Ground Circuit Test

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect ECM A connector.
2. Install the required ECM adapter tool on ECM connector.
3. On multimeter, select Ω.
4. Probe terminals as per following table.

150, 180 AND 200 SERIES		
ECM ADAPTER	INJECTOR CONNECTOR PIN	RESISTANCE @ 20°C (68°F)
Pin A-15 (injector #1 - rear)	1 (BROWN wire with a tracer)	Close to 0 Ω
Pin A-33 (injector #2)		
Pin A-14 (injector #3)		

210 AND 230 SERIES		
ECM ADAPTER	INJECTOR CONNECTOR PIN	RESISTANCE @ 20°C (68°F)
Pin A-B3 (injector #1 - rear)	1 (BROWN wire with a tracer)	Close to 0 Ω
Pin A-K1 (injector #2)		
Pin A-K1 (injector #3)		

If ground circuit is at fault, repair or replace wiring and connectors.

If resistance values of the ground circuit are within specification, carry out the *FUEL INJECTOR CONTINUITY TEST (at Component)*.

Fuel Injector Resistance Test (at Component)

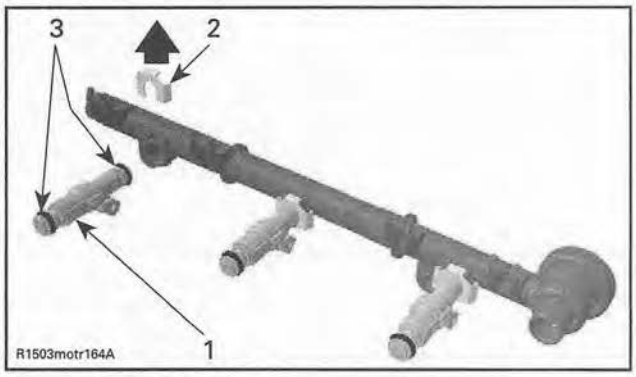
1. Remove injector connector.
2. Check resistance value between injector pins as per followings table.

INJECTOR PIN		RESISTANCE @ 20°C (68°F)
1	2	11.4 - 12.6 Ω

If readings are not as specified, replace injector.

Fuel Injector Removal

1. Remove fuel rail. Refer to *FUEL RAIL* in this subsection.
2. Remove the injector clip.



FUEL RAIL ASSEMBLY
1. *Fuel injector*
2. *Injector clip*
3. *O-ring*

3. Pull the fuel injector out of the fuel rail.

Fuel Injector Installation

Reverse the removal procedure however, pay attention to the following details.

1. If you reinstall a used injector, carefully inspect O-ring condition before reinstallation. Replace O-ring with a new one if damaged.
2. Apply a thin film of engine oil to O-rings.
3. Insert the fuel injector in the fuel rail.
4. Secure injector to fuel rail with a retaining clip.
5. Install fuel rail on engine. Refer to *FUEL RAIL* in this subsection.
6. Pressurize the fuel system and check for a fuel leak. Refer to *FUEL SYSTEM LEAK TEST* in *FUEL TANK AND FUEL PUMP* subsection.

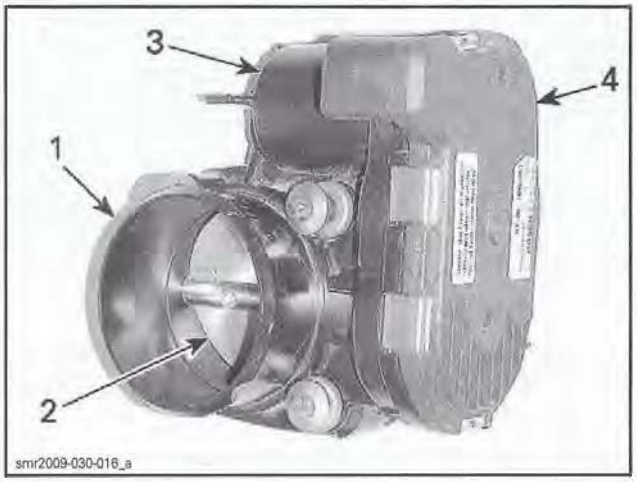
⚠ WARNING

Always carry out a fuel system high pressure leak test after working on the fuel system.

7. Reinstall all remaining removed parts, refer to applicable subsections.

THROTTLE BODY (210 AND 230 SERIES)

Throttle Body Description



1. *Throttle body*
2. *Throttle plate*
3. *Throttle actuator (electric motor inside)*
4. *Throttle position sensor (TPS) (inside)*

Electronic Throttle Actuator

The electronic throttle actuator (ETA) is a DC motor on the throttle body that regulates the throttle plate via a drive gear. Pulse width modulation (PWM) is used to control the motor.

Throttle Plate Operating Positions

Two torsional springs are connected to the throttle plate. A main spring and another one in a plunger mechanism.

When there is no power to the throttle actuator (ETA), the plunger mechanism maintains the throttle plate at a rest position.

When the throttle plate is opened by the ETA as commanded by the ECM, it acts against the main spring. If the ETA failed, the return spring would bring the throttle plate back to the limp home position.

ECM	ENGINE	THROTTLE BODY
OFF	Stopped	Throttle actuator: Off. Throttle plate: Rest position, maintained opened at approximately 8° (1). This is also the limp home position.
ON	Not started	Throttle actuator: On. Throttle plate: Moves from the rest position to approximately 14°. It then moves back to the rest position. This is the diagnostic mode where the rest position, actuator opening force to overcome the return springs and the motor return rate are monitored. If any of these parameters are out of range, a fault code is initiated.
ON	Started. Normal operation at idle	Throttle actuator: On. Throttle plate: Moves from the rest position to idle position (approximately 1-3°) according to ECM injection and ignition maps. Throttle plate is opened and closed as necessary to control the idle speed.
ON	Started. Normal operation at various RPM	Throttle actuator: On. Throttle plate: Opens and closes according to ECM torque management priorities.

(1) Degree values are given from the fully closed position.

Throttle Body Lubrication

No lubrication is required.

Throttle Body Cleaning

1. Remove air inlet hose from throttle body.
2. Check throttle body cleanliness using a flashlight. Fully open throttle plate and verify:
   - Throttle body bore
   - Throttle plate edge.

Look for:
- Dirt
- Oily surfaces
- Carbon and salt deposits on throttle plate and the surrounding bore.

3. Clean as necessary.
4. Use a throttle body cleaner such as GUNK INTAKE MEDIC or an equivalent.

NOTICE **Only use an appropriate throttle body cleaner that will not damage O-rings and EFI sensors.**

⚠ WARNING

Use the product in well ventilated area. Refer to product manufacturer's warnings. Wipe off any product leakage in bilge.

5. To avoid getting dirt into engine, spray cleaner on a clean rag (outside the bilge) then rub rag against throttle plate and bore. A toothbrush works well too.

⚠ WARNING

First ensure ECM is off. Otherwise, if ECM should suddenly turn off, it would quickly close the throttle plate which could cause serious finger injury.

6. Manually open throttle and hold fully open to reach all surfaces.

⚠ WARNING

Ensure nobody activate the electrical system. The ECM would turn on and the throttle actuator (ETA) would cycle. This could cause serious finger injury as the throttle plate moves quickly.

7. To remove residual dirt, spray cleaner on throttle plate and on bore.
8. Reinstall removed parts.

Throttle Body Actuator (ETA) Test

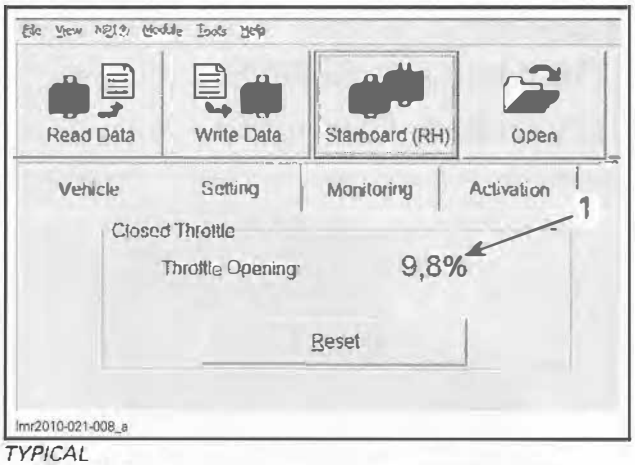
Throttle Body Actuator (ETA) Test with B.U.D.S.

NOTE: Use the **Setting** page, to confirm ETA movement. The **Monitoring** page will not read the actual ETA movement.

1. Enable electrical system.
2. Connect vehicle to the latest B.U.D.S. version.
3. Select the **Setting**, then **ECM** tabs.

NOTE: Click on the **Starboard/Port** button to starboard or port ETA readings.

4. On **210 series**, slowly move throttle/shift lever from NEUTRAL to WOT. The ETA should go from 0% to 100%.
5. On **230 series**, slowly move the throttle lever from the idle to WOT. The ETA should go from 0% to 100%.



TYPICAL
1. ETA position

If result is out of specification, carry out a *CLOSED THROTTLE RESET*. Refer to *ADJUSTMENT* in this subsection.

NOTE: The ETA is reset at the same time as the TPS.

After the reset, test ETA again.

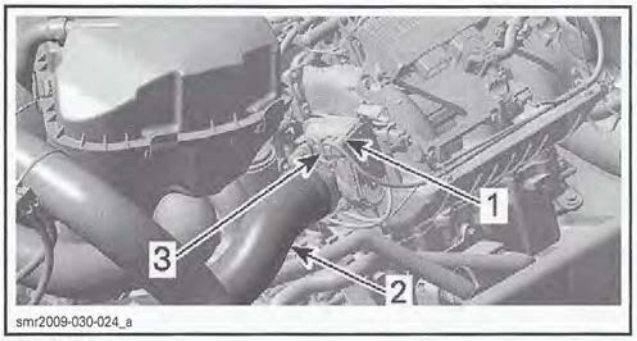
If the result is still out of specification, check wire continuity between ECM and throttle body before assuming the ETA is at fault.

Throttle Body Removal

1. Disconnect inlet hose from throttle body.
2. Disconnect throttle body connector.

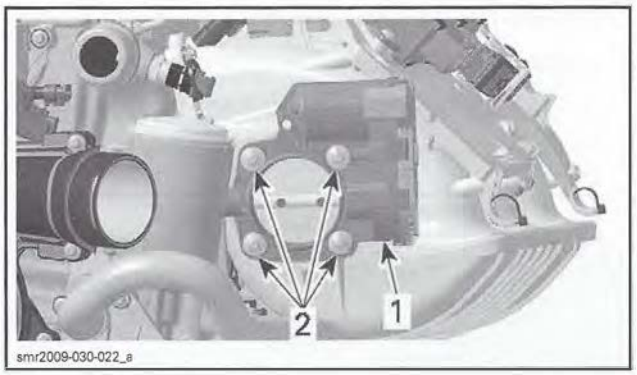
To remove connector from throttle body, press connector locking tab illustrated.

PRESS HERE TO UNLOCK



TYPICAL
1. *Throttle body*
2. *Inlet hose*
3. *Connector*

3. Remove retaining screws from throttle body.



1. *Throttle body*
2. *Screws*

4. Pull throttle body off intake manifold.

Throttle Body Installation

Installation of the throttle body is the reverse of the removal procedure. However, pay attention to the following.

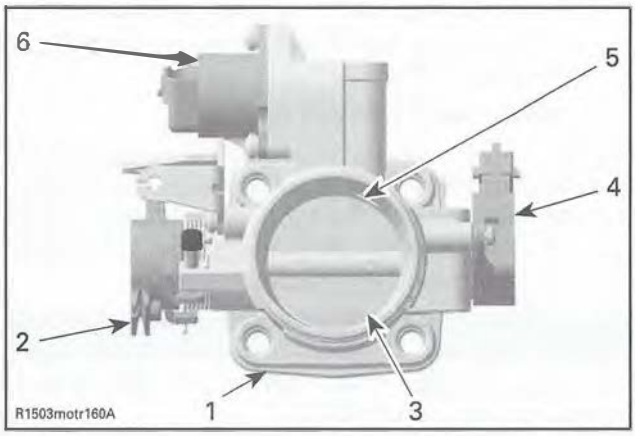
1. Torque retaining screws to specification in a crisscross sequence.

TIGHTENING TORQUE	
Throttle body retaining screws	9 N•m (80 lbf•**in**)

2. Perform the **Closed Throttle Reset**. See procedure in *ADJUSTMENTS*.

THROTTLE BODY (150, 180 AND 200 SERIES)

Throttle Body Description

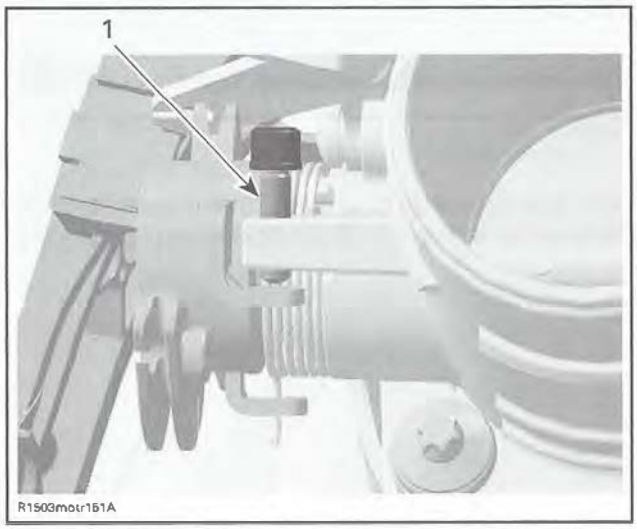


TYPICAL
1. *Throttle body*
2. *Throttle cable attachment*
3. *Throttle plate*
4. *TPS*
5. *Idle bypass channel*
6. *Idle bypass valve*

Throttle Body Idle Stop Screw Adjustment

The adjustment of the idle stop screw is optimized by the throttle body manufacturer and locked to prevent any modification.

NOTICE Never attempt to adjust the idle speed through this screw. See *IDLE SPEED* in *ADJUSTMENT*.



THROTTLE BODY
1. *Idle stop screw (do not tamper adjustment)*

Throttle Body Inspection

Check:

- If throttle body idle stop screw is loose or worn. If so, throttle body must be replaced.
- If TPS (throttle position sensor) is loose.
- For corroded or damaged wiring or connectors of TPS and IACV.
- Throttle plate for proper operation.

NOTE: Check that the throttle plate moves freely and smoothly then check for salt accumulation on throttle plate shaft. Try lubricating throttle plate shaft if not working properly. Open and close plate several times and recheck.

⚠ WARNING

Replace throttle body when throttle plate does not return properly.

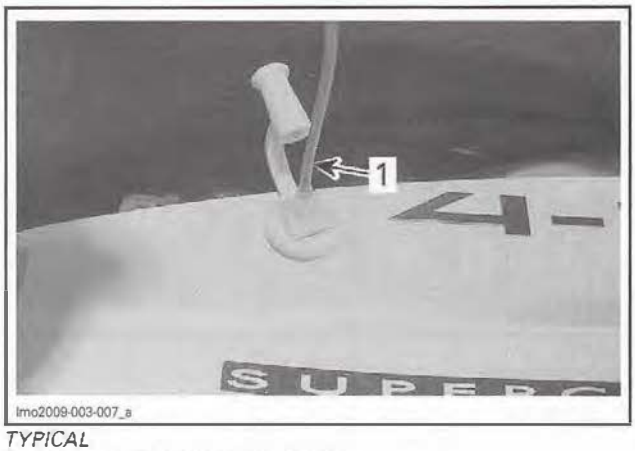
Throttle Body Lubrication

Lubricate throttle body on each engine with XPS LUBE (P/N 293 600 016) or an equivalent.

Use the lubrication fitting located on top of engine.

REMOVE CAP
1. Lubrication fitting

With the engine not running, make sure to spray lubricant at least 3 to 5 seconds for proper lubrication.

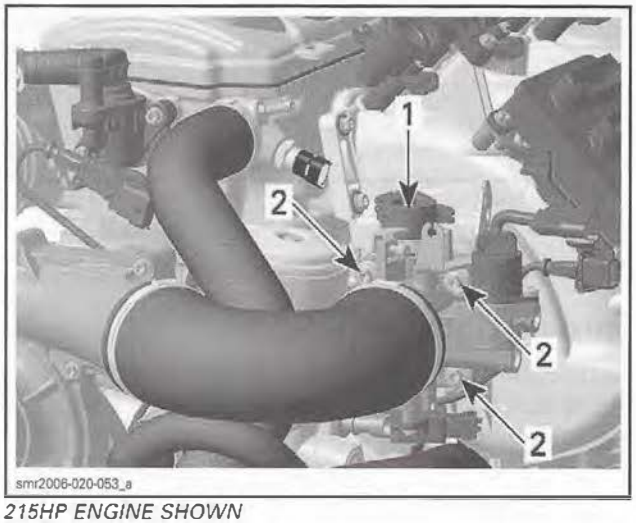


TYPICAL
1. Can needle into lubrication fitting

Throttle Body Replacement

Throttle Body Removal

1. Disconnect air intake hose from throttle body.
2. Remove retaining screws of throttle body.



215HP ENGINE SHOWN
1. Throttle body
2. Screws

3. Slightly pull throttle body out.
4. Disconnect connectors from idle bypass valve, and TPS.
5. Disconnect throttle cable.

Throttle Body Installation

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

Make sure throttle cable is correctly adjusted.

Perform the Closed Throttle and Idle Actuator reset. See procedure in *ADJUSTMENT*.

THROTTLE POSITION SENSOR (TPS) (210 AND 230 SERIES)

TPS Description

NOTE: The TPS is part of the throttle body.

The throttle position sensor (TPS) is a double potentiometer that sends a signal to the ECM that is proportional to the throttle plate angle. The TPS is located inside the throttle body.

TPS Reset

Refer to *CLOSED THROTTLE RESET* in *ADJUSTMENTS* to reset the TPS.

TPS Wear Test

1. With the engine turned off, slowly move throttle lever forwards and pay attention for smooth operation without physical stops.
2. Activate the electrical system.
3. Connect B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select the following:
   - Monitoring page tab
   - ECM page tab.
5. Slowly and regularly move the throttle lever.
6. Observe the Throttle Opening needle movement in B.U.D.S.

MONITORING AND ECM TABS

NOTE: The needle should move gradually and regularly as you move the throttle lever. If the needle "sticks", bounces or suddenly drops, it may indicate a worn TPS that needs to be replaced. An initial slight delay after the throttle lever is moved and before the needle starts to move is normal.

If the needle behavior is not as expected, proceed with the following steps.

7. Manually move the throttle plate in throttle body using a blunt tool (without sharp tip).

⚠ CAUTION Do not move throttle plate with your fingers. Otherwise, if ECM should turn off, it would quickly close the throttle plate which could cause finger injury.

1. Push here

8. Check needle movement again.
   - If needle moves as expected, check the throttle accelerator sensor (TAS). Refer to *THROTTLE ACCELERATOR SENSOR (TAS)* in *INTELLIGENT THROTTLE CONTROL (ITC)* subsection.
   - If needle does not move as expected, perform the *TPS VOLTAGE TEST* and the *TPS RESISTANCE TEST* in this subsection.

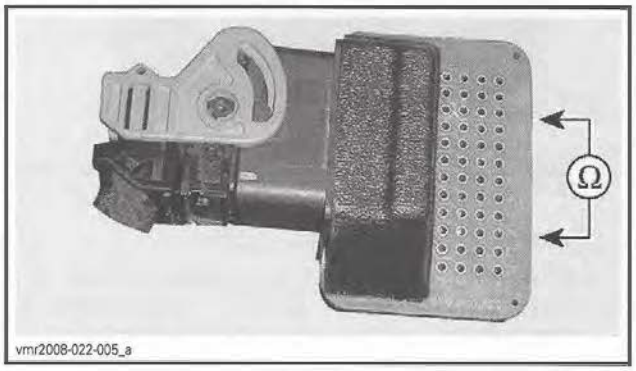
TPS Resistance Test

REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

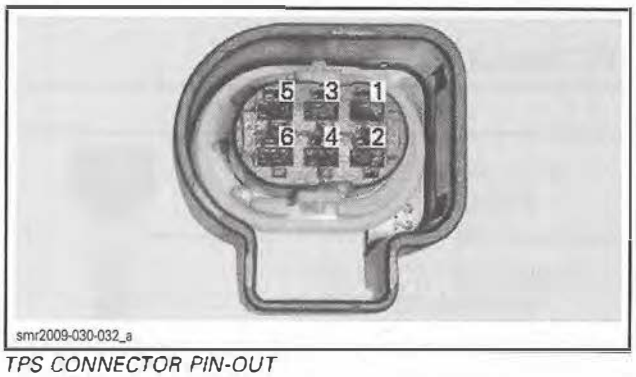
1. Ensure the throttle body connector is properly connected.
2. Disconnect ECM connector A from the ECM.
3. Install the ECM adapter tool on ECM connector.
4. On multimeter, select Ω.
5. Probe circuit as per following table while using your hand to manually move throttle plate.

ECM ADAPTER		FULLY CLOSED THROTTLE PLATE (1)		FULLY OPEN THROTTLE PLATE	
		RESISTANCE (Ω)			
PIN		MIN.	MAX.	MIN.	MAX.
A-A2	A-K4	875	1625	875	1625
A-A2	A-K3	954	1934	228	585
A-A2	A-F3	254	634	980	1983
A-K3	A-K4	228	585	954	1934
A-K3	A-F3	1385	2315	1385	2315
A-K4	A-F3	980	1983	254	634

(1) To obtain the fully closed position, it is necessary to push against the throttle plate in the throttle body with your hand and hold it in this position for the measurement.



If any resistance value is incorrect, check wire continuity between ECM and throttle body before assuming the TPS is at fault.

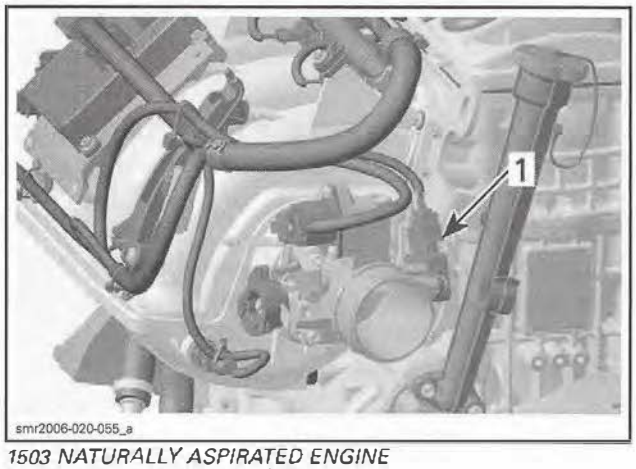


TPS CONNECTOR PIN-OUT

THROTTLE POSITION SENSOR (TPS) (150, 180 AND 200 SERIES)

TPS Description

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



1503 NATURALLY ASPIRATED ENGINE
1. Throttle position sensor (TPS)

1503 SUPERCHARGED INTERCOOLED ENGINE
1. Throttle position sensor (TPS)

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

TPS Faults

The TPS is a redundant sensor with two opposite outputs.

NOTE: If a TPS fault occurs, the ECM will trigger a fault and the boat will be in limp home mode.

TPS Plausibility Error or Deviation Fault

These faults are caused by the sensor reading.

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

NOTE: The TPS sensor reset (initialization) is carried out using B.U.D.S.

TPS Adaptation Fault

The following problems can be caused by a TPS adaptation failure fault, or a TPS adaptation canceled fault:

- Idle speed is out of range.
- Engine runs inconsistent in low partial loading or low RPM limp home.

POSSIBLE CAUSES	ACTION
Sensor has been replaced and TPS initialization was not performed	Reset **Throttle Position Sensor**.
Throttle body and TPS has been replaced	Reset **Throttle Position Sensor**.
ECM has been replaced and TPS initialization was not performed	Reset **Throttle Position Sensor**.
Sensor is loose	Tighten and reset **Throttle Position Sensor**.

NOTE: The TPS sensor reset (initialization) is carried out using B.U.D.S. software.

TPS Wear Test

While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.

Using the B.U.D.S. software, use the **Throttle Opening** display under **Monitoring** tab.

Slowly and regularly push 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.

TPS Voltage Test

REQUIRED TOOLS
FLUKE 115 MULTIMETER (P/N 529 035 868) 

Check the ECM voltage output from to the throttle position sensor.

Disconnect connector from throttle position sensor. To unlock connector, insert a small screwdriver between the folded tab.

NOTE: On the supercharged models, a mirror is useful to see under throttle body.

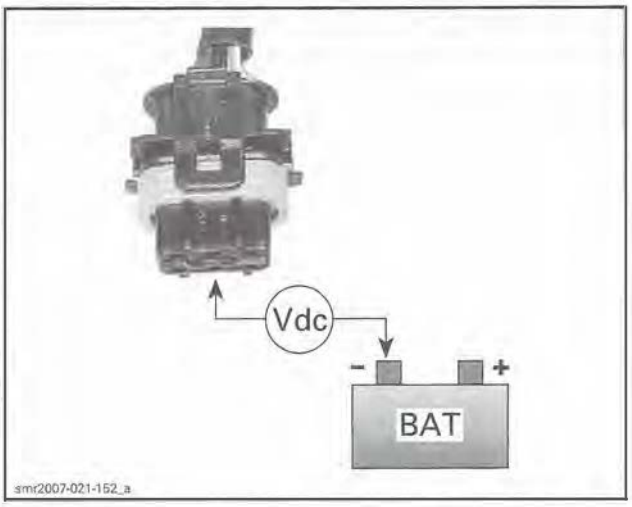
To see the connector pin-out, temporarily remove the connector shield joining the harness, to expose the terminal numbers.

On multimeter, select Vdc.

Remove and reinstall the tether cord to activate the ECM.

Check the voltage readings as follows.

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



If voltage test is good, replace the TPS.

If voltage test is not good, check the continuity of the TPS circuit.

TPS Resistance Test

REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 420 277 010)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Reconnect the TPS.

Disconnect the ECM connector "A" on the ECM.

Install ECM connector to ECM adaptor.

Probe circuit as per following table.

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

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

If resistance values are correct, check ECM. Refer to *ECM (ENGINE CONTROL MODULE)* in this subsection.

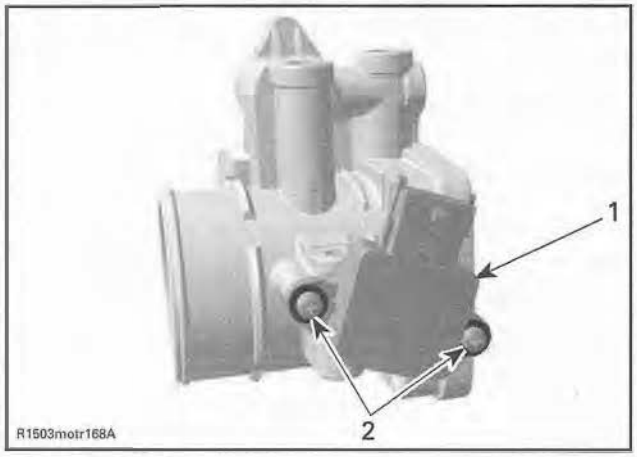
If resistance values are incorrect, replace TPS.

TPS Replacement

Remove the throttle body as described above.

Loosen two screws retaining the TPS.

Remove TPS.



THROTTLE BODY
1. Throttle position sensor (TPS)
2. Screws

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw threads, install the new TPS.

Reinstall remaining removed parts.

Proceed with the Closed Throttle and Idle Actuator reset as described in *ADJUSTMENT*.

IDLE BYPASS VALVE (IBV) (150, 180 AND 200 SERIES)

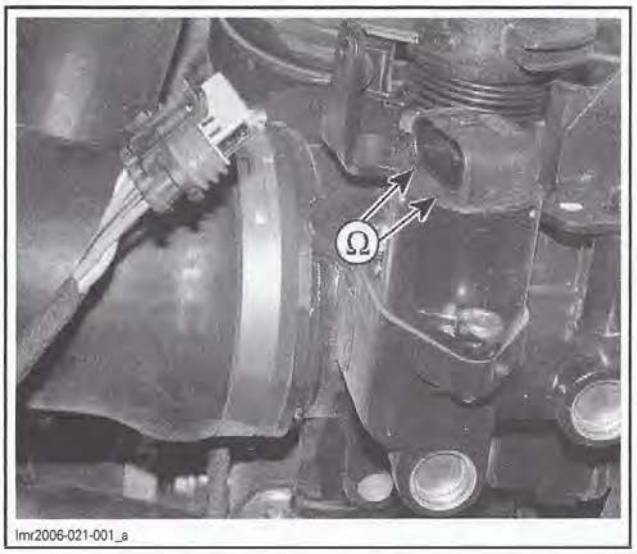
An idle bypass valve with good resistance measurement can still be faulty. It is also possible that a mechanical failure occurs which is not detectable without measuring the air flow. Replacing the idle bypass valve may be necessary as a test.

IBV Resistance Test

Disconnect idle bypass valve connector.

Check the resistance between pins as follows.

IDLE BYPASS VALVE		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A	D	50
B	C	



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If the resistance of one or both windings is inadequate, replace the idle bypass valve.

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

150, 180 AND 200 SERIES		
IBV	ECM	MEASUREMENT
Pin A	A-36	Close to 0 Ω
Pin B	A-38	
Pin C	A-37	
Pin D	A-35	

IBV Visual Inspection

Remove idle bypass valve from throttle body.

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

NOTICE Do not try to operate the piston of the idle bypass valve when it is dismounted. Also do not move the piston by hand. The screw drive is very sensitive and will be destroyed.

Clean the parts and install the idle bypass valve on the throttle body.

Proceed with the Closed Throttle and Idle Actuator reset as described in *ADJUSTMENT*.

CPS (CRANKSHAFT POSITION SENSOR)

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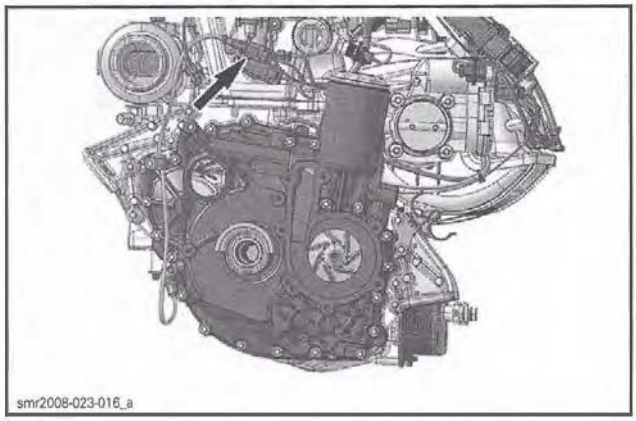
TYPICAL
1. Crankshaft Position Sensor (CPS)

NOTE: Take into account that a CPS fault can be triggered by a bent or missing trigger wheel tooth. First check for fault codes, then test the CPS as per following procedure. If it tests good, check trigger wheel teeth condition. Refer to *PTO HOUSING AND MAGNETO* in the *ENGINE* section.

CPS Voltage Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Remove the required parts to access the CPS, refer to *CPS REPLACEMENT*.
2. Disconnect CPS connector.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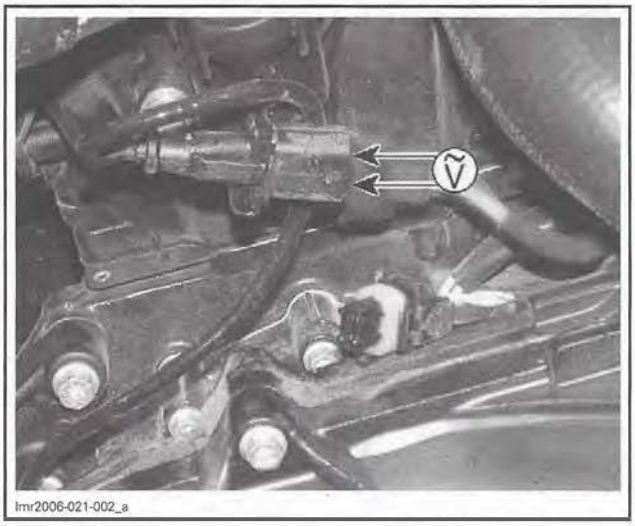
TYPICAL

3. Activate the drowned mode. Refer to *DROWNED MODE* in *ENGINE MANAGEMENT SYSTEM* subsection.
4. While cranking the engine, probe CPS terminals.

CPS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
1	2	Approximately 2.3 Vac



TYPICAL

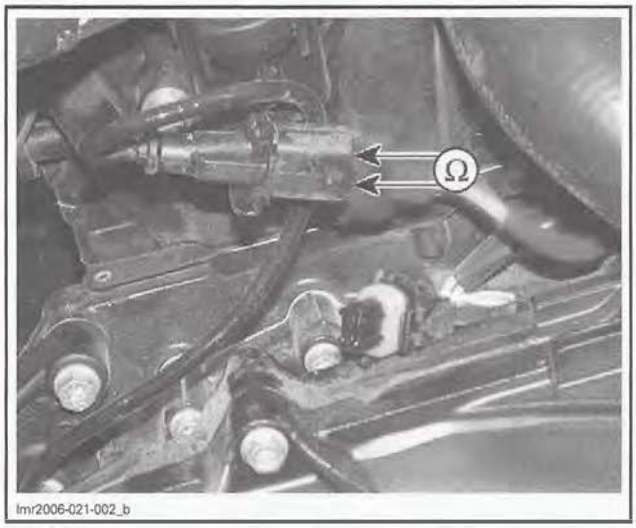
If voltage is not as specified, carry out a *CPS RESISTANCE TEST*.

If voltage is as specified, check continuity of wiring between CPS connector and ECM connector. Refer to appropriate *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547)*.

CPS Resistance Test (at Component)

1. Set multimeter to Ω and probe CPS terminals as per following table.

CPS CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
1	2	700 - 900 Ω



TYPICAL

If resistance is not within specifications, replace the CPS.

If resistance tests good, test CPS circuit. Refer to *CTS RESISTANCE TEST (AT ECM)*.

CPS Resistance Test (at ECM)

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	

1. Reconnect the CPS connector and disconnect ECM connector A from the ECM.
2. Install the appropriate ECM adapter tool.
3. Test circuit resistance through CPS as per following table.

150, 180 AND 200 SERIES		
ECM ADAPTER		MEASUREMENT
PIN		RESISTANCE (Ω) @ 20°C (68°F)
A-5	A-19	700 - 900 Ω

210 AND 230 SERIES		
ECM ADAPTER		MEASUREMENT
PIN		RESISTANCE (Ω) @ 20°C (68°F)
A-H1	A-K2	700 - 900 Ω

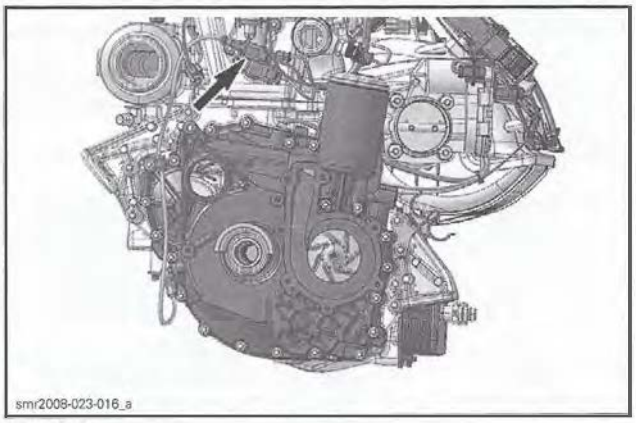
If resistance measured is not as specified and CPS tested good, repair or replace wiring and connectors between ECM and the CPS.

CPS Replacement

1. On 210 series, remove air intake silencer. Refer to *AIR INTAKE SYSTEM.*
2. Drain oil from PTO housing. Refer to *PTO HOUSING AND MAGNETO.*

NOTE: It is not necessary to drain oil from engine.

3. Disconnect CPS connector.



TYPICAL

4. Remove wire retaining clip (as applicable).
5. Remove CPS retaining screw.

1. Wire retaining clip
2. CPS retaining screw

6. Pull out CPS.

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

7. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on CPS retaining screw threads.
8. Tighten CPS to specification.

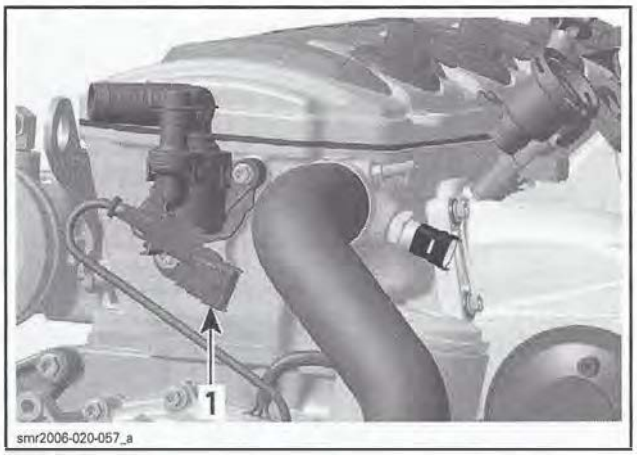
TIGHTENING TORQUE	
CPS retaining screws	9 N•m (80 lbf•in)

9. Refill engine oil and check oil level, refer to *LUBRICATION SYSTEM* subsection.

Trigger Wheel Inspection

Refer to *PTO HOUSING AND MAGNETO* in the *ENGINE* section.

CAMSHAFT POSITION SENSOR (CAPS)



TYPICAL
1. CAPS

CAPS Voltage Test (Harness Side)

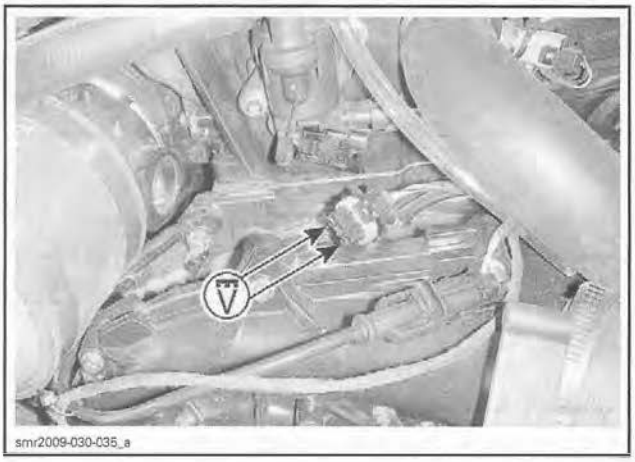
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Remove the parts required to access the CAPS, refer to *CAPS REPLACEMENT.*
2. Disconnect CAPS connector.

1. CAPS connector

3. Activate the electrical system.
4. Probe harness connector terminals as per following table.

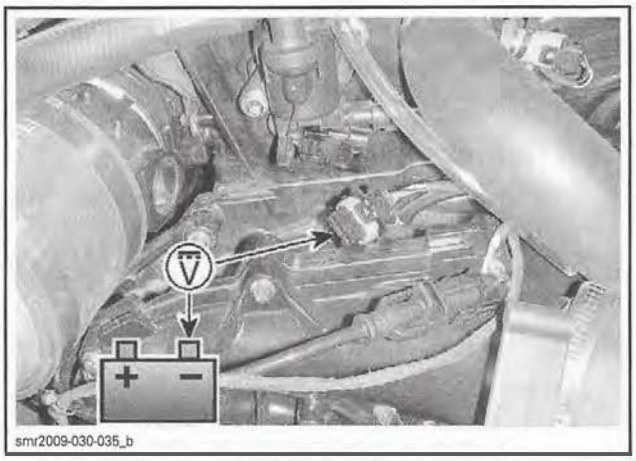
CAPS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
3	1	Battery voltage



If battery voltage is read, proceed with *CAPS DYNAMIC TEST* further in this subsection.

If battery voltage is not read, probe circuit as per following table.

CAPS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
3	Battery ground	Battery voltage



If voltage is read to battery ground, check continuity of ground circuit as per the following tables. Repair or replace wiring and connectors.

150, 180 AND 200 SERIES		
CAPS	ECM	MEASUREMENT
Pin 1	A-20	Close to 0 Ω

210 AND 230 SERIES		
CAPS	ECM	MEASUREMENT
Pin 1	A-D4	Close to 0 Ω

If voltage is not read to battery ground, carry out a *CAPS POWER CIRCUIT CONTINUITY TEST.*

CAPS Power Circuit Continuity Test

150, 180 and 210 Series

1. Remove cover from fuse box #1.
2. Remove the long bus bar.
3. On multimeter, select Ω.
4. Read resistance of the CAPS circuit as per following table.

FUSE BOX #1	CAPS CONNECTOR	RESISTANCE
TERMINAL	PIN	Ω
C6	3	Close to 0 Ω (continuity)

If continuity is good, wiring and connectors are functional.

If a high resistance or an open circuit is measured, repair or replace wiring and connectors from fuse box terminal to CAPS connector.

5. Reinstall bus bar and cover.

200 Series

1. Unplug the connector B from the EFB.

2. On multimeter, select Ω.
3. Read resistance of the CAPS circuit as per following table.

EFB	CAPS CONNECTOR	RESISTANCE
TERMINAL	PIN	Ω
B-A	3	Close to 0 Ω (continuity)

If continuity is good, wiring and connectors are functional.

If a high resistance or an open circuit is measured, repair or replace wiring and connectors from EFB terminal to CAPS connector.

230 Series

1. Remove cover from fuse box #1 or #2 according to engine tested.
2. Remove the long bus bar.
3. On multimeter, select Ω.
4. Read resistance of the CAPS circuit as per following table.

FUSE BOX	CAPS CONNECTOR	RESISTANCE
TERMINAL	PIN	Ω
C10	3	Close to 0 Ω (continuity)

If continuity is good, wiring and connectors are functional.

If a high resistance or an open circuit is measured, repair or replace wiring and connectors from fuse box terminal to CAPS connector.

5. Reinstall bus bar and cover.

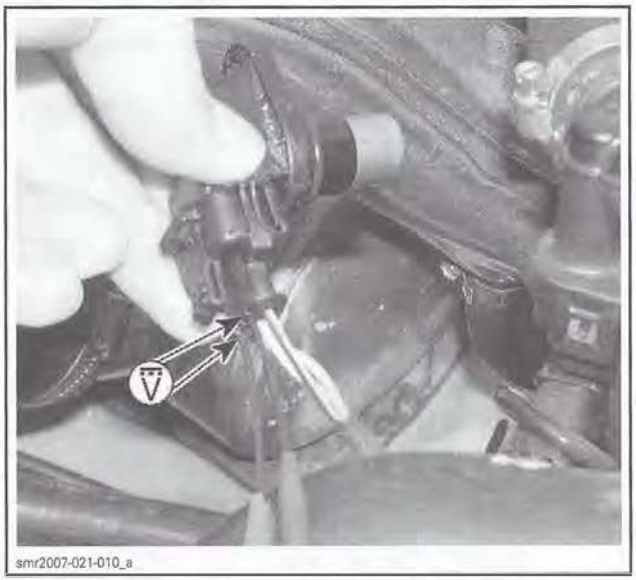
CAPS Dynamic Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	
FLUKE RIGID BACK PROBE (P/N TP88)	

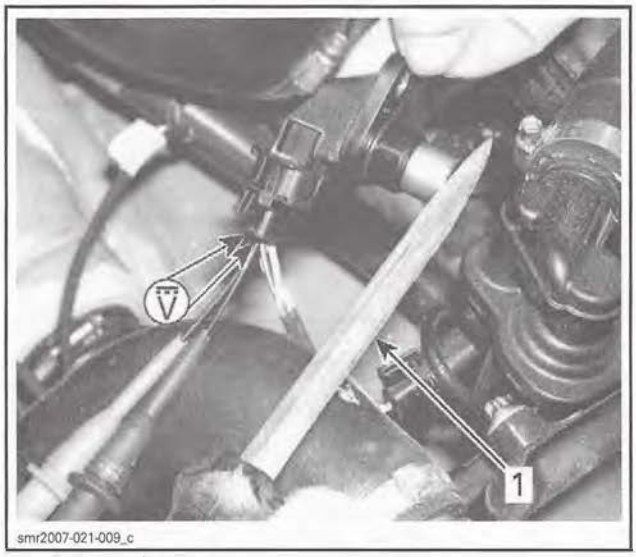
1. Remove the parts required to access the CAPS, refer to *CAPS REPLACEMENT*.
2. Remove CAPS sensor from engine.
3. Install the FLUKE RIGID BACK PROBE (P/N TP88) at the end of the multimeter probes
4. Back-probe connector and read voltage as follows.

BACK PROBE INSTALLED ON MULTIMETER PROBE

CAPS CONDITION	CAPS CONNECTOR		VOLTAGE
Free	3	2	Close to 0 Vdc



CAPS CONDITION	CAPS CONNECTOR		VOLTAGE
Metallic object on sensor	3	2	Battery voltage



1. Metallic object

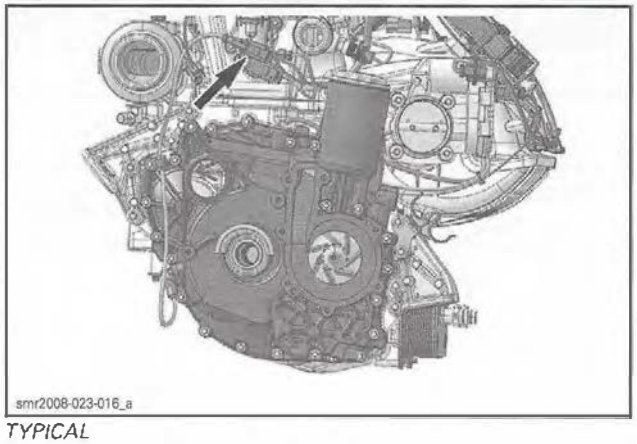
If voltage is as specified, repair or replace wiring and connectors between sensor and ECM.

If wiring is good, check ECM. Refer to *ECM (ENGINE CONTROL MODULE)*.

If battery voltage is not measured as specified, try a new CAPS.

CAPS Replacement

1. On 210 series, remove air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.
2. Detach CPS connector from its holder.



TYPICAL

3. Disconnect CAPS connector.

1. CAPS connector

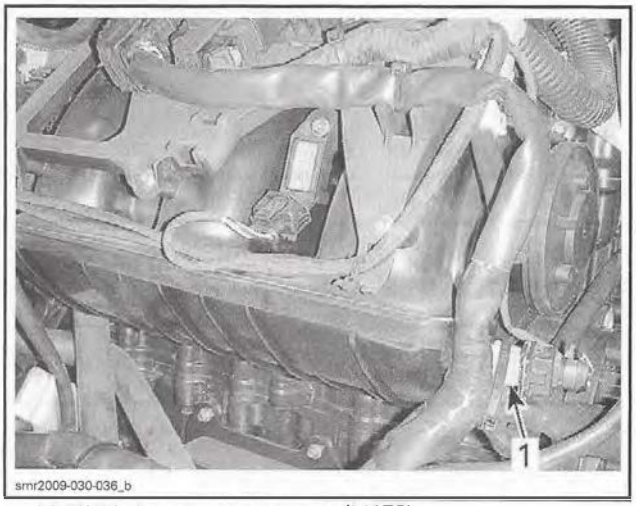
4. Unscrew the CAPS retaining screw.
5. Pull CAPS from engine.
6. Install the new CAPS.

NOTICE **Be sure to install new O-ring on the new CAPS.**

7. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the CAPS retaining screw threads.
8. Torque the CAPS retaining screw to specification.

TIGHTENING TORQUE	
CAPS retaining screw	9 N•m (80 lbf•**in**)

MANIFOLD AIR TEMPERATURE SENSOR (MATS)



1. Manifold air temperature sensor (MATS)

MATS Resistance Test (at Component)

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect the MATS connector.

1. MATS connector

2. Set the multimeter to Ω and probe the MAPS sensor terminals.

The resistance value measured should be as specified in the *MATS RESISTANCE CHART* that follows. Otherwise, replace the MATS.

If resistance value is as specified, test the MAPS circuit. Refer to *MATS RESISTANCE TEST (AT ECM)*.

MATS Resistance Test (at ECM)

REQUIRED TOOL	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	

1. Disconnect the ECM connector A on the ECM.
2. Install the appropriate ECM adapter tool.
3. Probe adapter terminals as follows.

150, 180 AND 200 SERIES		
ECM ADAPTER (P/N 420 277 010)		MEASUREMENT
A-7	A-21	See *MATS RESISTANCE CHART*

210 AND 230 SERIES		
ECM ADAPTER		MEASUREMENT
A-J3	A-H3	See *MATS RESISTANCE CHART*

MATS RESISTANCE CHART

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

If resistance value is not as specified and MATS tested good, repair or replace wiring and connectors between the ECM and the MATS.

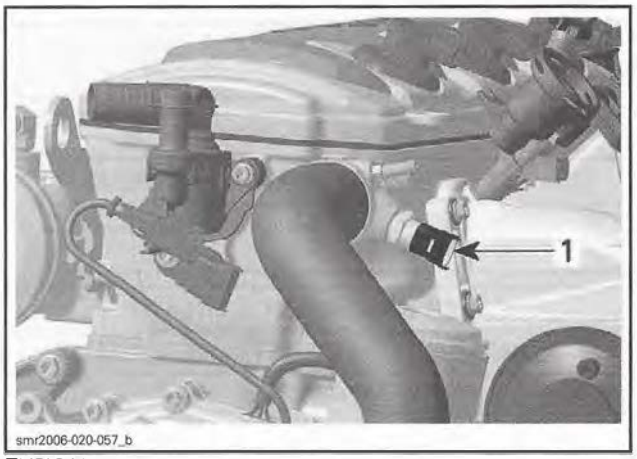
MATS Replacement

1. Disconnect the MATS connector.
2. Unscrew the MATS from the engine.
3. Install a new MATS and torque screw to specification.

TIGHTENING TORQUE	
MATS retaining screw	17 N•m (150 lbf•in)

NOTE: Be sure to install a new thrust washer on the MATS before installing it on the intake manifold.

COOLANT TEMPERATURE SENSOR (CTS)



TYPICAL
1. Coolant temperature sensor (CTS)

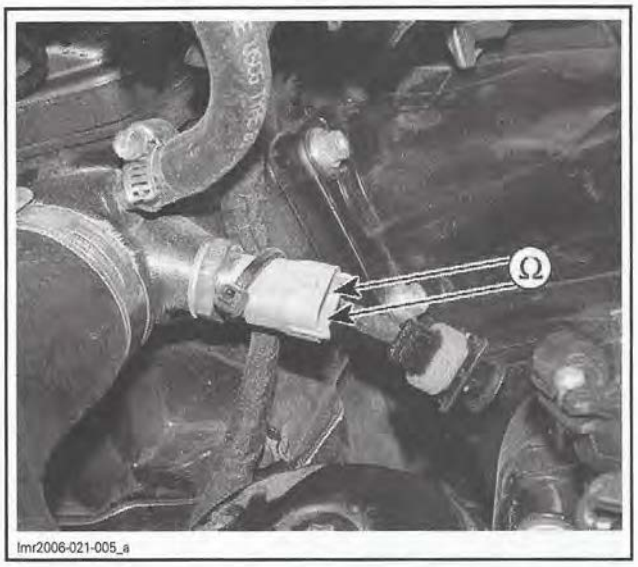
NOTE: An overheat indication will come on in the information center when the coolant temperature reaches:

MODELS	OVERHEAT TEMPERATURE
All	110°C (230°F)

CTS Resistance Test (at Component)

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect the connector from the CTS and test the resistance of the sensor. Refer to the *CTS RESISTANCE CHART* further in this topic.



If resistance measured is not as specified, replace the CTS.

If the resistance measured is as specified, test the CTS circuit. Refer to *CTS RESISTANCE TEST (AT ECM)*.

CTS Resistance Test (at ECM)

REQUIRED TOOL	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	

1. Disconnect ECM connector A from the ECM.
2. Install the appropriate ECM adapter tool
3. Check the CTS circuit resistance as per table.

150, 180 AND 200 SERIES		
ECM ADAPTER		MEASUREMENT
A-11	A-27	See *CTS RESISTANCE CHART*

210 AND 230 SERIES		
ECM ADAPTER		MEASUREMENT
A-A1	A-J2	See *CTS RESISTANCE CHART*

CTS RESISTANCE CHART				
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

If the resistance value is not within specification and CTS tested good, repair or replace wiring and connectors between ECM connector and the CTS.

CTS Replacement

1. Disconnect CTS connector and remove CTS.
2. Install the new CTS and torque it to specification.

TIGHTENING TORQUE	
CTS	18 N•m (159 lbf•in)

3. Reinstall remaining removed parts.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAPS)

TYPICAL
1. Manifold absolute pressure sensor (MAPS)

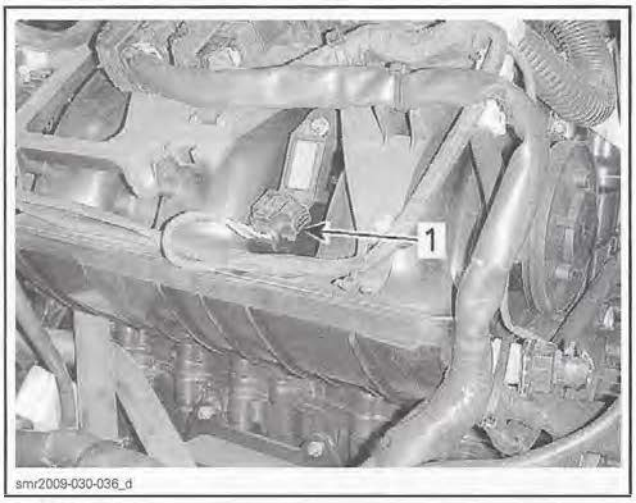
NOTE: This sensor is a dual function device. When the engine is started and runs at idle speed, the sensor measures atmospheric pressure and stores it in the ECM. Thereafter, it measures manifold absolute pressure at operating RPMs.

Ensure sensor is correctly installed on intake manifold. Otherwise, the MAPS could generate a fault code for an unexpected sensor range at idle when it reads atmospheric pressure. Remove sensor and check for oil or dirt on its end and if problem persists, check the condition and the position of the throttle plate and the wiring harness. Perform the following tests.

MAPS Voltage Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect connector from MAPS.



1. Disconnect

2. Activate the electrical system.
3. On multimeter, select Vdc.
4. Read voltage as per following table.

MAPS CONNECTOR	VOLTAGE
Terminal 1 to battery ground	Approx. 5 V
Terminal 2 to battery ground	Approx. 0 V
Terminal 3 to battery ground	Approx. 0 V

If voltage measured is as specified, replace the MAPS.

If voltage measured is not as specified, refer to *MAPS CIRCUIT CONTINUITY TEST*.

MAPS Circuit Continuity Test

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	

1. Disconnect ECM connector A from the ECM.
2. Install the appropriate ECM adapter.
3. Test for circuit continuity as per following table.

150, 180 AND 200 SERIES		
MAPS CONNECTOR	ECM CONNECTOR	RESISTANCE
Pin 1	A-40	Close to 0 Ω Continuity
Pin 2	A-28	
Pin 3	A-12	

210 AND 230 SERIES		
MAPS CONNECTOR	ECM CONNECTOR	RESISTANCE
Pin 1	A-B4	Close to 0 Ω Continuity
Pin 2	A-H2	
Pin 3	A-G4	

4. If wiring harness is good, check ECM. Refer to *ENGINE CONTROL MODULE (ECM)* in this subsection.
5. If a high resistance or an open circuit is measured, repair or replace wiring and connectors between the ECM and the MAPS.

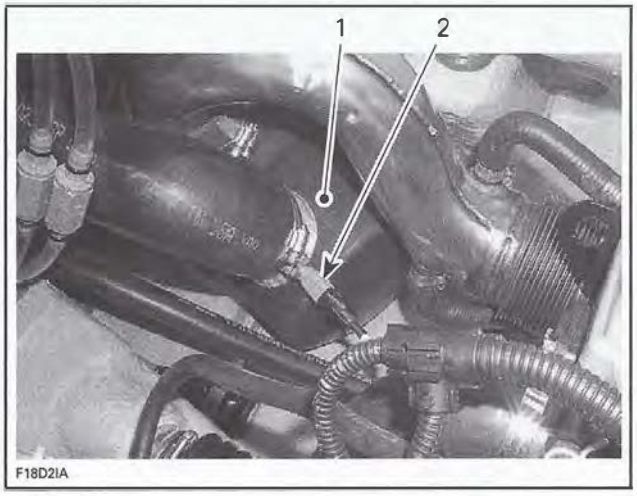
MAPS Replacement

1. Disconnect MAPS connector and remove the MAPS.
2. Install the new MAPS paying attention to index its tab into the adaptor notch.
3. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on retaining screw and torque it to specification.

TIGHTENING TORQUE	
MAPS retaining screw	10 N•m (89 lbf•in)

4. Reinstall remaining parts removed, refer to applicable subsections.

EXHAUST GAS TEMPERATURE SENSOR (EGTS)



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

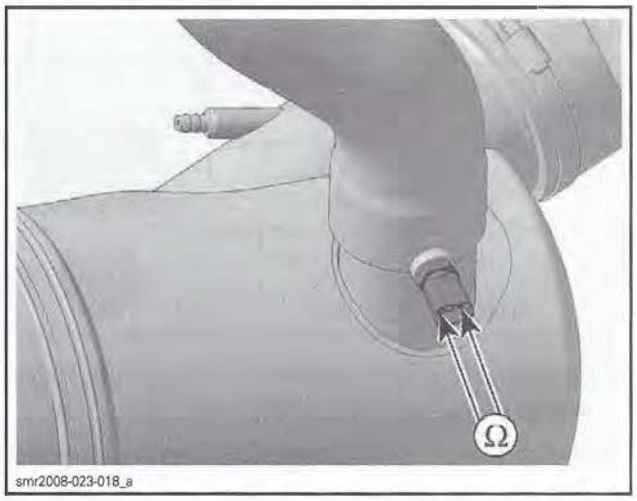
NOTE: An overheat signal will come on in the information center when the exhaust temperature reaches:

ENGINE	OVERHEAT TEMPERATURE
All 1503	110°C (230°F)

EGTS Resistance Test (at Component)

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect the connector from the EGTS.
2. Set the multimeter to Ω selection and measure the resistance of the sensor.



The resistance should be as per the *EGTS RESISTANCE CHART* that follows. Otherwise, replace the EGTS.

EGTS RESISTANCE CHART				
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

If the EGTS resistance is within specifications, test EGTS circuit. Refer to *EGTS RESISTANCE TEST (AT ECM)*.

EGTS Resistance Test (at ECM)

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	

1. Disconnect ECM connector A from the ECM.
2. Install the appropriate ECM adapter.
3. Check the circuit resistance as per following table.

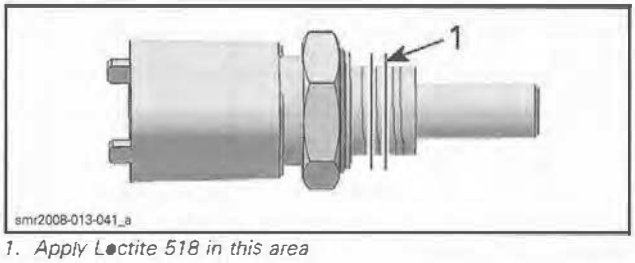
150, 180 AND 200 SERIES		
ECM ADAPTER		MEASUREMENT
A-10	A-26	See *EGTS RESISTANCE CHART*

210 AND 230 SERIES		
ECM ADAPTER		MEASUREMENT
A-J4	A-H4	See *EGTS RESISTANCE CHART*

If resistance value is not within specifications and EGTS tested good, repair or replace wiring and connectors between the ECM and the EGTS.

EGTS Replacement

1. Disconnect the EGTS connector.
2. Unscrew EGTS from muffler.
3. Apply LOCTITE 518 (P/N 293 800 038) on the middle threads of the new EGTS.



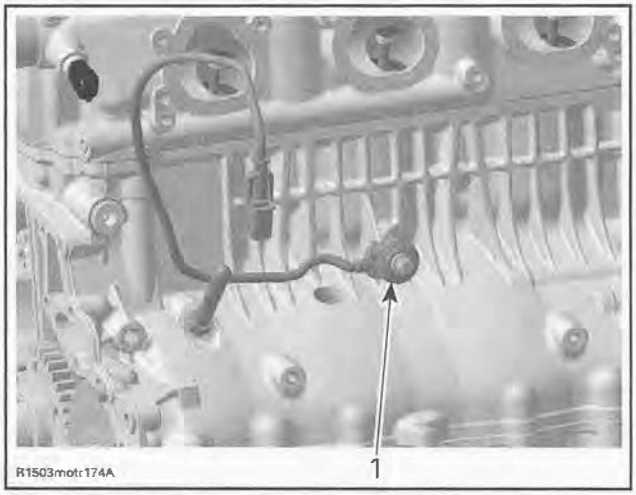
1. Apply Loctite 518 in this area

4. Install the EGTS.
5. Torque the sensor to specification.

TIGHTENING TORQUE	
EGTS	16 N•m (142 lbf•in)

6. Install the EGTS connector.
7. Install all other removed parts, refer to applicable subsections.

KNOCK SENSOR (KS)



1. Knock sensor (KS)

KS Dynamic Test

1. Connect B.U.D.S. software, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the **Faults** page tab and look for a **Knock sensor fault**.
3. Start the engine and bring engine RPM above 5000 RPM.

NOTE: If the boat is out of water, connect a garden hose to the hose adapter to cool exhaust system. Refer to *EXHAUST SYSTEM FLUSHING* in the *EXHAUST SYSTEM* subsection.

NOTICE **Damages may occur to exhaust system if not cooled with water.**

4. Using the B.U.D.S. software, monitor the knock sensor for a fault code.
5. Stop engine.

If no fault occurs, the knock sensor is good.

If a fault occurs, carry out the following.

- Ensure sensor and cylinder head contact surfaces are clean.
- Ensure the correct mounting bolt and washer are used and are properly torqued.
- Check the knock sensor resistance, refer to *KS RESISTANCE TEST*.

NOTE: It is necessary to remove the intake manifold to inspect the contact surfaces. Refer to *INTAKE MANIFOLD* subsection.

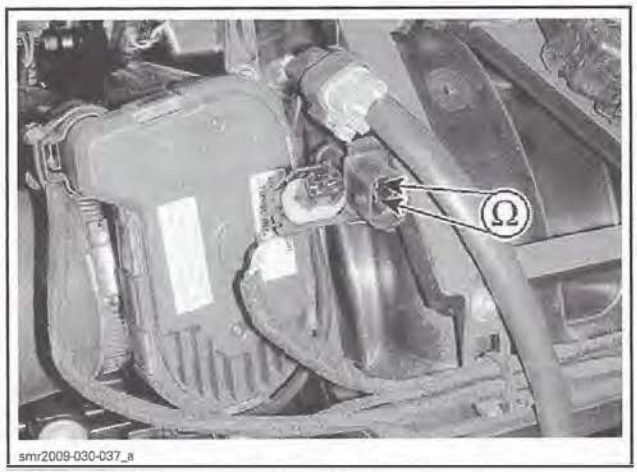
KS Resistance Test

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect the knock sensor connector.

TYPICAL – MODEL WITH iTC SHOWN
1. KS connector

2. Using the multimeter, measure the resistance between the knock sensor terminals.



TYPICAL – MODEL WITH iTC SHOWN

KNOCK SENSOR RESISTANCE @ 20°C (68°F)
Approximately 5 MΩ

If resistance is not as specified, replace knock sensor.

If resistance is as specified, carry on with the following steps.

3. Reconnect the knock sensor connector.
4. Disconnect connector A from the ECM.
5. Install the appropriate ECM adapter.
6. Check circuit resistance through the knock sensor as per following table.

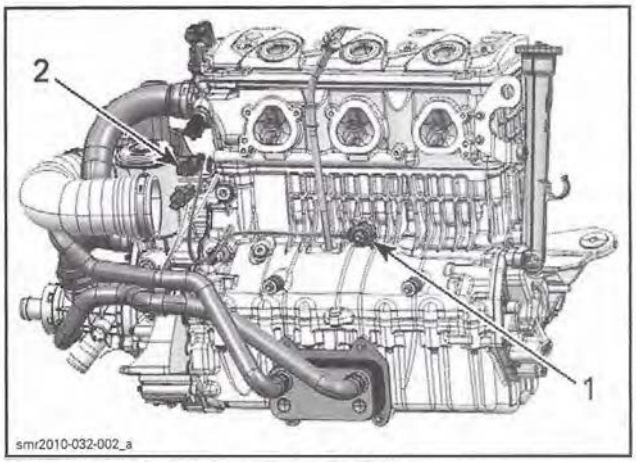
150, 180 AND 200 SERIES		
ECM ADAPTER		MEASUREMENT @ 20°C (68°F)
A-9	A-23	Approximately 5 MΩ

210 AND 230 SERIES		
ECM ADAPTER		MEASUREMENT @ 20°C (68°F)
A-C3	A-G2	Approximately 5 MΩ

If an open circuit is measured, repair or replace wiring and connectors between ECM and knock sensor.

KS Replacement

1. Remove the intake manifold. Refer to *INTAKE MANIFOLD* subsection.
2. Disconnect KS sensor connector.



TYPICAL - INTAKE MANIFOLD REMOVED
1. Knock sensor
2. Knock sensor connector

3. Unscrew and remove knock sensor from engine.
4. Clean contact surfaces.
5. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) in threaded hole then install the new knock sensor.

6. Torque sensor retaining screw to specification.

TIGHTENING TORQUE	
Knock sensor retaining screw	23 N•m (17 lbf•ft)

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

7. Reconnect knock sensor connector.

FUEL TANK AND FUEL PUMP

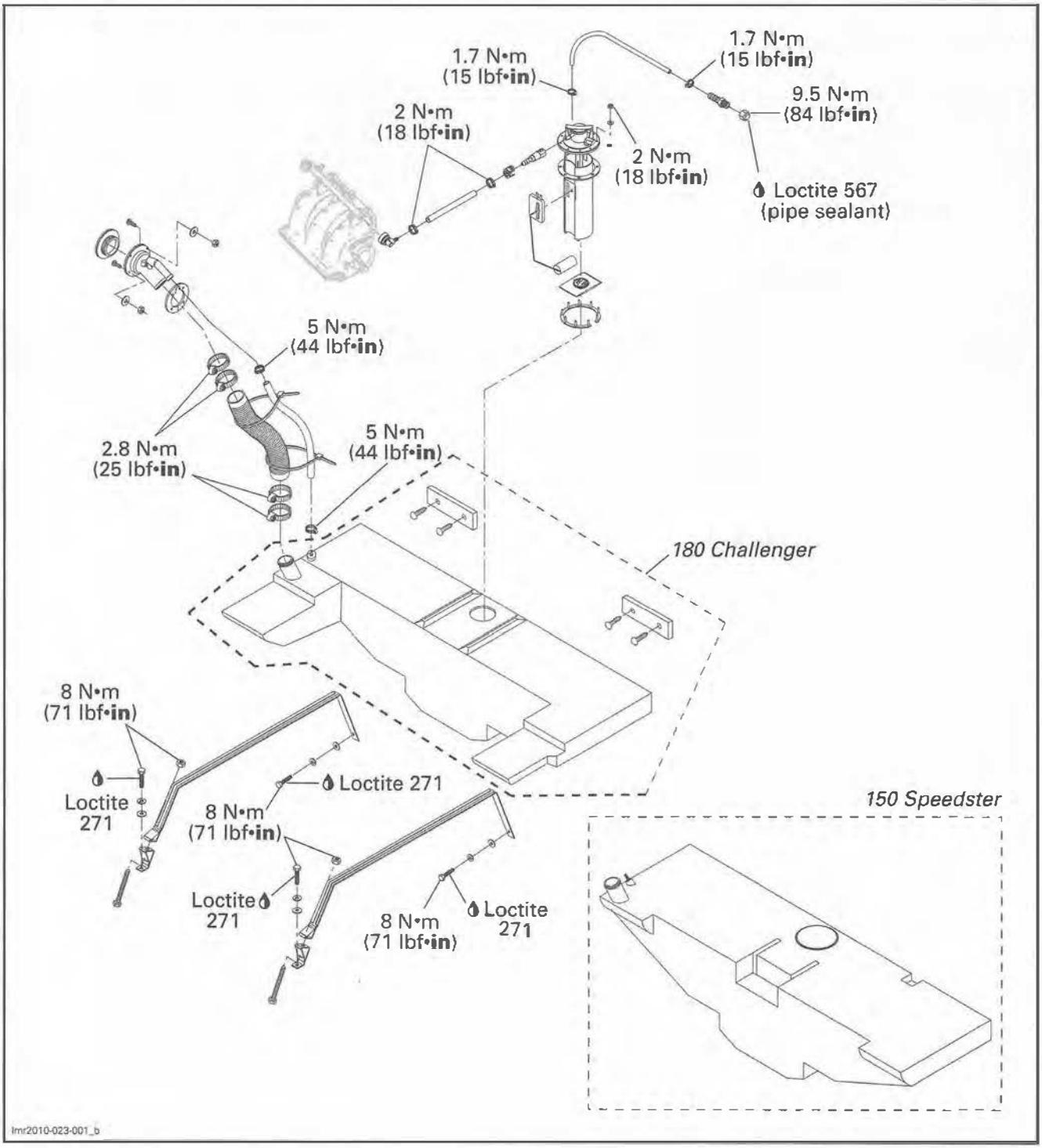
SERVICE TOOLS

Description	Part Number	Page
FUEL HOSE ADAPTER	529 036 023	287
FUEL TANK PRESSURE TEST CAP	529 035 870	286
PRESSURE GAUGE	529 035 709	287
STRAIGHT FITTING	293 710 037	286
VACUUM/PRESSURE PUMP	529 021 800	286

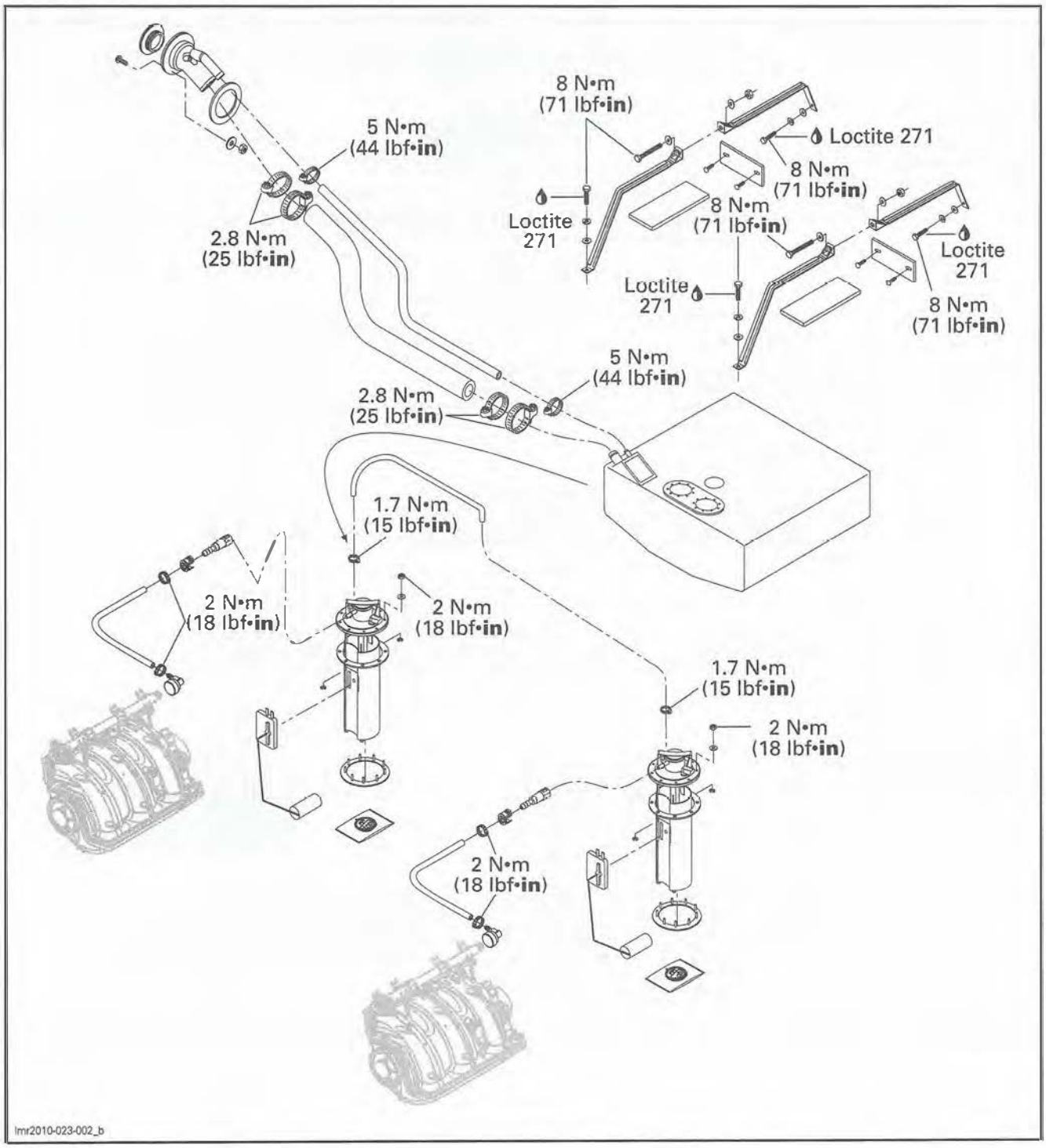
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 518	293 800 038	290

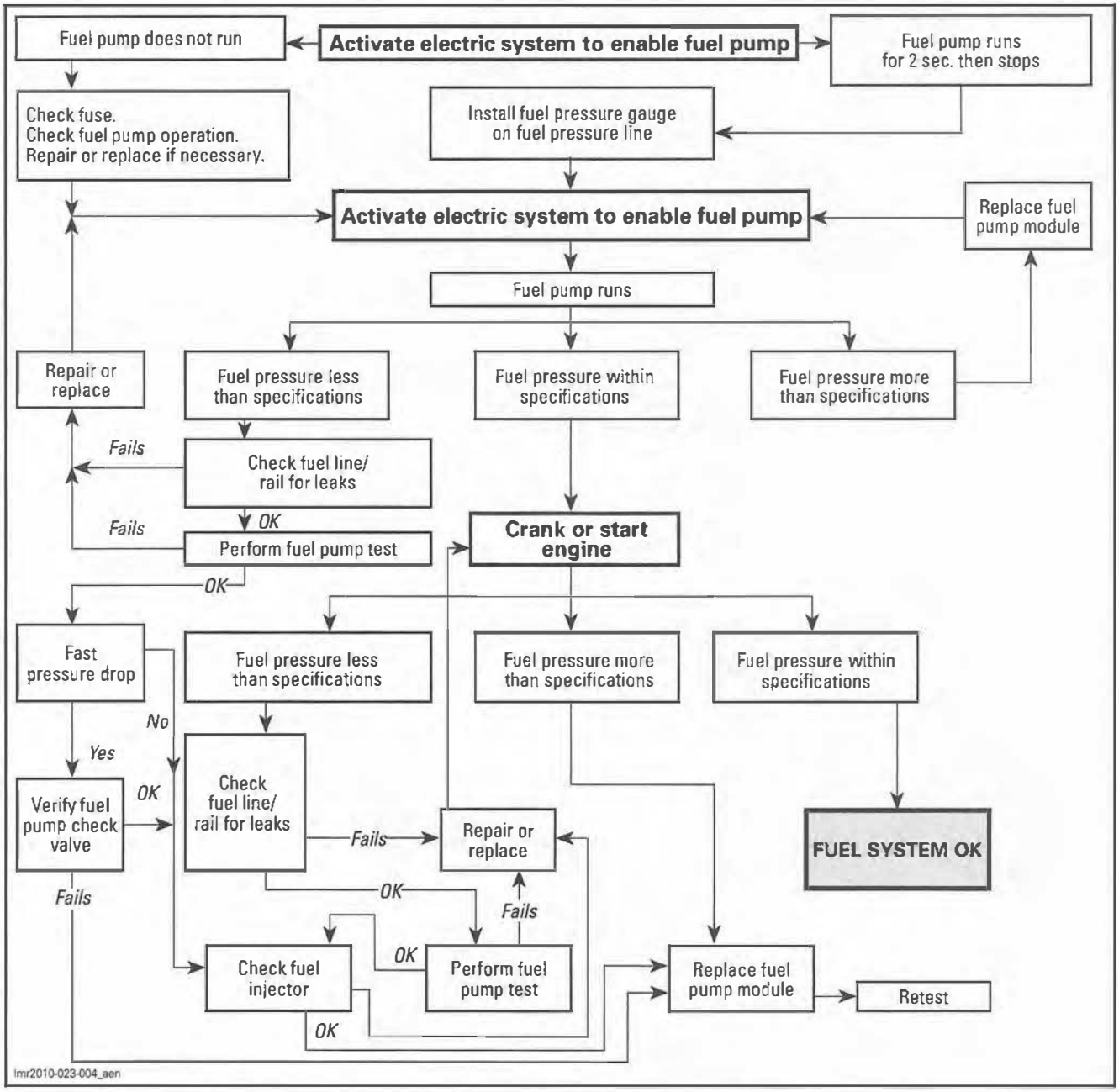
Single Engine Models



Twin Engine Models



FUEL SYSTEM DIAGNOSTIC FLOW CHART



GENERAL

⚠ WARNING

Always activate bilge blower 5 minutes minimum before working in the engine compartment to allow proper evacuation of any potential fuel fumes.

⚠ WARNING

Fuel lines remain under pressure at all times. Always proceed with care and use appropriate safety equipment when working on a pressurized fuel system. Wear safety glasses.

⚠ WARNING

Always disconnect battery or turn main battery cut-off switch to OFF position prior to working on the fuel system. Fuel vapors are flammable and explosive under certain conditions. Always work in a well ventilated area. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Proceed with care when removing/installing high pressure test equipment or disconnecting fuel line connections. Cover the fuel line connection with an absorbent shop rag. Wipe off any fuel spillage in the bilge.

⚠ WARNING

A high pressure leak test must be carried out whenever a fuel system component has been removed.

⚠ WARNING

The fuel pump is energized for a few seconds and builds fuel pressure very quickly whenever the D.E.S.S. key is installed or the ignition switch is turned ON. Prior to energize the electrical system, ensure there are no disconnected fuel lines.

⚠ WARNING

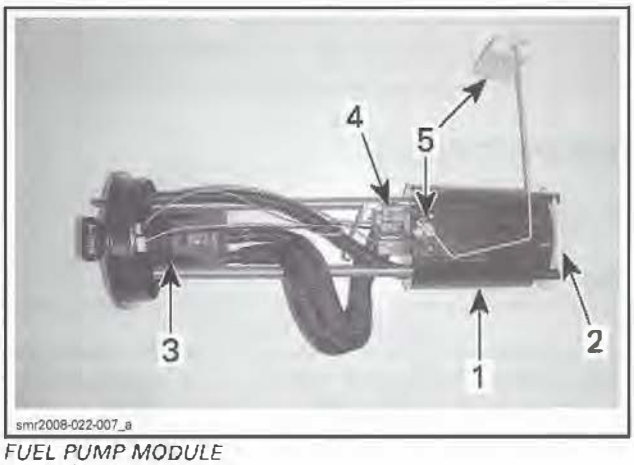
Ensure wires and hoses are routed and secured away from any vibrating, rotating, moving or hot components or sharp edges. Use appropriate shields and fastening devices as per factory standards.

NOTICE Whenever repairing the fuel system, always check for water infiltration in the fuel tank. Replace any damaged, leaking or deteriorated fuel line.

SYSTEM DESCRIPTION

The fuel system is comprised of:
- A fuel tank
- A non-vented fuel tank cap
- A fuel pump module (2 on twin engines) mounted inside the fuel tank
- A fuel vent system, and
- A variety of hoses.

The fuel pump module is basically comprised of:
1. An electric fuel pump mounted inside a canister type pump reservoir
2. A lower inlet filter
3. An upper outlet filter
4. A pressure regulator
5. A float type fuel level sensor.



FUEL PUMP MODULE
1. *Fuel pump reservoir*
2. *Lower inlet filter*
3. *Upper outlet filter*
4. *Fuel pressure regulator*
5. *Float type fuel level sensor*

Fuel Pump Operation

When the pump is in operation, it draws fuel into the canister through a lower inlet filter and a disk type valve.

The pressurized fuel is pushed through an upper outlet filter to the fuel rail.

Excess fuel pressure generated by the pump is routed from the upper filter back to the pump canister reservoir by a pressure regulator mounted on the pump reservoir cover.

When the electrical system is activated, the fuel pump will come on for approximately 2 seconds to pressurize the fuel rail in preparation for the engine start.

The ECM supplies the ground signal to turn on the fuel pump motor.

The pressure regulator will ensure appropriate fuel pressure is supplied to the injectors.

When the ECM receives a signal to shut down the engine it removes the fuel pump ground signal.

Fuel Level Indication

An electric float type fuel level sensor is mounted on the side of the fuel pump reservoir. As the float moves with changing fuel levels, it varies a resistance that changes the voltage signal coming from the fuel level gauge. This signal is representative of the fuel level.

The fuel level gauge interprets the voltage signal that comes back from the fuel level sensor. It then displays the proper fuel level and activates a low fuel warning signal when required.

The fuel level sensor resistance is at its lowest value when the fuel tank is full, and at its highest value when the tank is empty.

Refer to the *FUEL LEVEL SENSOR* in this subsection for fuel level sensor testing procedures.

INSPECTION

FUEL SYSTEM LEAK TEST

Fuel Tank Leak Test

REQUIRED TOOLS	
FUEL TANK PRESSURE TEST CAP (P/N 529 035 870)	
STRAIGHT FITTING (P/N 293 710 037)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

⚠ WARNING

Whenever doing any type of repair on boat or if any components of the fuel system are disconnected, a pressure test must be done before starting engine. Ensure to verify fuel line ends for damage. Always cut damaged end before reinstallation.

Proceed as follows:

1. Remove fuel tank cap and chain.
2. Fill up fuel tank.
3. Install the straight fitting on the fuel tank pressure test cap.
4. Install the test cap on fuel tank filler neck.
5. Connect the pump to fitting on pressure test cap.

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6. Pressurize fuel system.

NOTICE **Never pressurize over recommended pressure.**

PRESSURE	TIME WITHOUT PRESSURE DROP
34 kPa (5 PSI)	10 minutes

7. If pressure is not maintained locate leak and repair or replace component leaking. To ease leak search spray a solution of soapy water on components, bubbles will indicate leak location.

⚠ WARNING

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

Unscrew pressure test cap part way until pressure is relieved. Reinstall fuel tank cap.

Fuel Circuit Leak Test (High Pressure)

Refer to *FUEL PUMP PRESSURE TEST* below.

FUEL PUMP PRESSURE TEST

The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator, the fuel pump and leaks in the system.

Preparation

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

Turn main battery cut-off switch to OFF position.

Ensure there is enough gas in fuel tank.

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

Disconnect the pressure outlet hose from the fuel pump.

⚠ WARNING

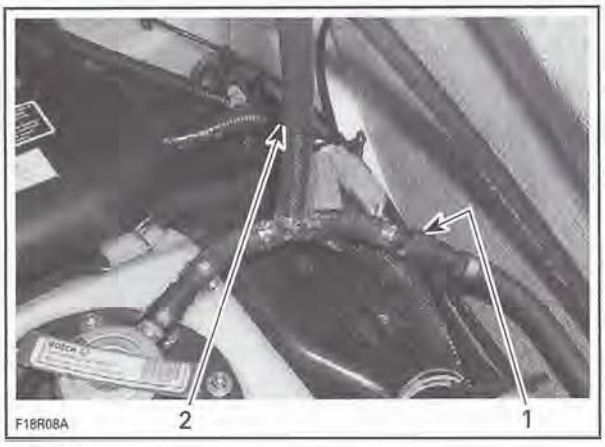
Cover the fuel line connection with an absorbent shop rag. Wipe off any fuel spillage inside the bilge.

Access the fuel pump. Refer to *FUEL TANK ACCESS* in this subsection.

Pressure Test

Install pressure test tools between disconnected hose and fuel pump fitting (in line installation).

REQUIRED TOOLS	
PRESSURE GAUGE (P/N 529 035 709)	
FUEL HOSE ADAPTER (P/N 529 036 023)	



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

Turn main battery cut-off switch to ON position.

Activate the electric system and observe fuel pressure. **Do not crank engine.**

Repeat test twice and compare readings to specifications in following table.

NOTE: Release pressure using the valve on the pressure gauge between each test so that the gauge is "reset" to zero (0).

MODEL	FUEL PRESSURE (when installing key)
150 Speedster (155 engine)	290 kPa to 310 kPa (42 PSI to 45 PSI)
All other models	386 kPa to 414 kPa (56 PSI to 60 PSI)

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

Stop engine.

Conclusion

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

If pressure is maintained after engine is stopped, there is no leakage in the system.

A rapid pressure drop after engine is stopped indicates leakage either from the fuel rail or from the fuel pump check valve. Check fuel rail for leaks.

A slow pressure drop after engine is stopped indicates leakage either from the fuel injector or from the fuel pressure regulator. Check fuel injector for leaks (see below). If it is not leaking then replace fuel pump module.

PROCEDURES

FUEL HOSES AND HOSE CLAMPS

⚠ WARNING

Never use a hose pincher on high pressure hoses.

Fuel Hose and Clamp Inspection

Inspect all fuel hoses for wear or cracks.

Inspect all clamps for tightness.

Fuel Hose Replacement

When replacing the fuel lines, use only fuel homologated hoses to ensure proper and safe operation.

For all hoses, position clamp 6.35 mm (1/4 in) from the end of hose, fully behind the barb and keep clamping screws rotated 180°.

⚠ WARNING

Use of improper fuel lines could compromise fuel system integrity.

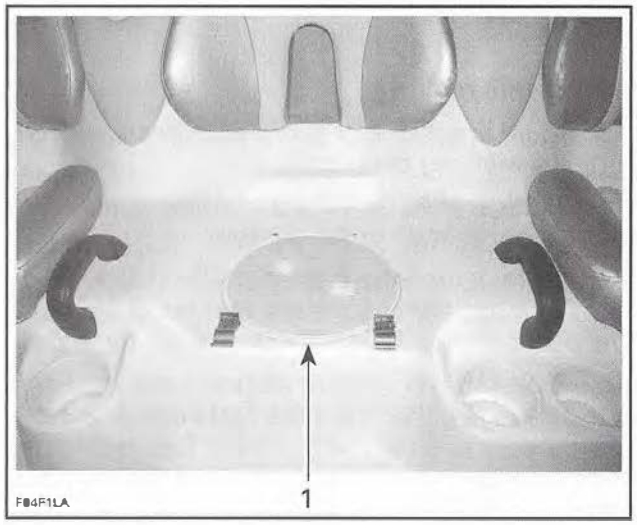
Perform a fuel system leak test after replacing a fuel hose or clamp. See procedure in *INSPECTION*.

FUEL PUMP

Fuel Pump Access

150 Speedster

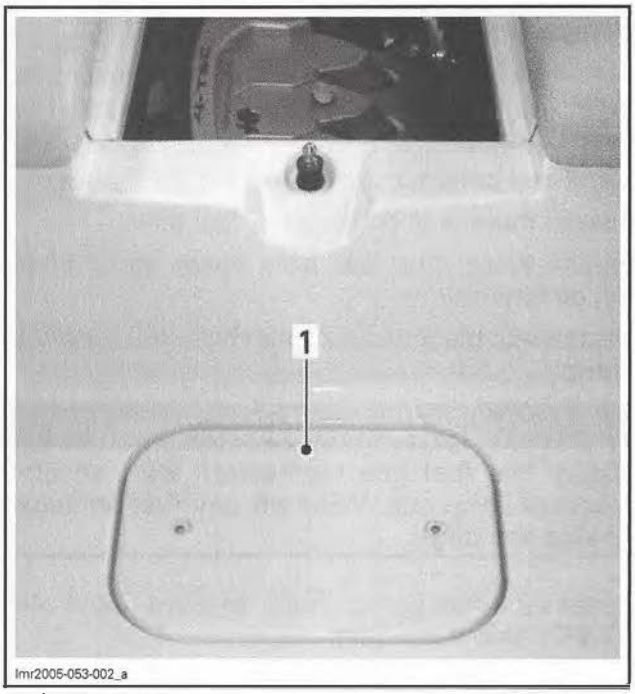
From the access cover under rear center seat.



1. Access cover

180 Challenger

From the access cover from floor.



1. Access cover

All Other Models

From the engine compartment.

Fuel Pump Operation Test

When activating the electrical system, the fuel pump should run for 2 seconds to build up the pressure in the system.

If the pump does not work, check fuel pump fuse.

Disconnect fuel pump connector.

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

Connect fuel pump to a 12 V battery.

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

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

If pump runs, carry out the *FUEL PUMP CIRCUIT TEST*.

Fuel Pump Circuit Test

Check voltage at fuel pump connector.

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Activate the fuel pump.

OBSERVATION	SIGNIFICATION
Battery voltage is read for approx. 2 seconds then, it will drop to approx. 11 Vdc	– Normal operation.
	– It validates the ground circuit through ECM.
	– When voltage drops to approx. 11 Vdc, it validates that ECM switches fuel pump on and off.
Battery voltage is not read	– Fuel pump power supply circuit is defective.
	– Fuel pump ground circuit to ECM is defective.

If battery voltage is not read, check the fuel pump power supply and ground circuits as follows.

Fuel Pump Power Supply

Check voltage between fuel pump connector and battery ground.

VOLTAGE TEST		
TEST PROBES		VOLTAGE
Pin A (+ probe)	Battery ground (- probe)	Battery voltage

If battery voltage is not read, back-probe the pin indicated in the next table with battery ground.

MODEL	PIN
150 Series 180 Series 210 Series	Pin A1 of fuse block 1
200 Series	Pin B-F of EFB
230 Series	Pin E1 of fuse block

If voltage is NOW good, check wiring and connectors between fuse and fuel pump.

If voltage is STILL not good, check fuse block. Refer to *INSTRUMENTS AND ACCESSORIES*.

Fuel Pump Ground Circuit

Check continuity of fuel pump going towards ECM.

MODEL	CIRCUIT
210 Series and 230 Series	B-M1
All other models	B-29

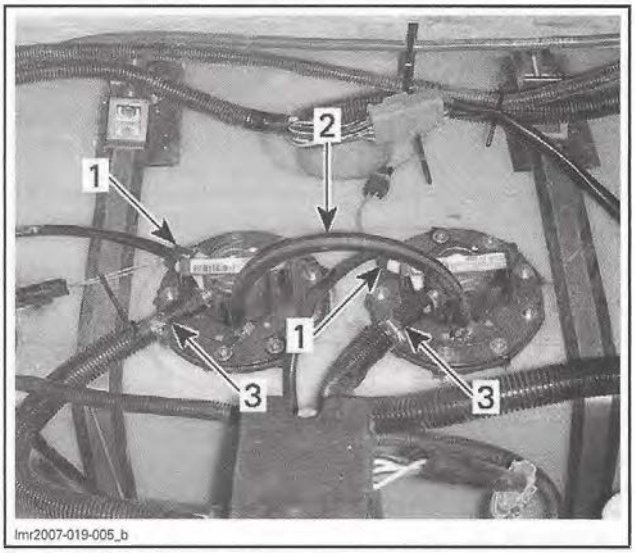
Fuel Pump Removal

Turn main battery cut-off switch to OFF position.

Access the fuel pump. Refer to *FUEL PUMP ACCESS* in this subsection.

Disconnect electrical connector.

Slowly disconnect all hoses from fuel pump.



1. *Connector*
2. *Vent tube*
3. *Outlet hose*

Remove fuel pump retaining nuts.

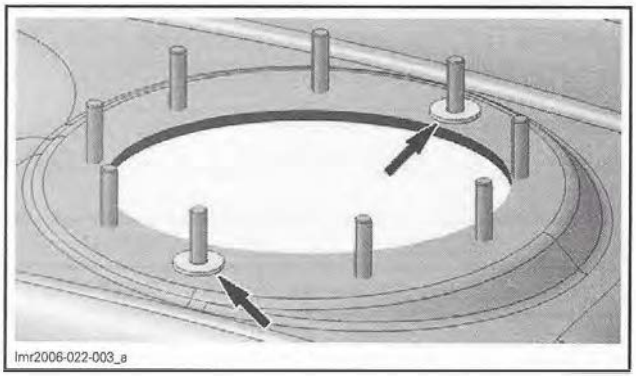
NOTICE **While pulling out the fuel pump, pay attention to fuel sensor float arm. Float arm can get stuck and bend which can reduce the fuel sensor capabilities.**

Pull fuel pump out from opening.

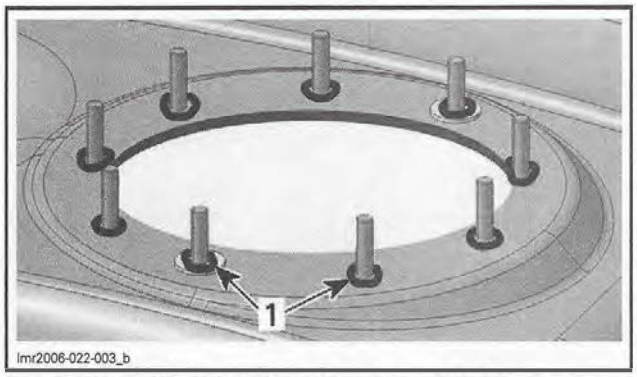
Fuel Pump Installation

Check C-ring for cracks, bends or damage, replace if necessary.

Install the studded C-ring and hold. Install new circlips on opposite studs to prevent ring from falling.

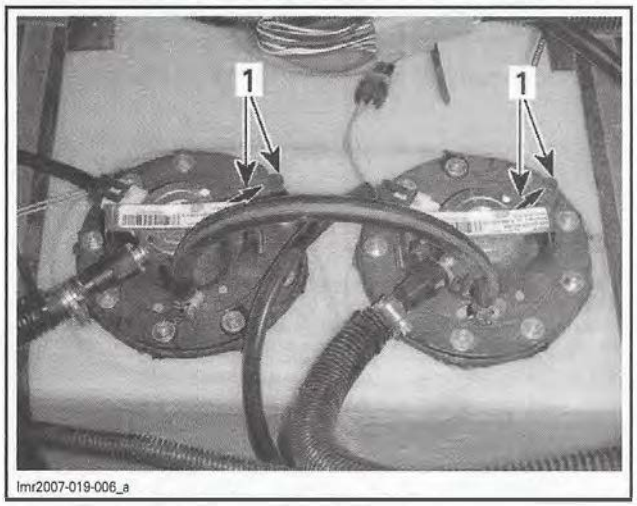


Apply LOCTITE 518 (P/N 293 800 038) around all studs.



1. *Loctite 518 around circlips and around each stud*

Install a **NEW** rubber gasket and align the arrow on fuel pump with the dot on the gasket.

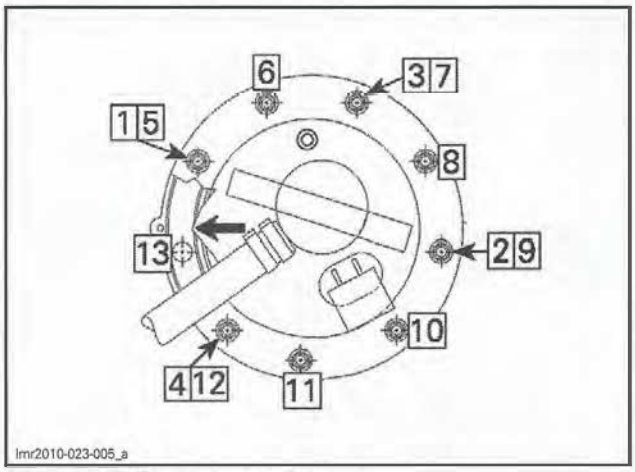


1. *Arrow on pump aligned with dot on gasket*

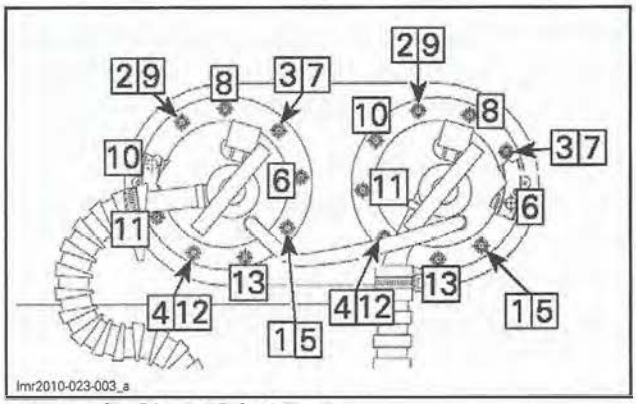
Secure fuel pump using stainless steel flat washers and M5 stainless steel stop nuts.

Tighten fuel pump nuts to specification using the following sequence.

TIGHTENING TORQUE	
Fuel pump retaining nuts	2 N•m (18 lbf•**in**)



SINGLE ENGINE CONFIGURATION



TWIN ENGINES CONFIGURATION

Plug in fuel level connector to fuel pump.

Perform a fuel system leak test. See procedure in *INSPECTION*.

Reinstall removed parts.

FUEL FILTER

Fuel Filter Removal

NOTE: The fuel filter does not require replacement under normal operating conditions. Replace only if permanently clogged or damaged. The fuel pump assembly has to be removed from the fuel tank to have access to the fuel filter.

Remove fuel pump. Refer to *FUEL PUMP* for the procedure.

Turn fuel pump upside down. Using a small flat screwdriver, remove the fuel filter by prying the inner plastic ring.

1. *Fuel filter*
2. *Inner plastic ring*

Fuel Filter Inspection

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

Fuel Filter Installation

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

Reinstall fuel pump.

FUEL LEVEL SENDER

Fuel Level Sender Resistance Test

150 and 180 Series

Disconnect the fuel pump/fuel level sender connector.

200 Series

Disconnect the starboard fuel pump/fuel level sender connector.

210 Series

For indication in the analog fuel gauge, disconnect the starboard fuel pump/fuel level sender connector.

For indication in the information center, disconnect the port fuel pump/fuel level sender connector.

230 Series

For indication in the analog fuel gauge, disconnect the port fuel pump/fuel level sender connector.

For indication in the information center, disconnect the starboard fuel pump/fuel level sender connector.

All Models

Set multimeter to Ohms.

Measure resistance as per table.

FUEL LEVEL SENDER PIN		MEASUREMENT @ 20°C (68°F)
B	C	See tables below for resistance value

FUEL LEVEL	RESISTANCE (Ω)
Full	4.8 ± 2.2
Empty	89.8 ± 3.6

FUEL TANK

Fuel Tank Inspection

Fuel Filler Hose

Verify fuel filler hose for damage.

Always ensure that clamps are well positioned and tightened.

TIGHTENING TORQUE	
Clamp	2.8 N•m (25 lbf•in)

Fuel Tank Straps

Inspect retaining straps for wear or cracks.

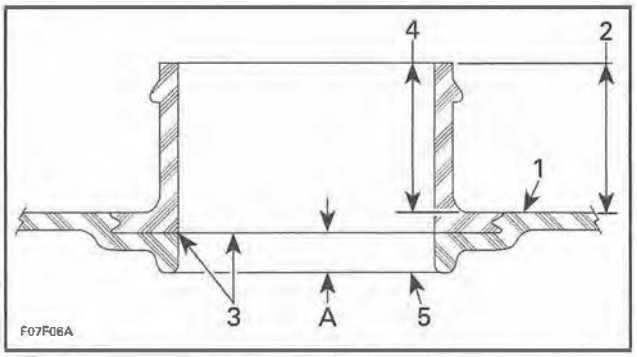
Fuel Tank

Inspect fuel tank for wear caused by any abnormal contact or rubbing with other component(s).

Disconnect fuel filler hose.

Visually inspect the inside and outside of the fuel tank necks for crack(s). If crack(s) are existing, replace fuel tank.

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 rotomolded cross-link polyethylene material. Therefore, no cracks are acceptable on any point of the tank.

Fuel Tank Removal

Engine(s) must be removed to withdraw the fuel tank.

Siphon fuel tank.

Disconnect fuel pump connections. See *FUEL PUMP* above.

Disconnect fuel tank filler hose and vent hose.

Cut locking ties as required to release wiring harness.

Release fuel tank straps.

Remove fuel tank from boat.

⚠ WARNING

Check that fiberglass is not exposed in the fuel tank area.

Fuel Tank Installation

Ensure rubber pads are in place and in good condition.

Properly secure straps. Refer to exploded views at the beginning of this subsection for threadlocker and proper torque.

Properly secure harnesses.

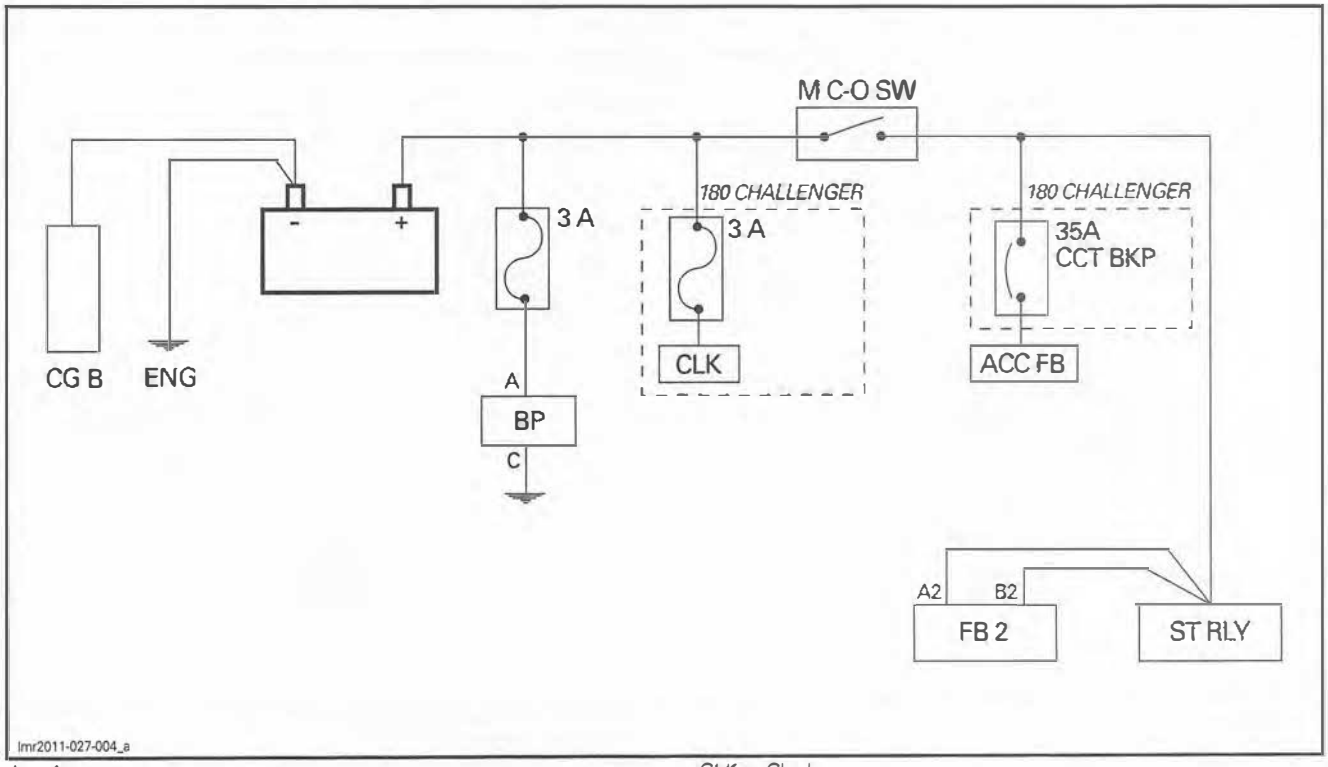
The vent line must be routed above the fuel fill hose with no sags in vent line between fill neck and tank. The vent line must be secured to fuel fill hose with locking ties but not inserted in the corrugated protector.

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

Perform a fuel system leak test. See procedure in *INSPECTION*.

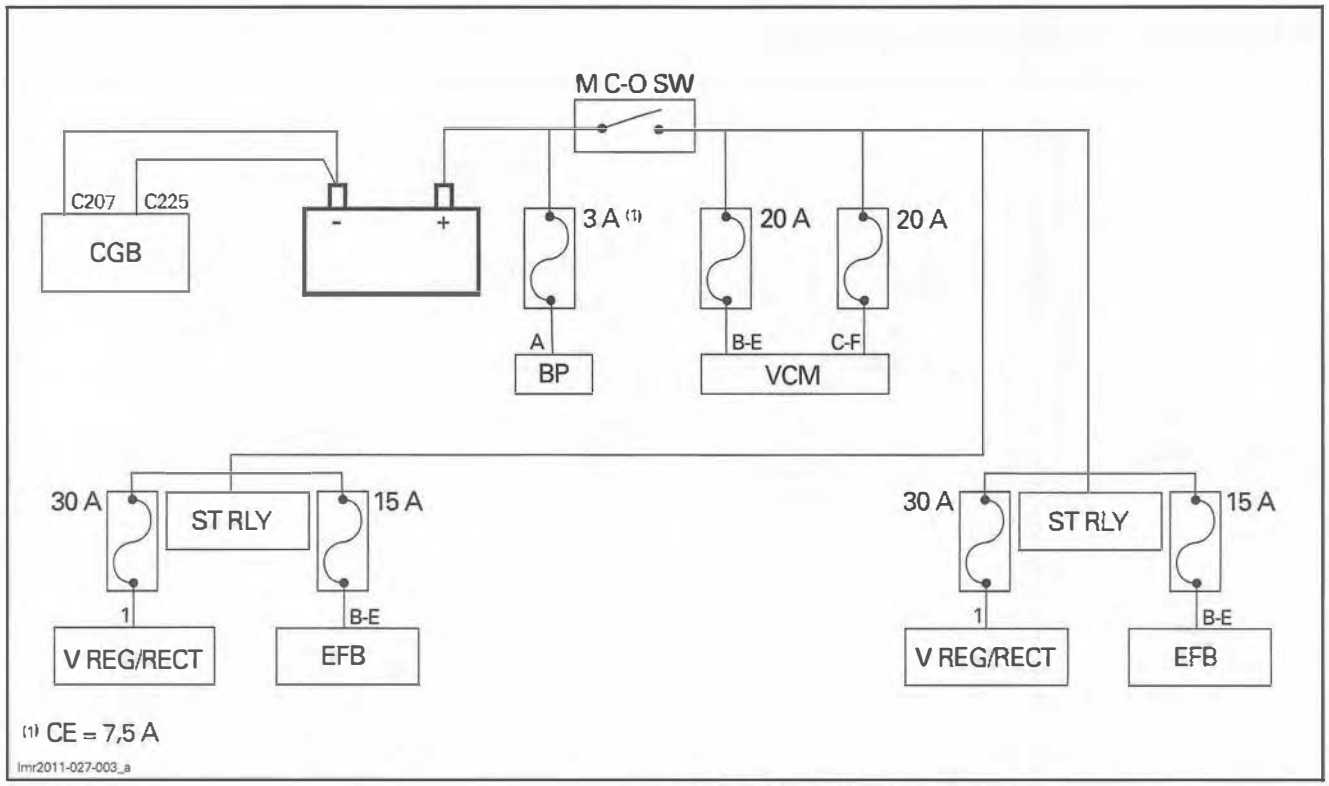
POWER DISTRIBUTION

150 Speedster and 180 Challenger Series



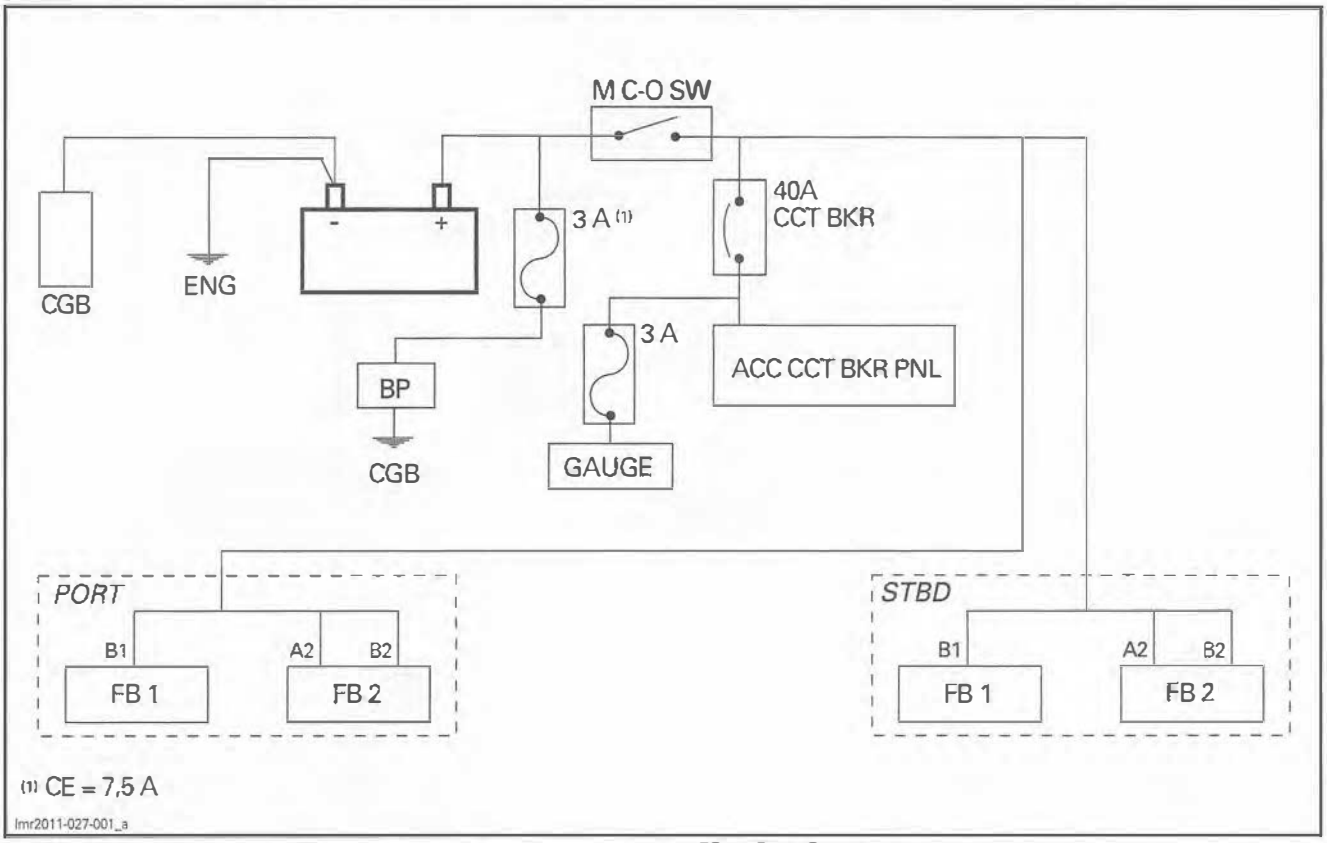
A = Amperes
ACC FB = Accessory Fuse Block
BP = Bilge Pump
CCT BKR = Circuit Breaker
CGB = Console Ground Block
CLK = Clock
ENG = Engine
FB2 - Fuse Box 2
M C-O SW = Main Cut-Off Switch
ST RLY = Starter relay

200 Speedster



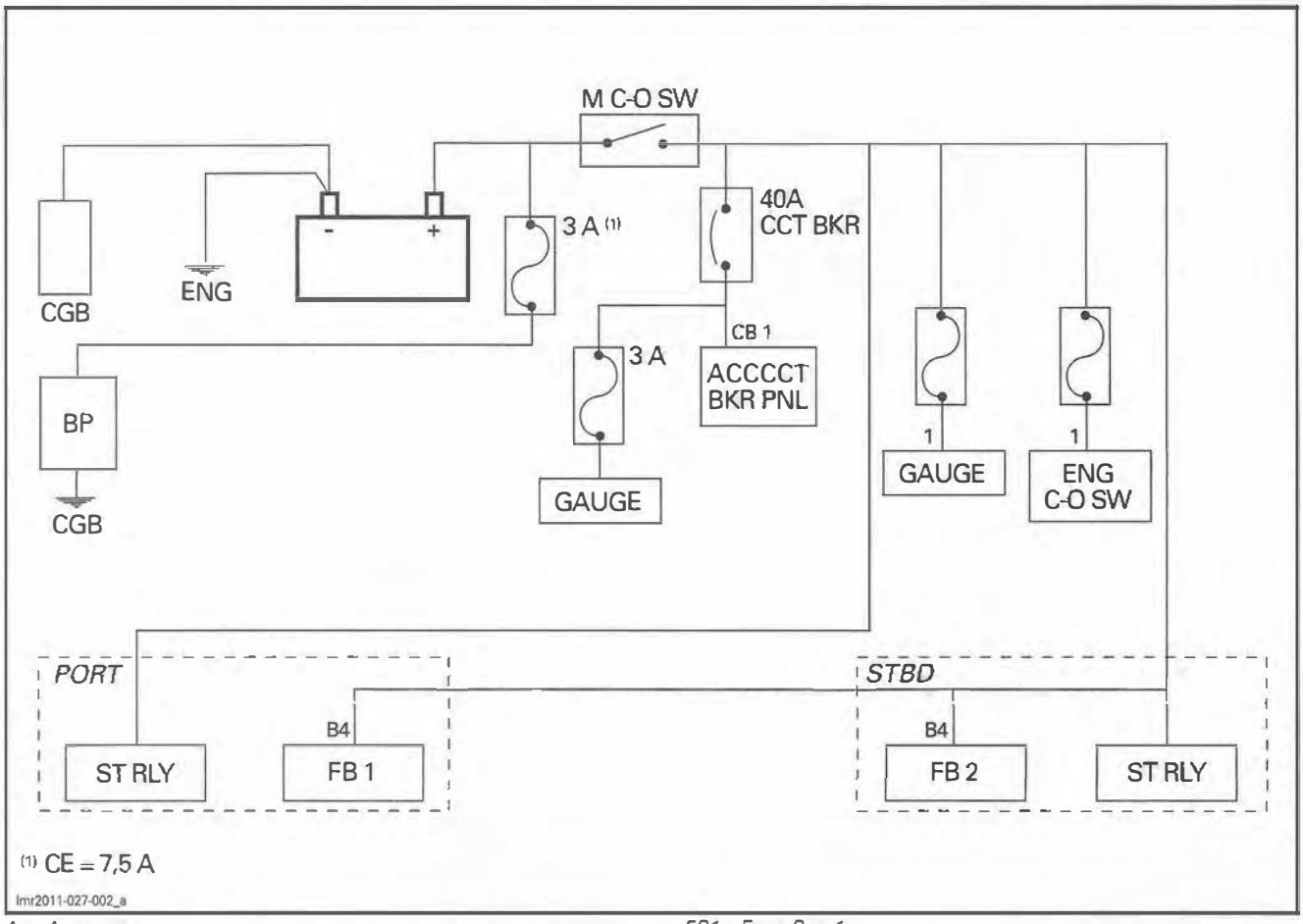
A = Amperes
BP = Bilge Pump
CGB = Console Ground Block
EFB = Engine Fuse Block
M C-O SW = Main Cut-Off Switch
ST RLY = Starter relay
VCM = Vehicle Control Module
V REG/RECT = Voltage regulator/rectifier

210 Challenger and 210 WAKE Series



A = Amperes
ACC CCT BKR PNL= Accessory Circuit Breaker Panel
BP = Bilge Pump
CCT BKR = Circuit Breaker
CGB = Console Ground Block
ENG = Engine
FB1 - Fuse Box 1
FB2 - Fuse Box 2
M C-O SW = Main Cut-Off Switch
STBD = Starboard
Gauge
Port

230 Challenger and 230 WAKE Series



A = Amperes
ACC CCT BKR PNL= Accessory Circuit Breaker Panel
BP = Bilge Pump
CCT BKR = Circuit Breaker
CGB = Console Ground Block
ENG = Engine
ENG C-O SW = Engine cut-off switch
FB1 - Fuse Box 1
FB2 - Fuse Box 2
M C-O SW = Main Cut-Off Switch
STBD = Starboard
ST RLY = Starter relay
Gauge
Port

GENERAL

NOTE: Always refer to the applicable wiring diagram for details. See *2011 WIRING DIAGRAM BOOKLET P/N 219 100 547*.

ELECTRICAL SYSTEM ACTIVATION

The electrical system can be activated without starting the engine. Proceed as follows:

150, 180 and 200 Series

- Turn main cut-off switch to ON.
- Install tether cord cap on the engine cut-off switch.

210 and 230 Series

- Turn main cut-off switch to ON.
- Turn ignition switch (key) to ON.
- Install tether cord clip on the engine cut-off switch.

MAIN CUT-OFF SWITCH

Main Cut-Off Switch Description

The main cut-off switch is used to control main electrical power application. When set to:

- ON position, the battery provides current to the electrical system.
- OFF position, the battery is isolated from the electrical system.

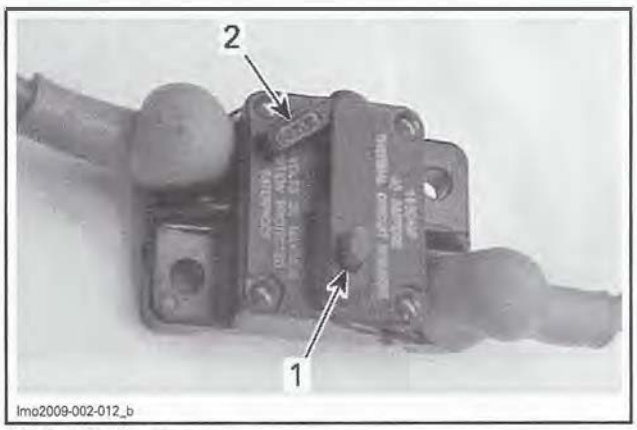
NOTE: In OFF position, only the bilge pump (automatic mode) remains powered.

MUST BE GREEN WHEN ON
1. ON position

MAIN CIRCUIT BREAKER (180/210/230 SERIES)

A main breaker is used to protect the accessory circuits.

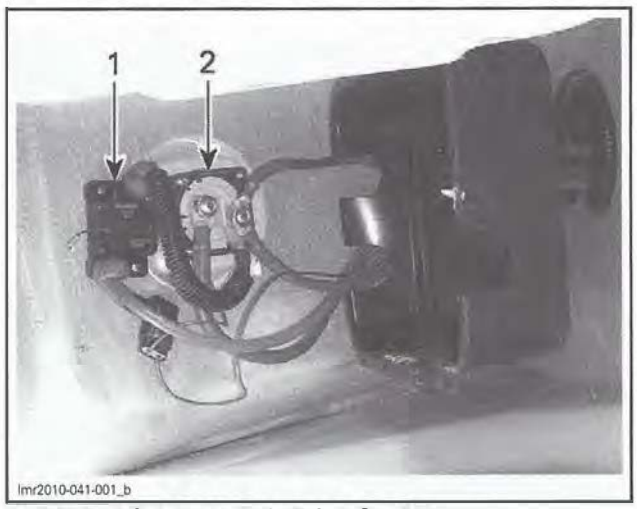
The main breaker can be manually tripped.



MAIN BREAKER
1. Test button
2. Reset lever tripped (off position)

Main Circuits Breaker Location

The main circuit breaker is located near the main cut-off switch.



TYPICAL - BEHIND MAIN CUT-OFF SWITCH
1. Main breaker
2. Main cut-off switch

210 WAKE and 230 WAKE Models

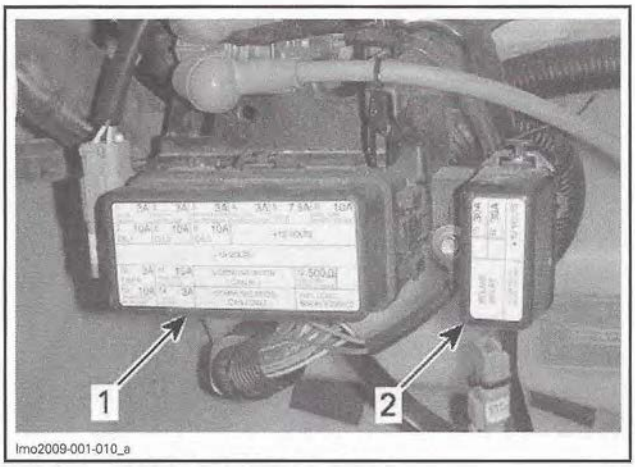
WAKE models use a second main breaker to protect the audio system.

FUSES (150/180 SERIES)

Most fuses are grouped in the main fuse boxes and the accessory fuse box.

Main Fuse Boxes Location

The main fuse boxes are located in the engine compartment.

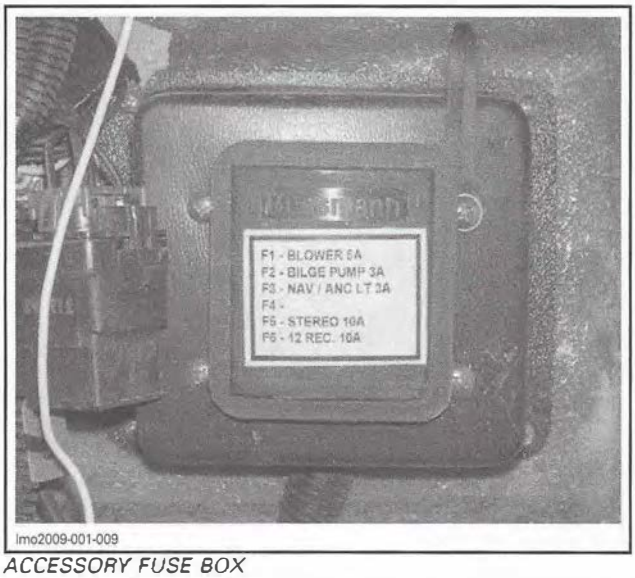


TYPICAL - ENGINE MAIN FUSE BOXES
1. Fuse box 1
2. Fuxe box 2

Accessory Fuse Box Location

150 Speedster

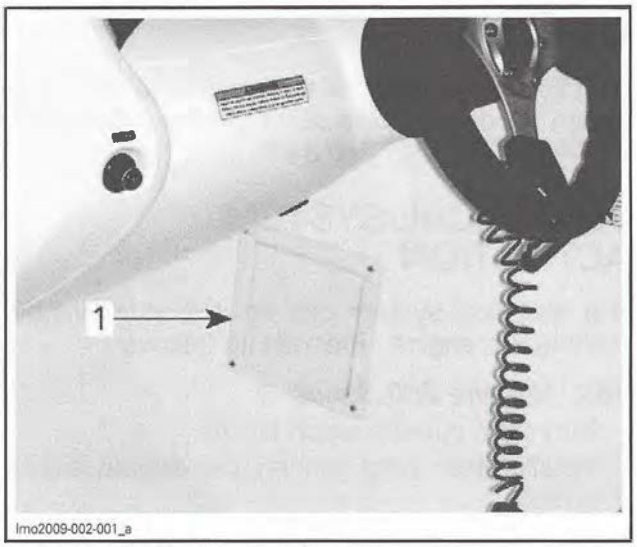
The accessory fuse box is located in the front storage compartment.



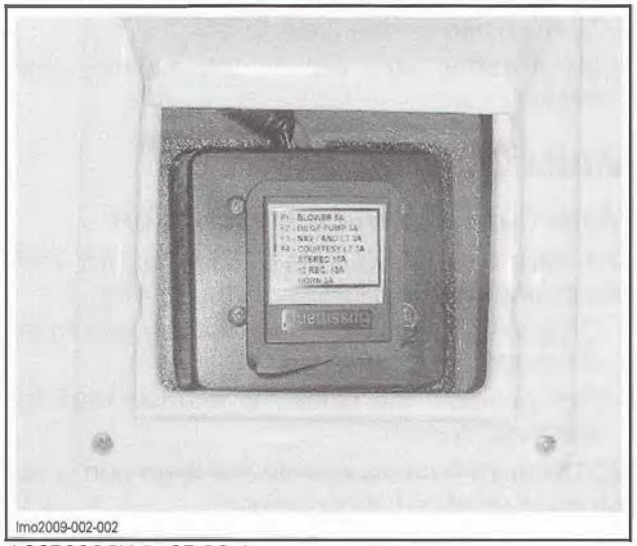
ACCESSORY FUSE BOX

180 Series

The accessory fuse box is located on the starboard side (RH), under the driver's console.



1. Access panel for accessory fuse box

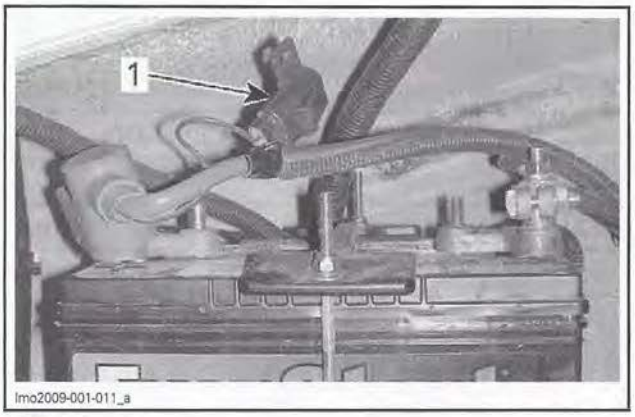


ACCESSORY FUSE BOX

Separate Fuse Holder Location

Automatic Bilge Pump Fuse

The automatic bilge pump fuse is located near the battery.



T PICAL
1. Auto-bilge fuse

Fuse Identification

Fuse Box 1

NO.	FB1 FUSES DESCRIPTION	
F1	Gauge	3 A
F2	Beeper	3 A
F3	Depth sounder (if equipped)	3 A
F4	Fuel level sensor	3 A
F5	Unused	–
F6	Fuel pump	10 A
F7	Fuel injector/Ignition coil cyl 1	10 A
F8	Fuel injector/Ignition coil cyl 2	10 A
F9	Fuel injector/Ignition coil cyl 3	10 A
F10	Unused	–
F11	Diagnostic connector	15 A
F12	Fuel level sensor resistor	–
F13	Starter relay	10 A
F14	CAPS	3 A

Fuse Box 2

NO.	FB2 FUSES DESCRIPTION	
F15	Charging system	30 A
F16	Main relay	30 A

Accessory Fuse Box

NO.	ACCESSORY FUSES DESCRIPTION	
F1	Bilge blower	5 A
F2	Bilge pump	3 A
F3	Navigation/Anchor lights	3 A
F4	Courtesy lights (if equipped)	3 A
F5	Radio	10 A
F6	12-volt power outlet	10 A
F7	Horn (if equipped)	7.5 A

Separate Fuses

SEPARATE FUSES DESCRIPTION	
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A

FUSES (200 SPEEDSTER)

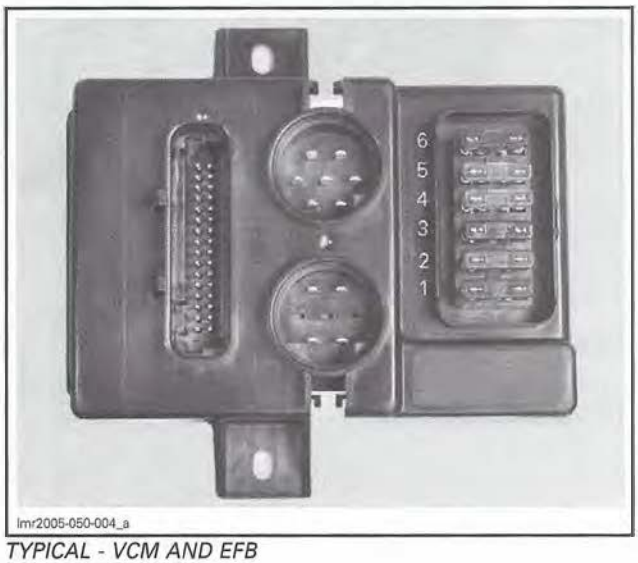
Most fuses are grouped in the VCM (vehicle control module) and the EFB (engine fuse box).

VCM and EFB Location

The VCM is located in the driver's console.

The EFBs are located in the engine compartment (one per engine).

NOTE: The VCM and EFB look alike but have different internal circuits.

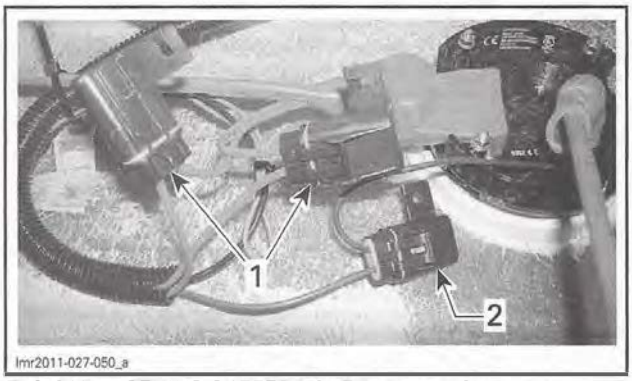


TYPICAL - VCM AND EFB

Separate Fuse Holders Location

Automatic Bilge Pump and VCM Fuses

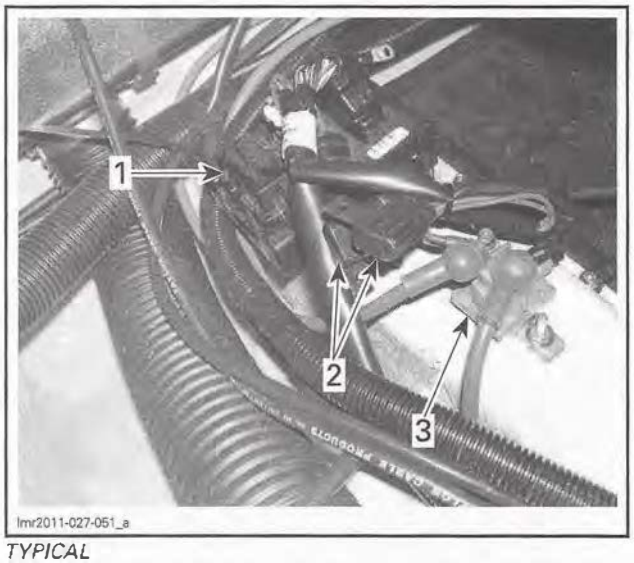
The automatic bilge pump and VCM fuses are located near the main cut-off switch.



TYPICAL — BEHIND BATTERY CUT-OFF SWITCH
1. *VCM fuse*
2. *Automatic bilge pump fuse*

Charging System and EFB Fuses

The charging system and EFB fuses are located near the starter relay.



TYPICAL
1. *EFB*
2. *Charging system and EFB fuses*
3. *Starter relay*

Bilge Blower Fuses

The bilge blower fuses are located near the blower motors.

Fuse Identification

VCM

NO.	VCM FUSES DESCRIPTION	
F1	Accessories	10 A
F2	Radio	10 A
F3	Bilge blower	10 A
F4	Bilge pump	3 A
F5	Navigation/anchor lights	3 A
F6	Courtesy lights	5 A

For more details on the VCM, refer to *VCM (VEHICLE CONTROL MODULE)* in this subsection.

EFB

NO.	EFB FUSES DESCRIPTION	
F1	Fuel pump	10 A
F2	Fuel injector/Ignition coil cyl 3	10 A
F3	ECM	5 A
F4	Fuel injector/Ignition coil cyl 1	10 A
F5	Fuel injector/Ignition coil cyl 2	10 A
F6	Gauges	2 A

For more details on the EFB, refer to *EFB (ENGINE FUSE BLOCK)* in this subsection.

Separate Fuses

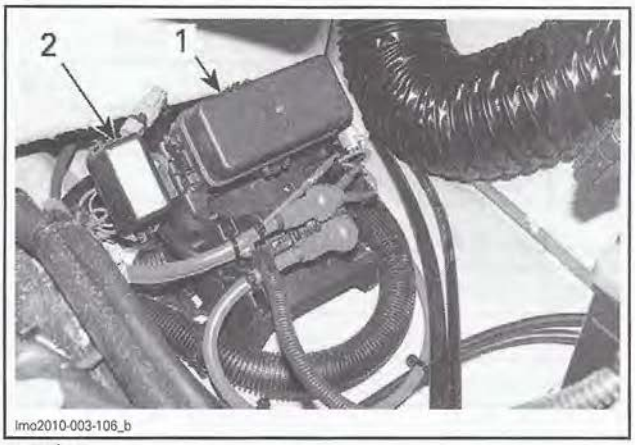
SEPARATE FUSES DESCRIPTION	
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A
VCM	20 A
Charging system	30 A
EFB	15 A
Bilge blower	5 A

FUSES (210 SERIES)

Most fuses are grouped in the main fuse boxes. Each engine has 2 fuse boxes.

Main Fuse Boxes Location

The main fuse boxes are located in the engine compartment.



TYPICAL
1. Fuse box 1 (one per engine)
2. Fuse box 2 (one per engine)

Separate Fuse Holders Location

Automatic Bilge Pump Fuse

The automatic bilge pump fuse is located near the main cut-off switch.

GPS Fuse

The GPS fuse is located in the console.

Bilge Blower Fuses

The bilge blower fuses are located near the blower motors.

Fuse Identification

Fuse Box 1

NO.	FB1 FUSES DESCRIPTION	
F1	Gauge	3 A
F2	Ignition Switch	3 A
F3	Depth sounder (1) (if equipped)	3 A
F4	Unused	–
F5	Unused	–
F6	Fuel pump	10 A
F7	Fuel injector/Ignition coil cyl 1	10 A
F8	Fuel injector/Ignition coil cyl 2	10 A
F9	Fuel injector/Ignition coil cyl 3	10 A
F10	Unused	–
F11	Diagnostic connector	15 A
F12	Port/Starboard detection	–
F13	Starter relay (2)	10 A
F14	CAPS	3 A

(1) In port fuse box only
(2) In starboard fuse box only

Fuse Box 2

NO.	FB2 FUSES DESCRIPTION	
F15	Charging system	30 A
F16	Main relay	30 A

Separate Fuses

SEPARATE FUSES DESCRIPTION	
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A
Bilge blower	5 A
GPS	3 A

CIRCUIT BREAKERS (210 SERIES)

The low amps circuit breakers are grouped in the accessory circuit breaker panel.

Accessory Circuit Breaker Panel Location

The accessory circuit breaker panel is located under the steering wheel.

1. Circuit breaker panel location

Circuit Breaker Identification

NO.	BREAKER PANEL DESCRIPTION	
A	Bilge pump (manual mode)	5 A
B	Bilge blower	3 A
C	Courtesy lights	3 A
D	Navigation/Anchor lights	3 A
E	12-volt power outlets	10 A
F	Horn	10 A
G	Audio system	7.5 A
H	Heater (if equipped)	10 A
I	Ballast (if equipped)	15 A
J	Unused	–

FUSES (230 SERIES)

Most fuses are grouped in the main fuse boxes.

Main Fuse Boxes Location

The main fuse boxes are located in the engine compartment.

Separate Fuse Holders Location

Ignition, Automatic Bilge Pump and Gauge Fuses

The ignition, automatic bilge pump and gauge fuses are located near the main cut-off switch.

Bilge Pump Fuses (CE Models)

The bilge pump fuses are located near the pumps.

Ballast Fuses (Wake Models)

The ballast fuses are located on the wake harness, near the 12-volt bus bar.

Fuse Identification

Fuse Box 1 (PORT)

NO.	FB1 FUSES DESCRIPTION	
F1	Fuel injector/Ignition coil cyl 1	10 A
F2	Fuel injector/Ignition coil cyl 2	10 A
F3	Fuel injector/Ignition coil cyl 3	10 A
F4	ECM	3 A
F5	Starter relay	5 A
F6	Depth sounder (if equipped)	3 A
F7	Main	30 A
F8	CAPS	3 A
F9	Gauges	3 A
F10	Charging System	30 A
F11	Fuel pump	10 A

Fuse Box 2 (STARBOARD)

NO.	FB2 FUSES DESCRIPTION	
F1	Fuel injector/Ignition coil cyl 1	10 A
F2	Fuel injector/Ignition coil cyl 2	10 A
F3	Fuel injector/Ignition coil cyl 3	10 A
F4	ECM	3 A
F5	Starter relay	5 A
F6	Main	30 A
F7	CAPS	3 A
F8	Diagnostic connector	15 A
F9	Bilge blower 1	5 A
F10	Charging System	30 A
F11	Bilge blower 2	5 A
F12	Ignition	5 A
F13	Fuel pump	10 A

Separate Fuses

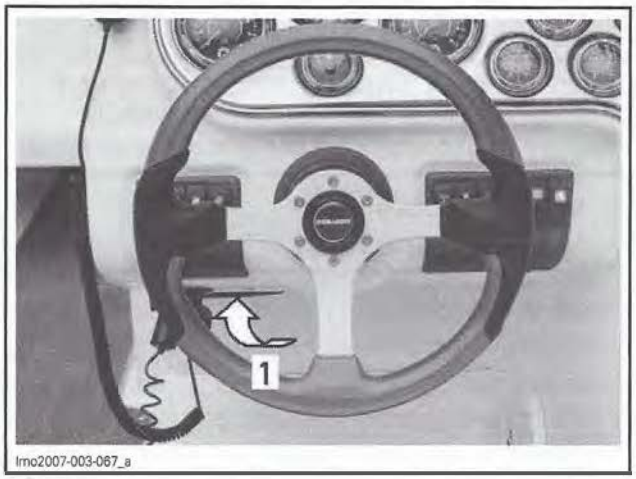
SEPARATE FUSES DESCRIPTION	
Ignition	3 A
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A
Bilge pump (CE models)	3 A
GPS	3 A
Ballast	5 A

CIRCUIT BREAKERS (230 SERIES)

The low amps circuit breakers are grouped in the accessory circuit breaker panel.

Accessory Circuit Breaker Panel Location

The accessory circuit breaker panel is located under the steering wheel.



TYPICAL
1. Circuit breaker panel location

Circuit Breaker Identification

NO.	BREAKER PANEL DESCRIPTION	
A	Bilge pump (manual mode)	5 A
B	Bilge blowers	3 A
C	Courtesy lights	3 A
D	Navigation/Anchor lights	3 A
E	12-volt power outlets	10 A
F	Horn	10 A
G	Audio system	7.5 A
H	Heater (if equipped)	10 A
I	Unused	–
J	Unused	–

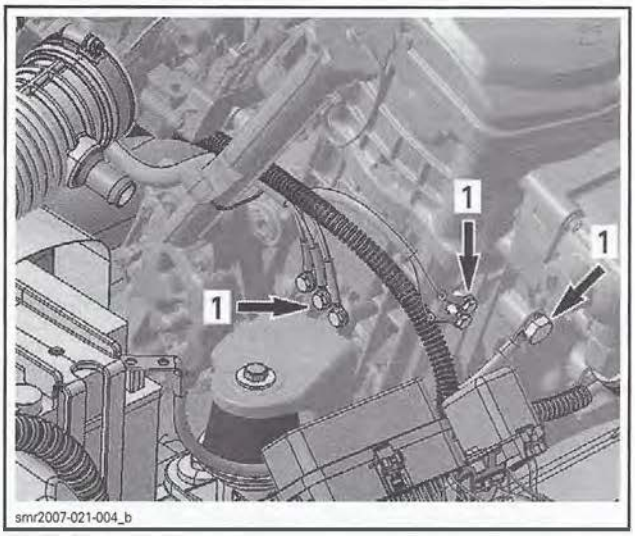
MAIN RELAY (150/180/210 SERIES)

Main Relay Location

MODEL	MAIN RELAY LOCATION
150 Speedster	Fuse box 2
180 Series	Fuse box 2
210 Series	Fuse box 2 (1 per engine)
230 Series	Fuse box 1 (PORT) Fuse box 2 (STARBOARD)

MAIN GROUNDS

Engine Grounds



YPICAL
1. Engine grounds

Ground Bus-Bar

A ground bus bar provides a common ground connection for many devices to the battery ground. It is usually located inside the console.

In the following illustration, a ground bus-bar can be seen through the access hole behind the backrest of the seat in front of the console.

TYPICAL - 230 SERIES ILLUSTRATED
1. Grounds from battery post
2. Accessory grounds

230 WAKE Model

Besides the console ground bus-bar, the WAKE model uses a second ground bus-bar used specifically for the wake accessories.

PROCEDURES

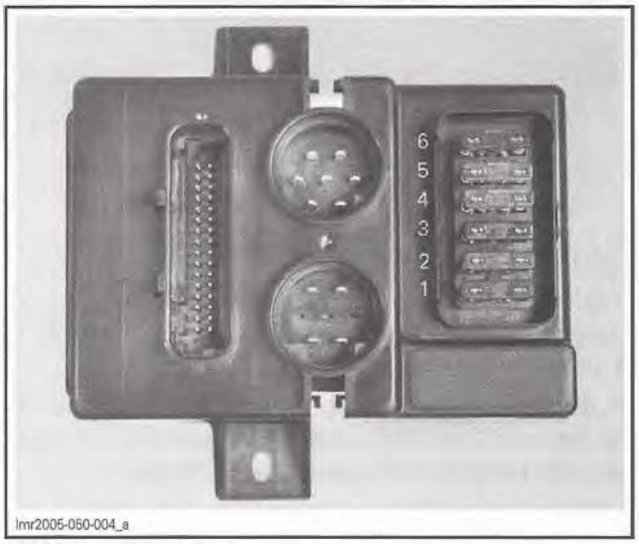
VCM (VEHICLE CONTROL MODULE) (200 SPEEDSTER)

VCM Description

The Vehicle Control Module (VCM) manages the vehicle electrical system.

The vehicle electrical components are protected by fuses integrated in the VCM.

NOTE: The VCM and EFB are visually identical but the internal circuits are different.



TYPICAL - VCM FUSES
1. *Accessories*
2. *Radio*
3. *Blower*
4. *Bilge pump*
5. *NAV lights*
6. *Courtesy lights (if so equipped)*

VCM Connectors

To identify the VCM connectors, follow the same instructions as for the EFB connectors. Refer to *ENGINE FUSE BLOCK (EFB)* in this subsection.

VCM Power Supply

Ensure EFB is powered. See following tests.

NOTE: Be aware that VCM low-current supply circuit gets its ground through the EFB. High-current supplies get their grounds through each accessory at the console ground bus.

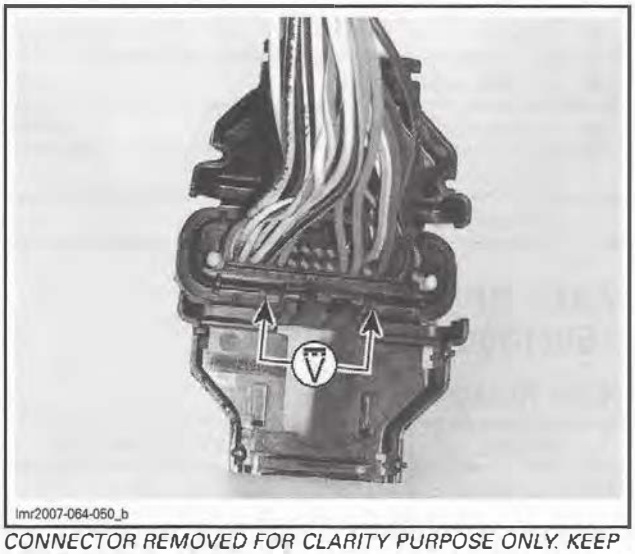
Low-Current Power Supply

QUICK INDICATION THAT LOW-CURRENT CIRCUIT OF VCM IS NOT POWERED (assuming the observed component is working)
– No D.E.S.S. operation – No speedometer operation.

Check the following:
- ECM fuse on EFB
- Gauge fuse on EFB
- VCM power supply wire and ground wires, see below.

1. Install tether cord.
2. Open back of connector "A" from VCM (see following illustration).
3. Back-probe connector and read voltage as follows.

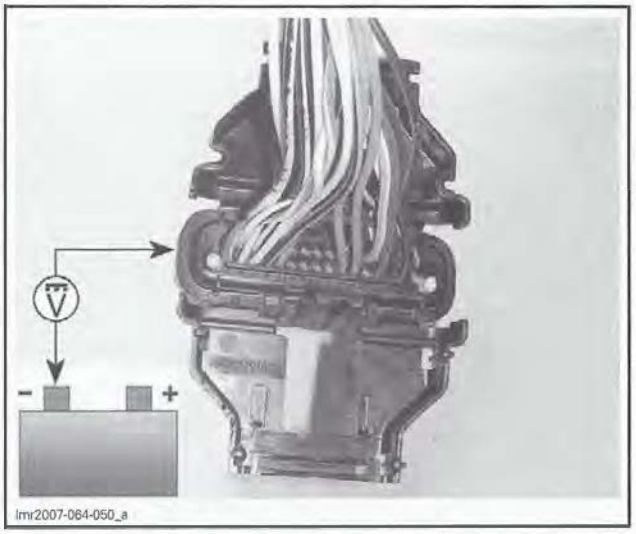
SIDE	VCM CONNECTOR "A"		VOLTAGE (Vdc)
Port	Pin A-4	Pin A-3	Battery voltage
Starboard	Pin A-19	Pin A-1	



CONNECTOR REMOVED FOR CLARITY PURPOSE ONLY. KEEP CONNECTED FOR THE TEST

If voltage is inadequate, recheck as follows.

SIDE	VCM CONNECTOR "A"	BATTERY	VOLTAGE (Vdc)
To port EFB	Pin A-4	Ground post	Battery voltage
To starboard EFB	Pin A-19		



If voltage is now good, problem is in the ground circuits. Check VCM grounds as described in *VCM GROUND CIRCUITS* that follows.

VCM Ground Circuits

1. Disconnect connector "A" from VCM and EFB.
2. Check continuity of wire between VCM and EFB as follows.

SIDE	VCM CONNECTOR "A"	EFB CONNECTOR "A"	RESISTANCE
Port	Pin A-3	Pin A-25	Close to 0 Ω (continuity)
Starboard	Pin A-1	Pin A-25	

If continuity test failed, check/repair wiring/connectors.

If continuity is good, check ground circuit of EFB (from pin A-27). If it tests good, try a new EFB. Refer to *EFB REPLACEMENT*.

High-Current Power Supply

NOTE: The tether cord is not required to power these circuits.

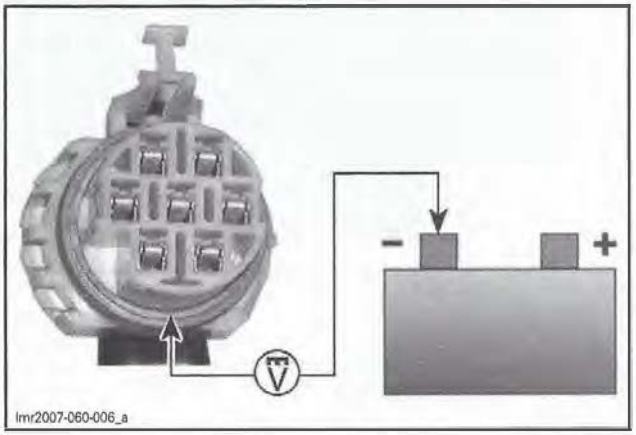
QUICK INDICATION THAT HIGH-CURRENT CIRCUIT OF VCM IS NOT POWERED (assuming the observed component is working)
Inoperative: Lights, blower, manual operation of bilge pump and accessories

Check the following:

- Both in-line 20 A fuses.

1. Disconnect "B" and "C" connectors from VCM.
2. Using a multimeter, measure voltage of each supply wire as follows.

VCM CONNECTOR	BATTERY	VOLTAGE (Vdc)
Connector B, pin E	Ground post	Battery voltage
Connector C, pin F		



If any test failed, check its wire continuity from battery.

VCM Replacement

Prior to replacing a VCM, ensure that all the tests have been carried out.

NOTE: There is no programming or reset to perform when replacing the VCM.

EFB (ENGINE FUSE BLOCK) (200 SPEEDSTER)

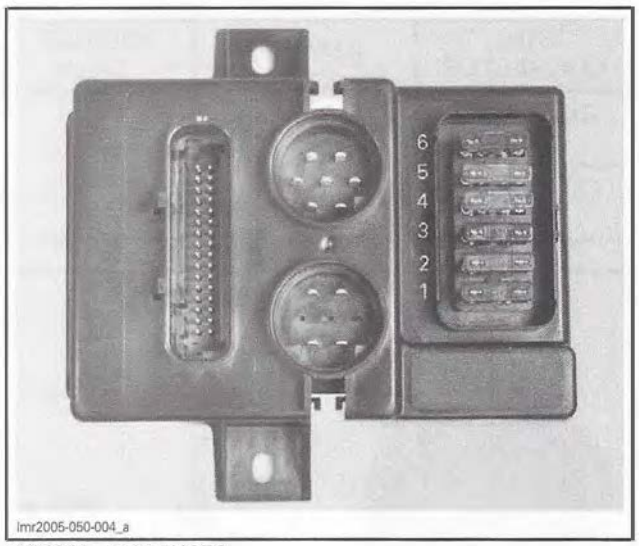
EFB Description

The Engine Fuse Block (EFB) distributes power to:

- Engine-related components
- ECM
- VCM
- Instrument(s).

These electrical components are protected by fuses integrated in the EFB.

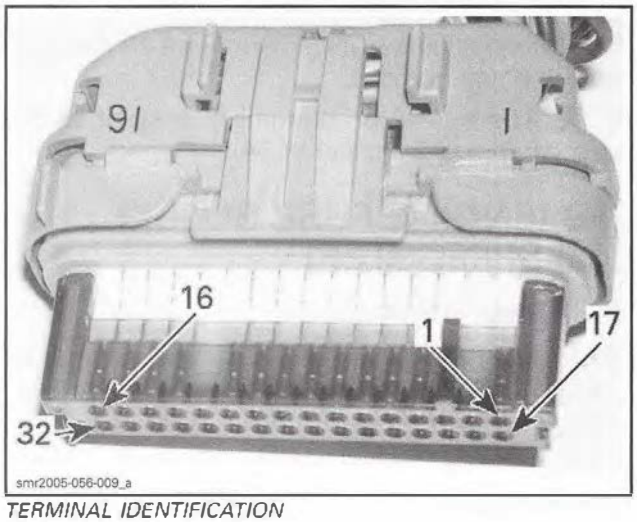
NOTE: The VCM and EFB are visually identical but the internal circuits are different.



TYPICAL - EFB FUSES
1. *Fuel pump*
2. *Injector and Ignition coil (cyl 3)*
3. *EMS*
4. *Injector and Ignition coil (cyl 1)*
5. *Injector and Ignition coil (cyl 2)*
6. *Gauges*

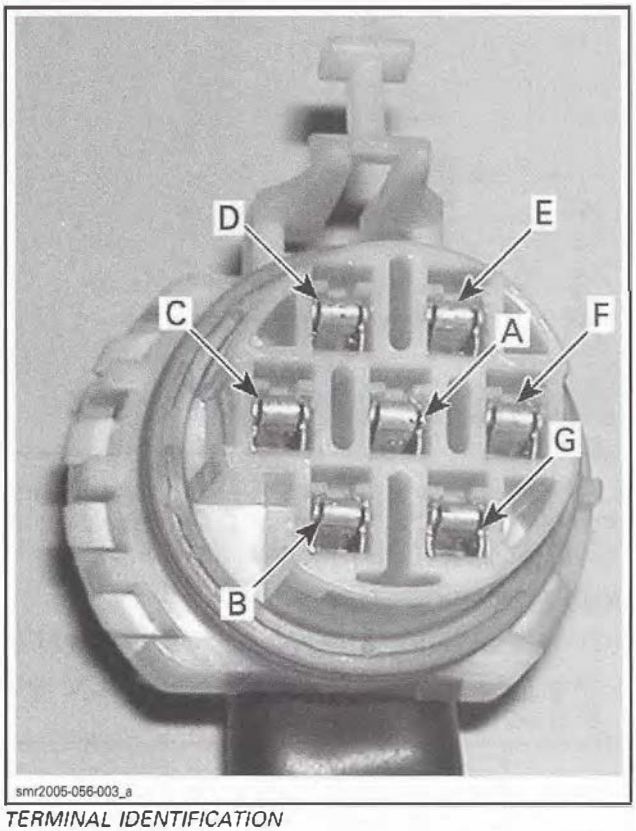
EFB Connectors

32-Pin Connector "A"



TERMINAL IDENTIFICATION

7-Pin Connector "B" and "C"



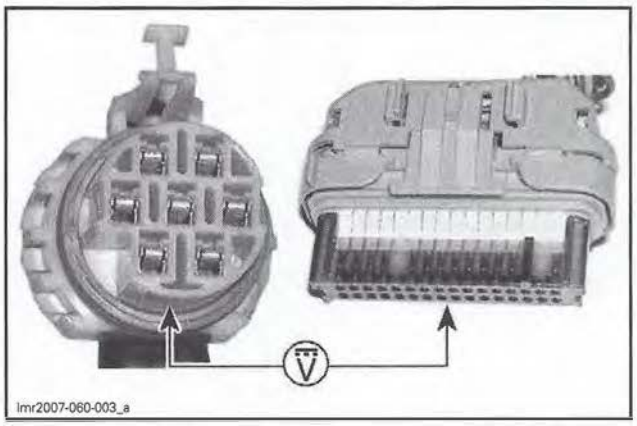
TERMINAL IDENTIFICATION

NOTE: For more details on connector servicing, refer to *ELECTRICAL CONNECTORS AND WIRING DIAGRAM* section.

EFB Power Supply

1. Disconnect "A" and "B" connectors from EFB.
2. Using a multimeter, measure voltage as follows.

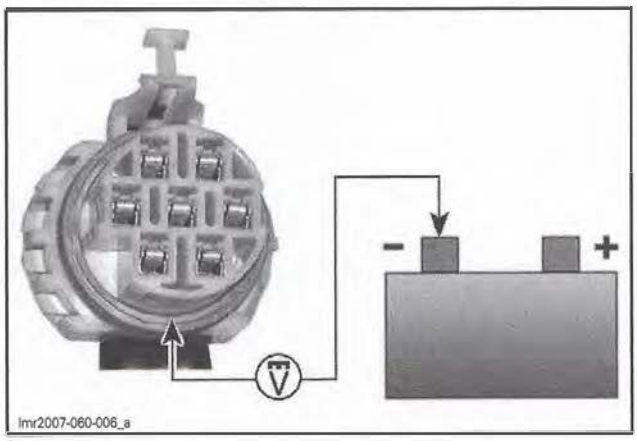
EFB CONNECTOR "B"	EFB CONNECTOR "A"	VOLTAGE (Vdc)
Pin B-E	Pin A-27	Battery voltage



If voltage is adequate EFB is properly supplied.

If voltage is not adequate, recheck as follows.

EFB CONNECTOR "B"	BATTERY	VOLTAGE (Vdc)
Pin B-E	Ground post	Battery voltage



If voltage is adequate check EFB ground circuit (wiring to pin A-27).

If voltage is still not adequate, check supply circuit.

EFB Replacement

NOTE: There is no programming or reset to perform when replacing the EFB.

IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	420 277 010	316
ECM ADAPTER TOOL	529 036 166	316
FLUKE 115 MULTIMETER	529 035 868	313–317

SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	318
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	319

GENERAL

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

⚠ WARNING

Never check for engine ignition spark from an open coil and/or spark plug as spark may cause potential fuel vapors to ignite. Always use an approved spark tester.

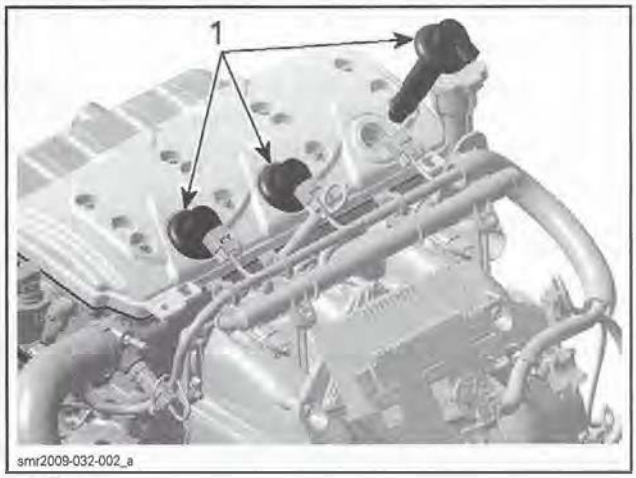
SYSTEM DESCRIPTION

The ignition system is a digital inductive type system.

Ignition system parameters such as ignition timing, spark duration, and firing order, as well as many other engine related functions are controlled by the engine management system (EMS) in order to meet engine operational requirements. The EMS can detect many abnormalities including a short circuit in the primary winding of the ignition coils as well as its associated circuits.

Three separate ignition coils receive power from three separate fuses.

When a ground signal is provided by the ECM to an ignition coil primary winding, a high voltage is induced in the coil secondary winding that is used to produce a spark at the spark plug electrode.



TYPICAL
1. Ignition coils

Ignition Timing

Ignition timing is not adjustable.

The ECM is programmed with data (ignition mappings) that it uses to establish optimum ignition timing under all engine operating conditions.

It receives signals from a variety of sensors that it compares with the ignition mappings and uses it to control the ignition spark timing, duration and firing order.

The firing of each spark plug is independent of the others.

Engine RPM Limiter

The ECM will limit the maximum engine speed by cutting off ignition spark and fuel at a predetermined engine RPM.

ENGINE	RPM LIMITER
155 engine	7750 RPM
215, 255 and 260 engine	8300 RPM

210 and 230 Series

On these models, the ECM will also control the throttle plate opening through the iTC system (intelligent Throttle Control) to limit maximum RPM. This is accomplished using an electronically controlled throttle body that uses and ETA (Electric Throttle Actuator) and TPS (Throttle Position Sensor).

Knock Sensor

A knock sensor is mounted on the cylinder block behind the intake manifold. It detects specific vibrations that would typically be generated by engine detonation.

If detonation occurs, the knock sensor detects it and the ECM goes into a specific operating mode whereby it temporarily retards the ignition advance until detonation stops.

The ECM is able to identify in which cylinder the knocking occurs and modifies the ignition advance on that cylinder only.

Refer to the *ELECTRONIC FUEL INJECTION (EFI)* subsection for testing and replacement procedures.

TROUBLESHOOTING

It is good practice to check for fault codes using the B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Refer to *POWER DISTRIBUTION* for fuses and relay information.

Always refer to the *WIRING DIAGRAM* when troubleshooting an electrical circuit.

IGNITION SYSTEM TESTING

1. Ensure Cyl 1, Cyl 2, and Cyl 3 fuses are in good condition (ignition/injection fuses).
2. If a fuse is burnt, test for a short circuit or faulty component on that fuse circuit before replacing the fuse.

⚠ WARNING

Due to the possibility of flammable vapors accumulating in the bilge, you should always test for a short circuit which may produce a spark and ignite the vapors before replacing a burnt fuse.

3. If a primary winding of an ignition coil or a circuit is at fault, a fault code will be set. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.
4. If one cylinder is not firing and there is no fault code, replace each spark plug with a known good spark plug until the faulty plug is located.
5. If the fault is not found, carry out an *IGNITION COIL TEST USING B.U.D.S.*

DIAGNOSTIC GUIDELINES

The following is provided to help in diagnosing the probable cause of a problem. It is a guideline and should not be assumed to list all possible causes.

ENGINE WILL NOT START (ENGINE TURNS OVER)

1. **Fouled or defective spark plug**
   - *Replace.*
2. **Defective CPS**
   - *Check operation of CPS and replace if necessary. Refer to ELECTRONIC FUEL INJECTION (EFI) subsection.*
3. **Defective trigger wheel**
   - *Check. Refer to PTO HOUSING AND MAGNETO subsection.*
4. **Defective ignition circuit**
   - *Check fuses, ignition coils, wiring and connectors.*

ENGINE HARD TO START

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

ENGINE MISFIRES, RUNS IRREGULARLY

1. **Fouled, defective, worn spark plugs**
   - *Check spark plug condition. Replace if required.*
2. **Defective T.O.P.S. switch (210 and 230 Series)**
   - *Check T.O.P.S. Refer to LUBRICATION subsection.*
3. **Damaged trigger wheel/loose CPS**
   - *Check. Refer to PTO HOUSING AND MAGNETO subsection.*

4. Defective ignition circuit
   - *Check ignition coils, CYL fuses, wiring and connectors condition.*
5. Poor engine grounds
   - *Check/ground condition. Refer to POWER DISTRIBUTION subsection.*

ENGINE CONTINUALLY BACKFIRES

1. Fouled, defective spark plugs
   - *Clean/replace.*
2. Damaged trigger wheel/defective or loose CPS
   - *Check, refer to PTO HOUSING AND MAGNETO and ELECTRONIC FUEL INJECTION (EFI) subsections.*

ENGINE DETONATION OR PINGING

1. Knock sensor disconnected or faulty
   - *Check, refer to ELECTRONIC FUEL INJECTION (EFI) subsection.*

ENGINE LACKS ACCELERATION OR POWER

1. Weak spark
   - *Check spark plugs, coils, wiring and connections.*

PROCEDURES

ENGINE CUT-OFF SWITCH (150, 180 AND 200 SERIES)

150 and 180 Series

The engine cut-off switch used on these models has 4 wires and contains 2 reed switches working in parallel.

200 Series

The engine cut-off switch used on these models has 3 wires and contains 1 reed switch.

Engine Cut-Off Switch Continuity Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

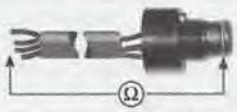
NOTE: The following tests validate the reed switch and the engine cut-off switch ground.

If any test fails, replace the engine cut-off switch.

If all readings are as specified, carry out a continuity test of the vehicle harness from the ECM to the engine cut-off switch.

Tether Cord Removed

1. Disconnect the engine cut-off switch connector.
2. Set multimeter to Ω.
3. Connect test probes to engine cut-off switch as per each applicable table and measure resistance.

ENGINE CUT-OFF SWITCH (150, 180 AND 200 SERIES)		
PROBE		RESISTANCE Ω @ 20°C (68°F)
BLACK	BLACK/YELLOW	Open circuit
	BLACK/PURPLE (150/180 series)	
		
WHITE/GREY	Post terminal	Close to 0 Ω
		
BLACK	Post ring	Close to 0 Ω
		

Tether Cord Installed

ENGINE CUT-OFF SWITCH (150, 180 AND 200 SERIES)		
PROBE		RESISTANCE Ω @ 20°C (68°F)
BLACK	BLACK/YELLOW	Close to 0 Ω
		

ENGINE CUT-OFF SWITCH (210 AND 230 SERIES)

Engine Cut-Off Switch Continuity Test

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect the engine cut-off switch connector.
2. Set multimeter to Ω selection.
3. Test the engine cut-off switch as per following table.

TETHER CORD	PROBE	READING
Removed	Between pins 1 and 2	OL (open circuit)
Installed		Close to zero Ω

If readings are as specified, engine cut-off switch is good. Carry out the following;

MODEL	TEST
210 Series	– Continuity test from engine cut-off switch (pin 2) to ignition switch (pin A)
	– Continuity test from engine cut-off switch (pin 1) to fuse F2 (contact A10) of each fuse block 1
230 Series	– Continuity test from engine cut-off switch (pin 2) to ignition switch (pin B)
	– Continuity test from engine cut-off switch (pin 1) to fuse holder (contact F)

On 210 Series, pay attention to the polarity of the 2 diodes in the circuit. Refer to appropriate *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547).*

IGNITION SWITCH

Ignition Switch Access

1. To access to engine ignition switch connector, open the backrest of the seat in front of the helm.
2. Open the soft access panel in front of the helm.

Ignition Switch Continuity Test

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Remove the connector from the switch.
2. Set the multimeter to Ω selection.
3. Test the ignition switch as per following table.

IGNITION SWITCH	PROBE	READING
OFF	Pins A and B	OL (open circuit)
	Pins C and D	
ACC.	Pins A and B	OL (open circuit)
	Pins C and D	Close to zero Ω
ON	Pins A and B	Close to zero Ω
	Pins C and D	

IGNITION SWITCH CONTACTS	FUNCTIONALITY
Pins A and B	Ignition system
Pins C and D	Radio

IGNITION COILS

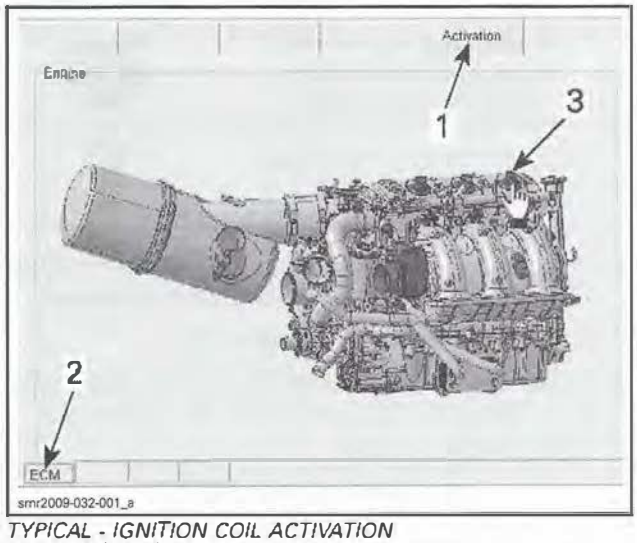
⚠ WARNING

Never check for engine ignition spark from an open coil and/or spark plug in the engine compartment as a spark may cause fuel vapors which may have accumulated in the bilge to ignite.

Ignition Coil Test Using B.U.D.S.

1. Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select:
   1. **Activation** page tab
   2. **ECM** tab.

Ignition coil to be tested by selecting it on the engine illustration.



TYPICAL - IGNITION COIL ACTIVATION
1. Activation tab
2. ECM tab
3. Click on the desired ignition coil

You should hear the spark occurring. If in doubt, use a sealed vapor proof spark tester or an inductive spark tester as available from tool suppliers, to prevent a spark from occurring in the bilge.

If there is no ignition at one or more coils, carry out an *IGNITION COIL INPUT VOLTAGE TEST*.

If spark is weak, try a new spark plug. If spark is still weak, try a new ignition coil.

NOTE: The voltage required to produce a spark in the combustion chamber is higher when the engine is running.

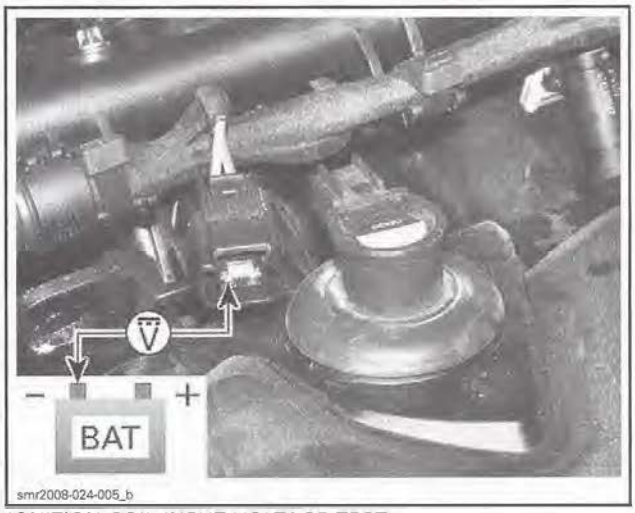
Ignition Coil Input Voltage Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Make sure all key switch fuses are good before testing.

1. Disconnect the applicable ignition coil connector.
2. Set the multimeter to Vdc.
3. Activate electrical system without starting the engine.
4. Measure voltage as per following table. Repeat for each ignition coil.

TEST PROBES		VOLTAGE
PURPLE/BLUE wire (ignition coil no. 1)	Battery negative (–) post	Battery voltage
PURPLE/GREEN wire (ignition coil no. 2)		
PURPLE/ORANGE wire (ignition coil no. 3)		



IGNITION COIL INPUT VOLTAGE TEST

If test succeeded, refer to *IGNITION COIL CONTROL CIRCUIT CONTINUITY TEST*.

If test failed, refer to *IGNITION COIL POWER CIRCUIT CONTINUITY TEST*.

Ignition Coil Power Circuit Continuity Test

1. Set multimeter to Ω position.
2. Read resistance of the applicable ignition coil circuit.

150 AND 180 SERIES		
IGNITION COIL WIRE	FUSE BOX NO. 1	RESISTANCE @ 20°C (68°F)
PURPLE/BLUE wire (ignition coil no. 1)	Terminal B11	Close to 0 Ω
PURPLE/GREEN wire (ignition coil no. 2)	Terminal B9	
PURPLE/ORANGE wire (ignition coil no. 3)	Terminal B7	

200 SERIES		
IGNITION COIL WIRE	EFB	RESISTANCE @ 20°C (68°F)
PURPLE/BLUE wire (ignition coil no. 1)	Terminal B-C	Close to 0 Ω
PURPLE/GREEN wire (ignition coil no. 2)	Terminal B-D	
PURPLE/ORANGE wire (ignition coil no. 3)	Terminal B-G	

210 AND 230 SERIES		
IGNITION COIL WIRE	FUSE BOX NO. 1 OR 2 (ACCORDING TO ENGINE)	RESISTANCE @ 20°C (68°F)
PURPLE/BLUE wire (ignition coil no. 1)	Terminal B11	Close to 0 Ω
PURPLE/GREEN wire (ignition coil no. 2)	Terminal B9	
PURPLE/ORANGE wire (ignition coil no. 3)	Terminal B7	

If test succeeded, the ignition coil power circuit is functional. Carry out a *IGNITION COIL CONTROL CONTINUITY TEST* wiring between the ignition coil and the ECM.

If test to any ignition coil failed, test the following items separately and repair or replace as required.

- Fuses (CYL 1, CYL 2, CYL 3)
- Wiring from fuse box to ignition coil.

Refer to appropriate *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for details.

Ignition Coil Control Circuit Continuity Test

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect ECM connector "A". Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
2. Disconnect ignition coil connector.
3. Install the ECM connector on the applicable ECM adapter tool and test for continuity of circuit as per model.

150, 180 AND 200 SERIES		
IGNITION COIL WIRE	ECM ADAPTER	RESISTANCE @ 20°C (68°F)
BROWN/BLACK wire (ignition coil no. 1)	A-41	Close to 0 Ω (continuity)
BROWN/ORANGE wire (ignition coil no. 2)	A-1	
BROWN/YELLOW wire (ignition coil no. 3)	A-29	

210 AND 230 SERIES		
IGNITION COIL WIRE	ECM ADAPTER	RESISTANCE @ 20°C (68°F)
BROWN/BLACK wire (ignition coil no. 1)	A-M4	Close to 0 Ω (continuity)
BROWN/ORANGE wire (ignition coil no. 2)	A-M2	
BROWN/YELLOW wire (ignition coil no. 3)	A-M1	

If test failed, repair the connector or replace the engine wiring harness.

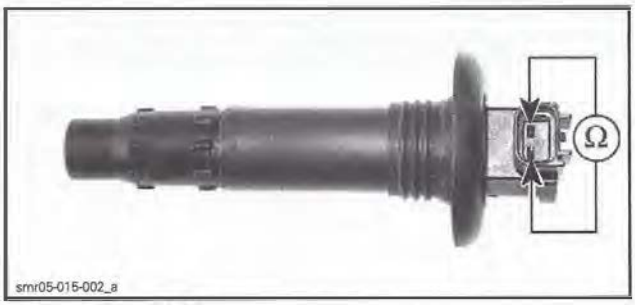
If test succeeded, carry out an *IGNITION COIL RESISTANCE TEST*.

Ignition Coil Resistance Test

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)

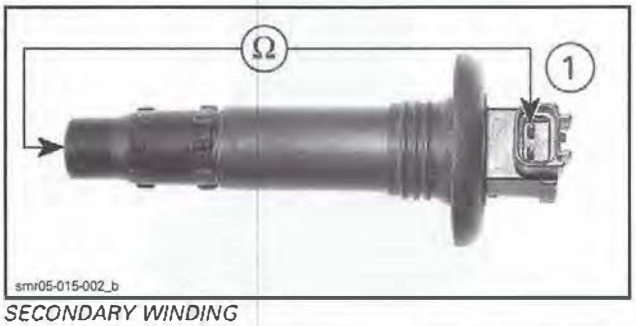
An ignition coil with a good resistance measurement can still be faulty. Current leakage can occur at high voltage levels which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

1. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.
2. Perform a visual inspection of the ignition coils. Check for corrosion, bent pins, loose or burnt contacts, and cracked or torn insulator.
3. Test the resistance in both primary and secondary windings.



PRIMARY WINDING

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



SECONDARY WINDING

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

If any test failed, replace ignition coil.

Ignition Coil Removal

1. Disconnect ignition coil connector.

NOTICE Do not remove the ignition coil before disconnecting the input connector or the wires may be damaged. Do not pry up ignition coil with a screwdriver to avoid damage.

NOTE: Twist ignition coil in both directions as you pull it up to ease removal.

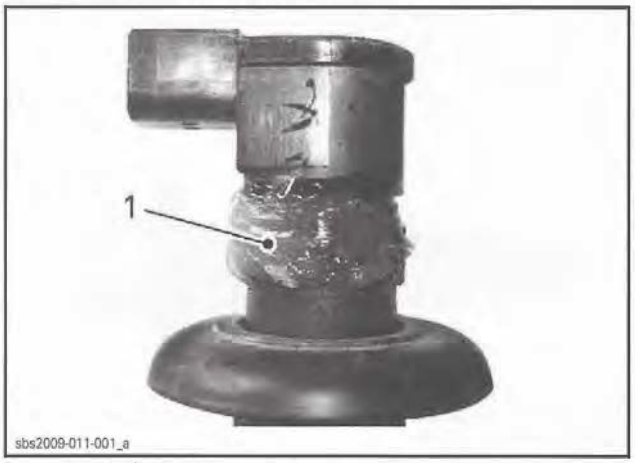
Remove ignition coil from spark plug.

Ignition Coil Lubrication

1. Pull rubber seal down.

1. Rubber seal pulled down

2. Apply DOW CORNING 111 (P/N 413 707 000) to rubber seal seat as shown.

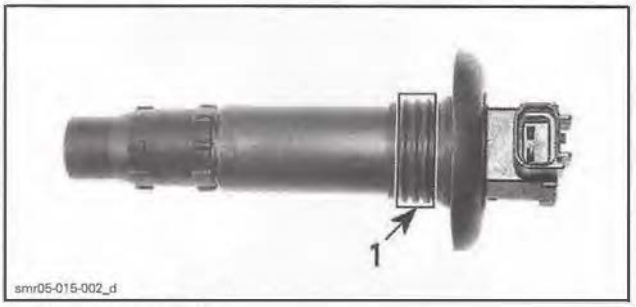


1. Apply product here

3. Pull rubber seal back on its seat making sure the tabs on the ignition coil and the slots in the seal properly match together.
4. Leave a ring of grease on top of the seal as shown to act as a water barrier. Wipe off the excess.

1. Correctly shaped excess of product

5. Apply DOW CORNING 111 (P/N 413 707 000) on rubber seal contact area.

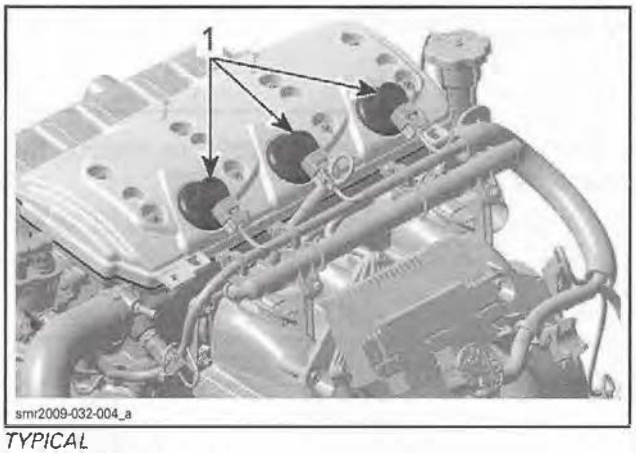


1. Apply product here

Ignition Coil Installation

NOTE: Prior to inserting the ignition coil on its spark plug, apply sealant as described in *IGNITION COIL LUBRICATION*.

1. Install coil in cylinder head hole.
2. Push the ignition coil down to securely install it on the spark plug tip.
3. Ensure the seal seats properly with top surface of engine valve cover.



TYPICAL
1. Seal properly seated

SPARK PLUGS

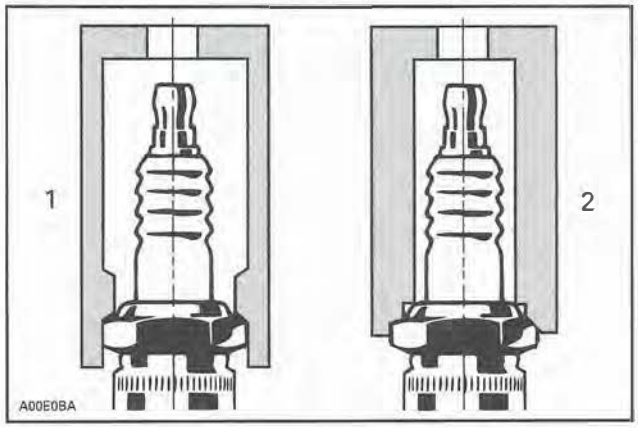
Spark Plug Removal

1. Disconnect the ignition coil input connector.
2. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.

⚠ WARNING

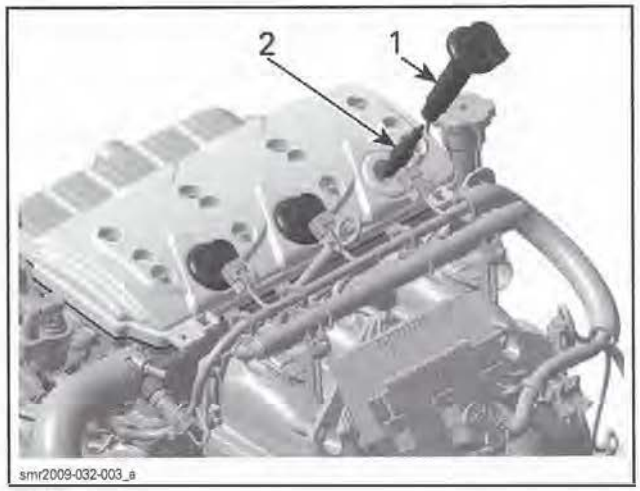
Never remove an ignition coil from a spark plug without disconnecting it from the wiring harness. Flammable vapors may be present in the bilge. Should the tether cord be installed on the engine cut-off switch, a spark could be generated at the spark plug end of the coil possibly resulting in an explosion.

3. Using a spark plug socket, release the torque applied to the spark plug.



1. Approved socket
2. Improper socket

4. Clean the spark plug and cylinder head with pressurized air.
5. Unscrew spark plug then use the ignition coil to take spark plug out of spark plug hole.



TYPICAL
1. Ignition coil
2. Spark plug

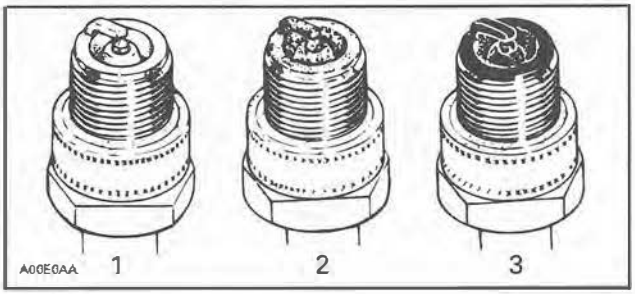
Troubleshooting a Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running or misfiring of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption.

Other possible causes are: use of an incorrect or bad fuel, defective ignition system, incorrect spark plug gap, loss of compression, or lubricating oil entering the combustion chamber.

The plug face of a fouled spark plug has either a wet or dry black carbon deposit. Such coatings form a conductive connection between the center electrode and the ground electrode.

Spark Plug Analysis



TYPICAL
1. Overheated (light grey, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, grey, melted coating)

The plug face 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 prescribed intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

Spark Plug Installation

Prior to installation, ensure the contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap as specified in the following chart.

ENGINE	SPARK PLUG	TORQUE	GAP MM (IN)
1503	NGK DCPR8E	Hand tighten + 1/4 turn with a socket	0.75 mm (.03 in)

2. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) 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 an approved spark plug socket.
4. Install ignition coil. Refer to *IGNITION COIL INSTALLATION* in this subsection.
5. Complete the installation in the reverse order of the removal.

CHARGING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	322

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
EXTECH INDUCTIVE AMMETER	380941	322

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	325

GENERAL

SYSTEM DESCRIPTION

The purpose of the charging system is to maintain the battery at a full state of charge and to provide the electrical system with the required electrical power for normal vehicle operation.

Magneto

The magneto is the primary source of electrical energy. It transforms a magnetic field into an electric current (AC).

The magneto has a 3 phase, delta wound, 18 pole stator that is rated at 380 watts.

TYPICAL

Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage to a maximum level to prevent any damage to electrical components.

Battery

The battery supplies DC power to the electric starter for cranking the engine. During engine starting, it also supplies DC power to every electrical and electronic system in the vehicle as well as all accessories.

At low engine RPM operation and high current load conditions, it supplements the magneto output and helps to maintain a steady system voltage.

INSPECTION

CHARGING SYSTEM OUTPUT

First ensure that battery is in good condition prior to performing the following tests. Refer to battery manufacturer's instructions.

NOTE: It is good practice to check for fault codes using the B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

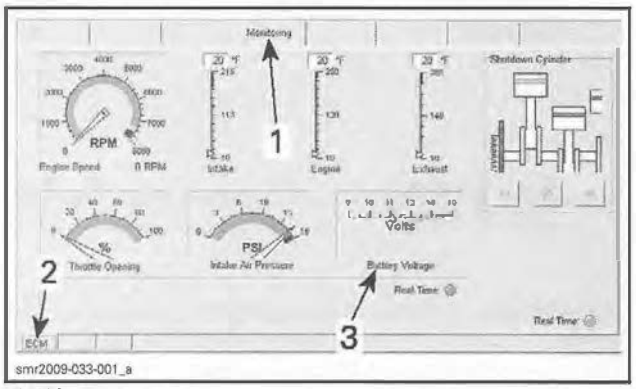
Output Voltage Test Using B.U.D.S.

1. Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Select Monitoring and ECM tabs.
3. Start engine.

NOTICE If boat is out of water, connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

4. Increase engine RPM as specified in the following table and read voltage in B.U.D.S.

OUTPUT VOLTAGE TEST USING B.U.D.S.	
TEST ENGINE SPEED	VOLTAGE (DC)
5500 RPM	14.5 ± .5 Vdc



TYPICAL
1. *Monitoring tab*
2. *ECM tab*
3. *Battery voltage*

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

If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *PTO HOUSING AND MAGNETO* subsection.

Output Voltage Test Using a Multimeter

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)

1. Set multimeter to Vdc.
2. Connect multimeter to battery posts.

TYPICAL - CHARGING SYSTEM VOLTAGE TEST AT BATTERY POSTS

3. Start engine.

NOTICE If boat is out of water, connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

4. Increase engine RPM as specified in the following table and read voltage with the multimeter.

OUTPUT VOLTAGE TEST USING A MULTIMETER	
TEST ENGINE SPEED	VOLTAGE (DC)
5500 RPM	14.5 ± .5 Vdc

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

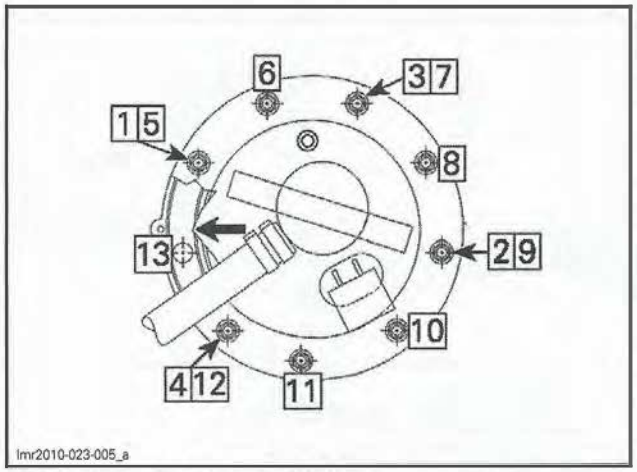
If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *PTO HOUSING AND MAGNETO* subsection.

Output Current Test with an Inductive Ammeter

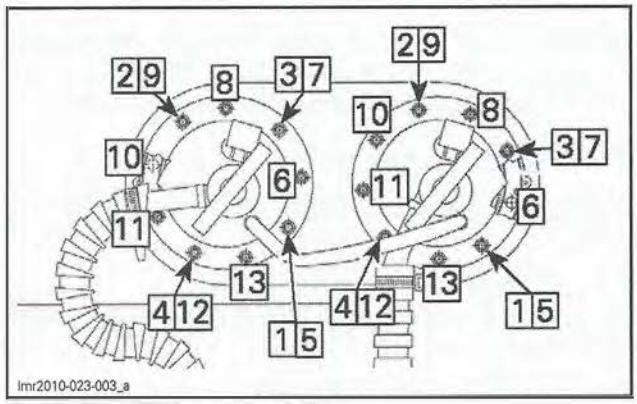
1. Use an inductive ammeter such as the EXTECH INDUCTIVE AMMETER (P/N 380941) or equivalent.

2. Turn on the ammeter and select 40 Adc.

NOTE: Zero set the ammeter before use or reading may be erroneous.



SINGLE ENGINE CONFIGURATION



TWIN ENGINES CONFIGURATION

Plug in fuel level connector to fuel pump.

Perform a fuel system leak test. See procedure in *INSPECTION*.

Reinstall removed parts.

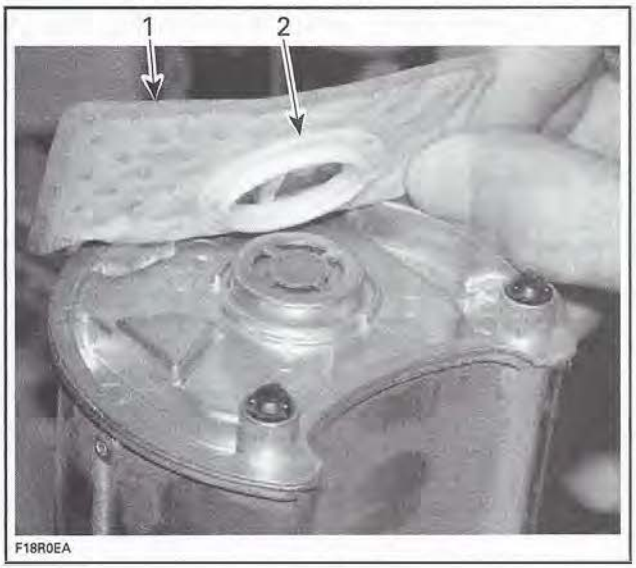
FUEL FILTER

Fuel Filter Removal

NOTE: The fuel filter does not require replacement under normal operating conditions. Replace only if permanently clogged or damaged. The fuel pump assembly has to be removed from the fuel tank to have access to the fuel filter.

Remove fuel pump. Refer to *FUEL PUMP* for the procedure.

Turn fuel pump upside down. Using a small flat screwdriver, remove the fuel filter by prying the inner plastic ring.



1. *Fuel filter*
2. *Inner plastic ring*

Fuel Filter Inspection

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

Fuel Filter Installation

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

Reinstall fuel pump.

FUEL LEVEL SENDER

Fuel Level Sender Resistance Test

150 and 180 Series

Disconnect the fuel pump/fuel level sender connector.

200 Series

Disconnect the starboard fuel pump/fuel level sender connector.

210 Series

For indication in the analog fuel gauge, disconnect the starboard fuel pump/fuel level sender connector.

For indication in the information center, disconnect the port fuel pump/fuel level sender connector.

230 Series

For indication in the analog fuel gauge, disconnect the port fuel pump/fuel level sender connector.

For indication in the information center, disconnect the starboard fuel pump/fuel level sender connector.

All Models

Set multimeter to Ohms.

Measure resistance as per table.

FUEL LEVEL SENDER PIN		MEASUREMENT @ 20°C (68°F)
B	C	See tables below for resistance value

FUEL LEVEL	RESISTANCE (Ω)
Full	4.8 ± 2.2
Empty	89.8 ± 3.6

FUEL TANK

Fuel Tank Inspection

Fuel Filler Hose

Verify fuel filler hose for damage.

Always ensure that clamps are well positioned and tightened.

TIGHTENING TORQUE	
Clamp	2.8 N•m (25 lbf•in)

Fuel Tank Straps

Inspect retaining straps for wear or cracks.

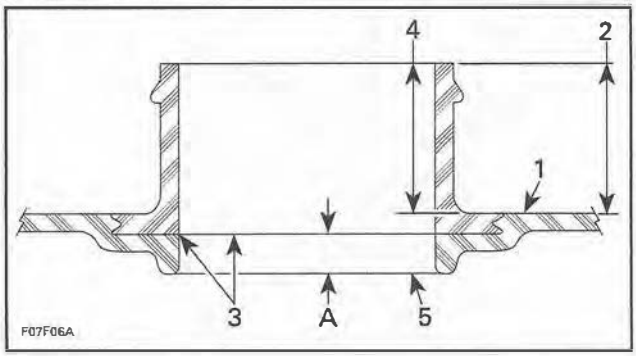
Fuel Tank

Inspect fuel tank for wear caused by any abnormal contact or rubbing with other component(s).

Disconnect fuel filler hose.

Visually inspect the inside and outside of the fuel tank necks for crack(s). If crack(s) are existing, replace fuel tank.

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 rotomolded cross-link polyethylene material. Therefore, no cracks are acceptable on any point of the tank.

Fuel Tank Removal

Engine(s) must be removed to withdraw the fuel tank.

Siphon fuel tank.

Disconnect fuel pump connections. See *FUEL PUMP* above.

Disconnect fuel tank filler hose and vent hose.

Cut locking ties as required to release wiring harness.

Release fuel tank straps.

Remove fuel tank from boat.

⚠ WARNING

Check that fiberglass is not exposed in the fuel tank area.

Fuel Tank Installation

Ensure rubber pads are in place and in good condition.

Properly secure straps. Refer to exploded views at the beginning of this subsection for threadlocker and proper torque.

Properly secure harnesses.

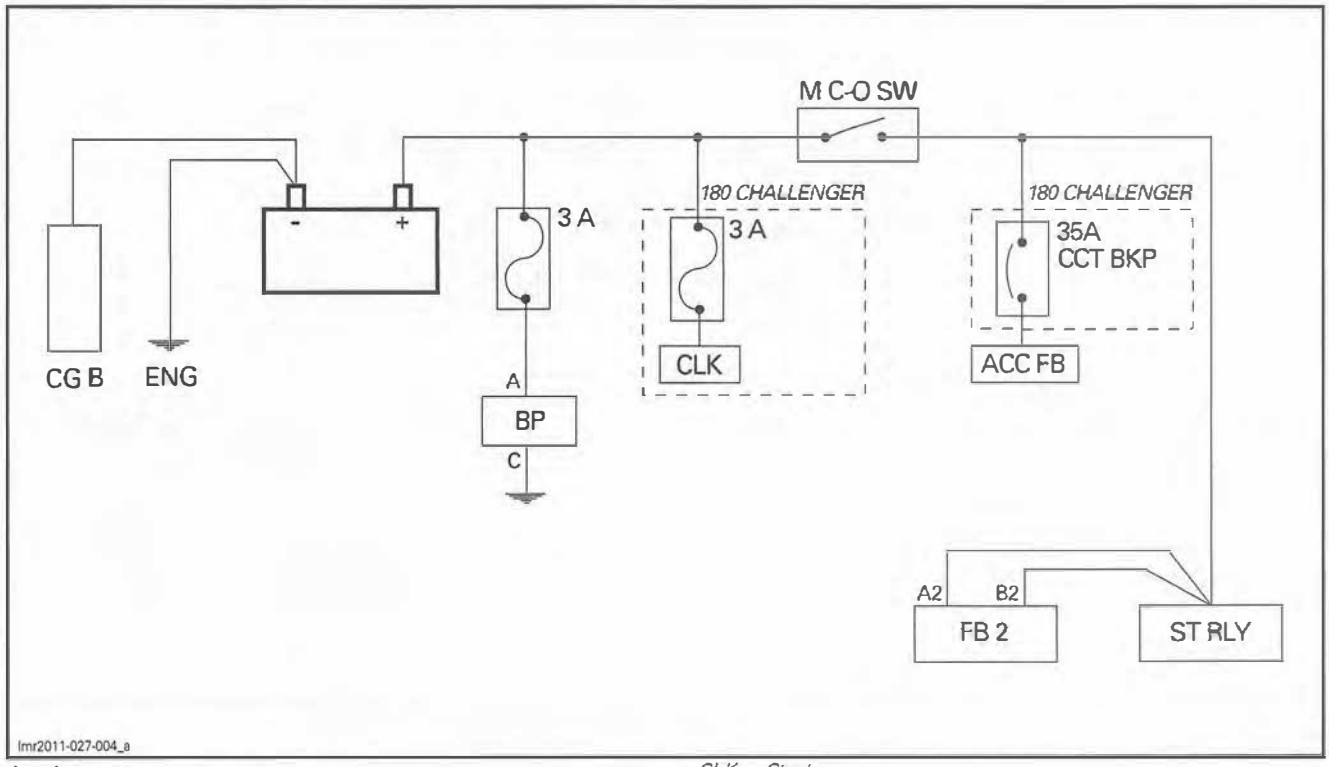
The vent line must be routed above the fuel fill hose with no sags in vent line between fill neck and tank. The vent line must be secured to fuel fill hose with locking ties but not inserted in the corrugated protector.

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

Perform a fuel system leak test. See procedure in *INSPECTION*.

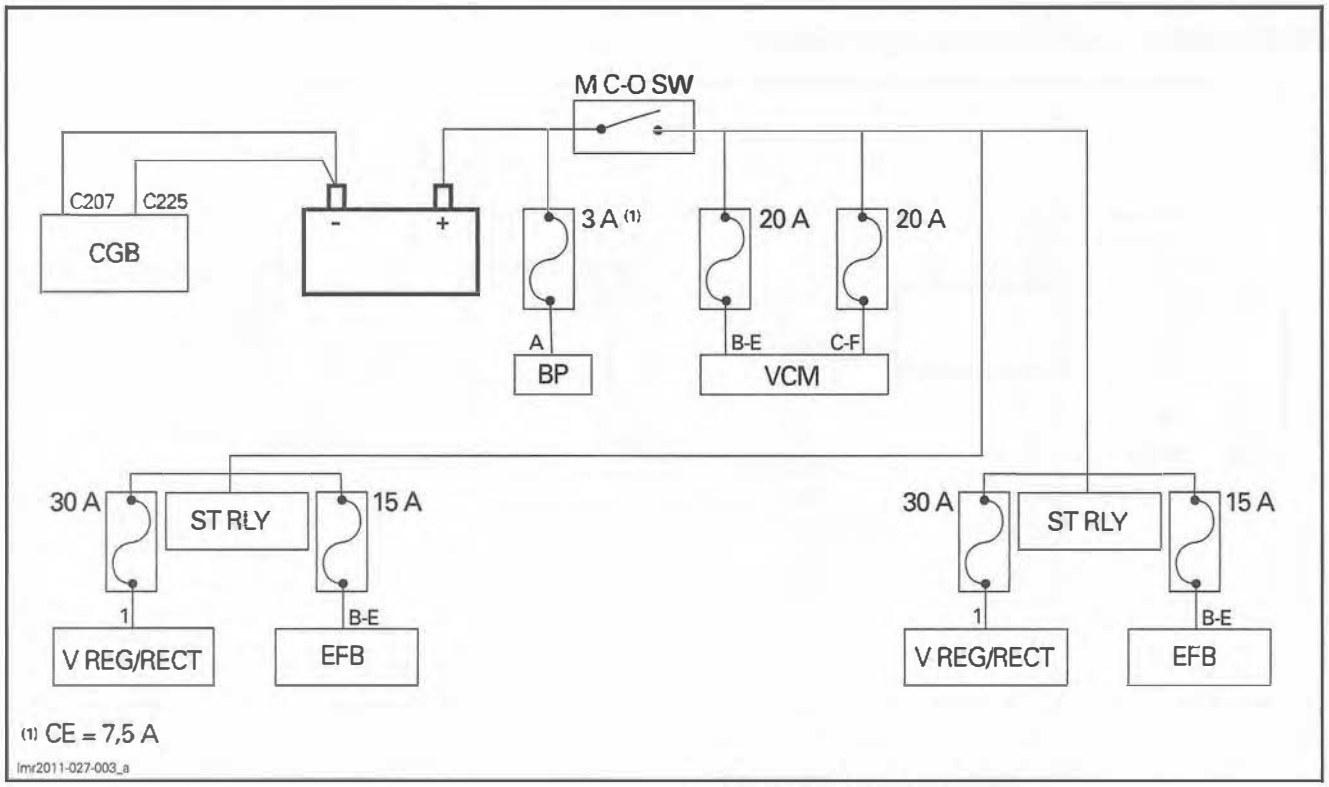
POWER DISTRIBUTION

150 Speedster and 180 Challenger Series



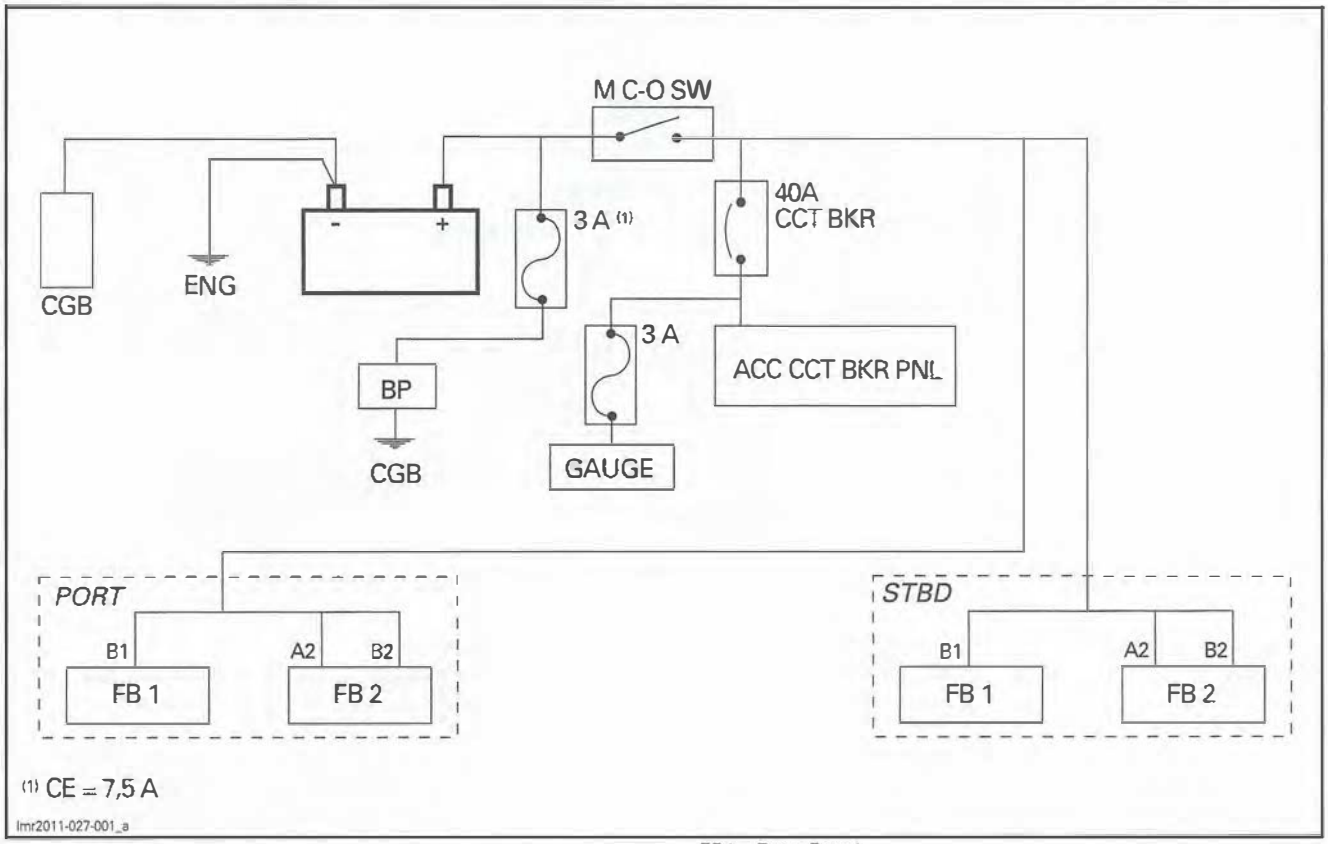
A = Amperes
ACC FB = Accessory Fuse Block
BP = Bilge Pump
CCT BKR = Circuit Breaker
CGB = Console Ground Block
CLK = Clock
ENG = Engine
FB2 - Fuse Box 2
M C-O SW = Main Cut-Off Switch
ST RLY = Starter relay

200 Speedster



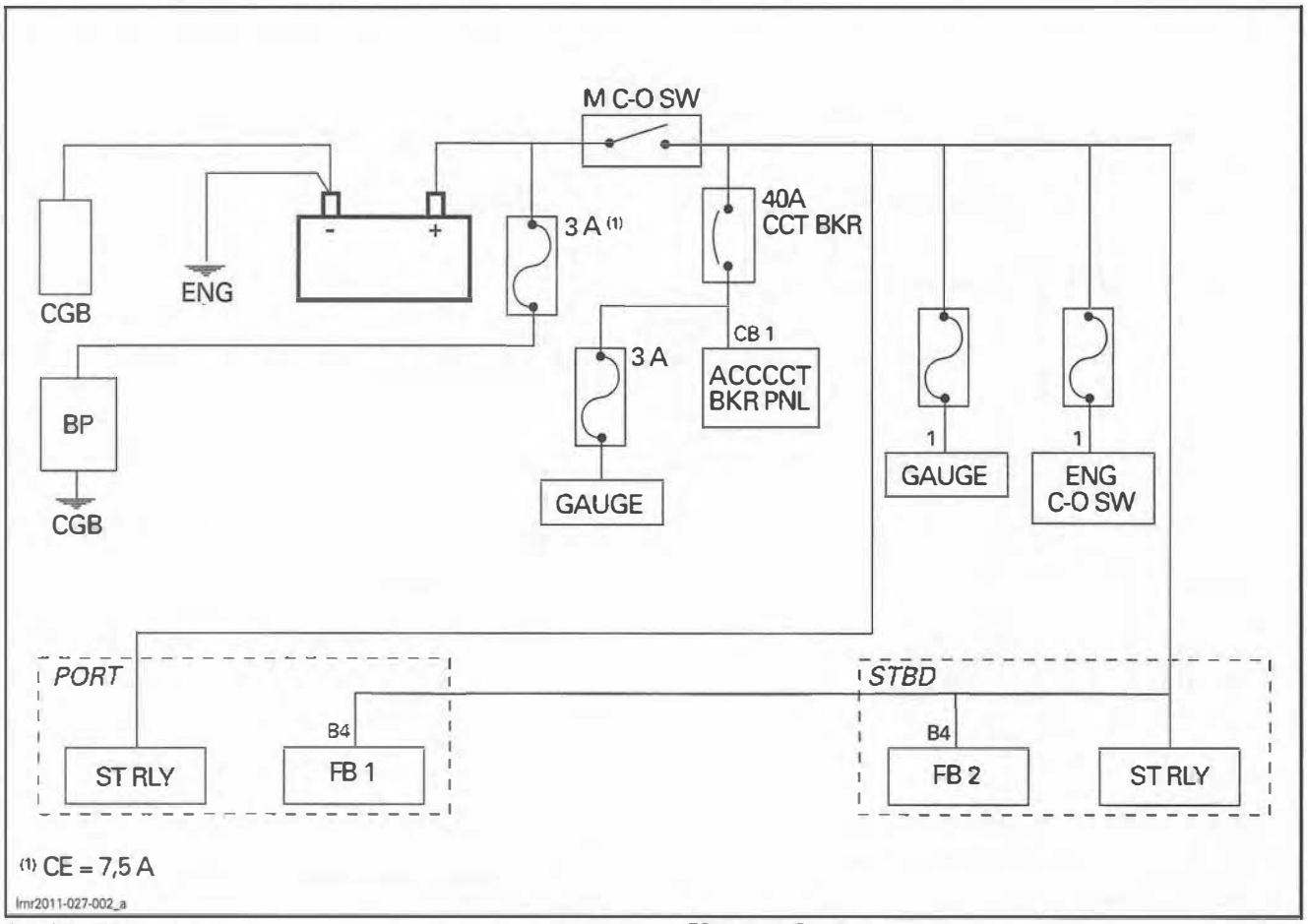
A = Amperes
BP = Bilge Pump
CGB = Console Ground Block
EFB = Engine Fuse Block
M C-O SW = Main Cut-Off Switch
ST RLY = Starter relay
VCM = Vehicle Control Module
V REG/RECT = Voltage regulator/rectifier

210 Challenger and 210 WAKE Series



A = Amperes
ACC CCT BKR PNL= Accessory Circuit Breaker Panel
BP = Bilge Pump
CCT BKR = Circuit Breaker
CGB = Console Ground Block
ENG = Engine
FB1 - Fuse Box 1
FB2 - Fuse Box 2
M C-O SW = Main Cut-Off Switch
STBD = Starboard
Gauge
Port

230 Challenger and 230 WAKE Series



A = Amperes
ACC CCT BKR PNL= Accessory Circuit Breaker Panel
BP = Bilge Pump
CCT BKR = Circuit Breaker
CGB = Console Ground Block
ENG = Engine
ENG C-O SW = Engine cut-off switch
FB1 - Fuse Box 1
FB2 - Fuse Box 2
M C-O SW = Main Cut-Off Switch
STBD = Starboard
ST RLY = Starter relay
Gauge
Port

GENERAL

NOTE: Always refer to the applicable wiring diagram for details. See *2011 WIRING DIAGRAM BOOKLET P/N 219 100 547*.

ELECTRICAL SYSTEM ACTIVATION

The electrical system can be activated without starting the engine. Proceed as follows:

150, 180 and 200 Series

- Turn main cut-off switch to ON.
- Install tether cord cap on the engine cut-off switch.

210 and 230 Series

- Turn main cut-off switch to ON.
- Turn ignition switch (key) to ON.
- Install tether cord clip on the engine cut-off switch.

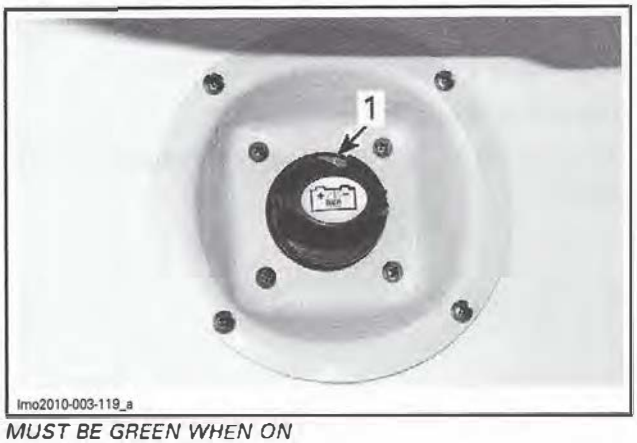
MAIN CUT-OFF SWITCH

Main Cut-Off Switch Description

The main cut-off switch is used to control main electrical power application. When set to:

- ON position, the battery provides current to the electrical system.
- OFF position, the battery is isolated from the electrical system.

NOTE: In OFF position, only the bilge pump (automatic mode) remains powered.

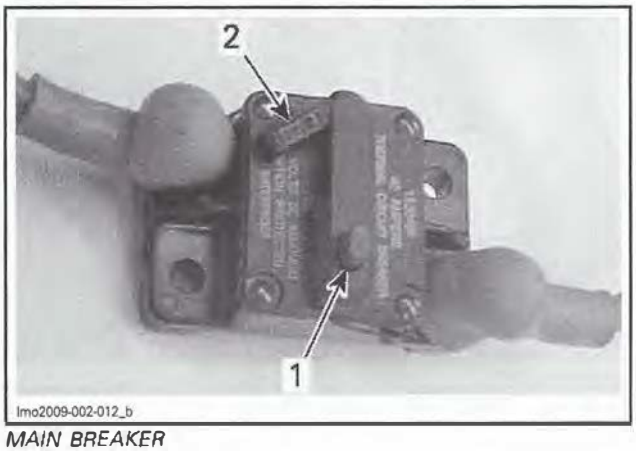


MUST BE GREEN WHEN ON
1. ON position

MAIN CIRCUIT BREAKER (180/210/230 SERIES)

A main breaker is used to protect the accessory circuits.

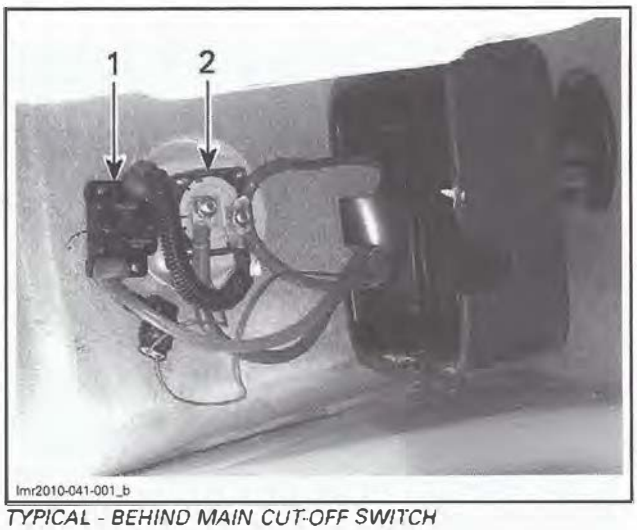
The main breaker can be manually tripped.



MAIN BREAKER
1. Test button
2. Reset lever tripped (off position)

Main Circuits Breaker Location

The main circuit breaker is located near the main cut-off switch.



TYPICAL - BEHIND MAIN CUT-OFF SWITCH
1. Main breaker
2. Main cut-off switch

210 WAKE and 230 WAKE Models

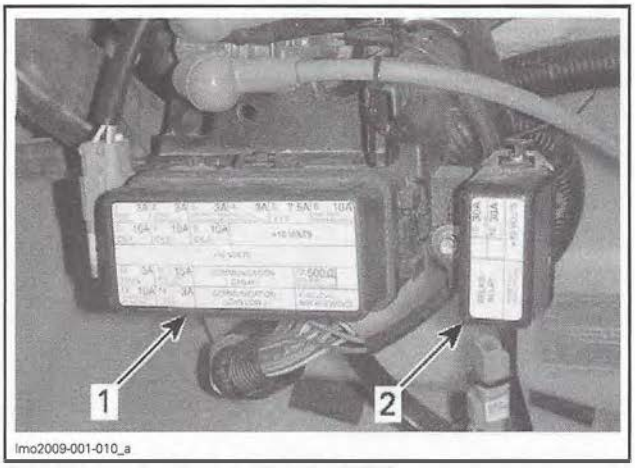
WAKE models use a second main breaker to protect the audio system.

FUSES (150/180 SERIES)

Most fuses are grouped in the main fuse boxes and the accessory fuse box.

Main Fuse Boxes Location

The main fuse boxes are located in the engine compartment.

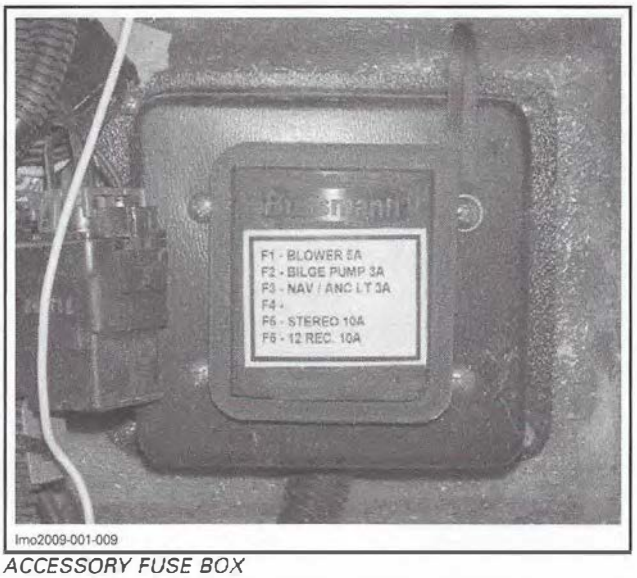


TYPICAL - ENGINE MAIN FUSE BOXES
1. *Fuse box 1*
2. *Fuxe box 2*

Accessory Fuse Box Location

150 Speedster

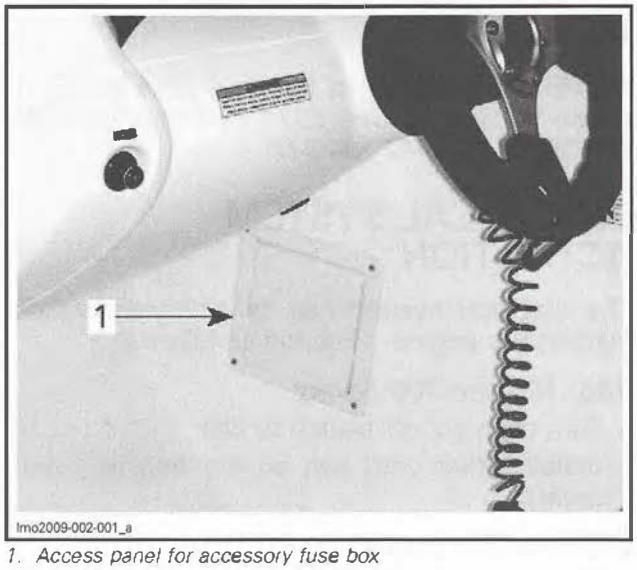
The accessory fuse box is located in the front storage compartment.



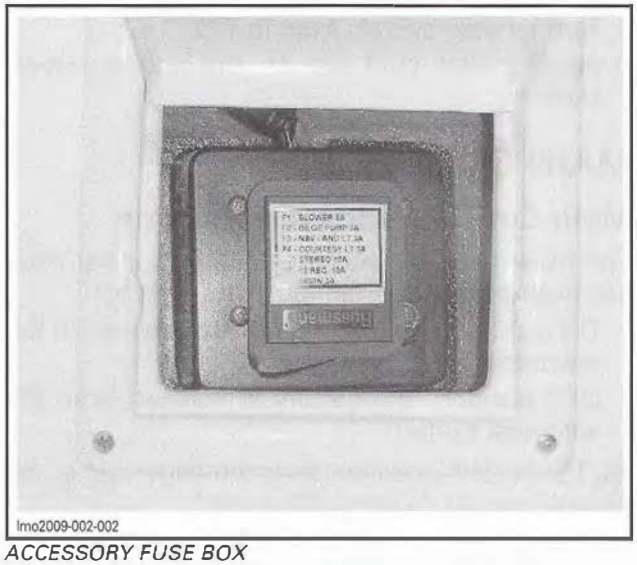
ACCESSORY FUSE BOX

180 Series

The accessory fuse box is located on the starboard side (RH), under the driver's console.



1. *Access panel for accessory fuse box*

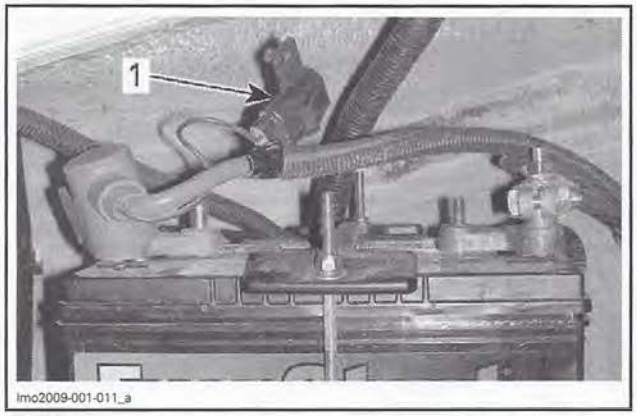


ACCESSORY FUSE BOX

Separate Fuse Holder Location

Automatic Bilge Pump Fuse

The automatic bilge pump fuse is located near the battery.



TYPICAL
1. Auto-bilge fuse

Fuse Identification

Fuse Box 1

NO.	FB1 FUSES DESCRIPTION	
F1	Gauge	3 A
F2	Beeper	3 A
F3	Depth sounder (if equipped)	3 A
F4	Fuel level sensor	3 A
F5	Unused	–
F6	Fuel pump	10 A
F7	Fuel injector/Ignition coil cyl 1	10 A
F8	Fuel injector/Ignition coil cyl 2	10 A
F9	Fuel injector/Ignition coil cyl 3	10 A
F10	Unused	–
F11	Diagnostic connector	15 A
F12	Fuel level sensor resistor	–
F13	Starter relay	10 A
F14	CAPS	3 A

Fuse Box 2

NO.	FB2 FUSES DESCRIPTION	
F15	Charging system	30 A
F16	Main relay	30 A

Accessory Fuse Box

NO.	ACCESSORY FUSES DESCRIPTION	
F1	Bilge blower	5 A
F2	Bilge pump	3 A
F3	Navigation/Anchor lights	3 A
F4	Courtesy lights (if equipped)	3 A
F5	Radio	10 A
F6	12-volt power outlet	10 A
F7	Horn (if equipped)	7.5 A

Separate Fuses

SEPARATE FUSES DESCRIPTION	
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A

FUSES (200 SPEEDSTER)

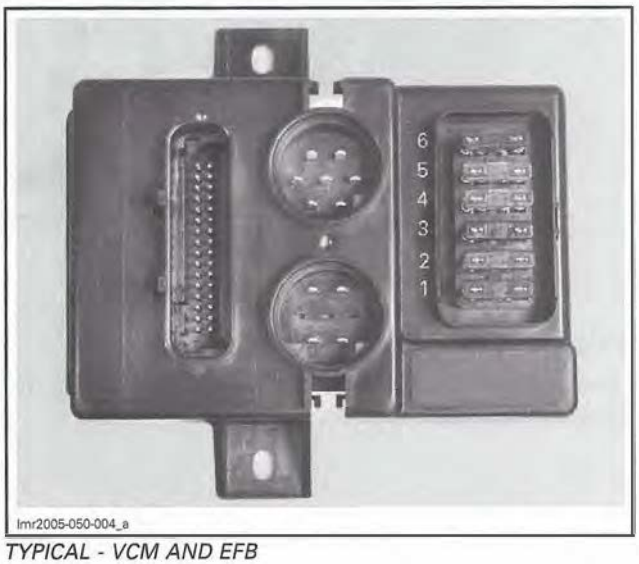
Most fuses are grouped in the VCM (vehicle control module) and the EFB (engine fuse box).

VCM and EFB Location

The VCM is located in the driver's console.

The EFBs are located in the engine compartment (one per engine).

NOTE: The VCM and EFB look alike but have different internal circuits.

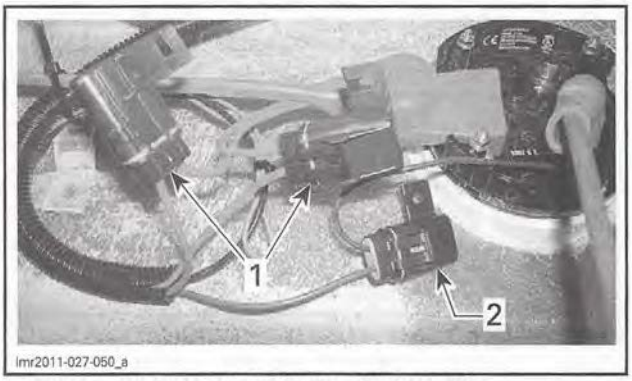


TYPICAL - VCM AND EFB

Separate Fuse Holders Location

Automatic Bilge Pump and VCM Fuses

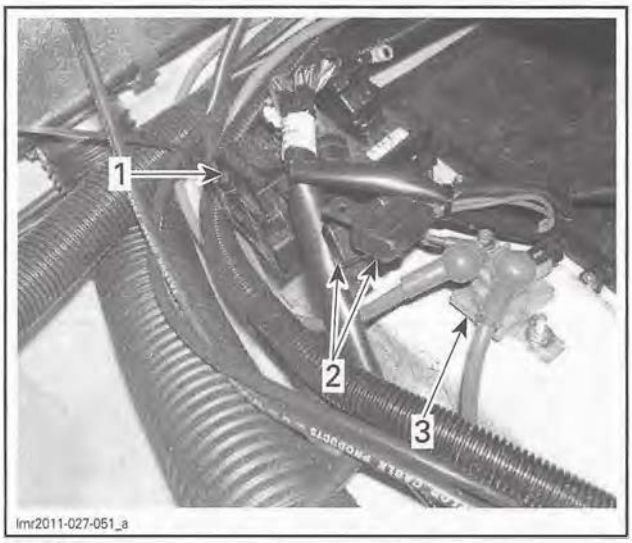
The automatic bilge pump and VCM fuses are located near the main cut-off switch.



TYPICAL — BEHIND BATTERY CUT-OFF SWITCH
1. *VCM fuse*
2. *Automatic bilge pump fuse*

Charging System and EFB Fuses

The charging system and EFB fuses are located near the starter relay.



TYPICAL
1. *EFB*
2. *Charging system and EFB fuses*
3. *Starter relay*

Bilge Blower Fuses

The bilge blower fuses are located near the blower motors.

Fuse Identification

VCM

NO.	VCM FUSES DESCRIPTION	
F1	Accessories	10 A
F2	Radio	10 A
F3	Bilge blower	10 A
F4	Bilge pump	3 A
F5	Navigation/anchor lights	3 A
F6	Courtesy lights	5 A

For more details on the VCM, refer to *VCM (VEHICLE CONTROL MODULE)* in this subsection.

EFB

NO.	EFB FUSES DESCRIPTION	
F1	Fuel pump	10 A
F2	Fuel injector/Ignition coil cyl 3	10 A
F3	ECM	5 A
F4	Fuel injector/Ignition coil cyl 1	10 A
F5	Fuel injector/Ignition coil cyl 2	10 A
F6	Gauges	2 A

For more details on the EFB, refer to *EFB (ENGINE FUSE BLOCK)* in this subsection.

Separate Fuses

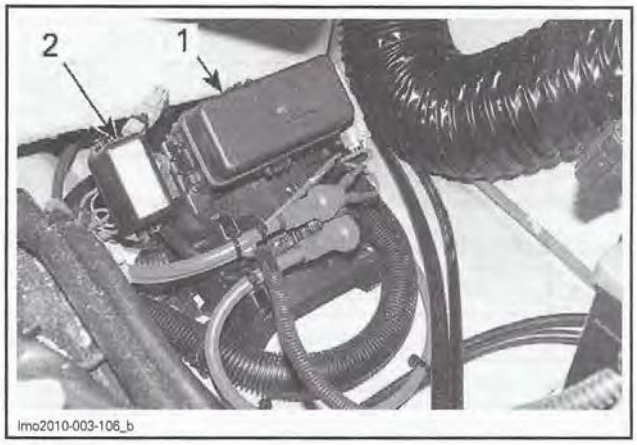
SEPARATE FUSES DESCRIPTION	
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A
VCM	20 A
Charging system	30 A
EFB	15 A
Bilge blower	5 A

FUSES (210 SERIES)

Most fuses are grouped in the main fuse boxes. Each engine has 2 fuse boxes.

Main Fuse Boxes Location

The main fuse boxes are located in the engine compartment.



TYPICAL
1. Fuse box 1 (one per engine)
2. Fuse box 2 (one per engine)

Separate Fuse Holders Location

Automatic Bilge Pump Fuse

The automatic bilge pump fuse is located near the main cut-off switch.

GPS Fuse

The GPS fuse is located in the console.

Bilge Blower Fuses

The bilge blower fuses are located near the blower motors.

Fuse Identification

Fuse Box 1

NO.	FB1 FUSES DESCRIPTION	
F1	Gauge	3 A
F2	Ignition Switch	3 A
F3	Depth sounder (1) (if equipped)	3 A
F4	Unused	–
F5	Unused	–
F6	Fuel pump	10 A
F7	Fuel injector/Ignition coil cyl 1	10 A
F8	Fuel injector/Ignition coil cyl 2	10 A
F9	Fuel injector/Ignition coil cyl 3	10 A
F10	Unused	–
F11	Diagnostic connector	15 A
F12	Port/Starboard detection	–
F13	Starter relay (2)	10 A
F14	CAPS	3 A

(1) In port fuse box only
(2) In starboard fuse box only

Fuse Box 2

NO.	FB2 FUSES DESCRIPTION	
F15	Charging system	30 A
F16	Main relay	30 A

Separate Fuses

SEPARATE FUSES DESCRIPTION	
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A
Bilge blower	5 A
GPS	3 A

CIRCUIT BREAKERS (210 SERIES)

The low amps circuit breakers are grouped in the accessory circuit breaker panel.

Accessory Circuit Breaker Panel Location

The accessory circuit breaker panel is located under the steering wheel.

1. Circuit breaker panel location

Circuit Breaker Identification

NO.	BREAKER PANEL DESCRIPTION	
A	Bilge pump (manual mode)	5 A
B	Bilge blower	3 A
C	Courtesy lights	3 A
D	Navigation/Anchor lights	3 A
E	12-volt power outlets	10 A
F	Horn	10 A
G	Audio system	7.5 A
H	Heater (if equipped)	10 A
I	Ballast (if equipped)	15 A
J	Unused	–

FUSES (230 SERIES)

Most fuses are grouped in the main fuse boxes.

Main Fuse Boxes Location

The main fuse boxes are located in the engine compartment.

Separate Fuse Holders Location

Ignition, Automatic Bilge Pump and Gauge Fuses

The ignition, automatic bilge pump and gauge fuses are located near the main cut-off switch.

Bilge Pump Fuses (CE Models)

The bilge pump fuses are located near the pumps.

Ballast Fuses (Wake Models)

The ballast fuses are located on the wake harness, near the 12-volt bus bar.

Fuse Identification

Fuse Box 1 (PORT)

NO.	FB1 FUSES DESCRIPTION	
F1	Fuel injector/Ignition coil cyl 1	10 A
F2	Fuel injector/Ignition coil cyl 2	10 A
F3	Fuel injector/Ignition coil cyl 3	10 A
F4	ECM	3 A
F5	Starter relay	5 A
F6	Depth sounder (if equipped)	3 A
F7	Main	30 A
F8	CAPS	3 A
F9	Gauges	3 A
F10	Charging System	30 A
F11	Fuel pump	10 A

Fuse Box 2 (STARBOARD)

NO.	FB2 FUSES DESCRIPTION	
F1	Fuel injector/Ignition coil cyl 1	10 A
F2	Fuel injector/Ignition coil cyl 2	10 A
F3	Fuel injector/Ignition coil cyl 3	10 A
F4	ECM	3 A
F5	Starter relay	5 A
F6	Main	30 A
F7	CAPS	3 A
F8	Diagnostic connector	15 A
F9	Bilge blower 1	5 A
F10	Charging System	30 A
F11	Bilge blower 2	5 A
F12	Ignition	5 A
F13	Fuel pump	10 A

Separate Fuses

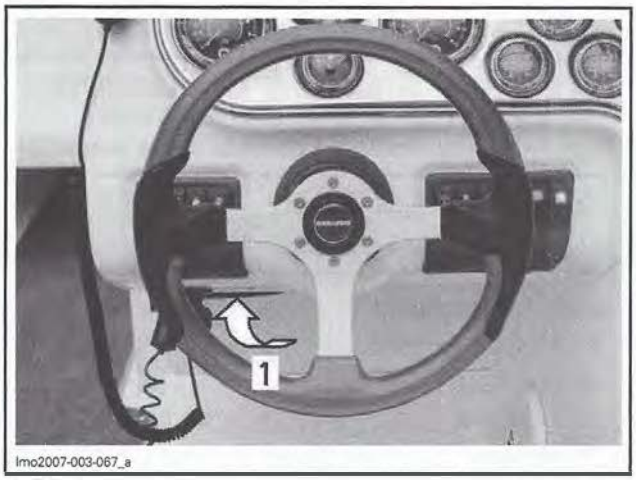
SEPARATE FUSES DESCRIPTION	
Ignition	3 A
Automatic bilge pump (All models except CE)	3 A
Automatic bilge pump (CE models)	7.5 A
Bilge pump (CE models)	3 A
GPS	3 A
Ballast	5 A

CIRCUIT BREAKERS (230 SERIES)

The low amps circuit breakers are grouped in the accessory circuit breaker panel.

Accessory Circuit Breaker Panel Location

The accessory circuit breaker panel is located under the steering wheel.



TYPICAL
1. Circuit breaker panel location

Circuit Breaker Identification

NO.	BREAKER PANEL DESCRIPTION	
A	Bilge pump (manual mode)	5 A
B	Bilge blowers	3 A
C	Courtesy lights	3 A
D	Navigation/Anchor lights	3 A
E	12-volt power outlets	10 A
F	Horn	10 A
G	Audio system	7.5 A
H	Heater (if equipped)	10 A
I	Unused	–
J	Unused	–

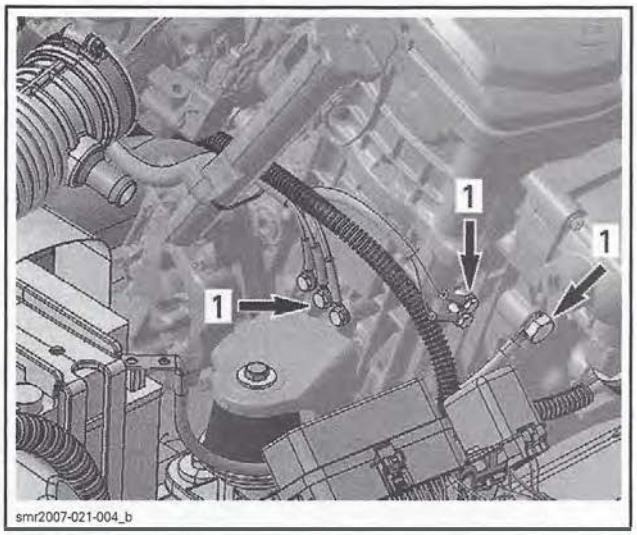
MAIN RELAY (150/180/210 SERIES)

Main Relay Location

MODEL	MAIN RELAY LOCATION
150 Speedster	Fuse box 2
180 Series	Fuse box 2
210 Series	Fuse box 2 (1 per engine)
230 Series	Fuse box 1 (PORT) Fuse box 2 (STARBOARD)

MAIN GROUNDS

Engine Grounds



TYPICAL
1. Engine grounds

Ground Bus-Bar

A ground bus bar provides a common ground connection for many devices to the battery ground. It is usually located inside the console.

In the following illustration, a ground bus-bar can be seen through the access hole behind the backrest of the seat in front of the console.

TYPICAL - 230 SERIES ILLUSTRATED
1. Grounds from battery post
2. Accessory grounds

230 WAKE Model

Besides the console ground bus-bar, the WAKE model uses a second ground bus-bar used specifically for the wake accessories.

PROCEDURES

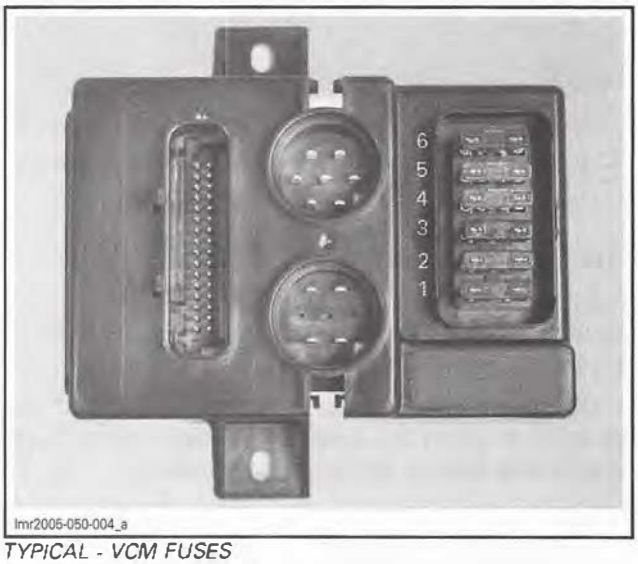
VCM (VEHICLE CONTROL MODULE) (200 SPEEDSTER)

VCM Description

The Vehicle Control Module (VCM) manages the vehicle electrical system.

The vehicle electrical components are protected by fuses integrated in the VCM.

NOTE: The VCM and EFB are visually identical but the internal circuits are different.



TYPICAL - VCM FUSES
1. *Accessories*
2. *Radio*
3. *Blower*
4. *Bilge pump*
5. *NAV lights*
6. *Courtesy lights (if so equipped)*

VCM Connectors

To identify the VCM connectors, follow the same instructions as for the EFB connectors. Refer to *ENGINE FUSE BLOCK (EFB)* in this subsection.

VCM Power Supply

Ensure EFB is powered. See following tests.

NOTE: Be aware that VCM low-current supply circuit gets its ground through the EFB. High-current supplies get their grounds through each accessory at the console ground bus.

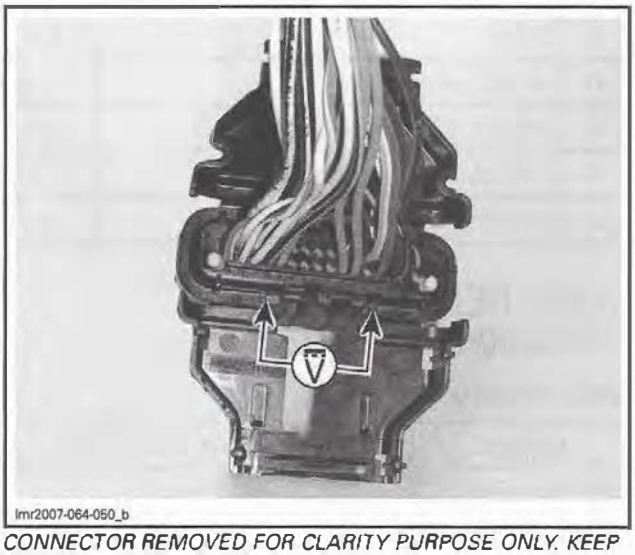
Low-Current Power Supply

QUICK INDICATION THAT LOW-CURRENT CIRCUIT OF VCM IS NOT POWERED (assuming the observed component is working)
– No D.E.S.S. operation – No speedometer operation.

Check the following:
- ECM fuse on EFB
- Gauge fuse on EFB
- VCM power supply wire and ground wires, see below.

1. Install tether cord.
2. Open back of connector "A" from VCM (see following illustration).
3. Back-probe connector and read voltage as follows.

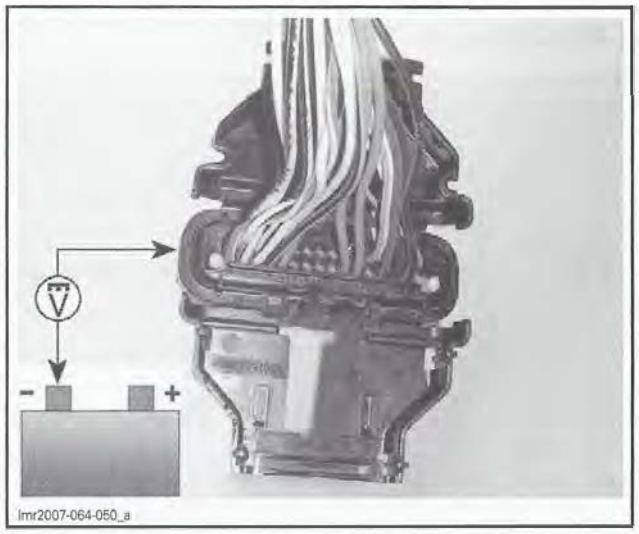
SIDE	VCM CONNECTOR "A"		VOLTAGE (Vdc)
Port	Pin A-4	Pin A-3	Battery voltage
Starboard	Pin A-19	Pin A-1	



CONNECTOR REMOVED FOR CLARITY PURPOSE ONLY. KEEP CONNECTED FOR THE TEST

If voltage is inadequate, recheck as follows.

SIDE	VCM CONNECTOR "A"	BATTERY	VOLTAGE (Vdc)
To port EFB	Pin A-4	Ground post	Battery voltage
To starboard EFB	Pin A-19		



If voltage is now good, problem is in the ground circuits. Check VCM grounds as described in *VCM GROUND CIRCUITS* that follows.

VCM Ground Circuits

1. Disconnect connector "A" from VCM and EFB.
2. Check continuity of wire between VCM and EFB as follows.

SIDE	VCM CONNECTOR "A"	EFB CONNECTOR "A"	RESISTANCE
Port	Pin A-3	Pin A-25	Close to 0 Ω (continuity)
Starboard	Pin A-1	Pin A-25	

If continuity test failed, check/repair wiring/connectors.

If continuity is good, check ground circuit of EFB (from pin A-27). If it tests good, try a new EFB. Refer to *EFB REPLACEMENT*.

High-Current Power Supply

NOTE: The tether cord is not required to power these circuits.

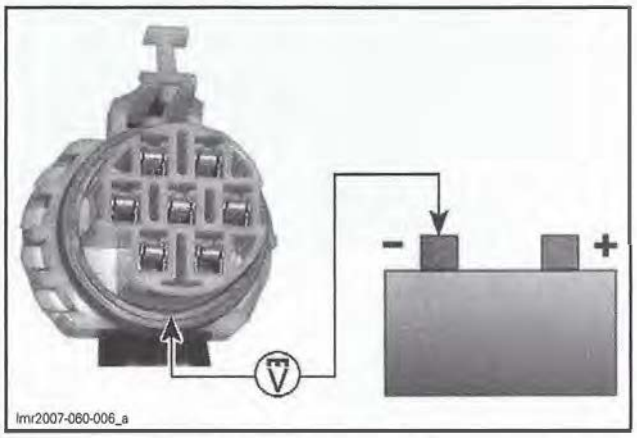
QUICK INDICATION THAT HIGH-CURRENT CIRCUIT OF VCM IS NOT POWERED (assuming the observed component is working)
Inoperative: Lights, blower, manual operation of bilge pump and accessories

Check the following:

- Both in-line 20 A fuses.

1. Disconnect "B" and "C" connectors from VCM.
2. Using a multimeter, measure voltage of each supply wire as follows.

VCM CONNECTOR	BATTERY	VOLTAGE (Vdc)
Connector B, pin E	Ground post	Battery voltage
Connector C, pin F		



If any test failed, check its wire continuity from battery.

VCM Replacement

Prior to replacing a VCM, ensure that all the tests have been carried out.

NOTE: There is no programming or reset to perform when replacing the VCM.

EFB (ENGINE FUSE BLOCK) (200 SPEEDSTER)

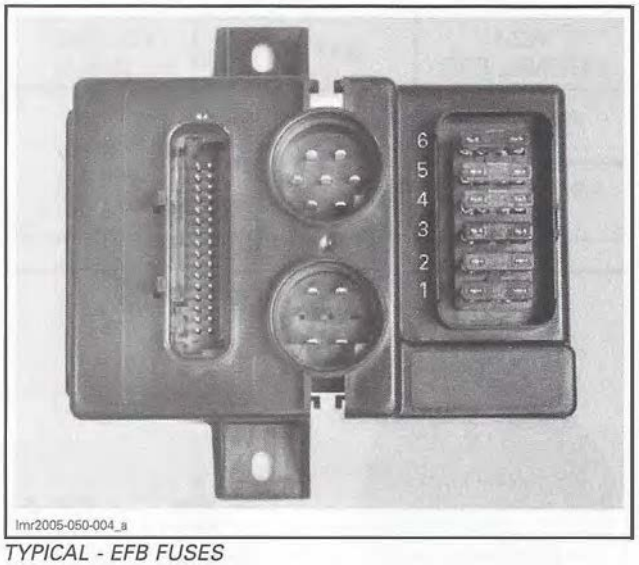
EFB Description

The Engine Fuse Block (EFB) distributes power to:

- Engine-related components
- ECM
- VCM
- Instrument(s).

These electrical components are protected by fuses integrated in the EFB.

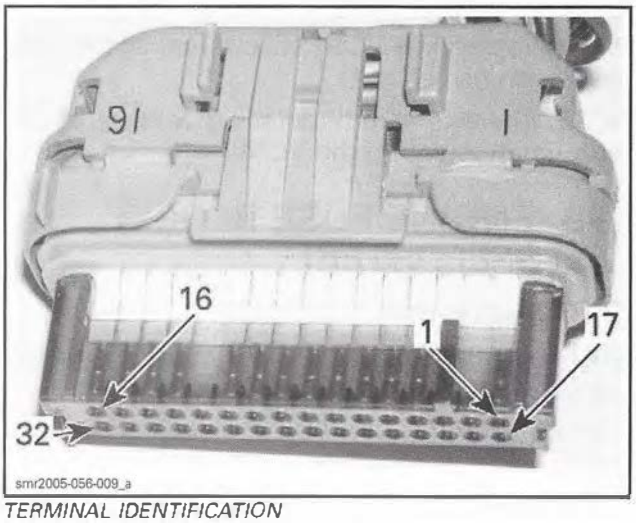
NOTE: The VCM and EFB are visually identical but the internal circuits are different.



TYPICAL - EFB FUSES
1. *Fuel pump*
2. *Injector and Ignition coil (cyl 3)*
3. *EMS*
4. *Injector and Ignition coil (cyl 1)*
5. *Injector and Ignition coil (cyl 2)*
6. *Gauges*

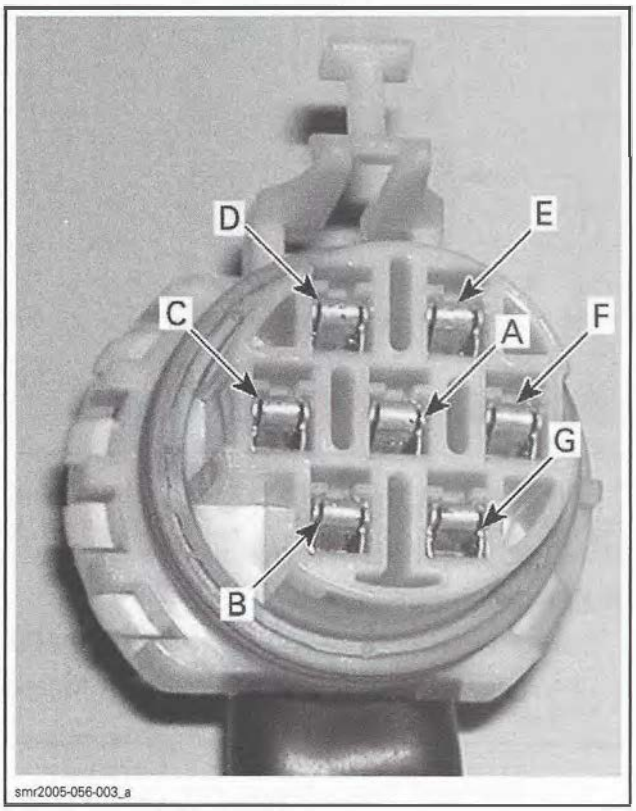
EFB Connectors

32-Pin Connector "A"



TERMINAL IDENTIFICATION

7-Pin Connector "B" and "C"



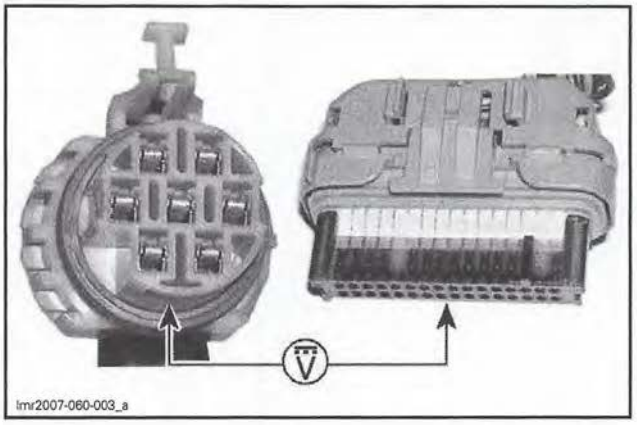
TERMINAL IDENTIFICATION

NOTE: For more details on connector servicing, refer to *ELECTRICAL CONNECTORS AND WIRING DIAGRAM* section.

EFB Power Supply

1. Disconnect "A" and "B" connectors from EFB.
2. Using a multimeter, measure voltage as follows.

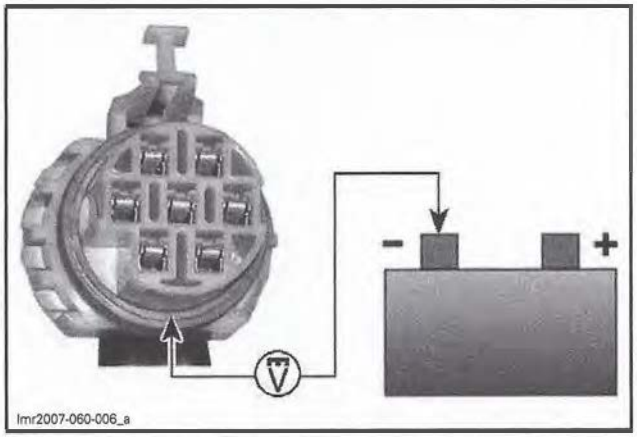
EFB CONNECTOR "B"	EFB CONNECTOR "A"	VOLTAGE (Vdc)
Pin B-E	Pin A-27	Battery voltage



If voltage is adequate EFB is properly supplied.

If voltage is not adequate, recheck as follows.

EFB CONNECTOR "B"	BATTERY	VOLTAGE (Vdc)
Pin B-E	Ground post	Battery voltage



If voltage is adequate check EFB ground circuit (wiring to pin A-27).

If voltage is still not adequate, check supply circuit.

EFB Replacement

NOTE: There is no programming or reset to perform when replacing the EFB.

IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	420 277 010	316
ECM ADAPTER TOOL	529 036 166	316
FLUKE 115 MULTIMETER	529 035 868	313–317

SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	318
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	319

GENERAL

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

⚠ WARNING

Never check for engine ignition spark from an open coil and/or spark plug as spark may cause potential fuel vapors to ignite. Always use an approved spark tester.

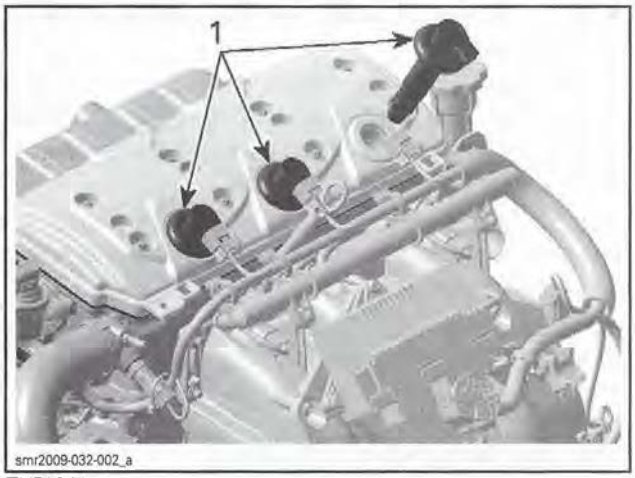
SYSTEM DESCRIPTION

The ignition system is a digital inductive type system.

Ignition system parameters such as ignition timing, spark duration, and firing order, as well as many other engine related functions are controlled by the engine management system (EMS) in order to meet engine operational requirements. The EMS can detect many abnormalities including a short circuit in the primary winding of the ignition coils as well as its associated circuits.

Three separate ignition coils receive power from three separate fuses.

When a ground signal is provided by the ECM to an ignition coil primary winding, a high voltage is induced in the coil secondary winding that is used to produce a spark at the spark plug electrode.



TYPICAL
1. Ignition coils

Ignition Timing

Ignition timing is not adjustable.

The ECM is programmed with data (ignition mappings) that it uses to establish optimum ignition timing under all engine operating conditions.

It receives signals from a variety of sensors that it compares with the ignition mappings and uses it to control the ignition spark timing, duration and firing order.

The firing of each spark plug is independent of the others.

Engine RPM Limiter

The ECM will limit the maximum engine speed by cutting off ignition spark and fuel at a predetermined engine RPM.

ENGINE	RPM LIMITER
155 engine	7750 RPM
215, 255 and 260 engine	8300 RPM

210 and 230 Series

On these models, the ECM will also control the throttle plate opening through the iTC system (intelligent Throttle Control) to limit maximum RPM. This is accomplished using an electronically controlled throttle body that uses and ETA (Electric Throttle Actuator) and TPS (Throttle Position Sensor).

Knock Sensor

A knock sensor is mounted on the cylinder block behind the intake manifold. It detects specific vibrations that would typically be generated by engine detonation.

If detonation occurs, the knock sensor detects it and the ECM goes into a specific operating mode whereby it temporarily retards the ignition advance until detonation stops.

The ECM is able to identify in which cylinder the knocking occurs and modifies the ignition advance on that cylinder only.

Refer to the *ELECTRONIC FUEL INJECTION (EFI)* subsection for testing and replacement procedures.

TROUBLESHOOTING

It is good practice to check for fault codes using the B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Refer to *POWER DISTRIBUTION* for fuses and relay information.

Always refer to the *WIRING DIAGRAM* when troubleshooting an electrical circuit.

IGNITION SYSTEM TESTING

1. Ensure Cyl 1, Cyl 2, and Cyl 3 fuses are in good condition (ignition/injection fuses).
2. If a fuse is burnt, test for a short circuit or faulty component on that fuse circuit before replacing the fuse.

⚠ WARNING

Due to the possibility of flammable vapors accumulating in the bilge, you should always test for a short circuit which may produce a spark and ignite the vapors before replacing a burnt fuse.

3. If a primary winding of an ignition coil or a circuit is at fault, a fault code will be set. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.
4. If one cylinder is not firing and there is no fault code, replace each spark plug with a known good spark plug until the faulty plug is located.
5. If the fault is not found, carry out an *IGNITION COIL TEST USING B.U.D.S.*

DIAGNOSTIC GUIDELINES

The following is provided to help in diagnosing the probable cause of a problem. It is a guideline and should not be assumed to list all possible causes.

ENGINE WILL NOT START (ENGINE TURNS OVER)

1. **Fouled or defective spark plug**
   - *Replace.*
2. **Defective CPS**
   - *Check operation of CPS and replace if necessary. Refer to ELECTRONIC FUEL INJECTION (EFI) subsection.*
3. **Defective trigger wheel**
   - *Check. Refer to PTO HOUSING AND MAGNETO subsection.*
4. **Defective ignition circuit**
   - *Check fuses, ignition coils, wiring and connectors.*

ENGINE HARD TO START

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

ENGINE MISFIRES, RUNS IRREGULARLY

1. **Fouled, defective, worn spark plugs**
   - *Check spark plug condition. Replace if required.*
2. **Defective T.O.P.S. switch (210 and 230 Series)**
   - *Check T.O.P.S. Refer to LUBRICATION subsection.*
3. **Damaged trigger wheel/loose CPS**
   - *Check. Refer to PTO HOUSING AND MAGNETO subsection.*

4. Defective ignition circuit
   - *Check ignition coils, CYL fuses, wiring and connectors condition.*
5. Poor engine grounds
   - *Check/ground condition. Refer to POWER DISTRIBUTION subsection.*

ENGINE CONTINUALLY BACKFIRES

1. Fouled, defective spark plugs
   - *Clean/replace.*
2. Damaged trigger wheel/defective or loose CPS
   - *Check, refer to PTO HOUSING AND MAGNETO and ELECTRONIC FUEL INJECTION (EFI) subsections.*

ENGINE DETONATION OR PINGING

1. Knock sensor disconnected or faulty
   - *Check, refer to ELECTRONIC FUEL INJECTION (EFI) subsection.*

ENGINE LACKS ACCELERATION OR POWER

1. Weak spark
   - *Check spark plugs, coils, wiring and connections.*

PROCEDURES

ENGINE CUT-OFF SWITCH (150, 180 AND 200 SERIES)

150 and 180 Series

The engine cut-off switch used on these models has 4 wires and contains 2 reed switches working in parallel.

200 Series

The engine cut-off switch used on these models has 3 wires and contains 1 reed switch.

Engine Cut-Off Switch Continuity Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

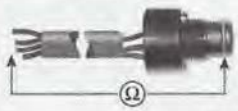
NOTE: The following tests validate the reed switch and the engine cut-off switch ground.

If any test fails, replace the engine cut-off switch.

If all readings are as specified, carry out a continuity test of the vehicle harness from the ECM to the engine cut-off switch.

Tether Cord Removed

1. Disconnect the engine cut-off switch connector.
2. Set multimeter to Ω.
3. Connect test probes to engine cut-off switch as per each applicable table and measure resistance.

ENGINE CUT-OFF SWITCH (150, 180 AND 200 SERIES)		
PROBE		RESISTANCE Ω @ 20°C (68°F)
BLACK	BLACK/YELLOW	Open circuit
	BLACK/PURPLE (150/180 series)	
		
WHITE/GREY	Post terminal	Close to 0 Ω
		
BLACK	Post ring	Close to 0 Ω
		

Tether Cord Installed

ENGINE CUT-OFF SWITCH (150, 180 AND 200 SERIES)		
PROBE		RESISTANCE Ω @ 20°C (68°F)
BLACK	BLACK/YELLOW	Close to 0 Ω
		

ENGINE CUT-OFF SWITCH (210 AND 230 SERIES)

Engine Cut-Off Switch Continuity Test

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect the engine cut-off switch connector.
2. Set multimeter to Ω selection.
3. Test the engine cut-off switch as per following table.

TETHER CORD	PROBE	READING
Removed	Between pins 1 and 2	OL (open circuit)
Installed		Close to zero Ω

If readings are as specified, engine cut-off switch is good. Carry out the following;

MODEL	TEST
210 Series	– Continuity test from engine cut-off switch (pin 2) to ignition switch (pin A)
	– Continuity test from engine cut-off switch (pin 1) to fuse F2 (contact A10) of each fuse block 1
230 Series	– Continuity test from engine cut-off switch (pin 2) to ignition switch (pin B)
	– Continuity test from engine cut-off switch (pin 1) to fuse holder (contact F)

On **210 Series**, pay attention to the polarity of the 2 diodes in the circuit. Refer to appropriate *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547).*

IGNITION SWITCH

Ignition Switch Access

1. To access to engine ignition switch connector, open the backrest of the seat in front of the helm.
2. Open the soft access panel in front of the helm.

Ignition Switch Continuity Test

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Remove the connector from the switch.
2. Set the multimeter to Ω selection.
3. Test the ignition switch as per following table.

IGNITION SWITCH	PROBE	READING
OFF	Pins A and B	OL (open circuit)
	Pins C and D	
ACC.	Pins A and B	OL (open circuit)
	Pins C and D	Close to zero Ω
ON	Pins A and B	Close to zero Ω
	Pins C and D	

IGNITION SWITCH CONTACTS	FUNCTIONALITY
Pins A and B	Ignition system
Pins C and D	Radio

IGNITION COILS

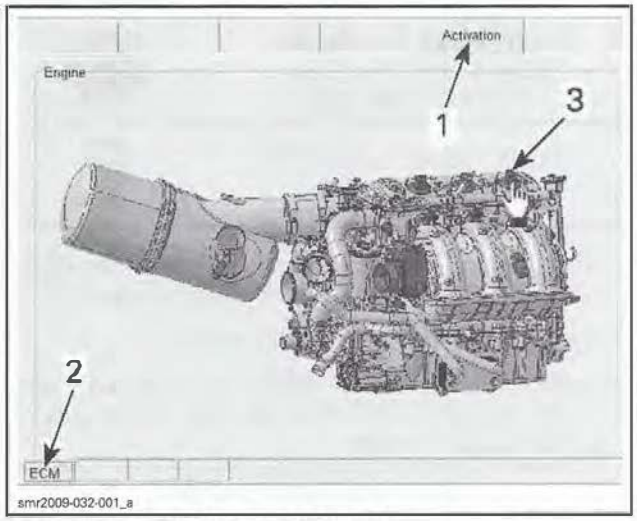
⚠ WARNING

Never check for engine ignition spark from an open coil and/or spark plug in the engine compartment as a spark may cause fuel vapors which may have accumulated in the bilge to ignite.

Ignition Coil Test Using B.U.D.S.

1. Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select:
   1. **Activation** page tab
   2. **ECM** tab.

Ignition coil to be tested by selecting it on the engine illustration.



TYPICAL - IGNITION COIL ACTIVATION
1. Activation tab
2. ECM tab
3. Click on the desired ignition coil

You should hear the spark occurring. If in doubt, use a sealed **vapor proof** spark tester or an inductive spark tester as available from tool suppliers, to prevent a spark from occurring in the bilge.

If there is no ignition at one or more coils, carry out an *IGNITION COIL INPUT VOLTAGE TEST.*

If spark is weak, try a new spark plug. If spark is still weak, try a new ignition coil.

NOTE: The voltage required to produce a spark in the combustion chamber is higher when the engine is running.

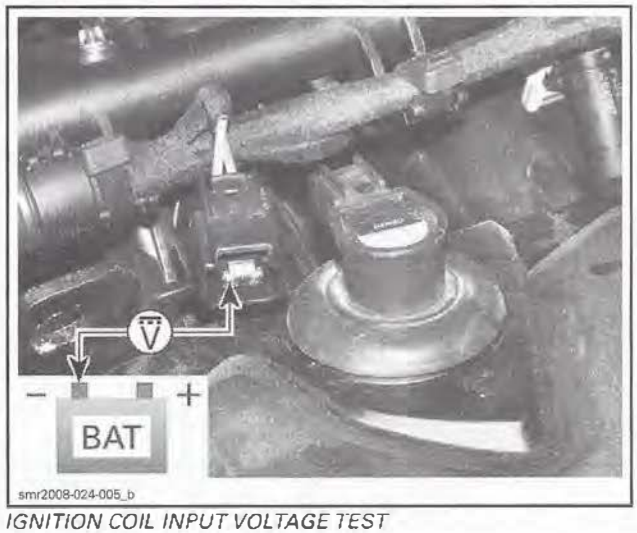
Ignition Coil Input Voltage Test

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Make sure all key switch fuses are good before testing.

1. Disconnect the applicable ignition coil connector.
2. Set the multimeter to Vdc.
3. Activate electrical system without starting the engine.
4. Measure voltage as per following table. Repeat for each ignition coil.

TEST PROBES		VOLTAGE
PURPLE/BLUE wire (ignition coil no. 1)	Battery negative (–) post	Battery voltage
PURPLE/GREEN wire (ignition coil no. 2)		
PURPLE/ORANGE wire (ignition coil no. 3)		



IGNITION COIL INPUT VOLTAGE TEST

If test succeeded, refer to *IGNITION COIL CONTROL CIRCUIT CONTINUITY TEST*.

If test failed, refer to *IGNITION COIL POWER CIRCUIT CONTINUITY TEST.*

Ignition Coil Power Circuit Continuity Test

1. Set multimeter to Ω position.
2. Read resistance of the applicable ignition coil circuit.

150 AND 180 SERIES		
IGNITION COIL WIRE	FUSE BOX NO. 1	RESISTANCE @ 20°C (68°F)
PURPLE/BLUE wire (ignition coil no. 1)	Terminal B11	Close to 0 Ω
PURPLE/GREEN wire (ignition coil no. 2)	Terminal B9	
PURPLE/ORANGE wire (ignition coil no. 3)	Terminal B7	

200 SERIES		
IGNITION COIL WIRE	EFB	RESISTANCE @ 20°C (68°F)
PURPLE/BLUE wire (ignition coil no. 1)	Terminal B-C	Close to 0 Ω
PURPLE/GREEN wire (ignition coil no. 2)	Terminal B-D	
PURPLE/ORANGE wire (ignition coil no. 3)	Terminal B-G	

210 AND 230 SERIES		
IGNITION COIL WIRE	FUSE BOX NO. 1 OR 2 (ACCORDING TO ENGINE)	RESISTANCE @ 20°C (68°F)
PURPLE/BLUE wire (ignition coil no. 1)	Terminal B11	Close to 0 Ω
PURPLE/GREEN wire (ignition coil no. 2)	Terminal B9	
PURPLE/ORANGE wire (ignition coil no. 3)	Terminal B7	

If test succeeded, the ignition coil power circuit is functional. Carry out a *IGNITION COIL CONTROL CONTINUITY TEST* wiring between the ignition coil and the ECM.

If test to any ignition coil failed, test the following items separately and repair or replace as required.

- Fuses (CYL 1, CYL 2, CYL 3)
- Wiring from fuse box to ignition coil.

Refer to appropriate *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for details.

Ignition Coil Control Circuit Continuity Test

REQUIRED TOOLS	
For 150, 180 and 200 Series: ECM ADAPTER TOOL (P/N 420 277 010)	
For 210 and 230 Series: ECM ADAPTER TOOL (P/N 529 036 166)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect ECM connector "A". Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
2. Disconnect ignition coil connector.
3. Install the ECM connector on the applicable ECM adapter tool and test for continuity of circuit as per model.

150, 180 AND 200 SERIES		
IGNITION COIL WIRE	ECM ADAPTER	RESISTANCE @ 20°C (68°F)
BROWN/BLACK wire (ignition coil no. 1)	A-41	Close to 0 Ω (continuity)
BROWN/ORANGE wire (ignition coil no. 2)	A-1	
BROWN/YELLOW wire (ignition coil no. 3)	A-29	

210 AND 230 SERIES		
IGNITION COIL WIRE	ECM ADAPTER	RESISTANCE @ 20°C (68°F)
BROWN/BLACK wire (ignition coil no. 1)	A-M4	Close to 0 Ω (continuity)
BROWN/ORANGE wire (ignition coil no. 2)	A-M2	
BROWN/YELLOW wire (ignition coil no. 3)	A-M1	

If test failed, repair the connector or replace the engine wiring harness.

If test succeeded, carry out an *IGNITION COIL RESISTANCE TEST.*

Ignition Coil Resistance Test

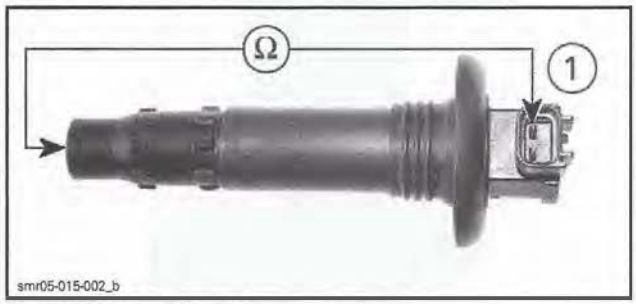
REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)

An ignition coil with a good resistance measurement can still be faulty. Current leakage can occur at high voltage levels which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

1. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.
2. Perform a visual inspection of the ignition coils. Check for corrosion, bent pins, loose or burnt contacts, and cracked or torn insulator.
3. Test the resistance in both primary and secondary windings.

PRIMARY WINDING

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



SECONDARY WINDING

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

If any test failed, replace ignition coil.

Ignition Coil Removal

1. Disconnect ignition coil connector.

NOTICE Do not remove the ignition coil before disconnecting the input connector or the wires may be damaged. Do not pry up ignition coil with a screwdriver to avoid damage.

NOTE: Twist ignition coil in both directions as you pull it up to ease removal.

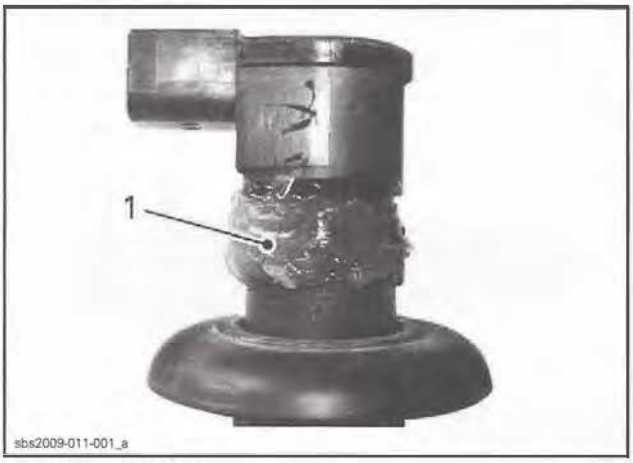
Remove ignition coil from spark plug.

Ignition Coil Lubrication

1. Pull rubber seal down.

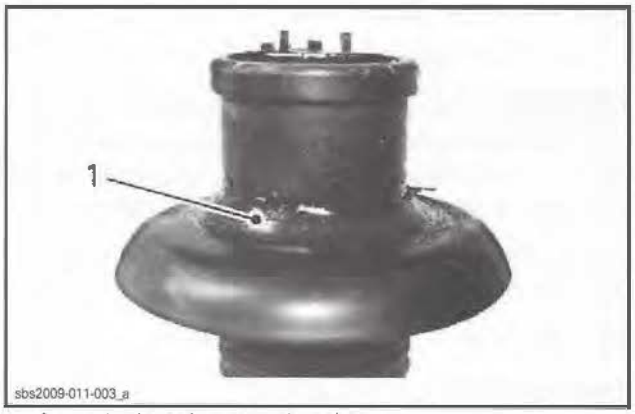
1. Rubber seal pulled down

2. Apply DOW CORNING 111 (P/N 413 707 000) to rubber seal seat as shown.



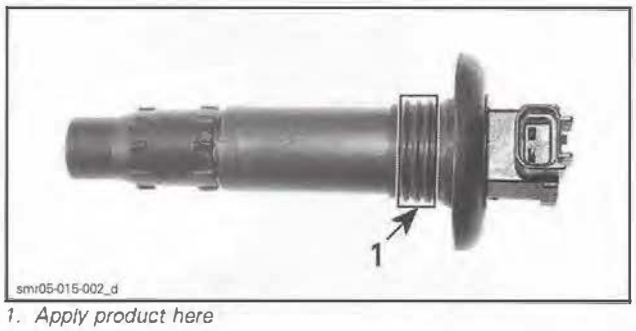
1. Apply product here

3. Pull rubber seal back on its seat making sure the tabs on the ignition coil and the slots in the seal properly match together.
4. Leave a ring of grease on top of the seal as shown to act as a water barrier. Wipe off the excess.



1. Correctly shaped excess of product

5. Apply DOW CORNING 111 (P/N 413 707 000) on rubber seal contact area.

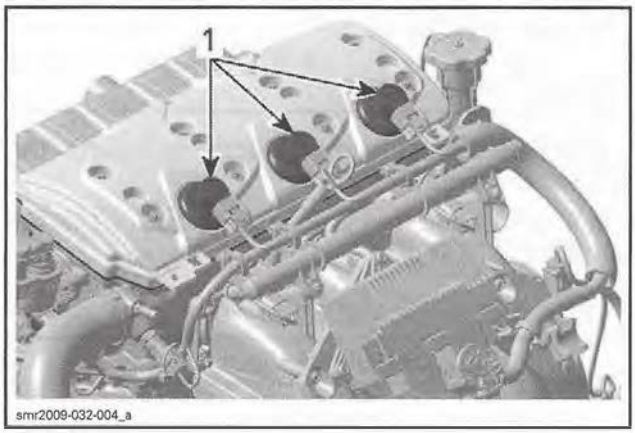


1. Apply product here

Ignition Coil Installation

NOTE: Prior to inserting the ignition coil on its spark plug, apply sealant as described in *IGNITION COIL LUBRICATION*.

1. Install coil in cylinder head hole.
2. Push the ignition coil down to securely install it on the spark plug tip.
3. Ensure the seal seats properly with top surface of engine valve cover.



TYPICAL
1. Seal properly seated

SPARK PLUGS

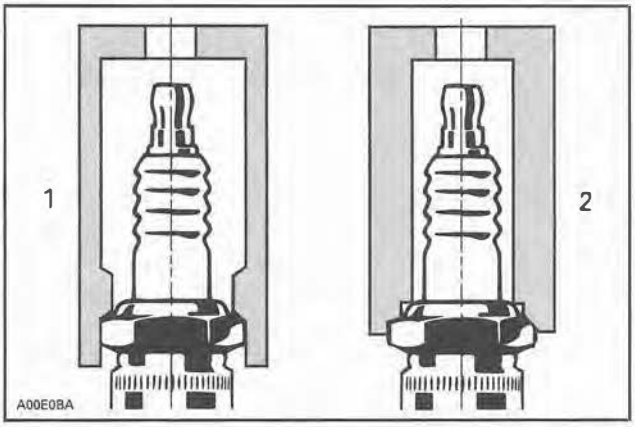
Spark Plug Removal

1. Disconnect the ignition coil input connector.
2. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.

⚠ WARNING

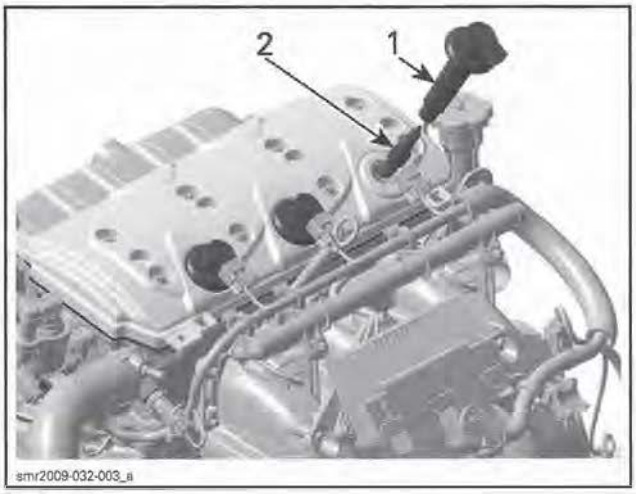
Never remove an ignition coil from a spark plug without disconnecting it from the wiring harness. Flammable vapors may be present in the bilge. Should the tether cord be installed on the engine cut-off switch, a spark could be generated at the spark plug end of the coil possibly resulting in an explosion.

3. Using a spark plug socket, release the torque applied to the spark plug.



1. Approved socket
2. Improper socket

4. Clean the spark plug and cylinder head with pressurized air.
5. Unscrew spark plug then use the ignition coil to take spark plug out of spark plug hole.



TYPICAL
1. Ignition coil
2. Spark plug

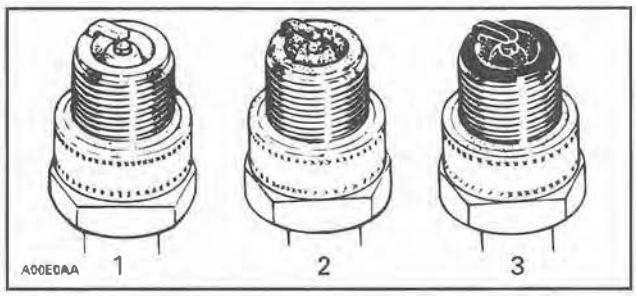
Troubleshooting a Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running or misfiring of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption.

Other possible causes are: use of an incorrect or bad fuel, defective ignition system, incorrect spark plug gap, loss of compression, or lubricating oil entering the combustion chamber.

The plug face of a fouled spark plug has either a wet or dry black carbon deposit. Such coatings form a conductive connection between the center electrode and the ground electrode.

Spark Plug Analysis



TYPICAL
1. Overheated (light grey, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, grey, melted coating)

The plug face 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 prescribed intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

Spark Plug Installation

Prior to installation, ensure the contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap as specified in the following chart.

ENGINE	SPARK PLUG	TORQUE	GAP MM (IN)
1503	NGK DCPR8E	Hand tighten + 1/4 turn with a socket	0.75 mm (.03 in)

2. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) 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 an approved spark plug socket.
4. Install ignition coil. Refer to *IGNITION COIL INSTALLATION* in this subsection.
5. Complete the installation in the reverse order of the removal.

CHARGING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	322

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
EXTECH INDUCTIVE AMMETER	380941	322

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	325

GENERAL

SYSTEM DESCRIPTION

The purpose of the charging system is to maintain the battery at a full state of charge and to provide the electrical system with the required electrical power for normal vehicle operation.

Magneto

The magneto is the primary source of electrical energy. It transforms a magnetic field into an electric current (AC).

The magneto has a 3 phase, delta wound, 18 pole stator that is rated at 380 watts.

TYPICAL

Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage to a maximum level to prevent any damage to electrical components.

Battery

The battery supplies DC power to the electric starter for cranking the engine. During engine starting, it also supplies DC power to every electrical and electronic system in the vehicle as well as all accessories.

At low engine RPM operation and high current load conditions, it supplements the magneto output and helps to maintain a steady system voltage.

INSPECTION

CHARGING SYSTEM OUTPUT

First ensure that battery is in good condition prior to performing the following tests. Refer to battery manufacturer's instructions.

NOTE: It is good practice to check for fault codes using the B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

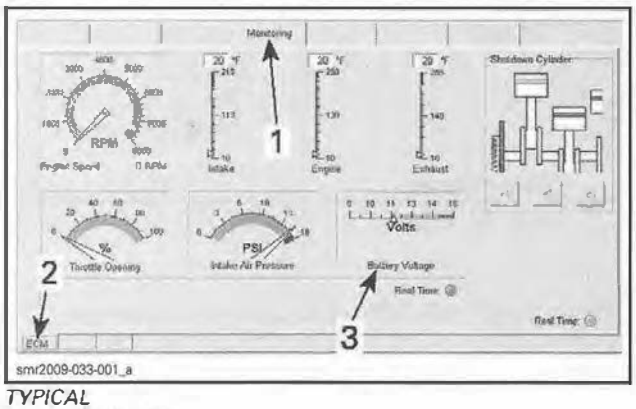
Output Voltage Test Using B.U.D.S.

1. Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Select **Monitoring** and **ECM** tabs.
3. Start engine.

NOTICE If boat is out of water, connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

4. Increase engine RPM as specified in the following table and read voltage in B.U.D.S.

OUTPUT VOLTAGE TEST USING B.U.D.S.	
TEST ENGINE SPEED	VOLTAGE (DC)
5500 RPM	14.5 ± .5 Vdc



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TYPICAL
1. *Monitoring tab*
2. *ECM tab*
3. *Battery voltage*

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

If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *PTO HOUSING AND MAGNETO* subsection.

Output Voltage Test Using a Multimeter

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)

1. Set multimeter to Vdc.
2. Connect multimeter to battery posts.

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TYPICAL - CHARGING SYSTEM VOLTAGE TEST AT BATTERY POSTS

3. Start engine.

NOTICE If boat is out of water, connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

4. Increase engine RPM as specified in the following table and read voltage with the multimeter.

OUTPUT VOLTAGE TEST USING A MULTIMETER	
TEST ENGINE SPEED	VOLTAGE (DC)
5500 RPM	14.5 ± .5 Vdc

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

If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *PTO HOUSING AND MAGNETO* subsection.

Output Current Test with an Inductive Ammeter

1. Use an inductive ammeter such as the EXTECH INDUCTIVE AMMETER (P/N 380941) or equivalent.

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2. Turn on the ammeter and select 40 Adc.

NOTE: Zero set the ammeter before use or reading may be erroneous.

3. Clamp the ammeter around the battery positive (+) cable (RED).
4. Start engine.

NOTICE **If boat is out of water, connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.**

5. Increase engine RPM as specified in the following table and read current with the ammeter.

TEST ENGINE SPEED	CURRENT
5500 RPM	Approx. 10 A

NOTE: Initial current reading will be higher than specified due to the battery drain from the engine start. This is an indication that the charging system is operating normally. Current load will come down as the battery recovers its charge.

If the current reading is far below specification, check:
- Stator
- Wiring harness
- Voltage regulator/rectifier.

TROUBLESHOOTING

TROUBLESHOOTING GUIDELINES

DISCHARGED OR WEAK BATTERY

1. **Battery posts and/or cable terminal oxidized.**
   - *Clean battery terminals, posts, and coat with dielectric grease.*
2. **Loose or bad connections.**
   - *Check for wiring and connector tightness, frayed or broken wires. Repair or replace cables or connectors.*
3. **Worn or faulty battery (sulfated, fretting, shorted plates or cell, damaged casing, loose post).**
   - *Carry out a BATTERY VOLTAGE TEST (LOAD APPLIED).*
   - *Replace battery.*
4. **Automatic bilge pump cycling frequently when boat is not in use.**
   - *Check boat for water leakage.*
5. **Burnt fuse(s).**
   - *Check charging system fuse(s).*
6. **Faulty regulator/rectifier or stator.**
   - *Check charging system output.*
   - *If charging system output is not within specification, check stator.*
   - *If stator is good, replace voltage regulator/rectifier.*
7. **Parasitic or "Key Off" current loads.**
   - *Isolate, reduce or eliminate such loads.*
   - *Recharge battery as recommended if vehicle is not used for extended periods of time.*

   NOTE: "Key Off" or parasitic loads may be loads due to installed accessories. Parasitic loads may also be due to water infiltration in connectors, or partial short circuits that slowly drain a battery without causing a fuse to burn.

LOW OR NO CHARGING SYSTEM VOLTAGE

1. **Blown charging system fuse.**
   - *Check charging system fuse.*
2. **Defective stator.**
   - *Test stator. Refer to PTO HOUSING AND MAGNETO subsection.*
3. **Defective charging system wiring or connections.**
   - *Check for damaged wiring.*
   - *Check for damaged or loose connections.*
4. **Defective voltage regulator/rectifier.**
   - *Replace.*

REPETITIVE BLOWN CHARGING SYSTEM FUSE

1. **Defective voltage regulator/rectifier.**
   - *Refer to VOLTAGE REGULATOR/RECTIFIER TEST FOR BLOWN CHARGING SYSTEM FUSE in this subsection.*
2. **Damaged wiring harness.**
   - *Check.*

FREQUENT LOW ELECTROLYTE LEVEL REQUIRING ADDITION OF DISTILLED WATER

1. **High charging system voltage.**
   - *Carry out a CHARGING SYSTEM VOLTAGE TEST.*
2. **Old battery with reduced current storage capacity.**
   - *Carry out a battery voltage test (load applied). Refer to battery manufacturers' instructions.*
   - *Replace battery.*

3. Cracked, leaking or improperly sealed battery.
   - *If battery is cracked or leaking electrolyte, replace battery and clean surrounding area as recommended in BATTERY further in this subsection.*

PROCEDURES

VOLTAGE REGULATOR/RECTIFIER

Voltage Regulator/Rectifier Test for Blown Charging System Fuse

1. Disconnect the voltage regulator/rectifier 2-wire connector.
2. Install a new fuse.

If the fuse still burns, check for a shorted wire or connector pin.

If fuse does not burn, replace regulator/rectifier.

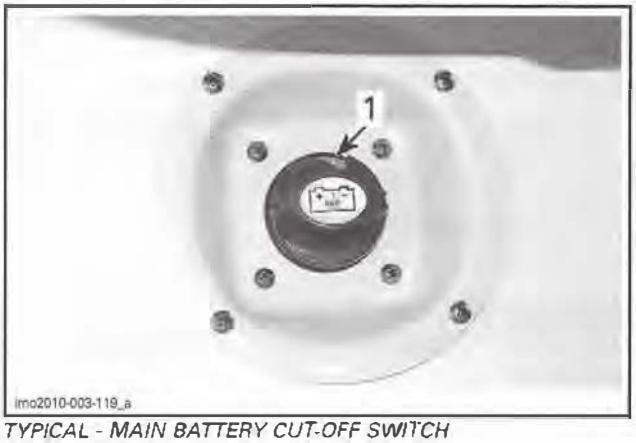
Voltage Regulator/Rectifier Continuity Test

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

Voltage Regulator/Rectifier Replacement

Voltage Regulator/Rectifier Removal

1. Select the main battery cut-off switch to the OFF position.



TYPICAL - MAIN BATTERY CUT-OFF SWITCH
1. ON position

2. Disconnect the two connectors from the voltage regulator/rectifier.
3. Remove the voltage regulator/rectifier.

Voltage Regulator/Rectifier Installation

Installation is the reverse of the removal procedure. However, pay attention to the following.

When installation is complete:

1. Set the main battery cut-off switch to the ON position.
2. Start engine and ensure proper charging system operation.

BATTERY

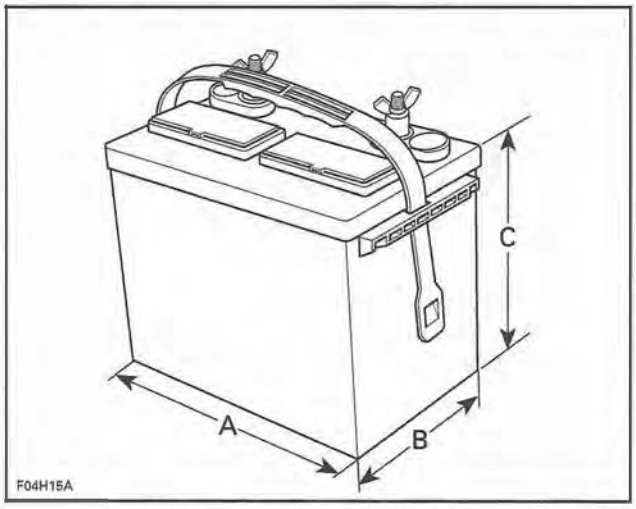
NOTE: For battery inspection, charging, testing and storage, refer to battery manufacturer's recommendations.

⚠ WARNING

Never use an automotive type battery. Its mechanical construction is not designed to withstand the shock conditions of boating operations. Use only the recommended type of battery.

Recommended Battery

12 V group 24 marine starting battery with top-mounted, round taper type battery posts.



MAXIMUM ALLOWED BATTERY SIZE
A. 273 mm (10-3/4 in)
B. 178 mm (7 in)
C. 219 mm (8-5/8 in)

Battery Removal

⚠ WARNING

Battery BLACK (–) cable must always be disconnected first and connected last. Never charge or boost battery while installed in boat.

Proceed as follows:

1. Disconnect the BLACK (–) cable first.
2. Disconnect the RED (+) cable last.
3. Remove the hold down.
4. Withdraw battery from craft.

⚠ WARNING

Electrolyte is corrosive and dangerous. Avoid contact with eyes, skin and clothing. Wear a suitable pair of non-absorbent gloves when removing the battery by hand.

NOTICE **Should any electrolyte spillage occur, immediately wash it off with a solution of baking soda and water.**

Battery Cleaning

Clean the battery casing, caps, cables and battery posts using a solution of baking soda and water.

NOTICE **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 thoroughly.

Battery Installation

⚠ WARNING

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

Proceed as follows:

1. Install battery in supplied tray.
2. First connect RED (+) cable.
3. Connect BLACK (–) cable last.
4. Apply DIELECTRIC GREASE (P/N 293 550 004) on battery posts.
5. Verify cable routing and attachment.

STARTING SYSTEM

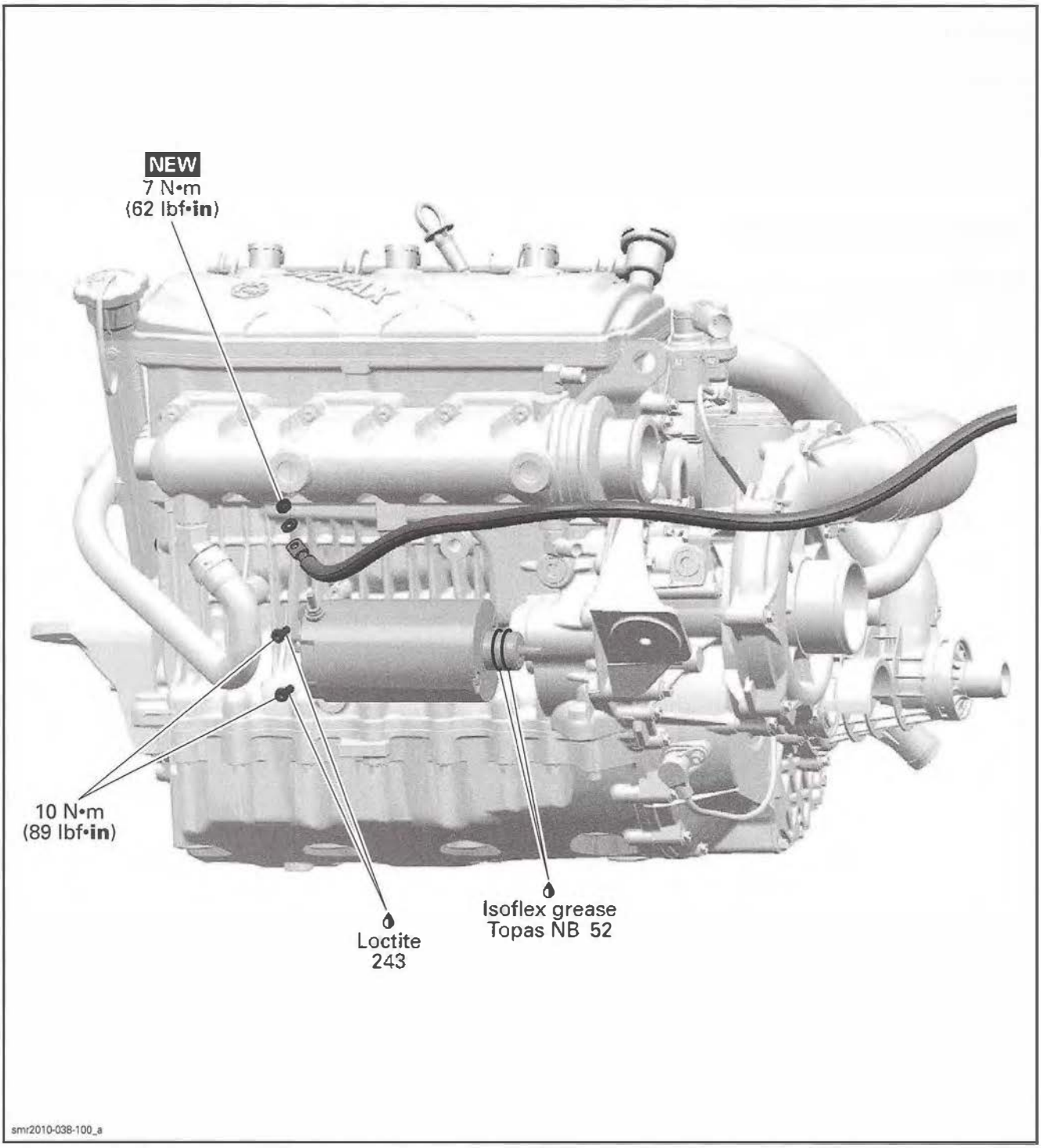
SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	420 277 010	336–337
ECM ADAPTER TOOL	529 036 166	336
FLUKE 115 MULTIMETER	529 035 868	336–339

SERVICE PRODUCTS

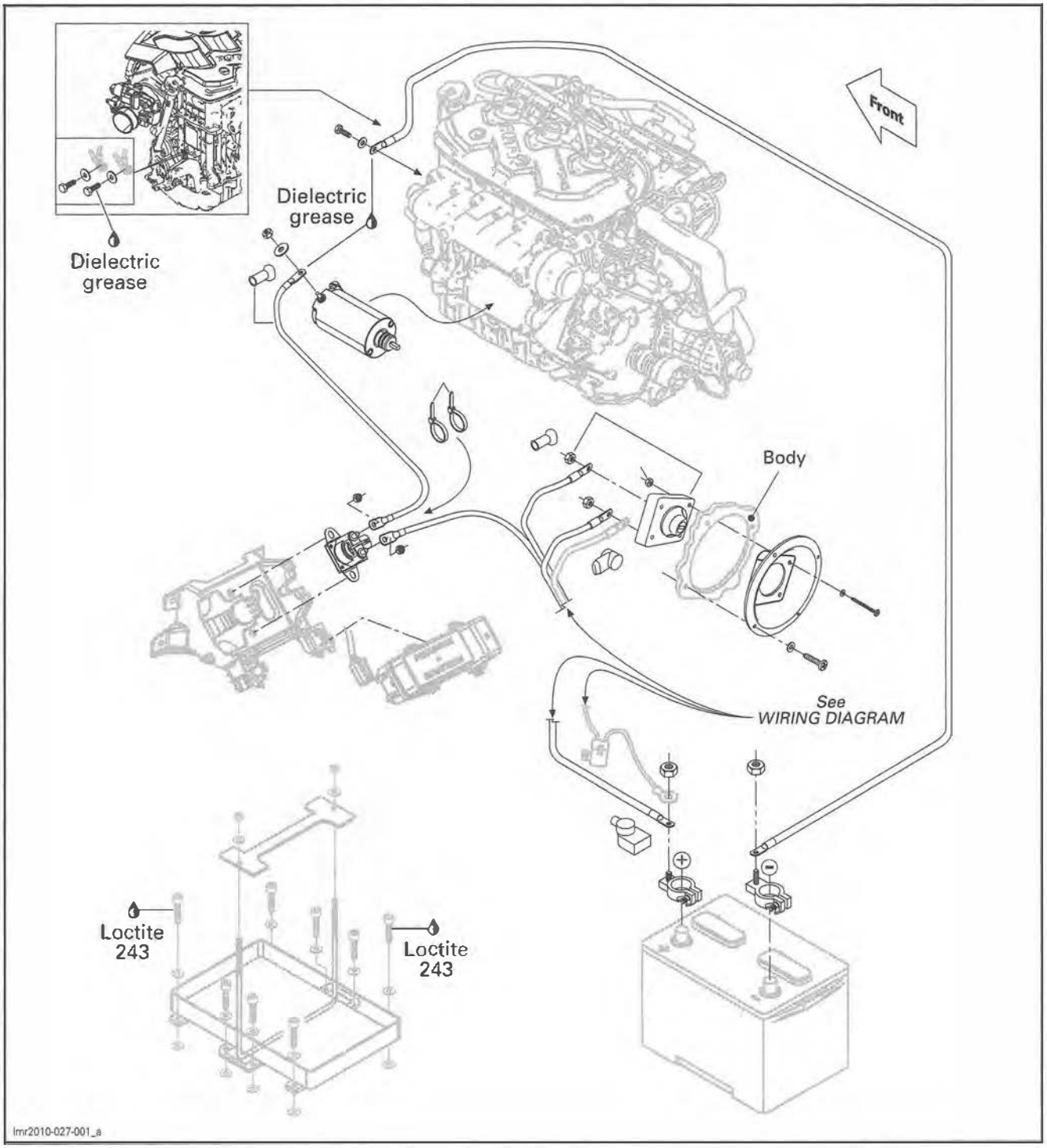
Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	342
ISOFLEX GREASE TOPAS NB 52	293 550 021	342
LOCTITE 243 (BLUE)	293 800 060	342

TYPICAL - STARTER

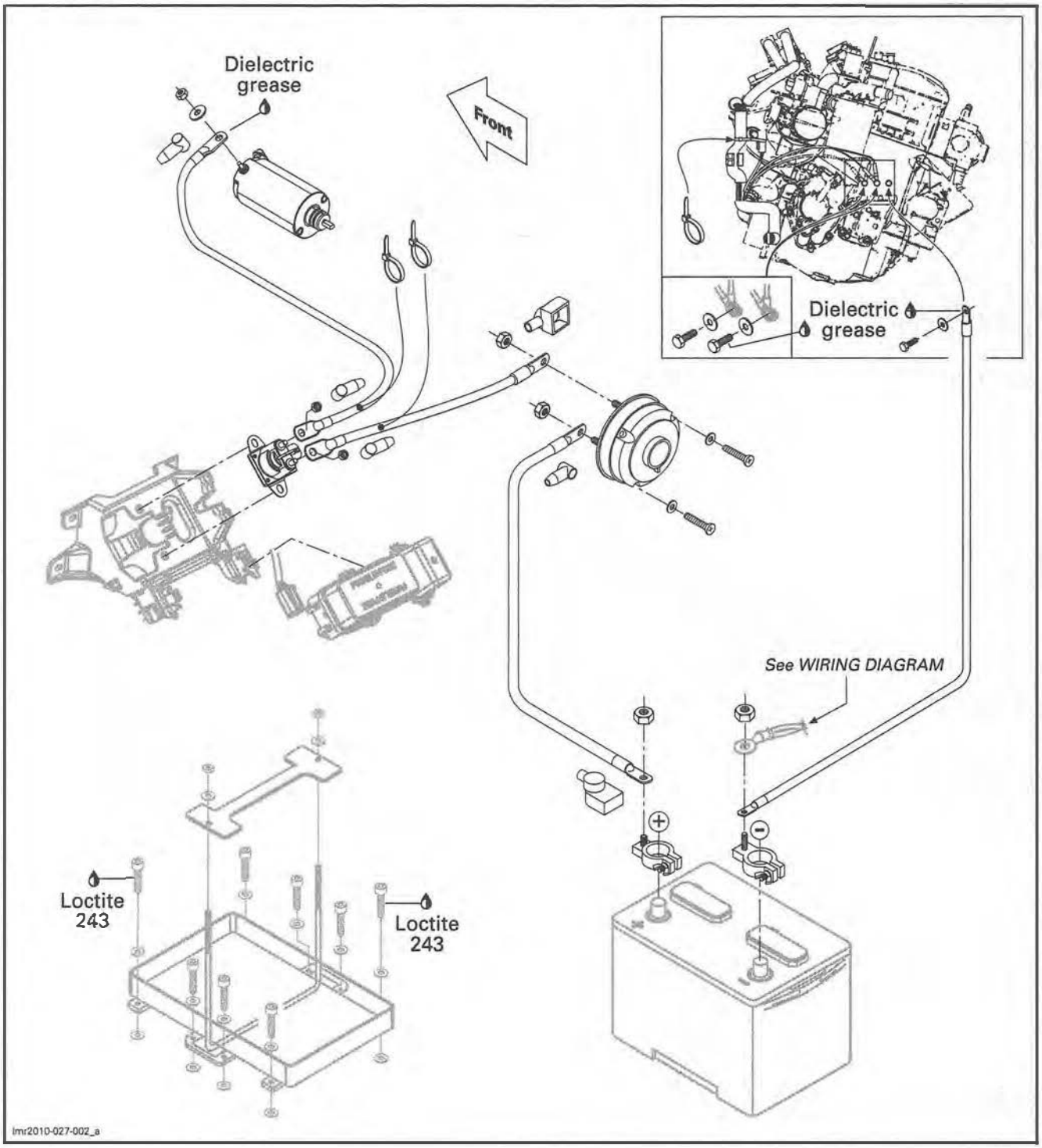


STARTING SYSTEM SCHEMATICS

150 Series



180 Series


Dielectric grease
Front
Dielectric grease
See WIRING DIAGRAM
Loctite 243
Loctite 243
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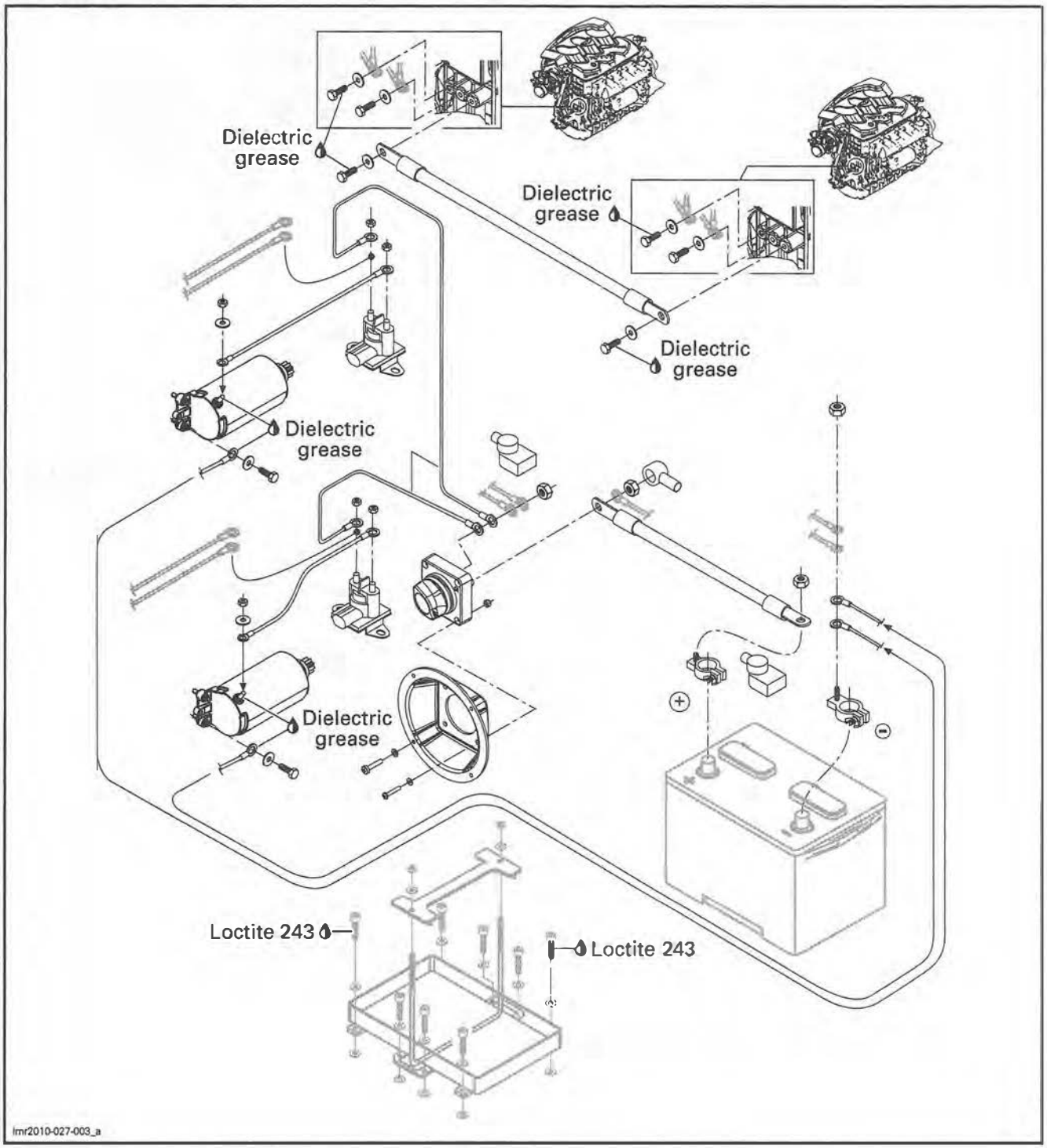
200 Series


Dielectric grease
Dielectric grease
Dielectric grease
Dielectric grease
Dielectric grease
Loctite 243
Loctite 243
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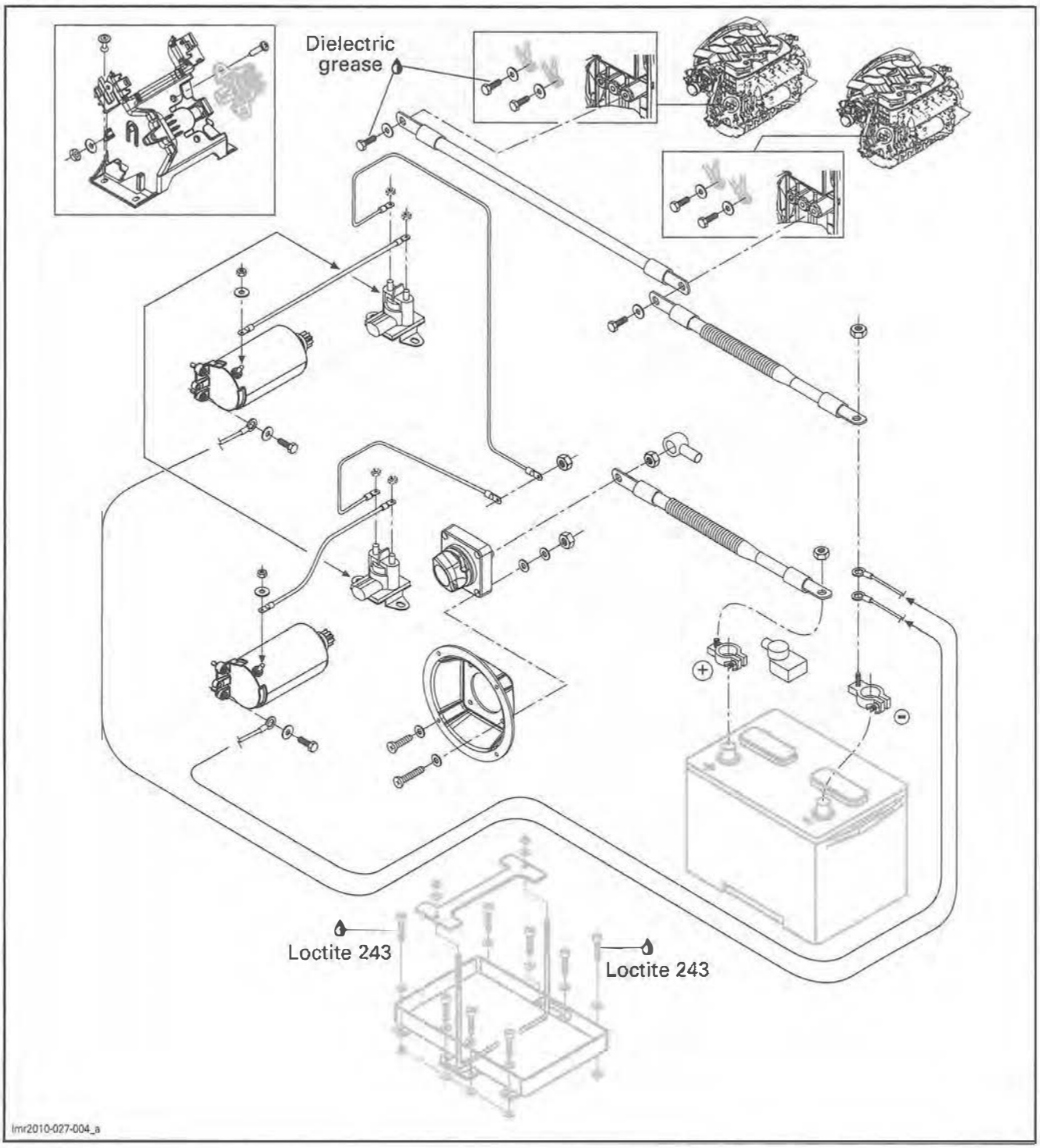
210 Series


Dielectric grease
Loctite 243
Loctite 243
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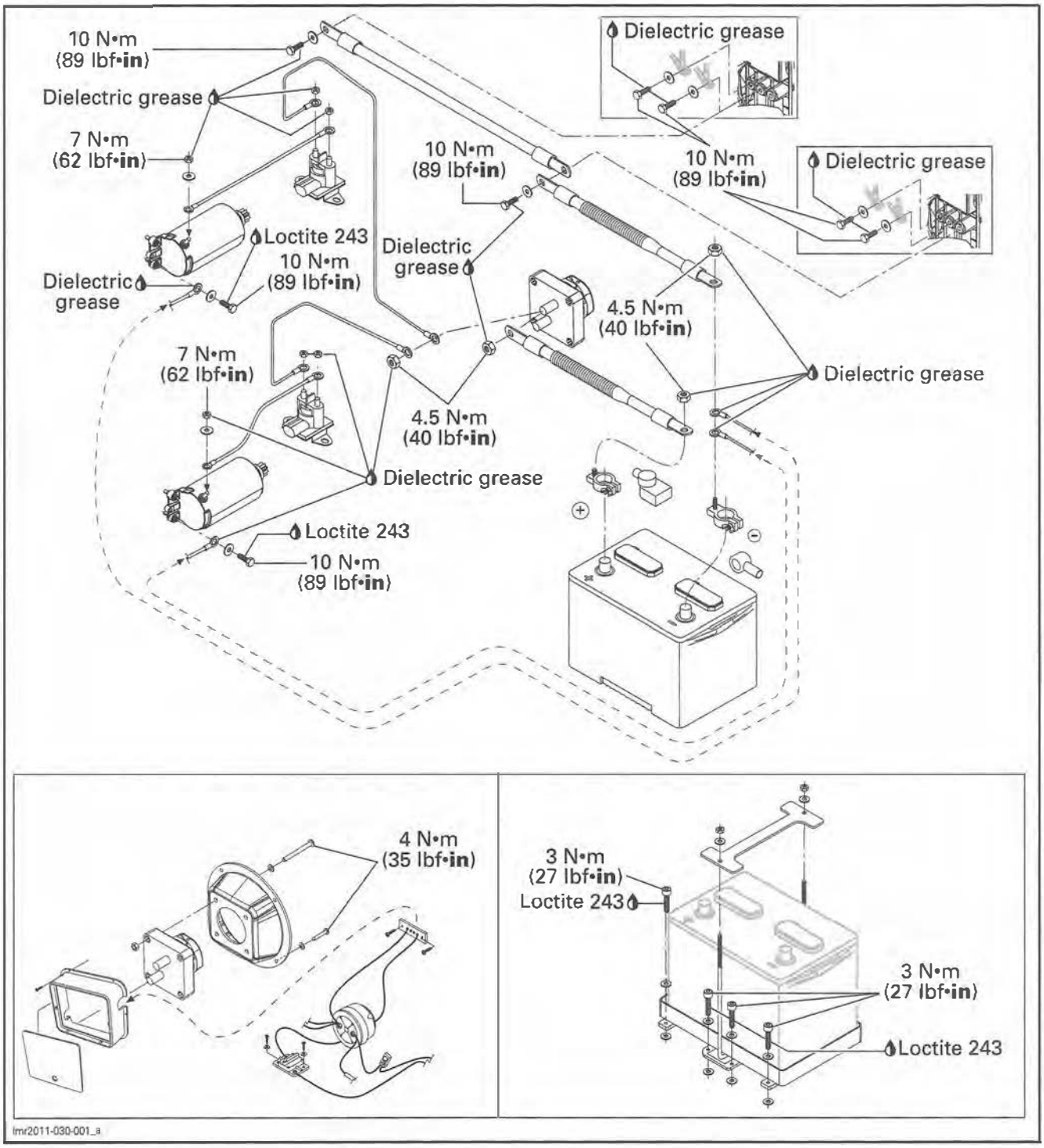
230 Series


10 N•m
(89 lbf•in)
Dielectric grease
7 N•m
(62 lbf•in)
Loctite 243
10 N•m
(89 lbf•in)
Dielectric grease
10 N•m
(89 lbf•in)
Dielectric grease
10 N•m
(89 lbf•in)
Dielectric grease
4.5 N•m
(40 lbf•in)
Dielectric grease
7 N•m
(62 lbf•in)
4.5 N•m
(40 lbf•in)
Dielectric grease
Loctite 243
10 N•m
(89 lbf•in)
4 N•m
(35 lbf•in)
3 N•m
(27 lbf•in)
Loctite 243
3 N•m
(27 lbf•in)
Loctite 243
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GENERAL

Each engine has its own starting system. Each starting system is connected to a single battery through the main battery cut-off switch.

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

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

ENGINE CRANKING CONDITIONS

The following conditions must be met to allow engine cranking:

1. Main battery cut-off switch turned to ON position.
2. Neutral position selected.
3. The tether cord securely installed on the engine cut-off switch and the D.E.S.S. key recognized by the ECM (D.E.S.S. equipped boats).
4. START/STOP button pressed and held.

TROUBLESHOOTING

DIAGNOSTIC TIPS

NOTE: It is good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to the *DIAGNOSTIC AND FAULT CODES* subsection.

Starting system failures are not necessarily related to the starter but may be due to one the following:

- Battery
- Fuses
- Starter solenoid
- Ignition switch
- START/STOP switch
- Starter solenoid
- Engine cut-off switch
- EFB (200 Series)
- ECM
- Wiring/connections.

Check these components before removing the starter. The components listed may not be applicable to every model since the electrical system varies from one model to the next.

NOTE: This subsection assumes the problem is related to an electrical component of the starting system. If the starting system tests good, ensure engine and jet pump integrity. Refer to applicable subsection.

DIAGNOSTIC GUIDELINES

The following is provided to help in diagnosing the probable cause of a problem. It is a guideline and should not be assumed to list all possible causes.

ENGINE DOES NOT CRANK

1. **D.E.S.S. operation non functional or wrong D.E.S.S. key (except 210 and 230 series)**
   - *2 short beeps should be heard, refer to DIGITALLY ENCODED SECURITY SYSTEM.*
2. **Burnt fuse**
   - *Inspect circuit. Replace fuse.*
3. **Discharged battery**
   - *Check/recharge. Refer to battery manufacturer's recommendations.*
4. **Defective START/STOP switch or ignition switch**
   - *Test switch, wiring and connections. Replace as required.*
5. **Neutral switch**
   - *Ensure shifter lever is at the neutral position.*
   - *Check neutral switch and circuit continuity.*
6. **Battery connections**
   - *Check/clean/tighten.*
7. **Poor/bad or corroded ground contacts (engine, battery ground cable, starter etc.)**
   - *Check/clean/repair.*
8. **Starter solenoid**
   - *Test solenoid. Replace as required.*
9. **Starter malfunction**
   - *Test starter. Replace as required.*
10. **Obstructed starter drive gear assembly**
    - *Check/repair, refer to PTO HOUSING AND MAGNETO.*

11. No ground provided by ECM for starter solenoid
    - *Test ECM grounds.*
12. Engine cannot be rotated (possibly seized)
    - *Inspect engine. Repair as required.*

ENGINE CRANKS SLOWLY

1. Loose, corroded or dirty battery cable connections
   - *Check/clean/tighten.*
2. Loose, corroded or dirty starter cable connections
   - *Check/clean/tighten.*
3. Discharged/weak battery
   - *Check/charge/replace. Refer to battery manufacturer's recommendations.*
4. Low voltage from starter solenoid
   - *Carry out a SOLENOID DYNAMIC TEST.*
5. Worn starter
   - *Check.*
6. Obstructed jet pump
   - *Inspect jet pump. Remove debris, repair as required.*

STARTER TURNS, BUT STARTER DRIVE DOES NOT MESH WITH RING GEAR

1. Worn starter drive gear
   - *Replace starter drive. Refer to PTO HOUSING AND MAGNETO.*
2. Defective drive
   - *Replace starter drive. Refer to PTO HOUSING AND MAGNETO.*
3. Poor movement of drive on splines
   - *Clean and correct. Refer to PTO HOUSING AND MAGNETO.*
4. Worn starter drive bushing
   - *Replace clutch. Refer to PTO HOUSING AND MAGNETO.*
5. Worn or damaged ring gear
   - *Replace ring gear. Refer to PTO HOUSING AND MAGNETO.*

STARTER KEEPS RUNNING

1. Shorted solenoid winding
   - *Test. Replace solenoid.*
2. Melted solenoid contacts
   - *Inspect. Replace solenoid.*
3. Sticking or defective starter drive
   - *Lubricate or replace. Refer to PTO HOUSING AND MAGNETO.*

PROCEDURES

⚠ WARNING

When carrying out any kind of maintenance on the starting system, always disconnect the battery ground cable. This will eliminate the possibility of shorting out a power cable, and generating a spark which could result in a fire or and explosion. Do not place any tool on the battery.

ENGINE START/STOP SWITCH

Test with B.U.D.S.

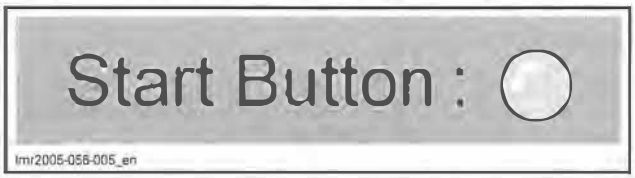
All Models Except 210 and 230 Series

A quick operational test can be carried out using the B.U.D.S. software.

1. Connect the boat to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

Select the following:
- Read data button
- Monitoring page tab
- ECM page tab.

2. Press the vehicle start button and look for the Start Button LED to come on in B.U.D.S.



It should turn on indicating the starting system is functioning on the input side (start button, EFB, ECM and wiring).

If it turns on, test for a problem on the output side of the starting system (EFB, ECM output signal to starter solenoid, neutral switch, wiring harness going to the solenoid and starter motor).

If it does not turn on, carry out a *CONTINUITY TEST OF START/STOP SWITCH CIRCUIT* as applicable to the model.

Continuity Test of Start/Stop Switch Circuit

150 and 180 Series

REQUIRED TOOLS
ECM ADAPTER TOOL (P/N 420 277 010) 
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect the ECM-B connector.
2. Install the ECM adapter tool on ECM connector.
3. Remove fuse box 1 cover.
4. Remove the starter solenoid fuse (F13).
5. Measure circuit continuity as follows.

SWITCH POSITION	FUSE BOX 1	ECM CONNECTOR	RESISTANCE
Released	E-12	B-19	Infinite (OL)
Pressed and held			Close to 0 Ω

If the readings obtained are not as specified, carry out continuity tests of the switch and wiring separately. Refer to applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for circuit details.

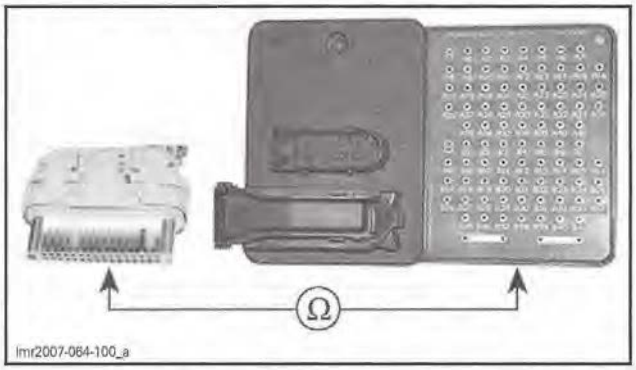
If the readings obtained are as specified, start switch and wiring from fuse box to ECM are good.

200 Series

REQUIRED TOOLS
ECM ADAPTER TOOL (P/N 420 277 010) 
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect connector "A" from EFB.
2. Disconnect connector "B" from ECM.
3. Install the ECM adapter tool on ECM connector.
4. Set the multimeter to Ω.
5. Measure resistance, as follows.

SWITCH POSITION	EFB CONNECTOR	ECM CONNECTOR	RESISTANCE
Released	A-7	B-19	Infinite (OL)
Pressed and held			Close to 0 Ω



If test is out of specification, check wiring/connectors; if they are good, replace switch.

If test is good, check the EFB power supply and ECM ground. Refer to *POWER DISTRIBUTION* subsection.

210 and 230 Series

REQUIRED TOOLS
ECM ADAPTER TOOL (P/N 529 036 166) 
FLUKE 115 MULTIMETER (P/N 529 035 868) 

1. Disconnect the ECM-B connector.
2. Install the ECM adapter tool on ECM connector.
3. Set multimeter to Vdc position.
4. Measure for voltage as follows.

SWITCH POSITION	PROBE		READING
Released	ECM-B pin 01	Engine ground	0 Vdc
Pressed and held			Battery voltage

If the readings obtained are not as specified, carry out the following:
- Test fuse F13
- Continuity tests of the switch and wiring separately.

Refer to applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for circuit details.

If the readings obtained are as specified, start switch and wiring from fuse box to ECM are good.

NEUTRAL SWITCH

When the shifter lever is not set to NEUTRAL, the neutral switch prevents engine cranking when the start button is pressed. Refer to applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for details.

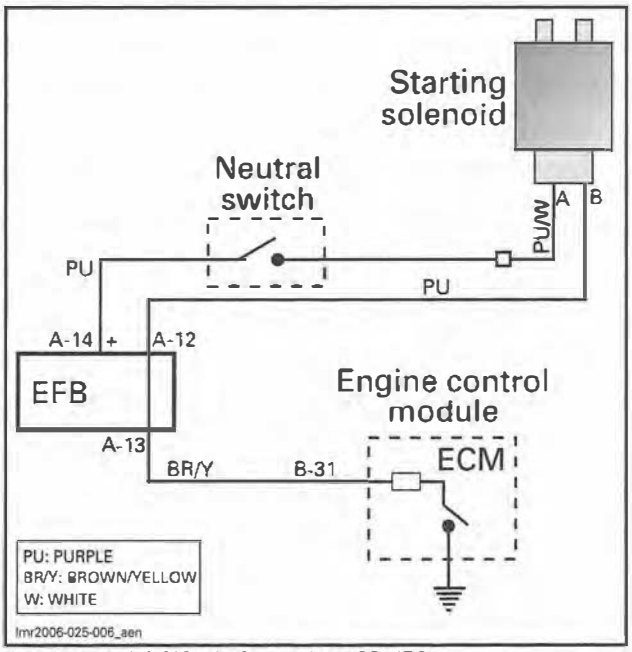
All Models Except 200 Series

These models use only 1 neutral switch mounted on the throttle/shifter controller.

NOTE: The neutral switch used on 210 Series has three wires but only two are used, the third (grey wire) is stored in heat shrink against the other wires, it is not spliced to either wire.

200 Series

These models use 2 neutral switches — one for each engine. They are mounted on the throttle/shifter controller.



EXAMPLE – LOGIC DIAGRAM (200 SERIES)

Neutral Switch Continuity Test

150 and 180 Series

REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 420 277 010)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect the ECM-B connector.
2. Install the ECM adapter tool on ECM connector.
3. Test for neutral switch continuity as per following table.

SHIFTER CONTROLLER POSITION	PROBE		READING
Forward or Reverse	ECM-B pin 40	Battery ground	Open circuit (infinite)
Neutral			Close to 0 Ω

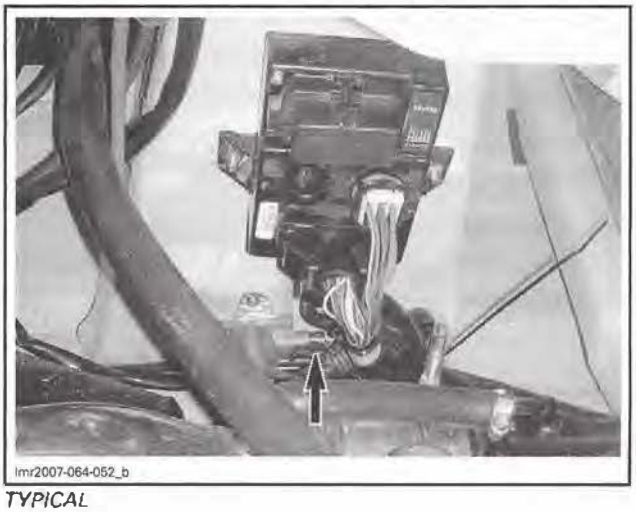
If test fails, carry out a continuity test of the switch and switch circuit. Refer to the applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for circuit details.

Neutral Switch Voltage Test

200 Series

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect starter solenoid connector.

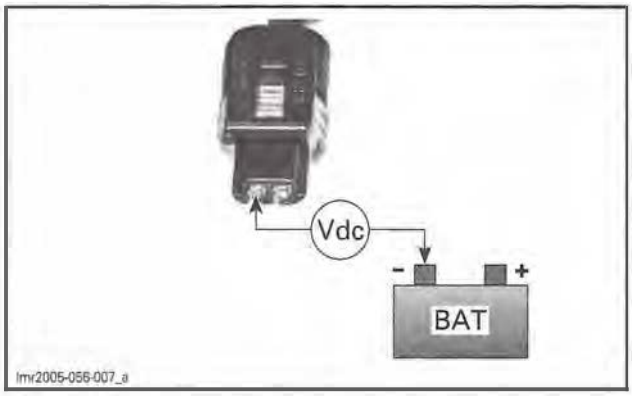


TYPICAL

2. Set main battery cut-off switch to ON.
3. Install tether cord.
4. Set multimeter to Vdc.
5. Measure for voltage as per following table.

SHIFTER POSITION	PROBE		VOLTAGE
Forward or Reverse	Solenoid connector pin A	Battery ground	0 Vdc
Neutral			Battery voltage (1)

(1) If the reading is more than 0.2 Vdc below battery voltage, it indicates the switch is faulty (bad contacts).



If tests succeeded switch circuit is good.

If any test failed, check neutral switch circuit from EFB to starter solenoid. Refer to applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)*.

210 Series

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect starter solenoid connector.
2. Set main battery cut-off switch to ON.
3. Install tether cord on engine cut-off switch.
4. Turn ignition key to ON.
5. Set the multimeter to Vdc.
6. Test for battery voltage at each starter solenoid connector as per following table.

THROTTLE/ SHIFTER LEVER POSITION	PROBE		VOLTAGE
Forward or Reverse	Solenoid connector pin A	Battery ground	0 Vdc
Neutral			Battery voltage (1)

(1) If the reading is more than 0.2 Vdc below battery voltage, it may indicate the switch is faulty (bad contacts).

If no voltage is measured, carry out a continuity test from the starter fuse (F13) through the switch to the starter solenoid. Refer to the applicable *WIRING DIAGRAM* in *WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for circuit details.

230 Series

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

1. Disconnect starter solenoid connector.
2. Set main battery cut-off switch to ON.
3. Install tether cord on engine cut-off switch.
4. Set multimeter to Vdc.
5. Test for battery voltage at each starter solenoid connectors as per following table.

SHIFTER LEVER POSITION	PROBE		VOLTAGE
Forward or Reverse	Solenoid connector pin A	Battery ground	0 Vdc
Neutral			Battery voltage (1)

(1) If the reading is more than 0.2 Vdc below battery voltage, it may indicate the switch is faulty (bad contact).

If no voltage is measured, check circuit continuity from fuse (F13) to starter solenoid. Refer to the applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for circuit details.

STARTER SOLENOID

The starter solenoid is located in the engine compartment near the battery or EFB (as applicable to model).

Solenoid Input Voltage Test (Solenoid Coil)

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)

1. Disconnect starter solenoid connector.
2. Ensure main battery cut-off switch is set to ON.

210 and 230 Series

3. Set ignition switch to ON.

All Models

4. Install tether cord on the engine cut-off switch.
5. Ensure shifter lever is set to NEUTRAL position.
6. Measure voltage as per following table.

SOLENOID INPUT VOLTAGE TEST (SOLENOID COIL)		
SOLENOID CONNECTOR	BATTERY	VOLTAGE READING
Pin A	Negative (-) battery post	Battery voltage

If test succeeded, test/repair the solenoid control circuit.

If test failed, test/repair solenoid input circuit.

Refer to applicable wiring diagram in *2011 WIRING DIAGRAM BOOKLET (P/N 219 100 547)* for circuit details.

Solenoid Resistance Test

REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)

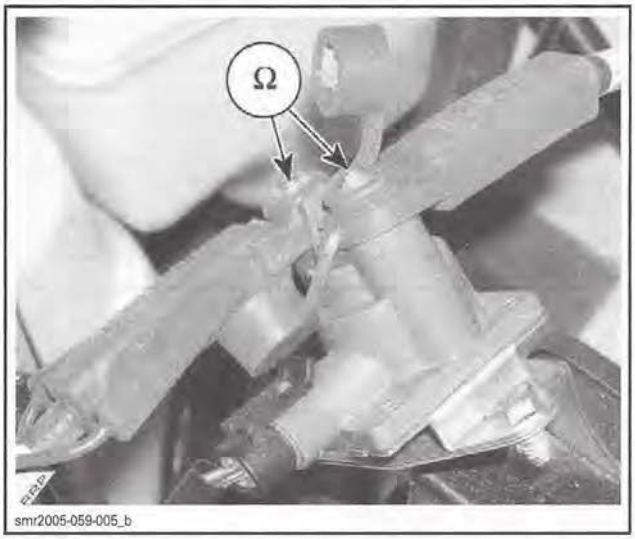
1. Set multimeter to Ω setting.
2. Measure solenoid coil resistance, as follows.

PINS	RESISTANCE
A and B	Approximately 5 Ω

TYPICAL

3. Test solenoid main contact as follows.

SOLENOID POST		RESISTANCE
Solenoid battery post	Solenoid starter post	OL (open circuit)



TYPICAL

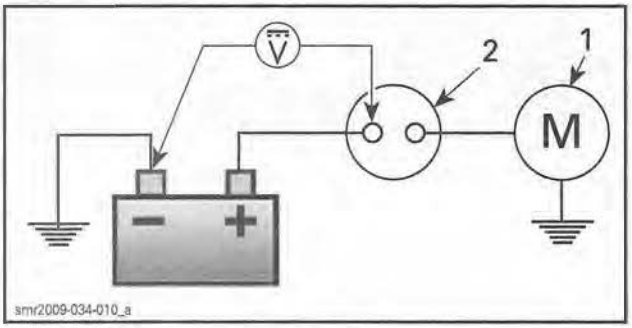
If readings are out of specification, replace solenoid.

If readings are as specified, carry out a *SOLENOID DYNAMIC TEST*.

Solenoid Dynamic Test

1. Remove the following fuses to deactivate ignition and injection and prevent engine starting:
   - Cyl 1
   - Cyl 2
   - Cyl 3.
2. Set multimeter to Vdc.
3. Activate the boat electrical system.
4. Depress the START/STOP button.
5. **While the engine is cranking,** measure for voltage as per following tables.

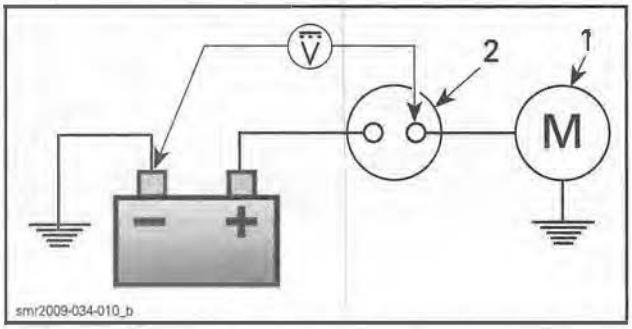
SOLENOID DYNAMIC TEST (ENGINE CRANKING)		
TEST PROBES		VOLTAGE (DC)
Solenoid battery post	Battery ground	Battery voltage



1. *Starter motor*
2. *Starter solenoid*

6. If test failed, check battery and cable from battery to solenoid.
7. If test succeeded, continue with next step.

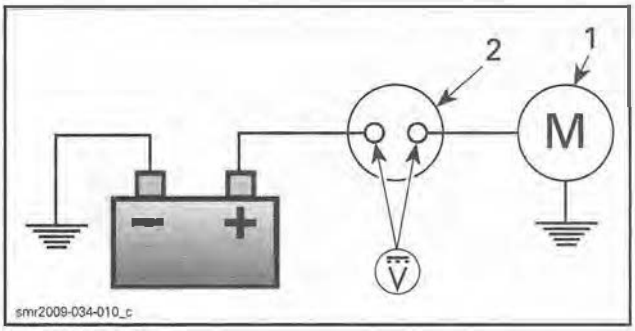
SOLENOID DYNAMIC TEST (ENGINE CRANKING)		
TEST PROBES		VOLTAGE (DC)
Solenoid starter post	Battery ground	Battery voltage



1. *Starter motor*
2. *Starter solenoid*

8. If test failed, replace solenoid.
9. If test succeeded, continue with next step.

SOLENOID DYNAMIC TEST (ENGINE CRANKING)		
TEST PROBES		VOLTAGE (DC)
Solenoid battery post	Solenoid starter post	0.2 Vdc max.



1. *Starter motor*
2. *Starter solenoid*

If test failed, replace solenoid.

If all solenoid dynamic tests are as specified, carry out a *STARTER QUICK TEST*.

10. Reinstall removed parts.

STARTER

Starter Quick Test

To easily bypass the starter solenoid and the start control circuits, proceed as follows.

- Use a fully charged 12 V battery with a capacity of at least 30 A-h.
- Use a set of booster cables to power the starter.

This procedure tests the following:

- Electric starter
- Starter power cable
- Battery to engine ground cable.

⚠ WARNING

Fuel, oil, or electrolyte vapors are flammable and may become explosive if certain conditions are met. These vapors may collect near the bottom of the hull when present. All types of ignition including electrical sparks are to be avoided when maintaining or testing boat.

⚠ WARNING

Always wear safety glasses when working with or around batteries. Be sure to leave the booster battery out of the boat.

1. Connect booster cables in this strict order:

RED booster cable:

- Connect one clip to the starter post on the starter solenoid.
- Connect the other clip to the positive (+) terminal on the external battery.

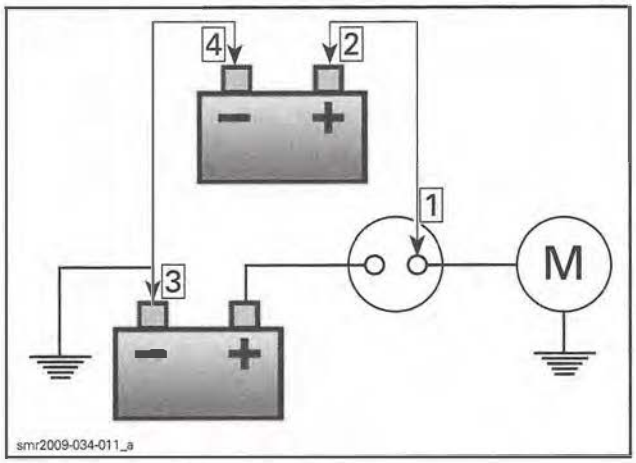
BLACK booster cable:

- Connect one clip to the negative (–) battery terminal in the **boat**.

2. Momentarily apply the second clip to the negative (–) terminal of the **external** battery.

⚠ WARNING

Always use an external battery for this test to prevent any electrical sparks from occurring within the hull. Always make the final connection to the external battery negative (-) terminal using the BLACK booster cable clip. Do not short starter solenoid contacts across the main power connections on the relay with a tool that would cause electrical sparks. Failure to follow this procedure may result in an explosion.



Step 1: Connect cable to solenoid starter post
Step 2: Connect cable to vehicle battery positive post
Step 3: Connect cable to external battery negative post
Step 4: Make a momentary contact

If engine does not crank (or cranks slowly), check the following:

- Booster cable connections
- Vehicle battery ground cable connections to engine
- Starter power cable/connections from solenoid to starter
- Carry out a *SOLENOID DYNAMIC TEST*.

If the above items all test good, replace the starter.

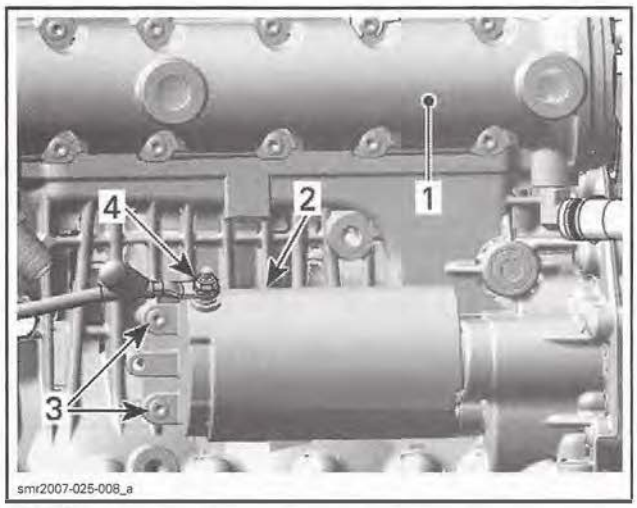
Starter Removal

1. Disconnect battery.

⚠ WARNING

Always disconnect the BLACK (-) battery cable first and reconnect last.

2. Disconnect starter power cable.
3. Remove starter retaining screws.



TYPICAL
1. Exhaust manifold
2. Starter
3. Starter retaining screws
4. Starter power cable retaining nut

Starter Gear Removal

1. Remove starter.
2. Remove and discard gear retaining circlip.
3. Pull out starter gear.

1. Retaining circlip
2. Starter gear

Starter Gear Installation

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

Use a new circlip.

Starter Installation

1. Installation is the reverse of the removal procedure. However, pay particular attention to the following.
2. Ensure starter and engine mating surfaces are free of debris. Serious problems may arise if starter is not properly aligned.
3. Apply ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021) on starter O-rings.

1. Apply Isoflex grease Topas NB 52

Install starter.

NOTE: If starter does not mesh properly with the intermediate gear: Pull starter out, slightly rotate the starter gear then reinstall the starter. Temporarily removing both O-rings makes it easier to align both gears. Once gears are aligned, remove starter to install O-rings being careful not to rotate starter gear out of position, then reinstall the starter.

4. Secure starter to engine.

STARTER RETAINING SCREWS	
PRODUCT	TIGHTENING TORQUE
LOCTITE 243 (BLUE) (P/N 293 800 060)	10 N•m (89 lbf•**in**)

5. Connect the RED positive cable to the starter.

TIGHTENING TORQUE	
Starter cable nut	7 N•m (62 lbf•**in**)

6. Apply DIELECTRIC GREASE (P/N 293 550 004) on terminal and nut.
7. Install rubber protector over starter power cable retaining nut.
8. Reinstall all other removed parts.

DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.)

GENERAL

SYSTEM DESCRIPTION

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *COMMUNICATION TOOLS AND B.U.D.S.*

The D.E.S.S. system allows starting the engine only with a tether cord(s) that has a D.E.S.S. key programmed to operate that specific boat.

NOTE: If desired, the tether cord can be used on another boat equipped with the D.E.S.S. It only needs to be programmed for the other boat.

The following components are specially designed for this system: ECM, D.E.S.S. key and engine cut-off switch.

The tether cord cap contains a magnet and a ROM chip.

- The magnet actually closes the reed switches inside the engine cut-off switch, which is the equivalent of a mechanical ON/OFF switch.
- The chip has a unique digital code, which is the equivalent of the notch pattern on a conventional key.

The D.E.S.S. system is quite flexible. It allows several keys to be programmed into the memory of the ECM. They can also be erased individually.

The memory of the ECM is programmed to recognize the digital code of each D.E.S.S. key. The programming is achieved using the B.U.D.S. software.

D.E.S.S. Key Beeper Codes

When the tether cord is installed on the engine cut-off switch and the START button is pressed, the D.E.S.S. key is identified by the ECM and coded beeper signals are emitted according to the key recognition. See table:

BEEPER	SIGNIFICATION
2 short beeps	Indicates the D.E.S.S. recognizes the key.
1 long beep	Indicates the D.E.S.S. does not recognize the key.
	Indicates the D.E.S.S. cannot read the key (dirty or improperly installed tether cord).
4 short beeps at different intervals	Indicates the tether cord has been left on the engine cut-off switch without the engine running. Remove tether cord to prevent battery discharge.

IMPORTANT: On twin engine sport boats, the first beep(s) are from the LH engine. Then, the RH engine will emit its beep(s).

Other beeps can be heard. The ECM features a self-diagnostic mode. Refer to *DIAGNOSTIC AND FAULT CODES* for more information.

D.E.S.S. Key Reminder

If the engine the is not started within 5 seconds after installing the tether cord on the engine cut-off switch, 4 very short beeps every 30 second interval will sound to remind you to start the engine or to remove the tether cord. The same will occur when the tether cord is left on the engine cut-off switch 5 seconds after the engine(s) is stopped.

NOTE: The beeps stop only when the tether cord is removed, the main cut-off switch is turned off or the battery is discharged.

Always ensure tether cord is not left on the engine cut-off switch after the engine(s) is stopped.

IMPORTANT: Leaving the tether cord on the engine cut-off switch when the engine is not running will slowly discharge the battery.

PROCEDURES

D.E.S.S. KEY

D.E.S.S. Key Programming

Adding a Key

1. Connect to the latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

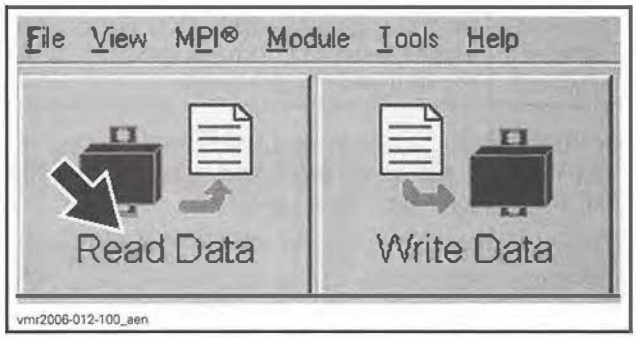
IMPORTANT: Ensure all connections have been made before starting B.U.D.S. to allow proper operation.

2. Start B.U.D.S. and logon.

⚠ 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.

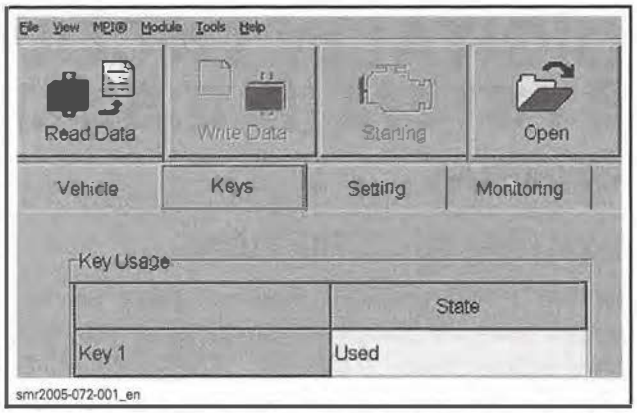
3. Read ECM using **Read Data** button.



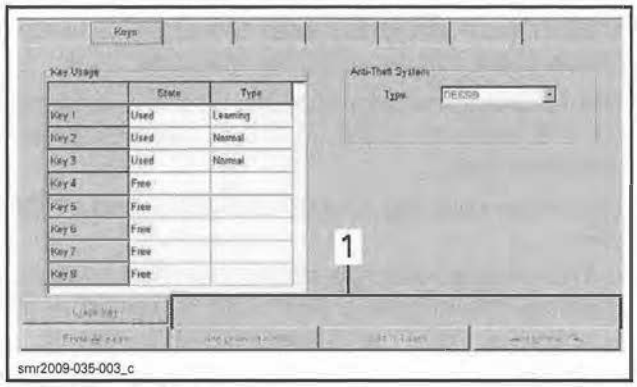
4. Install the new D.E.S.S. key (tether cord) to be programmed on the D.E.S.S. post interface.

D.E.S.S. POST INTERFACE

5. Click on **Keys** tab.



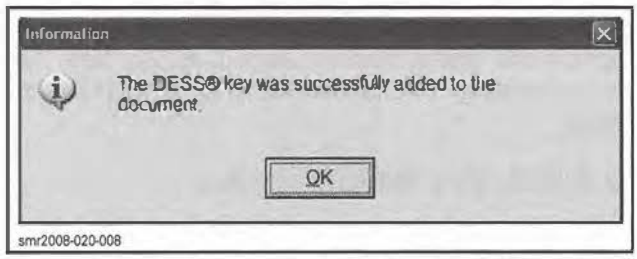
6. Click on the **Add Normal Key** button at the bottom of the screen according to the type of key you want to program.



1. Add Key buttons

NOTE: Use only the **Add Normal Key** button.

When this window pops up, a new key has been saved in the computer.

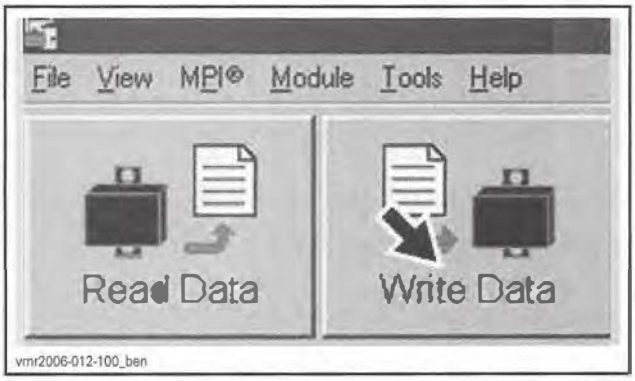


7. Remove key from D.E.S.S. post interface and install it on the vehicle engine cut-off switch.

NOTE: To program other key(s), click again on the desired Add Key button.

8. When key programming is complete, be sure to save the new data in the ECM using the **Write Data** button so that the programming becomes effective.

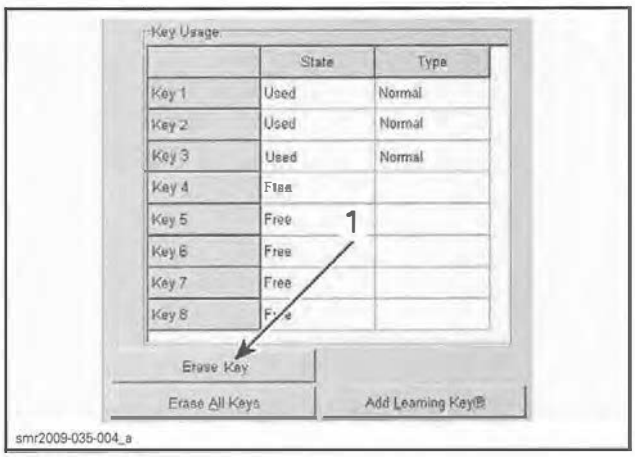
NOTE: On twin engine sport boats, program the same key(s) to each engine individually.



Erasing a Key

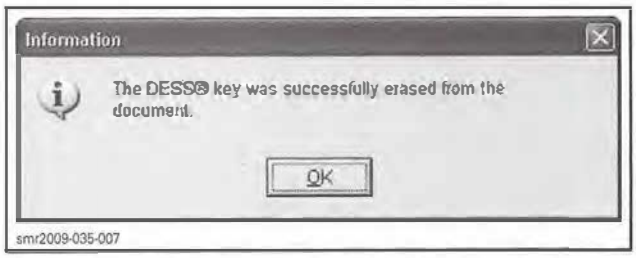
Carry out same procedure as for Adding a Key except for the following:

1. Click on Erase Key button at bottom of B.U.D.S. screen.



TYPICAL
1. Click on this button

After approximately 10 seconds the following message will appear.



The key is now erased in the PC computer.

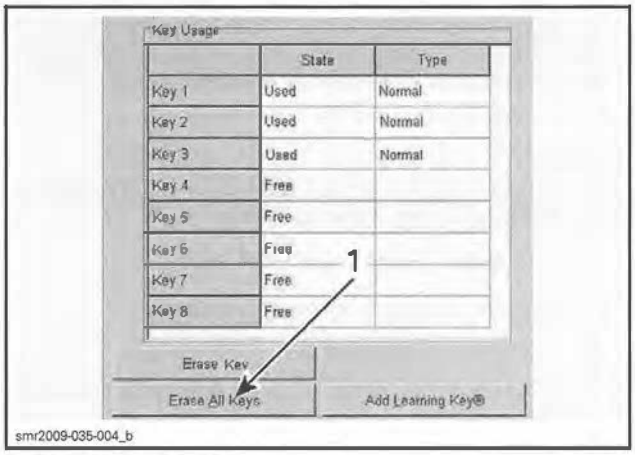
2. If programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

Erasing Another Key

1. Install the following tether cord to be erased on the MPI or D.E.S.S. post interface.
2. Click on Erase Key button.
3. If programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

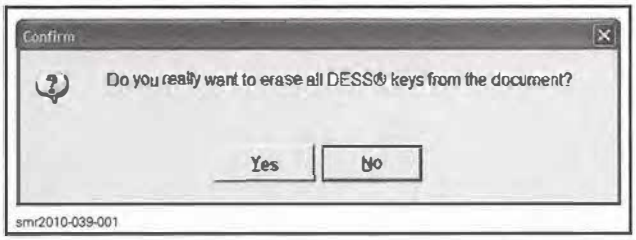
Erasing All Keys

1. Click on Erase All Keys button at bottom of screen.



1. Click on this button

NOTE: The following message will be displayed in B.U.D.S.



2. Click "Yes" to proceed with erasing all keys.
3. When done, program at least one new key to the vehicle. Refer to *ADDING A KEY* in this subsection.

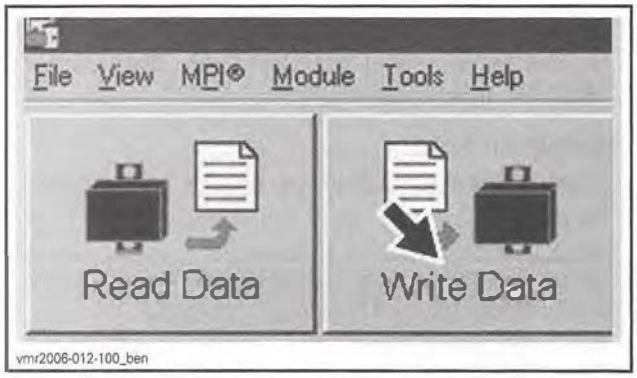
NOTE: If there isn't at least one key programmed to the boat, B.U.D.S. will not allow you to write the changes to the ECM and will prompt you to add a key.

4. When programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

Writing Changes to ECM

Save the changes made in B.U.D.S. into the ECM as follows.

1. Click the Write Data button.



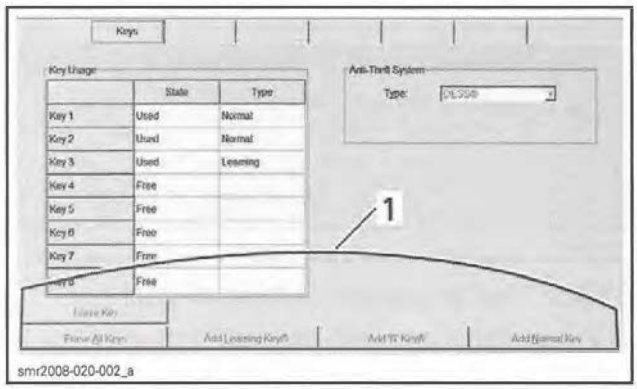
NOTE: If for some reason the writing operation fails, exit B.U.D.S. Restart B.U.D.S. and reenter all the previously lost information.

2. Try the tether cord(s) on the boat.

Key Programming Troubleshooting

If all buttons are greyed out in Keys tab:

- The batteries in the D.E.S.S. post interface are weak.
- The batteries are not installed.
- The D.E.S.S. post interface was connected after B.U.D.S. has been started.



1. All buttons greyed out

Install new batteries as required.

In all cases, exit B.U.D.S., ensure the D.E.S.S. post interface is properly connected, then restart B.U.D.S.

BEEPER

Beeper Troubleshooting

If no beep is heard when installing the tether cord on the engine cut-off switch, but the engine can be started, refer to *INSTRUMENTS AND ACCESSORIES* subsection to check beeper operation.

INSTRUMENTS AND ACCESSORIES

SERVICE TOOLS

Description	Part Number	Page
LARGE HOSE PINCHER	529 032 500	365

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON TERMINAL REMOVER	TT600-4	359

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	355, 368–370

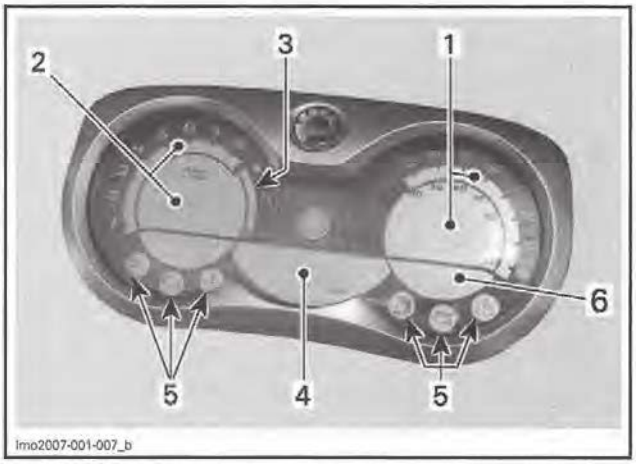
GENERAL

INFORMATION CENTER DESCRIPTION (150 AND 180 SERIES)

This is a multifunction gauge that supplies several real time useful information to the driver either in English, French or Spanish.

At start-up, all LCD segments and indicator lights will turn on for 3 seconds each time the information center is activated (when tether cord is installed). This allows the driver to validate they are all working properly.

NOTE: Gauge is illuminated whenever the navigation lights are used.



1. *Speedometer*
2. *Tachometer*
3. *Fuel level*
4. *Information display*
5. *Indicator lights*
6. *Water temperature display*

Speedometer

Speedometer indicates the speed of the boat in miles per hour (MPH) or kilometers per hour (km/h).

Tachometer

Tachometer indicates the revolutions per minute (RPM) of the engine. Multiply by 1000 to obtain the actual revolutions.

Fuel Level

Bar gauge that continuously indicates the amount of fuel left in the fuel tank while riding.

Information Display

FUNCTION	DESCRIPTION
Compass	Displays the cardinal points to indicate the orientation of the boat.
Hourmeter (HR)	Displays the time in hours of the boat usage.
Water Temperature Display	Displays the water temperature of the water surface in degrees Celsius (°C) or Fahrenheit (°F).
Water Depth Display (150 Speedster only)	Display the water depth under the hull within 0 m to 50 m (0 ft to 170 ft). NOTE: Under certain conditions, the gauge may stop displaying. The gauge ability to display the depth depends on the usage conditions.
Message Code	Displays a message code whenever one of the following circumstances occurs. The abbreviations between parenthesis here are the codes displayed.

MESSAGE CODE	
ABBREVIATION	DESCRIPTION
(H-TEMP)	Engine or exhaust system overheating.
(OIL)	Low or high oil pressure in the engine.
(12 V LOW)	Low battery voltage.
(12 V HI)	High battery voltage.
(FUEL-LOW)	Low fuel level.
(MAINT)	Maintenance reminder.
(CHK ENG)	Check engine.
(SENSOR)	Sensor failure (boat electronic equipment).
(KEY)	Invalid tether cord (D.E.S.S. key).
Additional Information	A beeper will sound and indicator light will blinks depending on the fault occurring to catch the driver attention when necessary.

Indicator Lights

	Low oil pressure (OIL)
	Check engine (CHK ENG)
	Engine or exhaust system overheating (H-TEMP)
	Low fuel level (FUEL-LOW)
	Low/high battery voltage (12 V LOW/HI)
	Maintenance reminder (MAINT)

INFORMATION CENTER DESCRIPTION (210 AND 230 SERIES)

The information center is a cluster of gauge, indicator lights and a digital screen to display operational information to the operator.

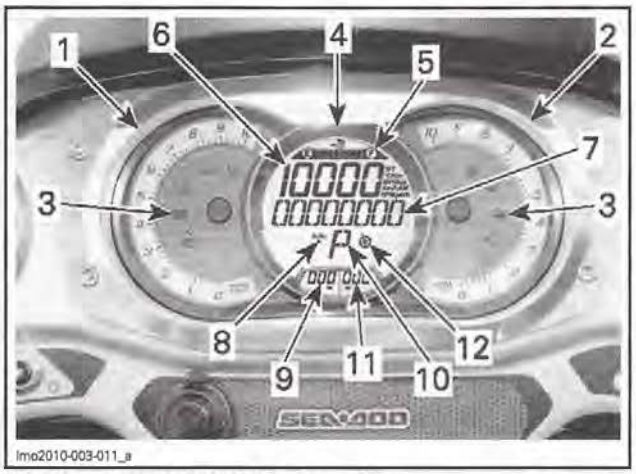
The text message can be displayed in 3 different languages and the units of measurement can be displayed in metric or imperial units.

It allows the operator to view at a glance several indications such as, engines RPM, fuel level and engine temperature. The gauge can also be used to navigate through and select several functions, modes of operation and change certain settings and system parameters.

Indicator lamps advise the operator of selected functions or malfunctions.

The gauge incorporates a GPS (global positioning system) that it uses for the compass and speedometer indications, and provides signals to other systems as required for their operation.

Should a fault be detected during the self-test function, an error message will be displayed, an indicator light may come on, and an audible signal (beep code) may be heard to signal that a fault has been detected.



INFORMATION CENTER FUNCTIONS
1. *Tachometer (Port Engine)*
2. *Tachometer (Starboard Engine)*
3. *Indicator lights*
4. *Digital screen*
5. *Fuel level*
6. *Numerical display*
7. *Multifunction display*
8. *Depth sounder indicator*
9. *Hour meter display (Port Engine)*
10. *Engine (P = Port, S = Starboard)*
11. *Hour meter display (Starboard Engine)*
12. *Compass*

Tachometer

The tachometers provide an analog indication of the revolutions per minute (RPM) of the engines. Multiply the indicated number by 1000 to obtain the actual engines RPM.

Indicator Lights

Indicator lights (pilot lamps), located in the tachometers, inform you of a selected function, a normal condition or a system anomaly.

An indicator light may be accompanied by a scrolling message in the multifunction display.

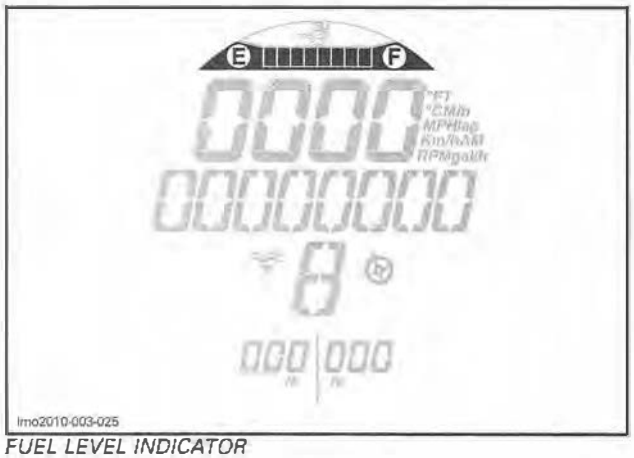
See table below for usual pilot lamp information.

PILOT LAMPS	MESSAGE DISPLAY	DESCRIPTION
LH TACHOMETER		
SKI MODE	–	When turn ON: SKI MODE is engaged. When blinking: SKI MODE is selected but not engaged
CRUISE	–	CRUISE mode engaged
	MAINTE-NANCE REMINDER	Maintenance required

PILOT LAMPS	MESSAGE DISPLAY	DESCRIPTION
RH TACHOMETER		
SYNC	–	Indicate both engines turn at the same RPM
	LOW-FUEL	Low fuel level, approx. 25% tank capacity 41.6 L (11 U.S. gal.)
	–	Good GPS uplink

Fuel Level

A bar gauge located on the top of the digital screen continuously indicates the amount of fuel in the fuel tank while riding.



FUEL LEVEL INDICATOR

When the fuel tank is full, 8 segments (bars) of the indicator are turned on.

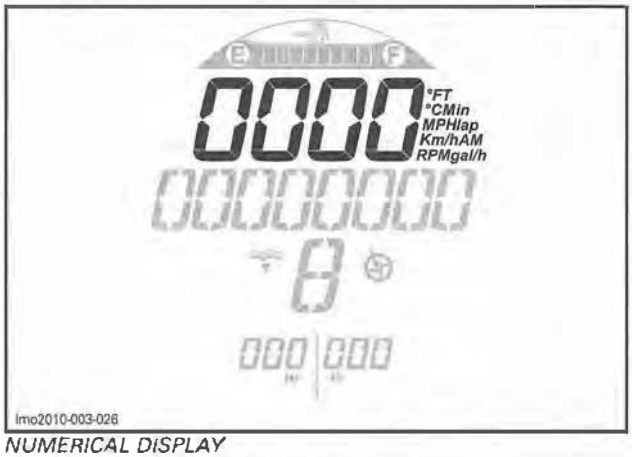
When there is only 2 segments of fuel indicated (approximately 25% fuel tank capacity or 41.6 L (11 U.S. gal.), the low fuel indicator light will come on to advise you of the low fuel condition.

An audible warning (one long beep) will be heard periodically as long as the low fuel condition exists.

Numerical Display

The numerical display is used to provide a variety of indications as per selection made from the DISPLAY function in the multifunction display:

- Water depth
- Engines RPM
- Boat speed
- Fuel consumption (instant and average)
- Remaining fuel range (distance and time)
- Engines temperature
- Altitude
- Top and average speed
- Top and average engines RPM
- Clock.



NUMERICAL DISPLAY

When the information center is first powered up, the numerical display defaults to the last function chosen by the operator from the multifunction display.

The numerical display is also used to display various system mode settings such as:

- SKI MODE setting
- CRUISE setting
- LAP TIME setting.

Multifunction Display

When the boat is being operated, the multifunction display provides an indication of compass heading or scrolling messages from the monitoring system.

It also displays a menu for the selection of various functions which, permit changing the numerical display indication, system modes of operation, settings, and displaying system fault codes.

⚠ WARNING

Selecting various numerical displays, system modes of operation or changing settings should only be carried out with the boat stopped. Selecting these various functions while operating the boat at speed is not recommended as it deters your attention from situational awareness.

MULTIFUNCTION DISPLAY - COMPASS HEADING INDICATED

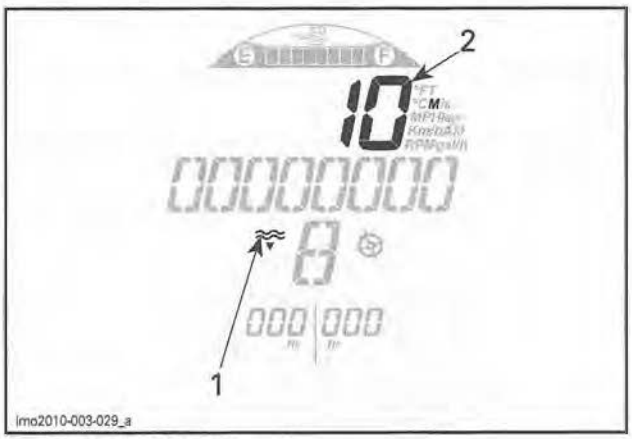
Depth Sounder Indicator

The numerical display can be selected to provide an indication of the water depth.

The system is capable of indicating water depth under the hull in single increments up to 50 m (164 ft).

NOTE: Under certain conditions, the digital screen may stop displaying. The digital screen's ability to display the depth depends on the conditions of use.

To activate depth indication, refer to *CHANGING NUMERICAL DISPLAY INDICATION* in this subsection.



1. Depth finder indicator
2. Water depth indication

⚠ WARNING

Never use the depth sounder as a warning device to ride in shallow water.

Hour Meter Display (HR)

Continuously displays the time in hours of the boat engines usage.

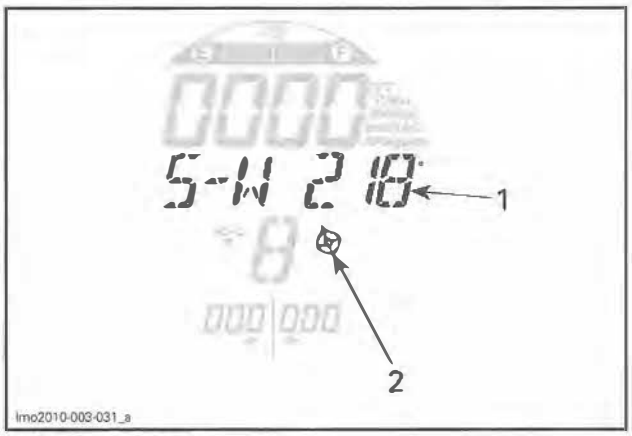
HOUR METER
1. Port side
2. Starboard side

Compass

A GPS incorporated in the information center provides the indication in the multifunction display.

The cardinal points, intermediate cardinal points, as well as the azimuth the boat is travelling are displayed in the multifunction display by default when the boat is moving.

For a compass indication to be displayed, the GPS must have a good link with the navigation satellites. This is confirmed when the COMPASS active indicator is visible in the digital screen.



1. Compass indication
2. Compass active indicator

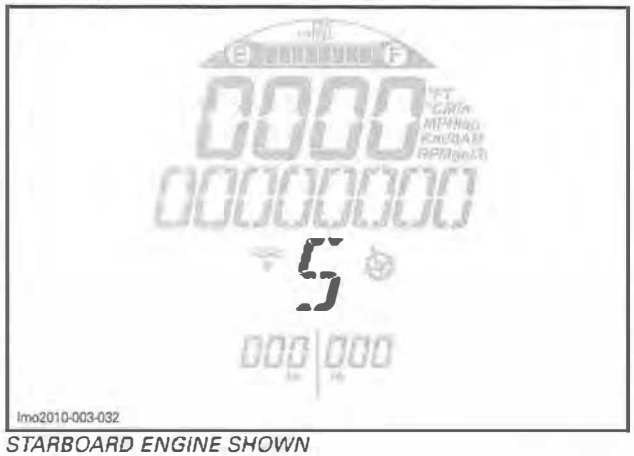
NOTE: The compass indication is only available above 5 km/h (3 MPH).

⚠ WARNING

Use the compass as a guide only. Not to be used for precision navigation purposes.

Engine Identification

Identify which engine is associated with the information from the numerical display.



STARBOARD ENGINE SHOWN
P = PORT
S = STARBOARD

Selecting Functions

When operating at speed, the multifunction display normally provides an indication of the compass direction and azimuth the boat is traveling.

To select the various functions available through the multifunction display, press the MODE button repeatedly until the desired function is visible:

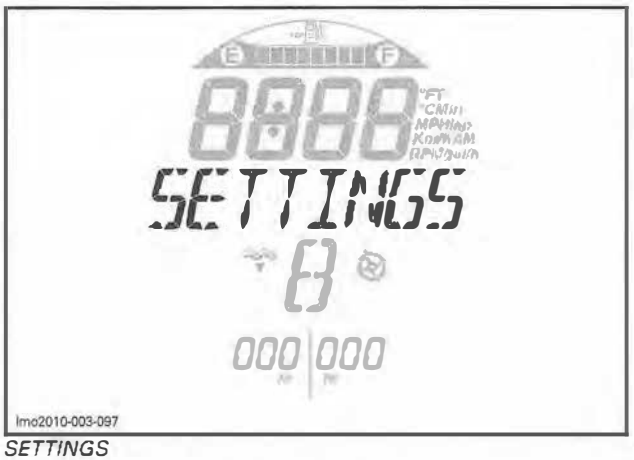
- SKI MODE
- CRUISE MODE
- DOCKING
- LAP TIME
- DISPLAY
- FUEL ECONOMY
- FAULT CODES
- SETTINGS
- SYNCHRONIZATION.

Then press the SET button to enter that function.

NOTE: The fault code function is available only when there is an active fault. The settings function is only available when the engine is shut off. The synchronization function is shown only. It can not be modified.

Changing Clock

1. Press MODE button repeatedly until SETTINGS is displayed.



SETTINGS

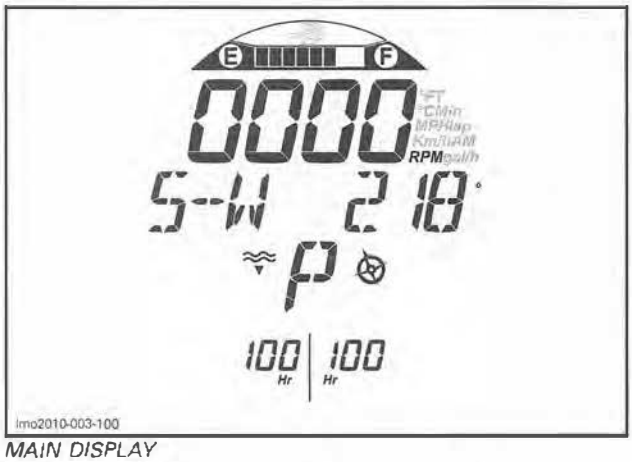
2. Press the SET button to validate your choice. The hour and the message CLOCK will be displayed.

CLOCK

3. Press the SET button again, the message CHANGE CLOCK will be displayed.

CHANGE CLOCK

4. Use UP and DOWN switch to adjust the clock.
5. Press MODE or SET button to save the clock and return to the main display.



MAIN DISPLAY

Changing Numerical Display Indication

To change the indication in the numerical display, press the MODE button repeatedly until DISPLAY is visible in the multifunction display.

DISPLAY MENU

Move switch stem up or down until the preferred indication selection is visible in the multifunction display.

Press the SET button to select and save the preferred indication, or wait for the display function to time out. The last indication visible will be automatically save. The numerical display will then switch to the new indication with a small abbreviation of the indication type to its right:

- FT or M
- RPM
- MPH or Km/h
- °F or °C
- Lap
- Gal/h or L/h
- Min
- AM or PM.

For example, to display the ALTITUDE information:

- Press the MODE button repeatedly until DISPLAY is displayed
- Then press SET button once
- Lift up the UP and DOWN switch until ALTITUDE is displayed
- And finally, press SET button to confirm and save your selection.

Lap Time Mode

The lap timer can be used to record up to 50 individual lap times.

The Lap Time mode is a chronograph to compile intermediate times after your rides. You can see any individual lap times or the total of lap times.

To activate and use the lap timer, carry out the following:

1. Press MODE button repeatedly until LAP TIME is displayed.

LAP TIME

2. Press the SET button once to confirm your selection. The first lap timer will be displayed.

FIRST LAP TIMER

3. When ready, press the SET button to start the lap timer.

LAP TIMER STARTED

NOTE: The timer starts immediately when pressing the SET button.

4. To record each lap time, press the SET button at the start of each lap.

NOTE: The lap time will be recorded, the lap counter (in numerical display) will count the number of laps recorded, and the timer will continue to run.

5. To save the last lap time and stop the timer, press the MODE button.

To verify the recorded lap times, use the UP and DOWN switch to toggle through all lap times.

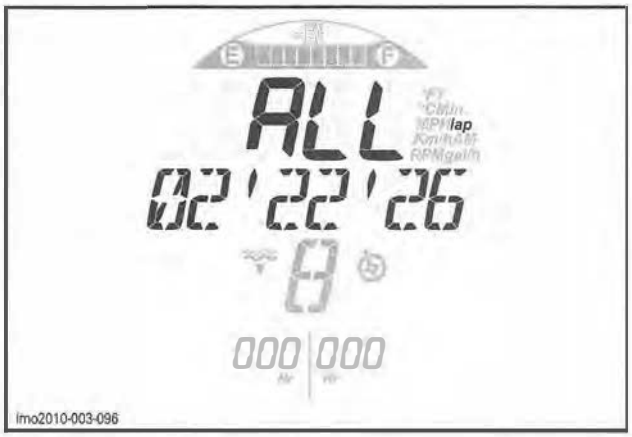
To reset an individual lap time:

1. Using the UP and DOWN switch, go to the lap time to be reset.

2. Press and hold the SET button until the lap time is reset.

To reset all lap times:

1. Using the UP and DOWN switch, go to ALL.



2. Press and hold the SET button until the time is reset to 0 (zero).

Fuel Economy Mode

The iTC (intelligent Throttle Control) system allows to maintain a steady speed and constant RPM to reduce fuel consumption.

To engage the fuel economy mode:

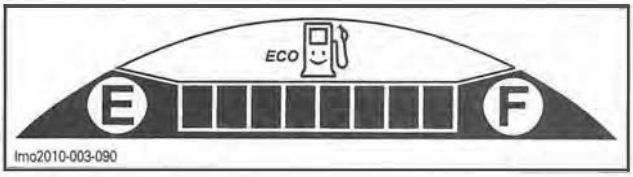
1. Press MODE button repeatedly until FUEL ECONOMY MODE is displayed.

FUEL ECONOMY MODE

2. Press the SET button once, the following message will be displayed "FUEL ECONOMY MODE - PRESS SET to activate or MODE to exit".

3. Press and hold the SET button until FUEL ECONOMY MODE reappears.

To confirm the Fuel Economy mode, the symbol ECO is displayed on the LH of the smiling fuel tank.



To cancel the fuel economy mode:

1. Move throttle/shifter handle in NEUTRAL position.
2. Press the MODE button.

TROUBLESHOOTING

DIAGNOSTIC TIPS

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

IMPORTANT: When troubleshooting an electrical system fault, check battery condition, cables and connections first.

Circuit Testing

Make sure the main battery cut-off switch is ON for testing.

Check the related-circuit fuse condition with a fuse tester or ohmmeter (a visual inspection could lead to a wrong conclusion).

Electrical Connection Inspection

When replacing an electric or electronic component, always check electrical connections. Make sure they are tight, make good contact, and are corrosion-free. Dirty, loose or corroded contacts are poor conductors and are often the source of a system or component malfunction.

Pay particular attention to ensure that pins are not bent or pushed out of their connectors.

Ensure all wire terminals are properly crimped on wires, and connector housings are properly fastened.

Check for signs of moisture, corrosion or dullness. Clean pins properly and coat them with DIELECTRIC GREASE (P/N 293 550 004) or other appropriate lubricant when reassembling them, except if otherwise specified such as for the ECM connectors.

Pay attention to ground wires.

PROCEDURES

INFORMATION CENTER (150 AND 180 SERIES)

Information Center Self Test Function

When the tether cord cap is installed on the engine cut-off switch, all LCD segments and indicator lights in the information center will turn ON for 3 seconds (self test function). This self test function allows the driver time to ensure that all indications are functioning properly.

It also validates the information centers internal circuits, however, this does not validate proper operation of the individual external circuits and sensors that provide inputs to the information center.

If a system fault is detected by the ECM, the applicable message and/or indicator light will be displayed, and a beep code may be heard.

If the tether cord is not installed, the indications in the information center will shut off a few seconds after the self test function, but the electrical system power stays on for approximately 3 minutes. Installing the tether cord on the engine cut-off switch will turn the indications back on.

NOTE: If the START/STOP button is pressed and held without the tether cord installed, the information center will stay on as long as the START button is held.

Information Center Access

150 Series

To access the information center connector, open the front storage compartment, then remove the storage bin.

180 Series

Pull out dashboard.

Information Center Removal

150 Series

To access information center retaining screws, remove trim by sliding a chamfered wooden coffee stick between trim and information center, in line with the locking tabs, see illustrations.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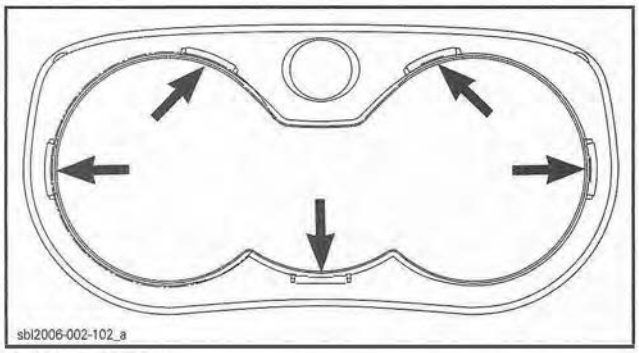
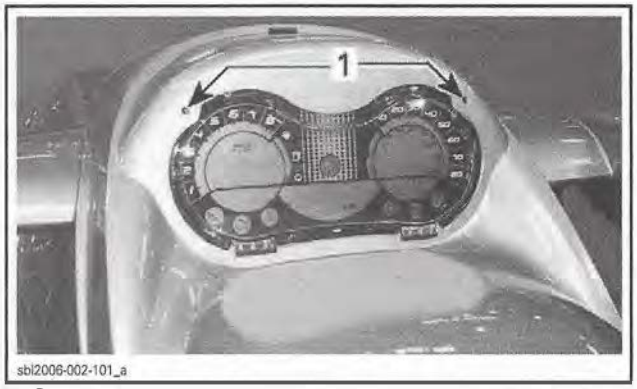


TAB LOCATION

Remove the retaining screws, then remove information center.



TYPICAL
1. Retaining screws

180 Series

Pull out dashboard and remove the retaining screws from behind.

Information Center Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	A	RED/BLUE
Ground	B	BLACK
CAN HI	C	WHITE/RED
CAN LOW	D	WHITE/BLACK

INFORMATION CENTER (210 AND 230 SERIES)

Information Center Self Test Function

When the ignition key is turned ON, all LCD segments and indicator lights in the information center will turn **ON for 3 seconds** (self test function). This self test function allows the driver time to ensure that all indications are functioning properly.

It also validates the information centers internal circuits, however, this does not validate proper operation of the individual external circuits and sensors that provide inputs to the information center.

If a system fault is detected by the ECM, the applicable message and/or indicator light will be displayed, and a beep code may be heard.

Information Center Access

Open the starboard bow backrest.

Open the cover.

Information Center Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	1	PURPLE
CAN HI	2	WHITE/RED
CAN LOW	3	WHITE/BLACK
Illumination	4	BLUE
Analog speedometer signal	6	RED
Mode button	7	BLACK
Set button	8	BLACK
Ground	11	BLACK
Power 12 Vdc	12	RED/BLUE
Display up/down switch	16	WHITE
Display up/down switch	17	GREEN
Port fuel sending unit	19	PINK
Port fuel sending unit	20	PINK/BLACK

SPEEDOMETER (210 AND 230 SERIES)

The speed indication is based on a GPS (Global Positioning System) incorporated within the information center.

Speedometer Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	RED
Ground	5	BLACK
Speed signal	8	RED
Ground	4	BLACK
Illumination	3	BLUE

Speedometer Access

Open the starboard bow backrest.

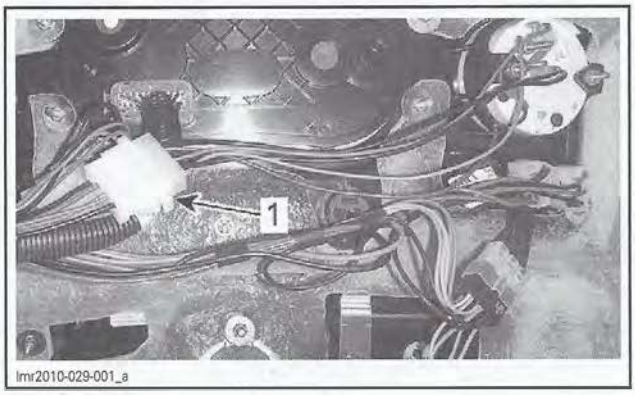
Open the cover.

Speedometer Voltage Test

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Read voltage as per following table.

SPEEDOMETER CONNECTOR (main harness side)		MEASUREMENT
WIRE		VOLTAGE
RED (pin 2)	BLACK (pin 5)	12 Vdc



TYPICAL
1. Speedometer connector

If voltage is not as specified, test positive and negative circuits separately.

If voltage and ground are good and speedometer is still not working, check speed signal wire.

SPEEDOMETER (200 SERIES)

Speedometer Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	PURPLE
Ground	4	BLACK
Speed signal	8	WHITE
Speed signal ground	5	WHITE/BLACK
Illumination	3	BLUE

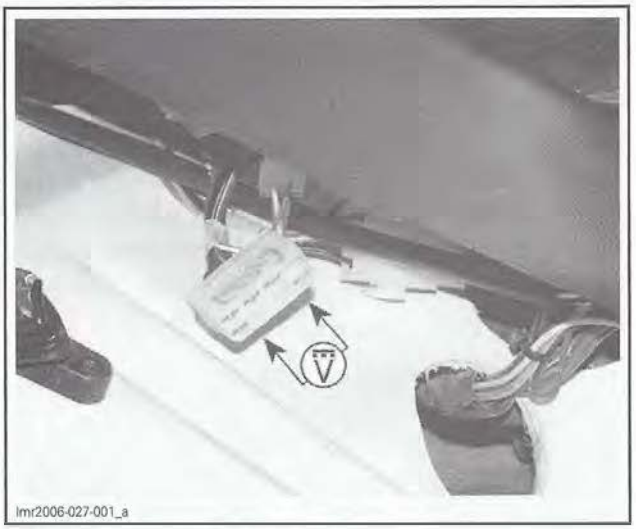
Speedometer Voltage Test

Disconnect gauge connector.

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Read voltage as per following table.

SPEEDOMETER CONNECTOR (main harness side)		MEASUREMENT
WIRE		VOLTAGE
PURPLE	BLACK	12 Vdc



TYPICAL

If voltage is inadequate, test positive and negative circuits separately.

If voltage is appropriate and gauge is not working, check speed sensor as described in this subsection.

If speed sensor tests good and gauge is still not working, check signal wires.

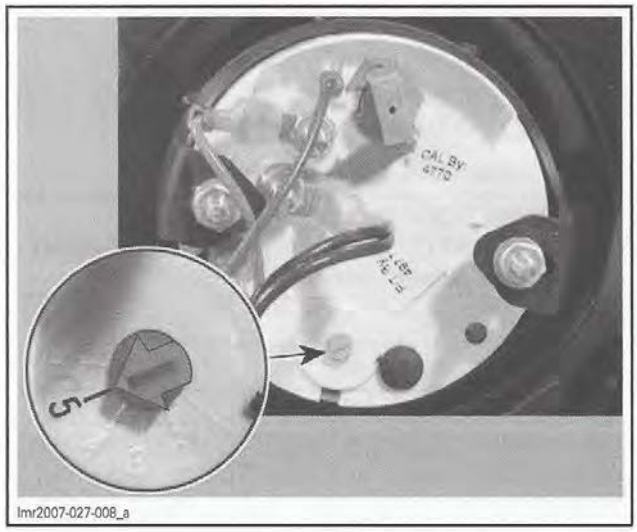
Speedometer Calibration

If you suspect that a speedometer on a boat is not accurate, check it by using a GPS to validate the speed. Comparing speeds over long runs on smooth water will yield better results.

If the indicated speed is too high or low with respect to the GPS, the speedometer can be adjusted to a more accurate setting.

To adjust the speedometer, pull up dashboard to gain access to the rear of the speedometer head.

Make sure the selector switch is pointing to the number "5".



Remove the rubber plug just below the speedometer mounting stud and insert a 2 mm Allen wrench into the adjustment pot.

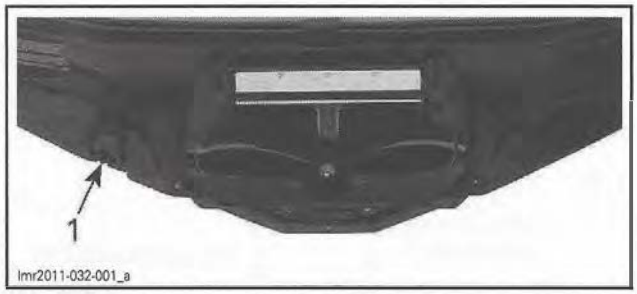
Turning clockwise will increase indicated speed, and counterclockwise will decrease indicated speed.

Make small adjustments then compare speedometer and GPS readings. Adjust as required.

Reinstall rubber plug when finished then secure dashboard.

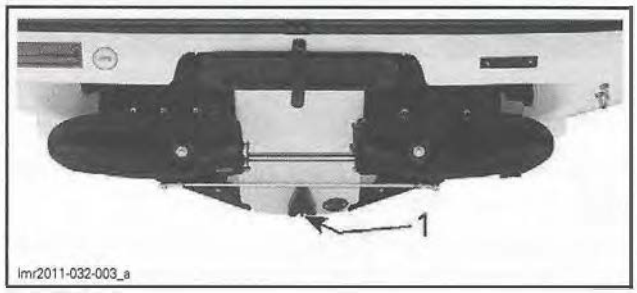
SPEED SENSOR (ALL EXCEPT 210 AND 230 SERIES)

The speedometer gets a signal from a speed sensor. It works with the water flow which turns a magnetic paddle wheel that triggers an electronic pick-up that sends the signal.



150 SERIES
1. Speed sensor

180 SERIES
1. Speed sensor



200 SERIES
1. Speed sensor

Spray water on paddle wheel using a garden hose.

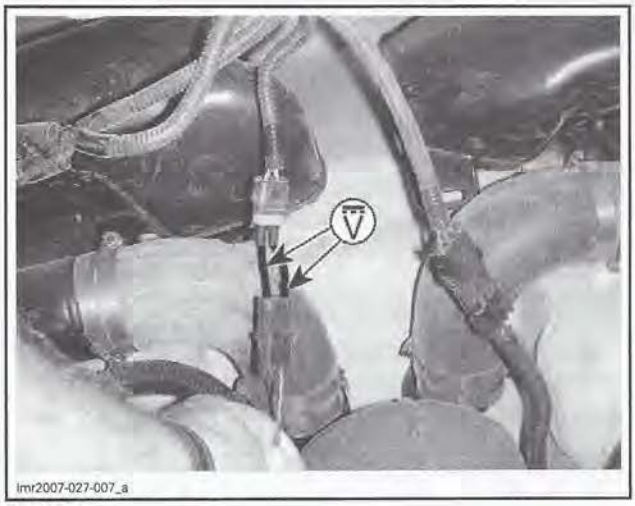
Speedometer should display some speed. Otherwise, disconnect the speed sensor connector housing from inside bilge.

NOTE: The wheel should turn freely. Otherwise inaccurate speed will be displayed.

Using a SNAP-ON TERMINAL REMOVER (P/N TT600-4), remove wires from position "A" and "B" in tab housing of speed sensor.

Reconnect wires in receptacle housing.

Connect multimeter to speed sensor wires and set it to Vdc.



TYPICAL

TEST CONDITION	SENSOR CONNECTOR TERMINAL		READING (Vdc)
Slowly rotate paddle wheel	A	B	Fluctuation within 5.5 - 8.5

TACHOMETER (200 SERIES)

Tachometer Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	PURPLE
Ground	5	BLACK
Tachometer signal	7	GRAY
Illumination	3	BLUE

Tachometer Voltage Test

Disconnect gauge connector.

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Read voltage at boat harness as per following table.

TACHOMETER CONNECTOR (main harness side)		MEASUREMENT
WIRE		VOLTAGE
PURPLE (pin 2)	BLACK (pin 3)	12 Vdc

If voltage is not as specified, test positive and ground separately.

Engine RPM Signal

NOTE: The tachometer signal initially comes from the CPS, goes to the ECM, to the EFB and then to the VCM using the communication link (CAN lines). Finally the VCM sends the signals to the tachometer.

Set the multimeter to frequency function (Hz VDC).

Probe as per following table.

Start engine.

PROBE		FREQUENCY (HZ)
GRAY wire (pin 7) boat harness side	Ground	1/10 the engine RPM

ANALOG FUEL GAUGE (210 AND 230 SERIES)

NOTE: The starboard fuel level sender, is connected to the analog fuel gauge and the port sender is connected to the information center for the digital fuel gauge.

Fuel Gauge Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	RED
Ground	5	BLACK
Fuel level input	8	PINK
Illumination	3	BLUE

Fuel Gauge Operation Test

Disconnect the starboard fuel pump/fuel level sender connector.

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Momentarily jump the PINK (pin B) and PINK/BLACK (pin C) wires together. Results should be as per table.

CONNECTOR (boat harness side)	FUEL GAUGE READING
Wires jumped together	Full
Open connector	Empty

If "FULL" is not reached on the gauge, check wiring/connectors. If they test good, replace gauge.

If "FULL" is reached on the gauge, gauge is working correctly. Check fuel sender resistance, refer to *FUEL GAUGE AND FUEL PUMP.*

Fuel Gauge Input Voltage Test

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Back-probe connector and read voltage as per following table.

ANALOG FUEL GAUGE CONNECTOR		MEASUREMENT
WIRE		VOLTAGE
RED (pin 2)	BLACK (pin 5)	12 Vdc

If there is no voltage, check wiring/connectors.

If voltage is as specified and gauge is not working, check fuel level sender as described in *FUEL TANK AND FUEL PUMP* subsection.

ANALOG FUEL GAUGE (200 SERIES)

NOTE: Although each fuel pump module has its own fuel level sender, only the port sender is connected to monitor fuel level.

Fuel Gauge Wire Identification

FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	1	PURPLE
Ground	3	BLACK
Fuel level input	5	PINK
Fuel level input	4	PINK/BLACK
Illumination	2	BLUE

Fuel Gauge Operation Test

Enable electric circuits.

Disconnect the port fuel pump/fuel level sender connector.

Momentarily jump the PINK (pin B) and PINK/BLACK (pin C) wires together. Results should be as per table.

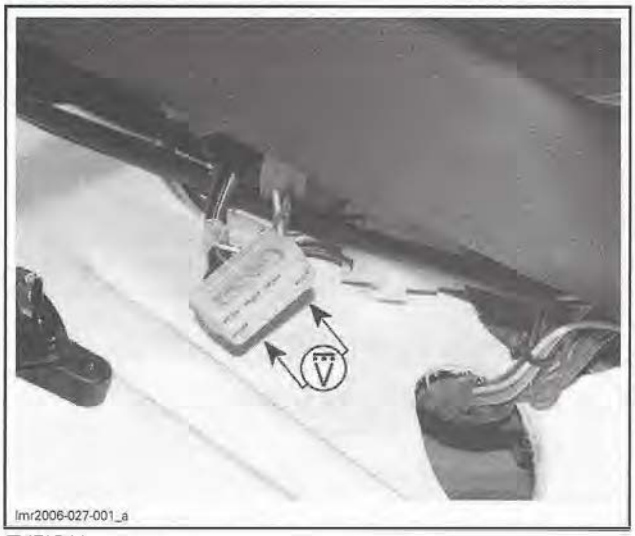
CONNECTOR (boat harness side)	FUEL GAUGE READING
Wires jumped together	Full
Open connector	Empty

If "FULL" is not reached on the gauge, check wiring/connectors. If they test good, replace gauge.

If "FULL" is reached on the gauge, gauge is working correctly. Check fuel sender resistance, refer to *FUEL TANK AND FUEL PUMP.*

Fuel Gauge Input Voltage Test

Disconnect gauge connector. Install tether cord to engine cut-off switch. Read voltage from boat harness. It should be 12 Vdc.



TYPICAL

If there is no voltage, check wiring/connectors.

If voltage is appropriate and gauge is not working, check fuel level sender as described in *FUEL TANK AND FUEL PUMP* subsection.

MONITORING GAUGE (200 SERIES ONLY)

Monitoring Gauge Wire Identification

Port Side

FUNCTION	PIN	WIRE COLOR
Common power supply	4	RED/BLUE
CHK engine	1	GREEN
HI temp	3	PURPLE
Low oil	6	YELLOW
Low battery	7	RED

Starboard Side

FUNCTION	PIN	WIRE COLOR
Common power supply	4	PURPLE
CHK engine	1	RED
HI temp	3	PURPLE
Low oil	6	YELLOW
Low battery	7	RED

Monitoring Gauge Voltage Test

When enabling electrical circuits, all lamps will turn on for a brief moment. This confirms their operation.

Otherwise, unplug cluster connector.

Individually validate the lamps supply from VCM as follows:

- Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.
- Read voltage between wires as per table.

GAUGE CONNECTOR		LAMP	**MEASUREMENT**
PINS			VOLTAGE Vdc
4	1	CHK engine	Battery voltage
	3	HI temp	
	6	Low oil	
	7	Low battery	

TYPICAL

NOTE: Perform the voltage reading quickly before the VCM stops sending the test signal to the lamps. Reinstalling tether cord will re-initialize the VCM.

BEEPER (200 SERIES)

Beeper Access

Pull out dashboard.

Beeper Operation Test

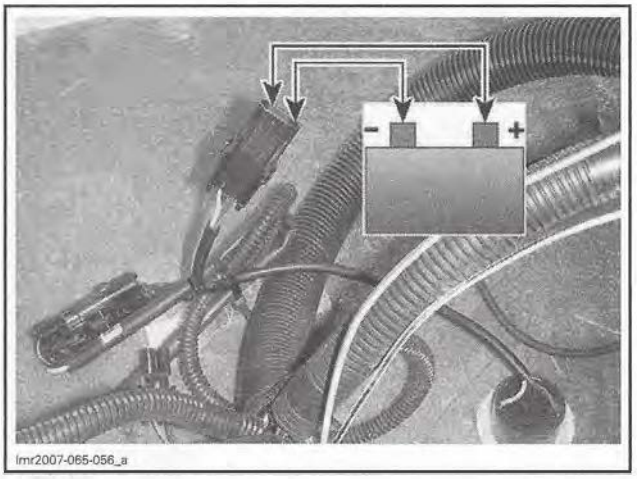
If no beep is heard when installing tether cord to engine cut-off switch, first check "gauges" fuse on EFB and ensure EFB is powered.

Disconnect beeper connectors.

Connect wires to an external 12 V battery as per table.

NOTE: Reverted wires will not allow beeper operation.

WIRE (BEEPER SIDE OF HARNESS)	BATTERY POST
PURPLE/TAN	Positive
TAN/BLACK	Negative



TYPICAL

If beeper does not sound, replace beeper.

If beeper works, check wires and connectors between ECM and beeper.

RADIO

Radio Troubleshooting

If the radio does not work:
- Check 12 volt input.
- Check ground circuit.

If radio is powered but there is no sound, check the radio power amplifier.

NOTE: On audio systems with an external amplifier, if the radio turns on but there is no sound, refer to *RADIO POWER AMPLIFIER* in this subsection.

Radio Power Source Identification

150 AND 180 SERIES		
WIRE COLOR	PIN	SUPPLY
ORANGE	C 085 pin 1	Fuse 5 of Accessories fuse block

200 SERIES		
WIRE COLOR	PIN	SUPPLY
ORANGE	C 085 pin 1	VCM

210 SERIES		
WIRE COLOR	PIN	SUPPLY
ORANGE	C 085 pin 1	Ignition switch pin C

230 SERIES		
WIRE COLOR	PIN	SUPPLY
ORANGE	C 085 pin 1	Breaker G (breaker panel)

Radio Ground Identification

ALL MODELS		
WIRE COLOR	PIN	CONNECTED TO
BLACK	C 085 pin 2	Console ground block

RADIO AMPLIFIER (210 AND 230 WAKE ONLY)

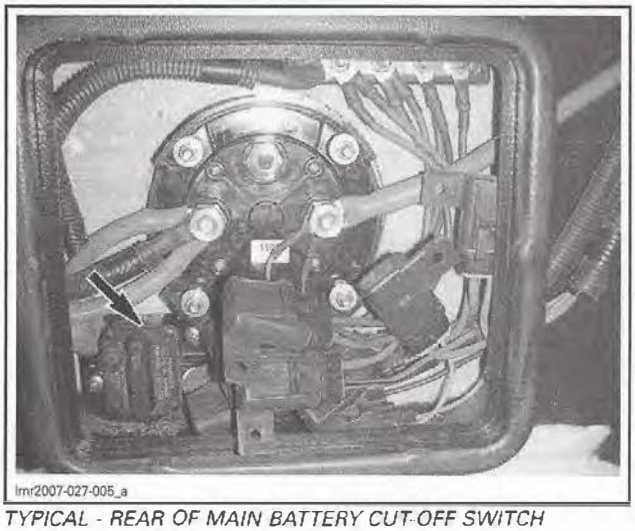
Radio Amplifier Troubleshooting

If there is no sound coming out from the tower speakers, check the power amplifier 12 volt input, ground circuit, RCA cables and amplifier power-up wire.

Radio Amplifier Power Source Identification

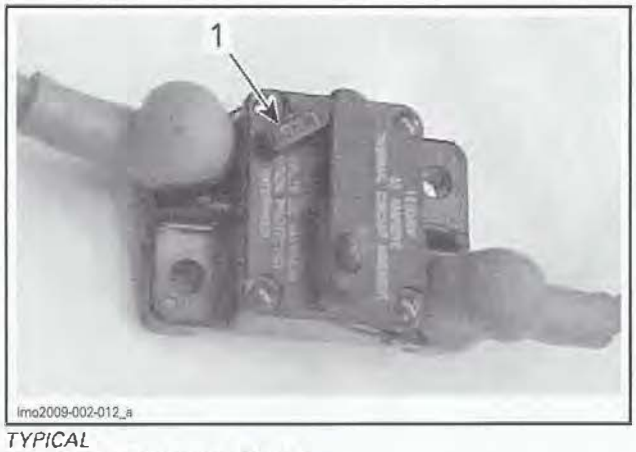
210 AND 230 WAKE		
WIRE COLOR	CONNECTOR	SUPPLY
ORANGE	C 001	High amperage circuit breaker

The radio amplifier breaker is located behind main battery cut-off switch.



TYPICAL - REAR OF MAIN BATTERY CUT-OFF SWITCH

To reset an open breaker, push the lever in.



TYPICAL
1. Reset lever out (open circuit)

Radio Amplifier Ground Identification

210 AND 230 WAKE		
WIRE COLOR	CONNECTOR	CONNECTED TO
BLACK	C 002	Console ground block

Radio Amplifier Power Signal

The power signal wire should supply voltage to the amplifier any time the radio is on.

210 AND 230 WAKE		
WIRE COLOR	CONNECTOR	CONNECTED TO
ORANGE	C 003	Radio pin C004

DEPTH SOUNDER (ALL EXCEPT 200 SERIES)

Boat must be in the water to allow proper operation of depth sounder.

The depth sounder transducer communicates with the information center through CAN.

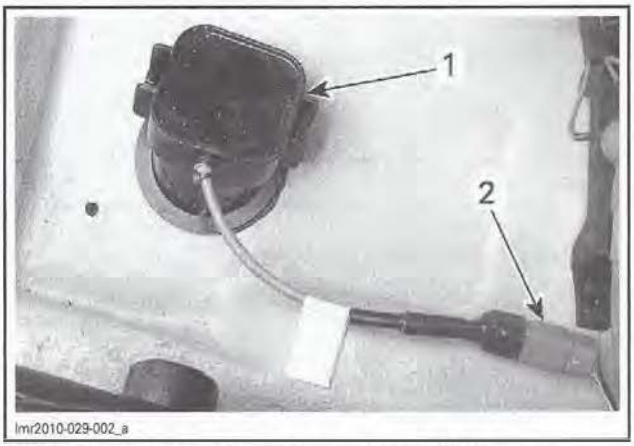
Depth Sounder Wire Identification

FUNCTION	WIRE COLOR
Power 12 Vdc	PURPLE (from fuse 3 of fuse block 1)
Ground	BLACK (to engine ground)
Transducer signal (CAN HI)	WHITE/RED
Transducer signal (CAN LOW)	WHITE/BLACK

Depth Sounder Voltage Test

Make sure fuse 3 of fuse block 1 is good.

1. Disconnect transducer connector.



BOTTOM OF HULL IN ENGINE COMPARTMENT
1. Depth sounder transducer
2. Connector

2. Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.
3. Measure voltage as per table.

DEPTH SOUNDER TRANSDUCER VOLTAGE TEST		
TEST PROBES		RESULT
PURPLE (pin 1)	BLACK (pin 2)	Battery voltage

If voltage is not as specified, test positive and ground separately, repair wiring/connectors if necessary.

DEPTH SOUNDER (200 SERIES)

Boat must be in the water to allow proper operation of depth sounder.

Depth Sounder Transducer Location

On all models, the depth sounder transducer is installed on the bottom of hull in the engine compartment.

DEPTH SOUNDER TRANSDUCER LOCATION	
MODEL	LOCATION
150 series	Port side near battery
180 series	In front of engine, port side
200 series	Underneath starboard engine
210 and 230 series	Port side near fuse box

Depth Sounder Wire Identification

FUNCTION	WIRE COLOR
Power 12 Vdc	PURPLE (common gauges power supply from starboard EFB)
Ground	BLACK (common gauges ground to console ground block)
Transducer signal	2 wires

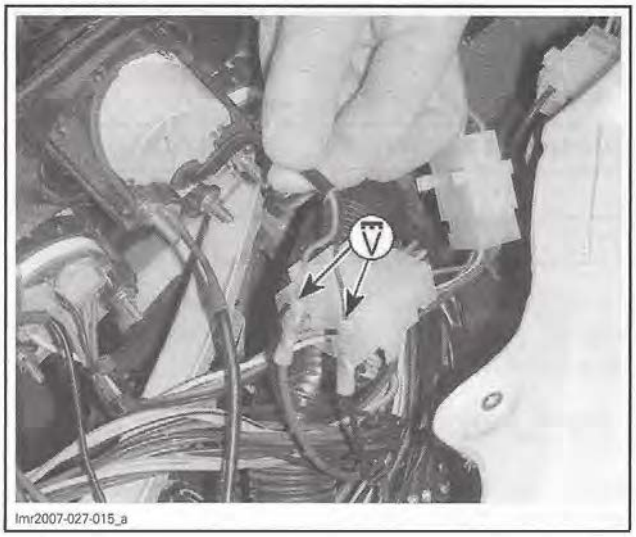
Depth Sounder Voltage Test

Check voltage to depth sounder as follows.

Pull out dashboard.

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Probe splice connectors and read voltage as shown.



If there is 12 Vdc and gauge does not turn on, try a new depth sounder.

If voltage is not good, check wiring/connectors. If they test good, check wires from starboard EFB.

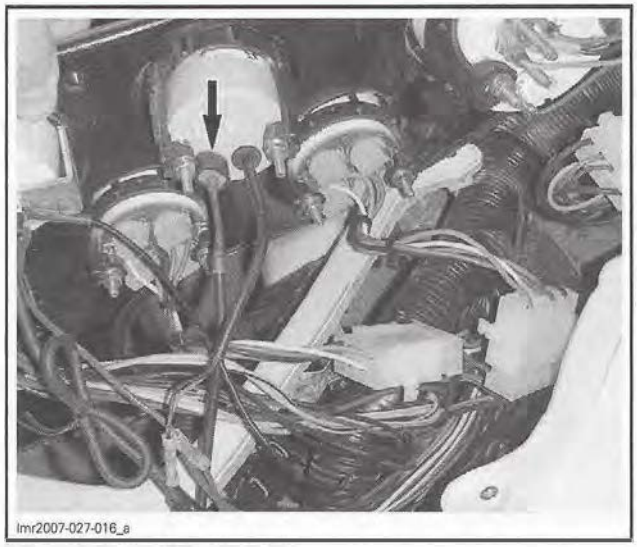
Depth Sounder Transducer Signal

If depth sounder turns on but displays 2 dashes (– –), it means that it does not receive any signal from the transducer.

The possible causes are:

- Transducer not plugged to depth sounder
- Defective transducer wiring
- Faulty transducer.

Check if transducer wire is properly connected to the depth sounder.



TRANSDUCER CONNECTOR

If wiring is good and depth sounder always display 2 dashes (– –), replace transducer.

HEATER UNIT (210 AND 230 WAKE ONLY)

Heater Blower Voltage Test

First ensure main cut-off switch is turned on and 10 A fuse is good.

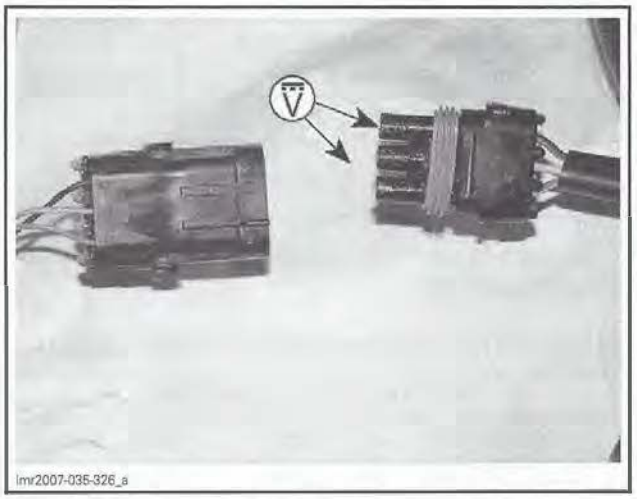
Remove seat.

Disconnect heater blower connector.

Enable electrical system. Refer to *POWER DISTRIBUTION* subsection.

Read voltage as follows.

SWITCH POSITION	**HEATER BLOWER CONNECTOR (boat harness side)**		READING
	TERMINAL		
L	C	B	Battery voltage
H	C	A	



If voltage is as specified, try a new fan motor.

If voltage is not read, test positive and ground separately.

Heater Blower Switch Access

Open the starboard bow backrest.

Open the cover.

Heater Blower Switch Test

Heater Blower Switch Input Voltage Test

Set multimeter to Vdc and read voltage.

TERMINAL		READING
5	Battery ground	Battery voltage

If voltage is not as specified, problem is in wiring or connectors from battery.

If voltage is good, test switch output.

Heater Blower Switch Output Voltage Test

Set multimeter to Vdc and back-probe switch as follows.

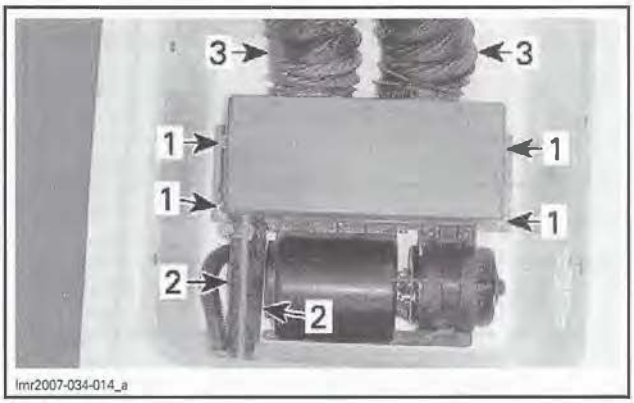
SWITCH POSITION	TERMINAL		READING
L	1 (ORANGE wire)	Ground	Battery voltage
H	4 (RED wire)		

If switch failed any test, replace by a new one.

Heater Unit Removal

Remove the LH rear seat cushion.

Remove screws that attach heating unit on body.



1. *Screws*
2. *Coolant hoses*
3. *Heating ducts*

Detach heating hoses from the unit.

REQUIRED TOOL
LARGE HOSE PINCHER (P/N 529 032 500)

Disconnect cooling hoses from the heating unit.

Lift the unit and unplug the heating fan connector.

Heating Unit Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Refill the cooling system. Refer to *COOLING SYSTEM* subsection.

ELECTRIC BILGE PUMP

Bilge Pump Operation

NOTE: The European models have 2 bilge pumps.

Automatic Mode

The bilge pump has a direct 12 volt input from the battery. It is powered at all times.

In the automatic mode, a built-in float switches the bilge pump on when water level rises in the bilge.

Manual Mode

The manual mode is enabled when the electrical system is powered and the main cut-off switch is ON.

To run the bilge pump in manual mode, turn on the switch located at helm.

Bilge Pump Access

Access the engine compartment, refer to *ENGINE REMOVAL AND INSTALLATION.*

The bilge pump is located on the bottom of the hull.

BILGE PUMP LOCATION	
MODEL	LOCATION
150, 180 and 200 series	At the rear of engine, port side
210 and 230 series	Between engines, near transom

Bilge Pump Operation Test (Automatic Mode)

Flood bilge pump area using a garden hose.

Pump should automatically run. Otherwise, check the in-line 3 A fuse.

If fuse is good, carry out the *BILGE PUMP INPUT VOLTAGE TEST (AUTOMATIC MODE).*

Bilge Pump Input Voltage Test (Automatic Mode)

Disconnect bilge pump connector.

Flood bilge pump area using a garden hose.

Set multimeter to Vdc and read voltage as per table.

BILGE PUMP CONNECTOR (boat harness side)		READING
TERMINAL		
A (BROWN/RED wire)	C (BLACK)	Battery voltage

If voltage is not as specified, test positive and ground separately.

Bilge Pump Input Voltage Test (Manual Mode)

Before testing, check the fuse or circuit breaker.

BILGE PUMP CIRCUIT PROTECTION	
150 and 180 Series	Fuse 2 of accessories fuse block
200 Series	Fuse 4 of VCM
210 and 230 Series	Circuit breaker A

Test voltage as follows:

1. Disconnect bilge pump connector.
2. Enable electric circuits.
3. Turn bilge pump switch ON.
4. Set multimeter to Vdc and read voltage as per table.

BILGE PUMP CONNECTOR (boat harness side)		READING
TERMINAL		
B (BROWN)	C (BLACK)	Battery voltage

If voltage is not as specified, test positive and ground separately.

Bilge Pump Switch Wire Information

150, 180 AND 200 SERIES		
FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	BROWN/RED
Output to pump (manual mode)	3	BROWN
Illumination ground	7	BLACK
Illumination power	8	BLUE

210 AND 230 SERIES		
FUNCTION	PIN	WIRE COLOR
Illumination ground	1	BLACK
Power 12 Vdc	5	BROWN/RED
Output to pump (manual mode)	6	BROWN

Bilge Pump In-line Diode Test

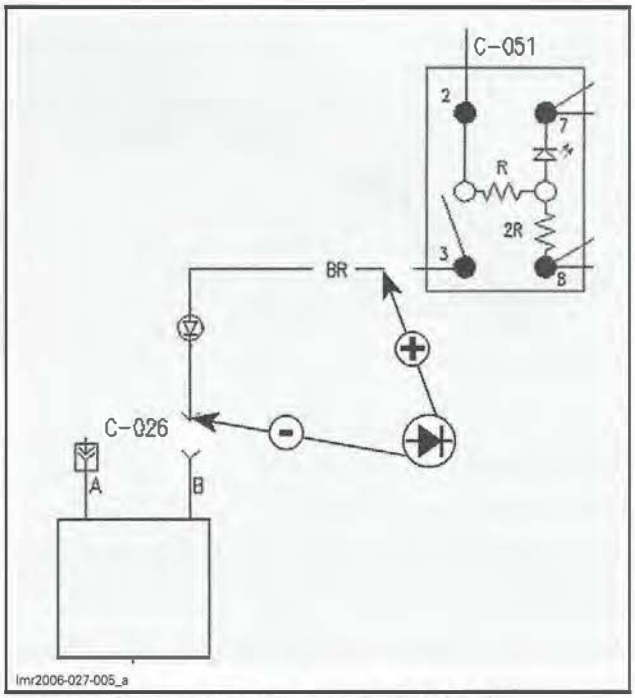
The in-line diode is located in the accessory harness near helm.

NOTE: A continuously burnt bilge pump fuse may be caused by a faulty diode.

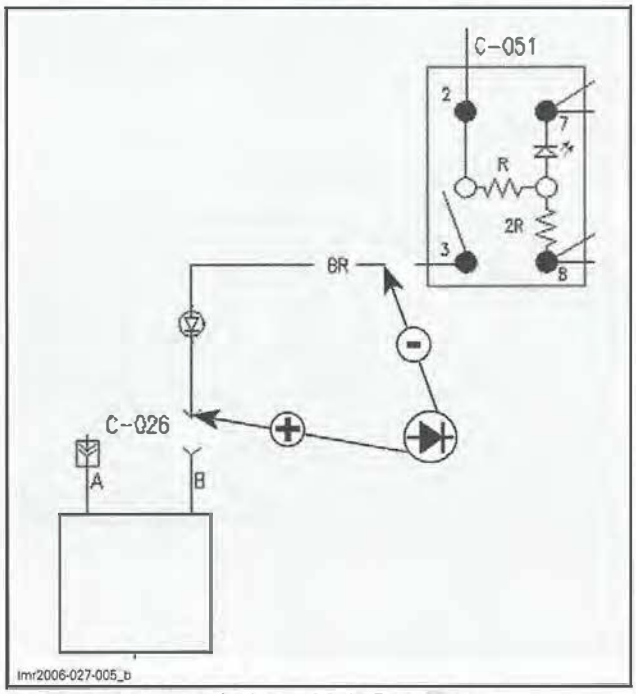
Test as follows:

1. Disconnect bilge pump connector.
2. Disconnect bilge pump switch connector.
3. Set multimeter to diode check.
4. Probe as illustrated.

NOTE: Respect polarity.



TYPICAL - READING SHOULD BE AROUND 0.5 V



TYPICAL - READING SHOULD BE OPEN CIRCUIT

If readings are not specified, replace diode.

BILGE BLOWER

Bilge Blower Access

Access the engine compartment, refer to *ENGINE REMOVAL AND INSTALLATION*.

Bilge Blower Input Voltage Test

Before testing, check the fuse or circuit breaker.

BILGE BLOWER CIRCUIT PROTECTION		
150 and 180 Series	Fuse 1 of fuse block 1	-
200 Series	10 A fuse in the gauge interface	5 A in-line fuses (1 per blower)
210 and 230 Series	Circuit breaker B	5 A in-line fuses (1 per blower)

Test voltage as follows:

1. Disconnect bilge blower connector.
2. Enable electric circuits.
3. Turn bilge pump switch ON.
4. Set multimeter to Vdc and read voltage as per table.

BILGE BLOWER CONNECTOR (boat harness side)		READING
TERMINAL		
A (BROWN/YELLOW)	B (BLACK)	Battery voltage

If voltage is not as specified, test positive and ground separately.

Bilge Blower Switch Wire Information

150, 180 AND 200 SERIES		
FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	BROWN/YELLOW
Output to blower	3	BROWN/YELLOW
Illumination ground	7	BLACK
Illumination power	8	BLUE

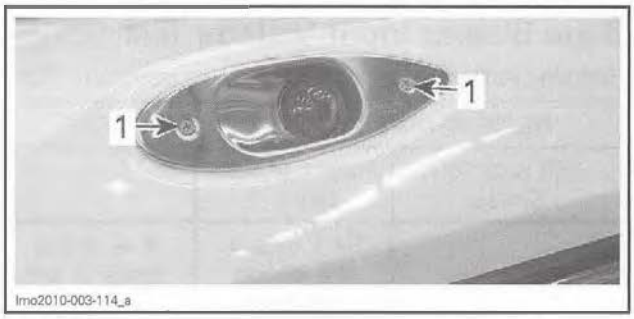
210 AND 230 SERIES		
FUNCTION	PIN	WIRE COLOR
Illumination ground	1	BLACK
Power 12 Vdc	5	BROWN/YELLOW
Output to blower	6	BROWN/YELLOW

BOW LIGHT

Bow Light Bulb Replacement

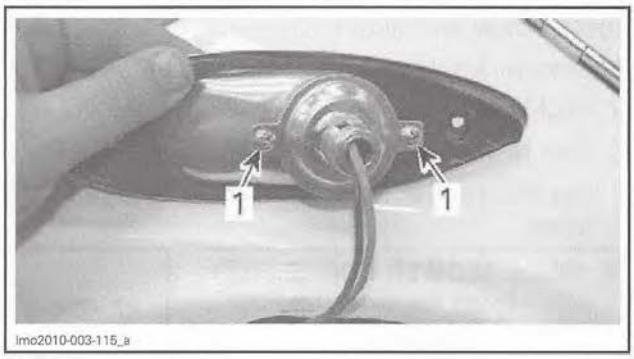
150, 210 and 230 Series

Remove screws securing the bow light.



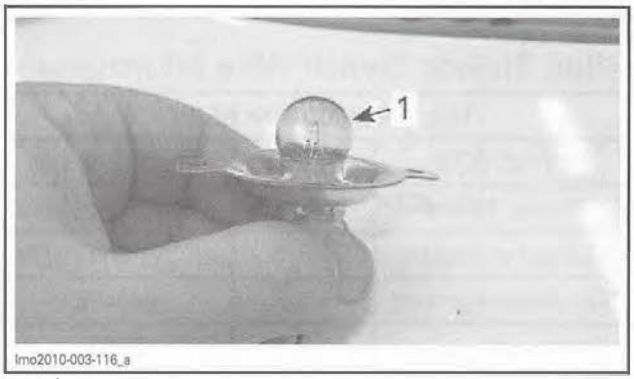
TYPICAL
1. Retaining screws

Turn bow light and remove the socket screws.



TYPICAL
1. Socket screws

Push bulb in and hold while turning counterclockwise to release.



TYPICAL
1. Bulb

Apply DIELECTRIC GREASE (P/N 293 550 004) on new bulb contact surface.

Install the new bulb by pushing it in while turning clockwise.

Finger tight all screws.

180 Series

Gently pry the bow light to detach it from its support.

1. Bow light

Remove the bow light cover.

Pull lens out.

Lift and remove the bulb.

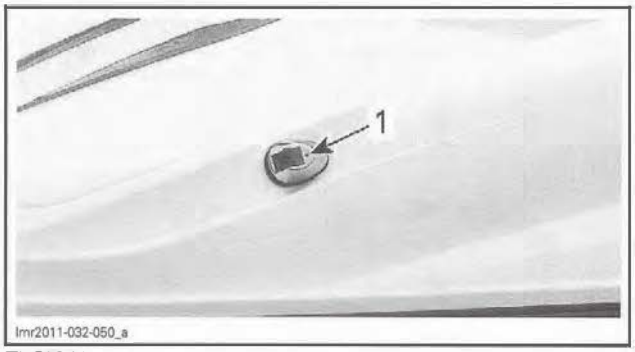
The assembly is essentially the reverse of removal procedures. However, pay particular attention to the following:

Apply DIELECTRIC GREASE (P/N 293 550 004) on bulb contact surface.

NOTE: When installing the bulb under the upper terminal plate, it is possible that the bulb remains loose. The cover will compress the terminal plate against the bulb at reinstallation.

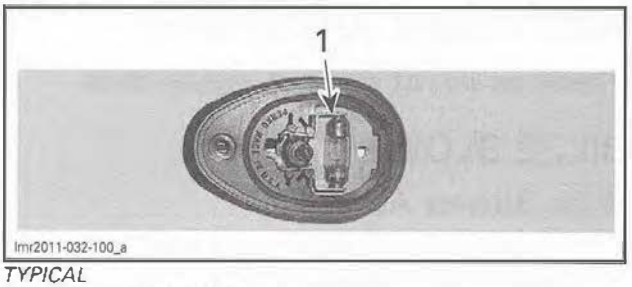
200 Series

Remove the bow light cover.



TYPICAL
1. Remove this screw

Remove bulb from socket.



TYPICAL
1. Lift up to remove bulb

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

Apply DIELECTRIC GREASE (P/N 293 550 004) on new bulb contact surface.

Bow Light Switch Wire Information

150, 180 AND 200 SERIES		
FUNCTION	PIN	WIRE COLOR (at switch)
Power 12 Vdc	2	GRAY/RED
Output to bow lights	6	GRAY/WHITE
Illumination ground	7	BLACK
Illumination power	3	BLUE

210 AND 230 SERIES		
FUNCTION	PIN	WIRE COLOR (at switch)
Power 12 Vdc	B	GRAY/RED
Output to bow lights	D	GRAY
Illumination ground	A	BLACK
Illumination power	D	BLUE

Bow Light Switch Input Voltage Test

Before testing, check the fuse or circuit breaker.

BOW LIGHT CIRCUIT PROTECTION	
150 and 180 Series	3A (fuse #3) of fuse block 1
200 Series	3A (fuse #5) in VCM
210 and 230 Series	3A Circuit breaker D

Test voltage as follows:

1. Disconnect bow light connector(s).
2. Enable electric circuits.
3. Turn NAV/ANC switch ON.
4. Set multimeter to Vdc and read voltage as per table.

BOW LIGHT CONNECTORS (boat harness side)		READING
TERMINAL		
1 or A (GRAY/WHITE)	2 or B (BLACK)	Battery voltage

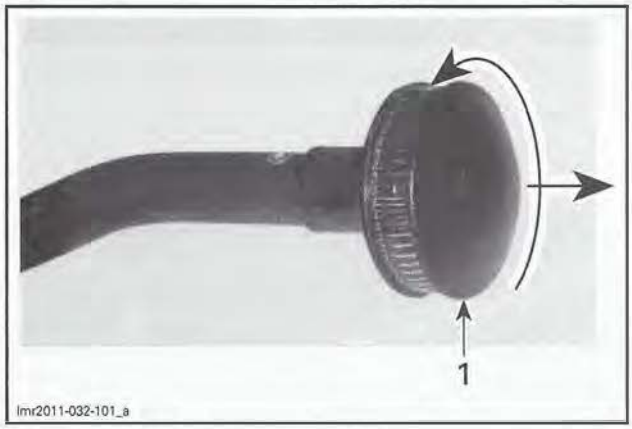
If voltage is not as specified, test positive and ground separately.

STERN LIGHT

Stern Light Bulb Replacement

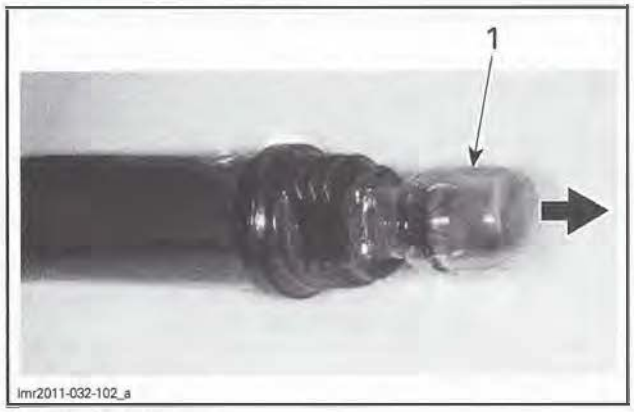
150 and 200 Series

Unscrew lens counterclockwise and pull it out.



1. Unscrew then pull

Pull bulb to remove it.



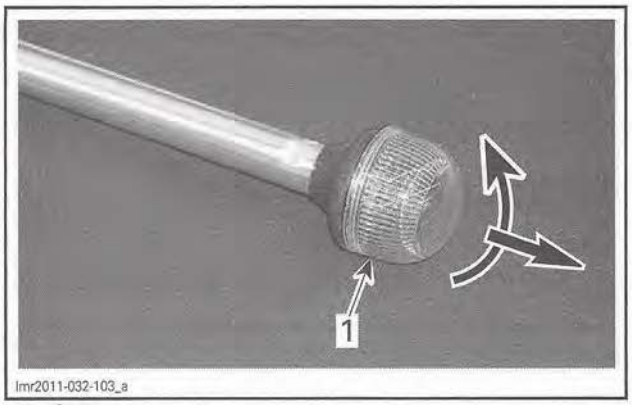
1. Pull bulb out

Apply DIELECTRIC GREASE (P/N 293 550 004) on new bulb contact surface.

Assembly is the reverse of removal procedure.

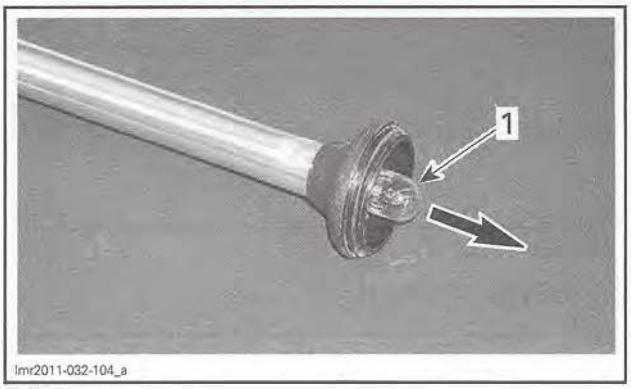
180, 210 and 230 Series

Unscrew lens counterclockwise and pull it out.



TYPICAL
1. Unscrew then pull

Pull bulb to remove it.



TYPICAL
1. Pull bulb out

Apply DIELECTRIC GREASE (P/N 293 550 004) on new bulb contact surface.

Assembly is the reverse of removal procedure.

Stern Light Switch Wire Information

150, 180 AND 200 SERIES		
FUNCTION	PIN	WIRE COLOR (at switch)
Power 12 Vdc	2	GRAY/RED
Output to stern light	3	GRAY/BLACK
Illumination ground	7	BLACK
Illumination power	3	BLUE

210 AND 230 SERIES		
FUNCTION	PIN	WIRE COLOR (at switch)
Power 12 Vdc	B	GRAY/RED
Output to stern light	C	GRAY/WHITE
Illumination ground	A	BLACK
Illumination power	D	BLUE

Stern Light Switch Input Voltage Test

Before testing, check the fuse or circuit breaker.

BOW LIGHT CIRCUIT PROTECTION	
150 and 180 Series	3A (fuse #3) of fuse block 1
200 Series	3A (fuse #5) in VCM
210 and 230 Series	3A Circuit breaker C

Test voltage as follows:

1. Disconnect stern light connectors.
2. Enable electric circuits.
3. Turn NAV/ANC switch ON.
4. Set multimeter to Vdc and read voltage as per table.

STERN LIGHT CONNECTORS (boat harness side)		READING
TERMINAL		
1 or A (GRAY/WHITE)	2 or B (BLACK)	Battery voltage

If voltage is not as specified, test positive and ground separately.

COURTESY LIGHT

Courtesy Light Replacement

Pry out the courtesy light cover.

1. Gently pry here with a screwdriver

Pull the bulb to remove it.

1. Pull and remove bulb

The installation is the reverse of the removal procedure.

Courtesy Light Input Voltage Test

Before testing, check the fuse or circuit breaker.

BILGE BLOWER CIRCUIT PROTECTION	
180 Series	3A (fuse #4) of fuse block 1
200 Series	3A (fuse #6) in VCM
210 and 230 Series	Circuit breaker B

Test voltage as follows:

1. Disconnect Courtesy Light connectors.
2. Enable electric circuits.
3. Turn courtesy light switch ON.
4. Set multimeter to Vdc and read voltage as per table.

COURTESY LIGHT CONNECTOR (boat harness side)		READING
TERMINAL		
+ (BROWN/YELLOW)	– (BLACK)	Battery voltage

If voltage is not as specified, test positive and ground separately.

Courtesy Light Switch Wire Information

150, 180 AND 200 SERIES		
FUNCTION	PIN	WIRE COLOR
Power 12 Vdc	2	BROWN/YELLOW
Output to blower	3	BROWN/YELLOW
Illumination ground	7	BLACK
Illumination power	8	BLUE

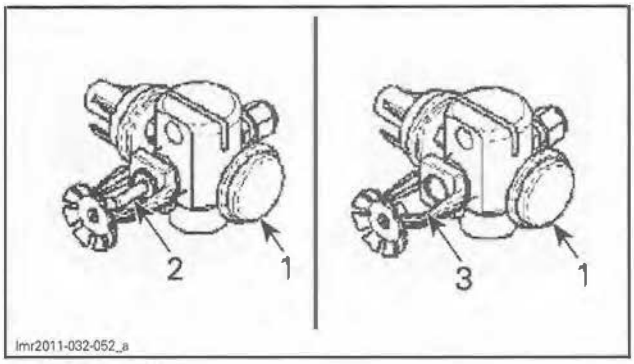
210 AND 230 SERIES		
FUNCTION	PIN	WIRE COLOR
Illumination ground	1	BLACK
Power 12 Vdc	5	BROWN/YELLOW
Output to blower	6	BROWN/YELLOW

EXTINGUISHER PRESSURE SWITCH (CE MODELS)

Extinguisher Pressure Switch Test

Should the indicator lamp fail to come ON when the ignition key is ON or when the tether cord is installed.

1. Check if the pressure gauge and actuator to see if the system has discharged.



1. Pressure gauge
2. System is ready
3. System is discharged

2. Check fuse. Refer to appropriate *WIRING DIAGRAM* from the *WIRING DIAGRAM BOOKLET (P/N 219 100 547)*.
3. Check the electrical pressure switch on the system bottle itself:
   3.1 Pull the connectors off the terminals.
   3.2 Place the probes of the multimeter directly on the terminals.

A closed circuit indicates a functioning pressure switch. Test the remaining wiring circuit.

Should the continuity of the pressure switch indicate an open circuit, the system will have to be replaced.

EXTINGUISHER INDICATOR LAMP (CE MODELS)

Extinguisher Indicator Lamp Troubleshooting

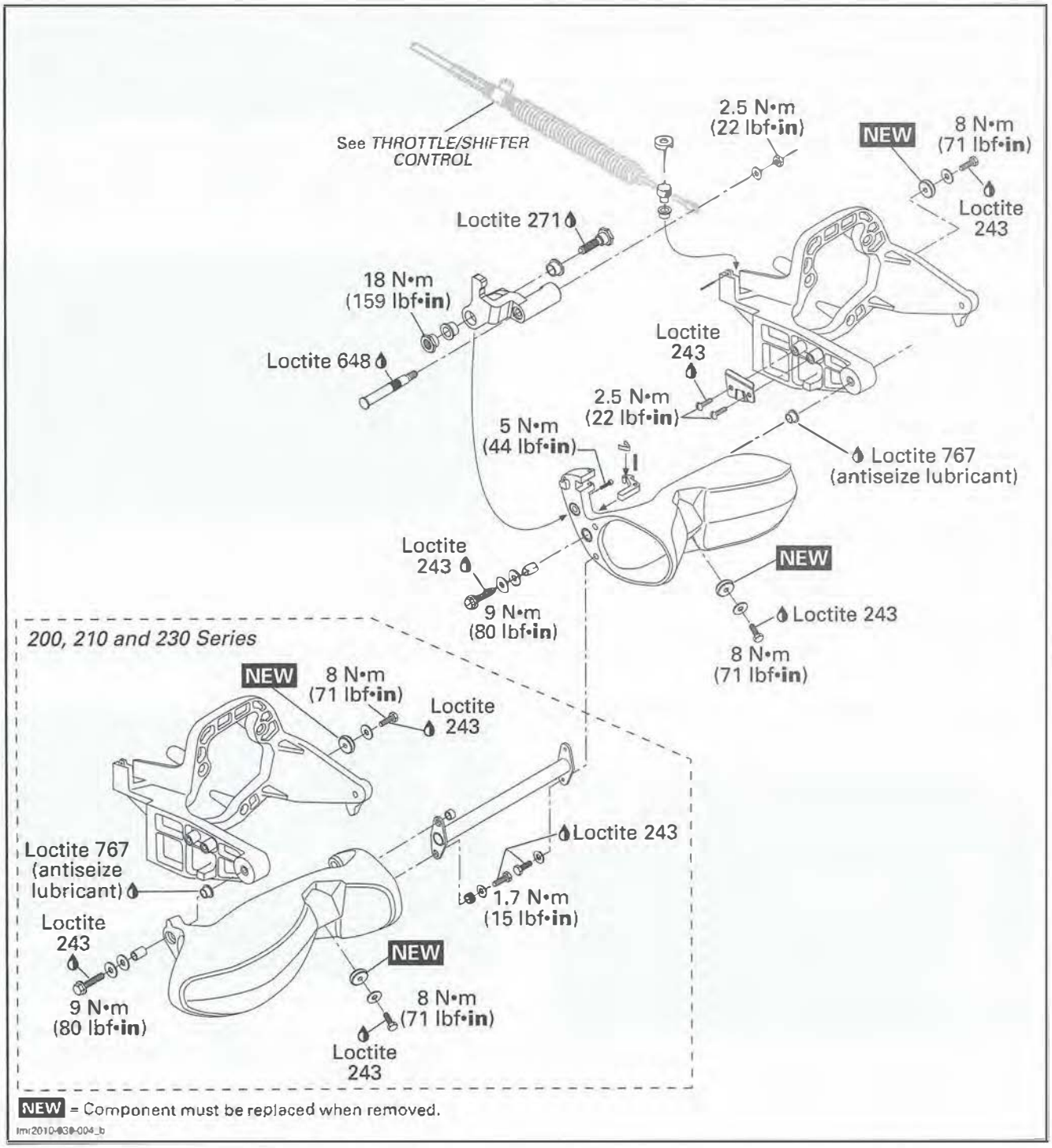
Should the indicator lamp fail to come ON when the ignition key is ON or when the tether cord is installed.

1. Check if the pressure gauge and actuator to see if the system has discharged.
2. Check in-line fuse.
3. The indicator lamp is a LED and cannot be tested with a multimeter. A simple method to test LED's is to remove the lamp and touch the RED wire to the + terminal and the BLACK wire to the – terminal of an ordinary 9-volt battery. Replace indicator lamp if required.

REVERSE SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	375, 377
LOCTITE 271 (RED)	293 800 005	376



GENERAL

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

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

⚠ WARNING

Torque wrench tightening specifications must strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

PROCEDURES

REVERSE CABLE

Reverse Cable Replacement and Adjustment

Refer to *THROTTLE/SHIFTER CONTROL* subsection.

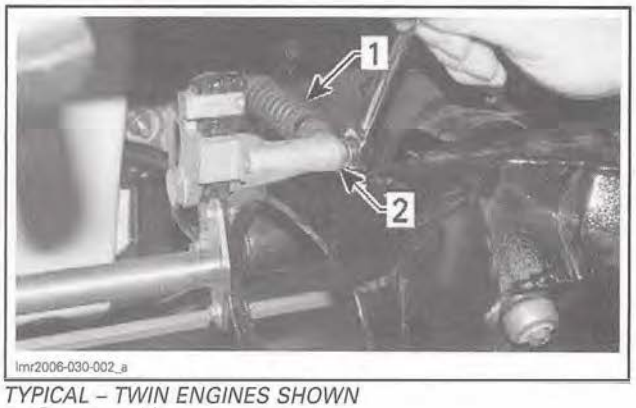
REVERSE GATE

Reverse Gate Removal

Starboard Side

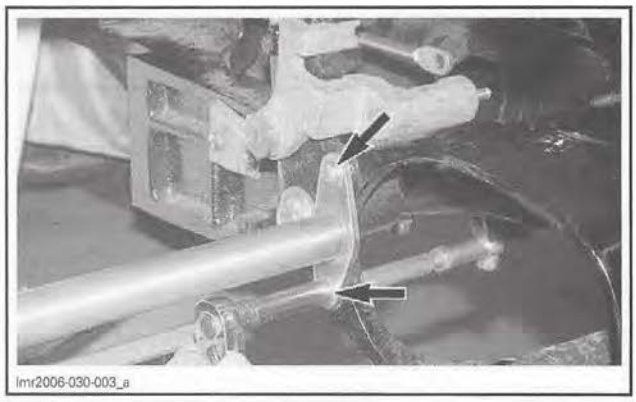
To remove reverse gate, put shift lever in reverse position.

Remove reverse cable from the reverse gate lever. Discard nut.

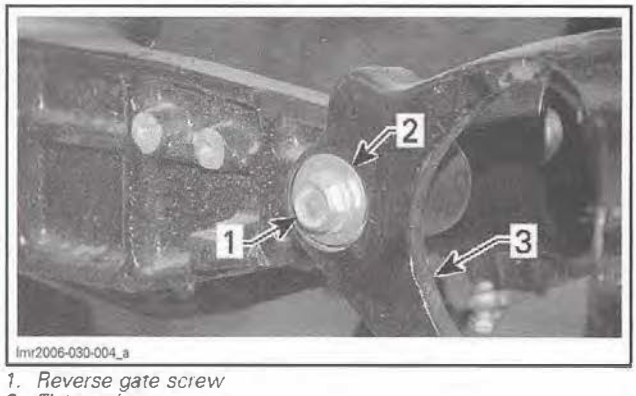


TYPICAL – TWIN ENGINES SHOWN
1. *Reverse cable*
2. *Reverse gate lever*

Unscrew screws securing reverse link rod to reverse gate.



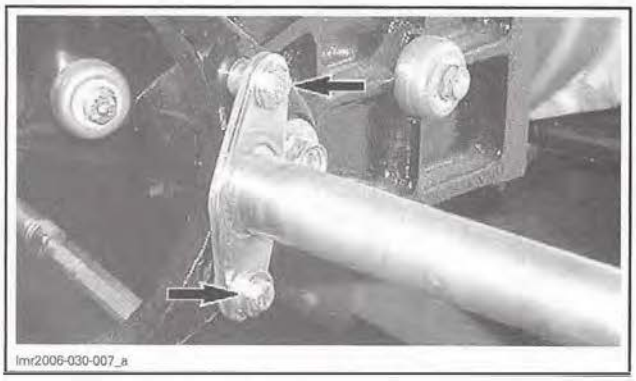
Remove screws, flat washers, plastic washers, sleeves and bushings holding reverse gate to reverse gate support.



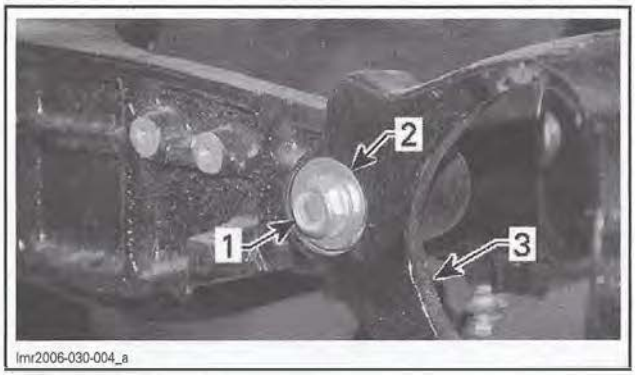
1. *Reverse gate screw*
2. *Flat washer*
3. *Reverse gate*

Port Side

Unscrew screws securing reverse rod to reverse gate.



Remove screws, flat washers, plastic washers, sleeves and bushings holding reverse gate to reverse gate support.



1. *Reverse gate screw*
2. *Flat washer*
3. *Reverse gate*

Reverse Gate Inspection

Visually inspect gate for wear or cracks. Replace if necessary.

Reverse Gate Installation

The installation is the reverse of the removal procedure.

REVERSE GATE SCREWS	
PRODUCT	LOCTITE 243 (BLUE) (P/N 293 800 060)
TORQUE	9 N•m (80 lbf•in)

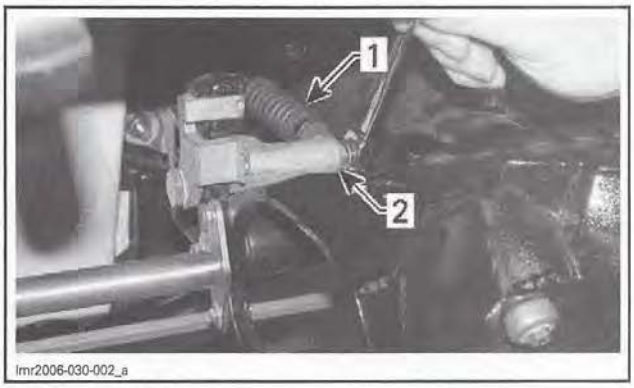
REVERSE LINK ROD SCREWS	
PRODUCT	LOCTITE 243 (BLUE) (P/N 293 800 060)
TORQUE	1.7 N•m (15 lbf•in)

REVERSE CABLE RETAINING NUT (NEW)	
TORQUE	2.5 N•m (22 lbf•in)

REVERSE GATE LEVER

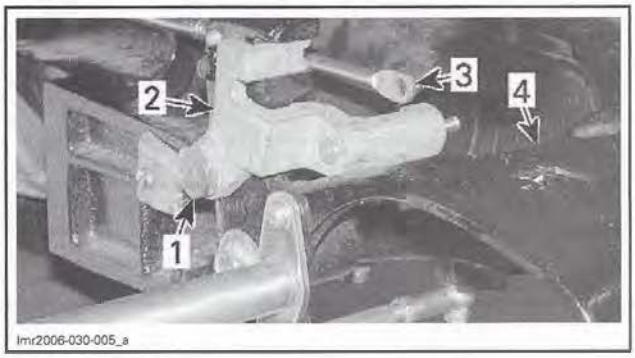
Reverse Gate Lever Removal

Remove reverse cable from the reverse gate lever. Discard nut.



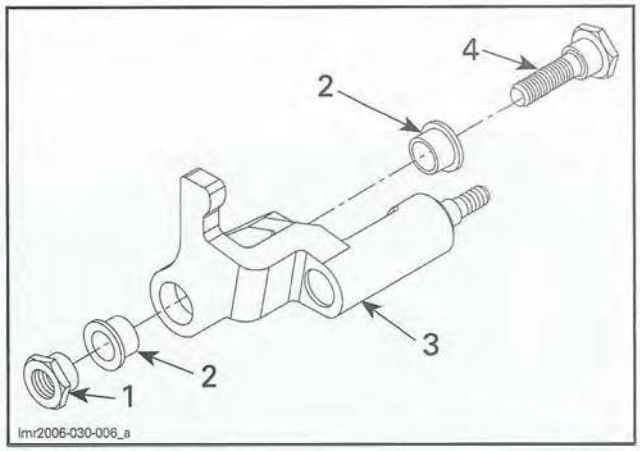
1. *Reverse cable*
2. *Reverse gate lever*

Unscrew the shoulder nut then remove the shoulder bolt. It may be necessary to heat shoulder nut to break the threadlocker.



1. *Shoulder nut*
2. *Reverse gate lever*
3. *Reverse cable*
4. *Reverse gate*

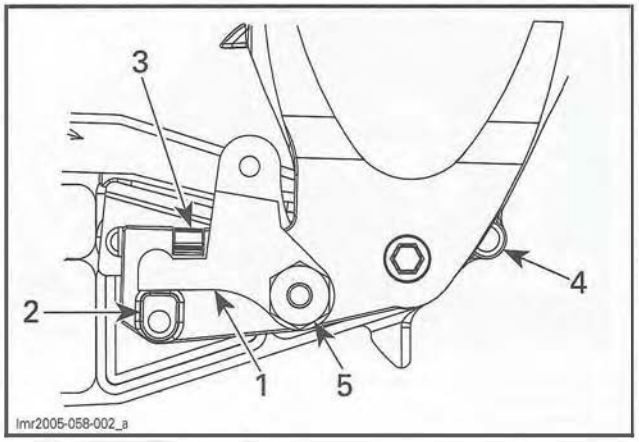
Remove bushings inside lever holes.



1. *Shoulder nut*
2. *Bushings*
3. *Reverse gate lever*
4. *Shoulder bolt*

Reverse Gate Lever Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.



TYPICAL - PARTS LOCATION
1. *Reverse gate lever*
2. *Reverse gate bump*
3. *Hook lever*
4. *Reverse gate*
5. *Shoulder nut*

Install bushings in lever holes.

Apply LOCTITE 271 (RED) (P/N 293 800 005) on threads of shoulder bolt.

TORQUE	
Shoulder nut	18 N•m (159 lbf•in)
Reverse cable retaining nut (NEW)	2.5 N•m (22 lbf•in)

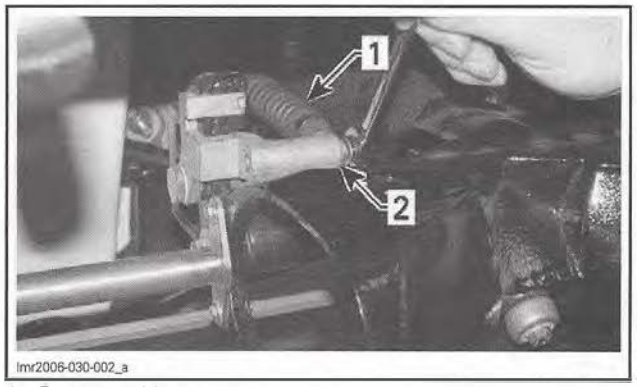
REVERSE GATE SUPPORT

Reverse Gate Support Removal

NOTE: The reverse gate support can be removed with the reverse gate in place.

Starboard Side

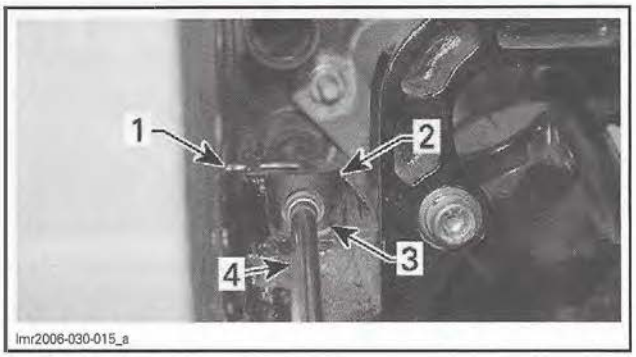
Remove reverse cable from the reverse gate lever. Discard nut.



1. *Reverse cable*
2. *Reverse gate lever*

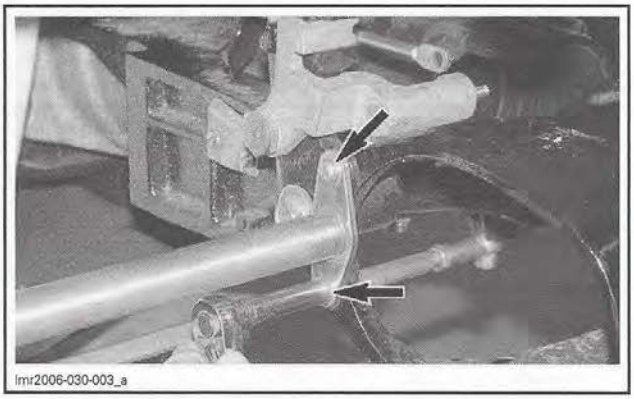
Remove cotter pin retaining the reverse cable bushing. Discard cotter pin.

Remove the reverse cable bushing then pull the brass bushing out of the reverse gate support.

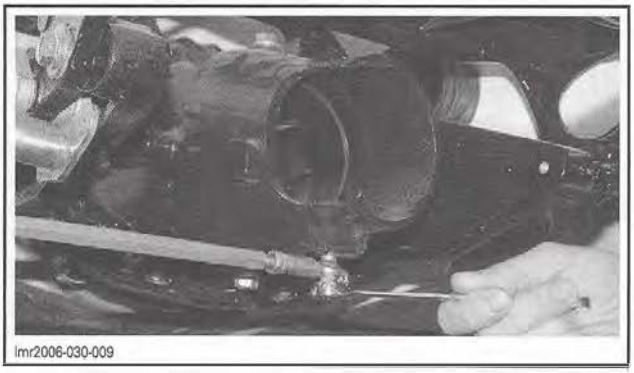


1. *Cotter pin*
2. *Reverse cable bushing*
3. *Brass bushing*
4. *Reverse cable*

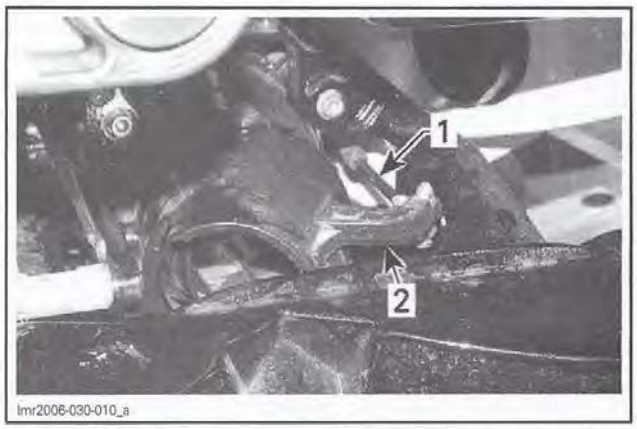
Remove screws securing reverse link rod to reverse gate.



Remove screw that attach the steering link rod to nozzle.

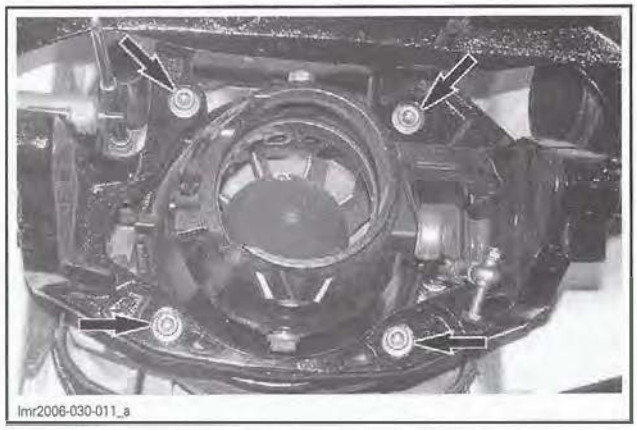


Detach steering cable from nozzle.



1. *Steering cable*
2. *Nozzle*

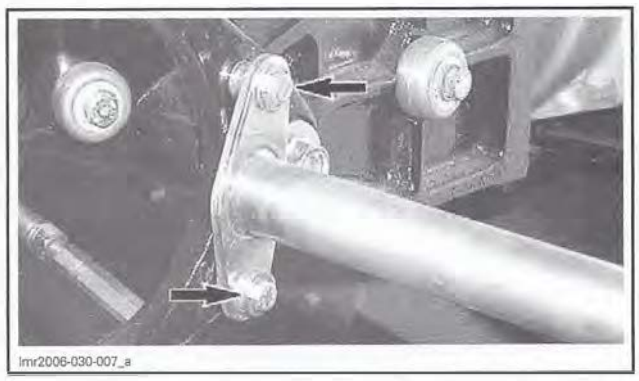
Remove socket screws holding the support and the venturi to the pump housing.



Pull out reverse gate support with reverse gate.

Port Side

Remove screws securing reverse link rod to reverse gate.



Remove screw that attach the steering link rod to nozzle.

Remove socket screws holding the support and the venturi to the pump housing.

Pull out reverse gate support with reverse gate.

Reverse Gate Support Inspection

Visually inspect support for wear or cracks. Replace if necessary.

Reverse Gate Support Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Torque screws holding reverse gate support and venturi to pump housing to specification.

TORQUE	
Reverse gate retaining screws	21 N•m (15 lbf•ft)

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of the steering link rod screw then torque it to specification.

TORQUE	
Steering link rod screws	13 N•m (115 lbf•**in**)

Reinstall reverse cable.

TORQUE	
Reverse cable retaining nut (NEW)	2.5 N•m (22 lbf•**in**)

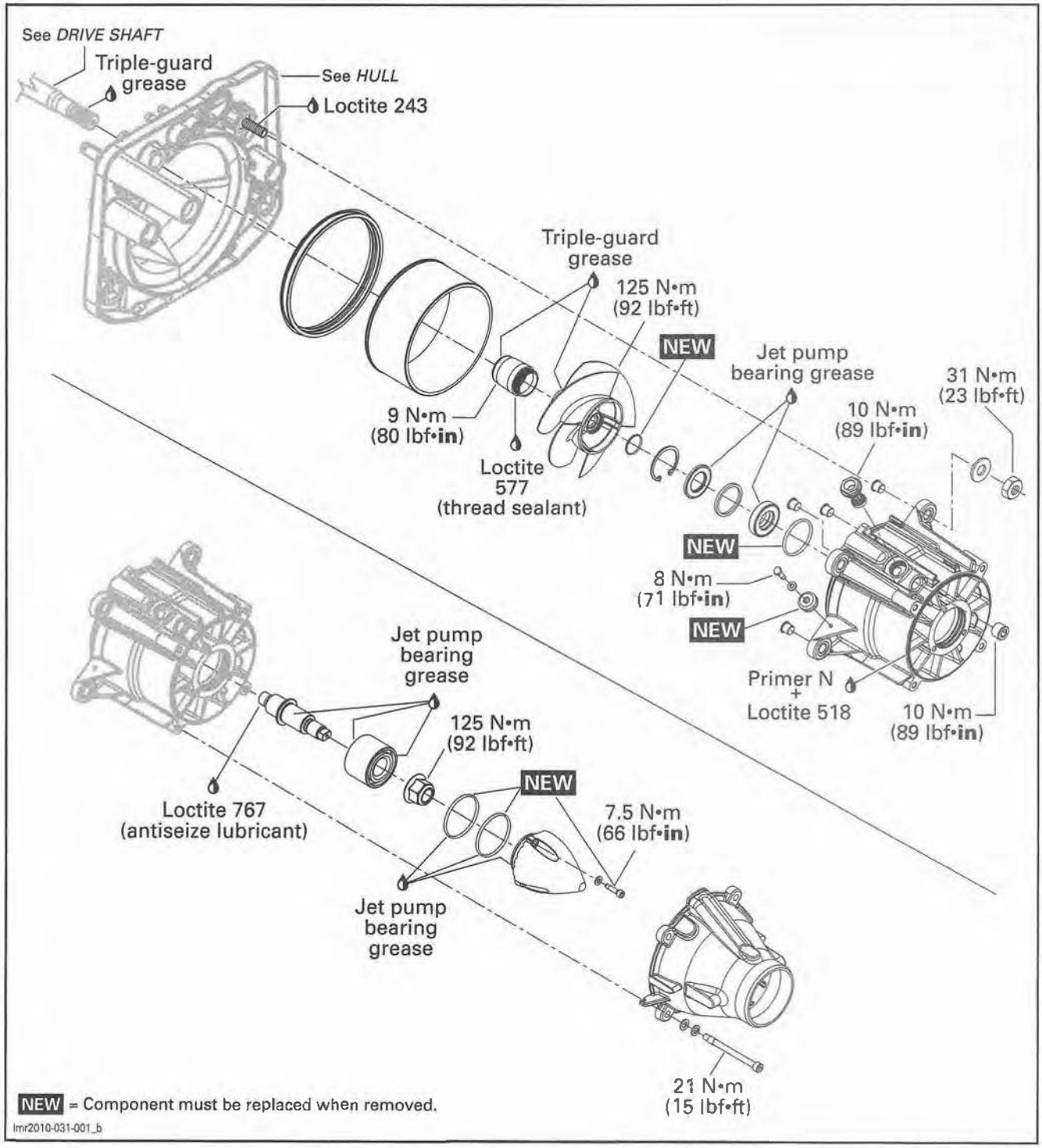
JET PUMP

SERVICE TOOLS

Description	Part Number	Page
DRIVE SHAFT HOLDER	529 035 986	384
IMPELLER REMOVER/INSTALLER	529 035 820	388-390, 392, 396
IMPELLER REMOVER/INSTALLER	529 035 956	388–390, 392, 396
IMPELLER SHAFT BEARING TOOL	529 036 168	392–394
IMPELLER SHAFT PUSHER	529 035 955	391, 393
PRESSURE CAP	529 036 172	382
SEAL/BEARING PUSHER	529 035 819	394
VACUUM/PRESSURE PUMP	529 021 800	382

SERVICE PRODUCTS

Description	Part Number	Page
JET PUMP BEARING GREASE	293 550 032	387, 394, 396
LOCTITE 243 (BLUE)	293 800 060	384–385
LOCTITE 518	293 800 038	383
LOCTITE 577 (THREAD SEALANT)	293 800 050	389
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	388
PULLEY FLANGE CLEANER	413 711 809	384
TRIPLE-GUARD GREASE	296 000 329	385, 389
XPS BRAKES AND PARTS CLEANER	219 701 705	388
XPS LUBE	293 600 016	385, 388


See DRIVE SHAFT
Triple-guard grease
See HULL
Loctite 243
Triple-guard grease
125 N•m (92 lbf•ft)
NEW
Jet pump bearing grease
31 N•m (23 lbf•ft)
10 N•m (89 lbf•in)
9 N•m (80 lbf•in)
Loctite 577 (thread sealant)
NEW
8 N•m (71 lbf•in)
NEW
Primer N + Loctite 518
10 N•m (89 lbf•in)
Jet pump bearing grease
125 N•m (92 lbf•ft)
NEW
7.5 N•m (66 lbf•in)
Loctite 767 (antiseize lubricant)
Jet pump bearing grease
21 N•m (15 lbf•ft)
NEW = Component must be replaced when removed.
lmr2010-031-001_b

GENERAL

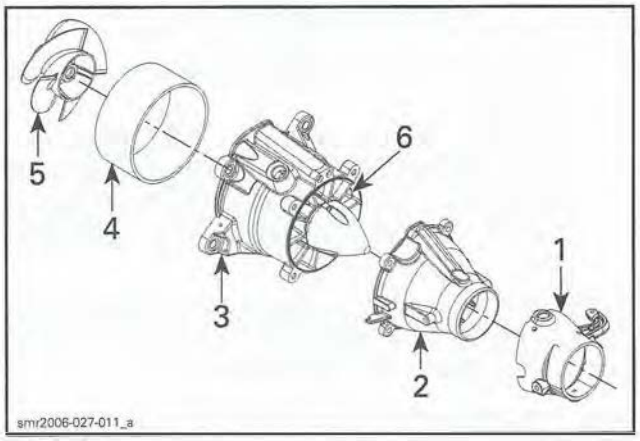
During assembly/installation, use torque values and service products as in the exploded view.

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

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

JET PUMP MAIN COMPONENTS



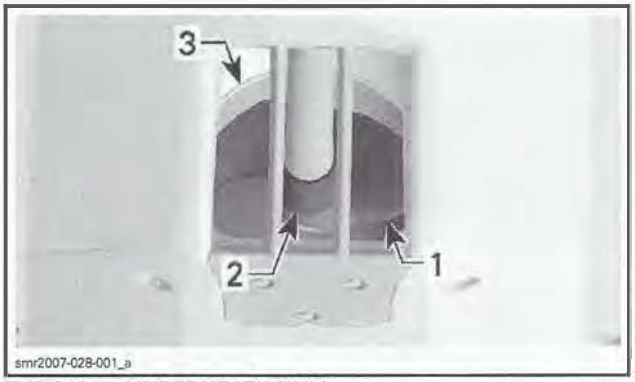
TYPICAL
1. *Nozzle*
2. *Venturi*
3. *Jet pump housing*
4. *Wear ring*
5. *Impeller*
6. *Stator*

INSPECTION

IMPELLER CONDITION

Condition of impeller, impeller boot and wear ring can be quickly checked from underneath hull through the inlet grate.

Check for contact between impeller boot and drive shaft guard. Replace impeller boot and inspect drive shaft guard for wear if contact is found.



TYPICAL — UNDERNEATH HULL
1. *Impeller*
2. *Impeller boot*
3. *Wear ring*

IMPELLER/WEAR RING CLEARANCE

This clearance is critical for jet pump performance.

To check clearance, remove jet pump.

Using a feeler gauge, measure clearance between impeller blade tip and wear ring. Measure each blade at its center.

MODEL	MAXIMUM WEAR CLEARANCE
All models	0.35 mm (.014 in)

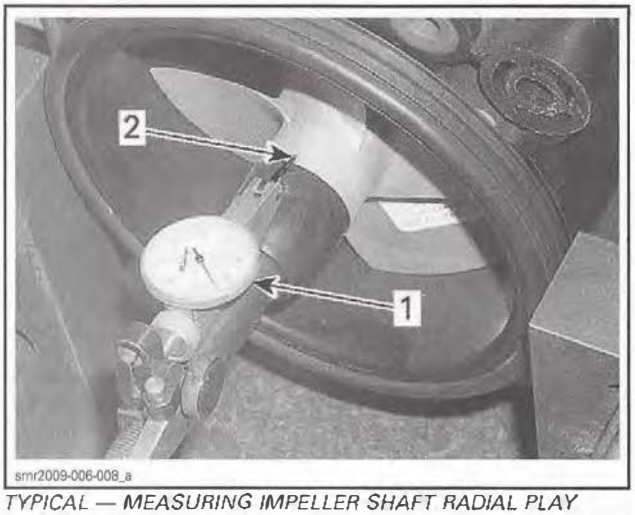
IMPELLER SHAFT RADIAL PLAY

Radial play is critical for jet pump life span.

To check radial play, remove jet pump.

Make sure impeller shaft turns freely and smoothly.

1. Retain housing in a soft jaw vise making sure not to damage housing lug.
2. Set a dial gauge and position its tip onto metal end, close to the end of the impeller hub.
3. Move shaft end up and down. Difference between highest and lowest dial gauge reading is radial play.



TYPICAL — MEASURING IMPELLER SHAFT RADIAL PLAY
1. Dial gauge
2. Measure close to impeller hub end

RADIAL PLAY
0 mm (0 in)

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

LEAK TEST

Whenever performing any type of repair on the jet pump, a leak test should be carry out.

Proceed as follows:

1. Remove impeller cover. Refer to *IMPELLER COVER* in this subsection.
2. Install required tools on pump housing.

REQUIRED TOOLS	
PRESSURE CAP (P/N 529 036 172)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

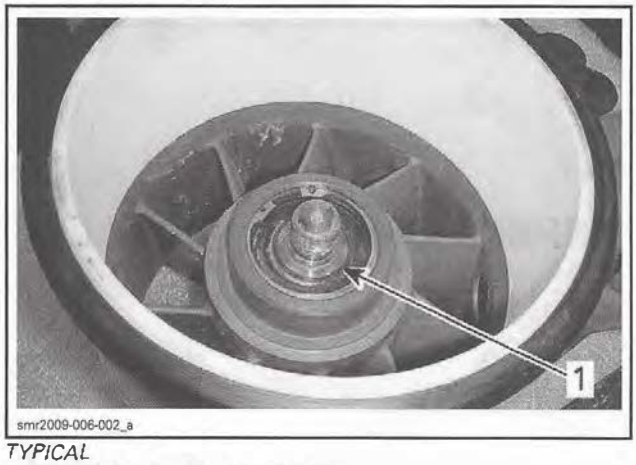
TYPICAL

3. Pressurize pump.

LEAK TEST PRESSURE
Maximum 70 kPa (10 PSI)

4. Pump must maintain this pressure for at least 5 minutes.
   - If there is a pressure drop, spray soapy water around cover. If there are no bubbles, impeller shaft, impeller shaft seal must be replaced. Jet pump unit has to be disassembled.

NOTE: If there is 2 or 3 bubbles coming out from the seal on the impeller side is acceptable. Leaks from other areas must be repaired.



TYPICAL
1. Small leak here is acceptable

NOTICE **Repair any leak. Failure to correct a leak will lead to premature wear of pump components.**

5. Disconnect pump and remove pressure cap.
6. Reinstall impeller cover. Refer to *IMPELLER COVER* in this subsection.

PROCEDURES

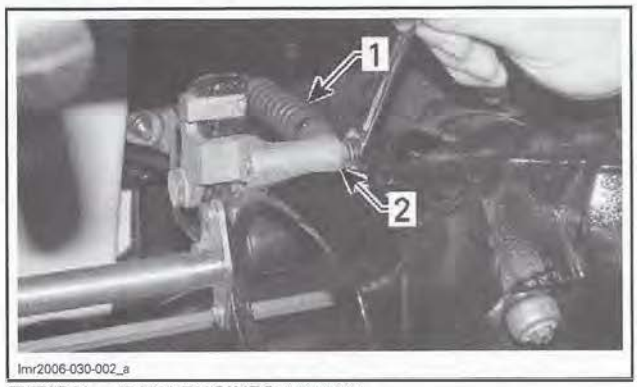
NOTE: Whenever removing a part, visually check for damage such as: corrosion, cracks, split, break, porosity, cavitation, deformation, distortion, heating discoloration, wear pattern, defective plating, missing or broken balls in ball bearing, water damage diagnosed by black-colored spots on metal parts,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

VENTURI

Venturi Removal

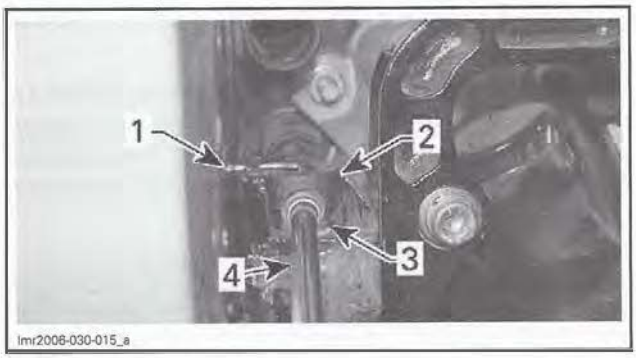
NOTE: On twin engines models, the steering and reverse cables are located on the starboard side.

1. Remove reverse cable from the reverse gate lever. Discard nut.



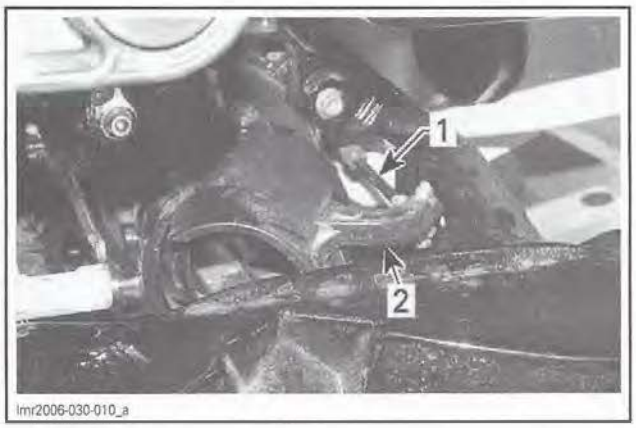
TYPICAL – TWIN ENGINES SHOWN
1. *Reverse cable*
2. *Reverse gate lever*

2. Remove cotter pin retaining the reverse cable bushing. Discard cotter pin.
3. Remove the reverse cable bushing then pull the brass bushing out of the reverse gate support.



1. *Cotter pin*
2. *Reverse cable bushing*
3. *Brass bushing*
4. *Reverse cable*

4. Detach steering cable from nozzle.



1. *Steering cable*
2. *Nozzle*

200, 210 and 230 Series

5. Remove the reverse link rod (*REVERSE SYSTEM*).
6. Remove the steering link rod (*STEERING SYSTEM*).

NOTE: If jet pump housing is to be removed with the venturi, nozzle and reverse gate, omit the remaining steps.

7. Remove socket screws holding the support and the venturi to the pump housing.

8. Pull out venturi, reverse gate and nozzle.

Venturi Inspection

Visually inspect venturi for wear or cracks. Replace if necessary.

Venturi Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Apply a thin layer of LOCTITE 518 (P/N 293 800 038) on mating surface of impeller housing. Refer to shaded part of the following illustration.

TYPICAL

Install the venturi.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of socket screws (or use NEW self-locking screws).

Install socket screws, lock washers and flat washers then torque them as specified in the following table.

PARTS	TORQUE
Venturi retaining screw (socket screw)	21 N•m (15 lbf•ft)

Reinstall all removed parts.

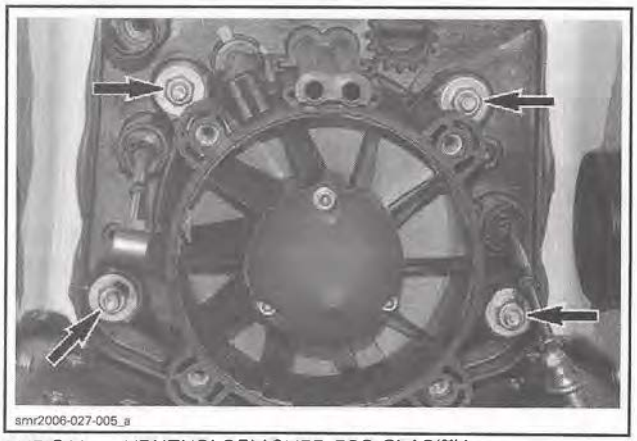
JET PUMP HOUSING

Jet Pump Housing Removal

Remove venturi, see procedure in *VENTURI* in this subsection.

NOTE: The jet pump housing can be removed with the reverse gate, nozzle and venturi. This is the preferred procedure when either the drive shaft or engine removal is required. To do so, follow the *VENTURI REMOVAL* procedure but do NOT unscrew venturi.

Remove nuts that attach jet pump housing to pump support.



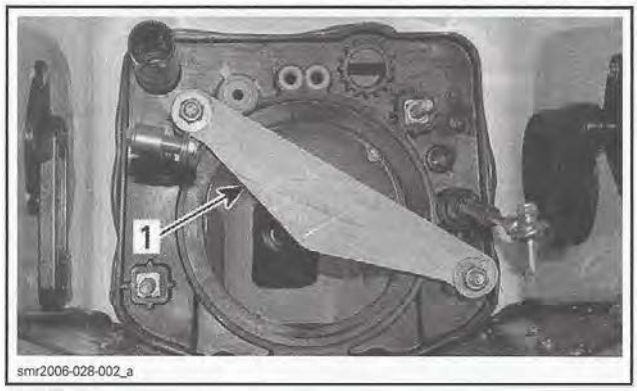
TYPICAL — VENTURI REMOVED FOR CLARITY

Remove jet pump with a wiggle movement.

NOTICE When removing pump unit, shims could have been installed between hull and pump housing. Be sure to reinstall them otherwise engine and jet pump alignment will be altered.

When removing jet pump from vehicle, support drive shaft to avoid engine oil seal damages.

REQUIRED TOOL
DRIVE SHAFT HOLDER (P/N 529 035 986) 



TYPICAL
1. Drive shaft holder

Jet Pump Housing Inspection

Visually inspect jet pump housing. Pay attention to the stator. Ensure the assembly is clean and free of any debris and defects.

Ensure the neoprene seal is in good condition. Replace it as required.

Jet Pump Housing Installation

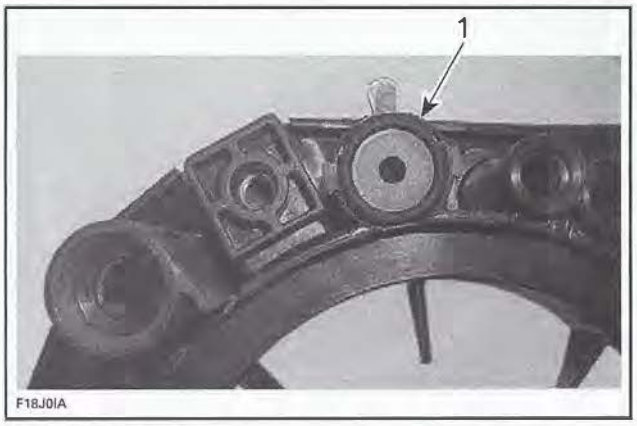
Brush and clean impeller splines and drive shaft splines with PULLEY FLANGE CLEANER (P/N 413 711 809) or equivalent. Splines must be free of any residue.

The exhaust system water flow is controlled by a reducer located between the jet pump support and the jet pump on the inlet side. The reducer is color coded according to boat model. See table below.

ENGINES	REDUCER COLOR
155 and 215	YELLOW
255 and 260	GREEN

Make sure that the reducer is installed as shown.

NOTICE A faulty installation can cause overheating and damage to exhaust system.



1. Color-coded reducer

Lubricate drive shaft splines, impeller splines and the inside of the impeller boot with TRIPLE-GUARD GREASE (P/N 296 000 329).

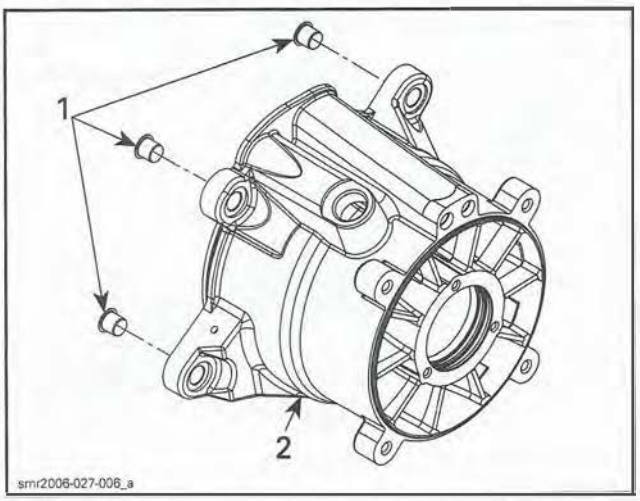
Ensure neoprene seal is properly installed on the jet pump housing.

Install jet pump. If necessary, wiggle jet pump to engage drive shaft splines in impeller.

NOTICE **Some boat require shims between hull and pump; if shims have been removed at pump removal, be sure to reinstall them, otherwise engine alignment will be altered.**

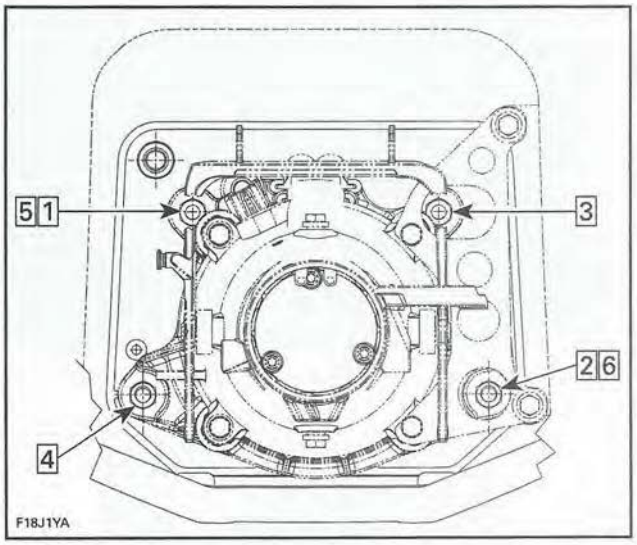
Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on stud threads of jet pump housing.

Ensure to reinstall bushings in fastener holes.



1. Bushings
2. Aluminum housing

Install nuts. Tighten as per the following sequence.



TYPICAL
Step 1: From 1 to 2: 16 N•m (142 lbf•in)
Step 2: From 3 to 6: 31 N•m (23 lbf•ft)

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

Install all other removed parts.

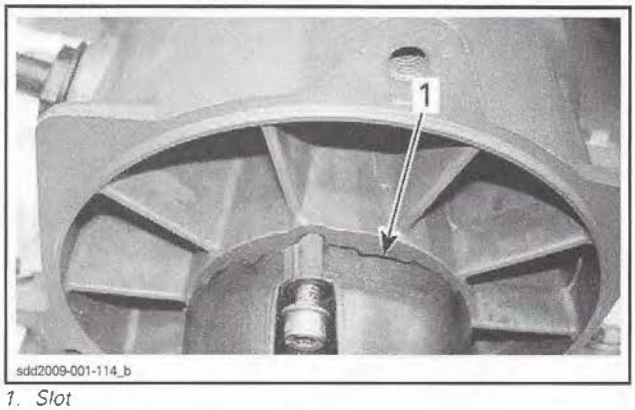
IMPELLER COVER

Impeller Cover Removal

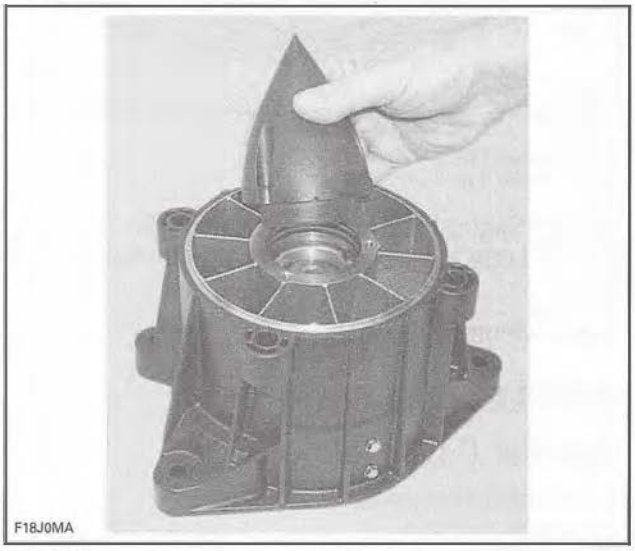
1. Remove the venturi.
2. With pump housing in vertical position, remove and discard the 3 retaining screws.

TYPICAL

3. Using a fiber hammer, gently tap impeller cover to help release it from the jet pump housing.
4. Use a flat screwdriver in the slots provided as pry points to remove it from the jet pump housing.

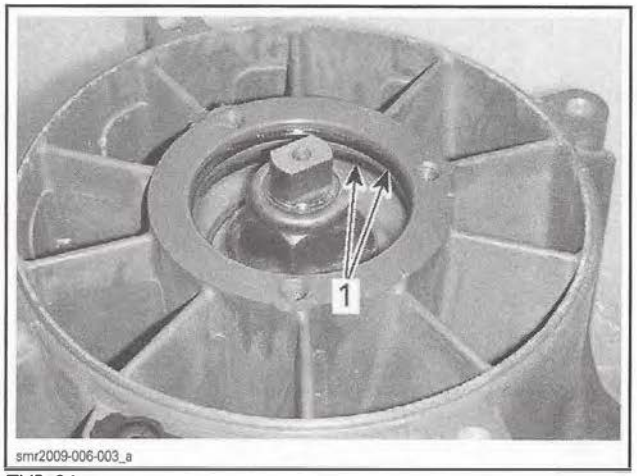


1. Slot



TYPICAL

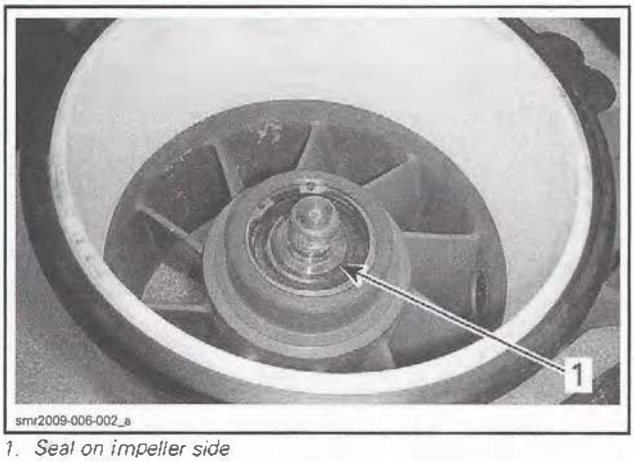
5. Remove both O-rings.



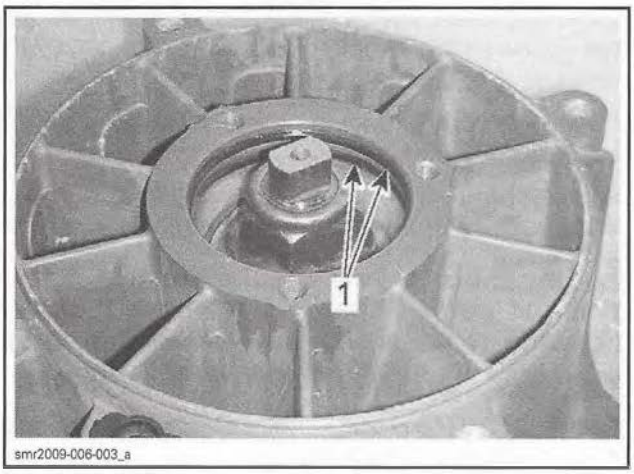
TYPICAL
1. O-rings

Impeller Cover Inspection

Check for presence of water in cover and bearing area. If water is found, replace seals on impeller side. Also replace O-rings and/or impeller cover.

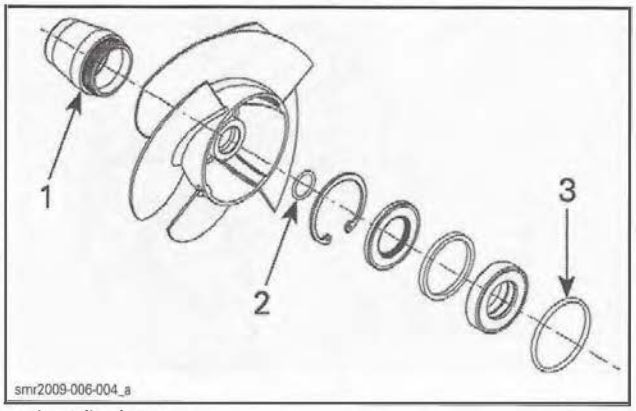


1. Seal on impeller side



1. Cover O-rings

Check impeller boot and O-rings condition on impeller. Replace as required.

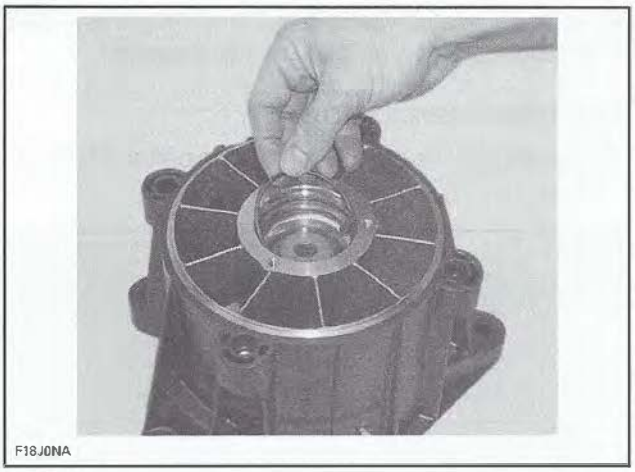


1. Impeller boot
2. Impeller O-ring
3. Pump housing O-ring

Perform a leak test. Refer to *LEAK TEST* in this subsection.

Impeller Cover Installation

1. Install O-rings in their respective groove.

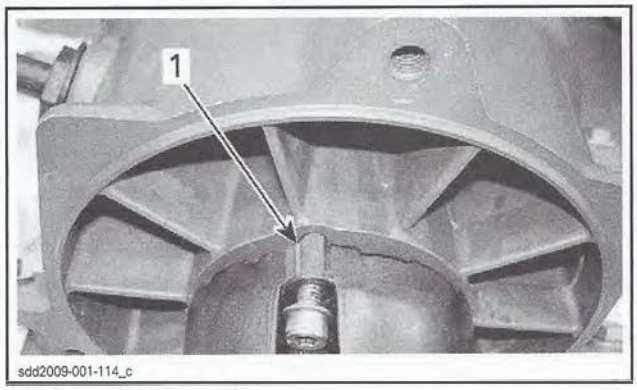


TYPICAL

2. Put 23 ml (.8 U.S. oz) of JET PUMP BEARING GREASE (P/N 293 550 032) in the cover.

TYPICAL

3. Install impeller cover by aligning the cover index mark with the pump top fin as shown.



1. Align mark with top fin

NOTE: Cover can only be installed in one position as screw holes are not located symmetrically.

4. Secure cover with **NEW** self-locking screws.

NOTE: Push cover against pump housing while alternately tightening screws. Make sure O-rings are positioned correctly and they are not damaged when pushing the cover.

5. Torque cover screws as per following table.

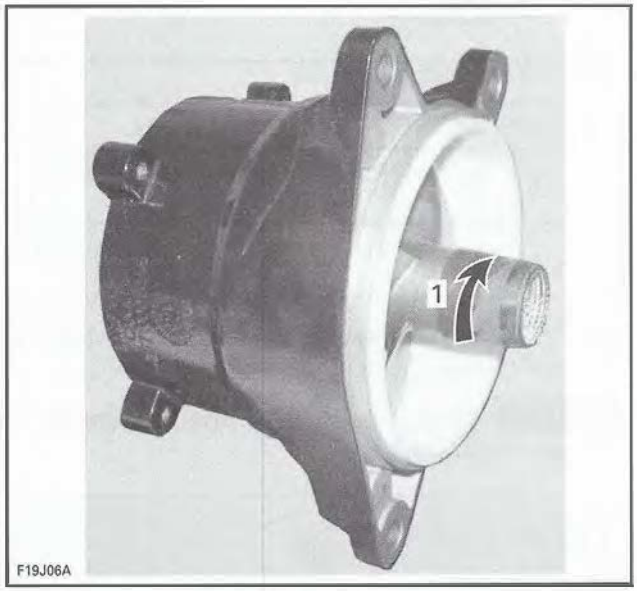
PARTS	TORQUE
Cover screws	7.5 N•m (66 lbf•**in**)

IMPELLER

Impeller Removal

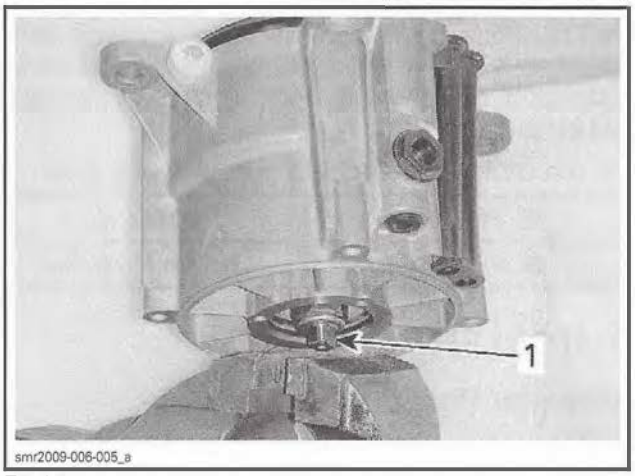
NOTE: If impeller shaft is to be disassembled, loosen the impeller shaft nut prior to removing the impeller.

1. Remove jet pump. Refer to *JET PUMP HOUSING* in this subsection.
2. Remove impeller cover. Refer to *IMPELLER COVER* in this subsection.
3. Remove impeller boot by turning it clockwise (LH threads).



TYPICAL
1. Unscrew clockwise

4. Mount the flat sides of impeller shaft in a vise.



TYPICAL
1. Flat side

5. Unscrew the impeller counterclockwise using the proper impeller remover/installer.

IMPELLER REMOVER/INSTALLER

ENGINE	REQUIRED TOOL
155	IMPELLER REMOVER/INSTALLER (P/N 529 035 820)
215, 255 and 260	IMPELLER REMOVER/INSTALLER (P/N 529 035 956)

NOTE: It may be necessary to heat the impeller to ease removal.

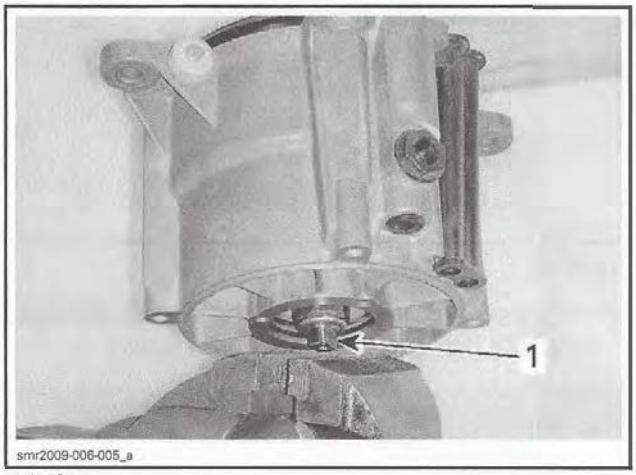
NOTICE Never use an impact wrench to loosen impeller.

TYPICAL

6. To pull impeller out of the pump, apply a rotating movement as you pull on the impeller.

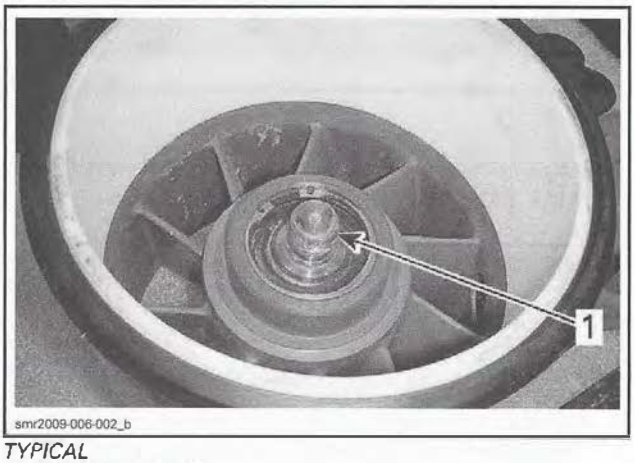
Impeller Installation

1. Mount the flat sides of the impeller shaft in a vise.



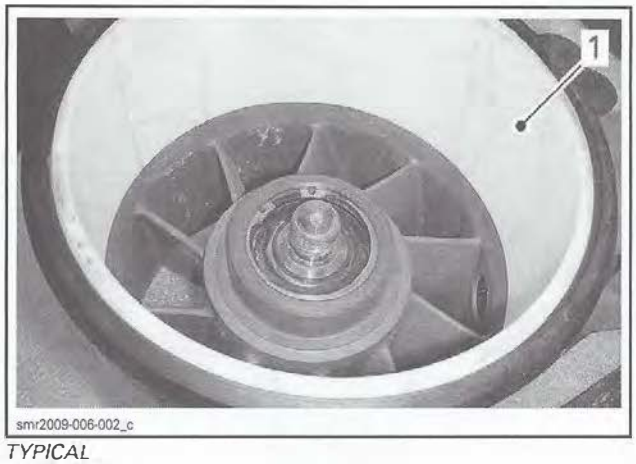
TYPICAL
1. Flat side

2. Clean the impeller shaft using XPS BRAKES AND PARTS CLEANER (P/N 219 701 705).
3. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on threads of impeller shaft.



TYPICAL
1. Antiseize lubricant

4. Apply XPS LUBE (P/N 293 600 016) on the wear ring surface.



TYPICAL
1. XPS lube

5. Start screwing the impeller on its shaft.

TYPICAL

6. Mount in the impeller splines the proper impeller remover/installer.

IMPELLER REMOVER/INSTALLER

ENGINE	REQUIRED TOOL
155	IMPELLER REMOVER/INSTALLER (P/N 529 035 820)
215, 255 and 260	IMPELLER REMOVER/INSTALLER (P/N 529 035 956)

7. Torque the impeller, then remove tool.

PART	TORQUE
Impeller	125 N•m (92 lbf•ft)

NOTICE Never use an impact wrench to tighten impeller shaft.

TYPICAL

8. Apply LOCTITE 577 (THREAD SEALANT) (P/N 293 800 050) on impeller boot threads.
9. Apply TRIPLE-GUARD GREASE (P/N 296 000 329) inside impeller boot.
10. Install impeller boot on impeller and tighten counterclockwise.

WEAR RING

Wear Ring Inspection

Check wear ring for:
- Deep scratches
- Irregular surface
- Any apparent damage.

Check *IMPELLER/WEAR RING CLEARANCE*, see procedure at the beginning of this subsection.

Wear Ring Removal

1. Remove jet pump. Refer to *JET PUMP HOUSING* in this subsection.
2. Remove impeller from jet pump housing, refer to *IMPELLER* in this subsection.
3. Place jet pump housing in a vise with soft jaws. It is best to clamp housing using a lower ear.
4. Cut wear ring at two places.

NOTICE 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.

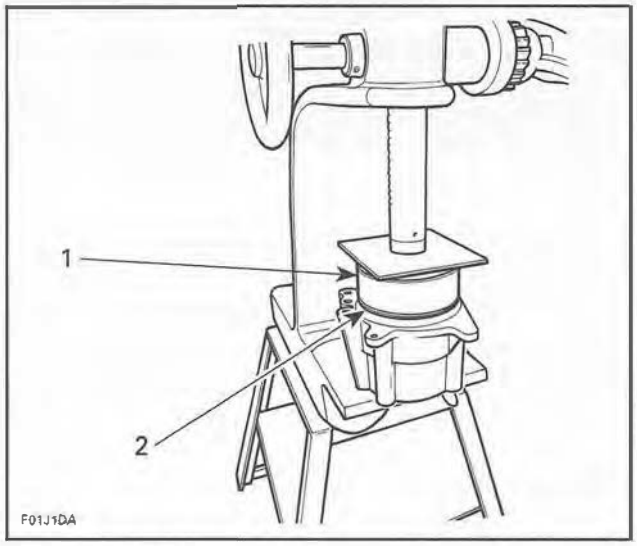
5. After cutting ring, insert a screwdriver blade between jet pump housing and ring outside diameter.

6. Push ring so that it can collapse internally.
7. Pull ring out.

Wear Ring Installation

To install wear ring in housing, use a square steel plate of approximately 180 x 180 mm x 6 mm thick (7 x 7 in x 1/4 in) and a press.

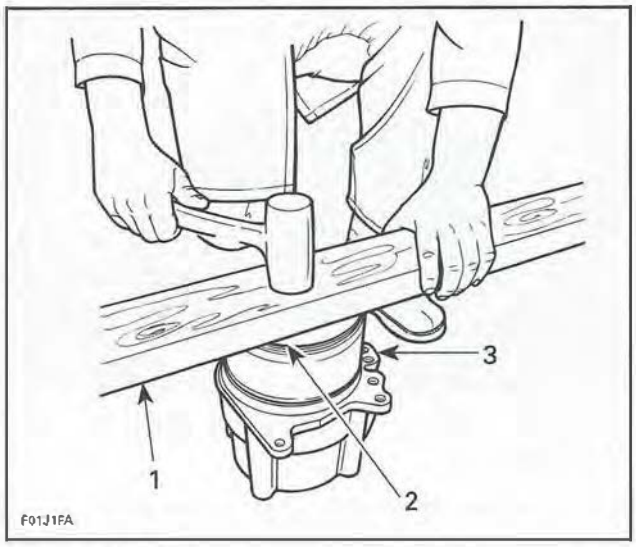
Manually engage ring in housing making sure it is equally inserted all around. Press ring until it seats into bottom of housing.



1. Rounded edge
2. Press wear ring

If a press is not readily available, a piece of wood such as a 2 x 4 in x 12 in long, can be used.

Manually engage ring in housing making sure it is equally inserted all around. Place wood piece over ring. Using a hammer, strike on wood to push ring. Strike one side then rotate wood piece about 90° and strike again. Frequently rotate wood piece so that ring slides in evenly until it seats into bottom of housing.



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

IMPELLER SHAFT AND BEARING

Impeller Shaft and Bearing Removal

1. Remove impeller cover. Refer to *IMPELLER COVER* in this subsection.
2. Mount in a vise the proper impeller remover/installer.

IMPELLER REMOVER/INSTALLER

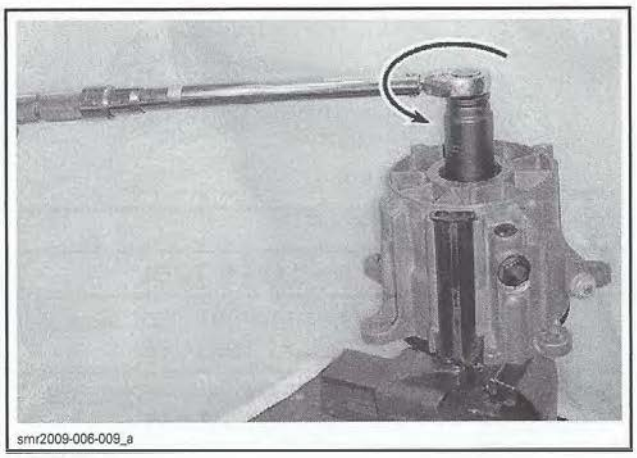
ENGINE	REQUIRED TOOL
155	IMPELLER REMOVER/INSTALLER (P/N 529 035 820)
215, 255 and 260	IMPELLER REMOVER/INSTALLER (P/N 529 035 956)

3. Install jet pump housing over impeller remover/installer tool.

TYPICAL

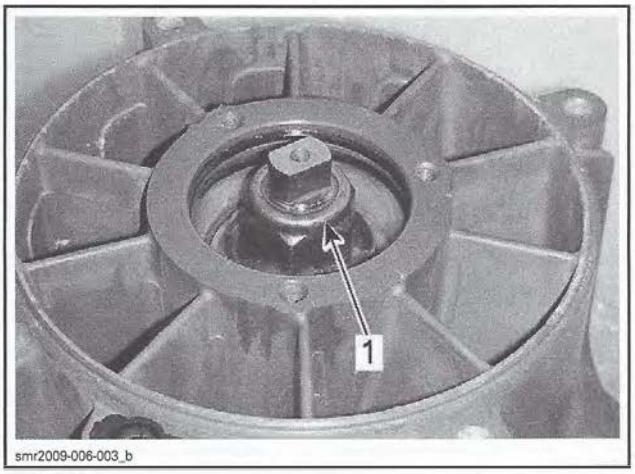
4. Using a 30 mm socket, unscrew the impeller shaft nut counterclockwise.

NOTE: If impeller loosens instead of shaft nut, refer to *IMPELLER SHAFT NUT REMOVAL IF IMPELLER HAS LOOSENED* further in this procedure.



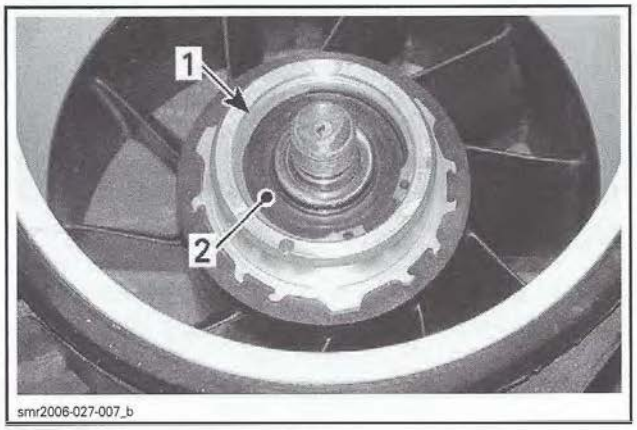
TYPICAL

5. Remove impeller shaft nut.



TYPICAL
1. Nut

6. Remove impeller as described in this subsection.
7. From the impeller side, remove circlip, seals, spacer and O-ring.

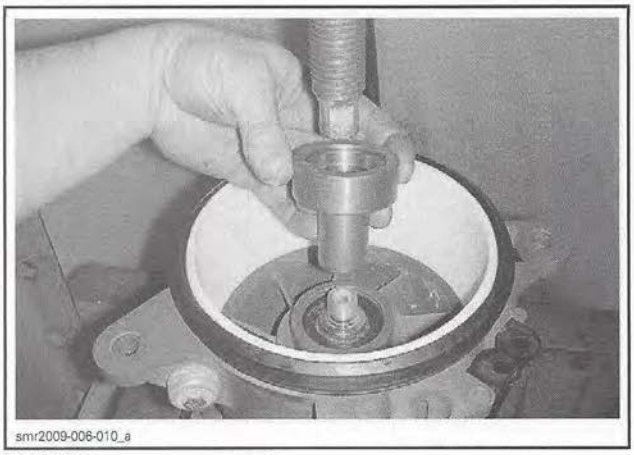


TYPICAL
1. Circlip
2. Seal

8. Press impeller shaft out of pump housing.

NOTE: Bearing will come out with the impeller shaft.

REQUIRED TOOL	
IMPELLER SHAFT PUSHER (P/N 529 035 955)	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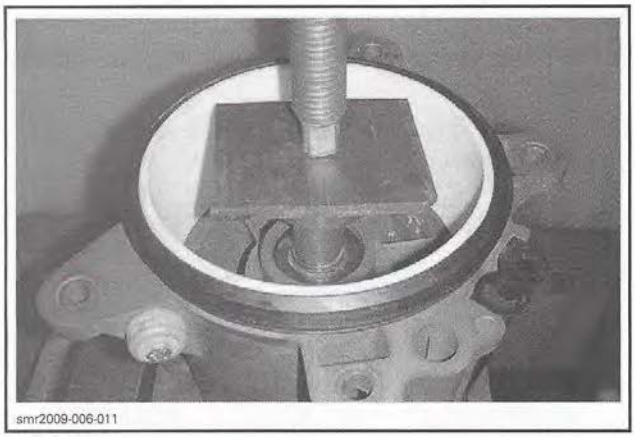
TYPICAL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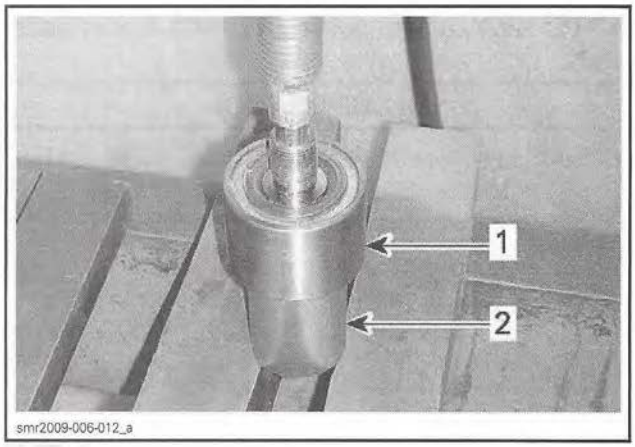
TYPICAL

9. Use the IMPELLER SHAFT BEARING TOOL (P/N 529 036 168) to press bearing off impeller shaft.

REQUIRED TOOL	
IMPELLER SHAFT BEARING TOOL (P/N 529 036 168)	



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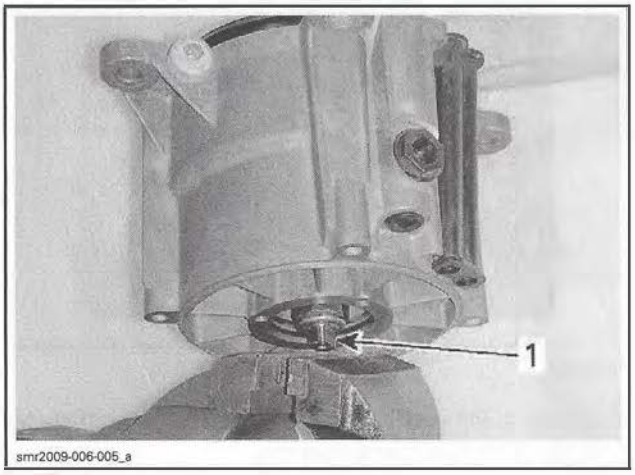
TYPICAL
1. Impeller shaft and bearing
2. Bearing tool on INNER race

Impeller Shaft Nut Removal if Impeller Has Loosened

1. Turn pump upside down and mount the flat sides of impeller shaft in a vise.



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TYPICAL
1. Flat side

2. Mount in the impeller splines the proper impeller remover/installer.


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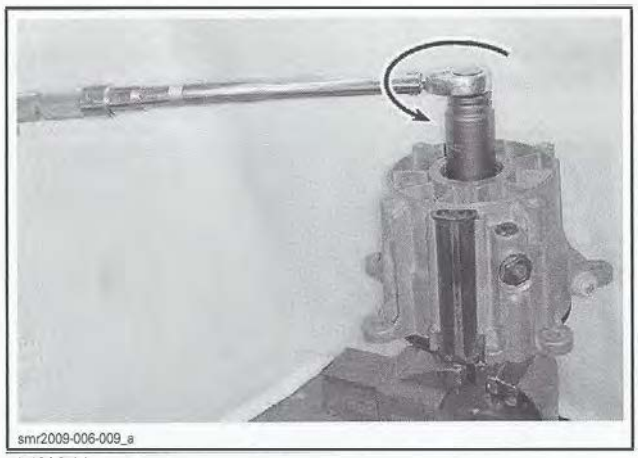
IMPELLER REMOVER/INSTALLER

ENGINE	REQUIRED TOOL
155	IMPELLER REMOVER/INSTALLER (P/N 529 035 820)
215, 255 and 260	IMPELLER REMOVER/INSTALLER (P/N 529 035 956)

3. Torque impeller more than impeller shaft nut.

TYPICAL

4. Turn pump upside down and retry unscrewing impeller shaft nut.



TYPICAL

5. If impeller still loosens instead of nut, retighten impeller more and retry. Repeat until nut loosens.
6. Remove impeller as described in this subsection.
7. Return to step 5 in the *IMPELLER SHAFT AND BEARING REMOVAL* main procedure.

Impeller Shaft and Bearing Inspection

With your finger nail, feel seal lip contact surface on shaft. If any irregular surface is found, replace shaft and seals.

Check condition of shaft threads.

TYPICAL
1. *Threads*
2. *Seal lip contact surface*
3. *Threads*

Inspect ball bearing for corrosion.

Impeller Shaft and Bearing Installation

Bearing Installation

The installation is essentially the reverse of the removal procedure. However, pay attention to the following.

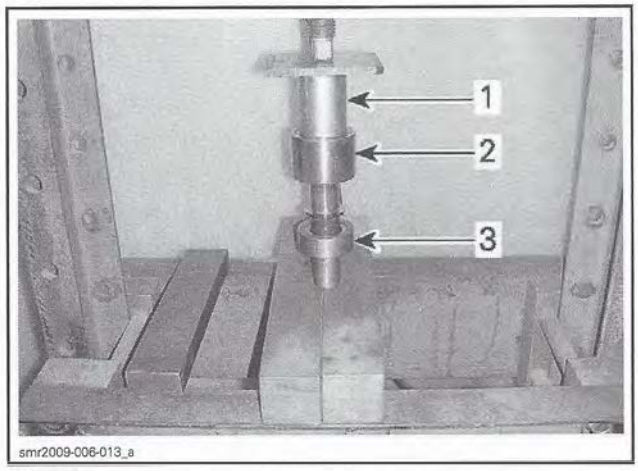
1. Protect the impeller shaft threads.

REQUIRED TOOL	
IMPELLER SHAFT BEARING TOOL (P/N 529 036 168)	

2. Press the bearing on the impeller shaft.

REQUIRED TOOL	
IMPELLER SHAFT PUSHER (P/N 529 035 955)	

NOTE: The bearing can be installed in either direction.



TYPICAL
1. *Impeller shaft bearing tool on INNER race*
2. *Impeller shaft and bearing*
3. *Impeller shaft installer/pusher tool*

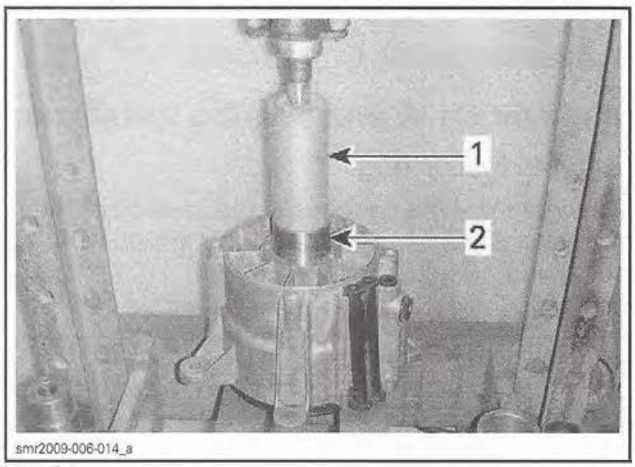
3. Press bearing until it bottoms.

Impeller Shaft Installation

NOTE: Ensure there is no O-ring in pump housing on the cover side.

1. From the outlet side of pump, press impeller shaft assembly into housing.

REQUIRED TOOL	
IMPELLER SHAFT BEARING TOOL (P/N 529 036 168)	

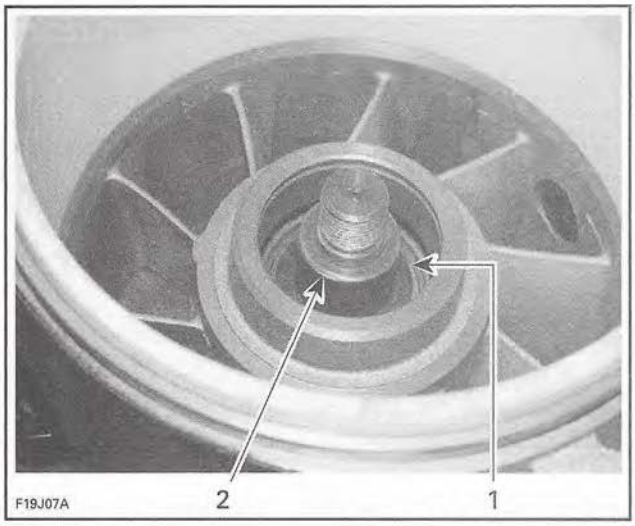


TYPICAL
1. Bearing tool
2. Impeller shaft and bearing

2. Press bearing until it bottoms.

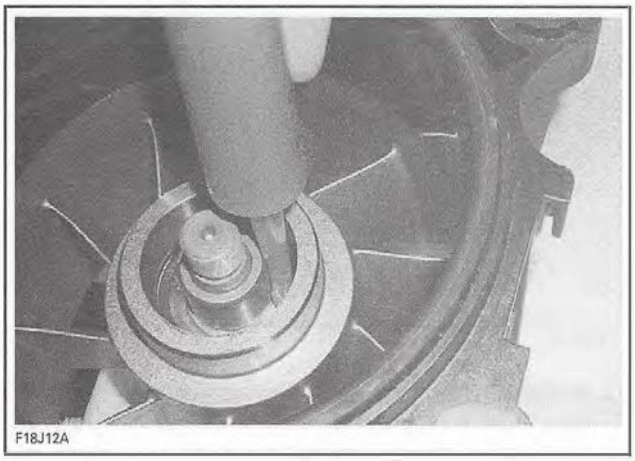
NOTE: Ensure impeller shaft turns freely and smoothly.

3. Turn pump upside down.
4. Coat shaft surface with JET PUMP BEARING GREASE (P/N 293 550 032).
5. Install O-ring at bottom.



TYPICAL
1. O-ring at bottom
2. Coat surface

6. Apply 4 ml (.1 U.S. oz) of JET PUMP BEARING GREASE (P/N 293 550 032) on bearing.

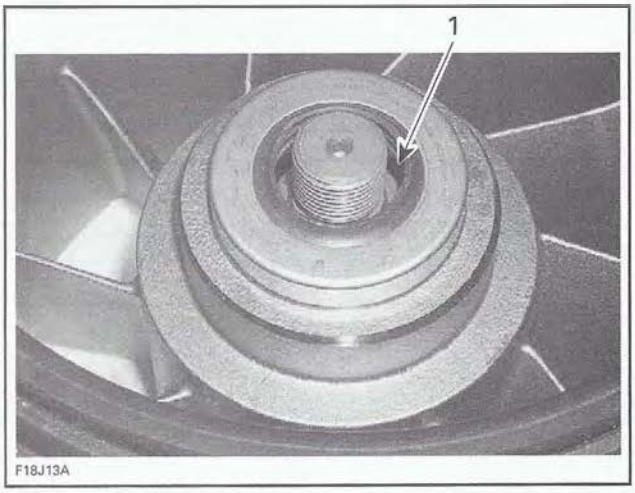


TYPICAL

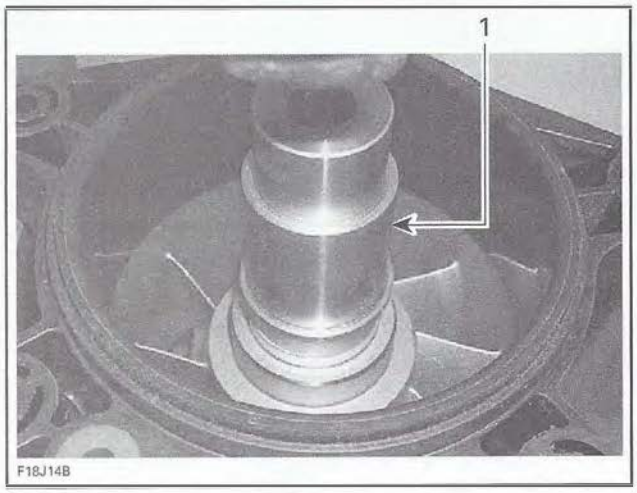
7. Press a **NEW** double lip seal until seal bottoms. Make sure seal lip are facing upwards.

REQUIRED TOOL	
SEAL/BEARING PUSHER (P/N 529 035 819)	

1. Seal lip up

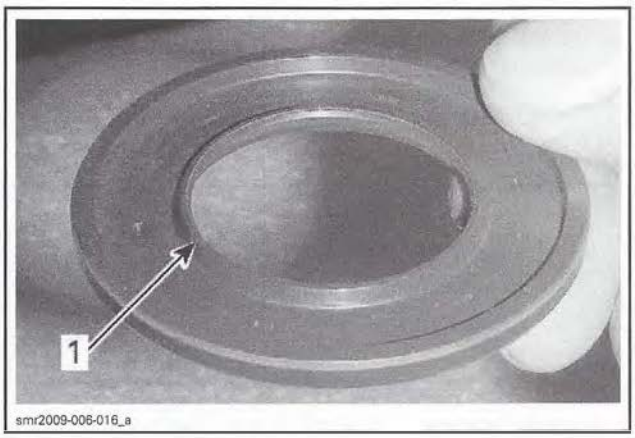


1. Seal lip facing up



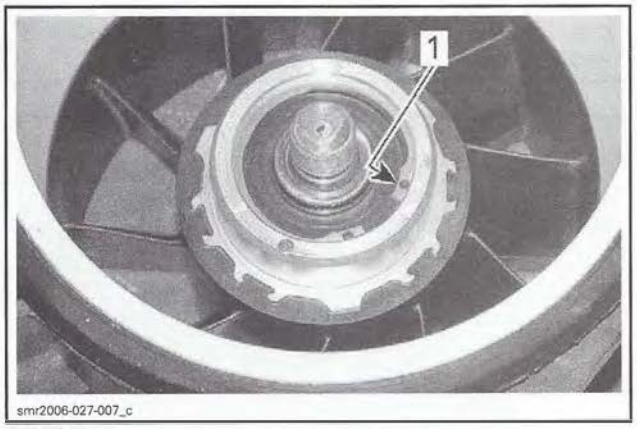
TYPICAL
1. Seal/bearing pusher

8. Install spacer and then the other seal (thin). Ensure seal lip is facing up.



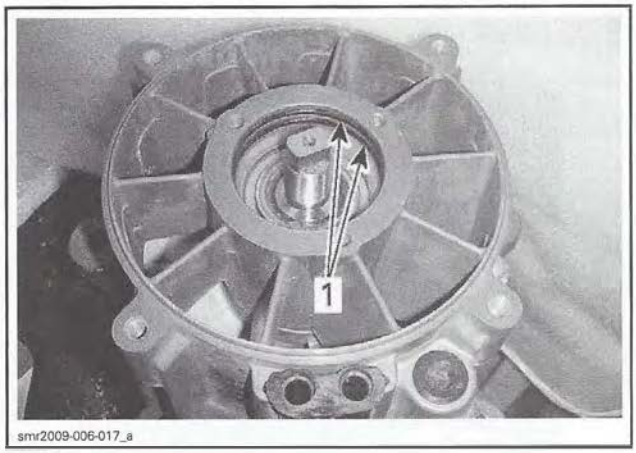
1. Seal lip facing up

9. Install circlip.



TYPICAL
1. Circlip

10. Turn pump upside down.
11. Install the two O-rings in pump housing.



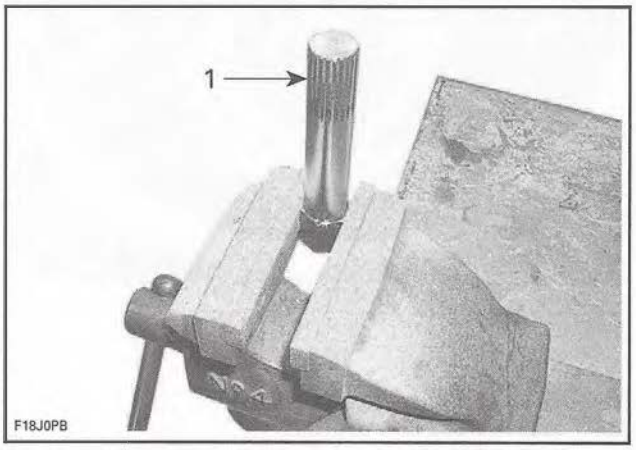
TYPICAL
1. O-rings

12. Before installing any other parts, pressurize jet pump to insure proper seal installation. Refer to *LEAK TEST* in this subsection.

13. Install impeller. Refer to *IMPELLER* in this subsection.
14. Mount in a vise the proper impeller remover/installer.

IMPELLER REMOVER/INSTALLER

ENGINE	REQUIRED TOOL
155	IMPELLER REMOVER/INSTALLER (P/N 529 035 820)
215, 255 and 260	IMPELLER REMOVER/INSTALLER (P/N 529 035 956)



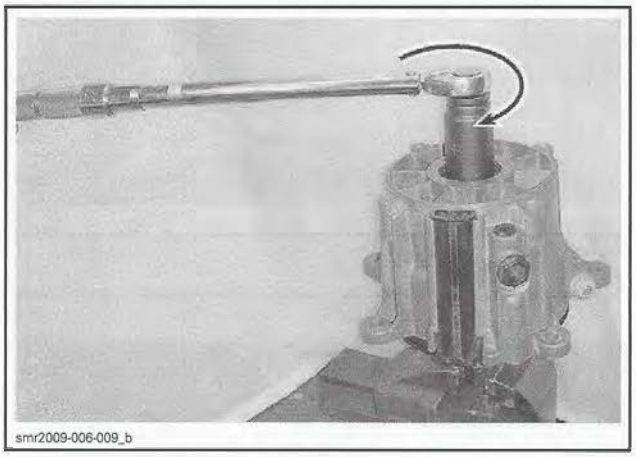
1. Impeller remover/installer tool

15. Install jet pump housing over this tool.

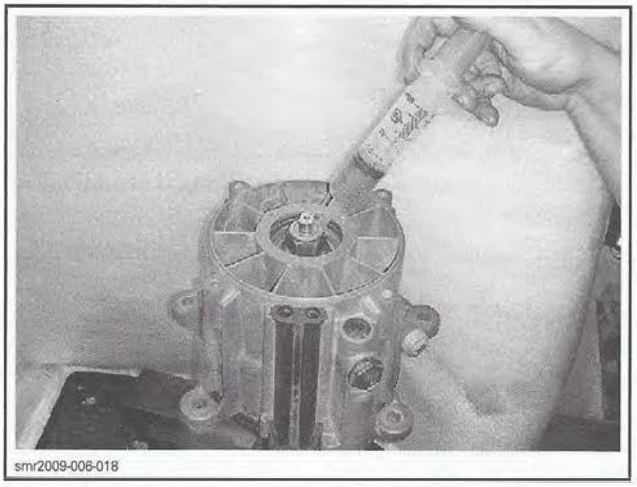
TYPICAL

16. Using a 30 mm socket, screw the impeller shaft nut on clockwise.

TORQUE	
Impeller shaft nut	125 N•m (92 lbf•ft)



17. Apply 24 ml (.8 U.S. oz) of JET PUMP BEARING GREASE (P/N 293 550 032) on the bearing (nut side).



18. Install the impeller cover. Refer to *IMPELLER COVER* in this subsection.

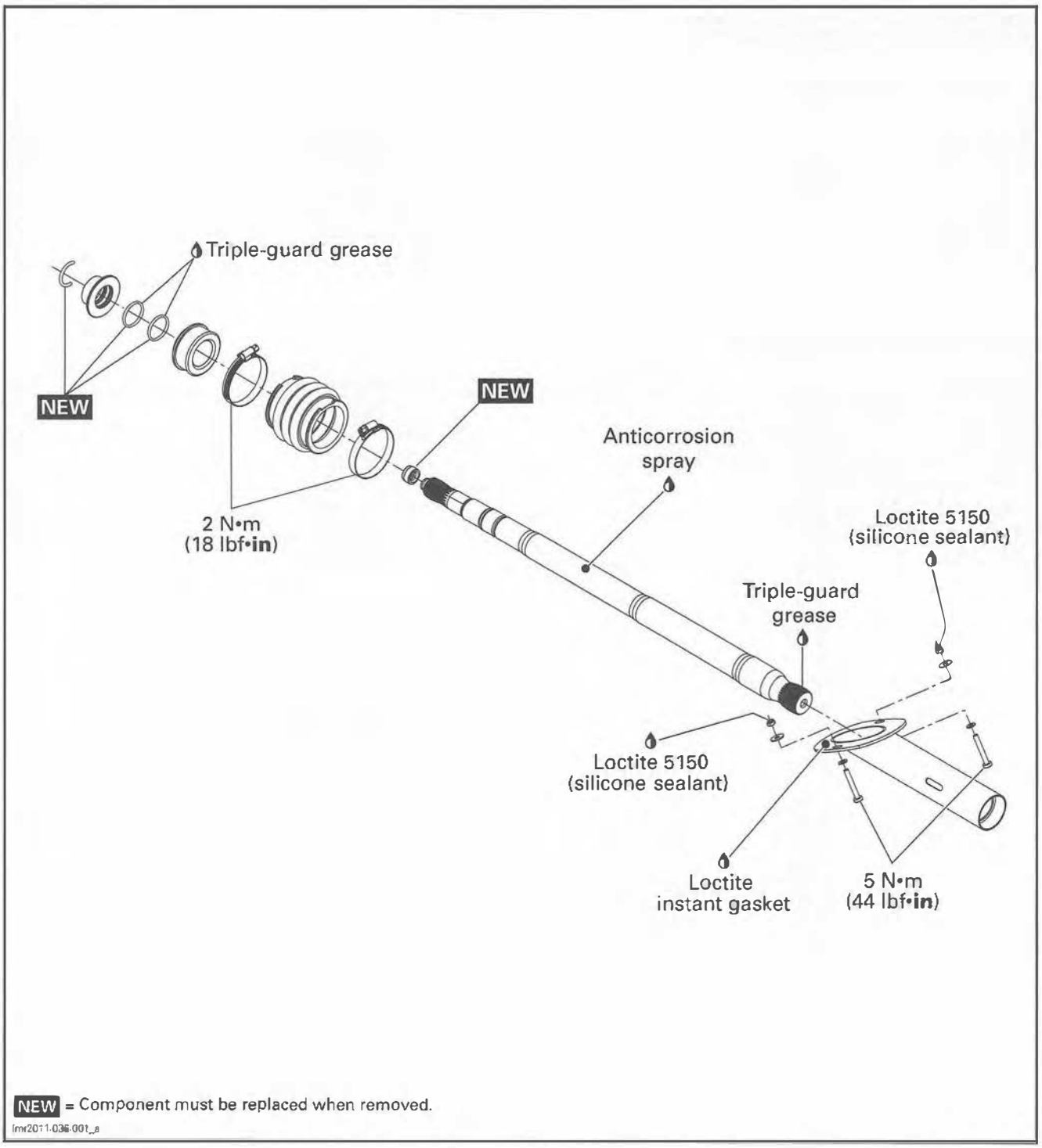
DRIVE SHAFT

SERVICE TOOLS

Description	Part Number	Page
DRIVE SHAFT C-CLIP REMOVER	529 036 026	400
DRIVE SHAFT HOLDER	529 035 986	399, 404
FLOATING RING TOOL (TYPE I)	529 035 841	400, 405
FLOATING RING TOOL (TYPE III)	529 035 987	400, 405
PTO SUPPORT TOOL	529 035 842	399, 403

SERVICE PRODUCTS

Description	Part Number	Page
ANTICORROSION SPRAY	219 700 304	399, 402
BRP HEAVY DUTY CLEANER	293 110 001	406
LOCTITE 5150 (SILICONE SEALANT)	296 000 309	406
LOCTITE INSTANT GASKET	219 701 421	406
PULLEY FLANGE CLEANER	413 711 809	401
TRIPLE-GUARD GREASE	296 000 329	403
XPS LUBE	293 600 016	401



NEW = Component must be replaced when removed.

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GENERAL

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

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

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

⚠ WARNING

Torque wrench tightening specifications must strictly be adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

MAINTENANCE

CORROSION PROTECTION

To prevent possible drive shaft corrosion in salt water, apply ANTICORROSION SPRAY (P/N 219 700 304) as per interval in *MAINTENANCE CHART*.

⚠ WARNING

Always work in a well ventilated area. Carefully read application instructions on product can.

Drive shaft should be dry and clean prior to applying the anticorrosion product.

From inside bilge, lift rubber protector to expose PTO seal assembly.

NOTE: On **supercharged engines**, remove inlet hose from supercharger to gain access.

Cover carbon seal ring and floating ring with a rag or plastic wrap to prevent the anticorrosion product to reach the carbon ring. Place a rag on bottom of hull to recover the excess of sprayed anticorrosion product. Spray the visible portion of drive shaft. When done, dispose soiled rag as per your local environmental regulations.

Install inlet hose to supercharger.

Reposition rubber protector.

Wait 2 hours prior to using the boat to allow the anticorrosion product to dry.

PROCEDURES

DRIVE SHAFT

Drive Shaft Removal

NOTE: When drive shaft will be removed, some oil will flow out. To prevent it, start engine, run at 4000 RPM for 10 seconds and stop engine at this RPM. This will move oil out of PTO housing into oil tank. If engine cannot be started, remove oil from the PTO area by following the procedure in *PTO HOUSING REMOVAL* of the *PTO HOUSING AND MAGNETO* section.

1. Remove jet pump. Refer to *JET PUMP* subsection.

NOTE: When removing jet pump from vehicle, support drive shaft to avoid engine oil seal damages.

REQUIRED TOOL	
DRIVE SHAFT HOLDER (P/N 529 035 986)	

TYPICAL
1. Drive shaft holder

2. Open engine cover.

215, 255 and 260 Engines

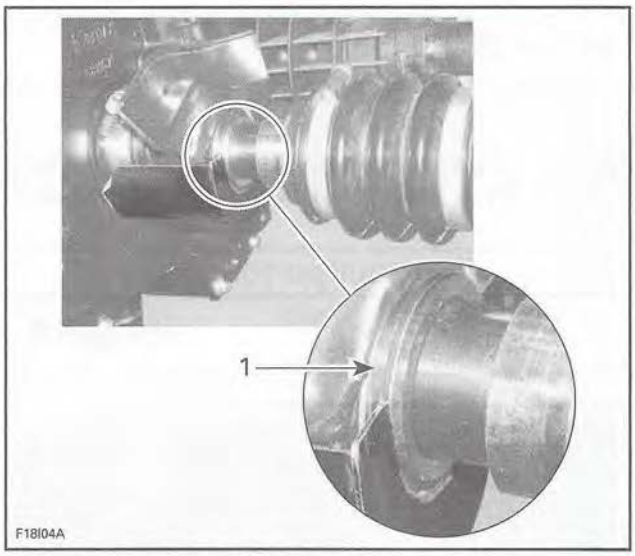
3. Remove supercharger. Refer to *SUPERCHARGER* in *ENGINE* section.

All Models

NOTE: Use this sequence to minimize the amount of movement the drive shaft will slide back into PTO seal assembly.

4. Lift rubber protector to expose PTO seal assembly. Install the PTO SUPPORT TOOL (P/N 529 035 842) on bottom of PTO seal assembly as shown.

NOTICE Strictly follow this procedure otherwise damage to component might occur.

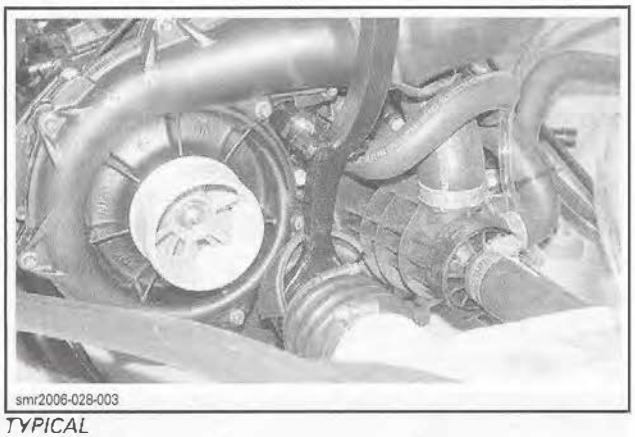


1. Insert in groove of PTO seal assembly

NOTE: Due to configuration of some models, it may be necessary to disconnect EGTS sensor to make room.

5. Push the floating ring rearwards to expose the circlip. This step is done to ensure floating ring is free and not stuck on the drive shaft. Do not remove circlip at this time.

REQUIRED TOOL	
DRIVE SHAFT C-CLIP REMOVER (P/N 529 036 026)	



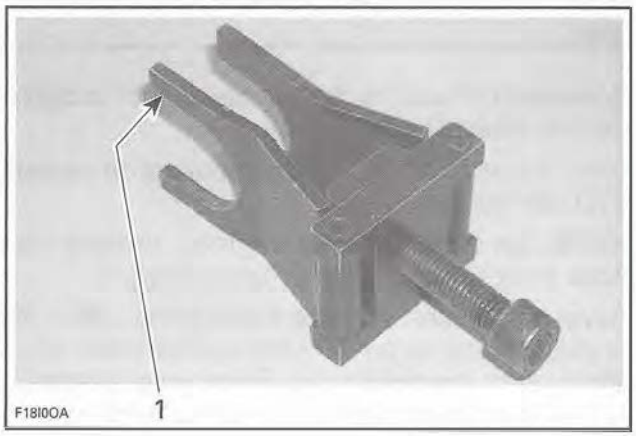
TYPICAL

NOTE: Place the fork of tool against floating ring and the adjustable arm on engine. Move the tool handle toward the front of vehicle to push floating ring.

6. Remove the drive shaft c-clip remover and the drive shaft holder.
7. Select the appropriate floating ring tool in accordance with the following table.

ENGINE	REQUIRED TOOL	
155	FLOATING RING TOOL (TYPE I) (P/N 529 035 841)	
215, 255 and 260	FLOATING RING TOOL (TYPE III) (P/N 529 035 987)	

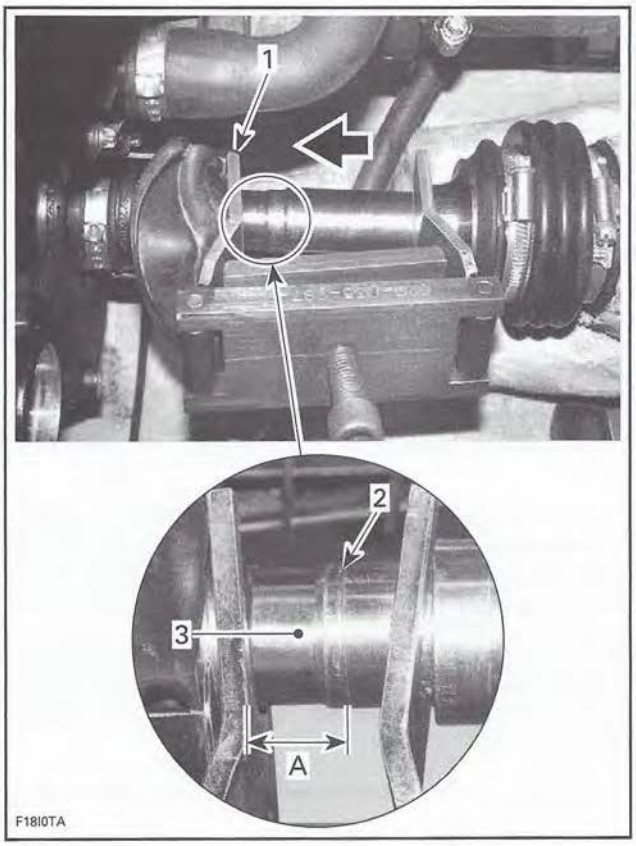
8. Install the floating ring tool with its largest opening on PTO seal side.



TYPICAL
1. Largest opening on PTO seal side

9. Turn screw clockwise so that the tool pushes the PTO seal forward and the drive shaft to the rear to expose the O-rings contact area. Continue to pull drive shaft out until there is a distance of 18 mm (23/32 in) between the

telltale groove and the tool edge. Lubricate O-rings contact area with XPS LUBE (P/N 293 600 016).

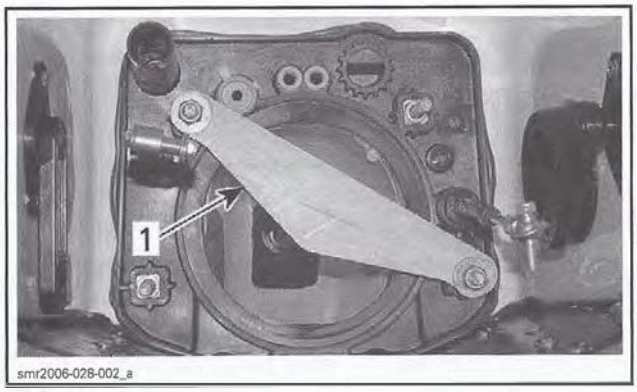


TYPICAL
1. *Largest opening here*
2. *Telltale groove*
3. *Lubricate O-rings contact area*

A. 18 mm (23/32 in)

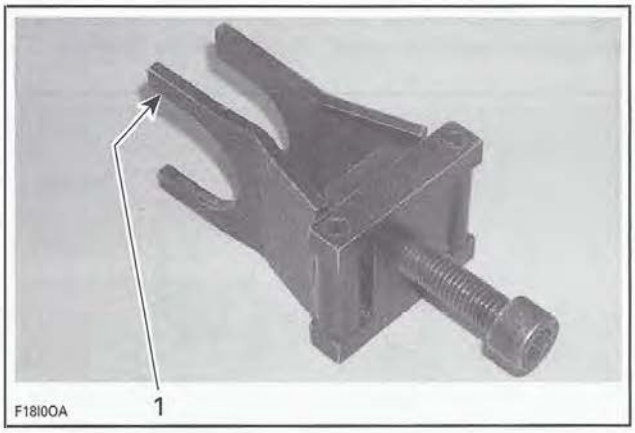
NOTE: This is necessary to ease drive shaft removal later in this procedure.

10. Remove the floating ring tool.
11. Push drive shaft in and reinstall drive shaft holder tool.



TYPICAL
1. *Drive shaft holder*

12. Reinstall the floating ring tool with its largest opening on PTO seal side.



TYPICAL
1. *Largest opening on PTO seal side*

13. Push floating ring rearwards to expose circlip and remove it. Discard circlip.

TYPICAL
1. *Largest opening here*
2. *Floating ring*
3. *PTO seal support tool*
4. *Remove circlip*

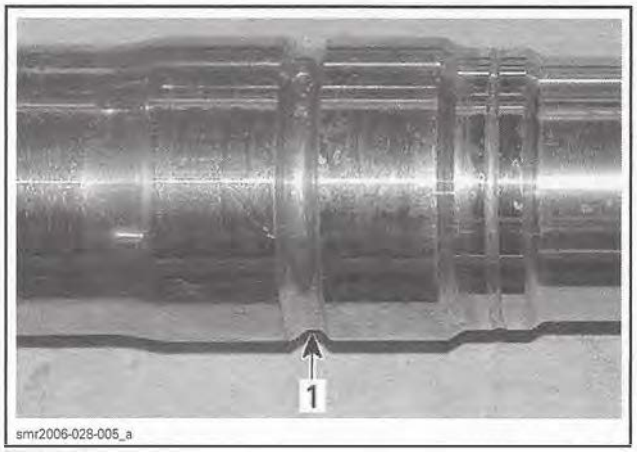
14. Remove drive shaft holder tool then the floating ring tool.
15. Place rags under PTO housing to prevent spillage. If spillage occurs, clean immediately with the PULLEY FLANGE CLEANER (P/N 413 711 809) to prevent oil stains.
16. Remove drive shaft.

NOTE: A slight jerk to the rear may be required to remove the drive shaft from the PTO seal assembly.

Drive Shaft Inspection and Lubrication

Drive Shaft

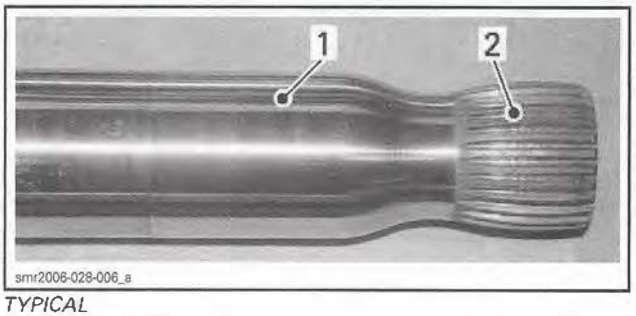
Inspect condition of circlip groove. If there is any damage or severe wear, replace drive shaft.



TYPICAL
1. Circlip groove

Inspect condition of drive shaft splines. If splines are damaged, replace drive shaft.

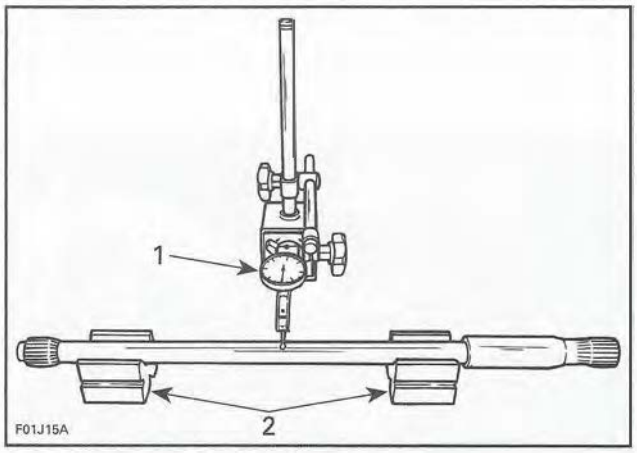
With your finger nail, feel machined surface of drive shaft. If any irregular surface is found, renew drive shaft.



TYPICAL
1. Surface condition
2. Splines condition

Excessive deflection could cause vibration and damage to drive shaft splines, impeller or floating ring.

Place drive shaft on V-blocks and set-up a dial gauge in center of shaft. Slowly rotate shaft; difference between highest and lowest dial gauge reading is deflection. Refer to the following illustration.

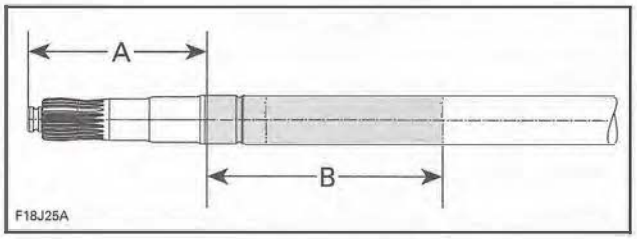


MEASURING DRIVE SHAFT DEFLECTION
1. Dial gauge
2. V-blocks

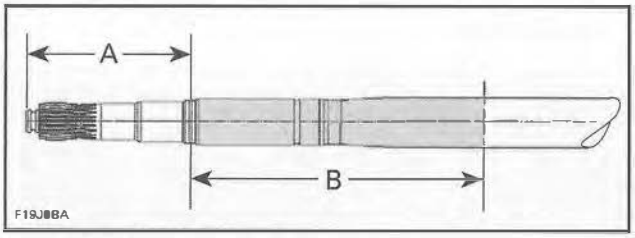
Maximum permissible deflection is 0.5 mm (.02 in).

To prevent possible drive shaft corrosion when the vehicle is used in salt water, apply ANTICORROSION SPRAY (P/N 219 700 304) on drive shaft where shown.

NOTE: Drive shaft should be dry and clean prior to applying the anticorrosion product. If the drive shaft is slightly corroded, a rotating wire brush may be used.



155 ENGINE
A. 89 mm (3-1/2 in)
B. 131 mm (5-5/32 in) — zone to apply anticorrosion product



215, 255 AND 260 ENGINES
A. 101 mm (4 in)
B. 180 mm (7-3/32 in) — zone to apply anticorrosion product

⚠ WARNING

Always work in a well ventilated area. Carefully read application instructions on product can.

Wait 2 hours prior to using the boat to allow anti-corrosion product to dry.

Floating Ring

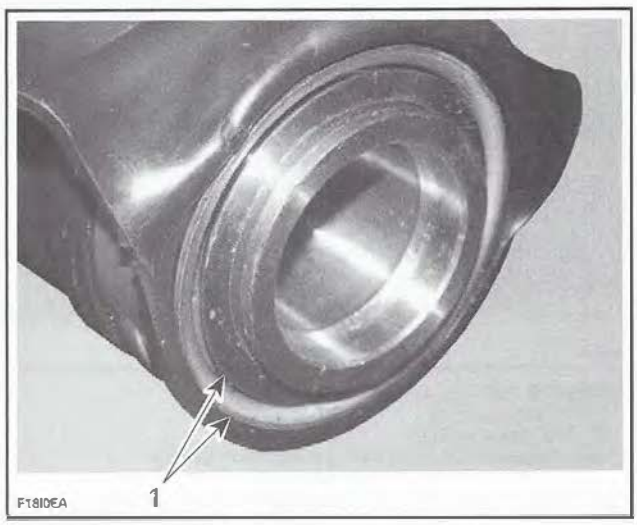
Inspect condition of O-rings and contact surface floating ring. Replace them if necessary.

Drive Shaft Installation

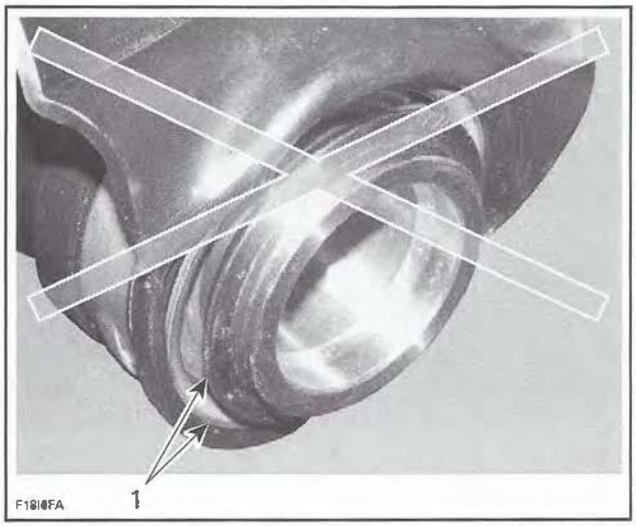
Before installing drive shaft, discard both O-rings inside PTO seal and install **NEW** ones.

1. O-rings

Inspect PTO seal assembly. The inner sleeve must be flush with outer circumference of the assembly. Otherwise, gently push or tap on inner sleeve until flush.

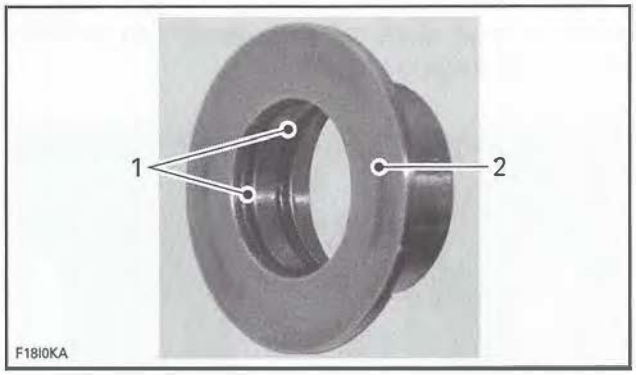


CORRECT POSITION
1. Inner sleeve flush with outer circumference



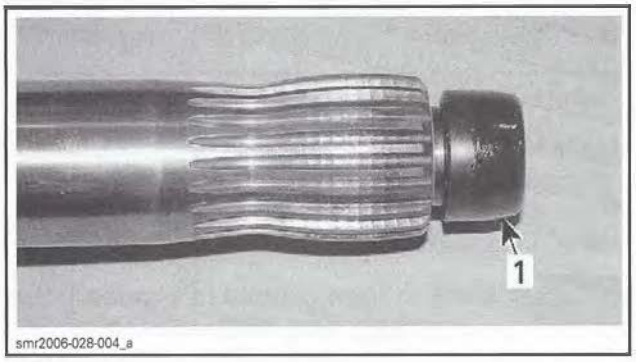
INCORRECT POSITION
1. Inner sleeve not flush with outer circumference

Apply a thin coat of TRIPLE-GUARD GREASE (P/N 296 000 329) on the floating ring O-rings. Do not get grease on floating ring contact surface.



1. Apply grease on O-rings
2. No grease on contact surface

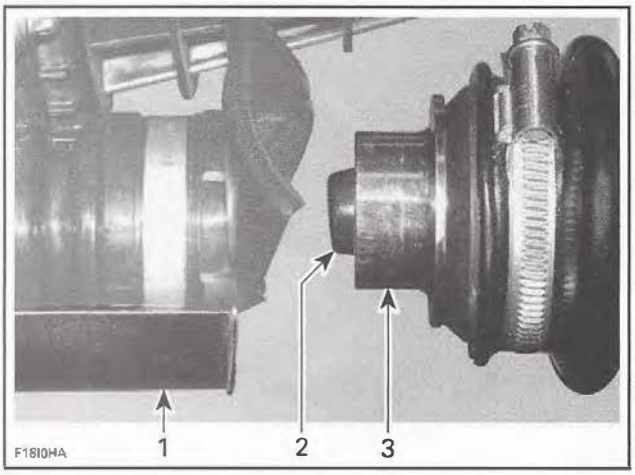
Remove the damper at the end of drive shaft and replace it with a **NEW** one.



1. Damper

Install the PTO SUPPORT TOOL (P/N 529 035 842) on PTO seal assembly.

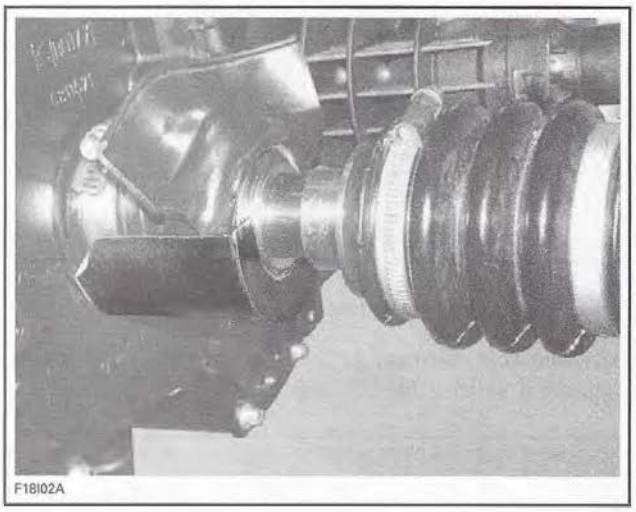
Slide drive shaft far enough to install floating ring.



1. PTO seal support
2. Drive shaft end
3. Insert floating ring on shaft end

Continue pushing drive shaft towards engine carefully guiding it in the PTO seal then in crankshaft splines. It may be necessary to move PTO seal assembly up and down to position it in the same axis as the drive shaft.

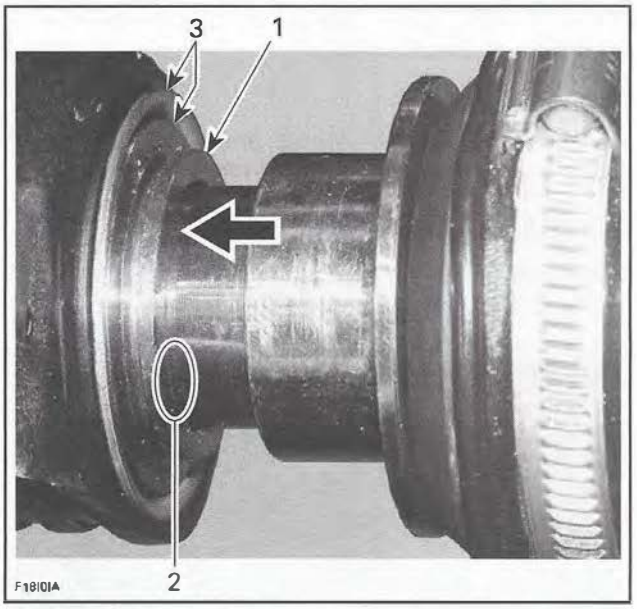
NOTE: If drive shaft does not enter into the PTO seal, check engine alignment.



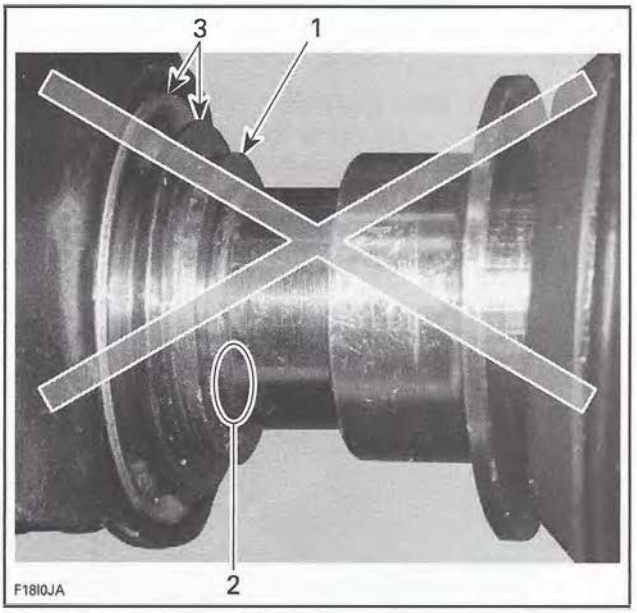
TYPICAL

Maintain PTO seal assembly in the proper position and tap shaft end until it bottoms against engine. At this time, the telltale groove **MUST NOT** be visible. This validates the correct position.

NOTICE **If the telltale groove is exposed, the installation is wrong and PTO seal assembly will be pressed into crankshaft splines which could rub a hole in seal thus creating an oil leak.**

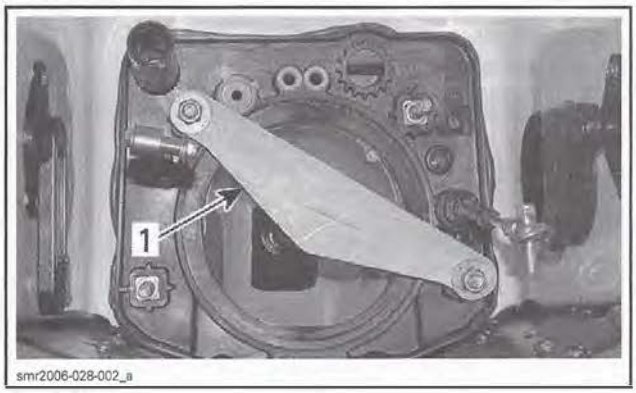


CORRECT INSTALLATION
1. PTO seal assembly
2. Shaft pushed in, hiding telltale groove
3. Inner sleeve flush with outer circumference



IMPROPER INSTALLATION
1. PTO seal assembly
2. Telltale groove visible
3. Inner sleeve NOT flush with outer circumference

Install the DRIVE SHAFT HOLDER (P/N 529 035 986).



TYPICAL
1. Drive shaft holder

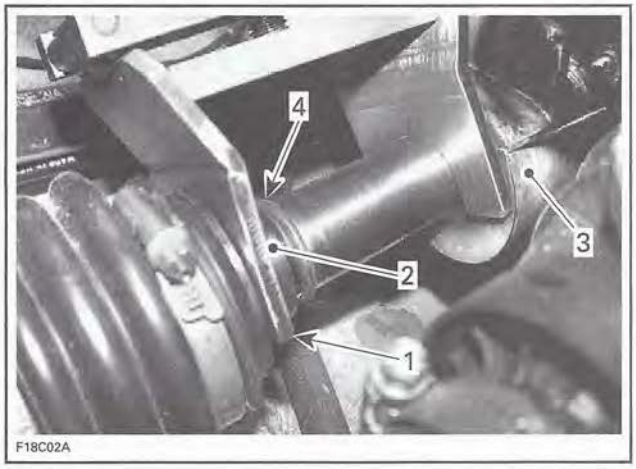
Install the floating ring tool with its largest opening on through-hull fitting side. Ensure PTO seal support is still in place.

TYPICAL
1. Largest opening on through-hull fitting side

Refer to the following table to use the appropriate tool according to the model.

ENGINE	REQUIRED TOOL
155	FLOATING RING TOOL (TYPE I) (P/N 529 035 841)
215, 255 and 260	FLOATING RING TOOL (TYPE III) (P/N 529 035 987)

Push floating ring rearwards and install a **NEW** circlip.



TYPICAL
1. Largest opening
2. Floating ring
3. PTO seal support tool
4. Install the NEW circlip

Remove floating ring tool, drive shaft holder then PTO seal support.

NOTE: Pushing drive shaft boot rearwards will ease removal of PTO seal support tool.

Now ensure everything is properly positioned:
- Telltale groove is not visible.
- Inner sleeve is flush with outer circumference of PTO seal assembly.
- Circlip is not exposed.

If telltale groove is visible, push PTO seal assembly rearwards to fully extend it.

If inner sleeve is not flush, gently tap it until it is flush.

Reposition rubber protector.

Reconnect EGTS sensor.

Install jet pump. Refer to *JET PUMP* subsection.

Check engine oil level. Refill as necessary.

Run boat then ensure there is no oil leak in PTO seal area.

DRIVE SHAFT BOOT

Drive Shaft Boot Inspection

Inspect the condition of boot. If there is any damage or evidence of wear, replace it.

Drive Shaft Boot Removal

Remove drive shaft. Refer to *DRIVE SHAFT* in this subsection.

Loosen gear clamp holding boot, then carefully pull boot and carbon ring from hull insert.

Drive Shaft Boot Installation

The installation is the reverse of the removal procedure.

CARBON RING

Carbon Ring Removal

Remove drive shaft. Refer to *DRIVE SHAFT* in this subsection.

Loosen gear clamp then pull carbon ring from drive shaft boot.

Carbon Ring Installation

The installation is the reverse of the removal procedure.

DRIVE SHAFT PROTECTOR

Drive Shaft Protector Removal

Remove the drive shaft. Refer to *DRIVE SHAFT*.

Inside hull, remove silicone sealant applied on nuts.

Unscrew the bolts securing the drive shaft protector to the hull.

Slide a flexible blade between protector and hull to cut the sealant.

Remove the protector from hull.

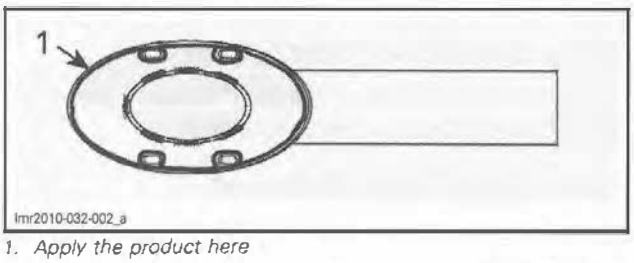
Drive Shaft Protector Cleaning

Scrape off all excess of sealant from protector and hull.

Clean hull surface with BRP HEAVY DUTY CLEANER (P/N 293 110 001) to eliminate grease, dust and any residue of sealant.

Drive Shaft Protector Installation

Apply LOCTITE INSTANT GASKET (P/N 219 701 421) on the flat side of drive shaft protector (all around perimeter and screw holes).



1. Apply the product here

Install the protector on hull with its bolts. Position bolts in the top holes and torque them to 5 N•m (44 lbf•**in**).

Install drive shaft. Refer to *DRIVE SHAFT* for proper procedure.

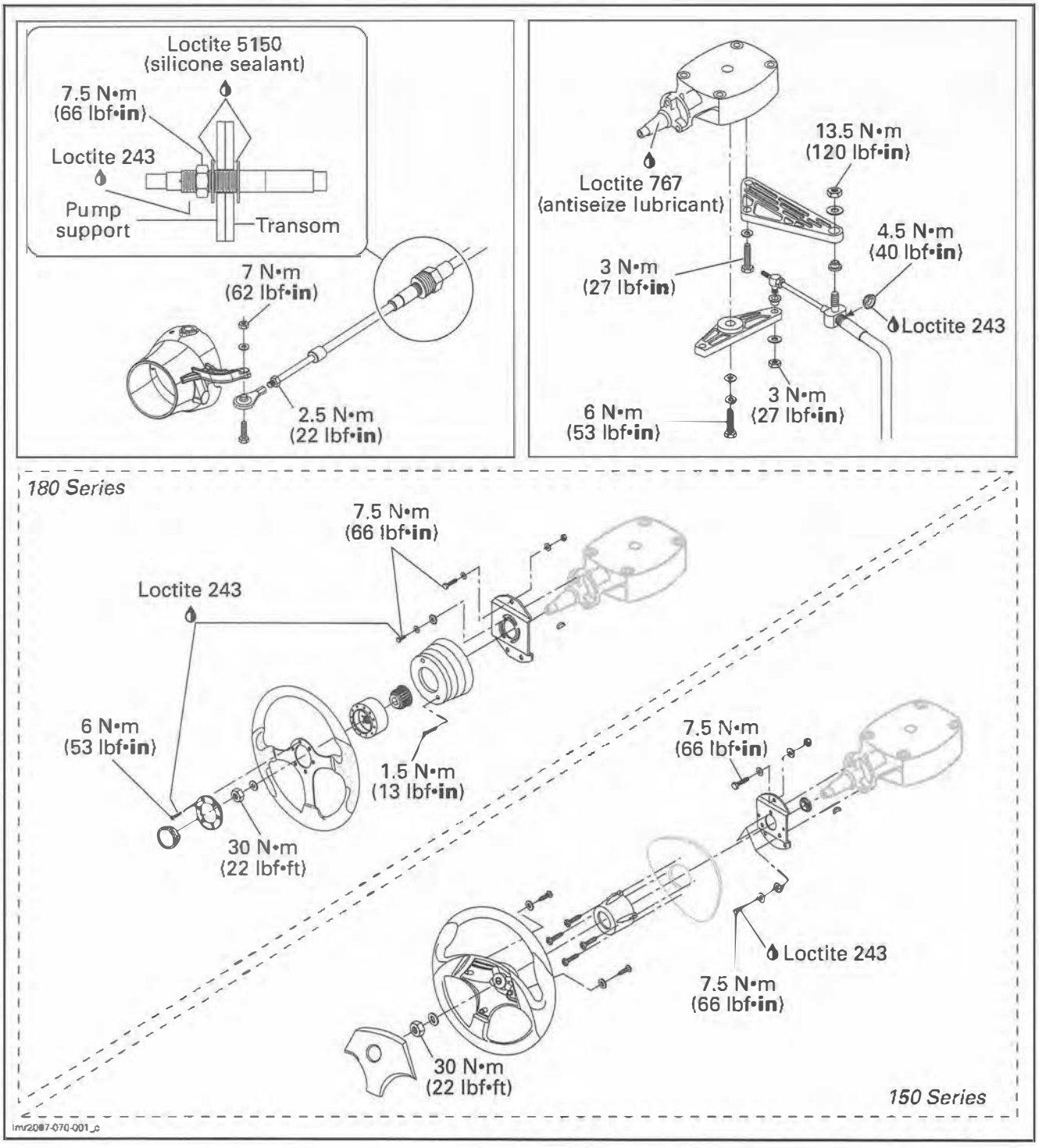
Inside hull, apply LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) on the end of drive shaft protector bolts.

STEERING SYSTEM

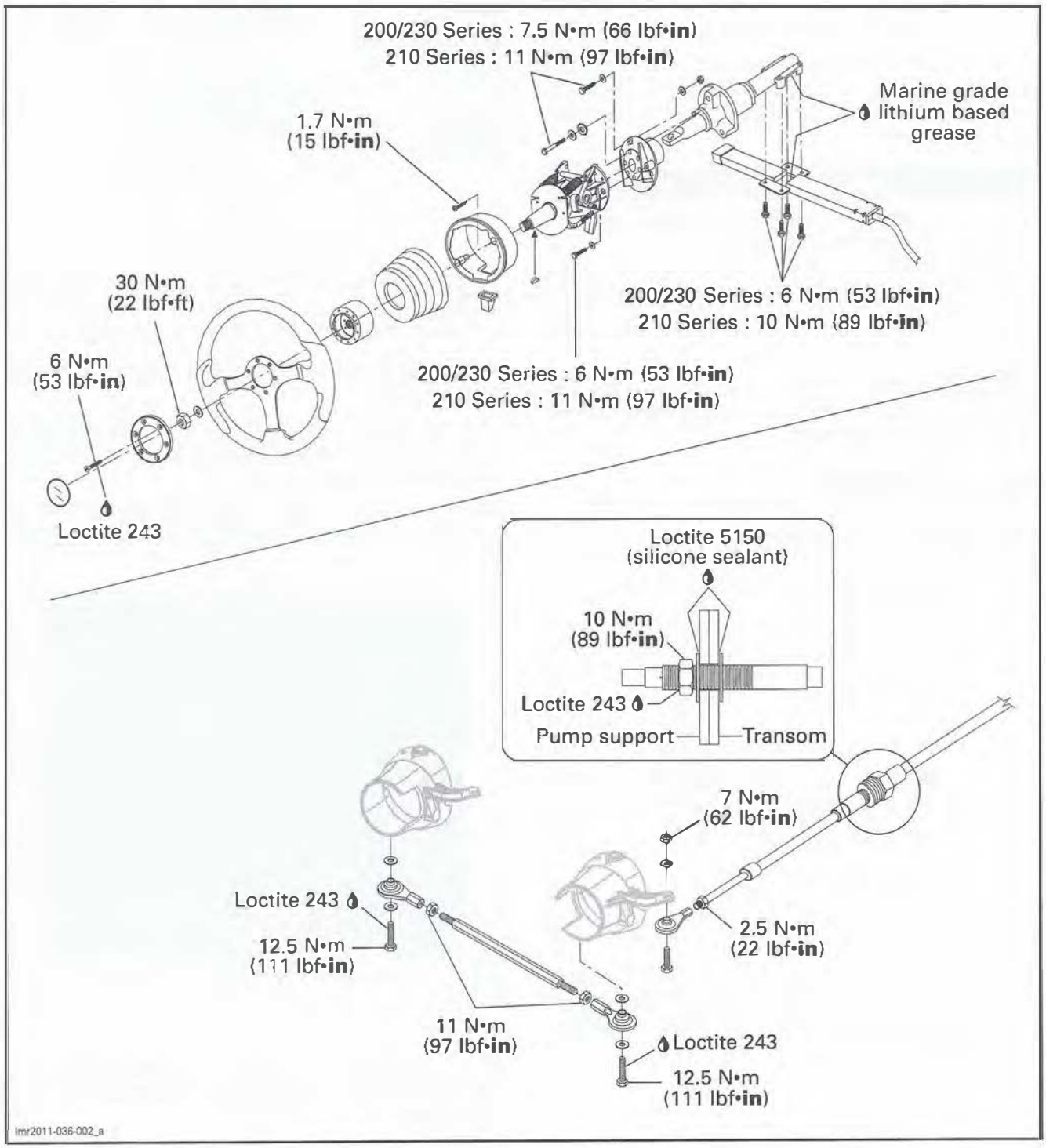
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	412–415, 417
LOCTITE 5150 (SILICONE SEALANT)	296 000 309	416

150 AND 180 SERIES



200, 210 AND 230 SERIES



GENERAL

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

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

⚠ WARNING

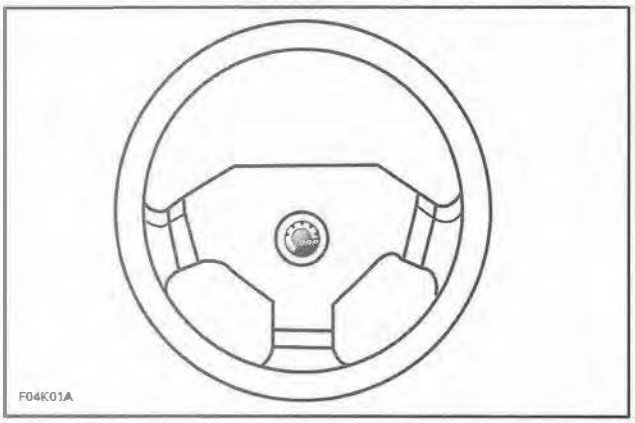
Torque wrench tightening specifications must strictly be adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

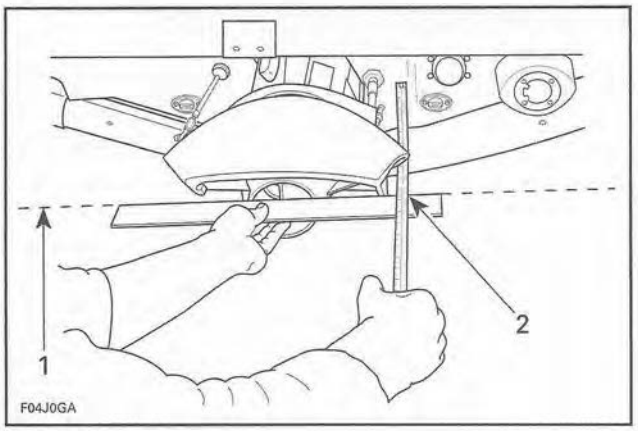
ADJUSTMENT

STEERING ALIGNMENT

Position steering in straight ahead position.



Check alignment of starboard jet pump nozzle and steering centering by placing a straight edge across nozzle end. Straight edge must be parallel with transom.

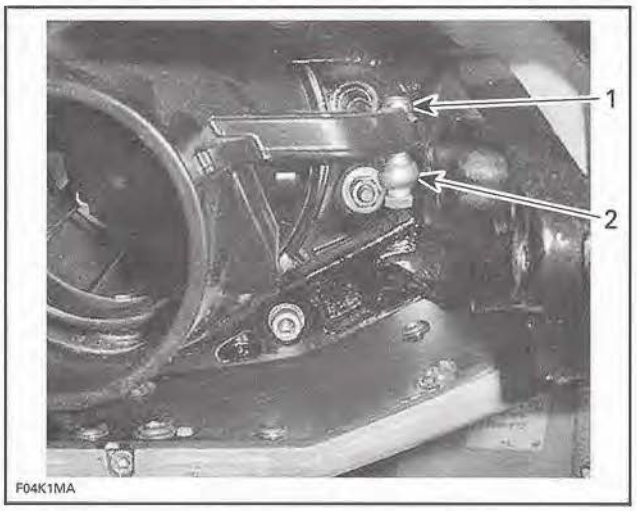


TYPICAL
1. Parallel with transom
2. Measure distance between transom and straight edge

NOTE: Take two measurement, one of each side of the nozzle.

A small adjustment can be made with the cable ball joint. Remove ball joint nut, unlock ball joint and rotate it to adjust.

NOTE: A minimum of 7 turns of the ball joint on the cable is necessary to assure a proper engagement.



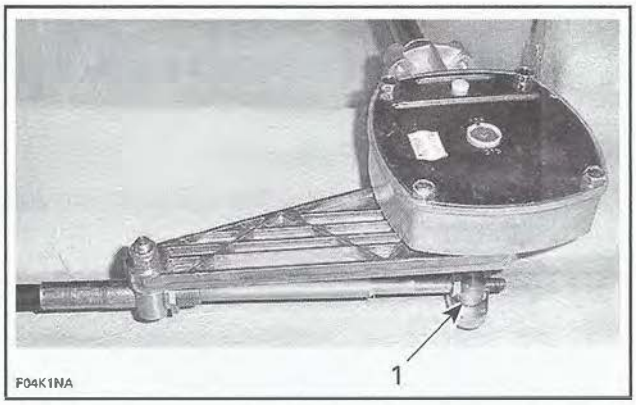
TYPICAL
1. Ball joint nut
2. Ball joint

When adjustment is done, reinstall all removed parts and make sure ball joint is parallel with the nozzle arm.

150 and 180 Series

For a bigger adjustment, adjust steering cable on steering helm arm.

NOTICE **Cable end must remain protruding through helm mounting block.**

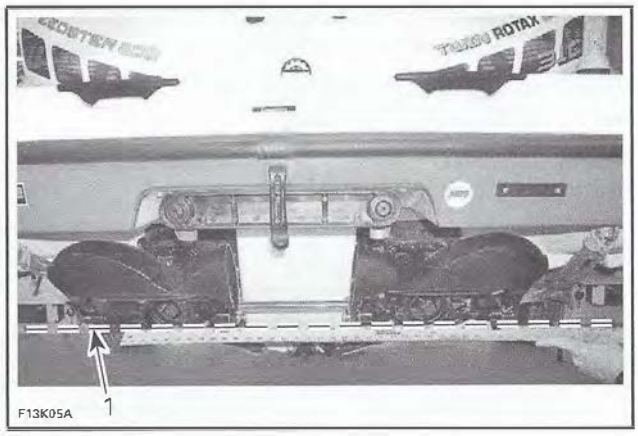


1. Adjust here. Cable end must remain protruding

Ensure to apply Loctite on parts as indicated on exploded view.

200, 210 and 230 Series

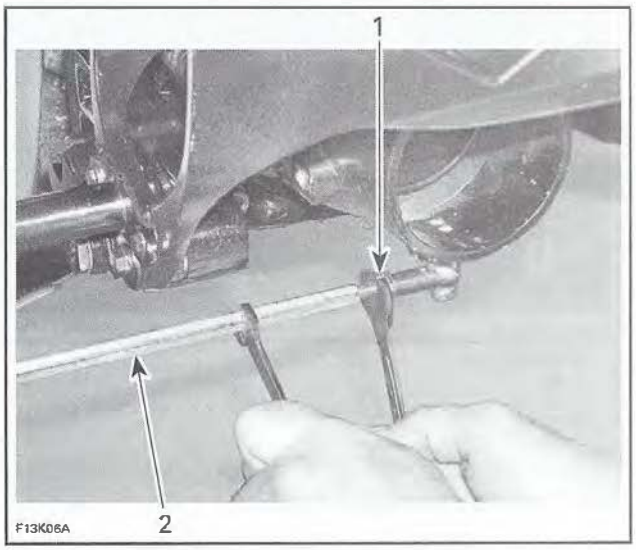
Install a straight edge across nozzle ends. Straight edge must be parallel with transom and touch both edges of each nozzle.



TYPICAL
1. Parallel with transom

To align nozzle, loosen lock nuts of nozzle link rod. While holding rod end, turn nozzle link rod to adjust.

NOTE: Ball joint ends must thread on link rod a minimum of 10 turns.



TYPICAL
1. Lock nut
2. Nozzle link rod

When finished, tighten lock nuts as per following table.

TORQUE	
Link rod lock nut	11 N•m (97 lbf•in)

TROUBLESHOOTING

ABNORMAL PLAY IN STEERING

150 and 180 Series

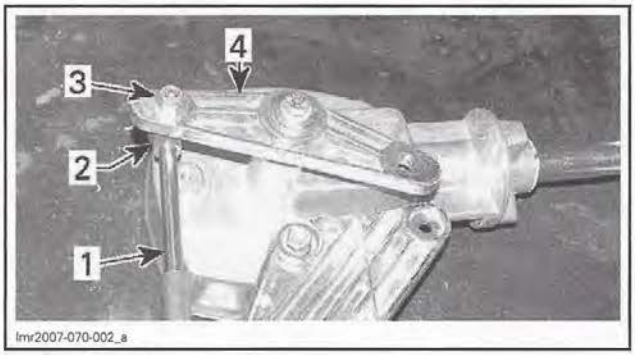
Steering wheel should turn easily and smoothly with a minimum resistance from side to side. No frictional sound should be heard or abnormal play noticed.

If an abnormal play is detected, isolate cable from steering helm to diagnose faulty part.

Remove the control panel.

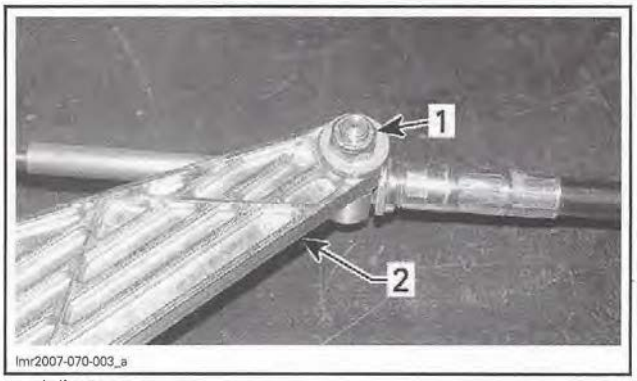
Visually check steering cable for wear and oxidation at steering helm and at nozzle. Check at end of cable housing. Replace as necessary.

Unscrew pivot nut then detach pivot from rotating arm.



1. *Steering cable*
2. *Pivot*
3. *Pivot nut*
4. *Rotating arm*

Loosen adjuster nut from steering helm arm to allow moving steering cable.



1. *Adjuster nut*
2. *Steering helm arm*

Check steering cable movement. Replace as necessary.

Check the rotating arm bushing and the steering helm arm bushing for wear. Replace as required.

Turn steering wheel from side to side, if rotation movement is abnormal or if end play is excessive, replace steering helm as an assembly.

⚠ WARNING

Disassembly of the steering helm can lead to steering failure. Replace complete assembly. For cable assembly, use supplied hardware only. Do not use substitutes.

PROCEDURES

NOZZLE LINK ROD

200, 210 and 230 Series

Nozzle Link Rod Inspection

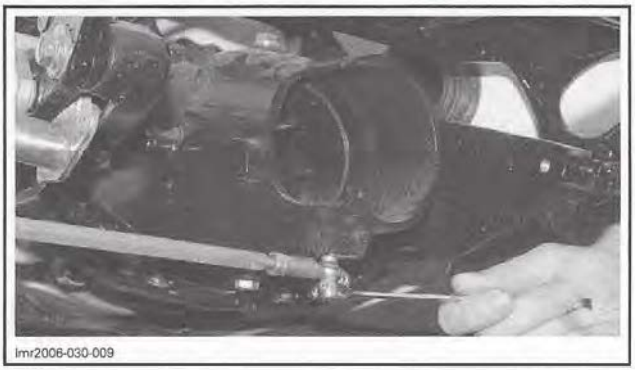
Check if the nozzle link rod is straight. If not replace the link rod.

Check if ball joint ends move freely.

Check ball joint end for wear and excessive free play.

Nozzle Link Rod Removal

Remove screws that attach the ball joint of nozzle link rod to nozzles.



Nozzle Link Rod Installation

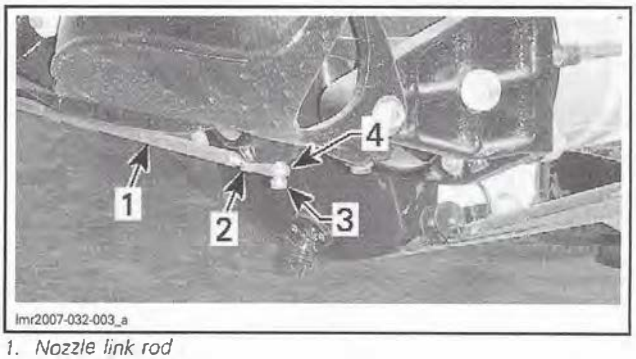
The installation is the reverse of the removal procedure. However, pay attention to the following.

Make sure the ball joint ends are threaded on link rod a minimum of 10 turns.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of ball joint screws.

Tighten ball joint retaining screws and link rod lock nuts as per following table.

TORQUE	
Ball joint retaining screw	12.5 N•m (111 lbf•**in**)
Link rod lock nut	11 N•m (97 lbf•**in**)



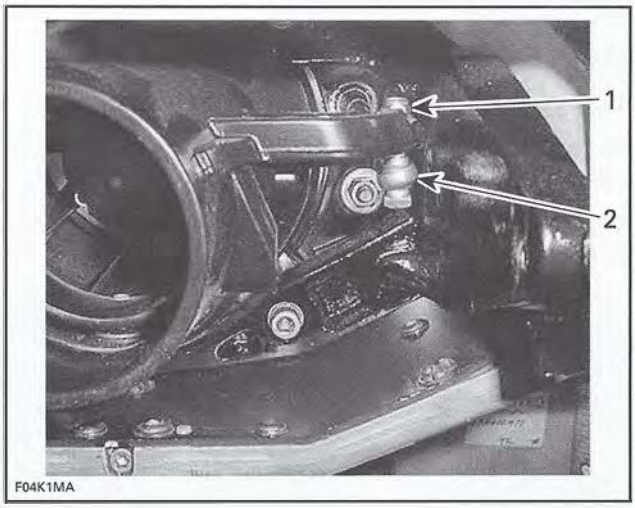
1. *Nozzle link rod*
2. *Link rod lock nut*
3. *Ball joint retaining screw*
4. *Ball joint end*

Proceed with steering alignment. Refer to *ADJUSTMENT*.

NOZZLE

Nozzle Removal

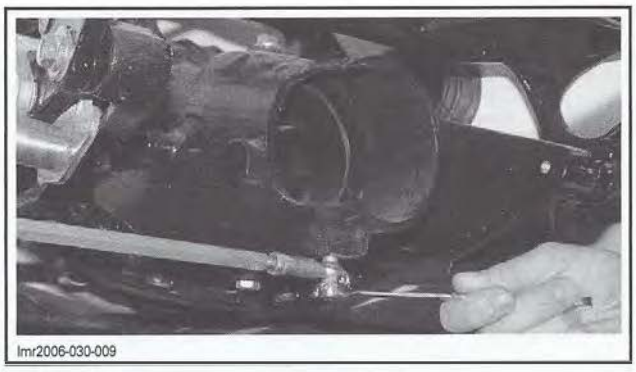
Disconnect steering cable from jet pump nozzle.



TYPICAL
1. *Steering cable nut*
2. *Steering cable*

200, 210 and 230 Series

Detach the nozzle link rod. Refer to *NOZZLE LINK ROD*.



All Models

Remove retaining screws, sleeves and washers on top and underneath nozzle.

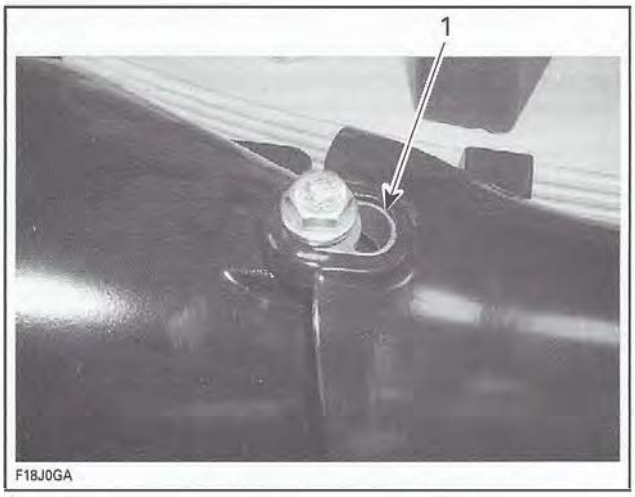
Remove nozzle.

Nozzle Installation

Before installing the nozzle, check threads in venturi for looseness or damages.

Insert lower bushing in nozzle.

Insert upper bushing in nozzle with its offset pointing rearward.



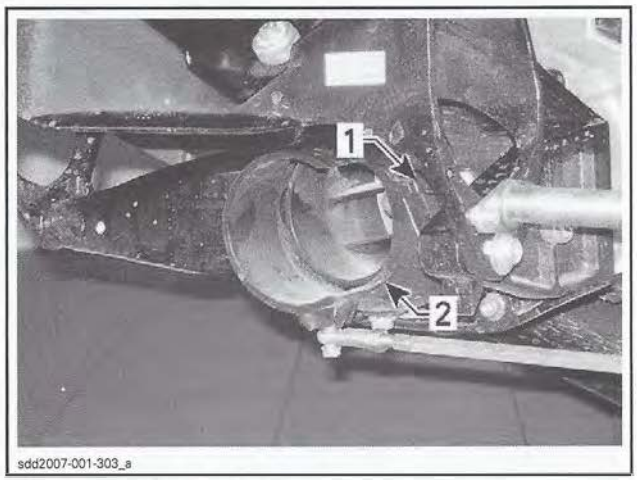
1. *Bushing offset*

Position their flanges from inside of nozzle.

Insert sleeves in bushings.

Install nozzle on venturi. Position the steering cable attachment arm on the RH side.

NOTE: On twin engines models, both nozzle openings must be placed face to face.



TYPICAL — PORT SIDE SHOWN
1. *Steering cable attachment arm*
2. *Nozzle opening*

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on nozzle screw threads (or use new self-locking screws).

Install nozzle screws and washer then them as per following table.

TORQUE	
Nozzle screw	25 N•m (18 lbf•ft)

⚠ WARNING

Screws must be torqued as specified.

Install nozzle link rod. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of ball joint retaining screws and torque them as per following table.

TORQUE	
Ball joint retaining screw	12.5 N•m (111 lbf•in)

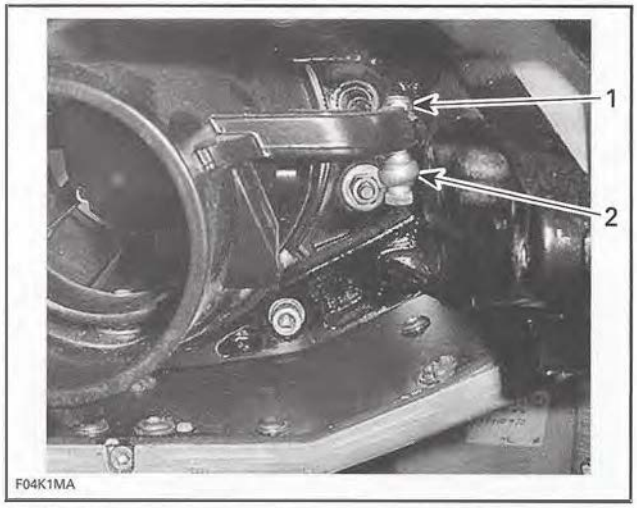
Proceed with steering alignment. Refer to *ADJUSTMENT*.

STEERING CABLE

Steering Cable Removal

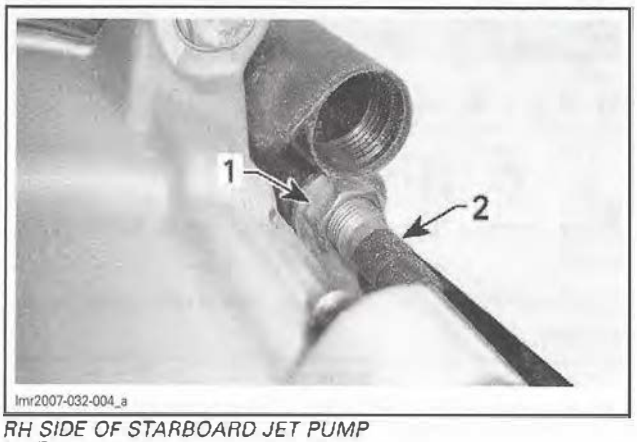
Nozzle Side

Disconnect steering cable from nozzle.



TYPICAL
1. *Steering cable nut*
2. *Steering cable*

Remove external nut from steering cable.



RH SIDE OF STARBOARD JET PUMP
1. *External nut*
2. *Steering cable*

Remove ball joint at the end of steering cable.

From Engine Compartment

On transom, remove silicone around steering cable.

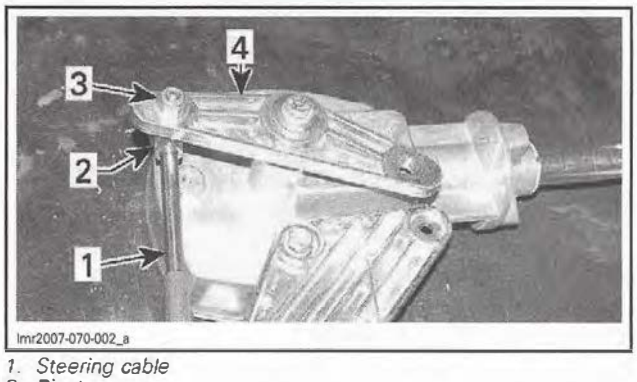
Fasten a rope at the end of the cable and pull steering cable inside hull.

Under Driver Console

150 and 180 Series

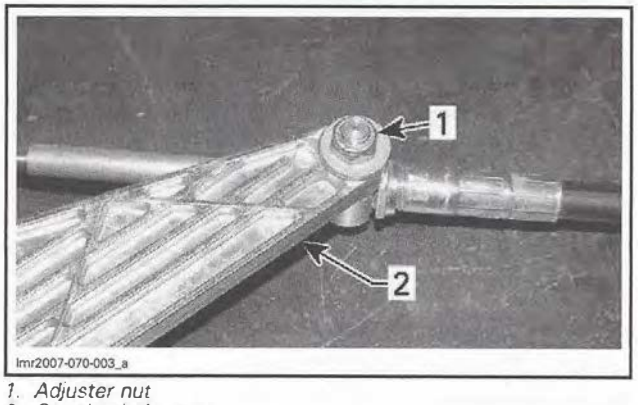
Access to steering helm. Refer to *STEERING HELM ACCESS*.

Unscrew pivot nut then detach pivot from rotating arm.



1. *Steering cable*
2. *Pivot*
3. *Pivot nut*
4. *Rotating arm*

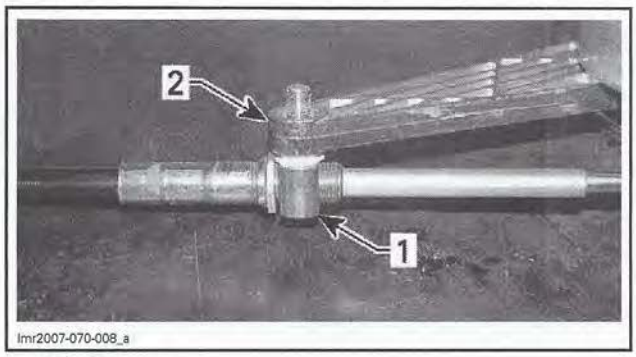
Remove adjuster nut from adjuster on steering helm arm to release steering cable.



1. *Adjuster nut*
2. *Steering helm arm*

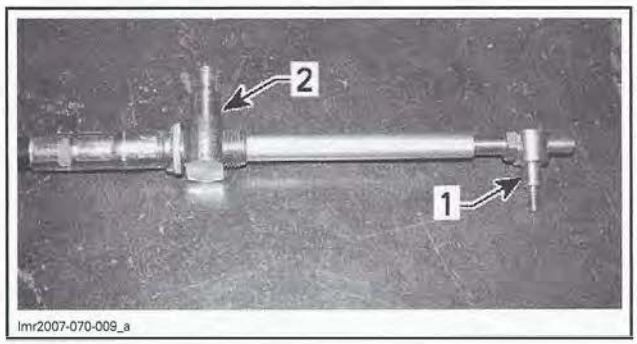
Rotate steering wheel (or steering helm shaft) to release tension on steering cable.

Detach adjuster from steering helm arm.



1. *Adjuster*
2. *Steering helm arm*

Unscrew pivot and adjuster from steering cable.



1. *Pivot*
2. *Adjuster*

Pull steering cable out of the driver's console

200, 210 and 230 Series

Access to steering pinion. Refer to *STEERING PINION ACCESS*.

Remove 4 screws securing the pinion from the rack.

Remove steering cable and rack from the driver's console.

Steering Cable Installation

Reinstall removed parts and pay attention to the following.

Fasten the rope at the end of the new cable and route it inside console and engine compartment.

Pass the steering cable end through the transom.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of external nut then torque it.

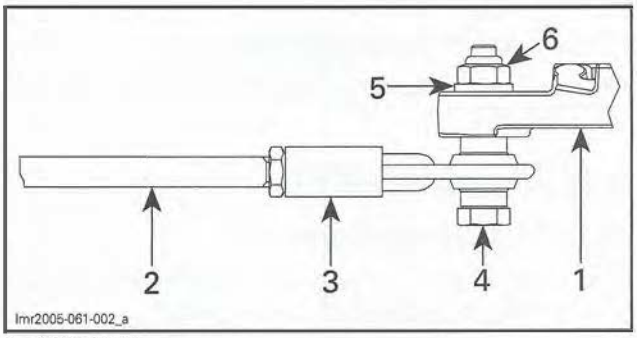
TORQUE	
External nut	7.5 N•m (66 lbf•ft)

Screw ball joint halfway onto cable end threaded section.

⚠ WARNING

Make sure cable ball joint is screwed a minimum of 7 complete revolutions.

Secure ball joint on nozzle. See the following illustration.

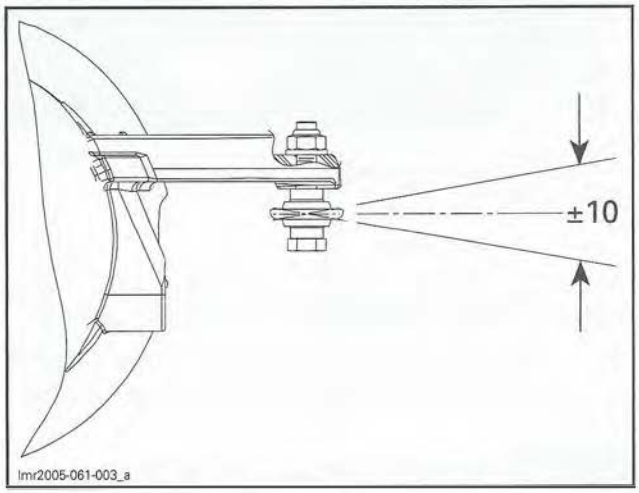


1. *Nozzle arm*
2. *Steering cable*
3. *Ball joint*
4. *Bolt*
5. *Flat washer*
6. *Nut*

Tighten ball joint retaining nut.

TORQUE	
Ball joint retaining nut	7 N•m (62 lbf•**in**)

NOTE: Be sure ball joint is parallel with the nozzle arm.



150 and 180 Series

Secure steering cable to steering helm arm and rotating arm.

200, 210 and 230 Series

Center the nozzles and the steering wheel.

Secure the steering cable rack to the steering pinion.

NOTE: New parts are shipped with the required amount of grease. Do not add grease during installation.

All Models

From inside and outside of hull, apply LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) around steering cable and nut.

Check cable/hull watertightness.

Proceed with steering alignment. Refer to *ADJUSTMENT*.

STEERING WHEEL

Steering Wheel Removal

To release steering cover, use a small screwdriver to push tabs inside and lift the cover.

TYPICAL — CAREFULLY REMOVE WITH A SMALL SCREWDRIVER

Loosen steering nut.

Install any suitable steering wheel puller to ease steering wheel removal and to prevent damage.

Hold steering wheel firmly and tighten puller screw to detach wheel from the steering helm shaft.

NOTICE Do not hammer on the shaft to dislodge the steering wheel.

Once steering wheel is unlocked, remove steering wheel puller, steering nut with washer and steering wheel.

Be careful to keep Woodruff key for reinstallation.

Steering Wheel Installation

Ensure to install Woodruff key.

Install steering wheel.

Install steering nut and its washer then torque steering nut as per following table.

TORQUE	
Steering nut	30 N•m (22 lbf•ft)

Proceed with steering alignment. Refer to *ADJUSTMENT*.

TILT MECHANISM

200, 210 and 230 Series

Tilt Mechanism Removal

Remove steering wheel. See procedure above.

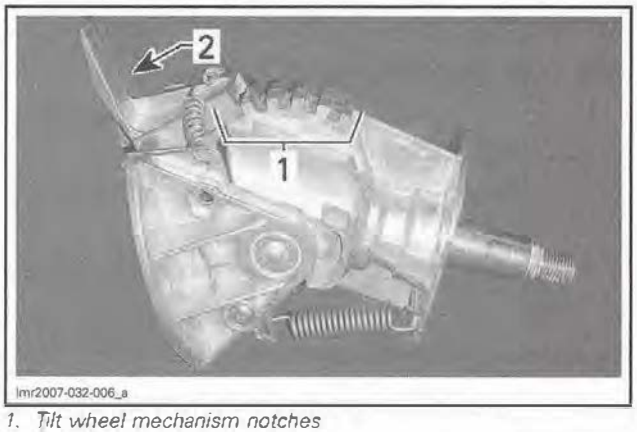
Remove both screws securing the collar support to the tilt mechanism.

Unscrew and remove screws that attach the tilt mechanism to steering helm support.

Pull tilt mechanism to remove it.

Tilt Mechanism Inspection

Check mechanism for looseness. Also, check lever and notches for wear. Replace the tilt mechanism as an assembly if necessary.



1. *Tilt wheel mechanism notches*
2. *Tilt lever*

NOTE: The tilt mechanism is available only as an assembly.

Tilt Mechanism Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

The screws securing the tilt mechanism to steering helm support must be torqued as per following table.

TORQUE	
Tilt mechanism screw	200/230 Series: 6 N•m (53 lbf•in)
	210 Series: 11 N•m (97 lbf•in)

STEERING HELM

150 and 180 Series

Steering Helm Access

150 Series

Open front storage cover and remove the storage bin.

180 Series

Unscrew the dashboard.

Pull it and disconnect all gauges.

Remove the dashboard from vehicle.

Steering Helm Removal

Remove steering wheel. Refer to *STEERING WHEEL* above.

Remove the tilt mechanism. See procedure above.

Disconnect steering cable as described above in this subsection.

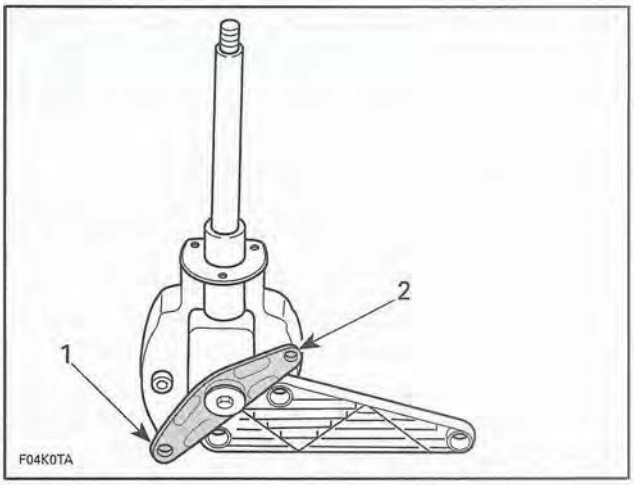
Remove screws securing steering helm to steering helm support and withdraw steering helm.

NOTE: Pay attention, spacer(s) may be present.

Steering Helm Installation

Reinstall removed parts and pay attention to the following:

Prior to installing steering helm to boat, position rotating arm as shown.



TYPICAL
1. Correct position
2. Rotating arm

When installing steering helm to boat, reinstall spacer(s) if some were present.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw threads (or use new self-locking screws) and tighten them as per following table.

TORQUE	
Steering helm screw	7.5 N•m (66 lbf•ft)

Install tilt mechanism and steering wheel.

Proceed with steering alignment. Refer to *ADJUSTMENT*.

STEERING PINION

200, 210 and 230 Series

Steering Pinion Access

200 Series

Open front storage cover and remove the storage bin.

210 and 230 Series

Open the bow seat backrest of the driver's console.

Unsnap the separating membrane.

Steering Pinion Removal

Remove 4 screws securing the steering pinion from the steering cable rack.

Remove steering wheel. Refer to *STEERING WHEEL* above.

Remove the tilt mechanism. See procedure in this subsection.

Remove the 3 screws securing steering pinion to tilt mechanism and withdraw steering pinion.

NOTE: Pay attention, spacer(s) may be present.

Steering Pinion Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Install tilt mechanism and steering wheel.

Centering the nozzles and the steering wheel before bolting the rack to the steering pinion.

NOTE: New steering pinion and steering cable are shipped with the required amount of grease. So not add other grease during installation. However, if a bit of grease is required between pinion gear teeth and cable teeth, use a marine grade lithium based grease only.

Proceed with steering alignment. Refer to *ADJUSTMENT*.

Install the steering cable rack. Refer to *STEERING CABLE INSTALLATION*.

THROTTLE/SHIFTER CONTROL

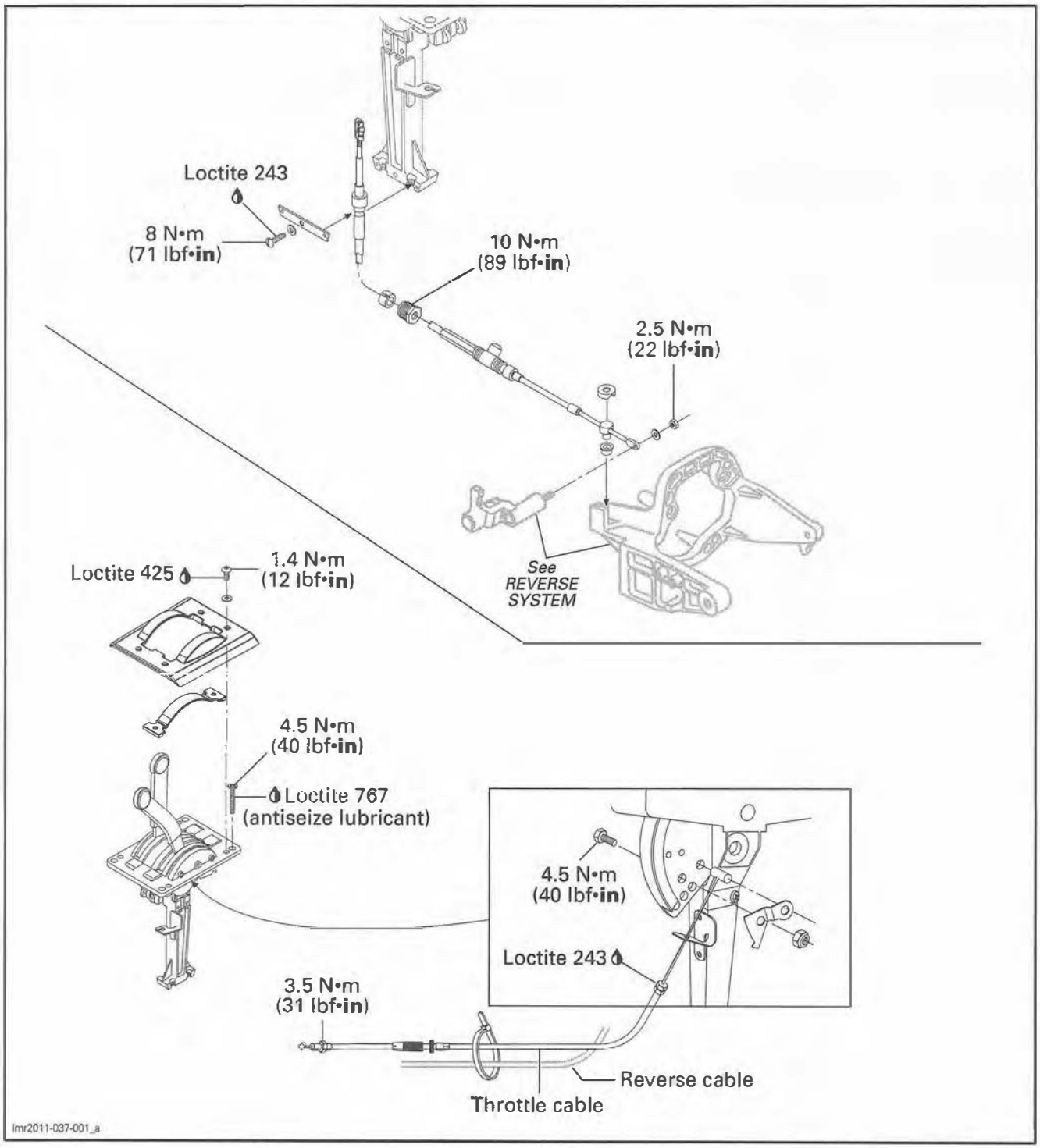
SERVICE TOOLS

Description	Part Number	Page
STEERING CABLE TOOL	295 000 145	432

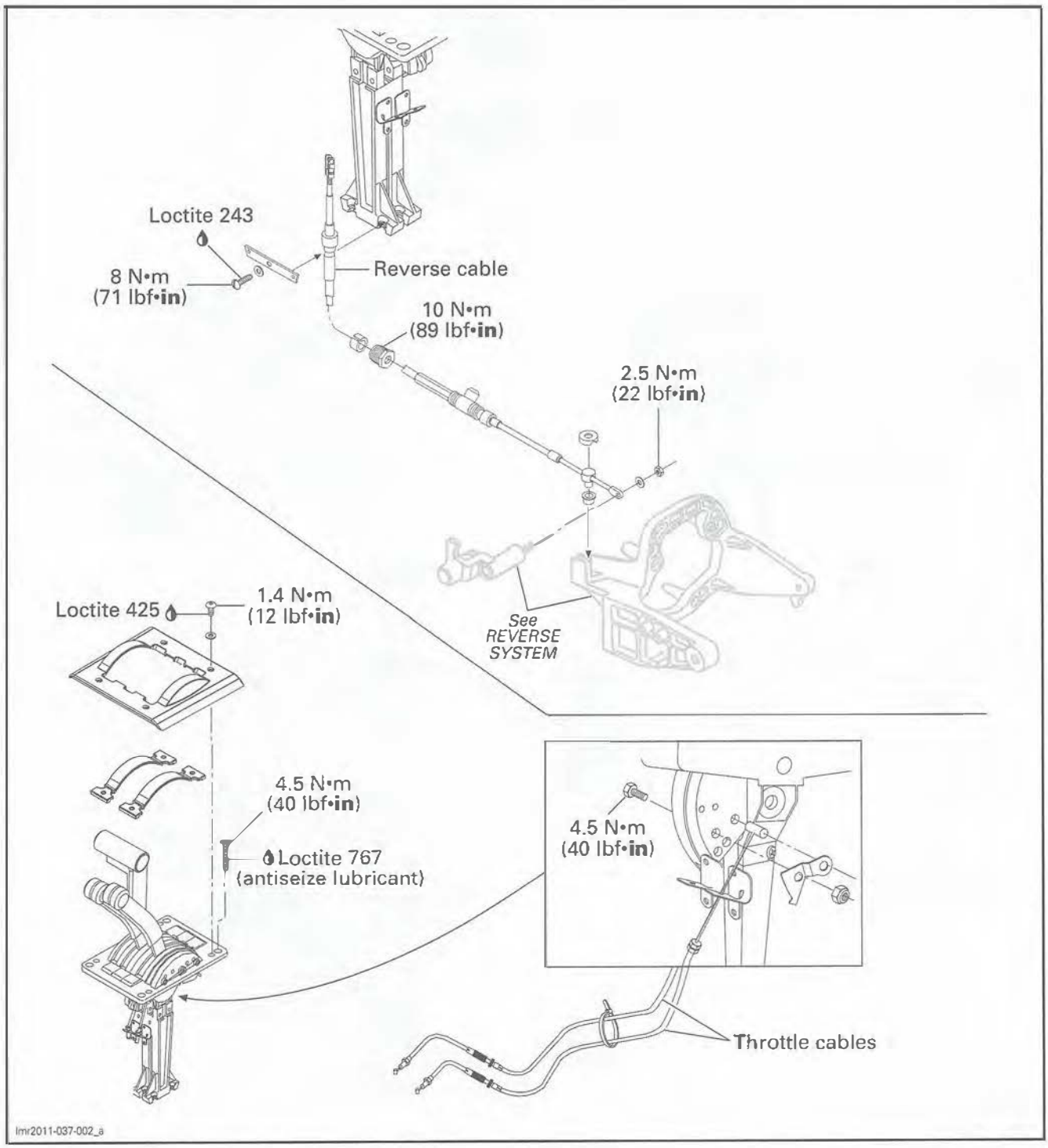
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	429, 431, 434
XPS LUBE	293 600 016	424
XPS SYNTHETIC GREASE	293 550 010	424

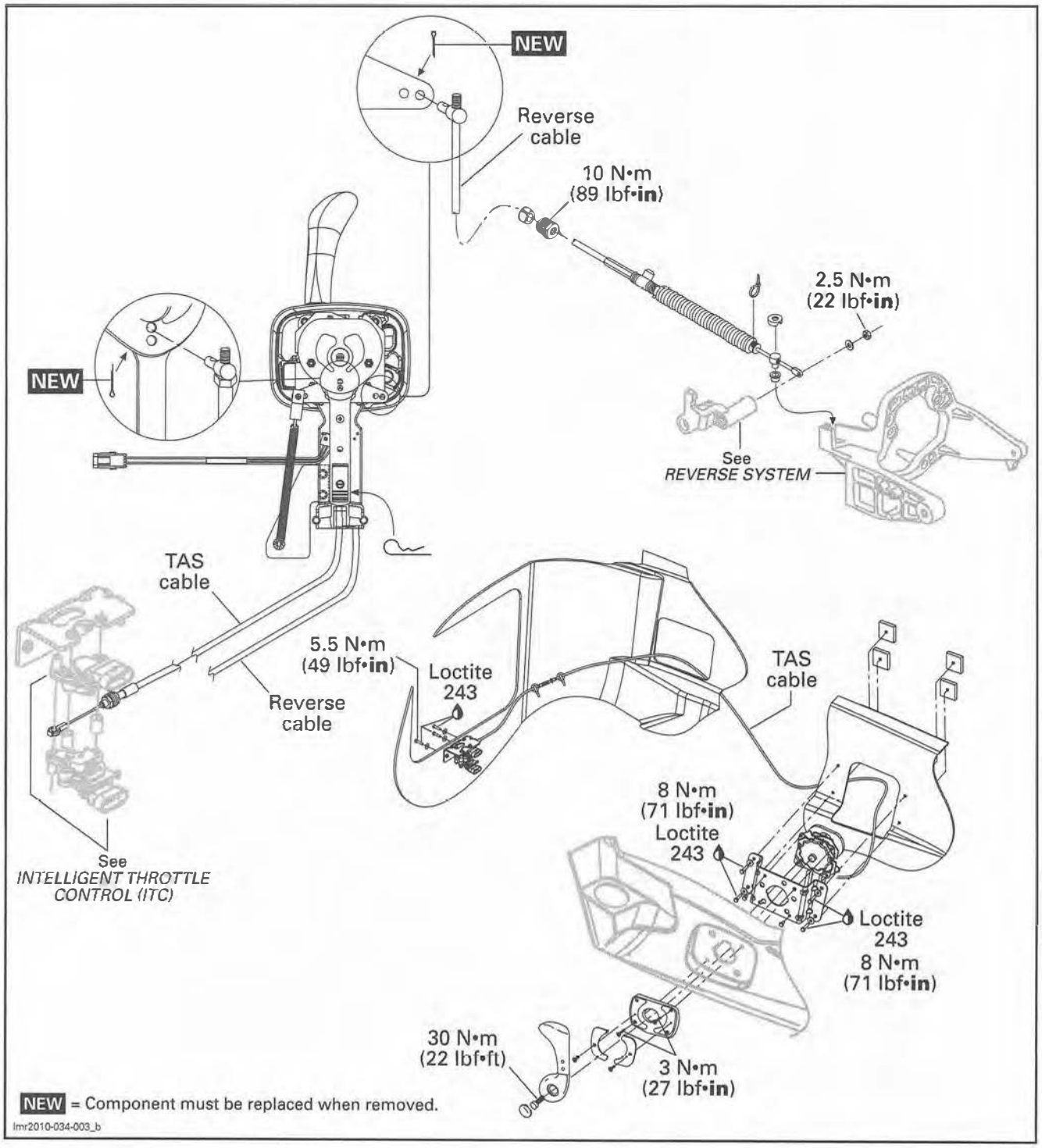
150 AND 180 SERIES



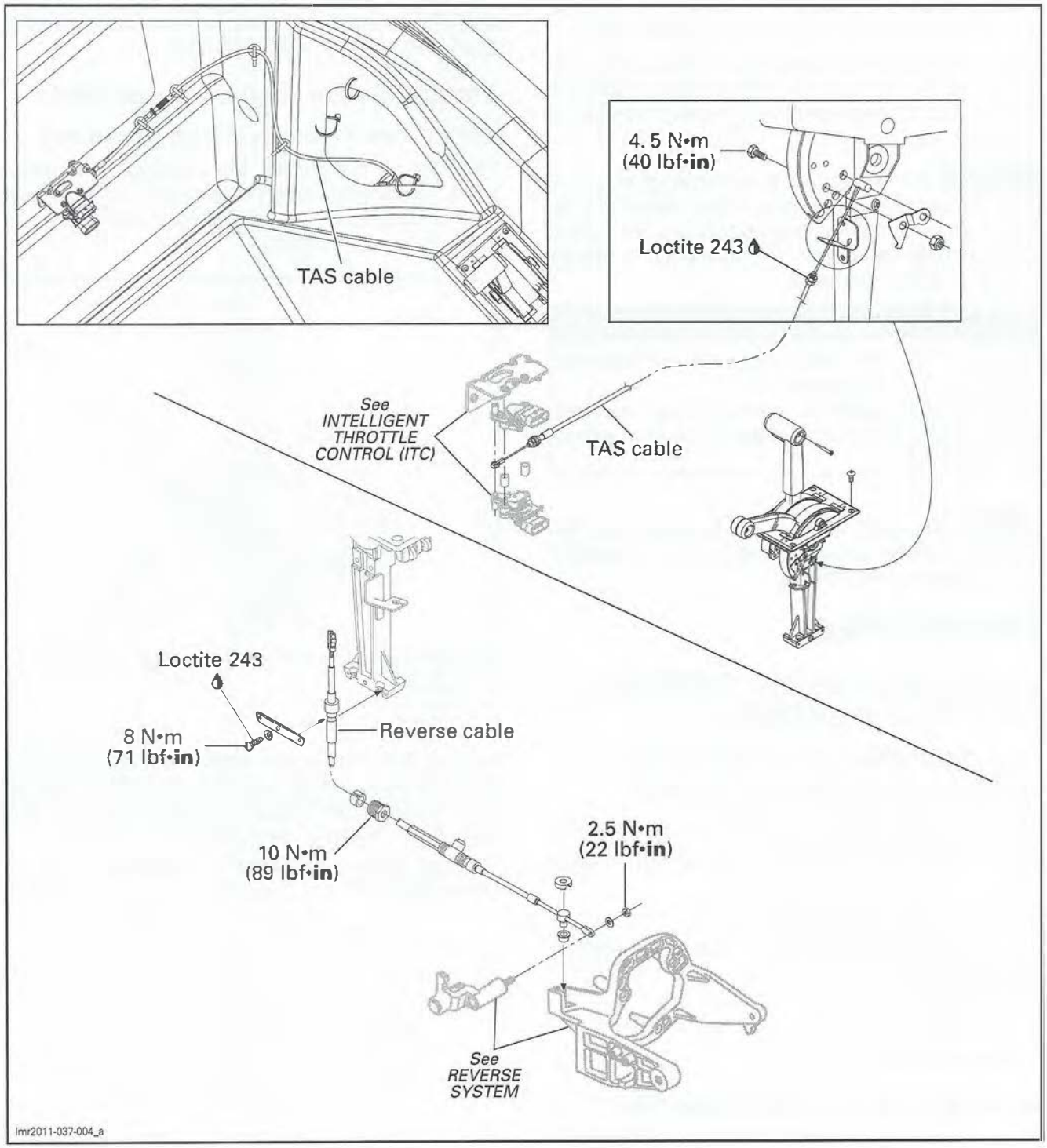
200 SERIES


Loctite 243
8 N•m
(71 lbf•in)
Reverse cable
10 N•m
(89 lbf•in)
2.5 N•m
(22 lbf•in)
See
REVERSE
SYSTEM
Loctite 425
1.4 N•m
(12 lbf•in)
4.5 N•m
(40 lbf•in)
Loctite 767
(antiseize lubricant)
4.5 N•m
(40 lbf•in)
Throttle cables
lmr2011-037-002_a

210 SERIES


NEW
Reverse cable
10 N•m (89 lbf•in)
2.5 N•m (22 lbf•in)
NEW
See REVERSE SYSTEM
TAS cable
5.5 N•m (49 lbf•in)
Loctite 243
Reverse cable
TAS cable
8 N•m (71 lbf•in)
Loctite 243
See INTELLIGENT THROTTLE CONTROL (ITC)
Loctite 243
8 N•m (71 lbf•in)
30 N•m (22 lbf•ft)
3 N•m (27 lbf•in)
NEW = Component must be replaced when removed.
lmr2010-034-003_b

230 SERIES


TAS cable
4.5 N•m
(40 lbf•in)
Loctite 243
See
INTELLIGENT
THROTTLE
CONTROL (ITC)
TAS cable
Loctite 243
8 N•m
(71 lbf•in)
Reverse cable
10 N•m
(89 lbf•in)
2.5 N•m
(22 lbf•in)
See
REVERSE
SYSTEM
lmr2011-037-004_a

GENERAL

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

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

NOTICE When applying threadlocker products (anaerobic products), pay attention so that it does not come in contact with ABS plastic parts (painted parts). It could lead to plastic cracks or other damage.

⚠ WARNING

Torque wrench tightening specifications must strictly be adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

NOTICE Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

PROCEDURES

THROTTLE/SHIFTER CONTROL (EXCEPT 210 SERIES)

Throttle/Shifter Control Removal

Remove caps or handles from each lever.

Remove screws from control cover and remove it.

Remove screws that retain control on the gunwale.

Pull control out of gunwale.

Remove the following cables. See procedures in this subsection.
- TAS cable
- Throttle cable(s)
- Reverse cable.

Throttle/Shifter Control Inspection

Check all moving parts for free movement and for excessive play.

Check cables for wear and oxidation.

Replace parts as required.

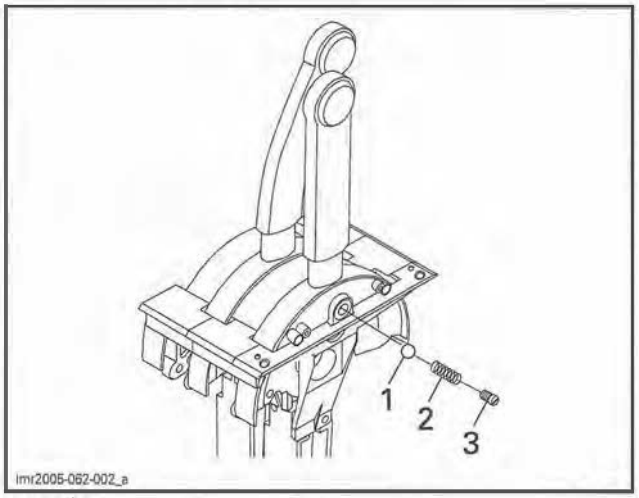
Throttle/Shifter Control Lubrication

Lubricate moving parts with XPS SYNTHETIC GREASE (P/N 293 550 010). Where not possible, apply XPS LUBE (P/N 293 600 016).

Throttle/Shifter Control Adjustments

Shifter Lever Friction and Lock Adjustment

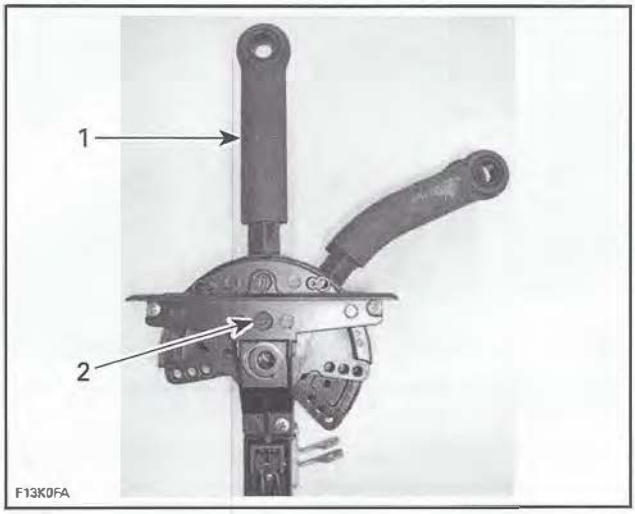
The locking action can be adjusted. The positions Forward/Neutral/Reverse are "notched" by means of a steel ball pushed by a spring against a notch on shifter plate.



TYPICAL
1. Steel ball
2. Spring
3. Set screw

Turning the set screw clockwise will increase spring pressure and therefore "hardens" shifter lock action. Conversely turning screw counterclockwise "softens" lock action.

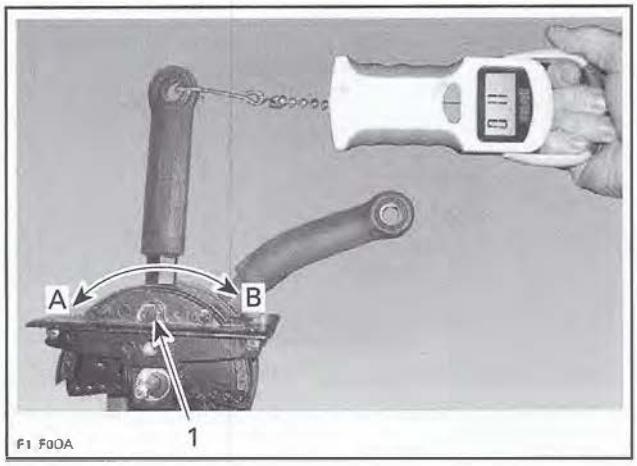
The set screw is located on the same side as shifter lever.



TYPICAL
1. Shifter lever
2. Set screw (shifter lock)

If adjustment becomes necessary, adjust the shifter tension using a fish scale as shown below.

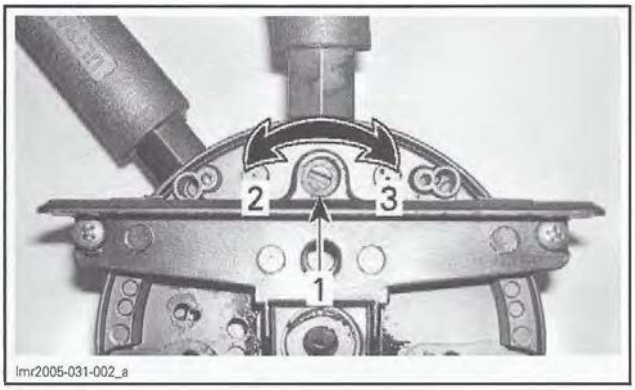
SHIFTER TENSION	
MODEL	TENSION
150 and 180 Series	3.6 kg - 4.5 kg (8 lb - 10 lb)
200 Series	5 kg - 6 kg (11 lb - 13 lb)
230 Series	4.5 kg - 5.5 kg (10 lb - 12 lb)



TYPICAL
1. Adjustment screw
A. Counterclockwise
B. Clockwise

Throttle Lever Friction Adjustment

The throttle friction is adjusted by a screw on the throttle side of the shifter control unit.



TYPICAL
1. Adjustment screw
2. Counterclockwise
3. Clockwise

Turning the set screw clockwise will increase spring pressure and therefore "hardens" throttle friction action. Conversely turning screw counterclockwise "softens" friction action.

Throttle/Shifter Control Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

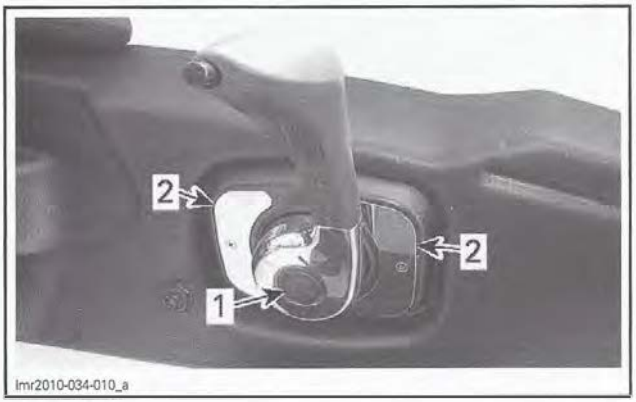
When reinstalling throttle/shifter control, be careful not to bend cables.

Ensure everything works properly before operating craft.

THROTTLE/SHIFTER CONTROL (210 SERIES)

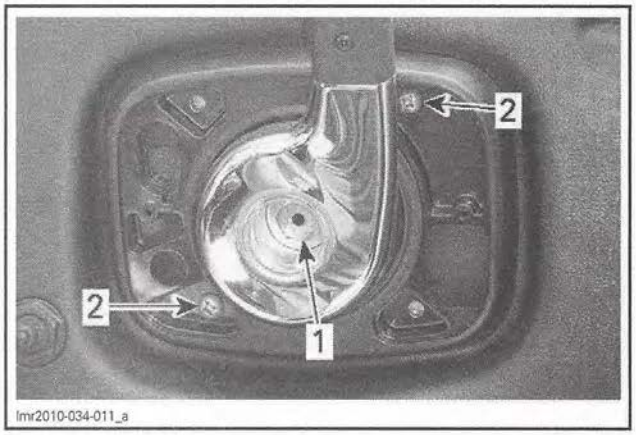
Throttle/Shifter Control Removal

1. Remove the lever and the bezel.
   1.1 Remove both chromed trims and lever cap.



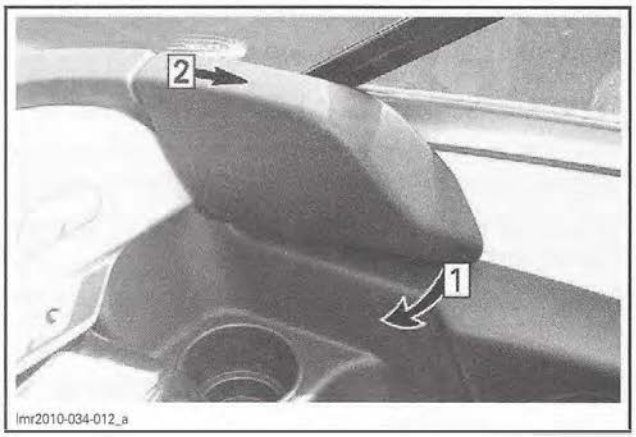
1. Lever cap
2. Chromed trims

   1.2 Remove lever and bezel.



1. Lever bolt
2. Bezel screws

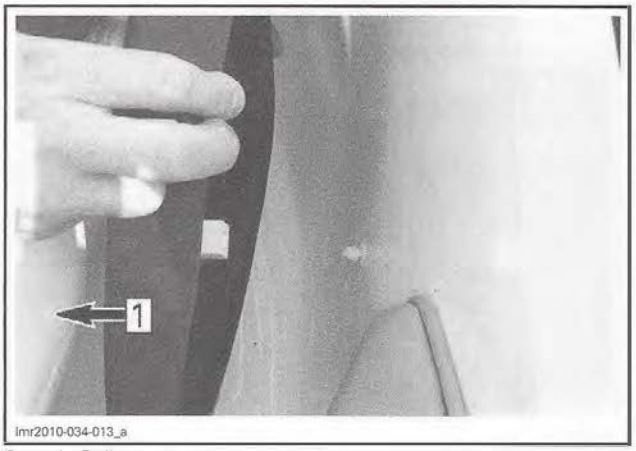
2. Remove the console lateral pad.



Step 1: Pull
Step 2: Slide

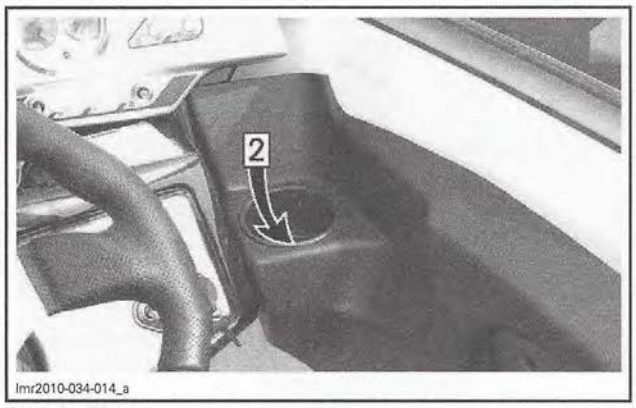
3. Remove the shifter panel.

3.1 Pull the rear portion of panel to unsnap it.



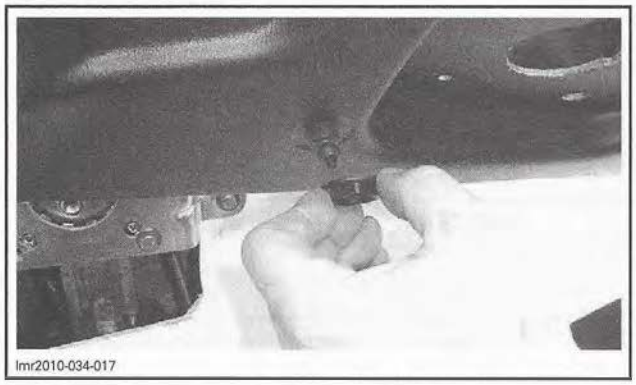
Step 1: Pull

3.2 Slide the front portion of panel toward the deck.

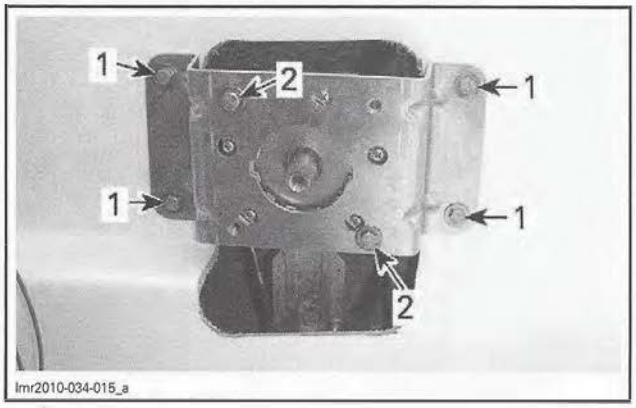


Step 2: Slide

3.3 Unscrew the engine cut-off switch nut and remove the panel.

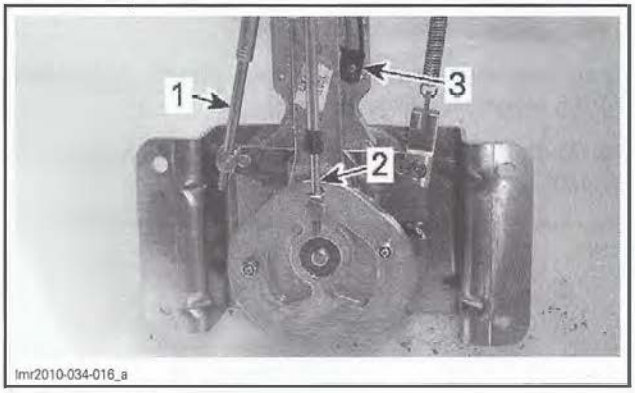


4. Detach throttle/shifter control support from upper deck.



1. Support screws
2. Control retaining screws

5. Remove throttle/shifter control from upper deck and detach both cables (throttle accelerator sensor (TAS) cable and reverse cables). See procedures in this subsection.
6. Unplug the neutral switch connector.



1. Reverse cable
2. TAS cable
3. Neutral switch

7. Remove the support from the throttle/shifter control.

Throttle/Shifter Control Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

When reinstalling throttle/shifter control, be careful not to bend cables.

Ensure everything works properly before operating craft.

THROTTLE ACCELERATOR SENSOR (TAS) CABLE (210 AND 230 SERIES)

TAS Cable Inspection

Check cable for wear and oxidation. Replace as necessary.

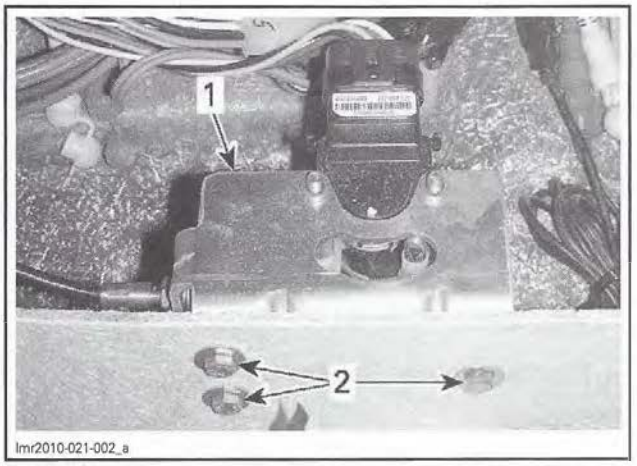
TAS Cable Removal

Inside Driver's Cockpit

Open the bow backrest.

Unclip the cover.

Remove the bracket retaining screws.

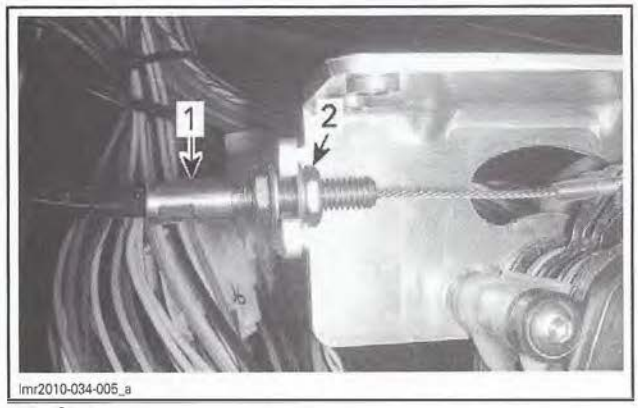


TYPICAL
1. Bracket
2. Bracket retaining screws

Remove and discard the cotter pin.

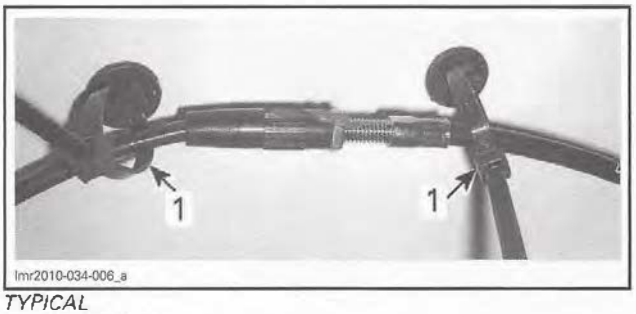
TYPICAL
1. Cotter pin

Unscrew cable locking nut and remove cable from the bracket.



TYPICAL
1. TAS cable
2. Locking nut

Cut locking ties securing TAS cable.



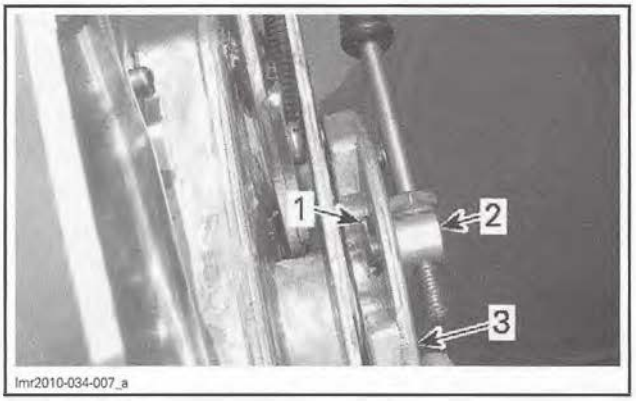
TYPICAL
1. Locking ties

At Throttle/Shifter Control

210 Series

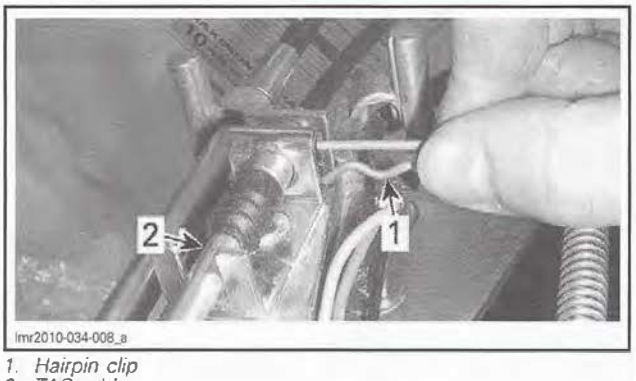
Remove throttle/shifter control from upper deck. Refer to *THROTTLE/SHIFTER CONTROL* in this subsection.

Remove and discard the cotter pin securing the brass adapter to throttle/shifter control plate.



1. Cotter pin
2. Brass adapter
3. Throttle/shifter control plate

Remove the hairpin clip that lock TAS cable.



1. Hairpin clip
2. TAS cable

Remove the brass adapter from the TAS cable.

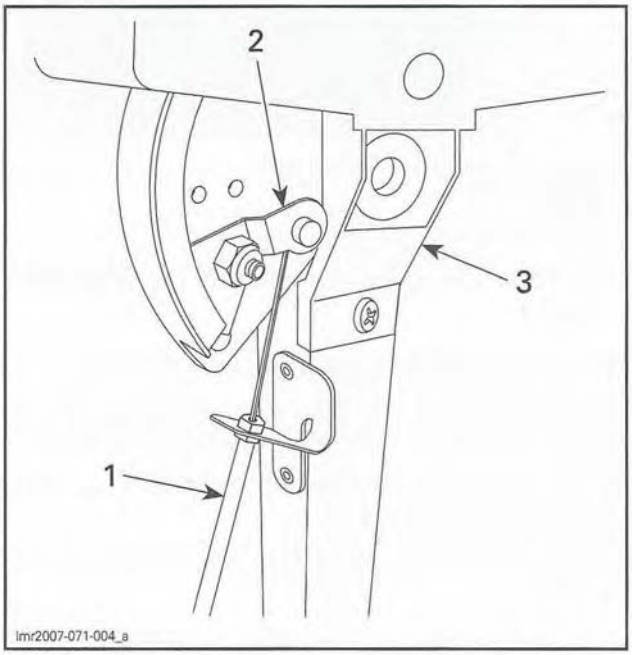
Remove the TAS cable from the throttle/shifter control.

Pull the cable out of driver's cockpit and upper deck.

230 Series

Unscrew and remove nut that attach TAS cable link to throttle/shifter control.

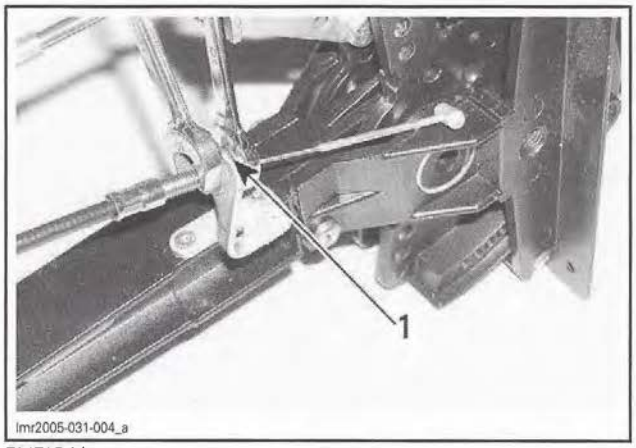
Remove TAS cable link and throttle cable end from control.



1. TAS cable
2. TAS cable link
3. Throttle/shifter control

Loosen nut and remove the front threaded end from control bracket.

NOTE: To help cable reinstallation and adjustment, count threads before the nuts are loosened.



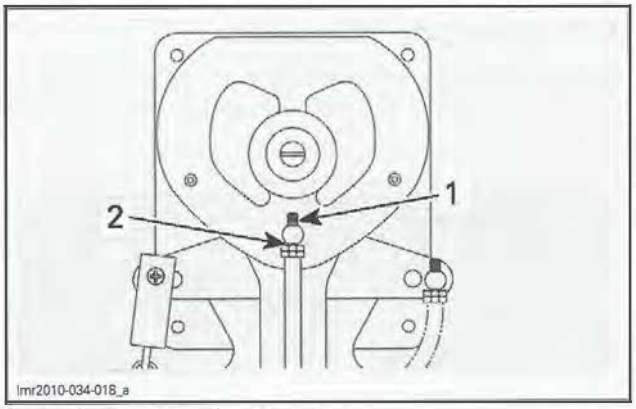
TYPICAL
1. Loosen and remove this nut

TAS Cable Installation

At Throttle/Shifter Control

210 Series

1. Tighten the brass adapter on threaded end of cable until approximately 11 threads are exposed).
2. Unscrew the brass adapter a few turns and apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads.
3. Reposition the adapter and secure it on throttle/shifter control plate with a new cotter pin. Fold both ends of cotter pin.



1. Approximately 11 threads exposed
2. Loctite 243 (BLUE) (P/N 293 800 060)

4. Align the groove in metallic portion of cable with the gap in cable support and install the hairpin clip.

1. Align the groove with this opening

5. Insert the brass adapter end in the upper hole of throttle/shifter control plate and secure it using a new cotter pin. Fold both ends of cotter pin.

230 Series

1. Install the TAS cable end in throttle plate hole and secure it with the TAS cable link.
2. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of TAS cable link bolt and install the nut.

TORQUE	
TAS cable link nut	4.5 N•m (40 lbf•**in**)

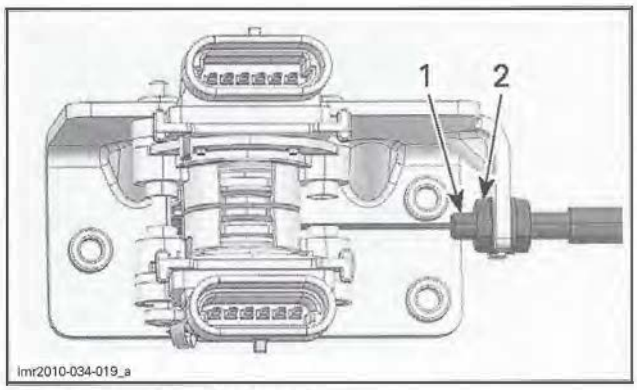
3. Attach the threaded end of TAS cable on cable support.

NOTE: As a preliminary adjustment, cable should have the same amount of threads on each side of bracket.

4. Temporarily secure TAS cable with upper nut.

At TAS Sensors Bracket

1. Install the cable on bracket and secure it using the locking nut so that approximately 5 threads are exposed.
2. Unscrew the locking nut a few turns and apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads.
3. Tighten locking nut.



1. Approximately 5 threads exposed
2. Loctite 243 (BLUE) (P/N 293 800 060)

4. Secure the TAS cable loosely with two new locking ties and secure the TAS bracket.

PART	TORQUE
TAS bracket screw	2.5 N•m (22 lbf•**in**) + LOCTITE 243 (BLUE) (P/N 293 800 060)

TAS Adjustment

When removing or replacing the TAS cable, the TAS adjustment must be performed. Refer to *INTELLIGENT THROTTLE CONTROL (ITC)* subsection.

THROTTLE CABLE (EXCEPT 210 AND 230 SERIES)

Throttle Cable Inspection

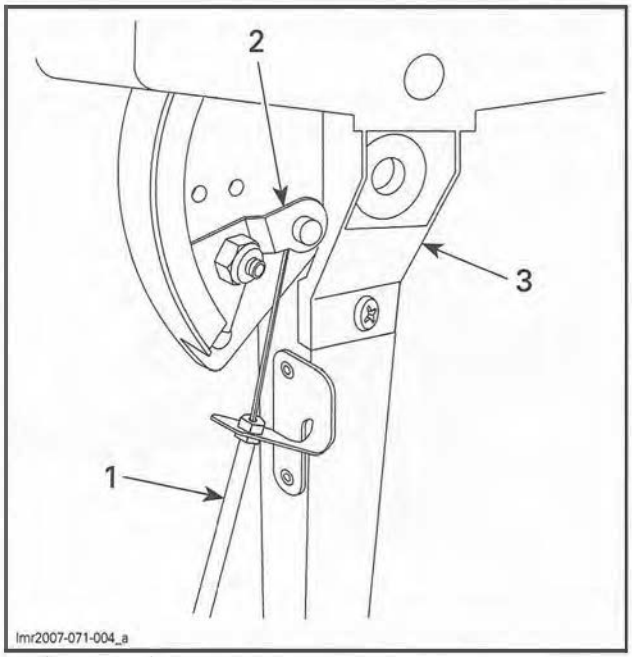
Check cable for wear and oxidation. Replace as necessary.

Throttle Cable Removal

At Throttle/Shifter Control

Unscrew and remove nut that attach throttle cable link to throttle/shifter control.

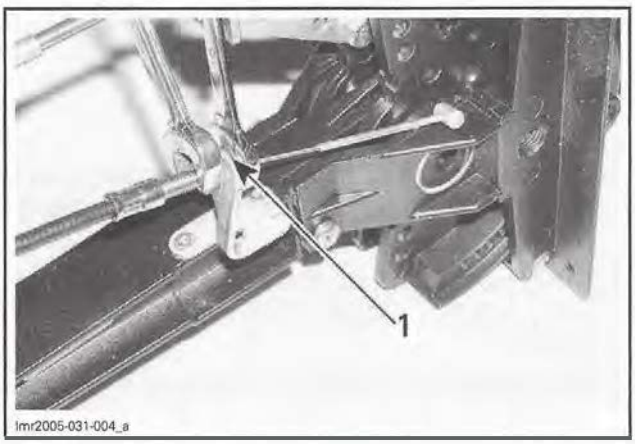
Remove throttle cable link and throttle cable end from control.



1. *Throttle cable*
2. *Throttle cable link*
3. *Control*

Loosen nut and remove the front threaded end from control bracket.

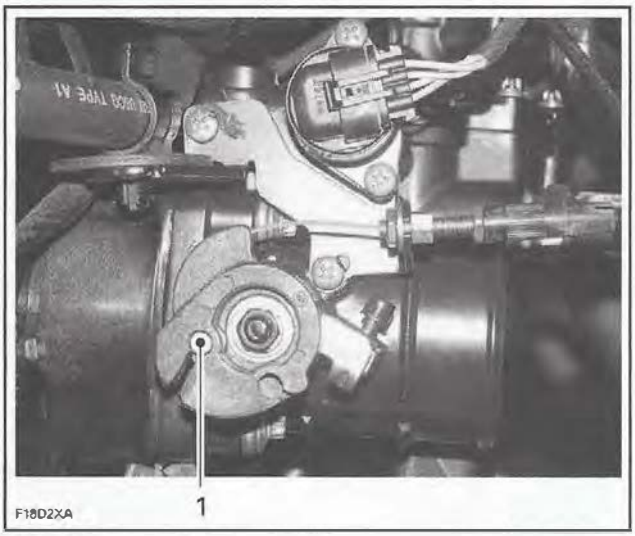
NOTE: To help cable reinstallation and adjustment, count threads before the nuts are loosened.



TYPICAL
1. *Loosen and remove this nut*

At Throttle Body

On each engine, detach throttle cable from throttle body support and detach cable from throttle lever.



TYPICAL
1. *Throttle lever*

Attach a small rope at the end of the throttle cable.

From the throttle/shifter control opening, pull cable through the bilge.

Detach rope from cable.

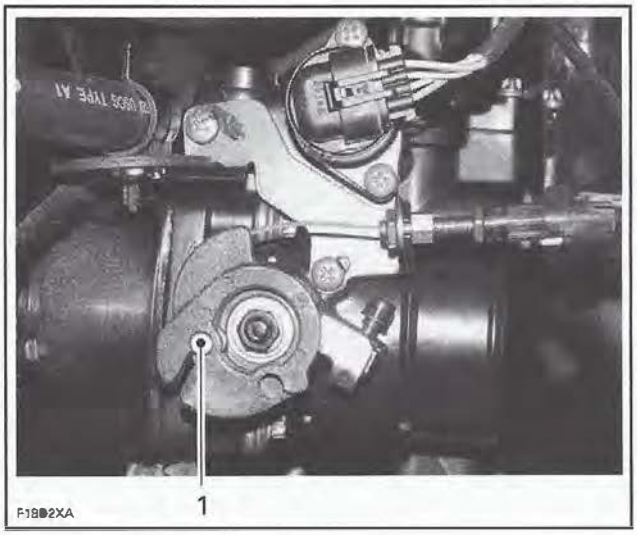
Throttle Cable Installation

NOTE: When throttle cable installation is completed, perform throttle cable adjustment.

Using a small rope attached to cable, pull throttle cable in engine compartment.

At Throttle Body

On each engine, insert throttle cable into the throttle lever and secure threaded end (normally in middle of threads) on throttle body support.



TYPICAL
1. Throttle lever

At Throttle/Shifter Control

1. Install the throttle cable end in throttle plate hole and secure it with the throttle cable link.
2. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of throttle cable link bolt and install the nut.

TORQUE	
Throttle cable link nut	4.5 N•m (40 lbf•**in**)

3. Attach the threaded end of throttle cable on cable support.

NOTE: As a preliminary adjustment, cable should have the same amount of threads on each side of bracket.

4. Temporarily secure cable with upper nut.

Throttle Cable Adjustment

1. Push control lever to WOT position and check if cable is pulled only by throttle body lever spring force (the throttle body lever must be at the limit to touch the stopper).
2. Adjust throttle cable as required using the cable threaded end.
3. Check engine operation to idle and WOT.
   3.1 Place the boat in water or connect a garden hose to the connector located at the rear of boat on jet pump support. Do not open water tap at this time.

TYPICAL
1. Flushing connector

   3.2 Start engine and open water tap immediately.
   3.3 Check engine RPM.

ENGINE RPM AT IDLE
1800 ± 50 RPM

   3.4 Try throttle lever at different position.

NOTICE **Never run engine longer than 2 minutes when using a garden hose. Drive line seal has no cooling when boat is out of water.**

   3.5 Close the water tap, then stop the engine.

NOTICE **Always close the water tap before stopping the engine.**

4. When throttle cable adjustment is completed, unscrew the upper nut from the cable threaded end attach and apply LOCTITE 243 (BLUE) (P/N 293 800 060) on nut threads.
5. Retighten nut without changing adjustment.

TORQUE	
Cable nut	4 N•m (35 lbf•**in**)

REVERSE CABLE

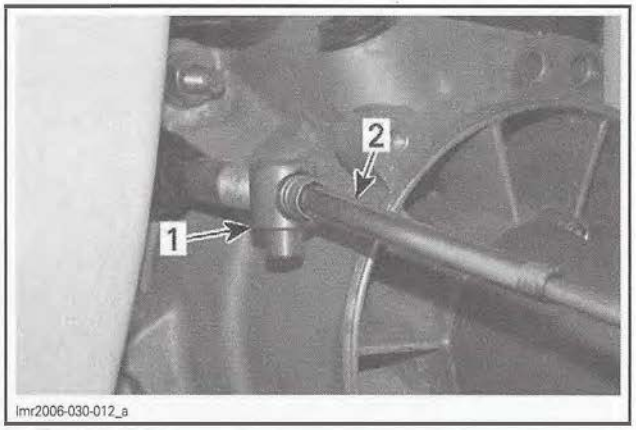
Reverse Cable Removal

Pump Side

Remove reverse gate support. See procedure above.

Remove venturi from jet pump housing.

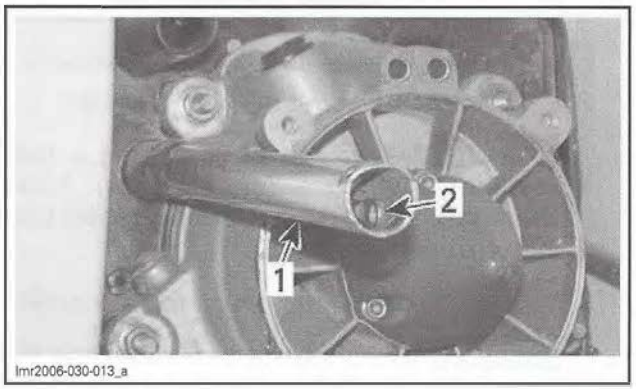
Unscrew the brass bushing to remove it from reverse cable.



1. Brass bushing
2. Reverse cable

Unscrew the reverse cable lock then remove rubber grommet from jet pump.

RECOMMENDED TOOL
STEERING CABLE TOOL (P/N 295 000 145)



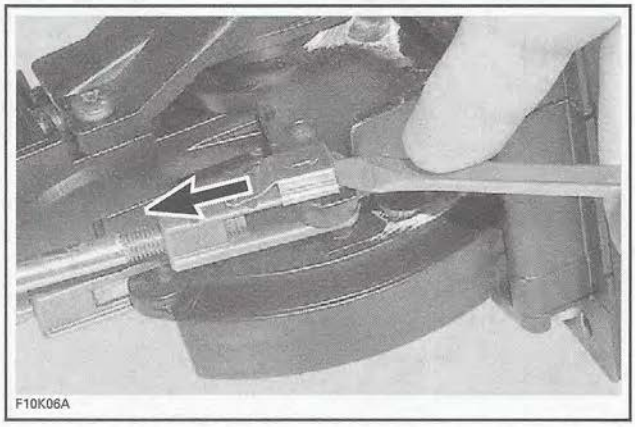
1. Steering cable tool
2. Reverse cable

Shifter Side

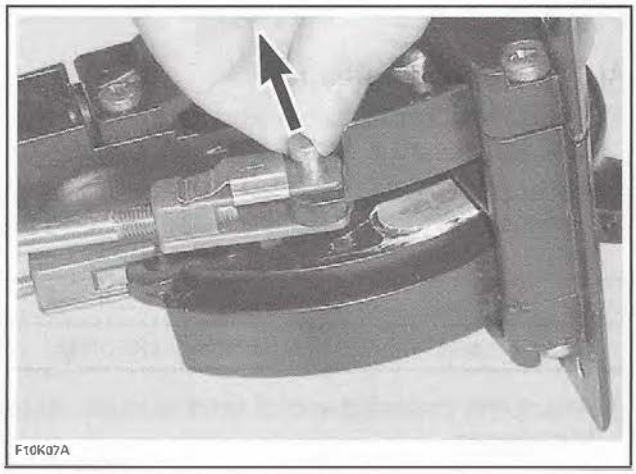
Remove the throttle/shifter control. Refer to *THROTTLE/SHIFTER CONTROL* in this subsection.

Detach reverse cable from the throttle/shifter control before pulling the cable out of bilge.

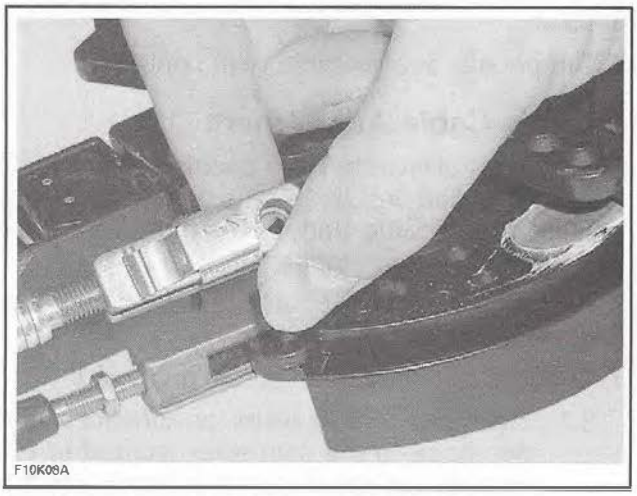
All Models Except 210 Series



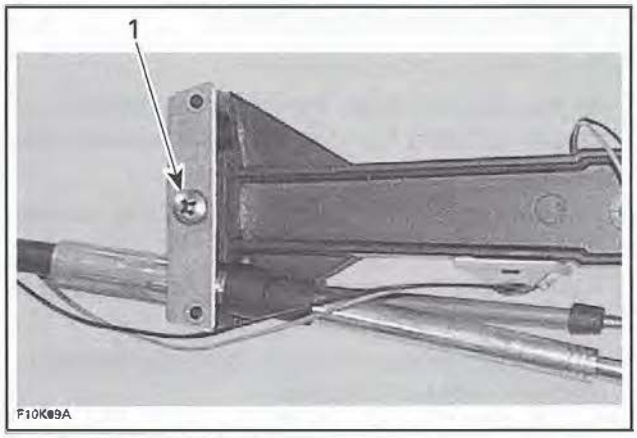
USING A SCREWDRIVER, SLIDE OFF THE LOCKING BRACKET



REMOVE LOCK PIN



REMOVE CABLE CONNECTOR FROM SHIFTER

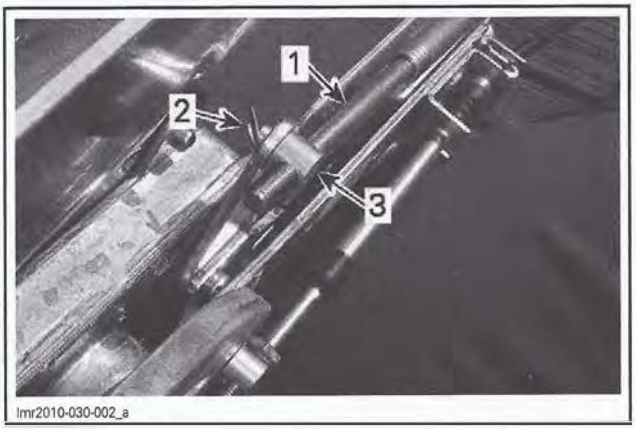


REMOVE BRACKET AND PULL CABLE OUT
1. Loosen this screw

210 Series

Remove and discard the cotter pin.

Remove the cable connector from the end of cable.



1. Reverse cable
2. Cotter pin
3. Cable connector

Reverse Cable Installation

The installation of the reverse cable is the reverse of the removal procedure. However, pay attention to the following.

Pump Side

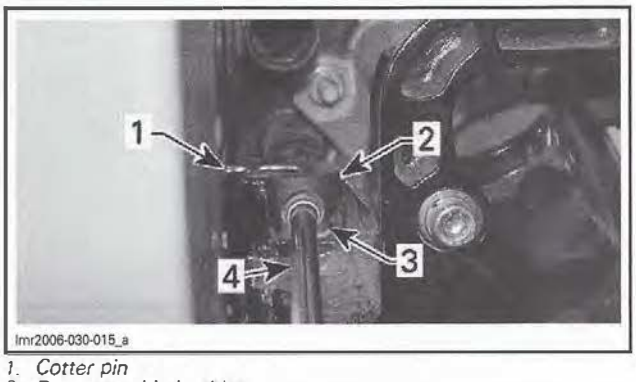
Torque reverse cable lock to specification.

TORQUE	
Reverse cable lock	10 N•m (89 lbf•**in**)

Install venturi and reverse gate support.

Screw brass bushing on reverse cable and install it in its hole located into reverse gate support. Make sure bushing is in place into reverse gate support hole.

Install the reverse cable bushing over brass bushing then install a **NEW** cotter pin.



1. Cotter pin
2. Reverse cable bushing
3. Brass bushing
4. Reverse cable

Install the reverse cable on reverse gate lever with a **NEW** elastic stop nut and torque it to specification.

TORQUE	
Reverse cable nut	2.5 N•m (22 lbf•**in**)

Shifter Side

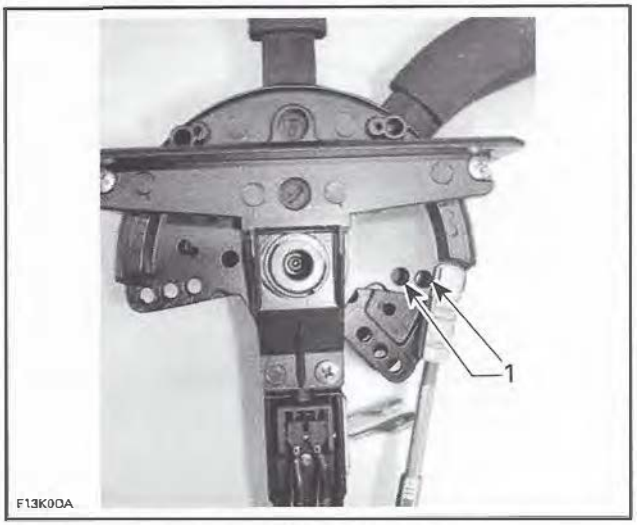
Place reverse gate in the up position.

Place shifter lever in reverse position.

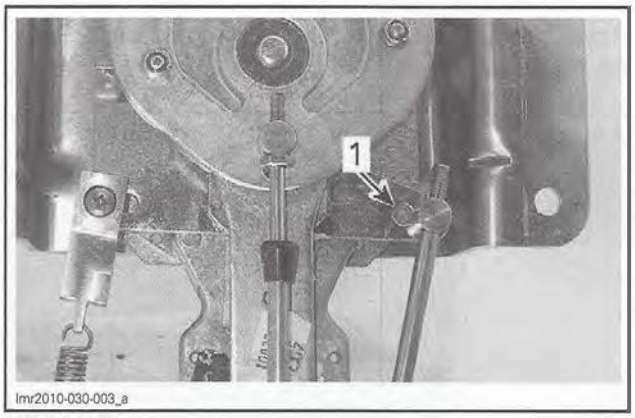
The cable threaded end must be screwed at least 6 turns into the cable connector.

Turn the cable connector until the connector end can be inserted in shifter plate hole.

NOTE: Due to cable length variation, more than one hole is available on shifter plate to install the cable. Select the appropriate hole.



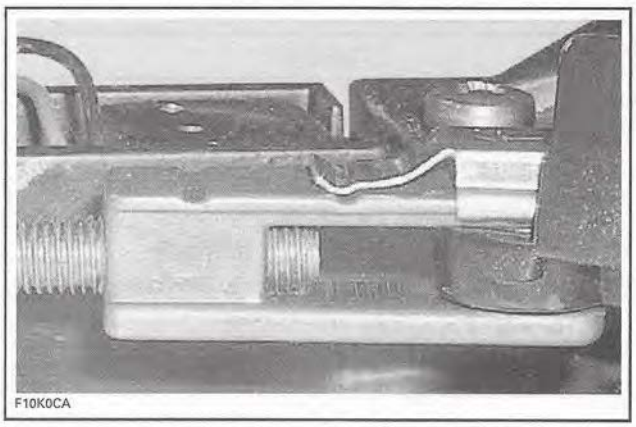
TYPICAL – ALL MODELS EXCEPT 210 SERIES
1. Alternate cable locations



210 SERIES
1. Alternate cable location

All Models except 210 Series

Install lock pin then push locking tab over the pin. Ensure locking bracket tab is properly locked in connector recess.



Attach reverse cable at the bottom of throttle/shifter control using cable bracket.

CABLE BRACKET RETAINING SCREW	
PRODUCT	TORQUE
LOCTITE 243 (BLUE) (P/N 293 800 060)	8 N•m (71 lbf•in)

Install throttle/shifter control in its receptacle. Refer to *THROTTLE/SHIFTER CONTROL*.

210 Series

Secure the cable connector with a new cotter pin. Both ends of cotter pin must be folded.

Install throttle/shifter control. Refer to *THROTTLE/SHIFTER CONTROL* in this subsection.

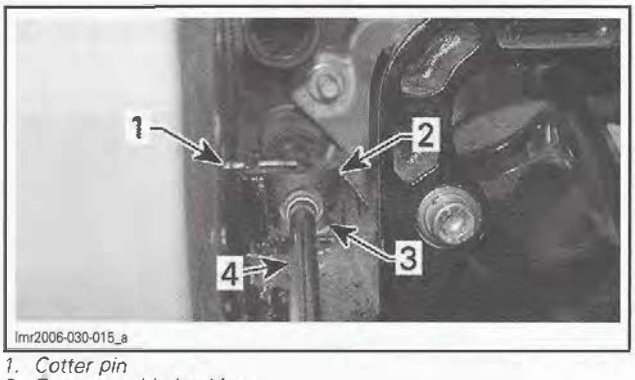
Reverse Cable Adjustment

Adjust reverse cable as follow:

1. At the back of boat, remove and discard cotter pin securing the reverse cable bushing over brass bushing.
2. Remove the brass bushing from the reverse gate support.
3. Turn the brass bushing, one turn at the time, to adjust the reverse cable.
4. Move reverse lever to check gate operation and readjust cable as required.

NOTE: If adjustment can not be achieved, the reverse cable may be not properly installed.

5. Install the reverse cable bushing and a NEW cotter pin.



1. Cotter pin
2. Reverse cable bushing
3. Brass bushing
4. Reverse cable

BODY

SERVICE TOOLS

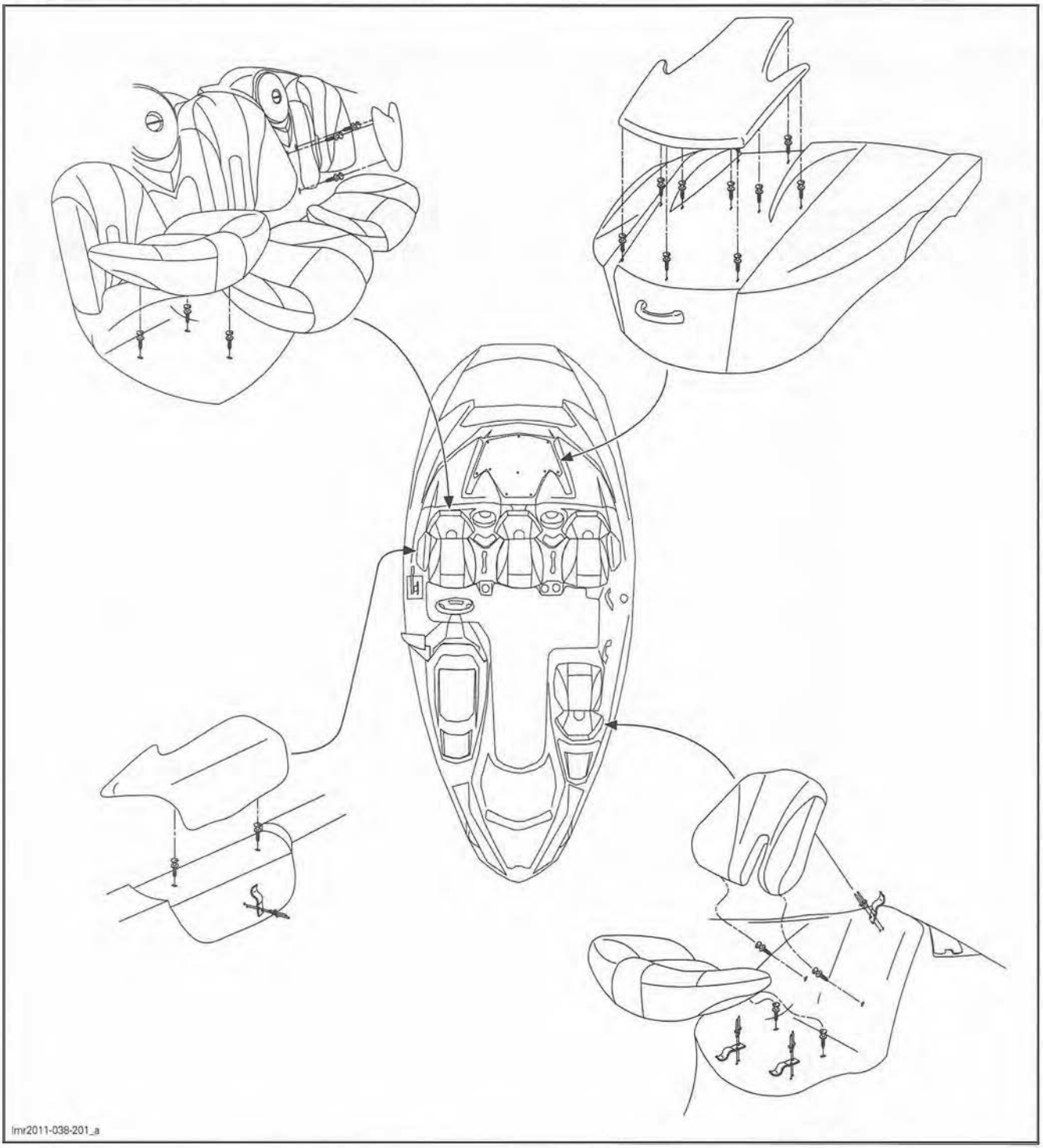
Description	Part Number	Page
SUPERTANIUM DRILL BIT 3/16"	529 031 800	494

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	496, 501–502
LOCTITE 5150 (SILICONE SEALANT)	296 000 309	496–497
XPS LUBE	293 600 016	494

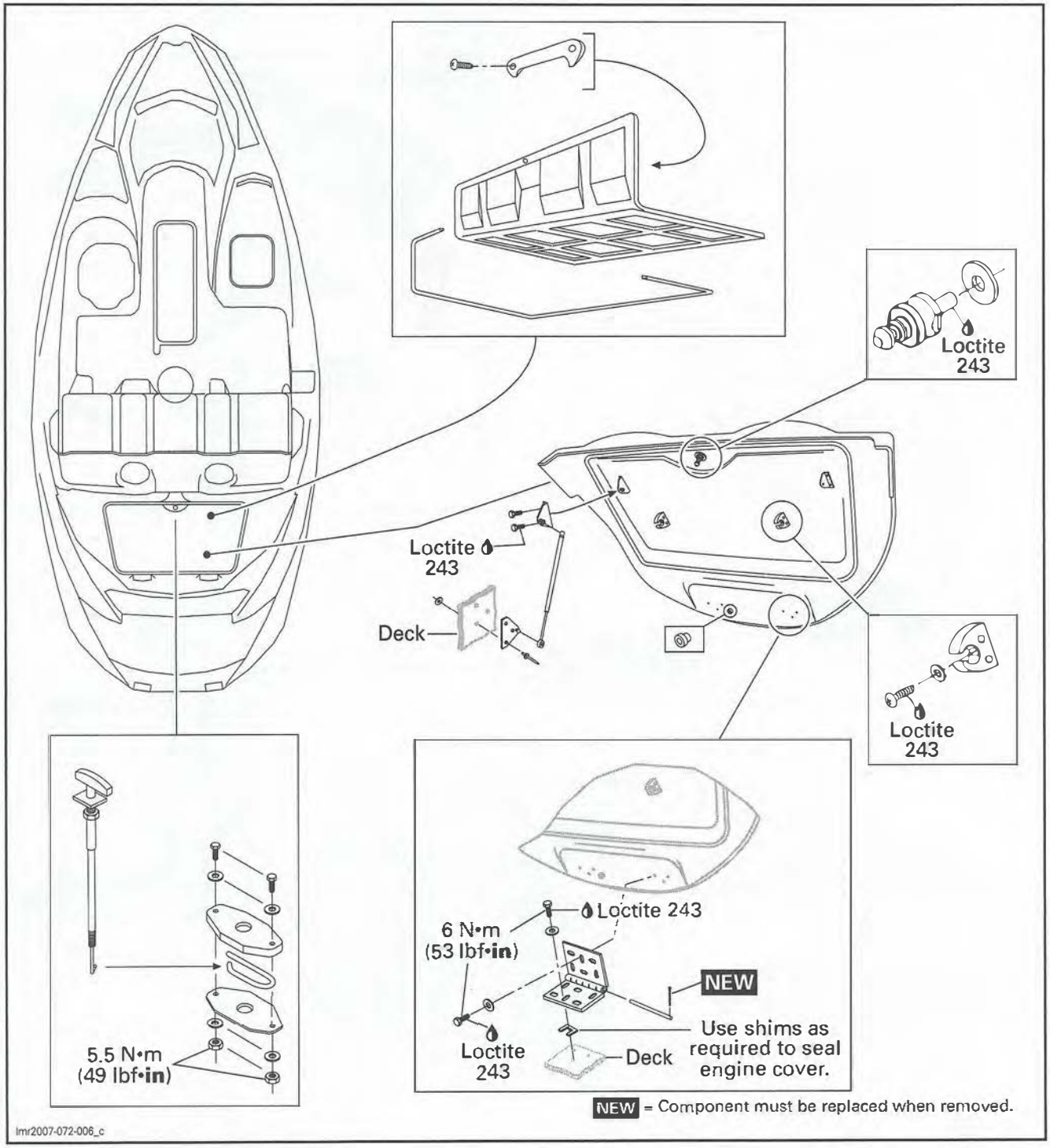
150 SERIES

Seats and Sun Pad



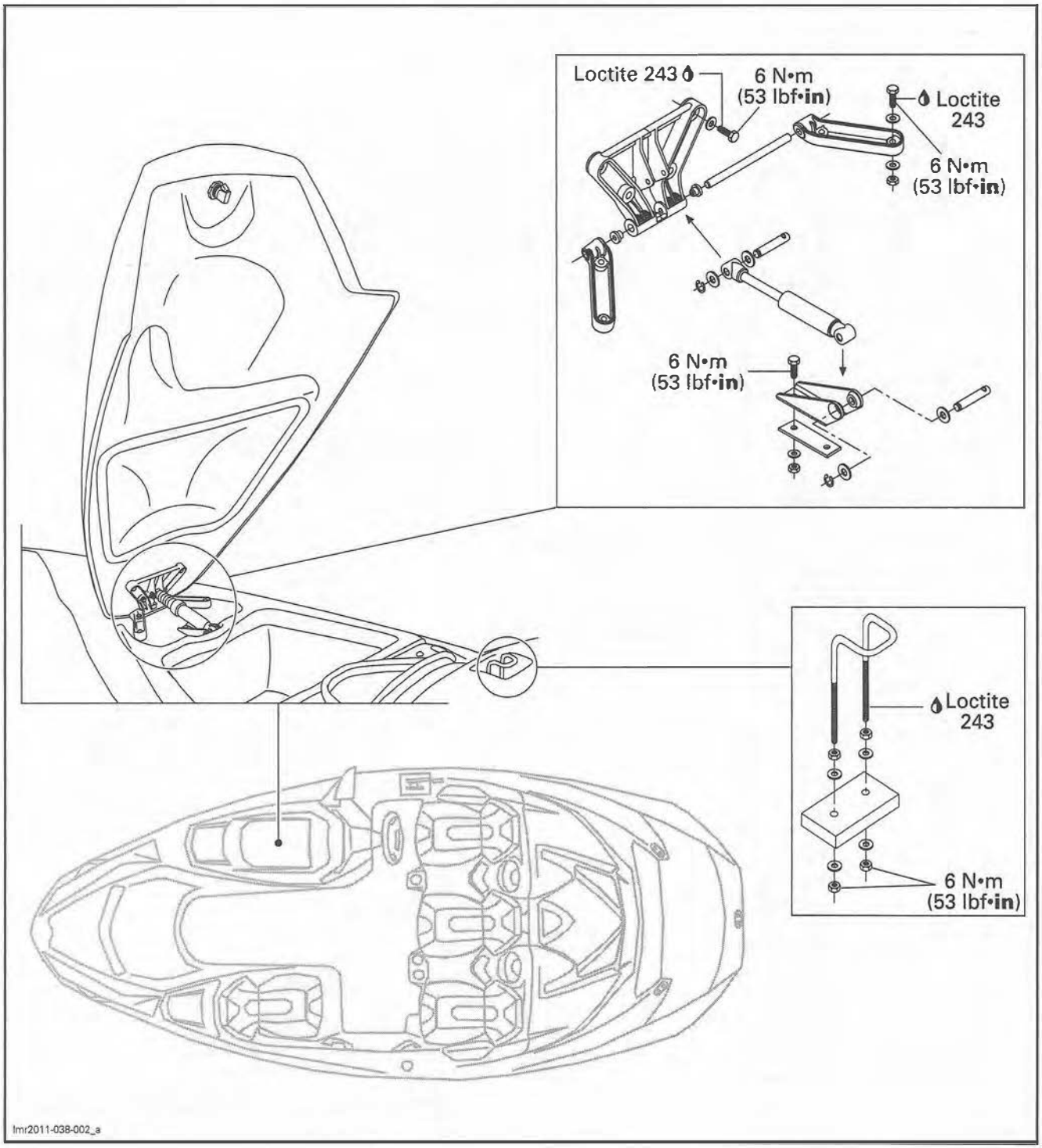
150 SERIES

Engine Compartment



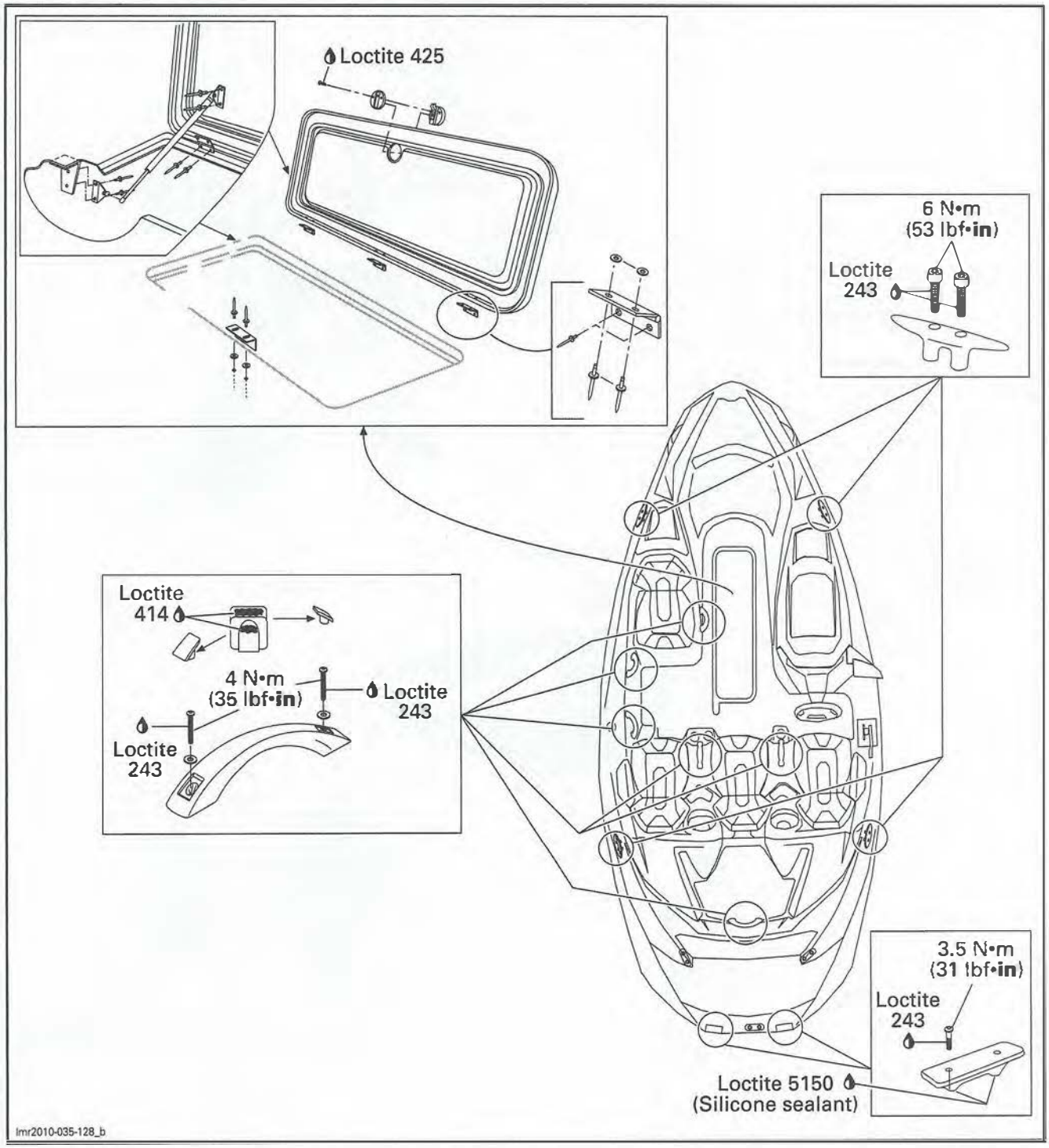
150 SERIES

Body (View 1) - Storage Compartment



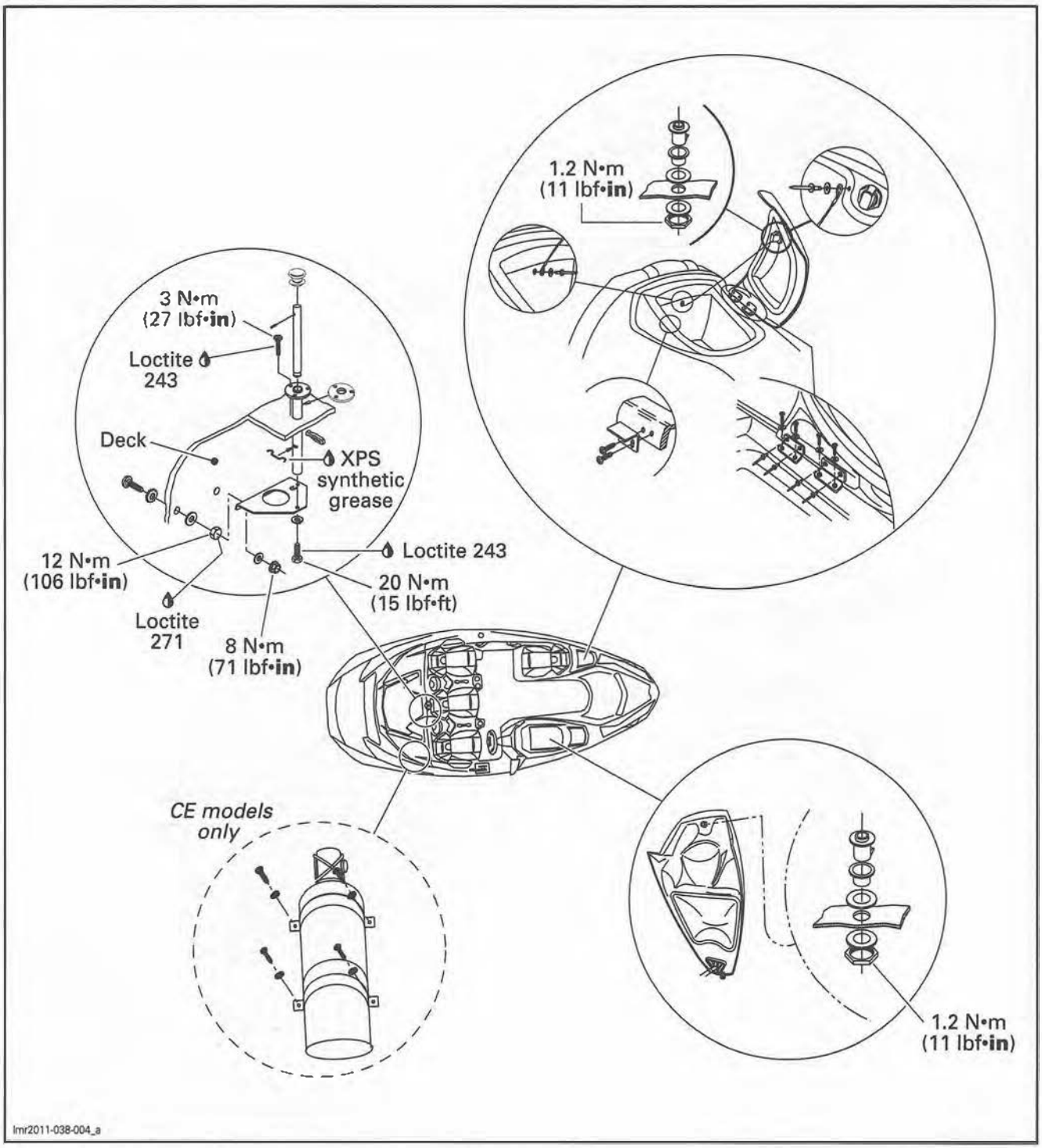
150 SERIES

Body (View 2) - Storage Compartment



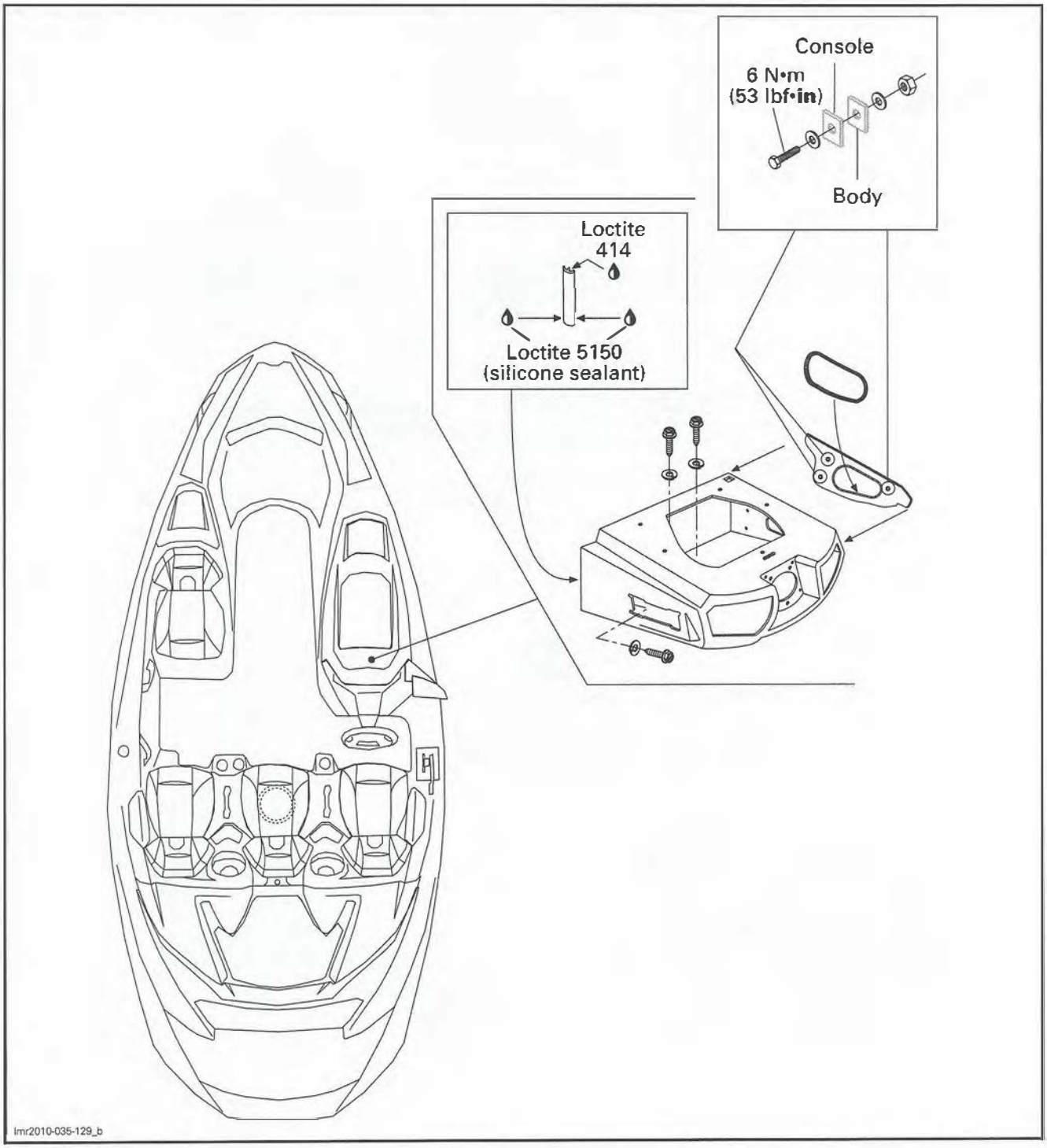
150 SERIES

Body (View 3)



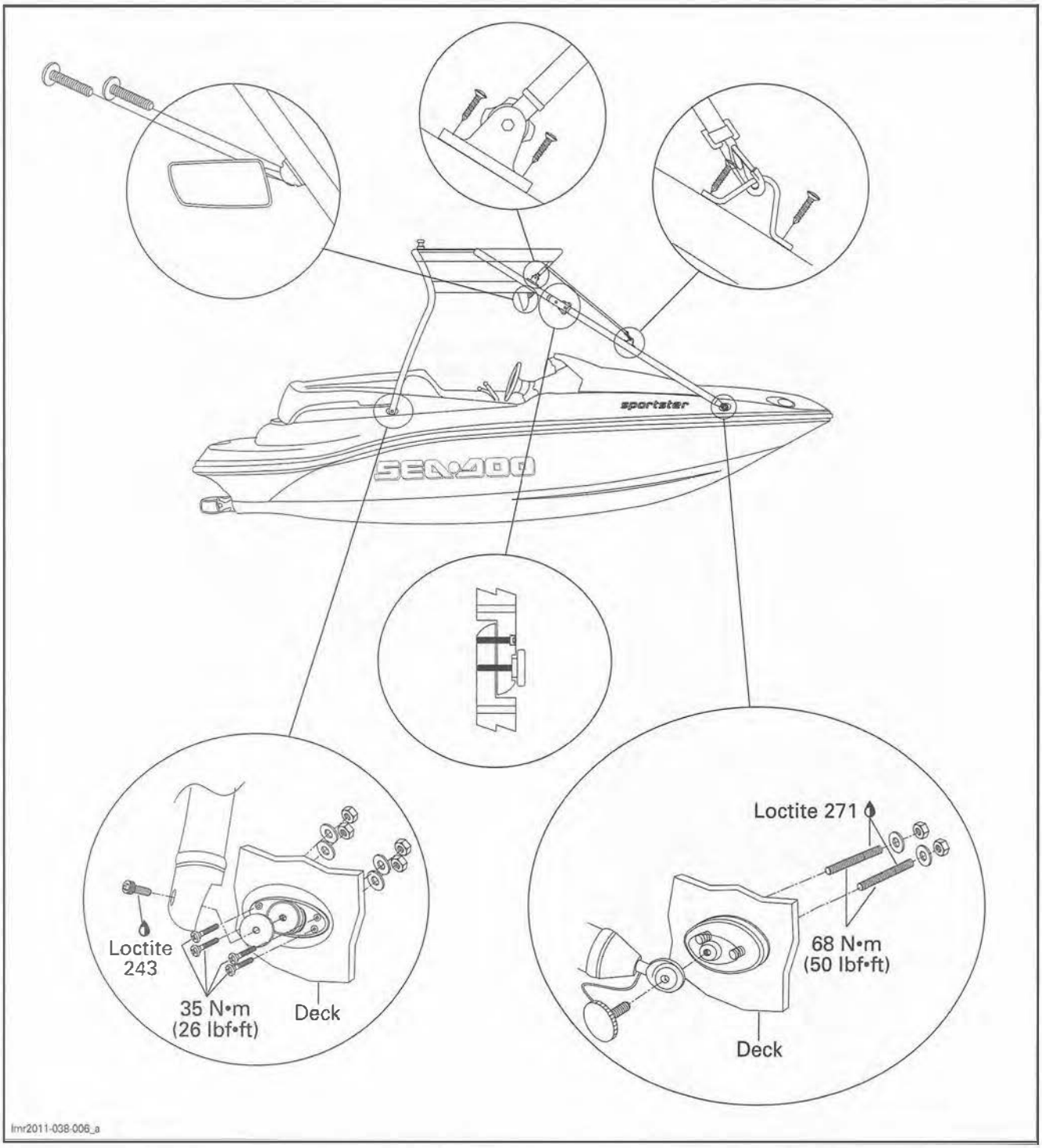
150 SERIES

Console



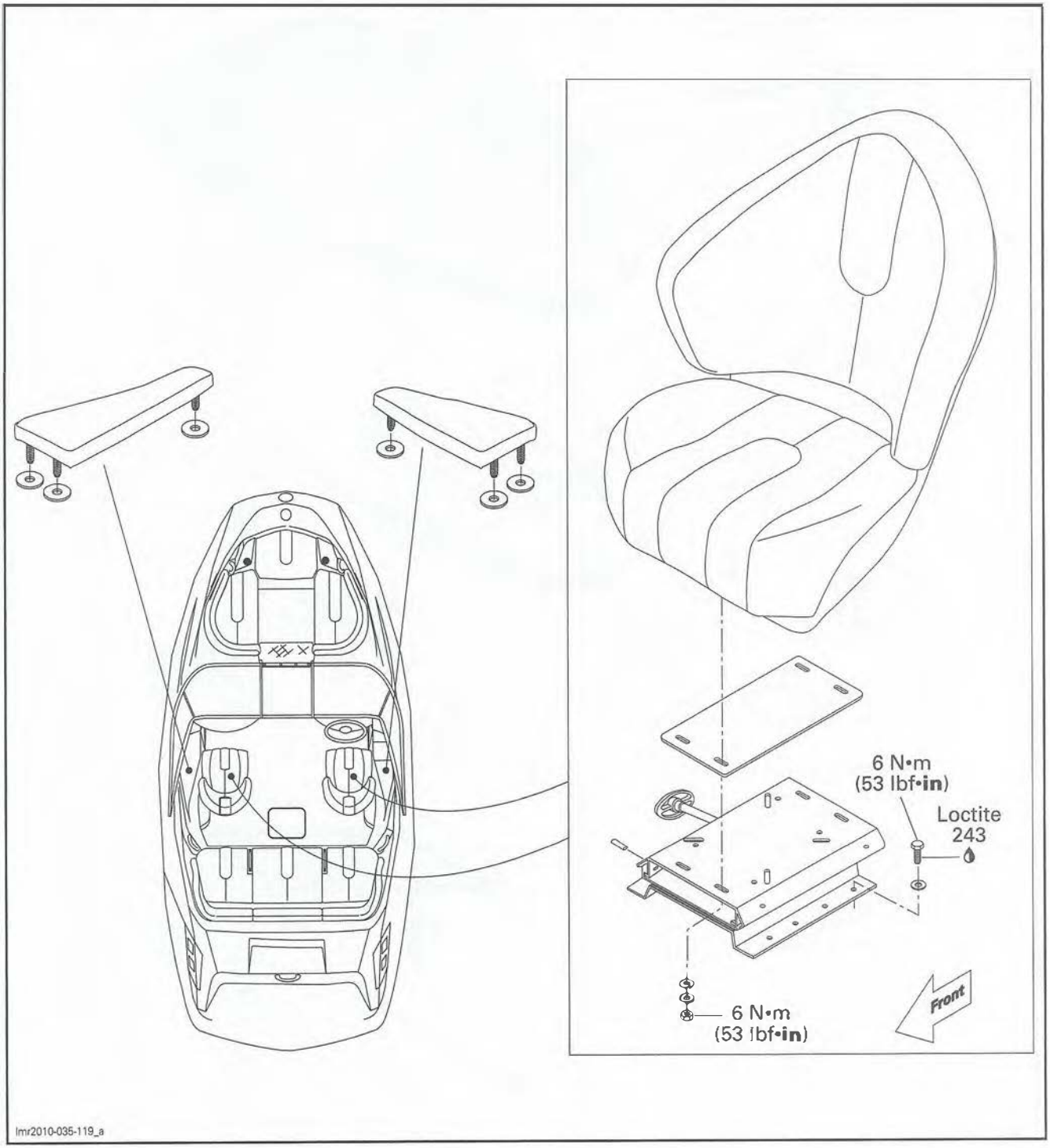
150 SERIES

Tower and Bimini Top



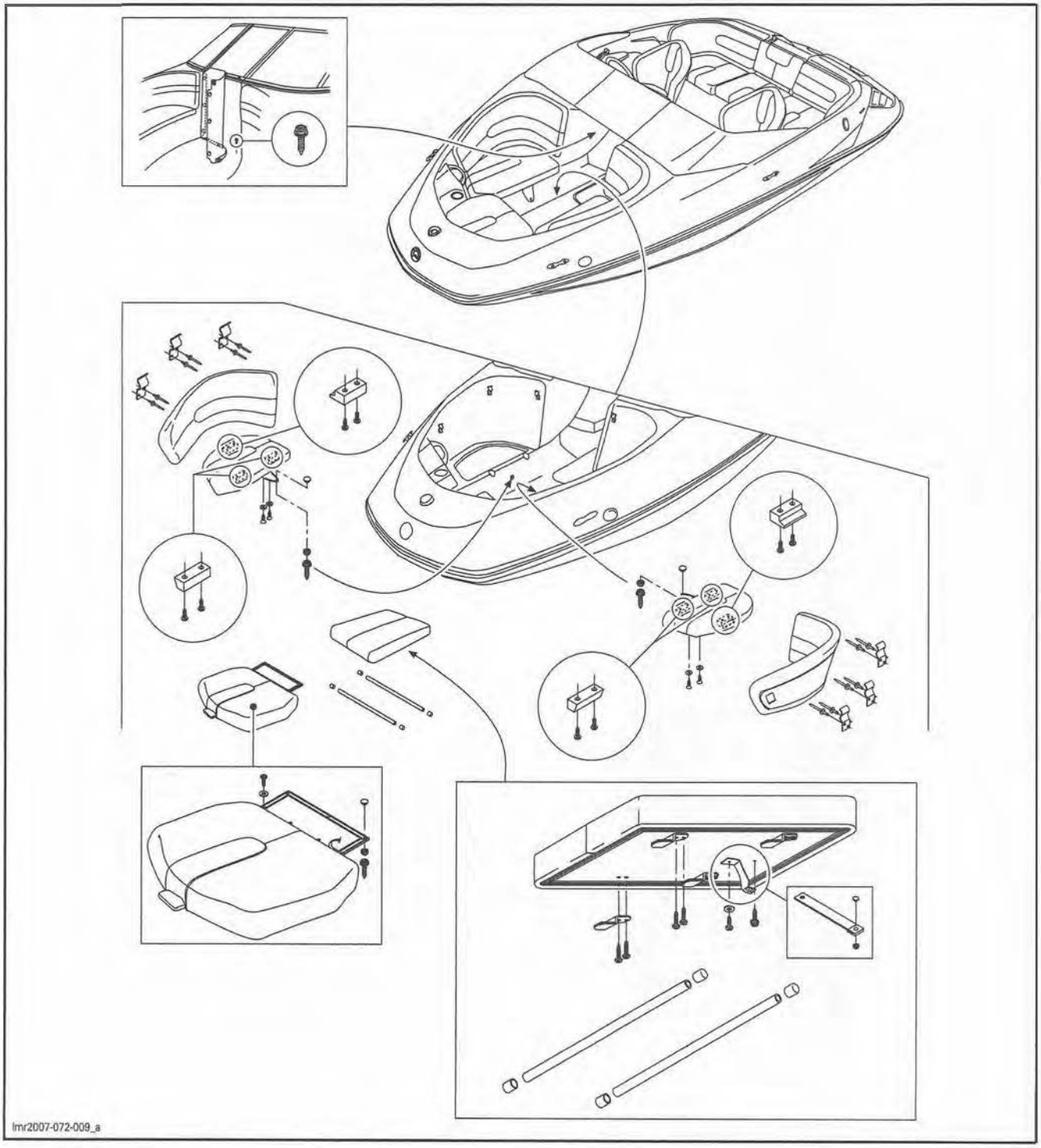
180 SERIES

Seats (View 1)



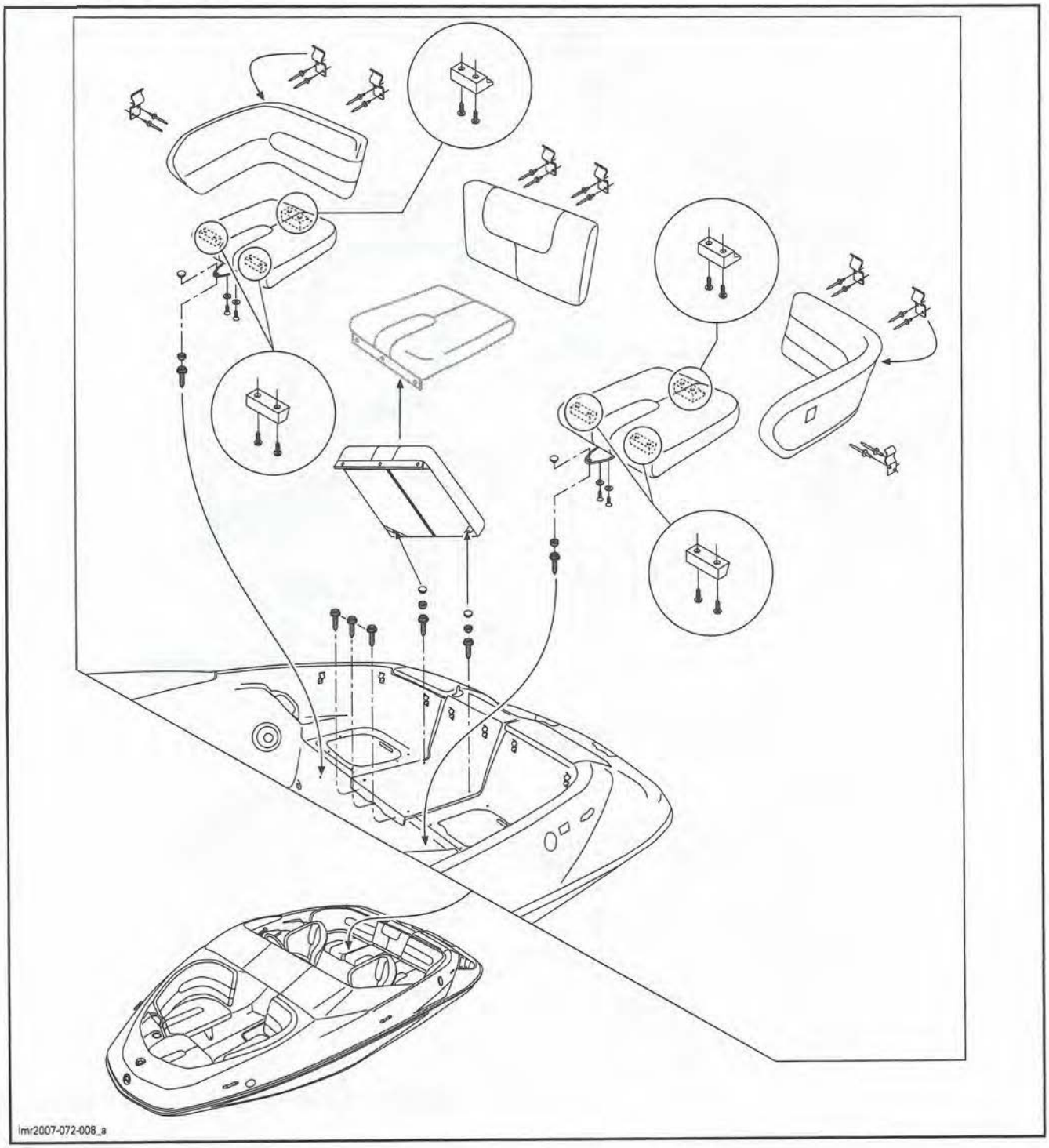
180 SERIES

Seats (View 2) - Front



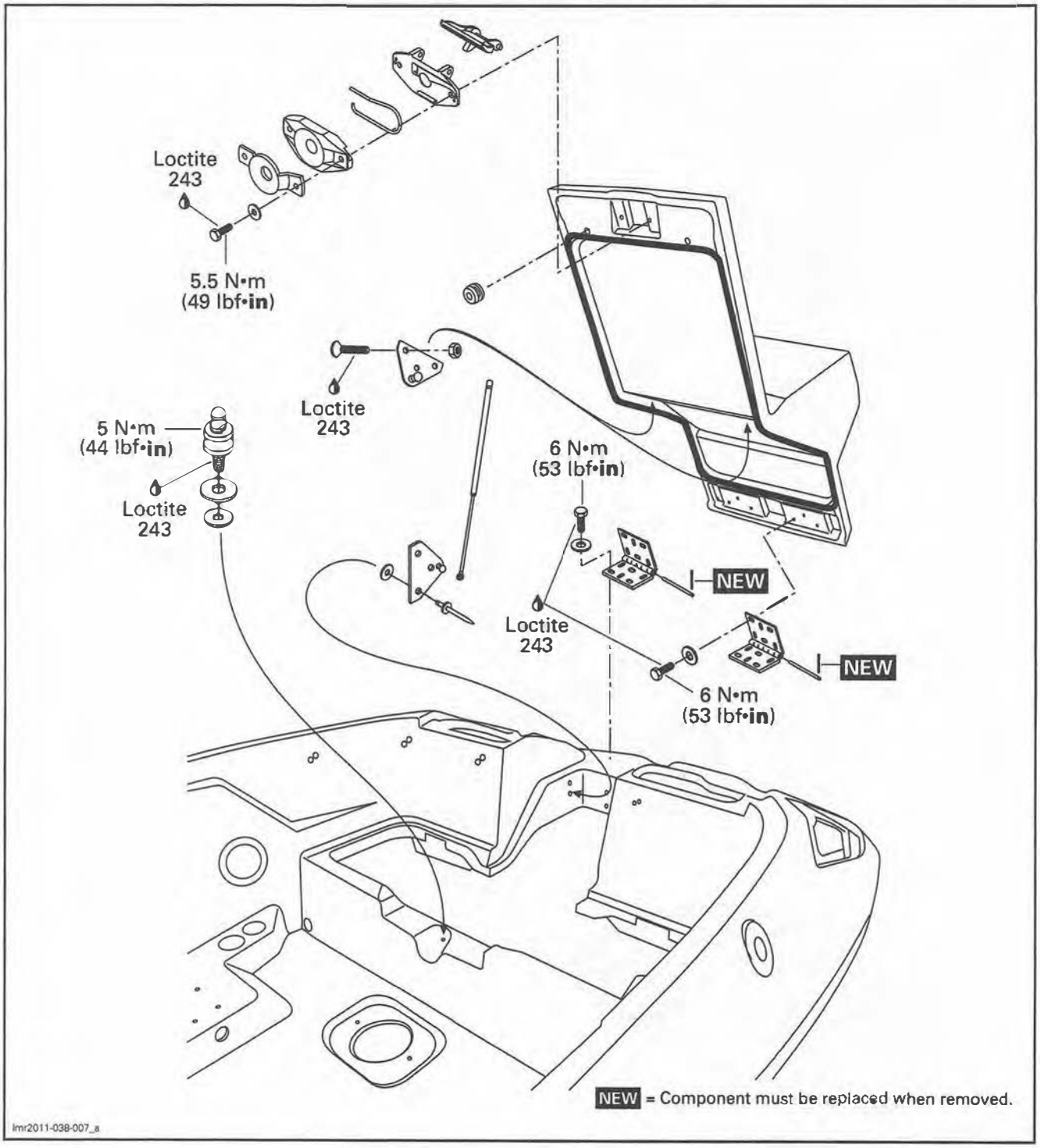
180 SERIES

Seats (View 3) - Rear



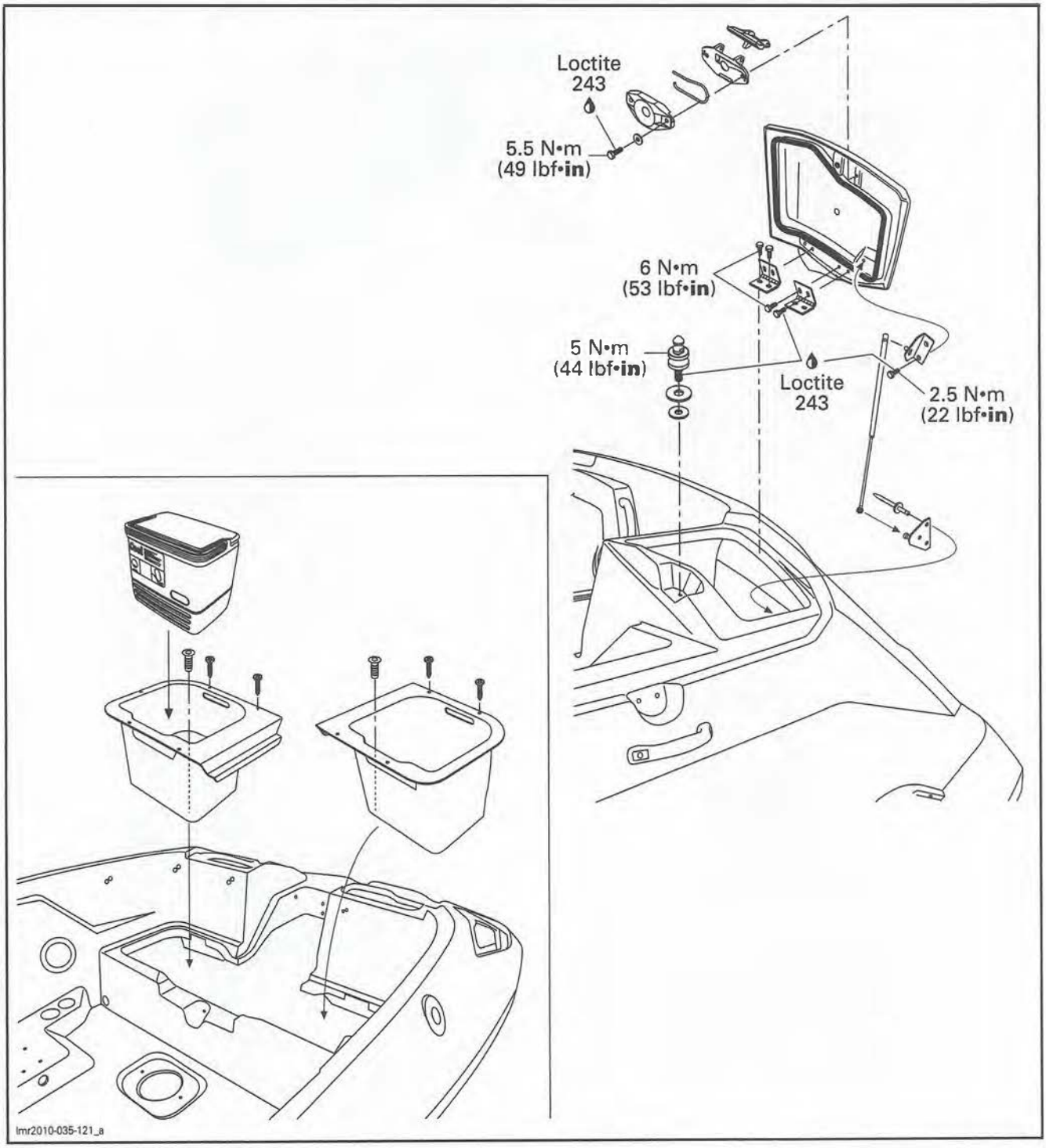
180 SERIES

Engine Compartment



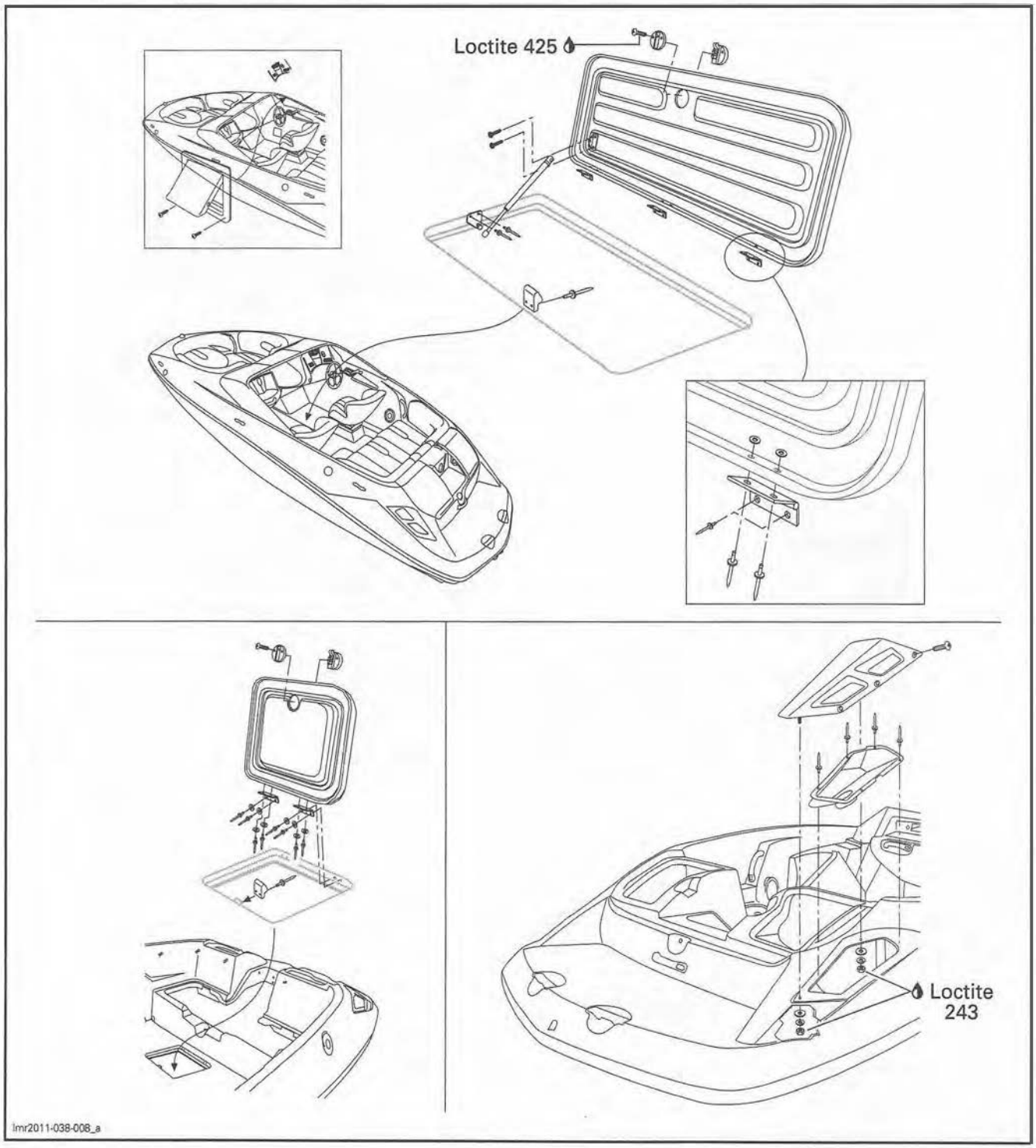
180 SERIES

Body (View 1) - Storage Compartment



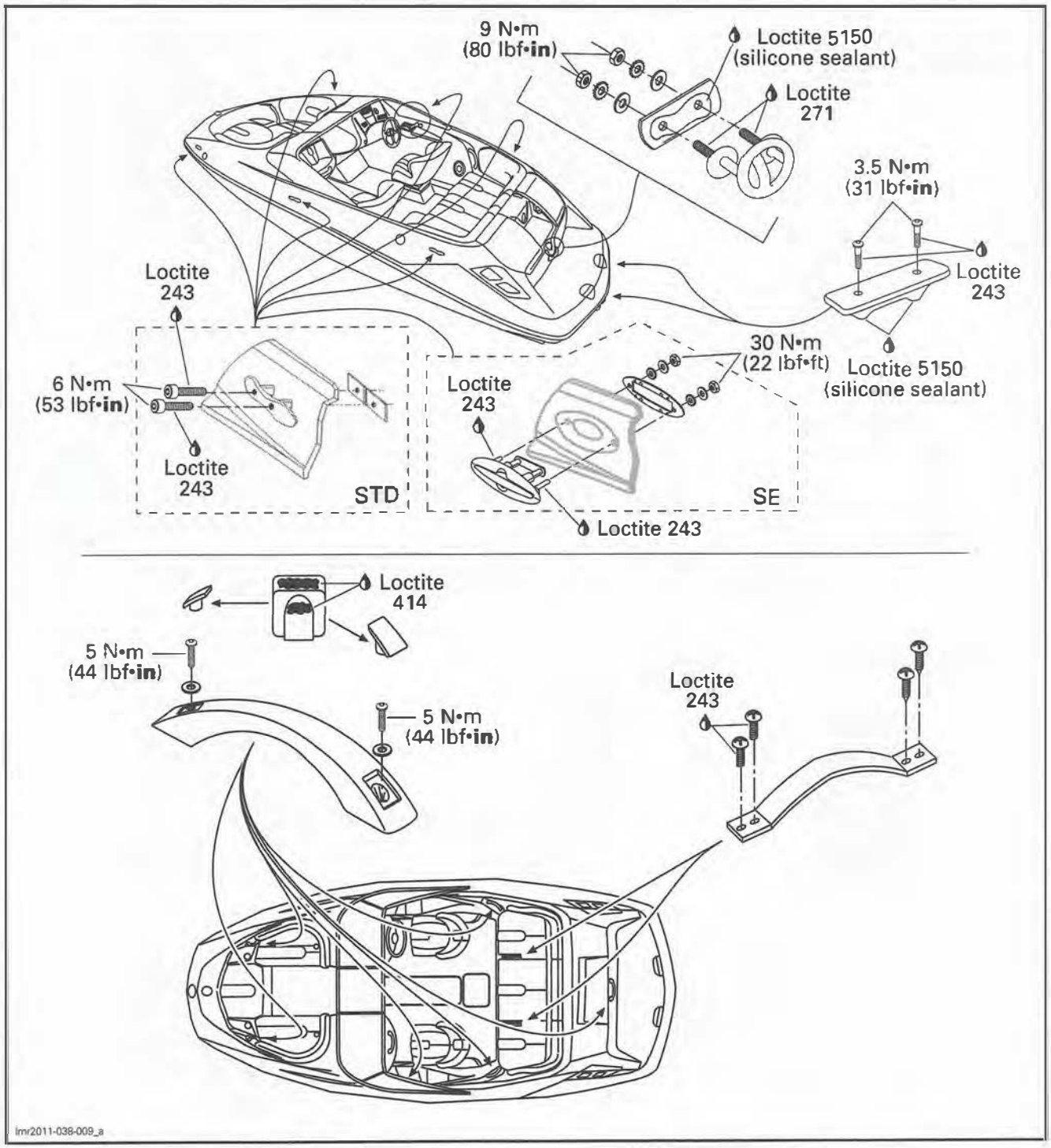
180 SERIES

Body (View 2) - Storage Compartment



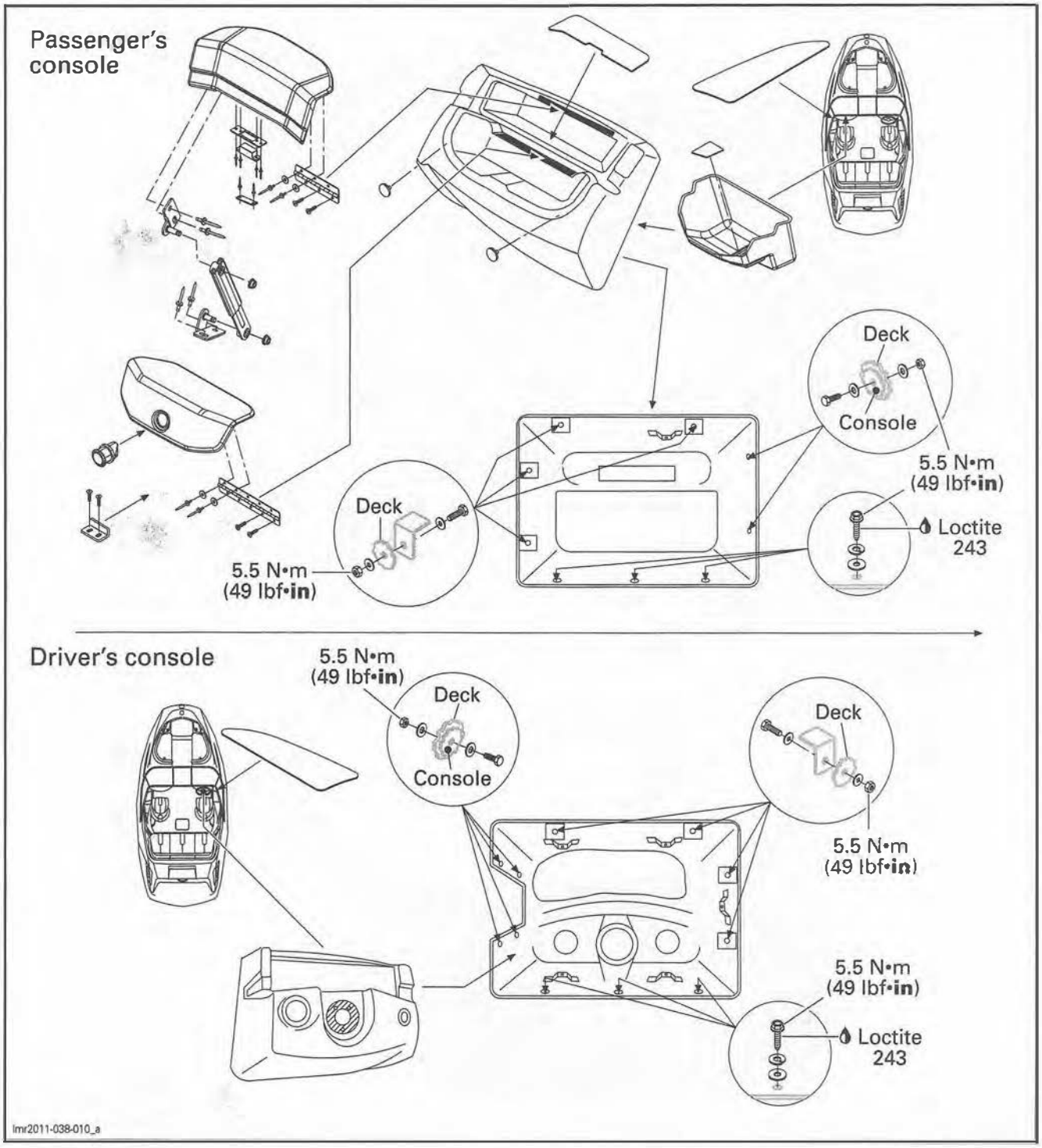
180 SERIES

Body (View 3)



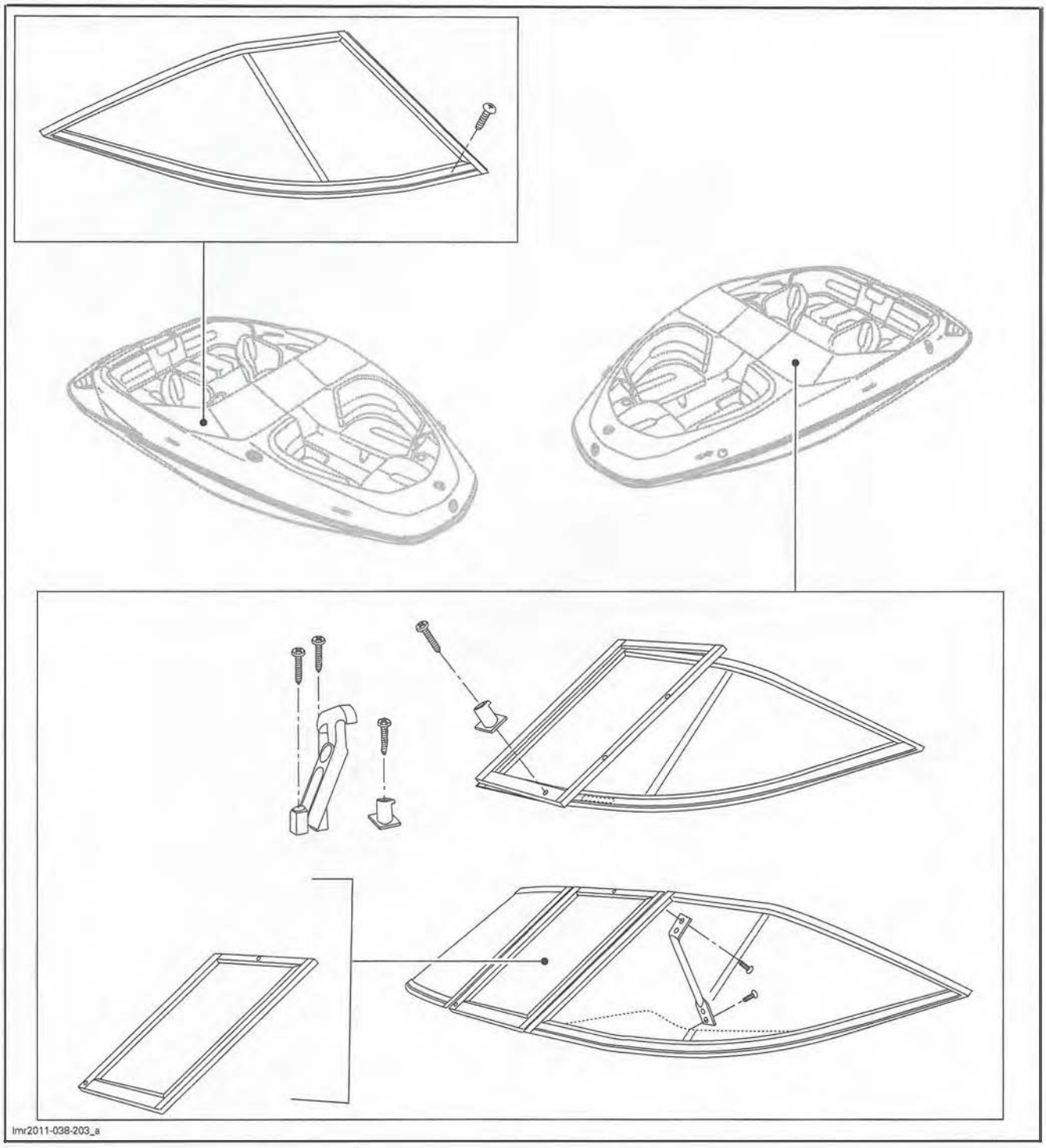
180 SERIES

Consoles



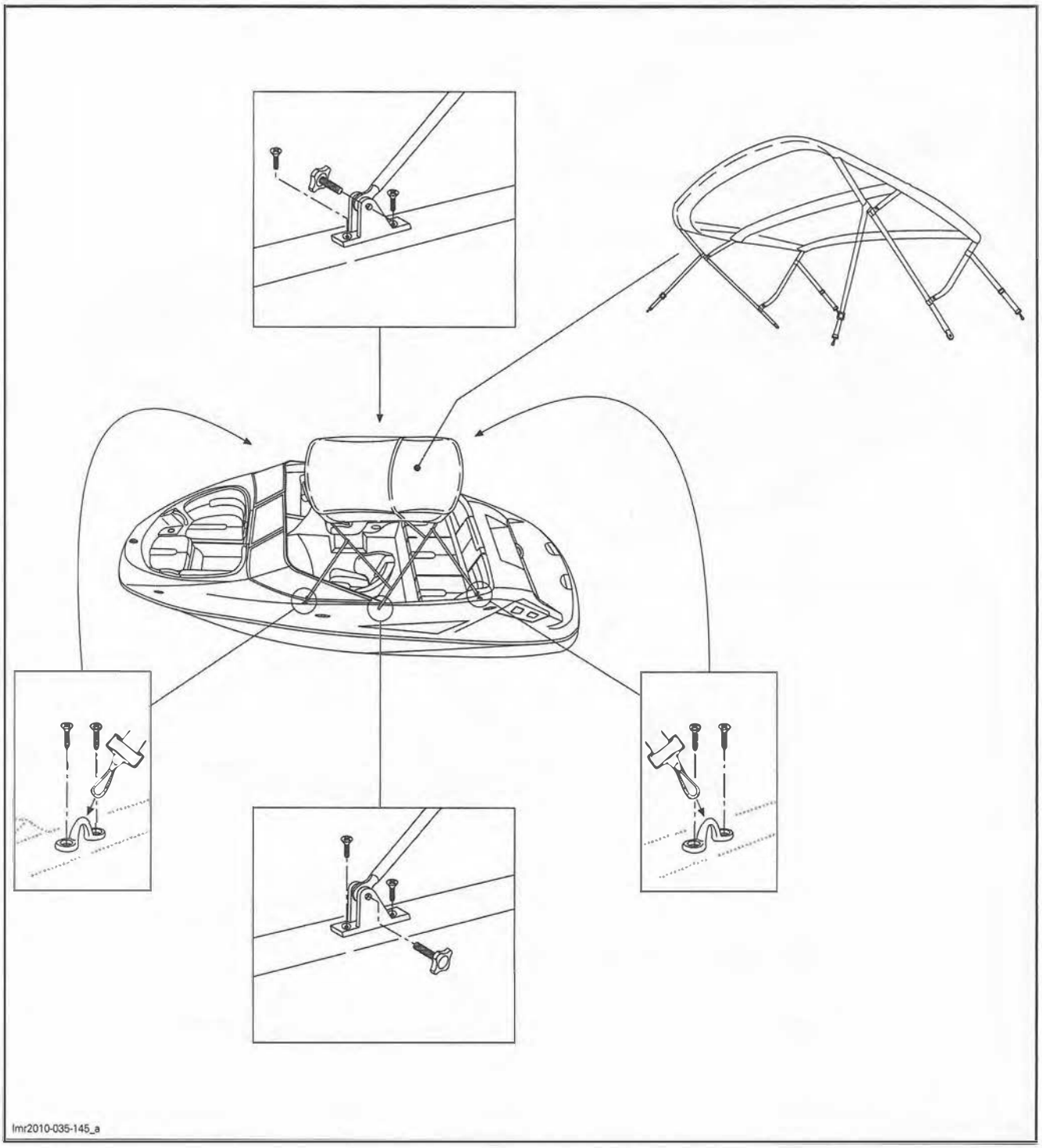
180 SERIES

Windshield



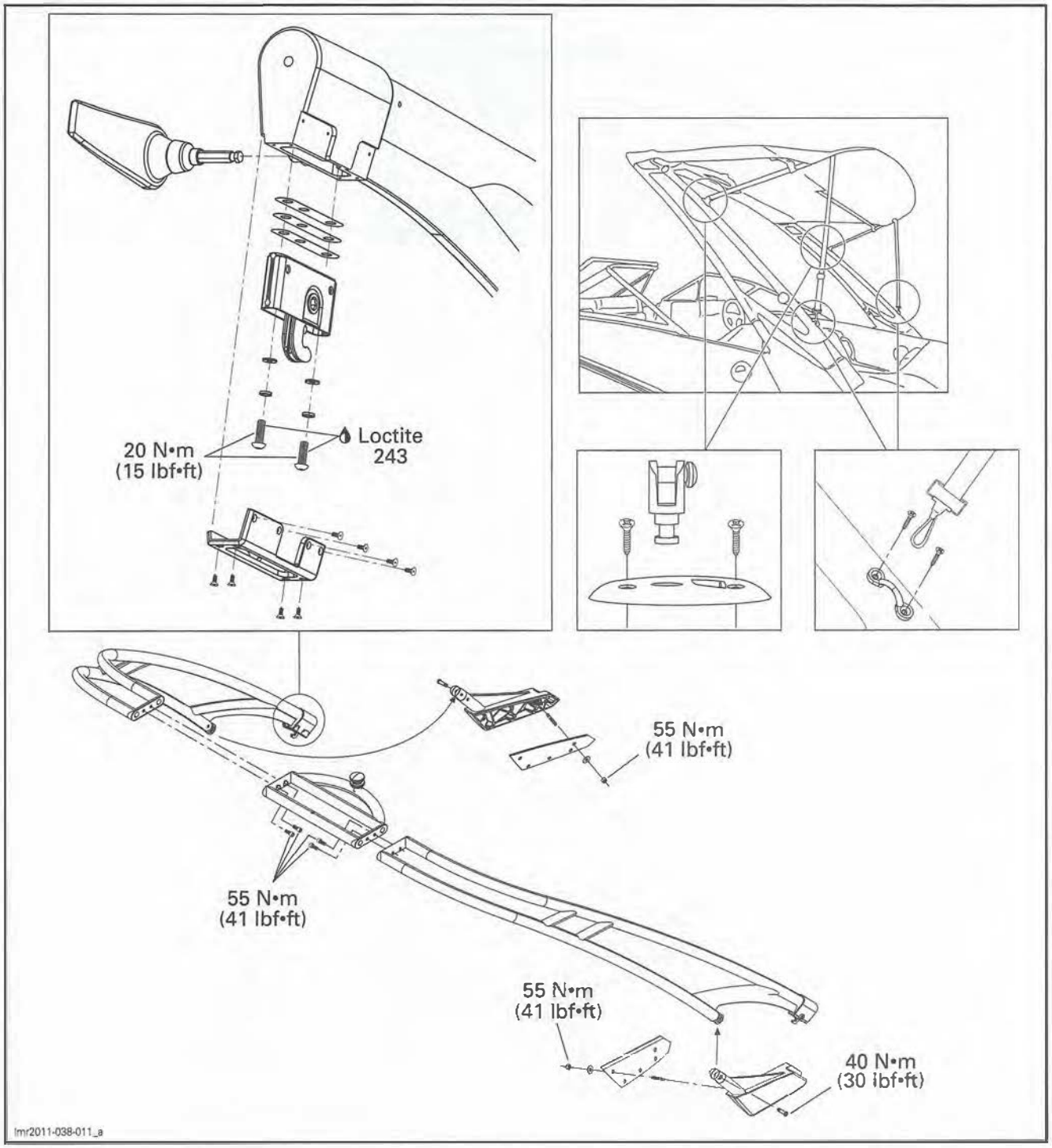
180 SERIES

Bimini Top



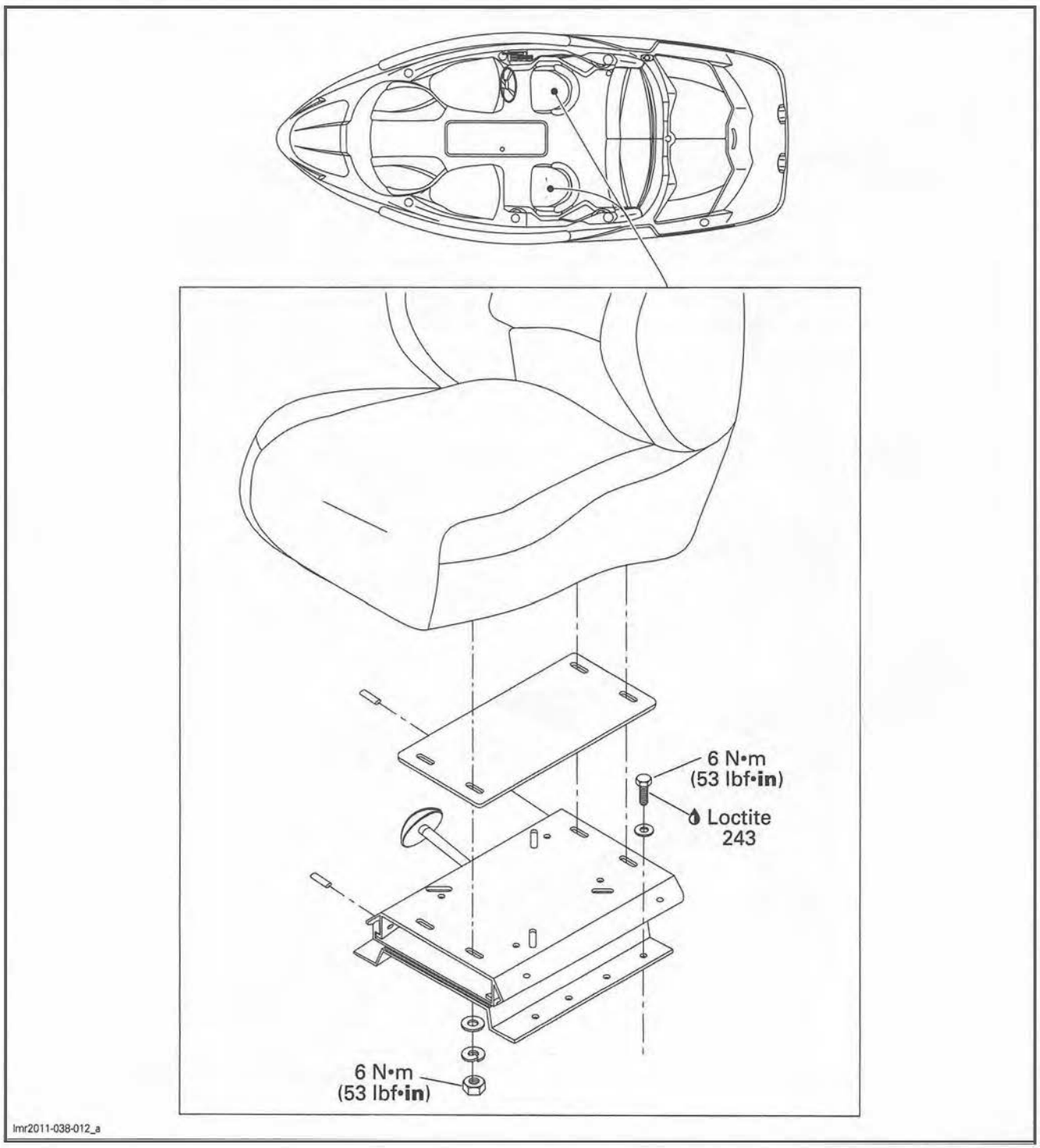
180 SERIES

Tower and Bimini Top



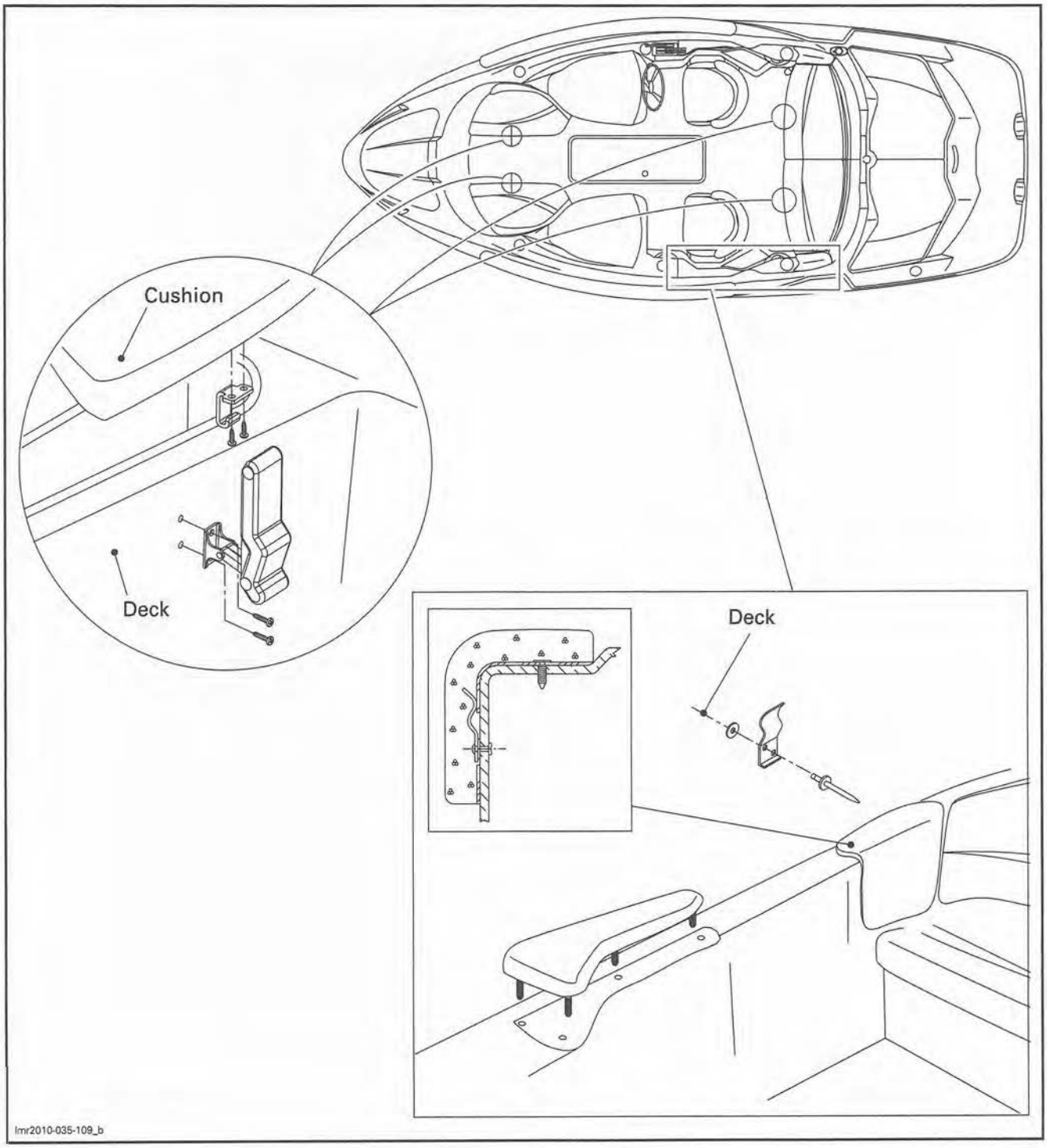
200 SERIES

Seats (View 1)



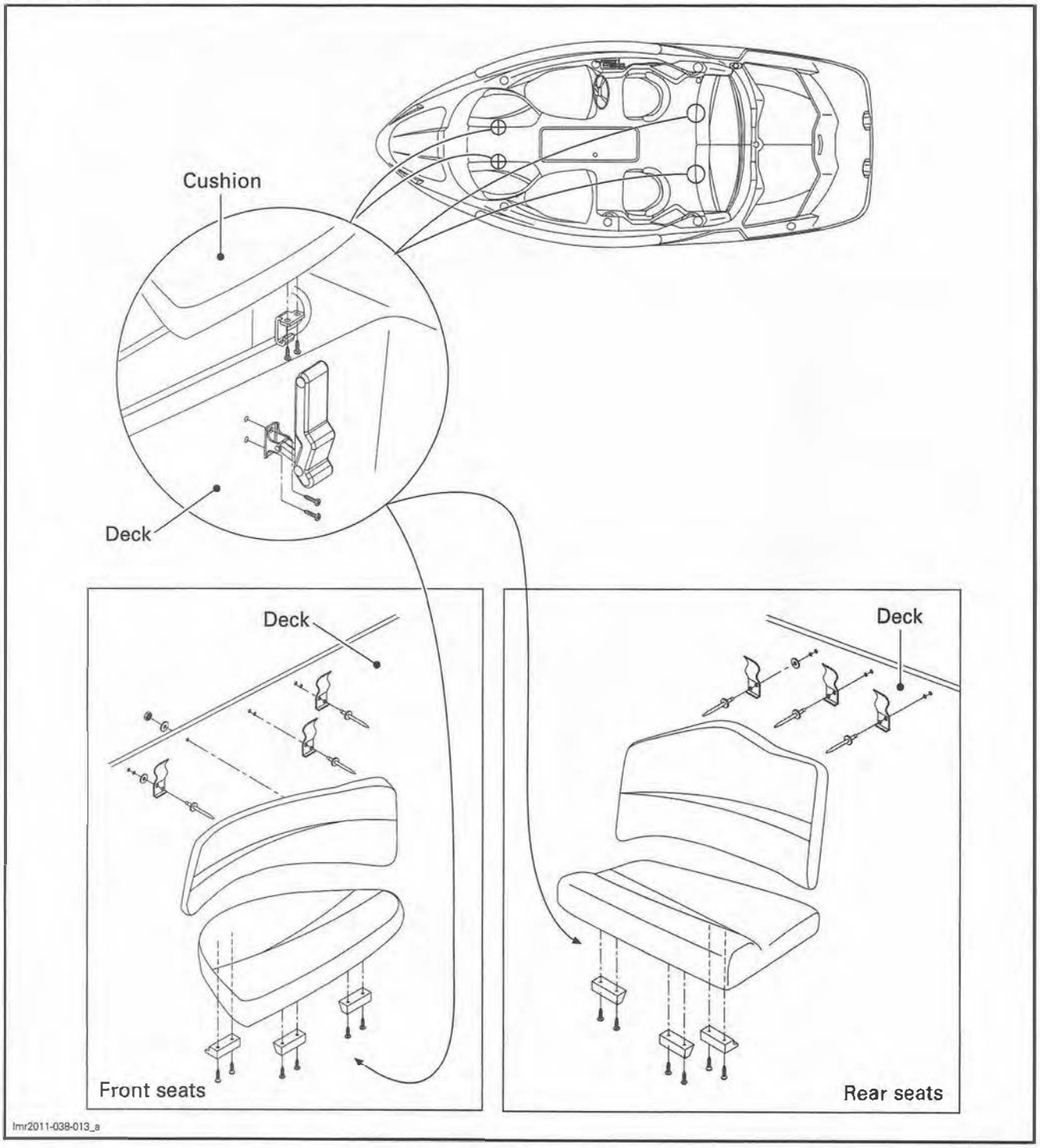
200 SERIES

Seats (View 2)



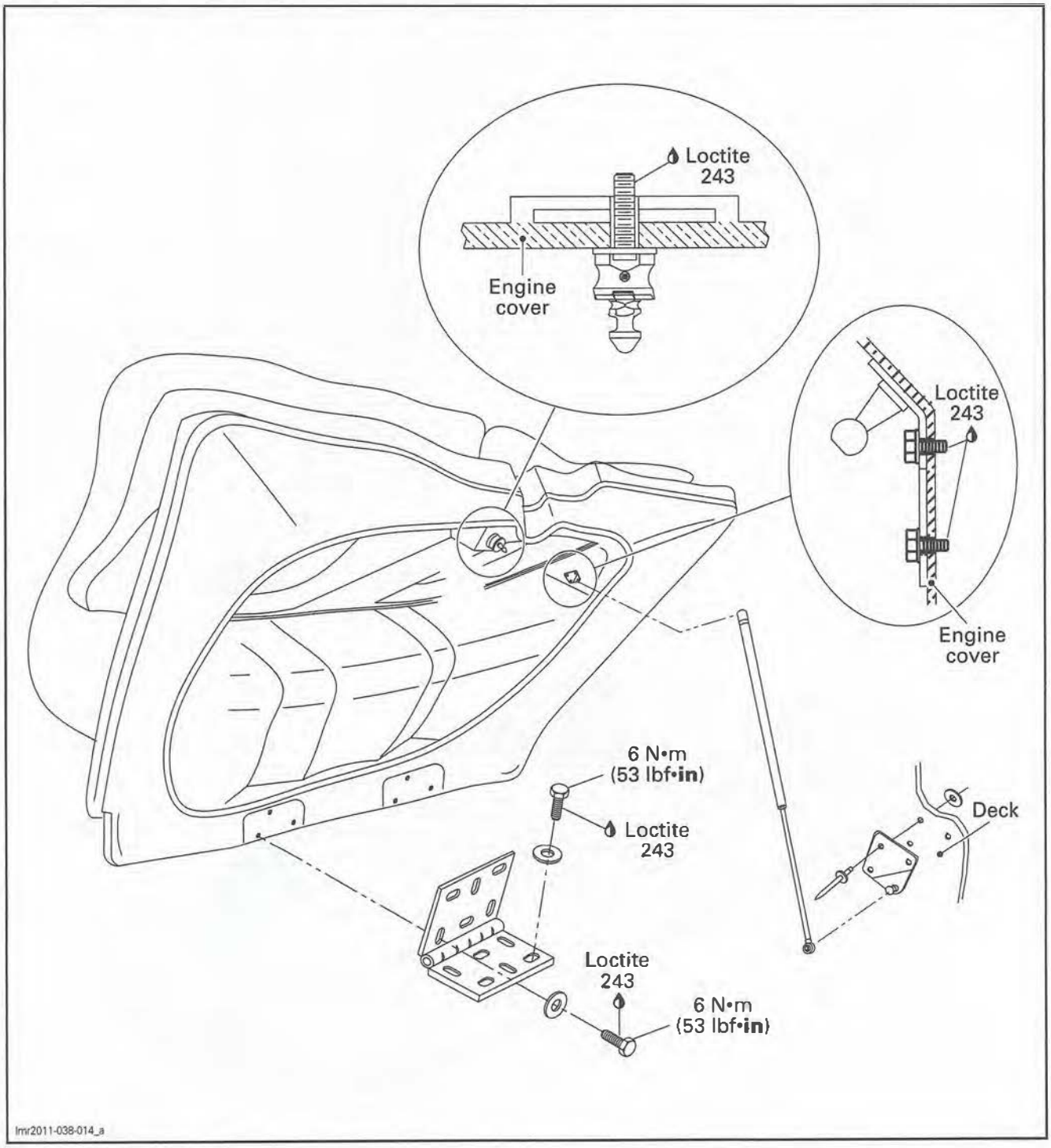
200 SERIES

Seats (View 3)



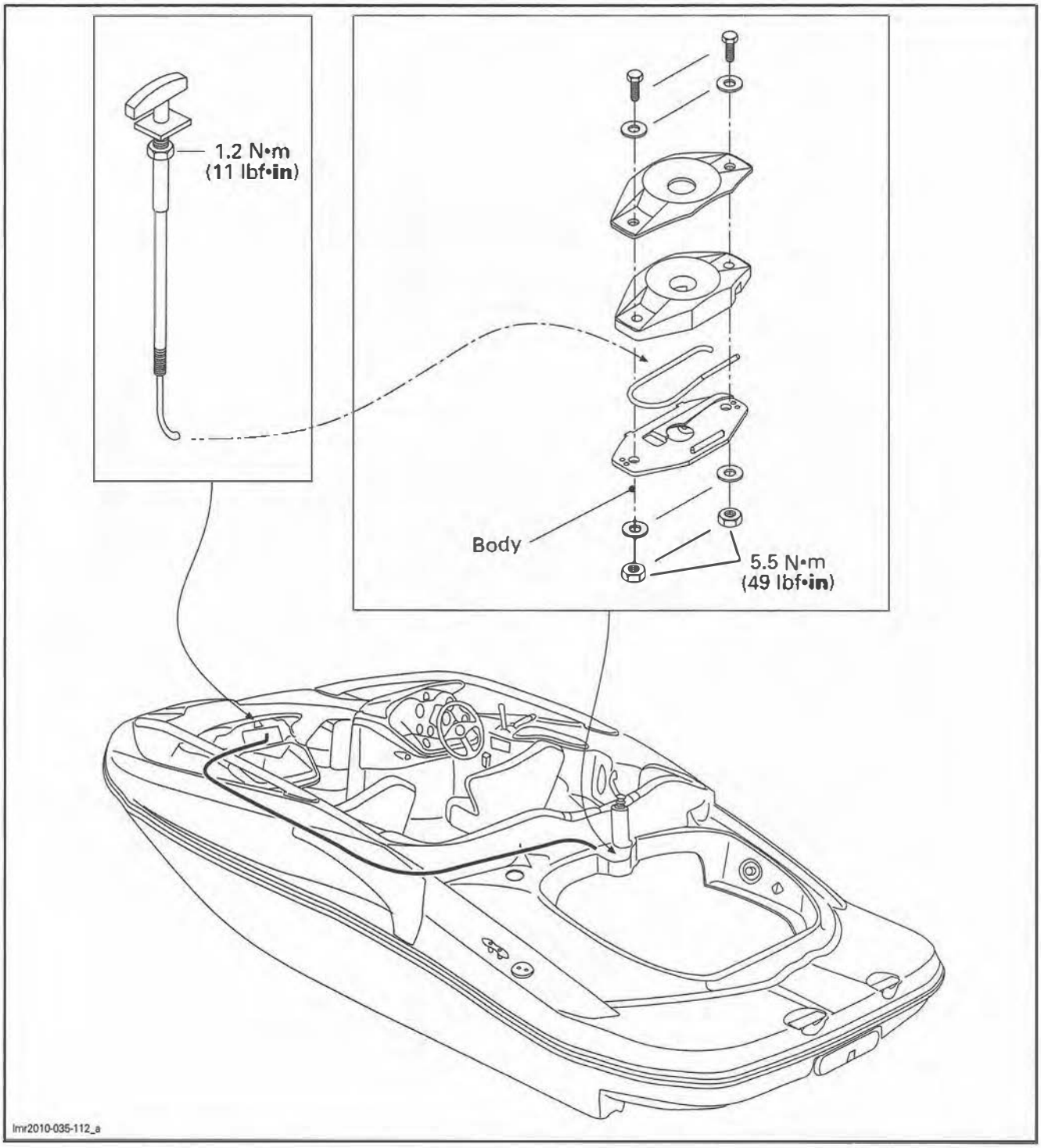
200 SERIES

Engine Compartment (View 1)



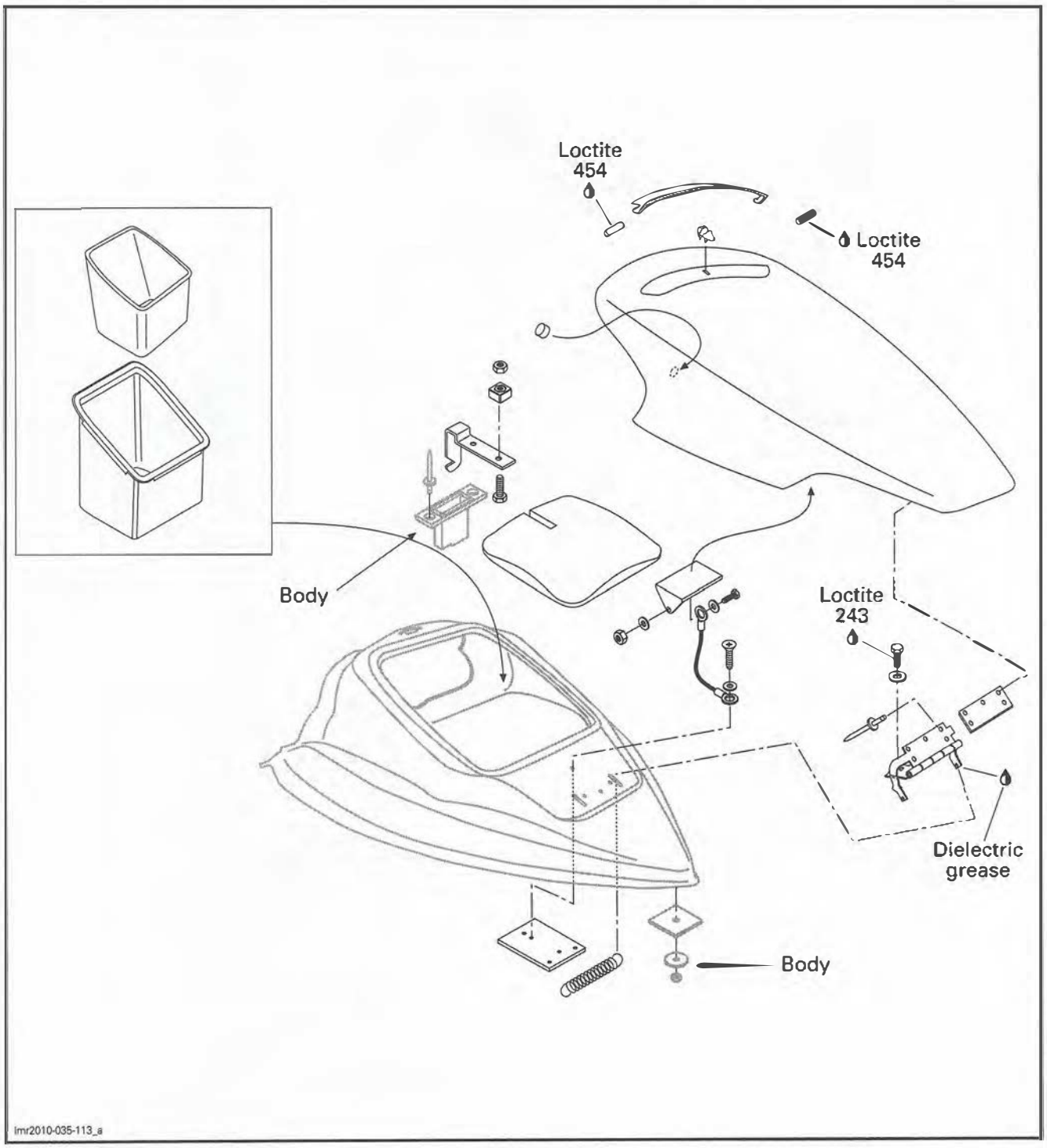
200 SERIES

Engine Compartment (View 2)



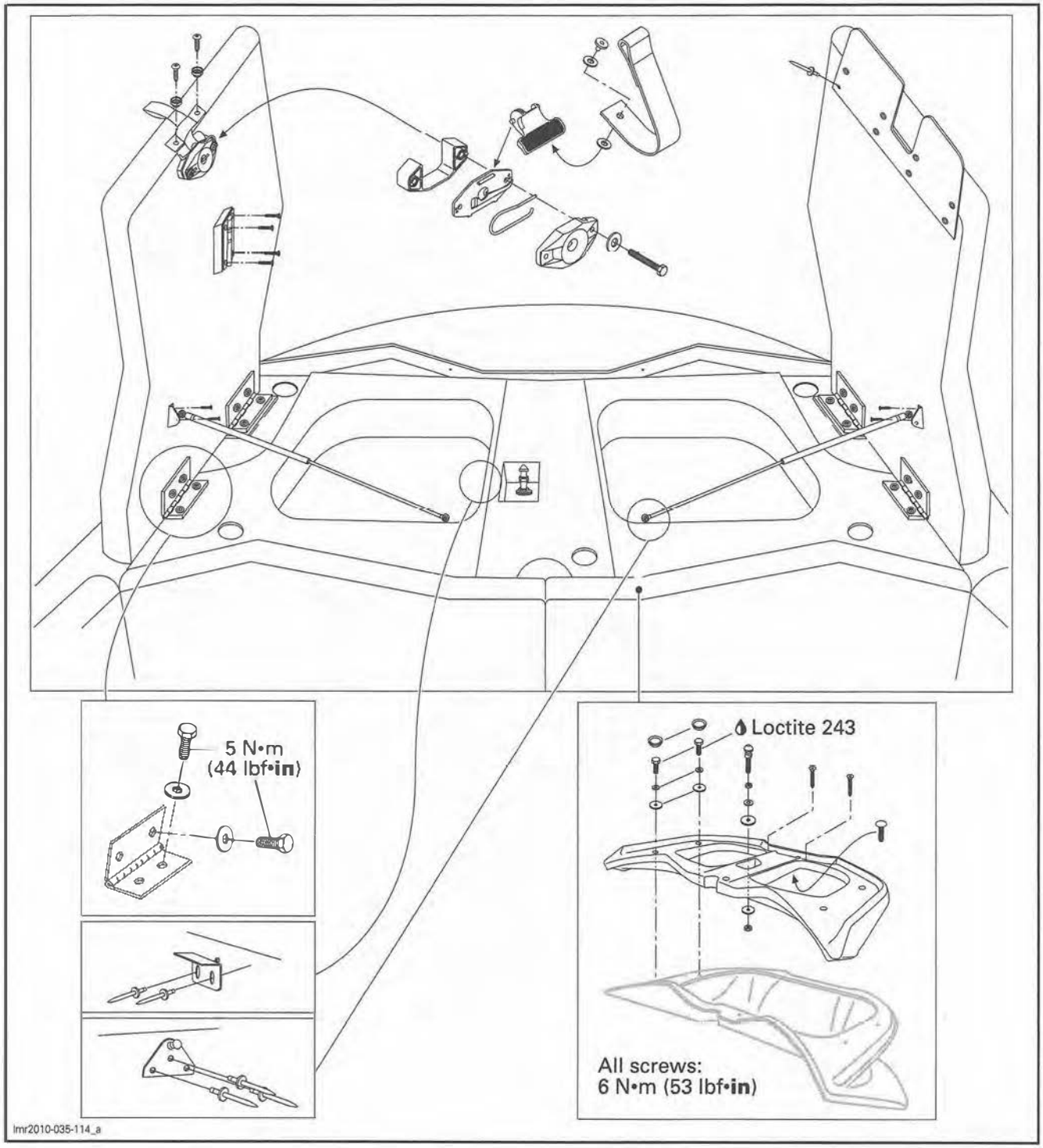
200 SERIES

Body (View 1)



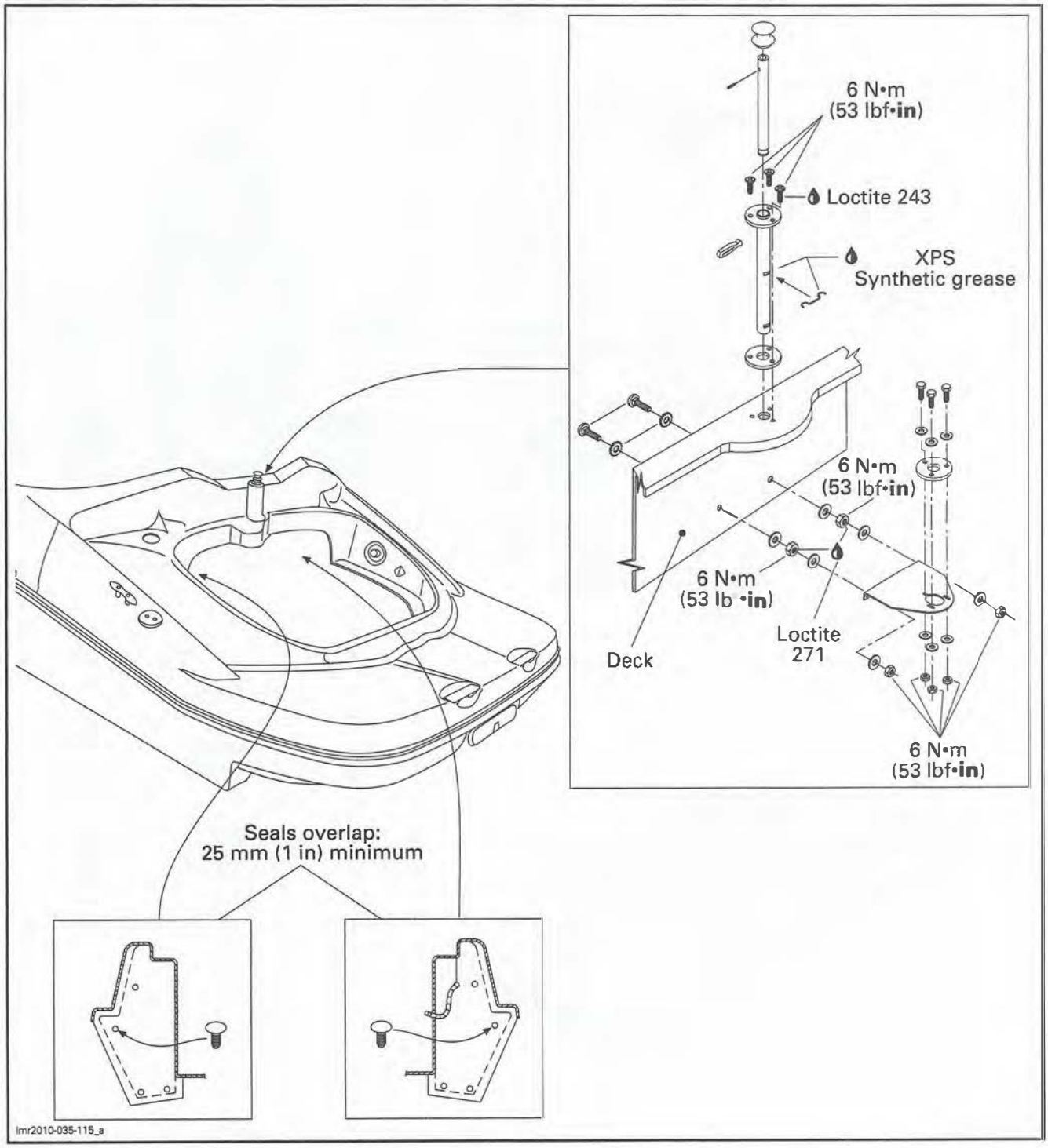
200 SERIES

Body (View 2)



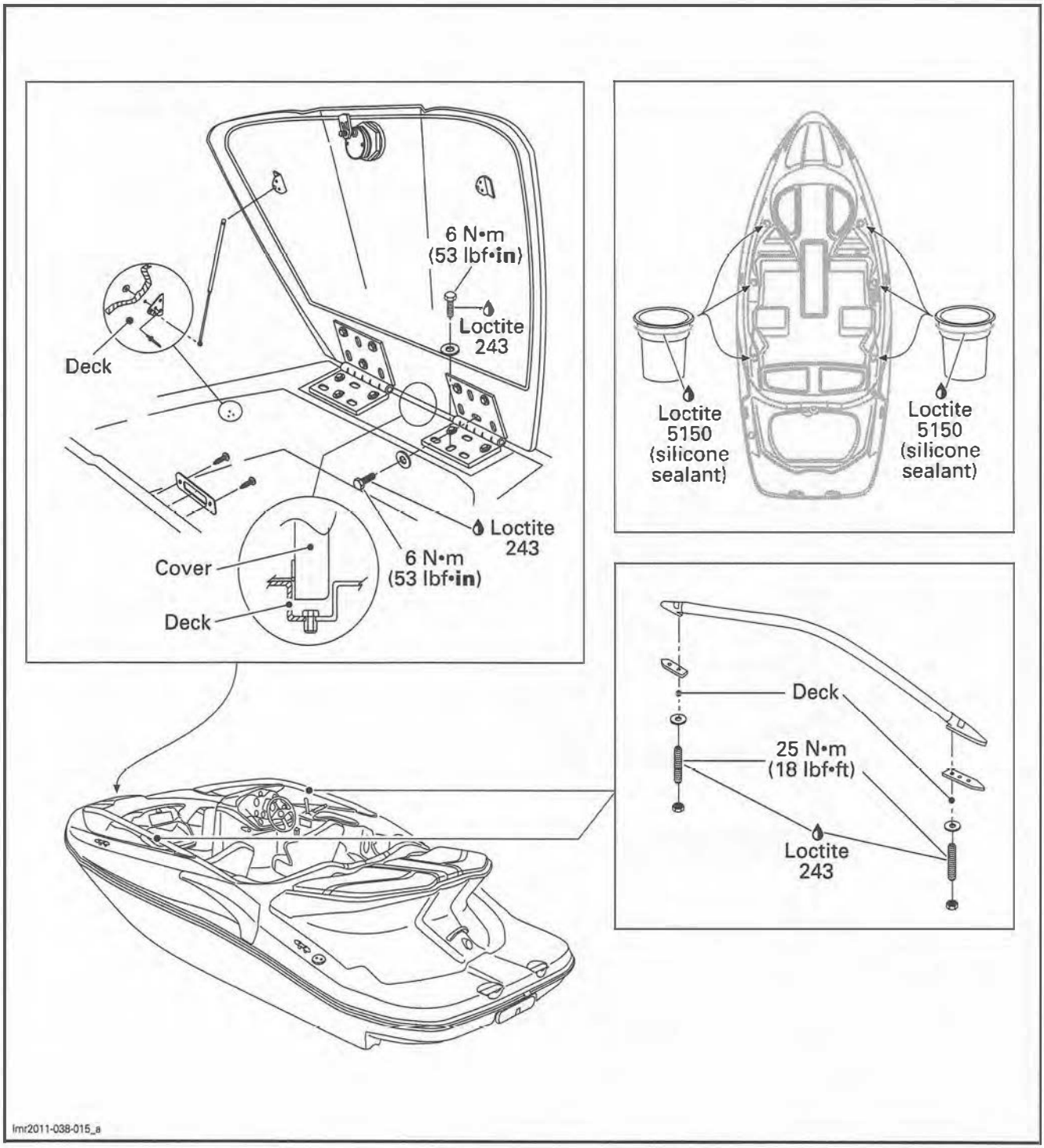
200 SERIES

Body (View 3)



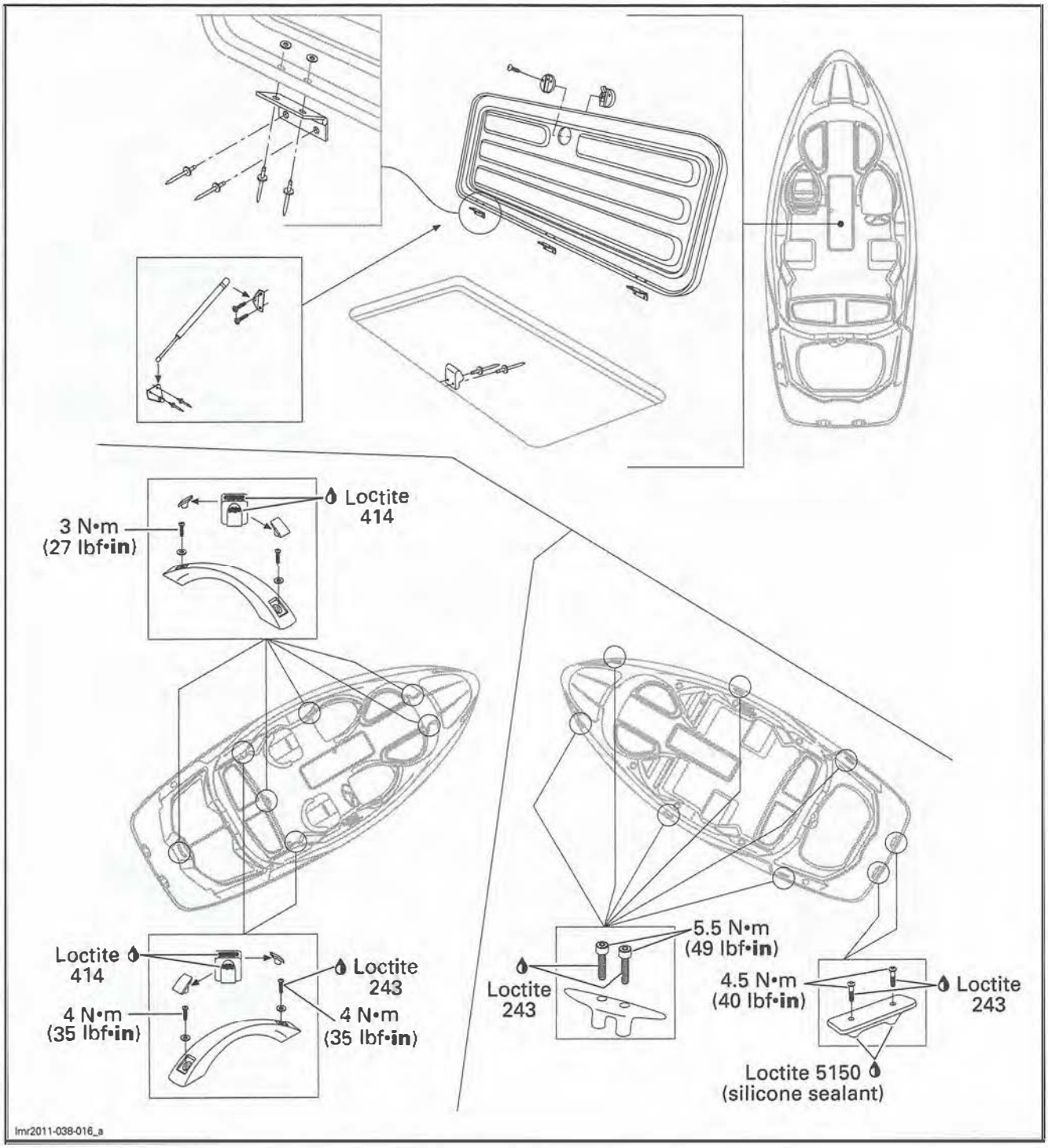
200 SERIES

Body (View 4)



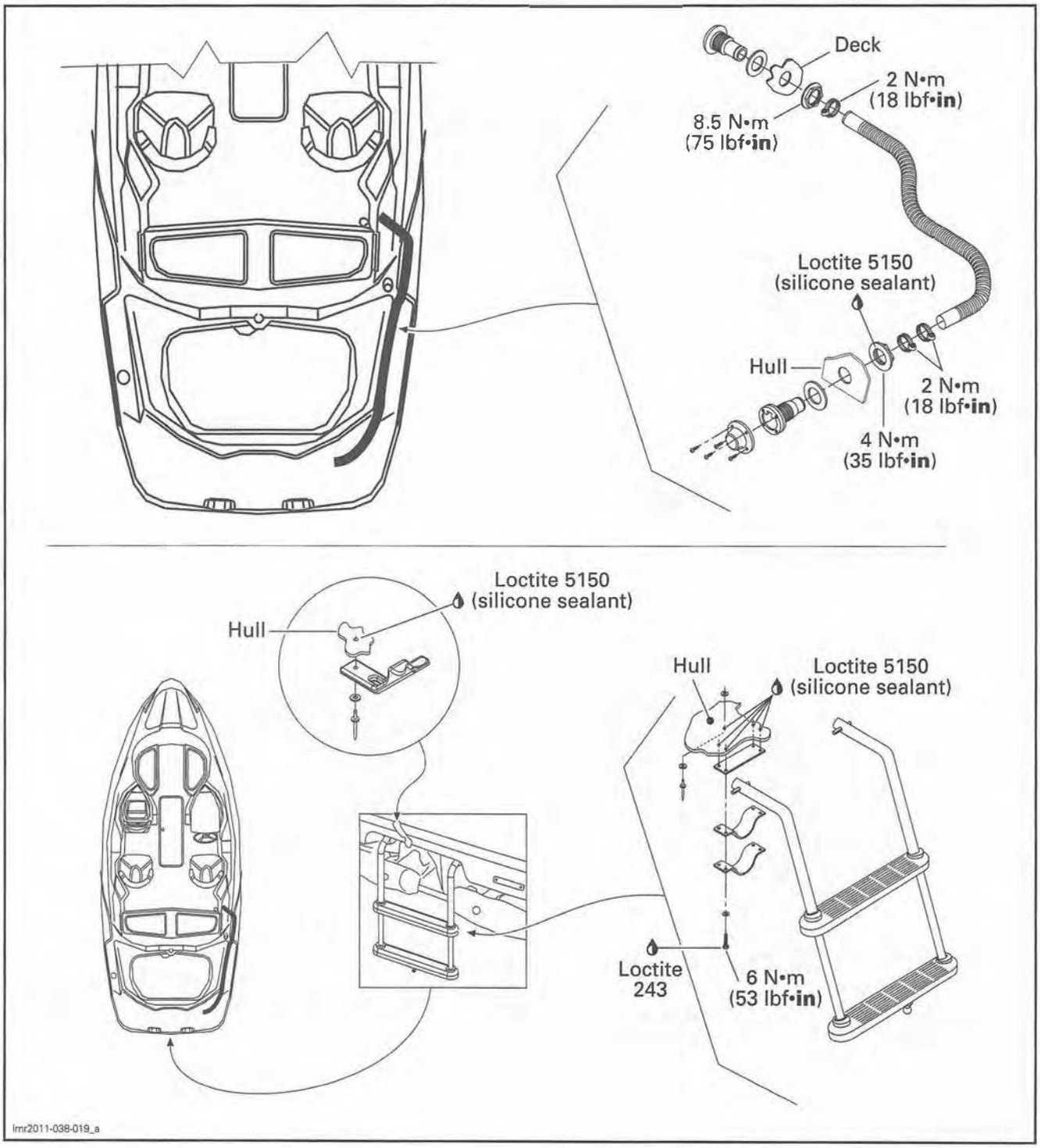
200 SERIES

Body (View 5) - Storage Compartment



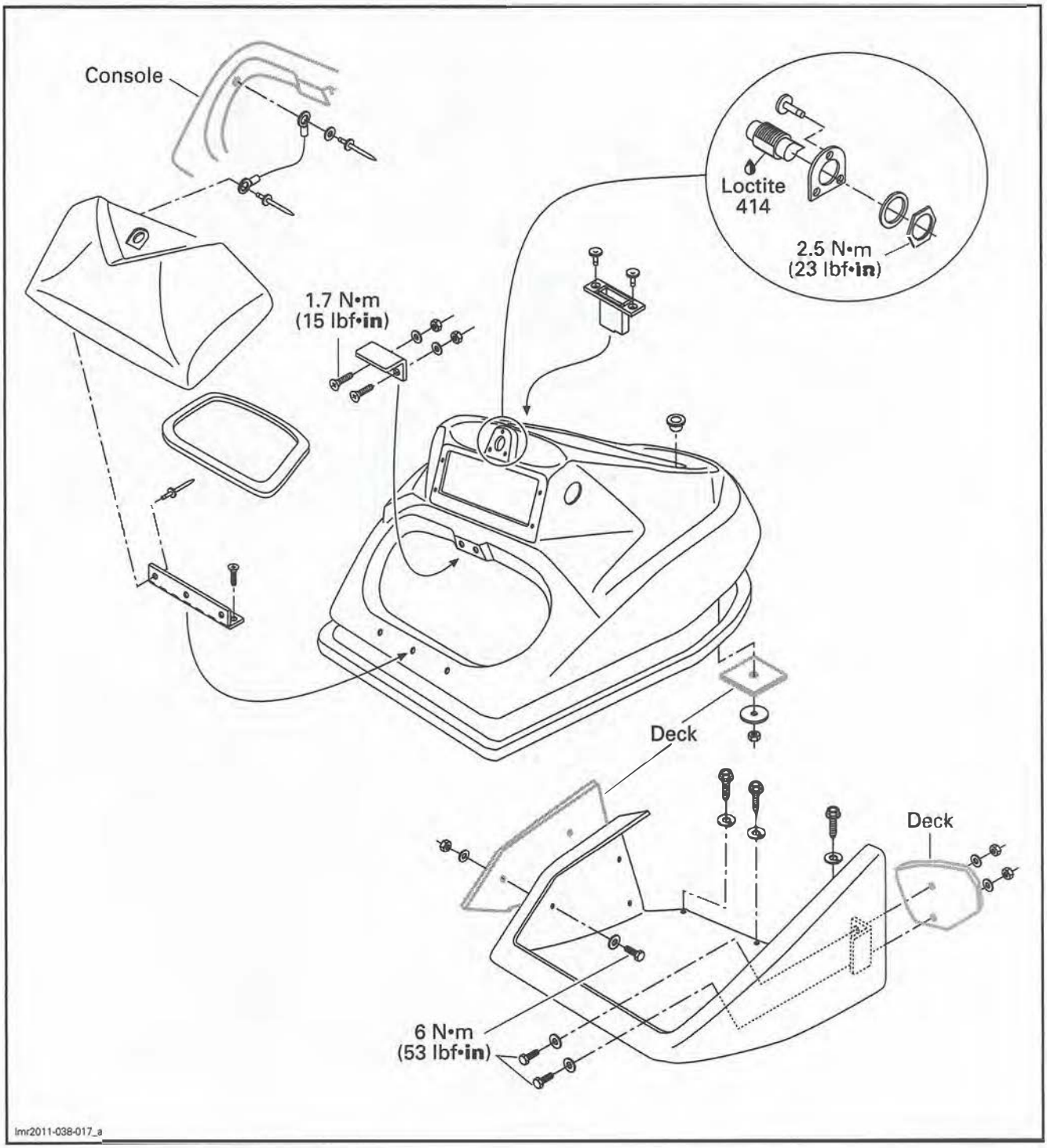
200 SERIES

Body (View 6) - Ladder



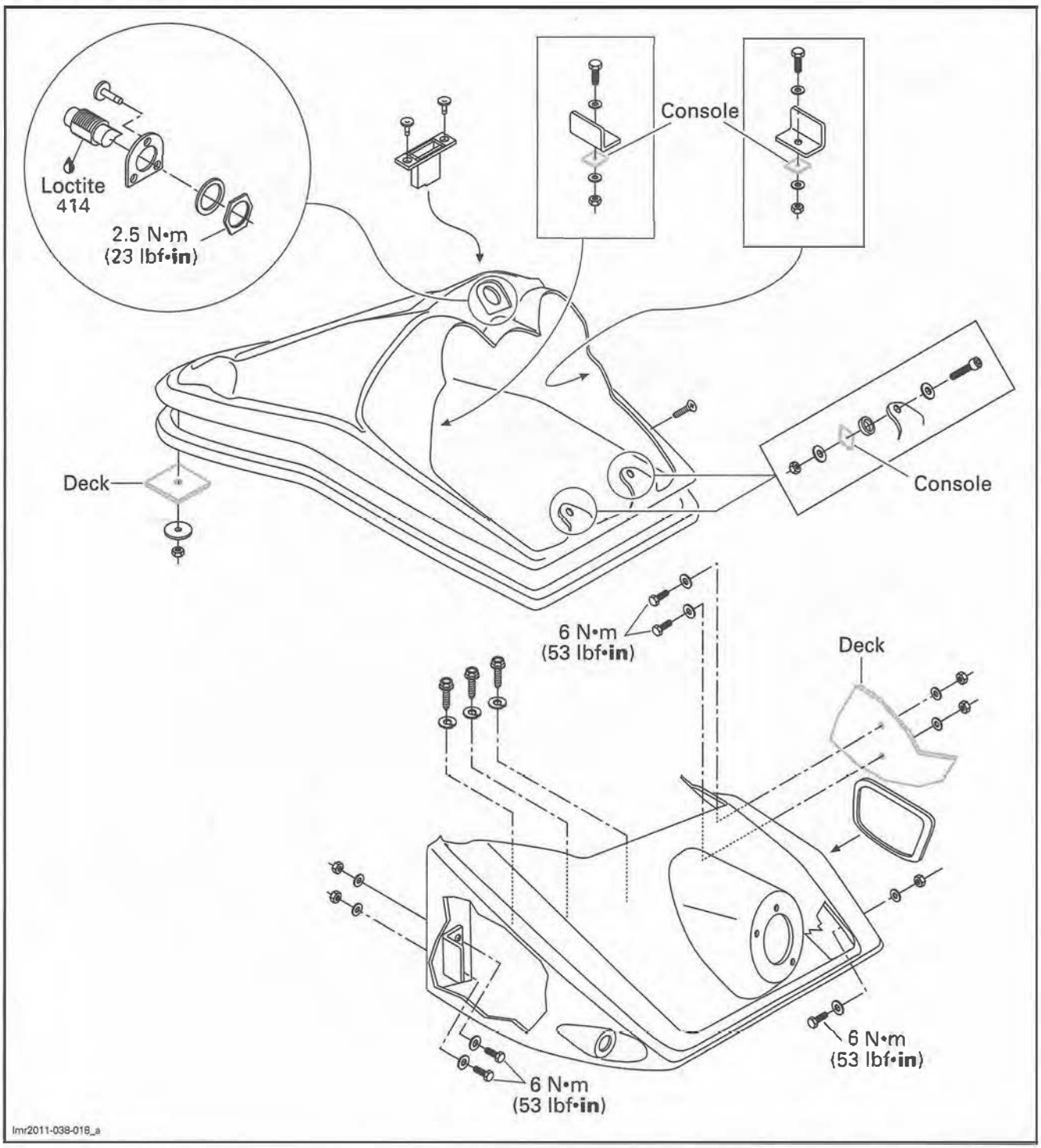
200 SERIES

Consoles (Passenger Side)



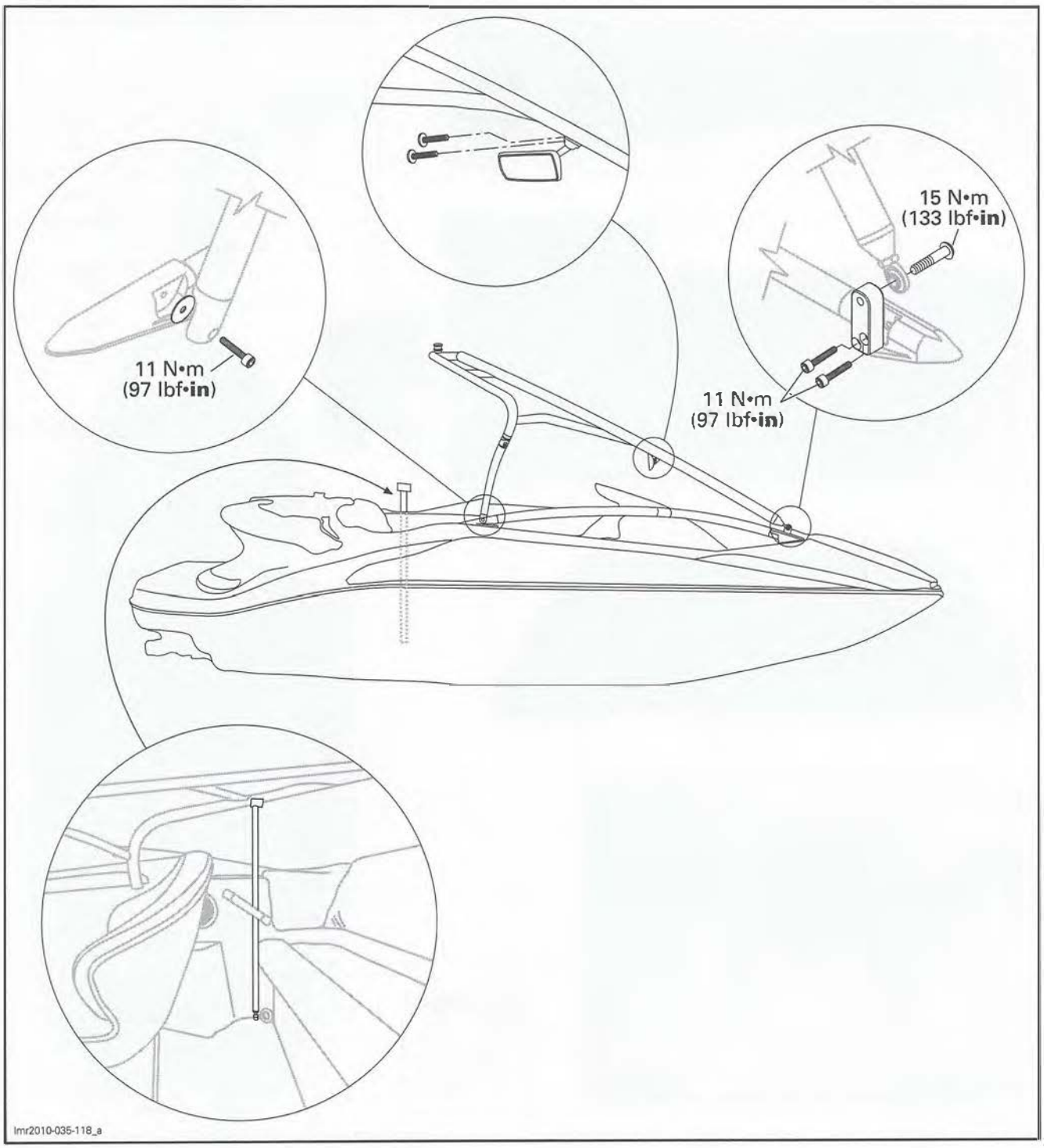
200 SERIES

Consoles (Driver Side)



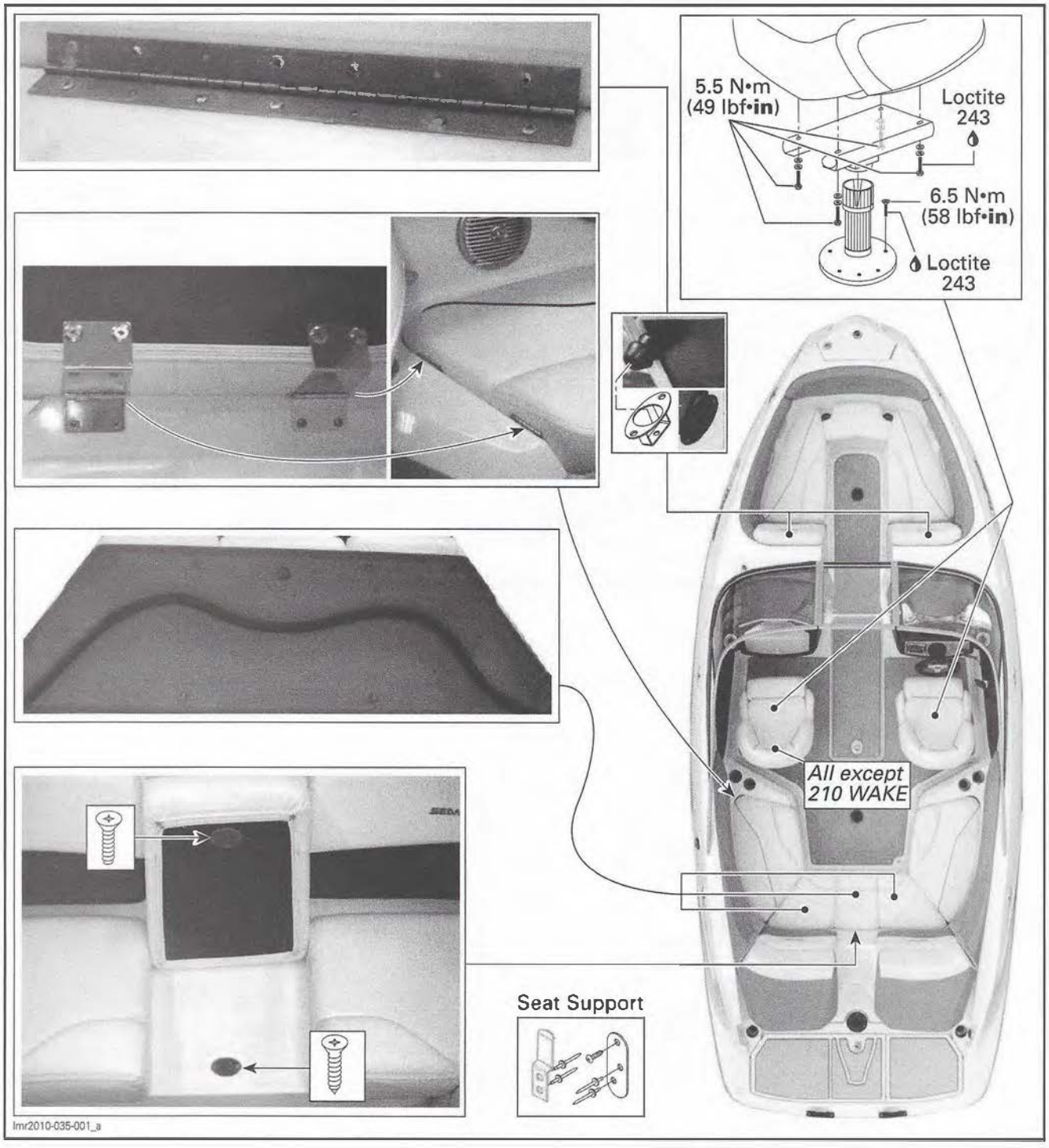
200 SERIES

Tower



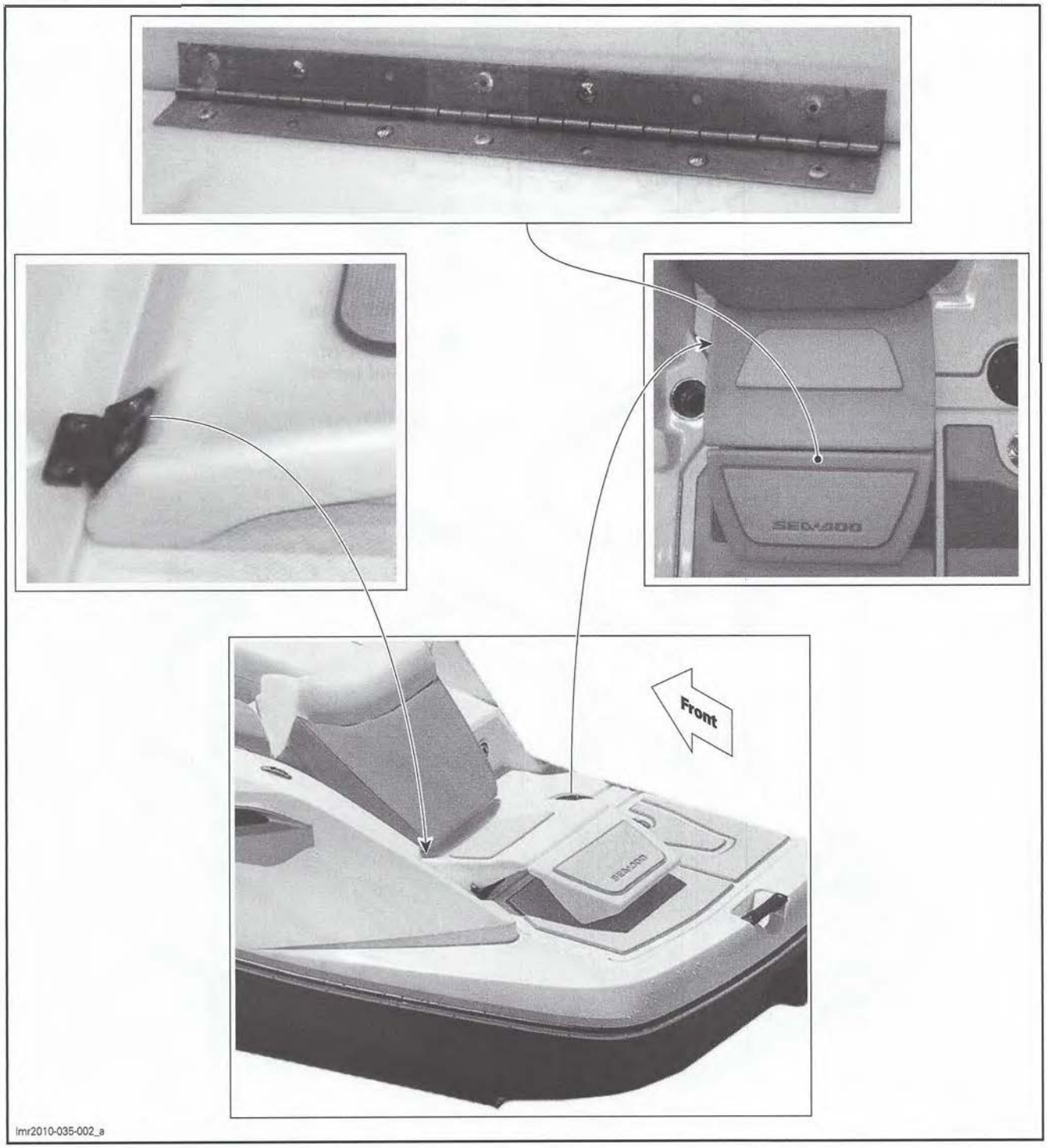
210 SERIES

Seats



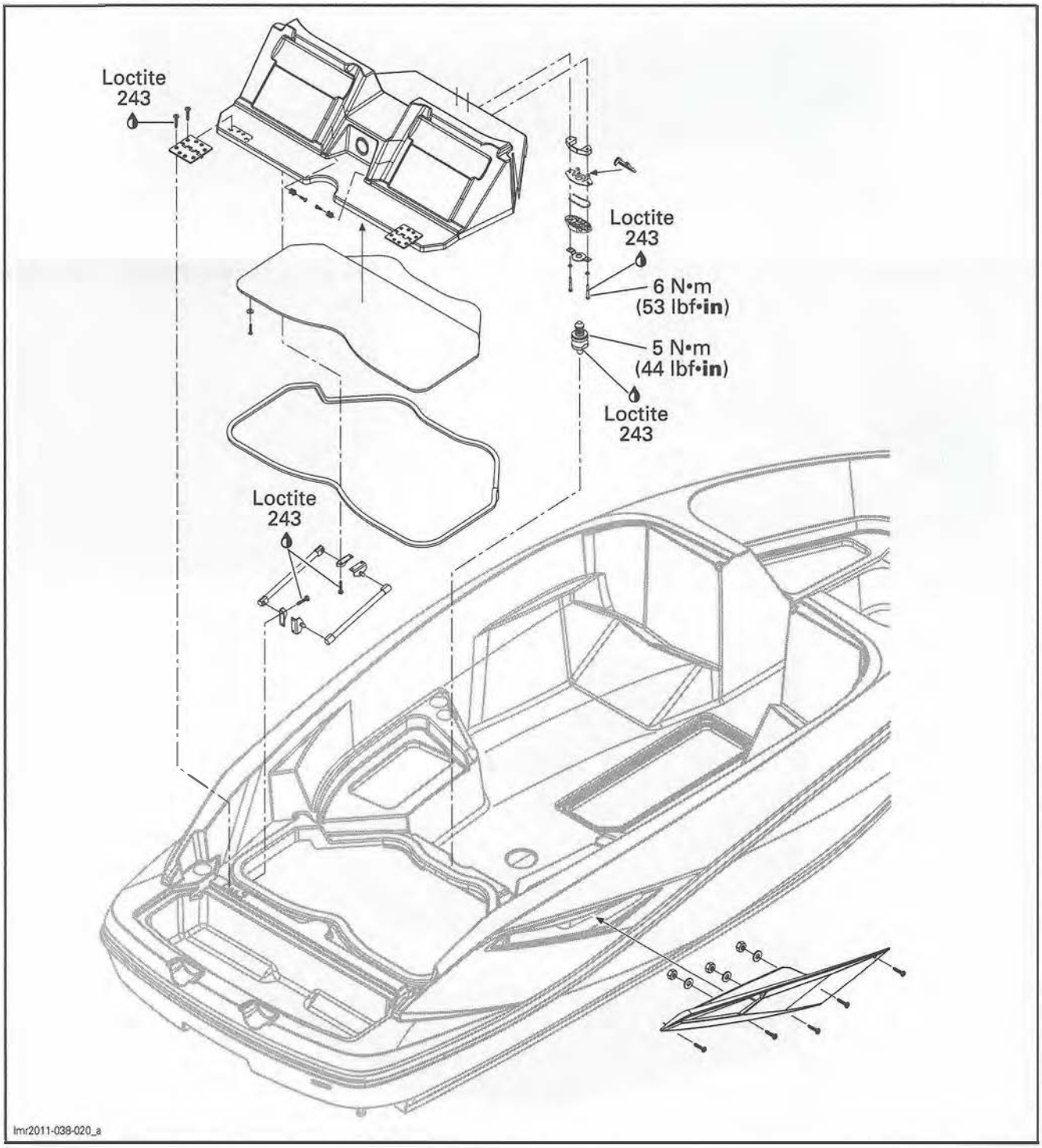
210 SERIES

Transat Seats (210 SE and 210 WAKE)



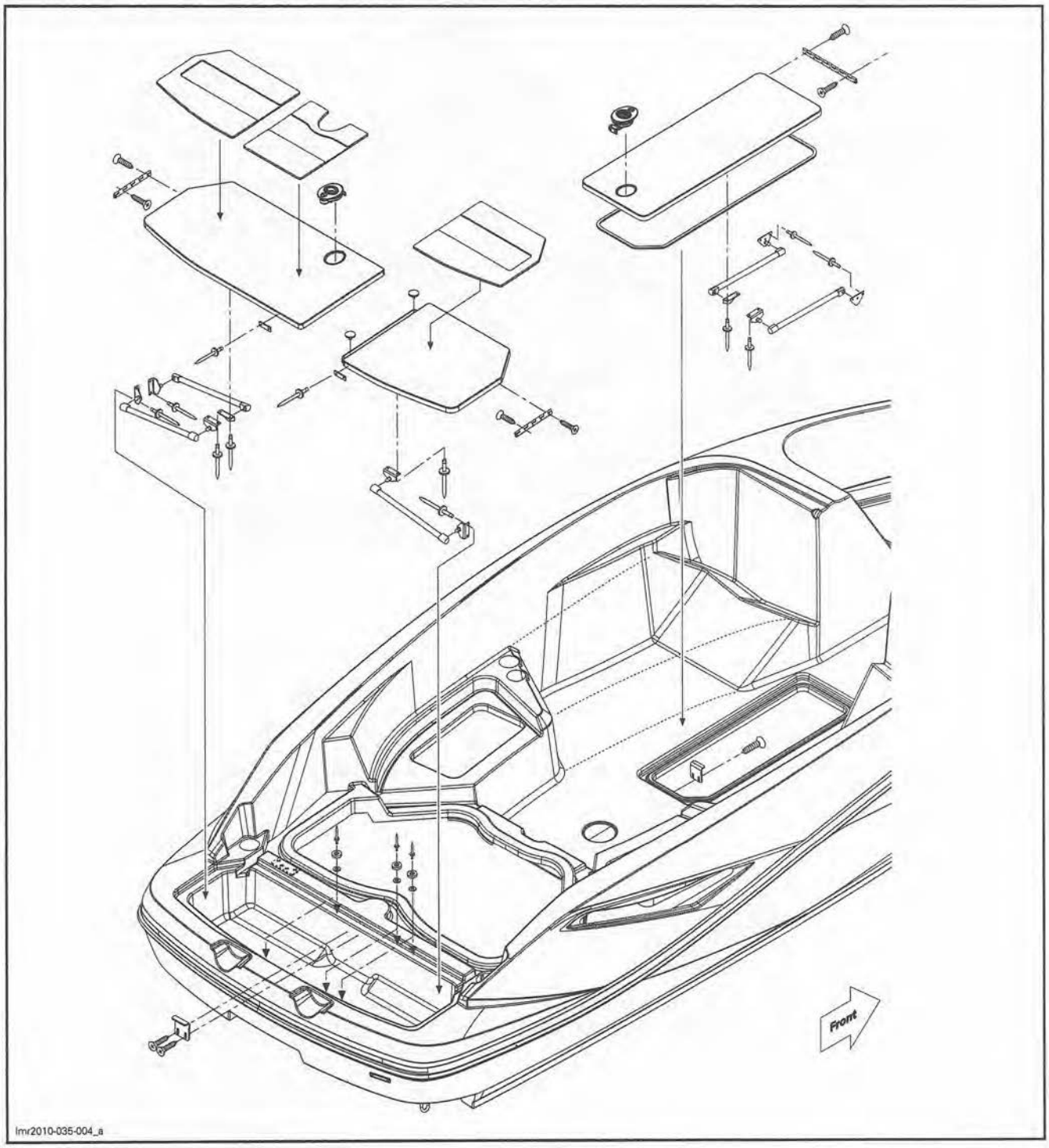
210 SERIES

Engine Compartment



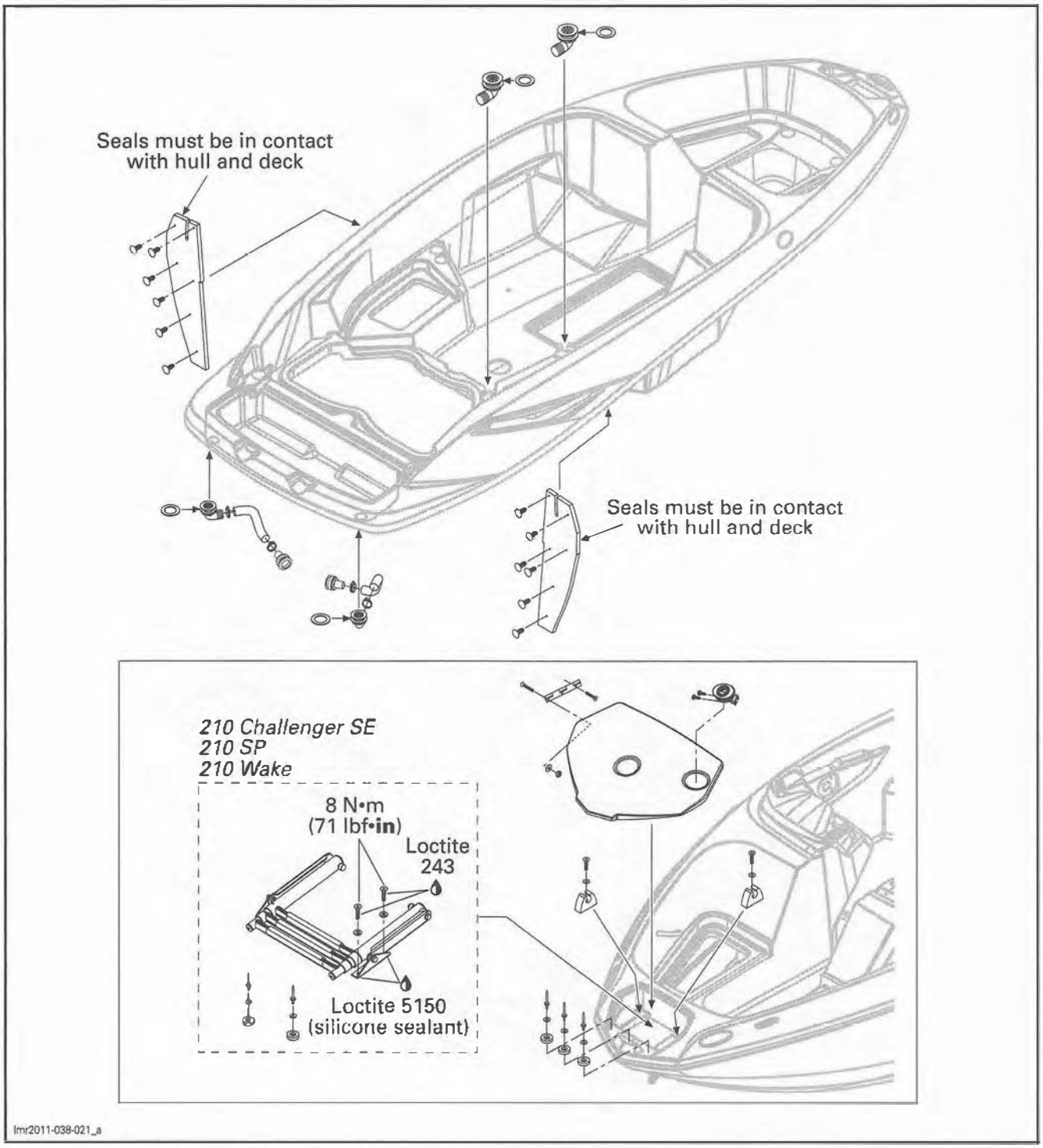
210 SERIES

Body (View 1) - Storage Compartment



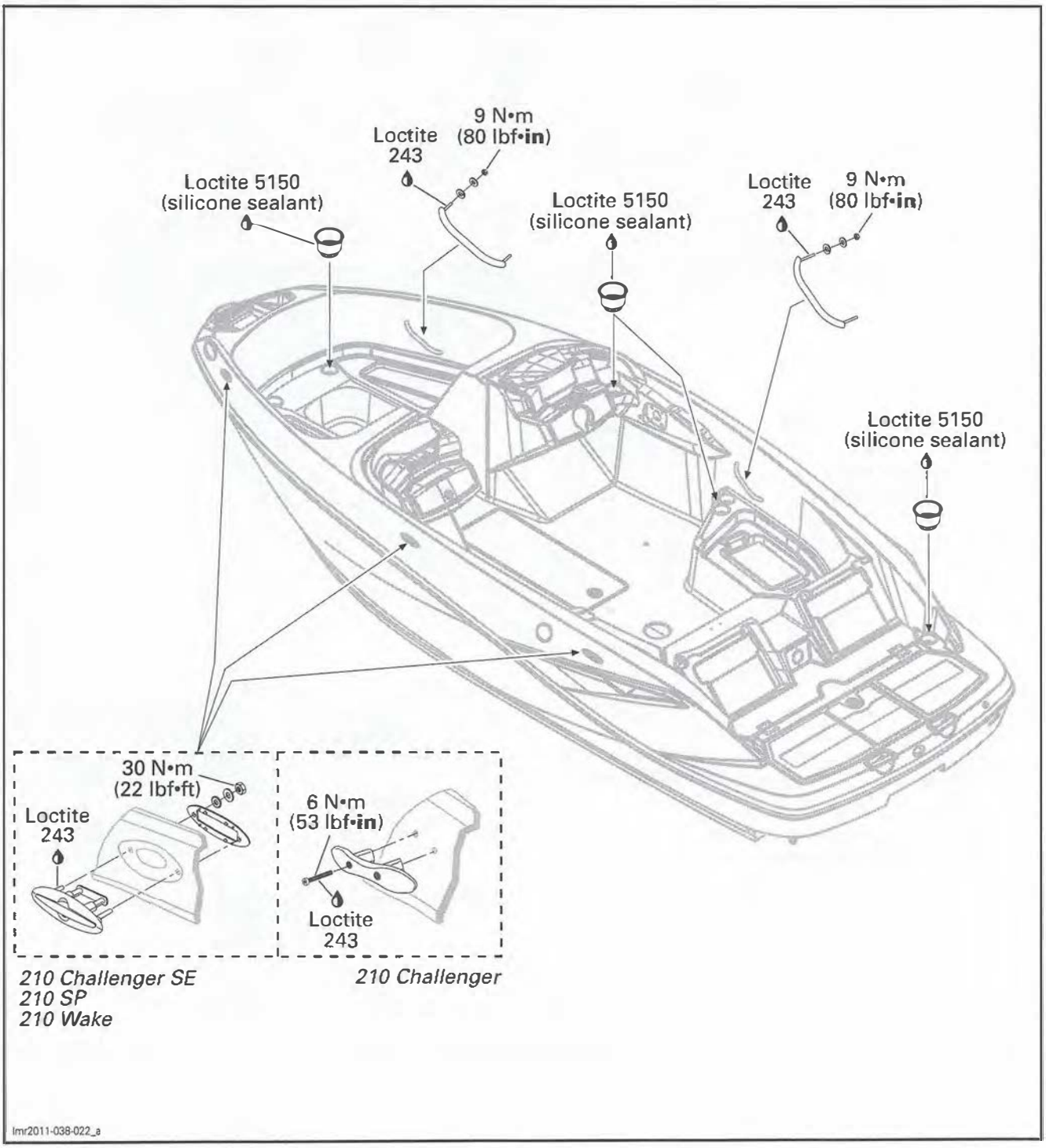
210 SERIES

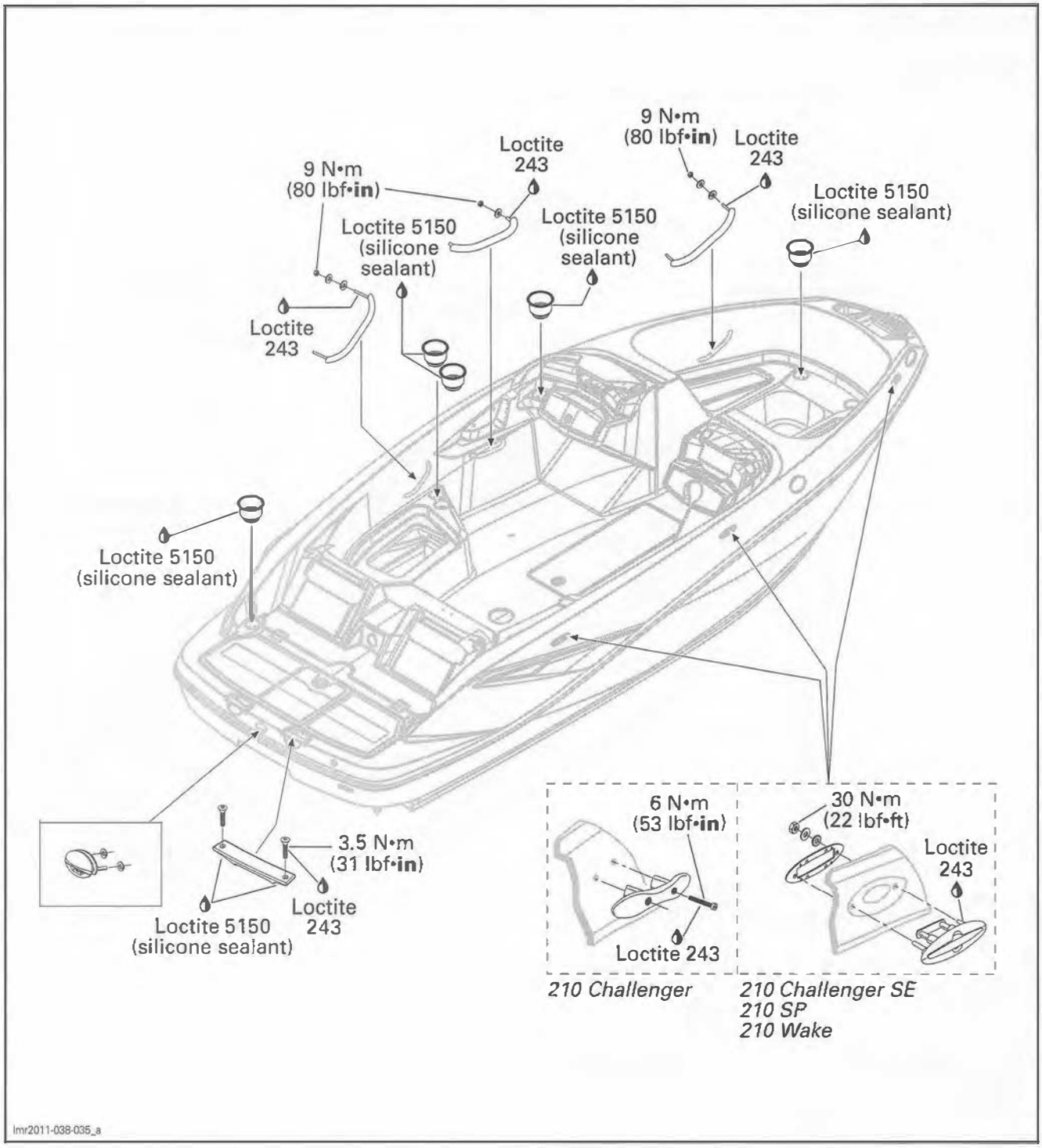
Body (View 2)



210 SERIES

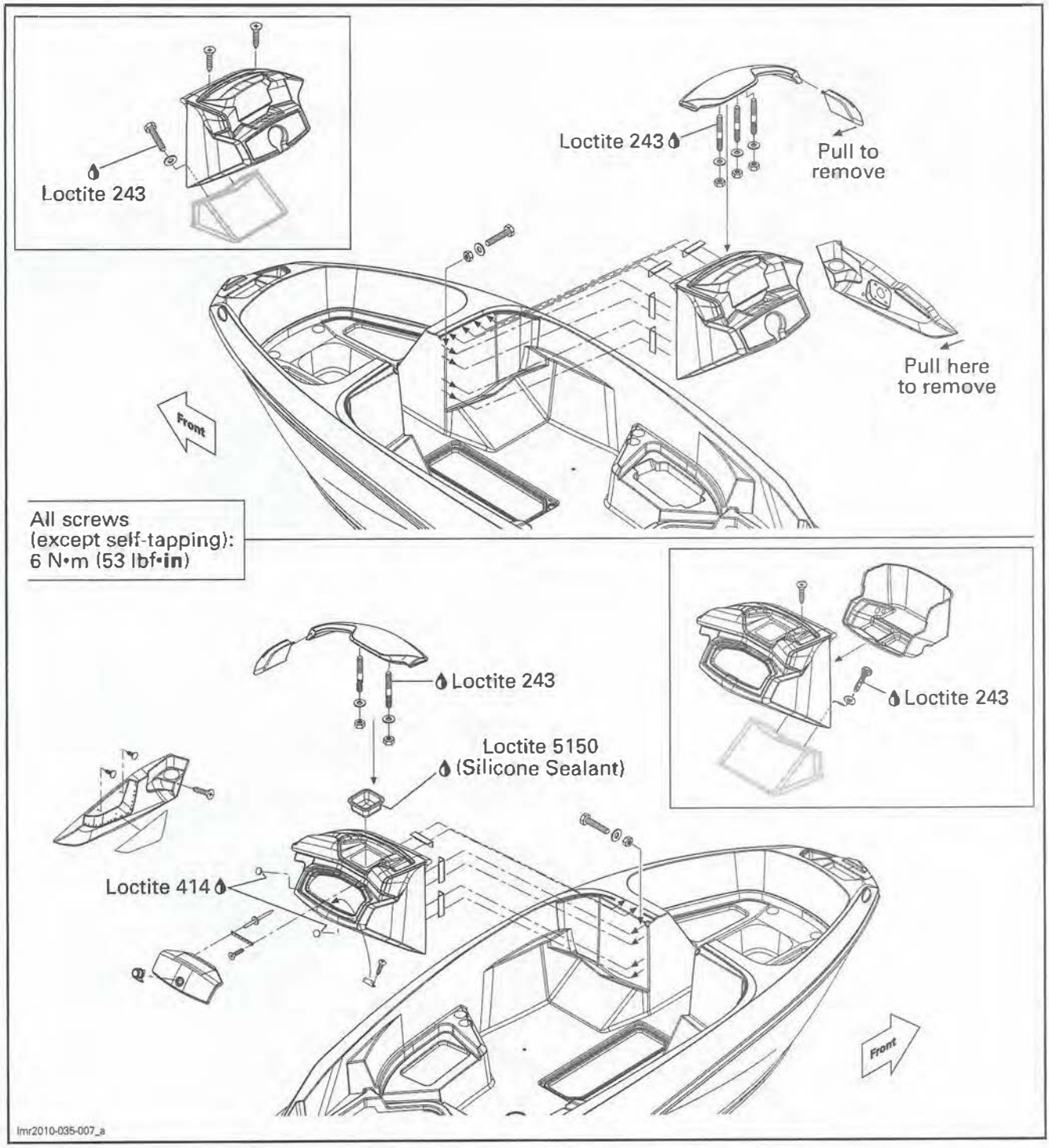
Body (View 3)




9 N•m
(80 lbf•in)
Loctite
243
9 N•m
(80 lbf•in)
Loctite
243
Loctite 5150
(silicone sealant)
Loctite 5150
(silicone
sealant)
Loctite 5150
(silicone sealant)
Loctite
243
Loctite 5150
(silicone sealant)
3.5 N•m
(31 lbf•in)
Loctite
243
Loctite 5150
(silicone sealant)
6 N•m
(53 lbf•in)
Loctite 243
30 N•m
(22 lbf•ft)
Loctite
243
210 Challenger
210 Challenger SE
210 SP
210 Wake
lmr2011-038-035_a

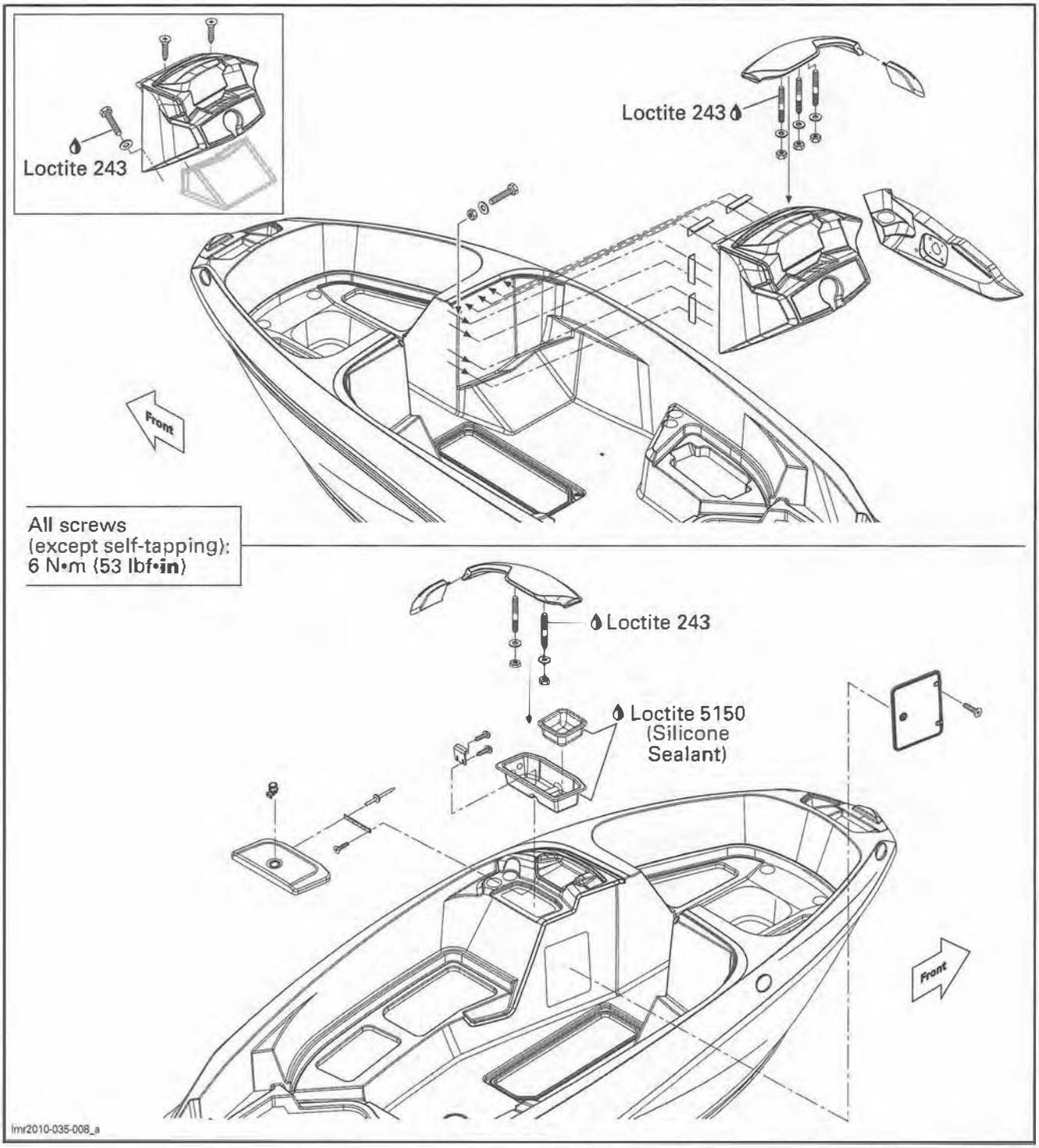
210 SERIES

Consoles (All except 210 WAKE)



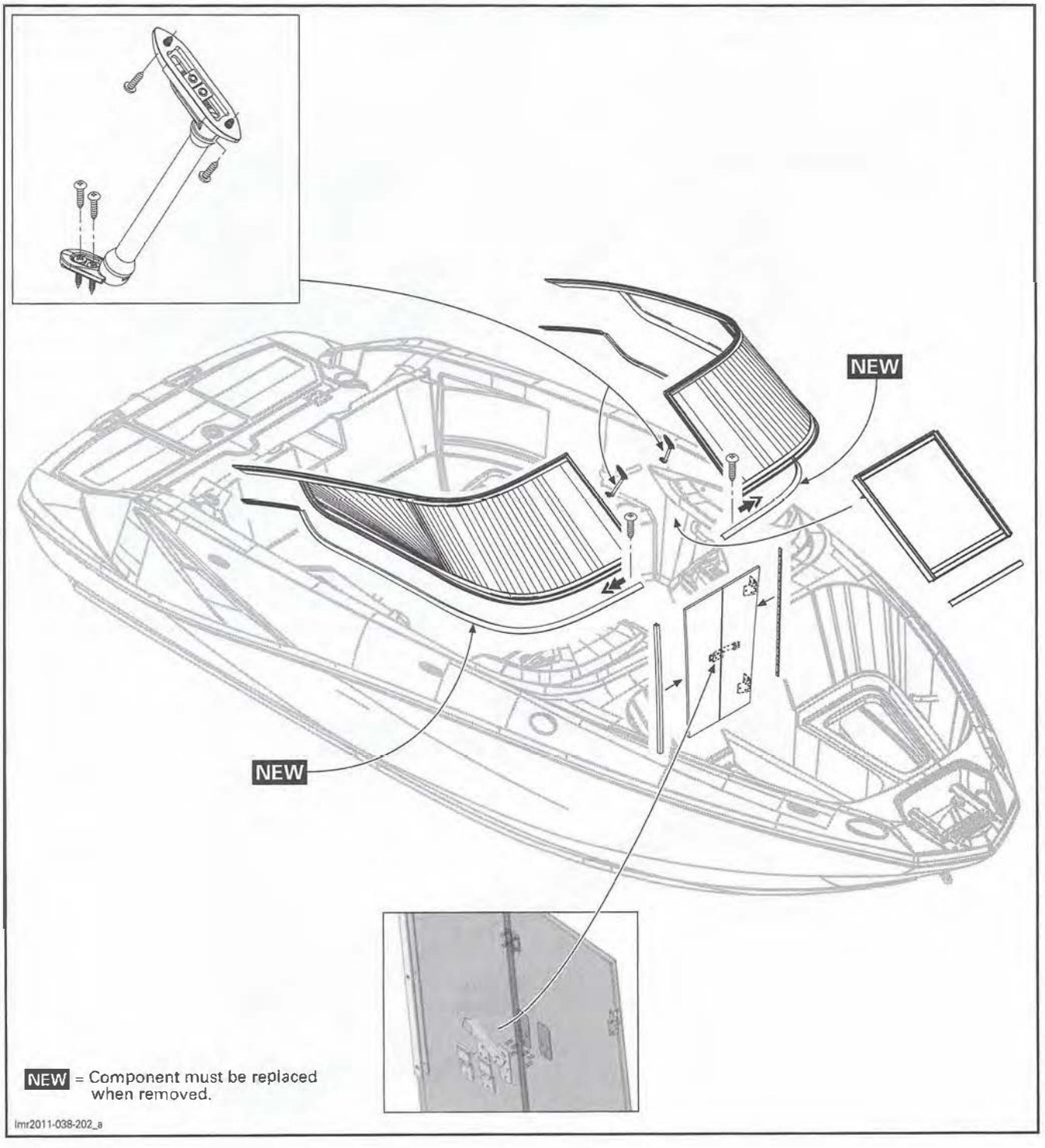
210 SERIES

Consoles (210 WAKE)



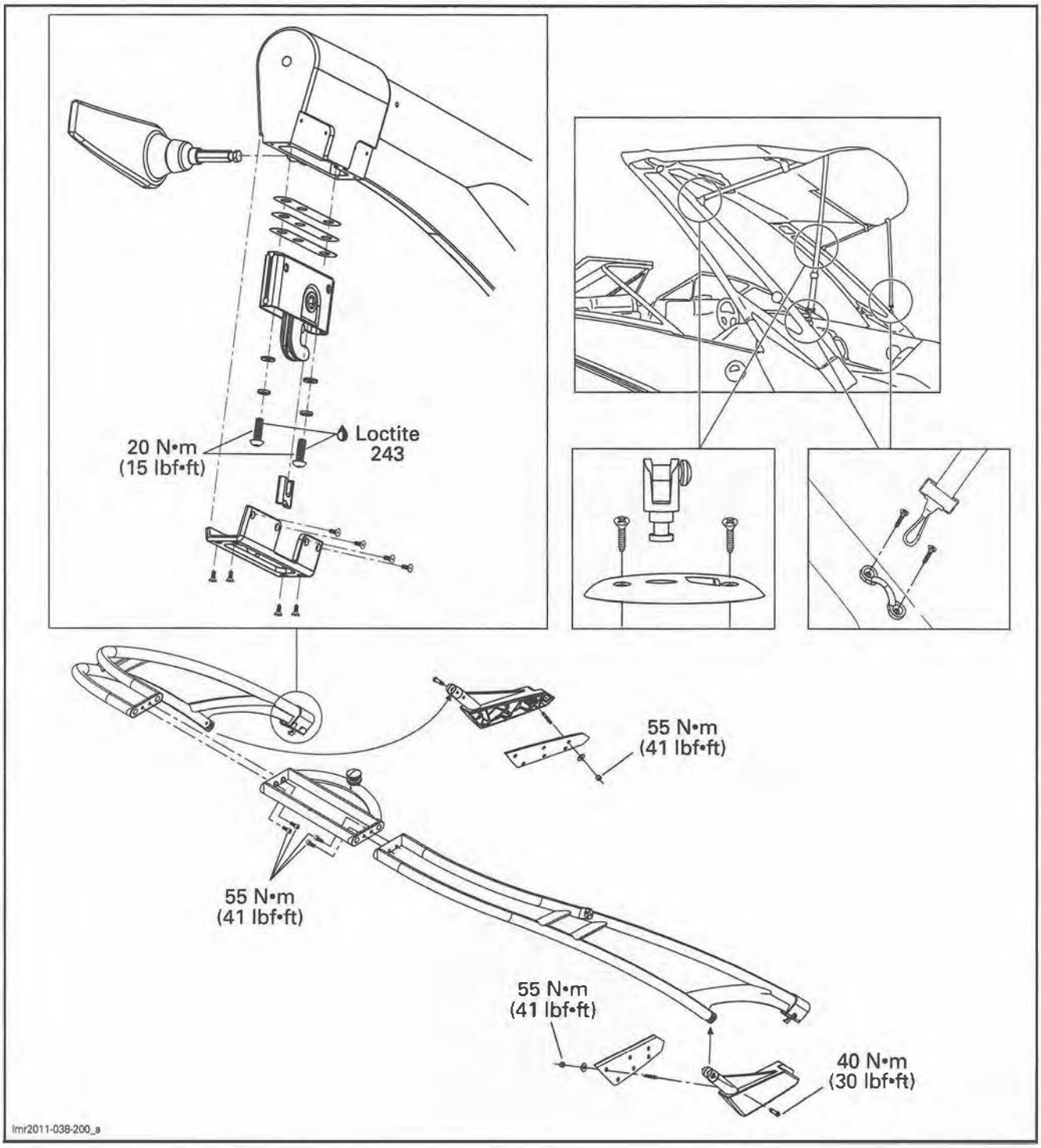
210 SERIES

Windshield



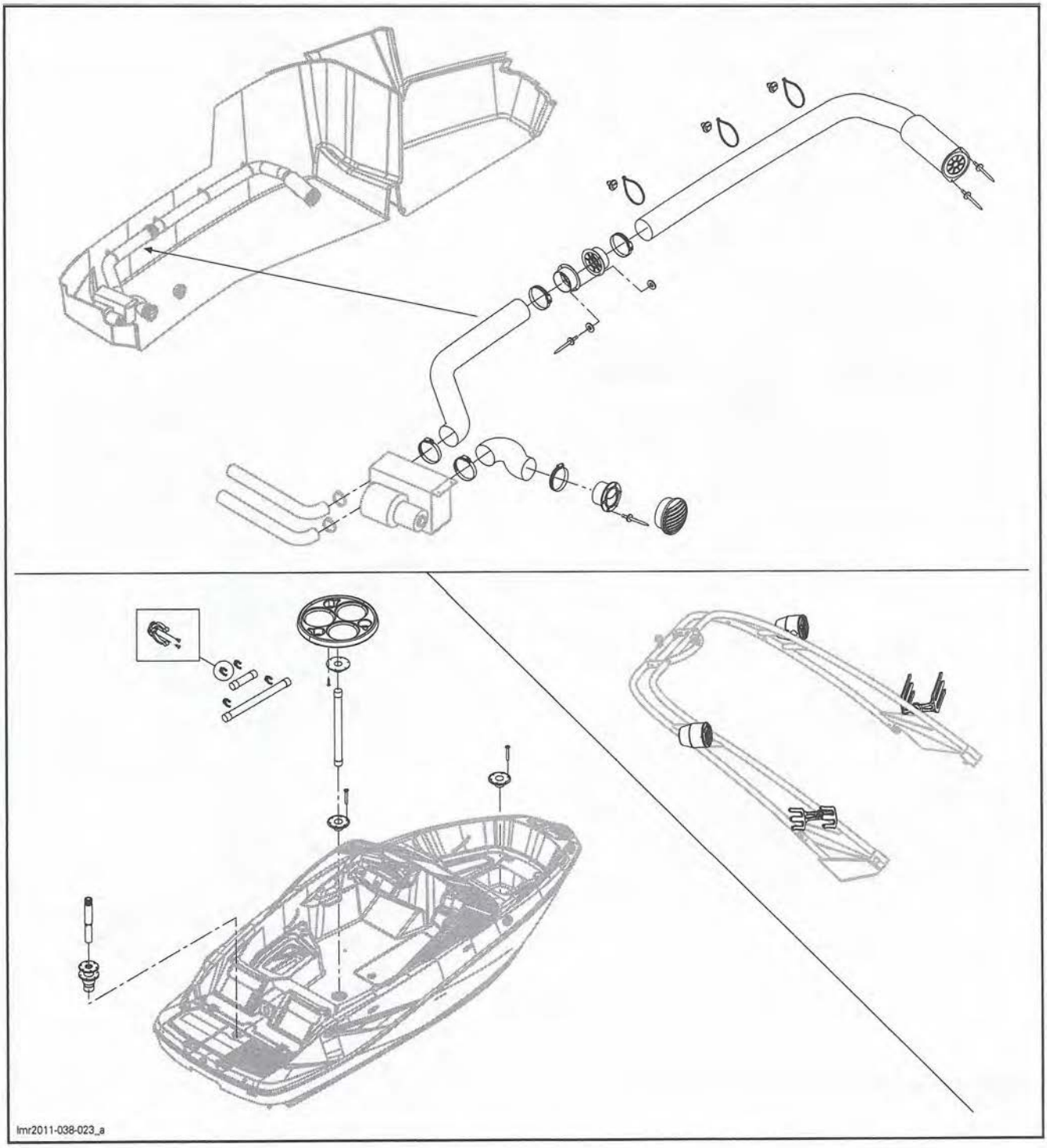
210 SERIES

Tower and Bimini Top



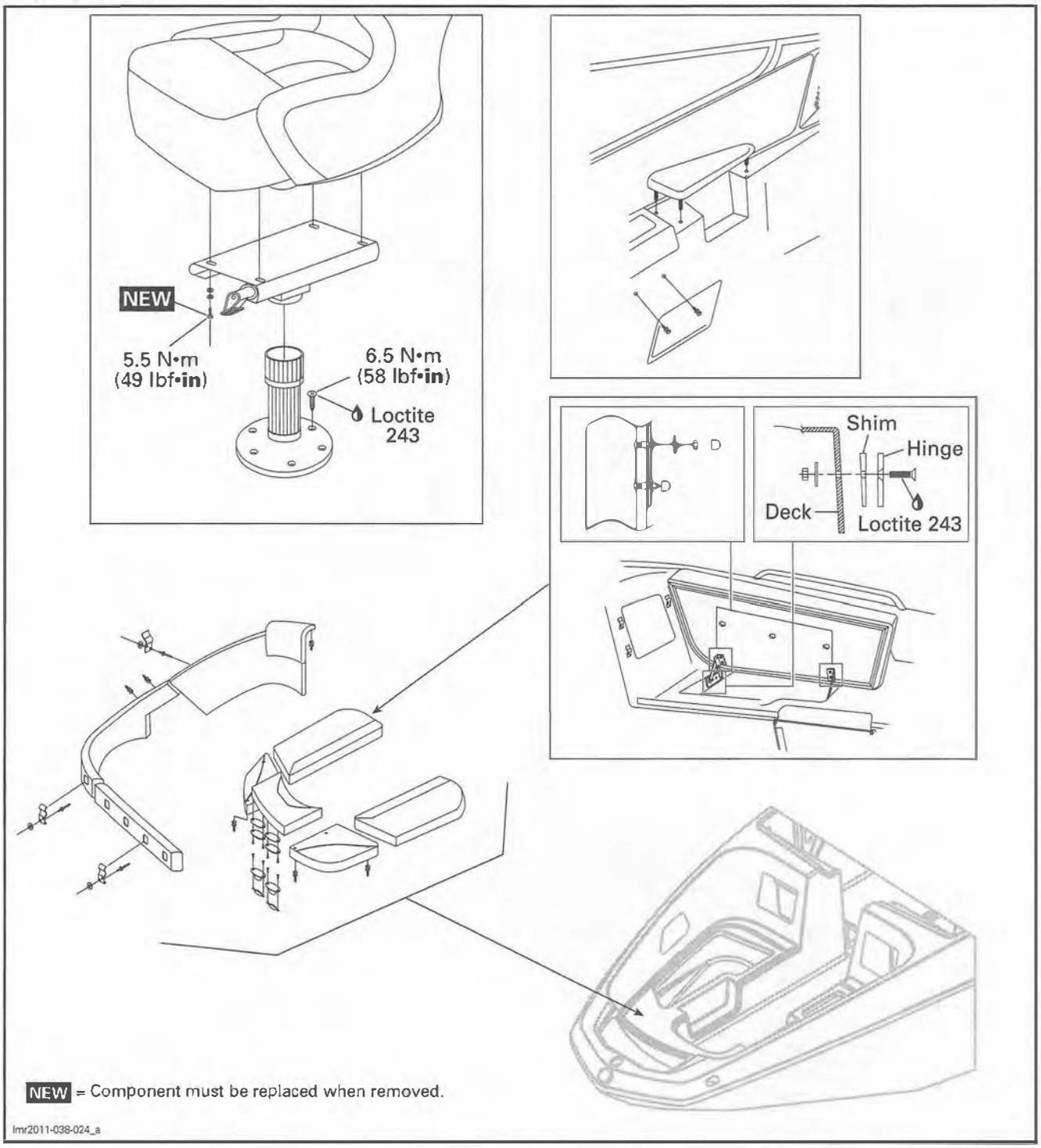
210 SERIES

Utilities



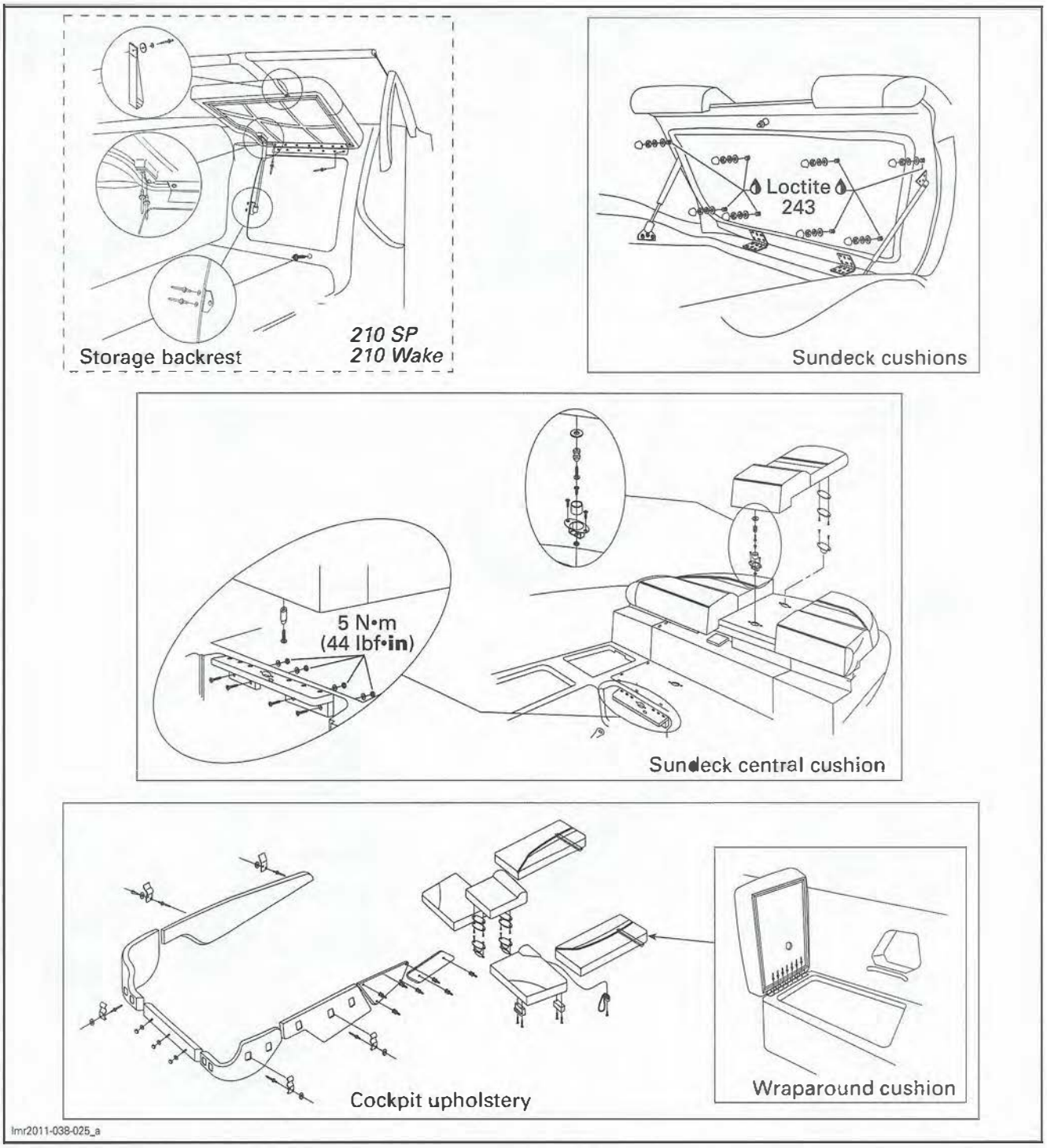
230 SERIES

Front Seats



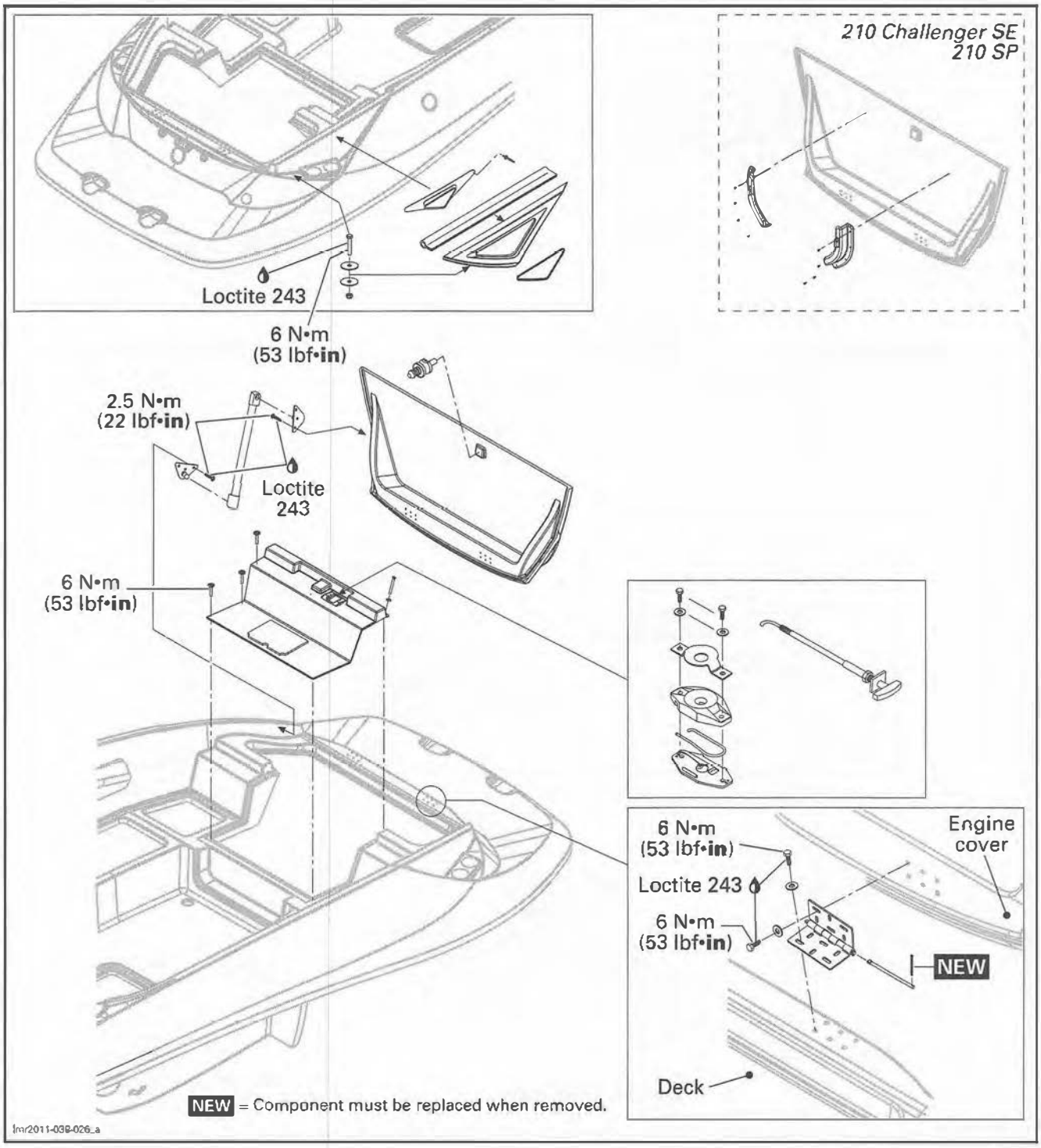
230 SERIES

Rear Seats



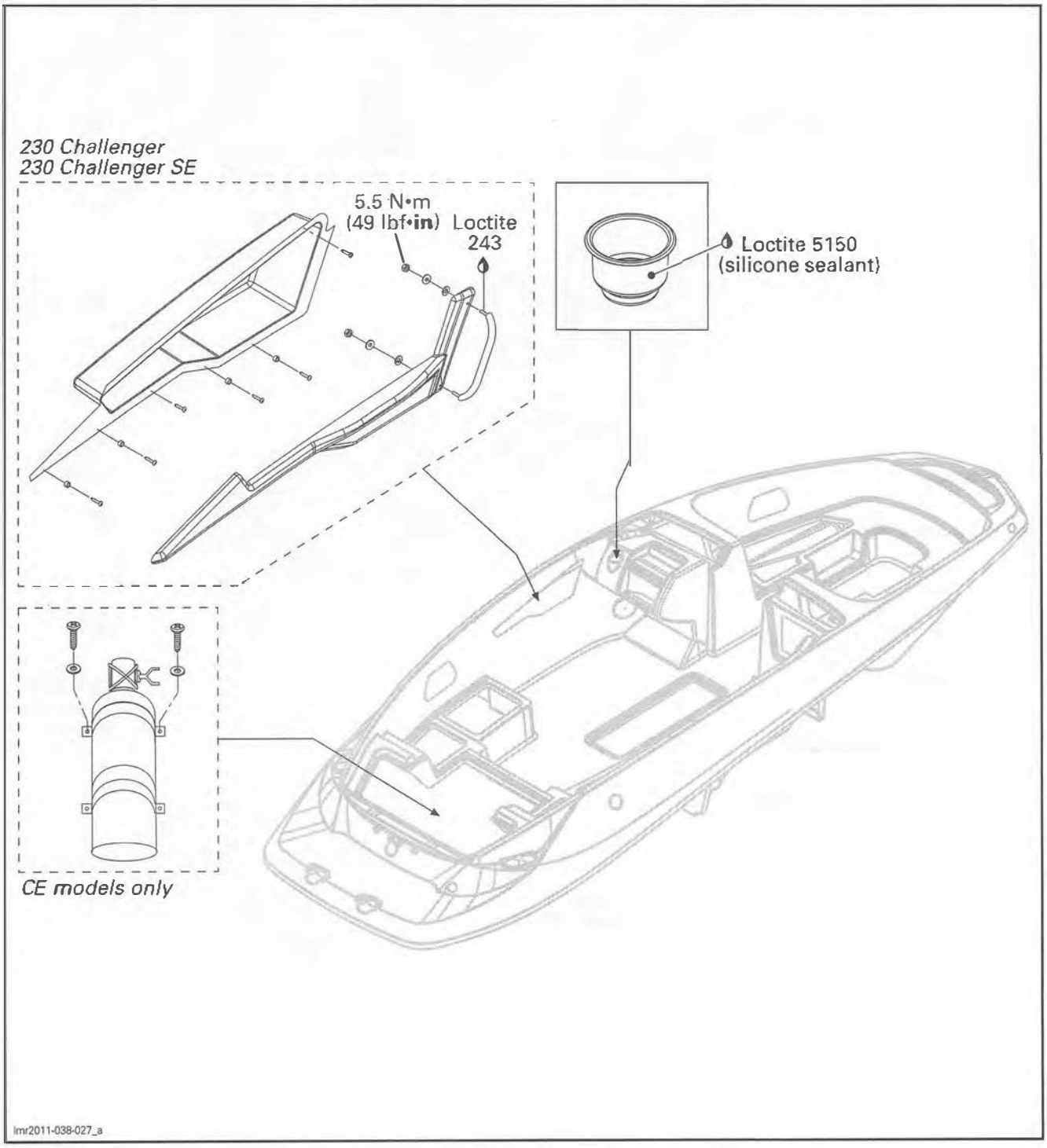
230 SERIES

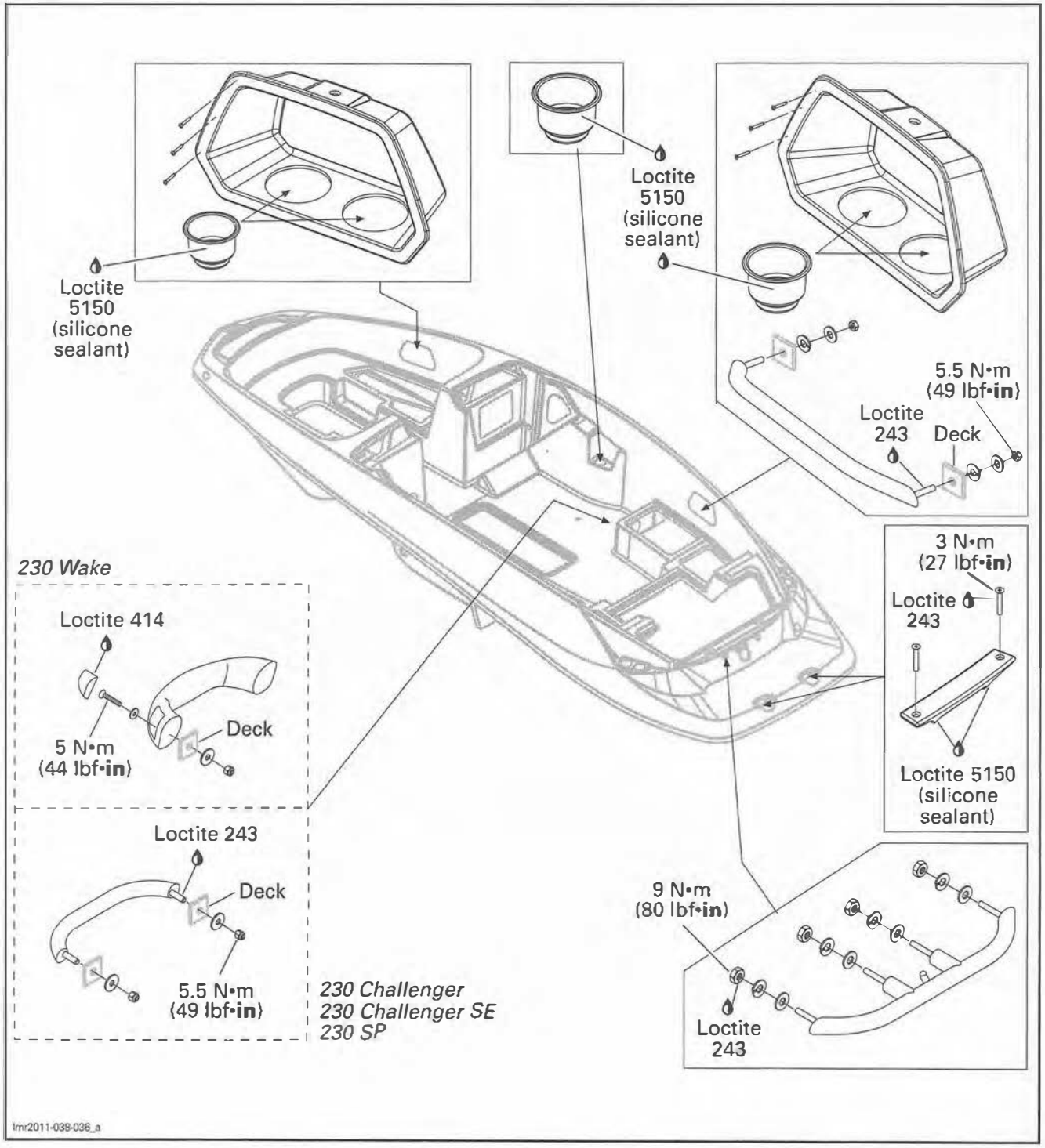
Engine Compartment



230 SERIES

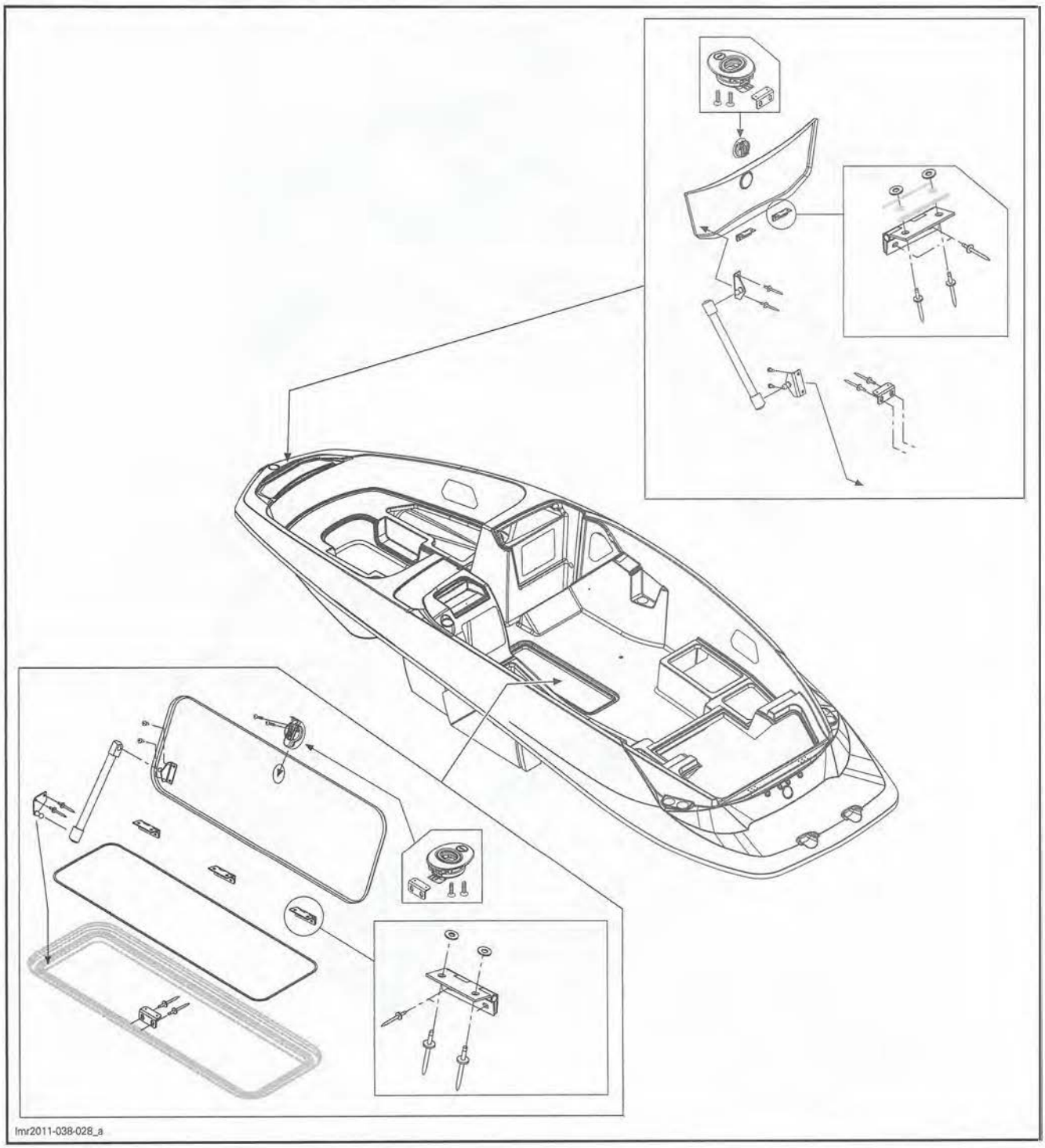
Body (View 1)




Loctite 5150 (silicone sealant)
Loctite 5150 (silicone sealant)
5.5 N•m (49 lbf•in)
Loctite 243
Deck
3 N•m (27 lbf•in)
Loctite 243
Loctite 5150 (silicone sealant)
230 Wake
Loctite 414
5 N•m (44 lbf•in)
Deck
Loctite 243
Deck
5.5 N•m (49 lbf•in)
230 Challenger
230 Challenger SE
230 SP
9 N•m (80 lbf•in)
Loctite 243
lmr2011-038-036_a

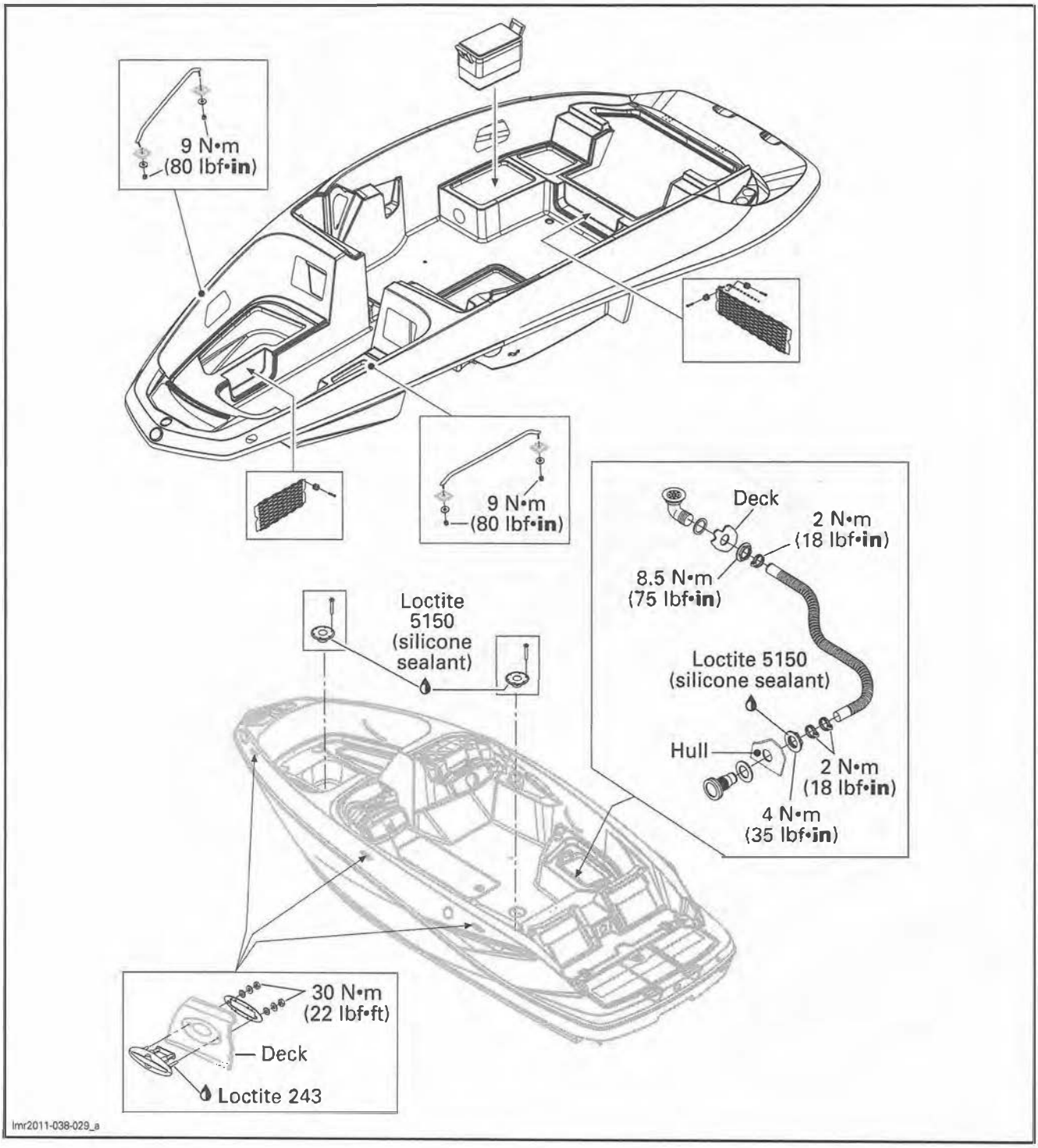
230 SERIES

Body (View 2) - Storage Compartment



230 SERIES

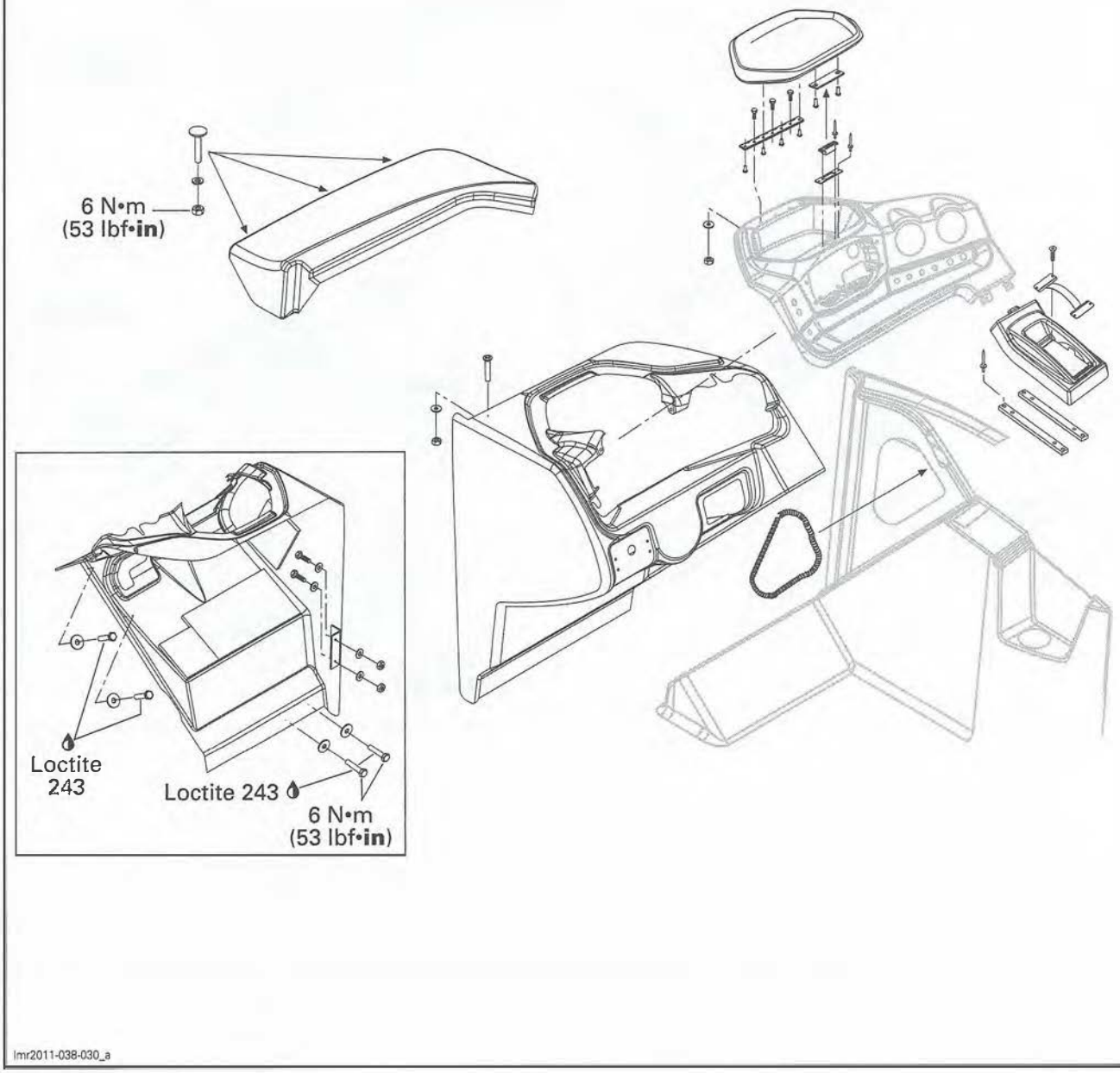
Body (View 3)



230 SERIES

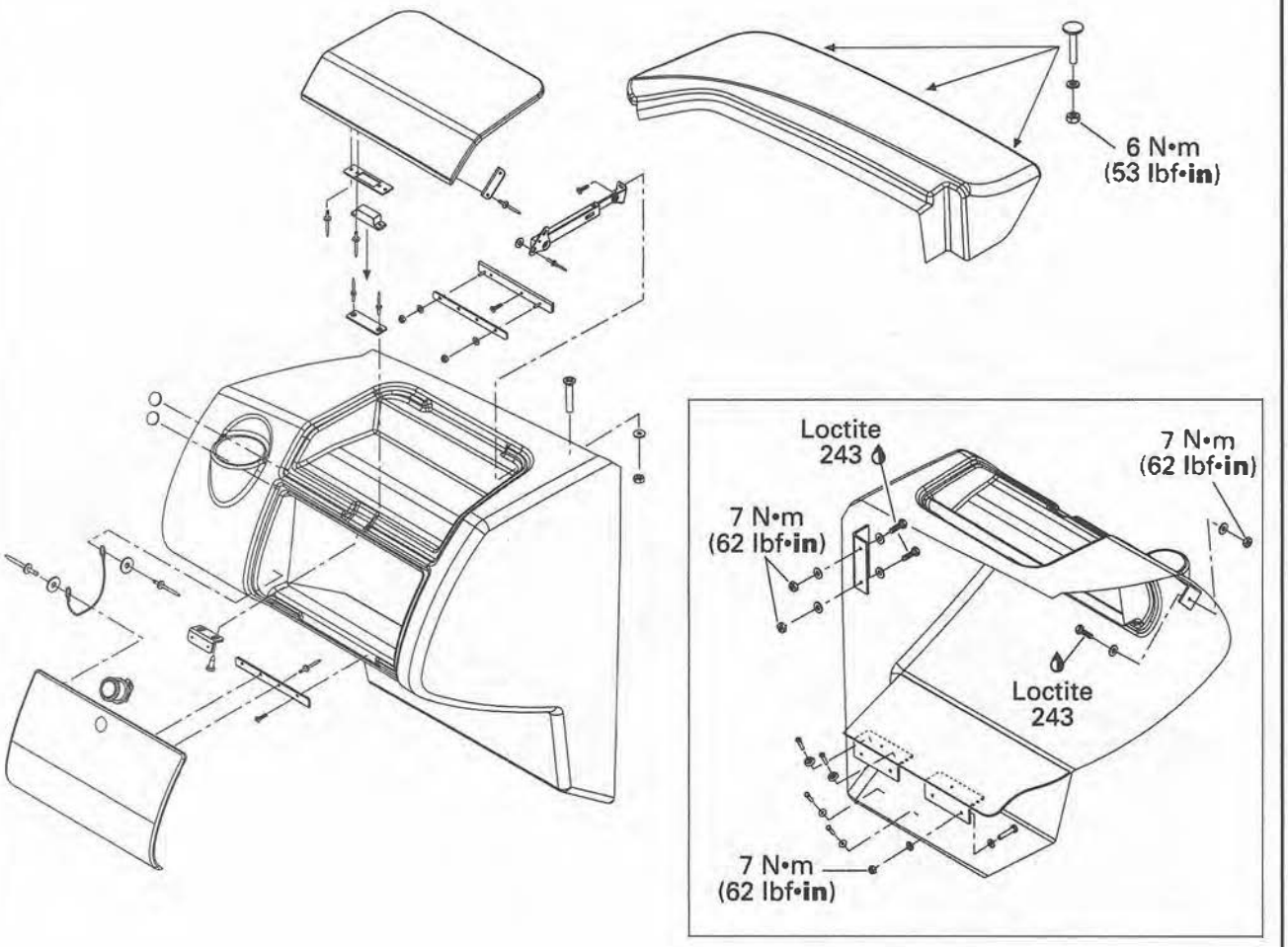
Consoles (230 and 230 SE)

Driver's console



lmr2011-038-030_a

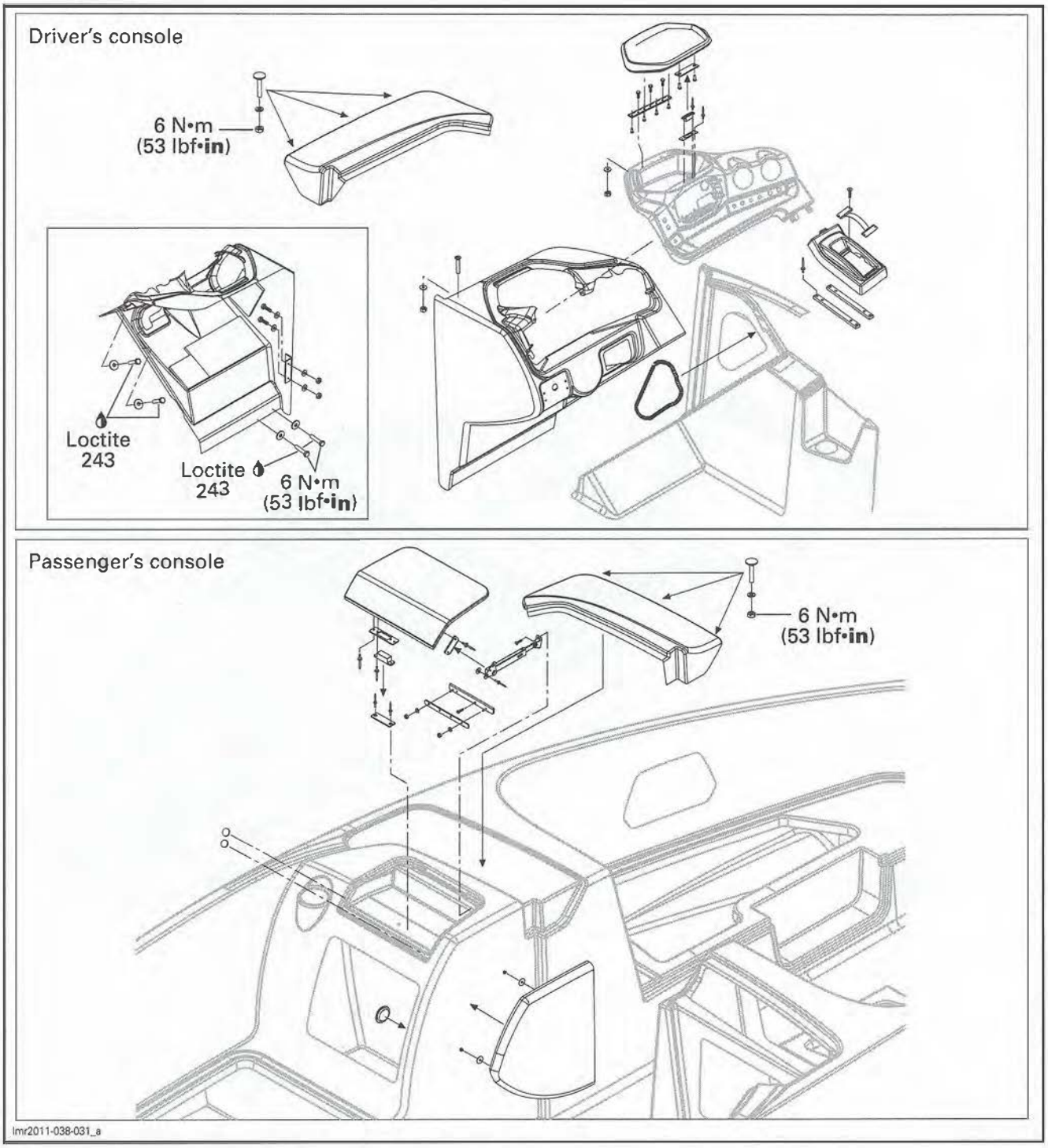
Passenger's console



lmr2011-038-037_a

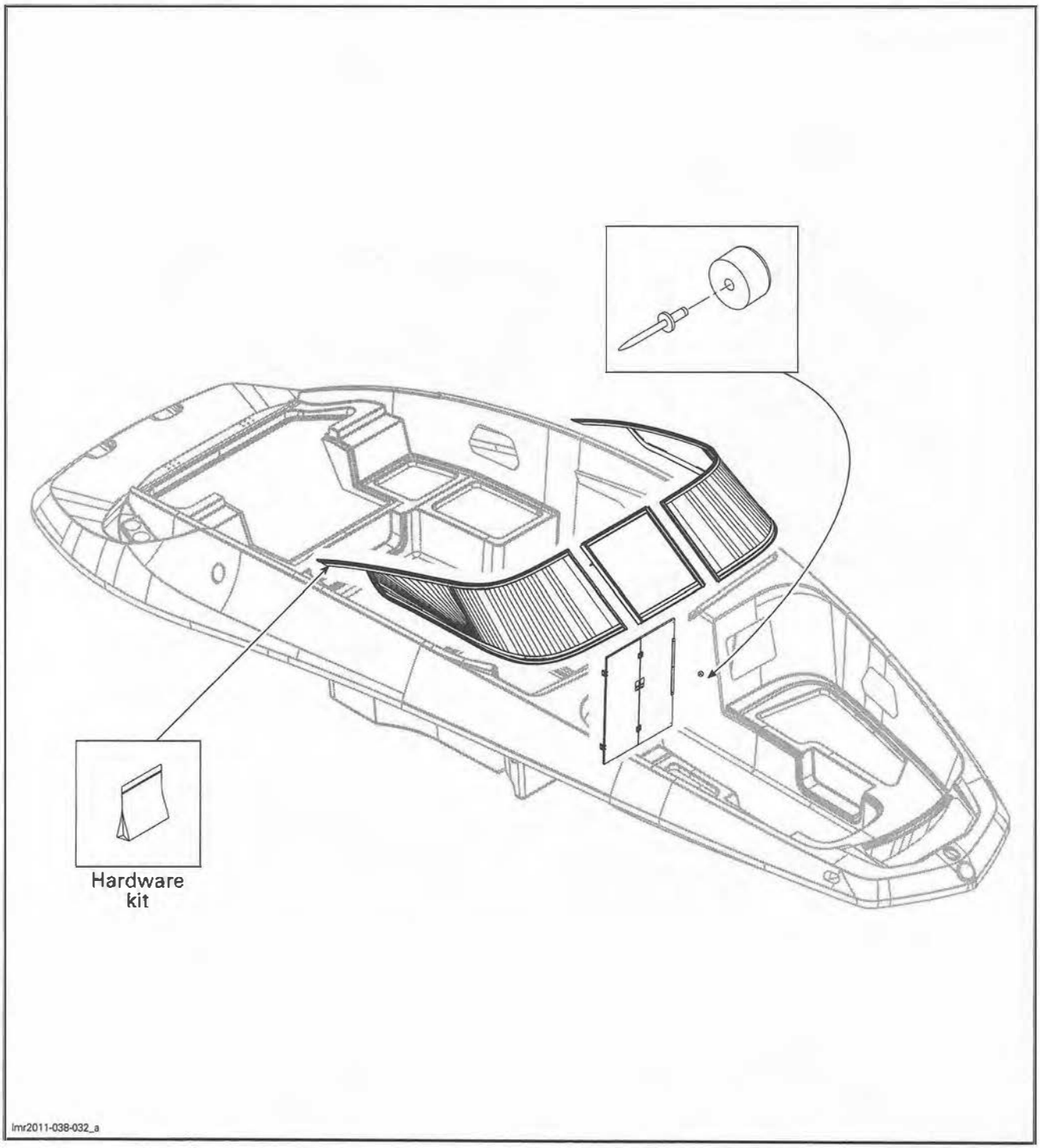
230 SERIES

Consoles (230 SP and 230 WAKE)



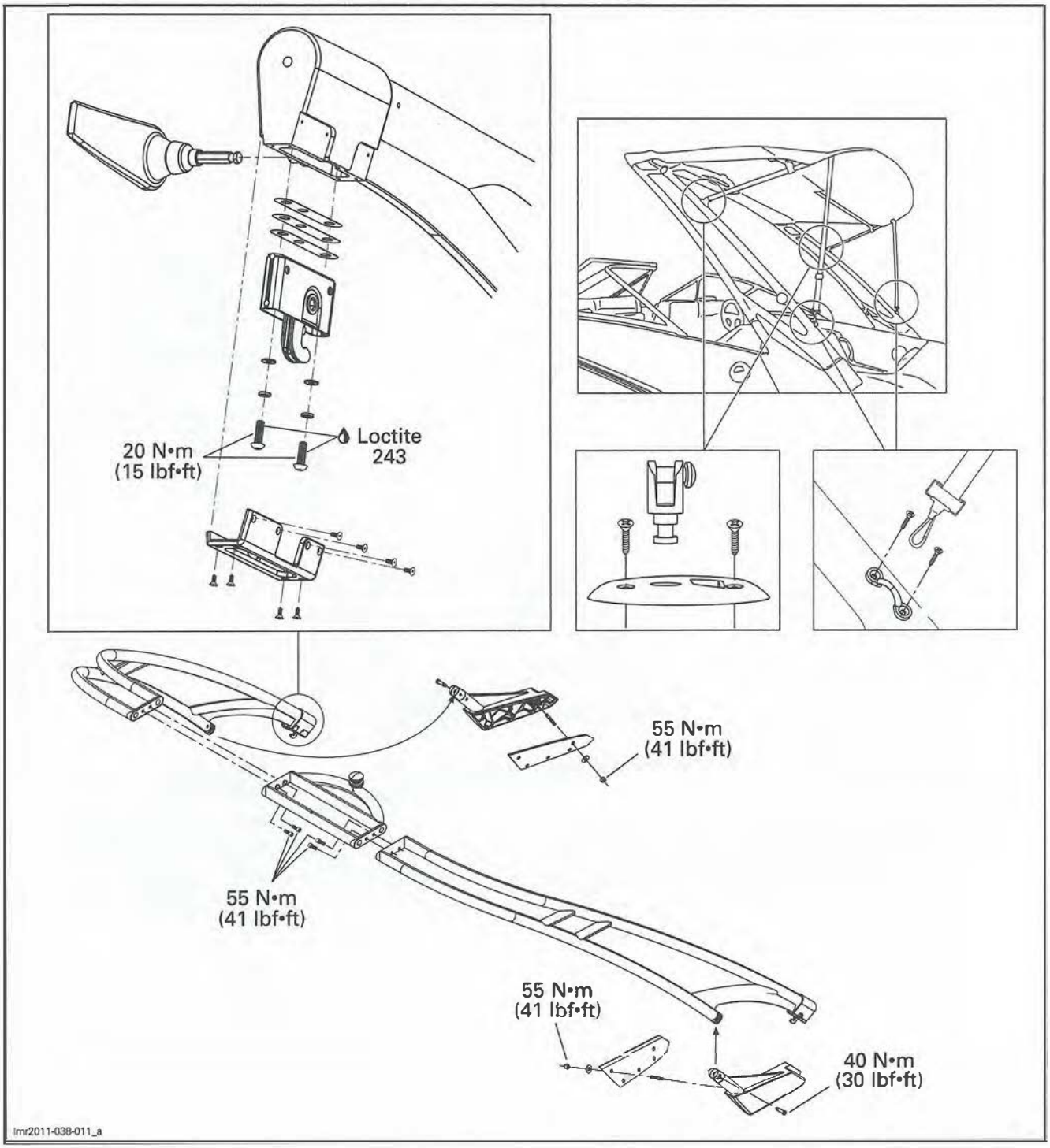
230 SERIES

Fixed Windshield



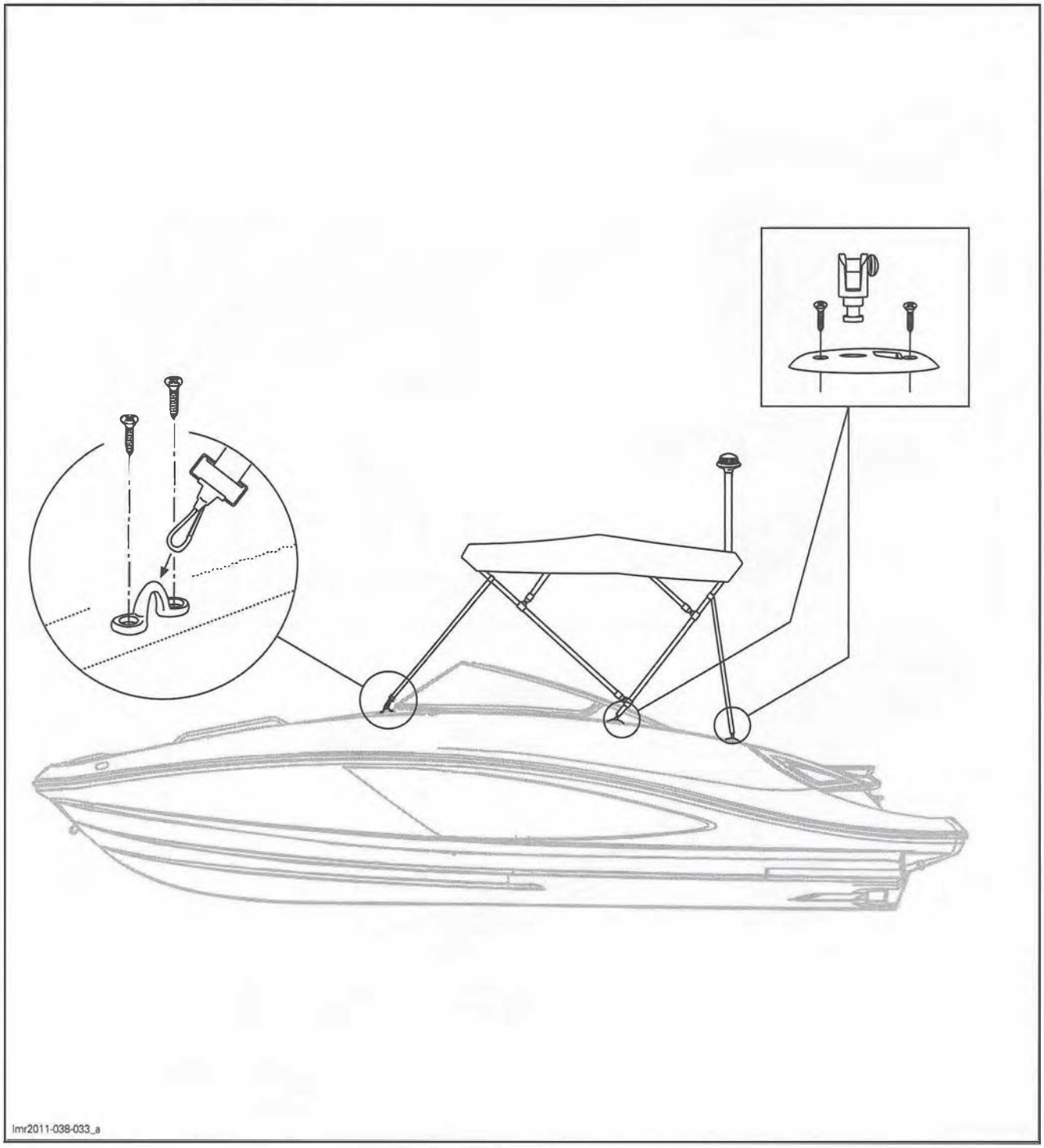
230 SERIES

Tower and Bimini Top



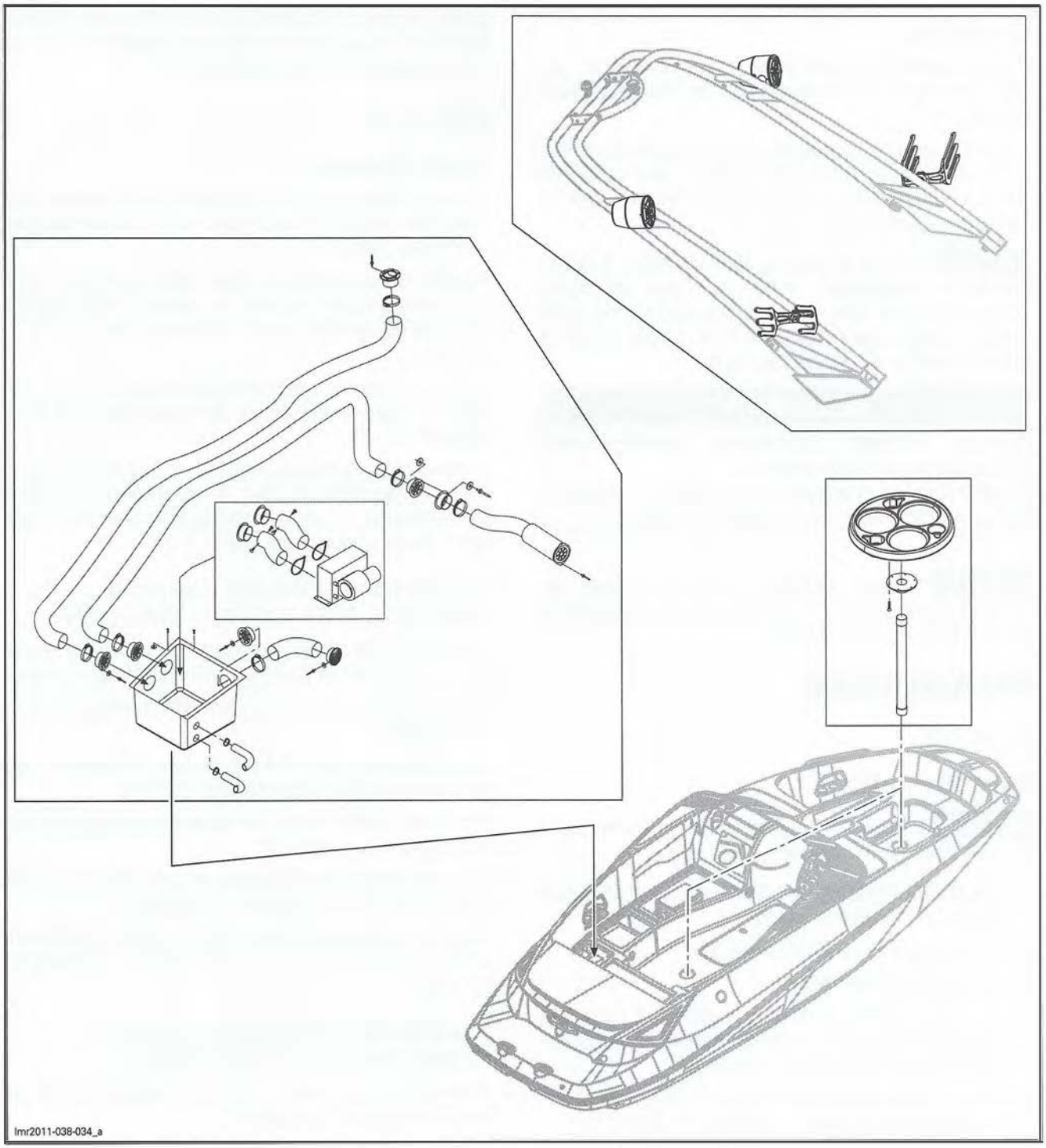
230 SERIES

Bimini Top



230 SERIES

Utilities



GENERAL

Verify hinges condition and latching mechanisms condition and operation. Replace any damaged components.

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

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

NOTICE **When applying threadlocker Loctite products (anaerobic products), pay attention so that it does not come in contact with ABS plastic parts (painted parts). It could lead to plastic cracks or other damage.**

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to.
Locking devices when removed (e.g.: locking tabs, cotter pins, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

PROCEDURES

RIVETS

Rivet Removal

NOTICE **When removing rivets, make sure do not enlarge or deform the holes.**

1. Use the SUPERTANIUM DRILL BIT 3/16" (P/N 529 031 800), shipped in packs of 2.
2. Always use a variable speed drill.
3. Always drill rivet head.
4. Maintain a slow to medium speed at all times when drilling. The proper speed is attained when a constant chip is ejected.
5. When rivet is located on plastic part, use pliers to avoid rivet turning and heating plastic.
6. Use a small punch to push the rivet end.

COVER LOCKS

Cover Lock Lubrication

Locks should be lubricated with XPS LUBE (P/N 293 600 016) to keep them working properly. This will help dissolving dried salt water.

DECALS

Decal Removal

Using a heat gun warm up one end of decal for a few seconds until decal can roll off when rubbing with your finger.

NOTE: When heating near light surfaces, duct tape should be applied to protect the surface. Otherwise the light color could become a yellowish color.

Pull decal slowly and when necessary apply more heat to ease removal on the area that has to be peeled off.

If decal tears while pulling off, it has to be heated for a few seconds longer. If decal tends to stretch while pulling off, stop heating and wait a few seconds to let it cool, then peel it off.

Installation of Decals Having a Protective Film on Back Side Only

These decals usually contain written information (e.g.: warning) and are used on gelcoat or metal.

Using isopropyl alcohol, clean the surface and dry thoroughly.

Using a pencil and the decal as a template, mark the area where decal will be located.

Remove half of the decal back protective film and align decal with marks.

Start sticking it from center and remove the other half of the film to stick it completely.

Carefully squeegee decal beginning at center and working outward using, firm, short, overlapping strokes.

Installation of Decals Having a Protective Film on Both Sides

These decals usually contain graphics and are used on gelcoat or plastic.

Installation on Gelcoat

Using isopropyl alcohol, clean the surface and dry thoroughly.

Using a pencil and the decal as a template mark the area where decal will be located.

For better adhesion a dry application is recommended, however, to ease decal installation a mild solution of soapy water can be sprayed over surface where decal will be installed.

Remove back protective film from decal and align decal with marks. When well aligned squeegee decal beginning at center and working outward using firm, short, overlapping strokes.

Remove front protective film once decal has adhered to hull.

Installation on Plastic (storage cover)

Clean surface with isopropyl alcohol and dry thoroughly.

Using a pencil and the decal as a template, mark the area where decal will be located.

NOTICE **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.

SHOCKS

Shock Inspection

Check if cover lift by itself (or with a little help), when latch is released.

- If cover does not lift, locate and replace defective shock(s).

Shock Removal

Insert a flat screwdriver into shock locking device.

Release shock from linkage bracket by moving locking device outwards.

TYPICAL

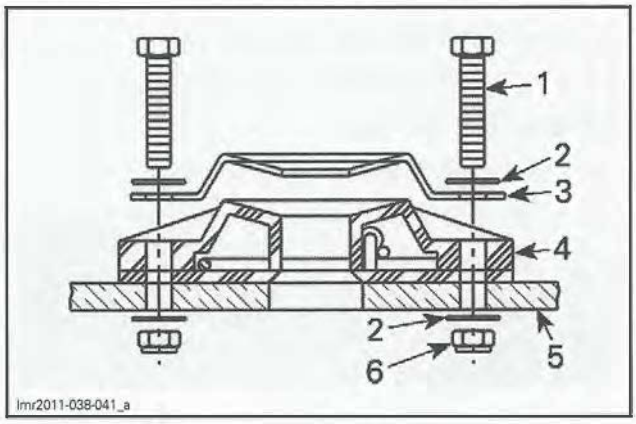
Shock Installation

The installation is the reverse of removal procedure, however pay attention to the following.

Position each shock so that the piston rod is at bottom.

ENGINE COVER LATCH

Engine Cover Latch Replacement



1. *Retaining bolt*
2. *Flat washers*
3. *Cover latch*
4. *Latch*
5. *Deck*
6. *Nut*

Unscrew engine cover latch from deck. Discard nuts.

Remove cover latch.

Detach the engine cover cable end from latch spring.

Remove the latch.

After attaching cable end to latch spring, secure latch to deck.

- Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of retaining screws.
- Install NEW nuts and torque them to specification.

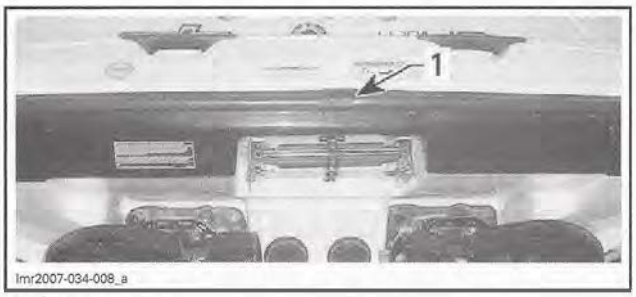
TIGHTENING TORQUE	
Engine cover latch nuts	5 N•m (44 lbf•in)

BUMPER

Bumper Removal

150, 180 and 200 Series

Remove bumper cover at rear of boat.



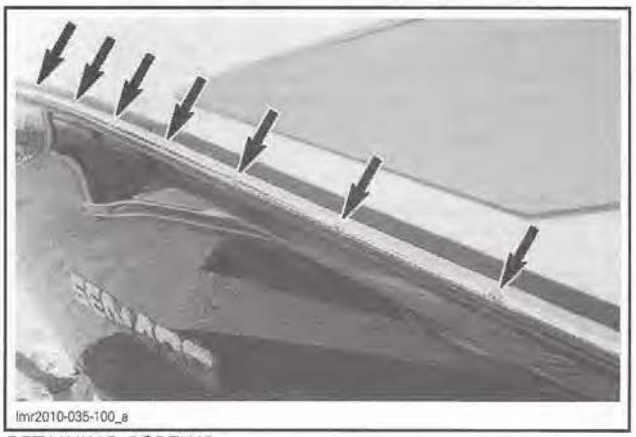
1. Bumper cover

Remove trim from side bumper rail.

Drill pop rivets to remove bumper rail.

210 and 230 Series

Remove bumper retaining screws.



RETAINING SCREWS

Remove bumper trims from bumper.

Remove bumper rail from hull.

Bumper Installation

NOTE: Prior to install bumper rail, place it in a container of hot water to soften material and ease installation.

Mark hole positions on body.

Before installing bumper rail, check condition of silicone joint between body and hull. If sealant is necessary, use LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) to reseal the joint.

Starting at center from the rear, position bumper on body.

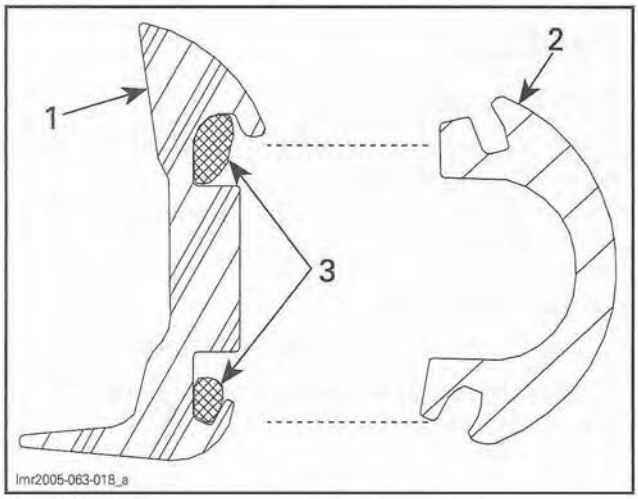
Use locating mark as a guide and install proper fastener (rivet or screw depending on models).

Process the same way for the other holes.

Position bumper rail properly all around body and cut excess length if necessary.

NOTE: Masking tape may be used to temporarily hold bumper rail to ease installation.

Prior to installing trim in bumper rail for rear corners, apply LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) inside bumper rail all around boat, as shown. This is required so that trim properly remains attached to rail.



1. Bumper rail
2. Bumper trim
3. Silicone sealant

Apply LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) on each fastener (rivet or screw depending on models).

Install trim using soapy water.

NOTE: Carefully tapping trim with a rubber hammer will help to fit trim in rail.

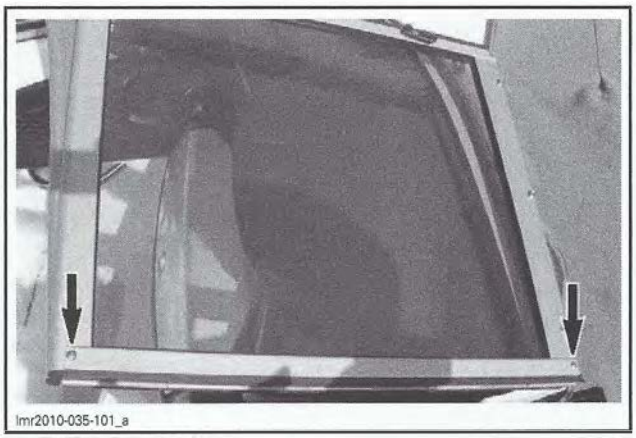
Reinstall bumper cover.

Check the gap between bumper rail and body. Fill gaps with LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) as necessary.

WINDSHIELD (180, 210 AND 230 SERIES)

Windshield Removal

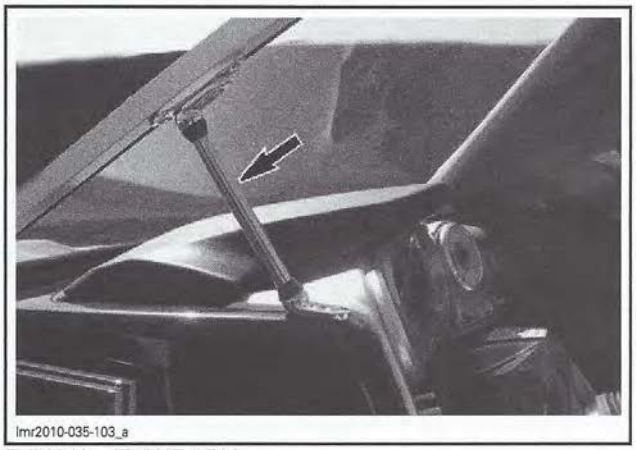
Remove front glass from windshield as follows:
- From inside, remove hinge retaining screws.
- From outside, remove hinge retaining rivets.



RETAINING SCREWS

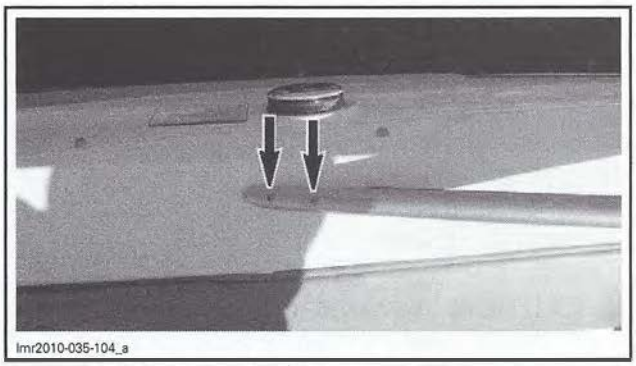
RETAINING RIVETS

Remove both front arms using retaining screws.



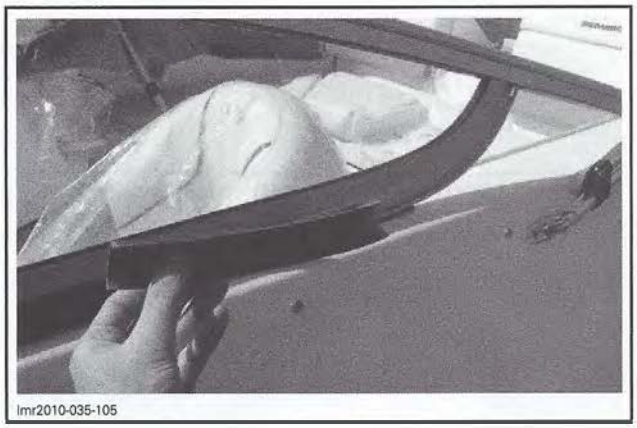
TYPICAL - FRONT ARM

Remove windshield rear retaining screws.

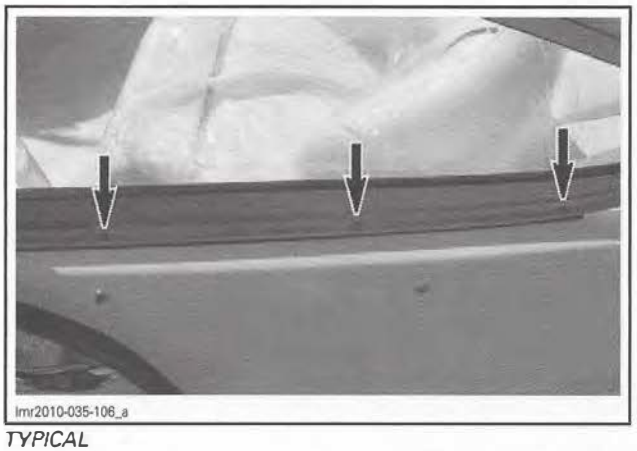


REAR RETAINING SCREWS (LH SIDE SHOWN)

Carefully remove windshield upper seal.



Remove windshield retaining screws.



TYPICAL

Carefully remove windshield then lower seal.

Windshield Installation

The installation is the reverse of removal procedure, however pay attention to the following.

Install a **NEW** lower seal.

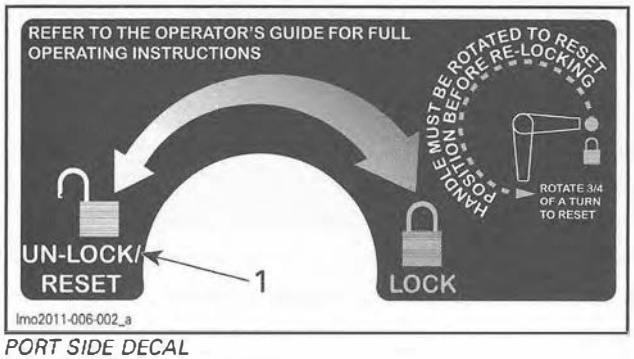
TOWER

Lowering Tower

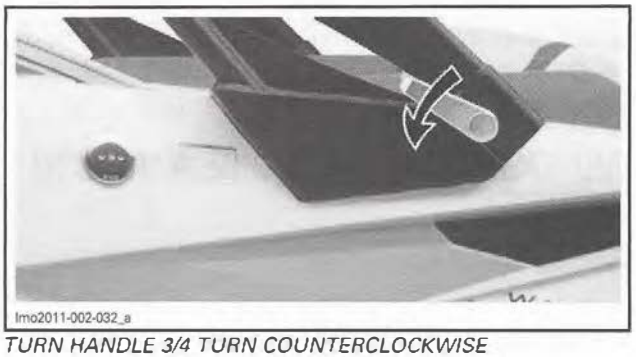
⚠ CAUTION **To avoid injury, never lower the tower alone. Ask someone to hold the tower for manipulation.**

To lower the tower, proceed as follows:

1. Have someone to support the tower front section.
2. On LH side of tower (port side), turn the handle 3/4 turn **COUNTERCLOCKWISE** to the unlock position.

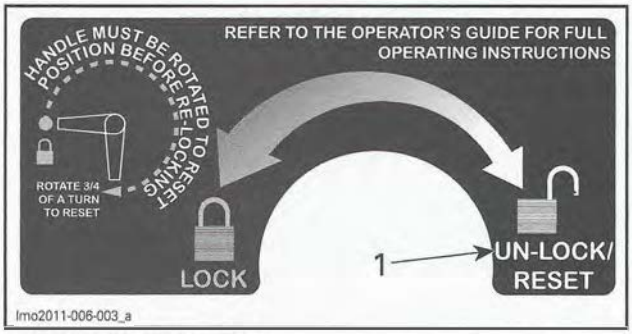


PORT SIDE DECAL
1. UNLOCK / RESET position

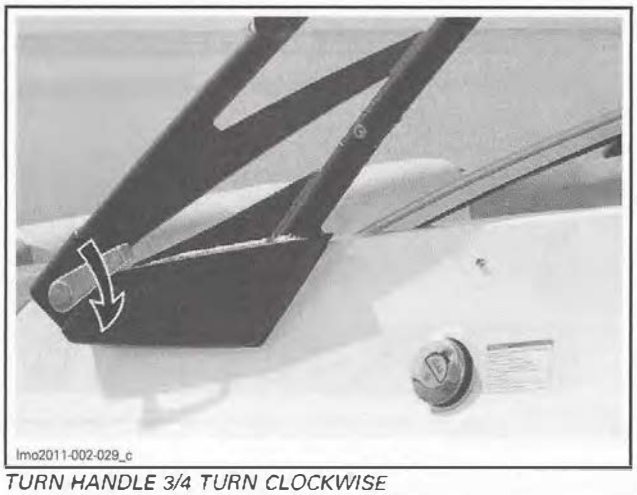


TURN HANDLE 3/4 TURN COUNTERCLOCKWISE

3. On RH side of tower (starboard side), turn the handle 3/4 turn **CLOCKWISE** to the unlock position.

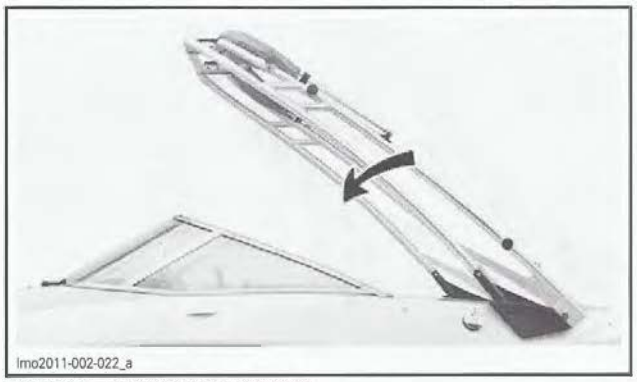


STARBOARD SIDE DECAL
1. UNLOCK / RESET position



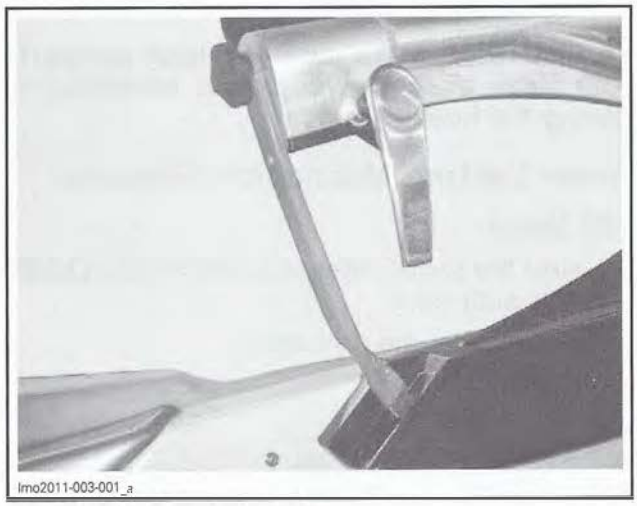
TURN HANDLE 3/4 TURN CLOCKWISE

4. Carefully lower and hold tower.



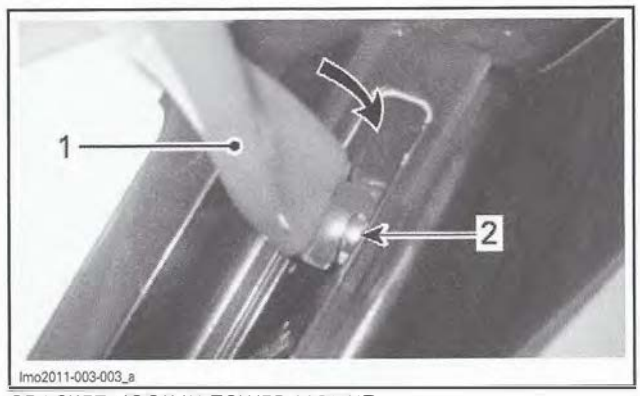
TYPICAL - LOWERING TOWER

5. Using holder brackets and knobs (provided with the boat), secure the tower in its lower position.



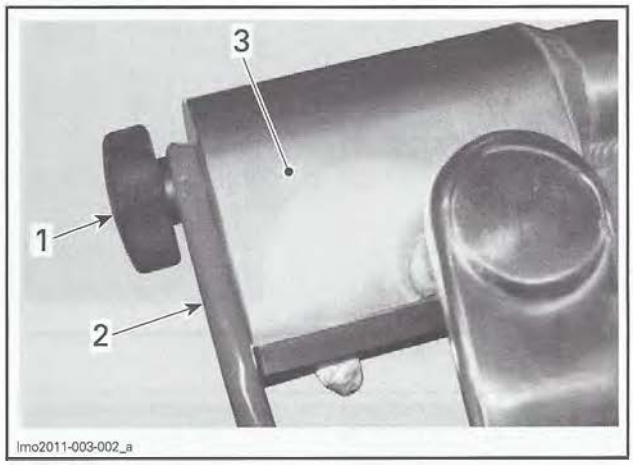
HOLDER BRACKET INSTALLED

5.1 Insert and secure hook end of the holder bracket into the tower mount of the boat.



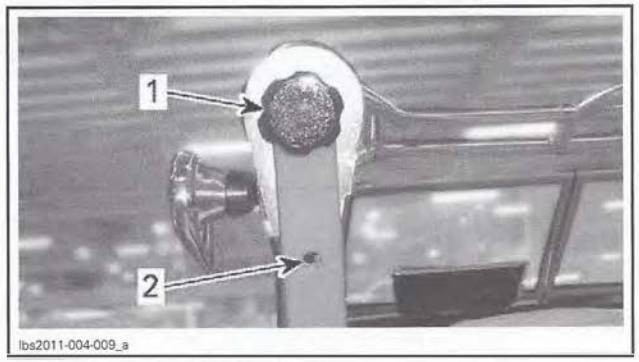
BRACKET HOOK IN TOWER MOUNT
1. *Bracket hook*
2. *Tower mount pin*

5.2 Secure the other end of bracket to tower leg end with the knob.



1. *Knob*
2. *Holder bracket (upper end)*
3. *Tower leg end*

NOTE: For holder bracket with 2 holes, use the upper hole.



1. *Upper hole (for knob location)*
2. *Lower hole*

6. Proceed with the holder bracket installation on the other side.

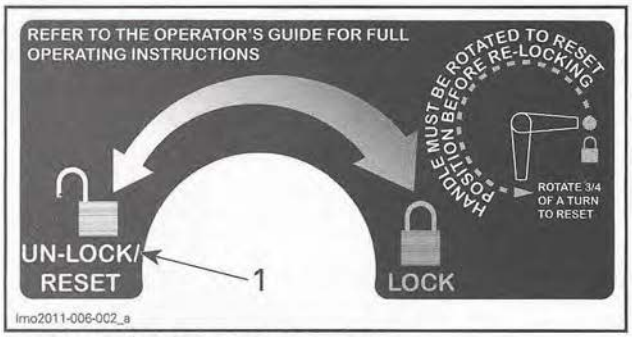
NOTICE When tower is folded down, always use the holder bracket and do not operate the boat more than 16 km/h (10 MPH). Never tow boat when tower is folded down.

Raising the Tower

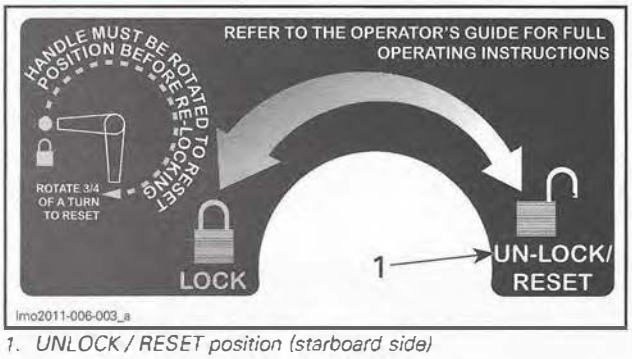
NOTE: The tower must be in the upright position when trailering boat or when riding.

Have someone to support the tower front section.

1. Remove tower support brackets from tower.
2. On both side of tower, confirms the handle is in the unlock position. If not, handle must be rotated to RESET position before re-locking the tower.

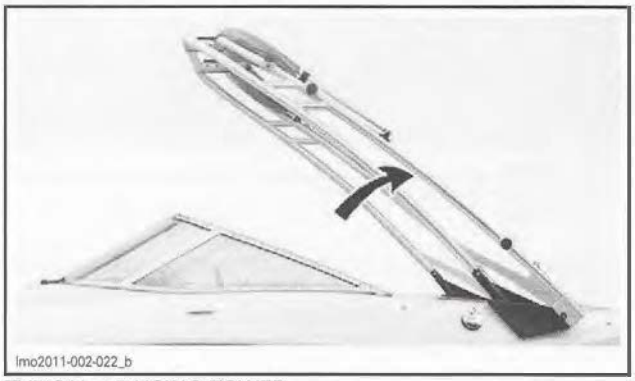


1. UNLOCK / RESET position (port side)



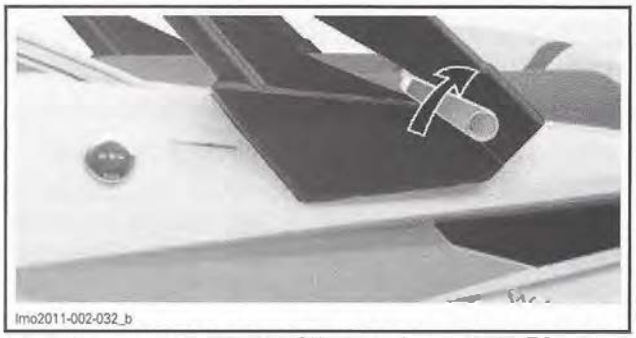
1. UNLOCK / RESET position (starboard side)

3. Raise the tower to its highest position.

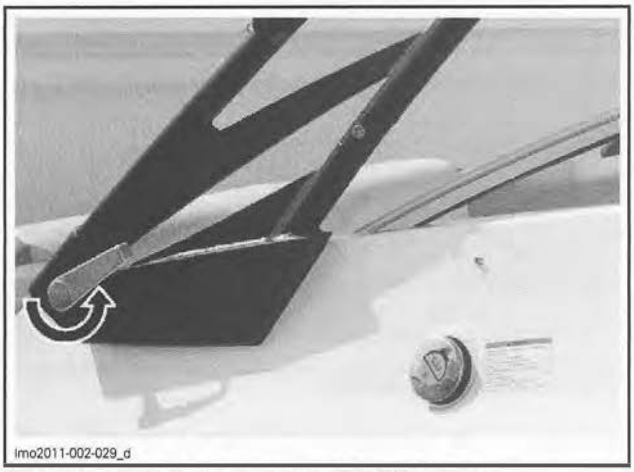


TYPICAL – RAISING TOWER

4. On both sides of tower, turn handle 3/4 of a turn to the LOCK position.



PORT SIDE – TURN HANDLE 3/4 TURN CLOCKWISE TO LOCK



STARBOARD SIDE – TURN HANDLE 3/4 TURN COUNTERCLOCKWISE TO LOCK

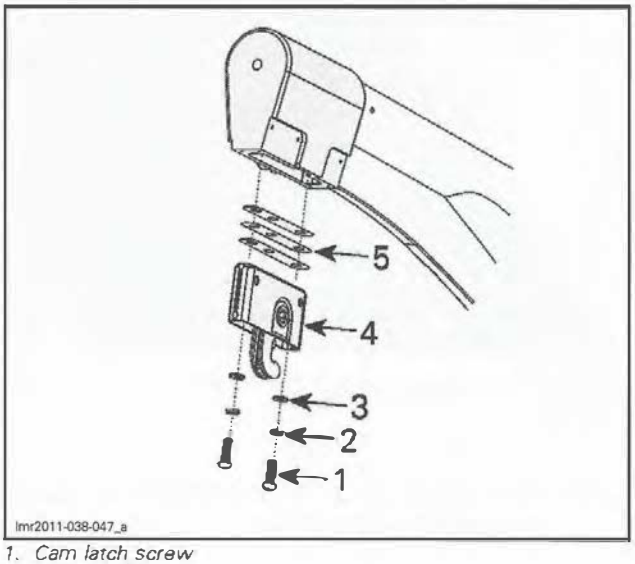
⚠ CAUTION Make sure to latch properly both sides of the tower before operating or towing the boat.

Tower Locking Mechanism Removal

180 Series

1. Lower the tower, refer to *LOWERING TOWER* in this subsection.
2. Remove from the cam latch:
   - Screws
   - Lock washers
   - Washers.
3. Remove the cam latch and all shims from the cam latch housing.

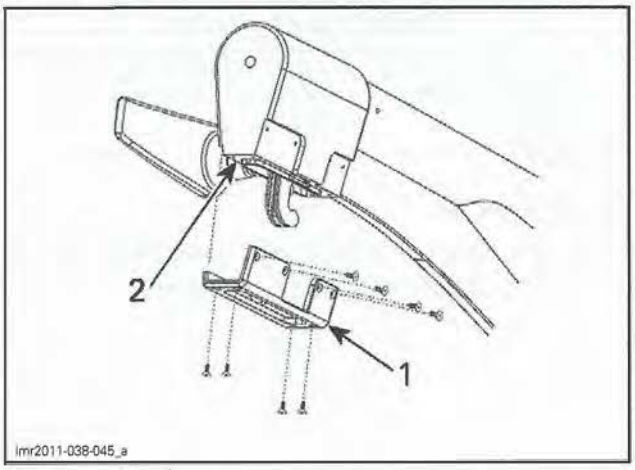
NOTE: A sharp tool may be required to removed shims stuck inside the cam latch housing.



1. *Cam latch screw*
2. *Lock washer*
3. *Flat washer*
4. *Cam latch*
5. *Shim*

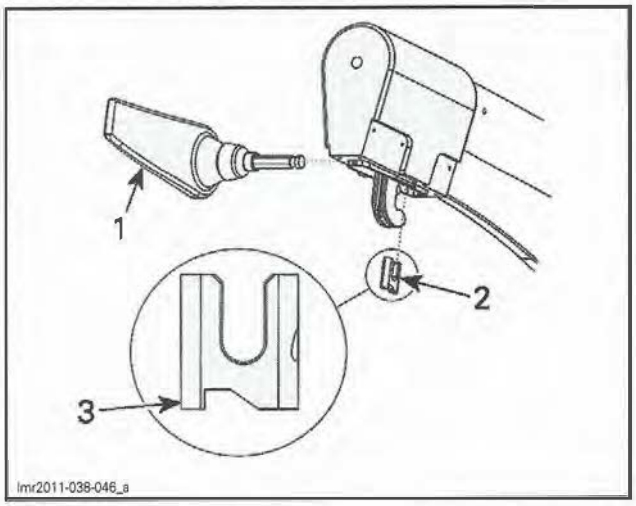
210 and 230 Series

1. Lower the tower, refer to *LOWERING TOWER* in this subsection.
2. Remove and discard the 8 small screws from the cam latch pad.
3. Remove the cam latch pad from the bottom of the cam latch housing.



1. *Cam latch pad*
2. *Cam latch housing*

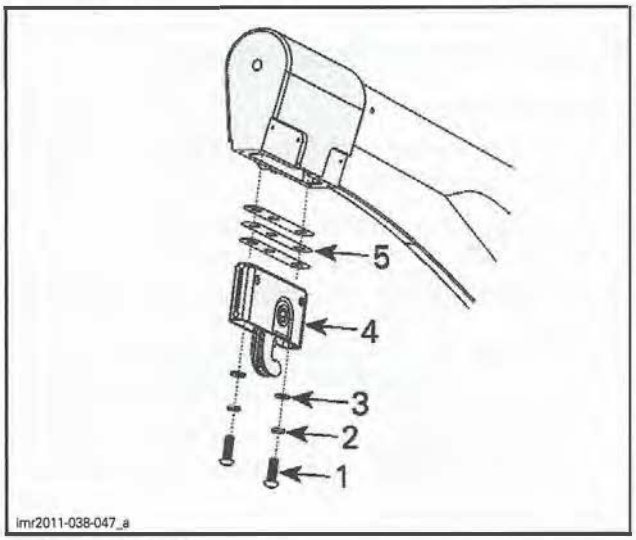
4. Loosen the small set screw that is locates in the handle lock.
5. Once the set screw is loosened, remove the handle lock with a pair of needle nose pliers.
6. Remove the handle.



1. *Handle*
2. *Handle lock*
3. *Grab this part of the lock with the pliers*

7. Remove from the cam latch:
   - Screws
   - Lock washers
   - Washers.
8. Remove the cam latch and all shims from the cam latch housing.

NOTE: A sharp tool may be required to removed shims stuck inside the cam latch housing.



1. *Cam latch screw*
2. *Lock washer*
3. *Flat washer*
4. *Cam latch*
5. *Shim*

Tower Locking Mechanism Adjustment

NOTE: Prior to proceed with adjustment, ensure the locking mechanism is properly lubricated (white lithium grease). Incorrect lubrication may cause locking mechanism malfunction.

Remove the cam latch, see procedure in this subsection.

Adjust the amount of shims according with the following:

- Add shim(s) if handle resistance is too low.
- Remove shim(s) if handle resistance is too high.

Assemble the cam latch and test.

NOTE: Do not install the handle lock.

Once the proper number of shims has been determined, install the locking mechanism.

Repeat the procedure on the other side.

Tower Locking Mechanism Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Tighten cam latch screws to specification

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on cam latch screw threads.

CAM LATCH SCREWS	
THREADLOCKER	LOCTITE 243 (BLUE) (P/N 293 800 060)
TIGHTENING TORQUE	20 N•m (15 lbf•ft)

Tower Section Replacement

Central Section

1. Lower the tower, refer to *LOWERING TOWER* in this subsection.
2. Remove the 4 socket screws securing the central section to lateral sections.
3. For reinstallation, reverse the removal procedure.

TIGHTENING TORQUE	
Central section (socket screws)	55 N•m (41 lbf•ft)

Lateral Section

1. Lower the tower, refer to *LOWERING TOWER* in this subsection.
2. Remove all accessories installed on the lateral section (bimini top attaches, wakeboard support, speaker, etc.)
3. Remove socket screws securing the lateral section to central section.
4. Install a temporarily support between central section and windshield.
5. Ask someone to support the front of tower while removing the holder bracket.
6. Remove the hinge screw.
7. Remove the lateral section from the tower support.
8. For reinstallation, reverse the removal procedure.

TIGHTENING TORQUE	
Hinge screw	40 N•m (30 lbf•ft)
Central section (socket screws)	55 N•m (41 lbf•ft)

Tower Support

Tower Support Removal

1. Remove the appropriate lateral section of tower. See procedure in this subsection.
2. Remove the rear cup holder compartment to reach tower support nuts.
3. Remove nuts and flat washers securing the tower support to boat.
4. Remove the tower support.

Tower Support Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.

Tighten tower support nuts to specification.

TIGHTENING TORQUE	
Tower support nuts	55 N•m (41 lbf•ft)

BODY

Body Repair

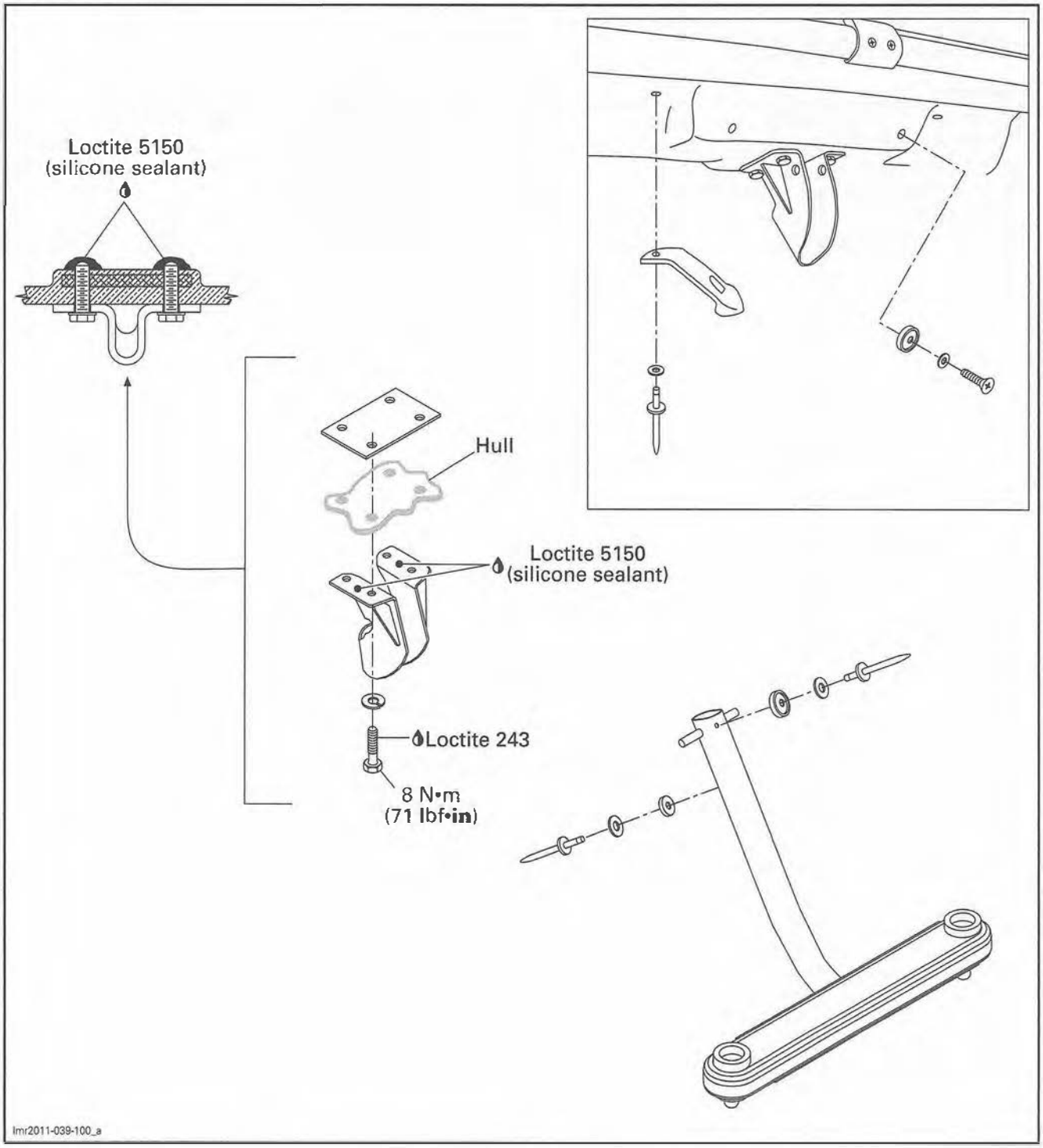
Use the same material and procedure as described in *HULL* subsection to repair body.

HULL

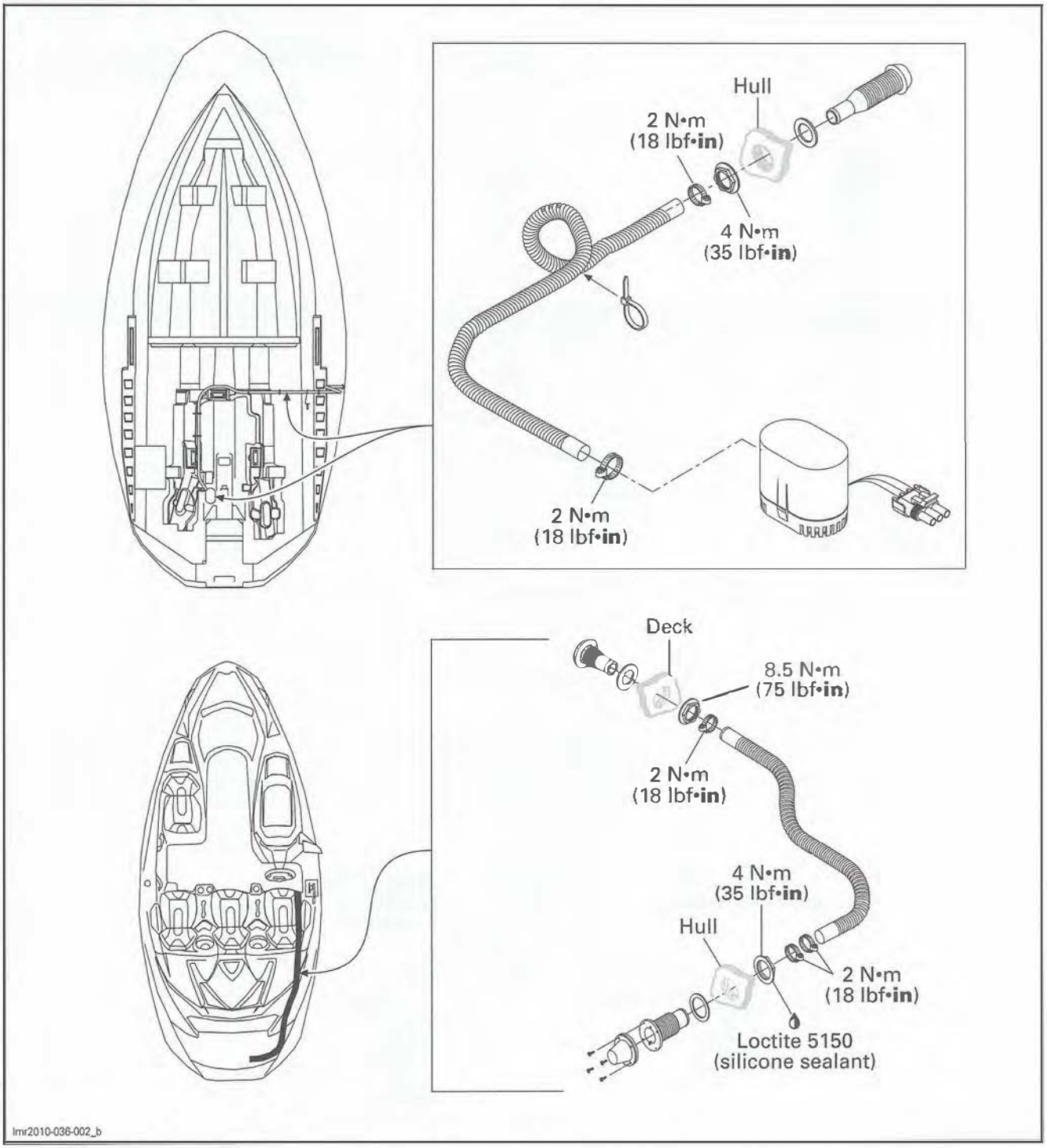
SERVICE PRODUCTS

Description	Part Number	Page
BRP HEAVY DUTY CLEANER	293 110 001	522–523, 525, 527–528
LOCTITE 243 (BLUE)	293 800 060	526–527
LOCTITE 271 (RED)	293 800 005	523
LOCTITE 5150 (SILICONE SEALANT)	296 000 309	522, 526
LOCTITE 518	293 800 038	527
LOCTITE INSTANT GASKET	219 701 421	523, 525, 527–528

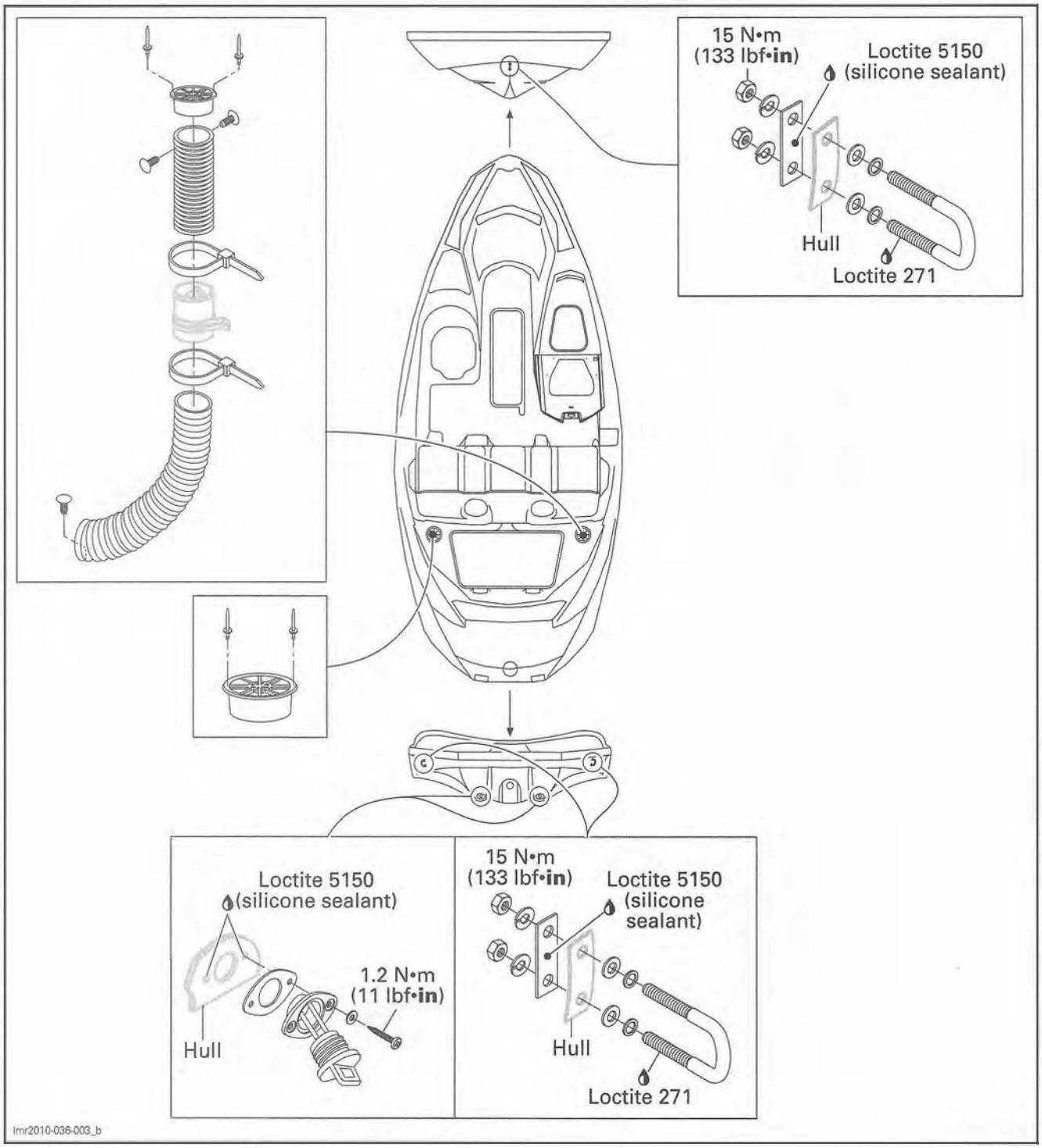
150 Series


Loctite 5150
(silicone sealant)
Hull
Loctite 5150
(silicone sealant)
Loctite 243
8 N•m
(71 lbf•in)
lmr2011-039-100_a

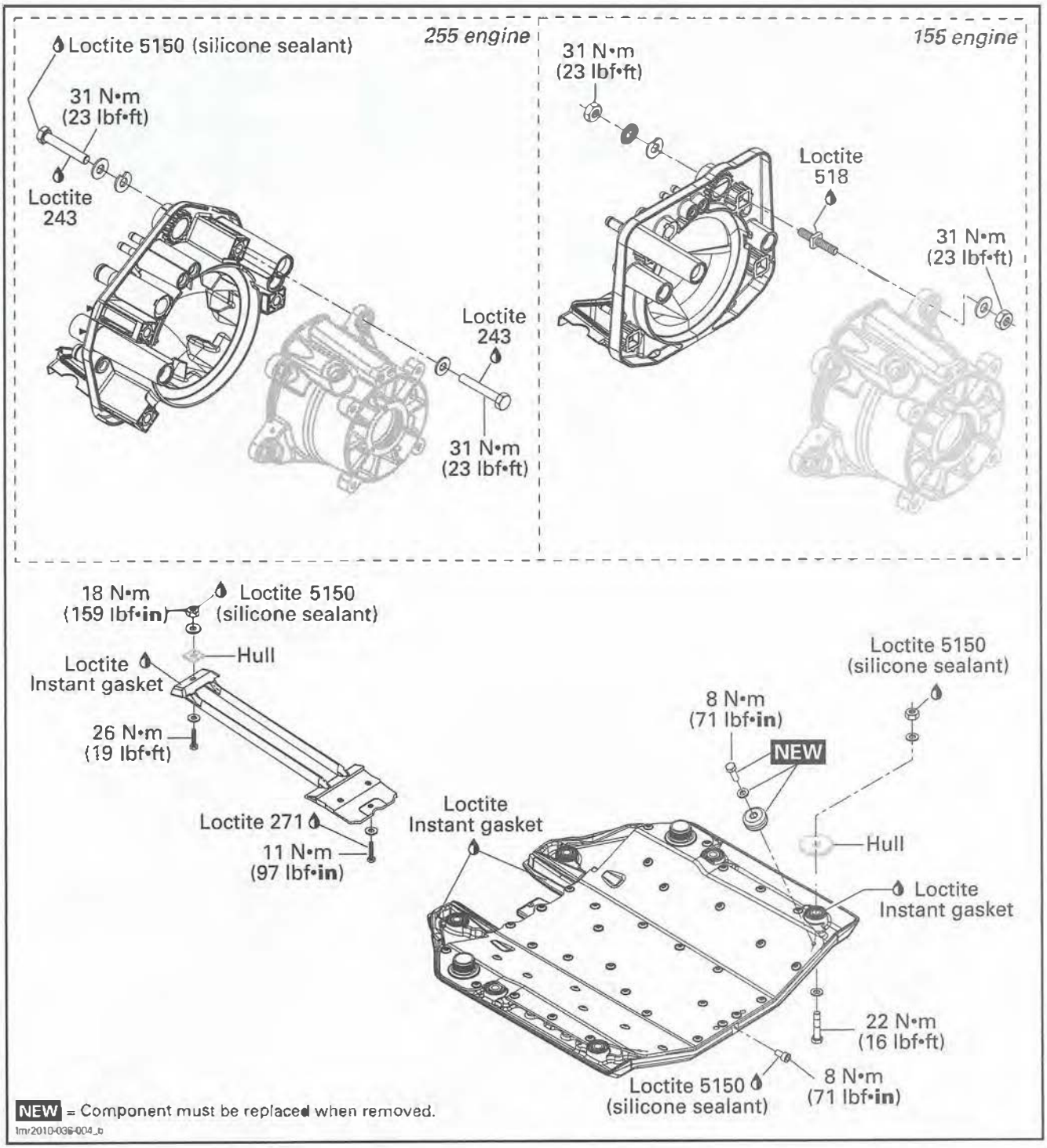
150 Series (cont'd)



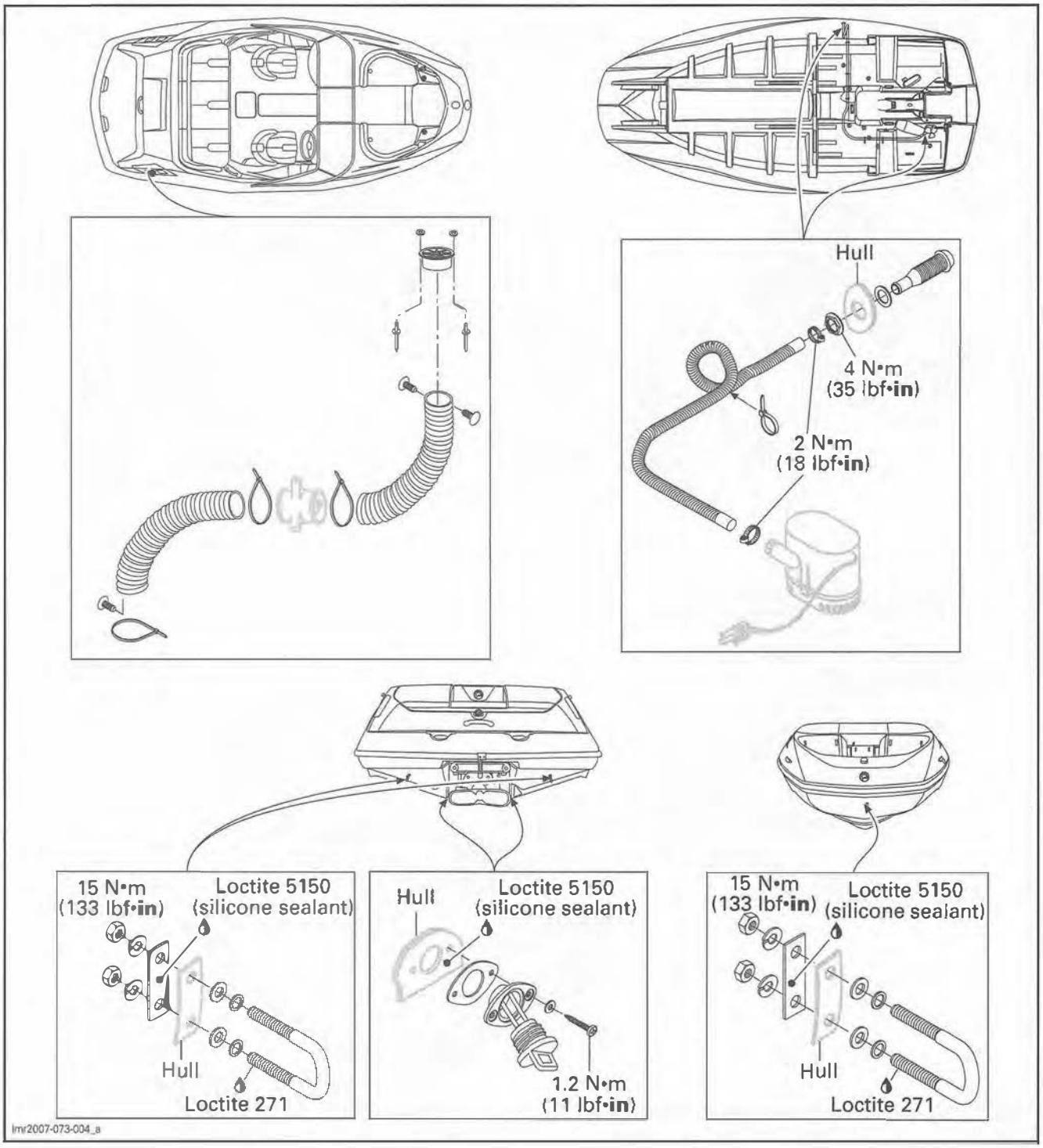
150 Series (cont'd)



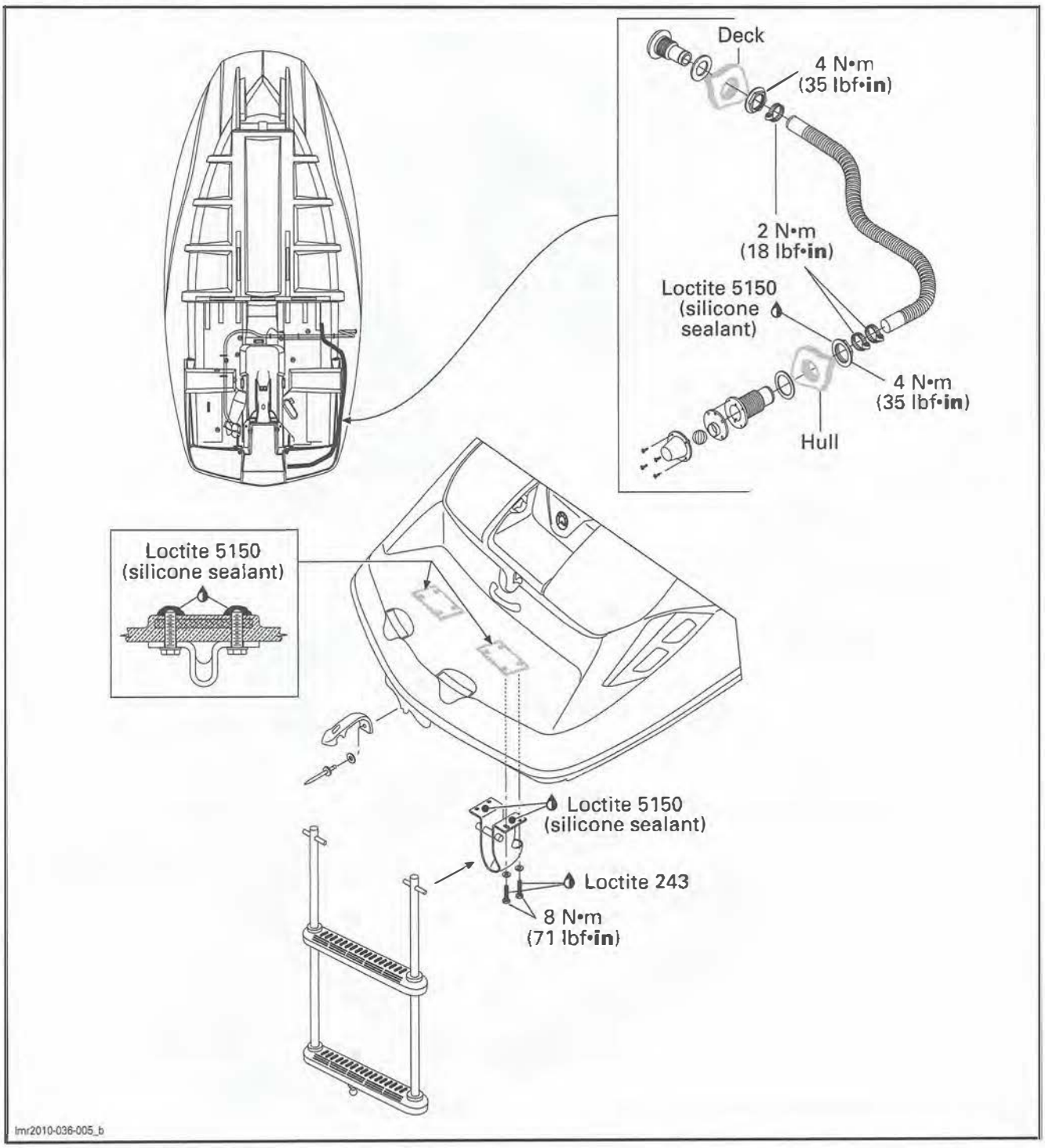
150 Series (cont'd)



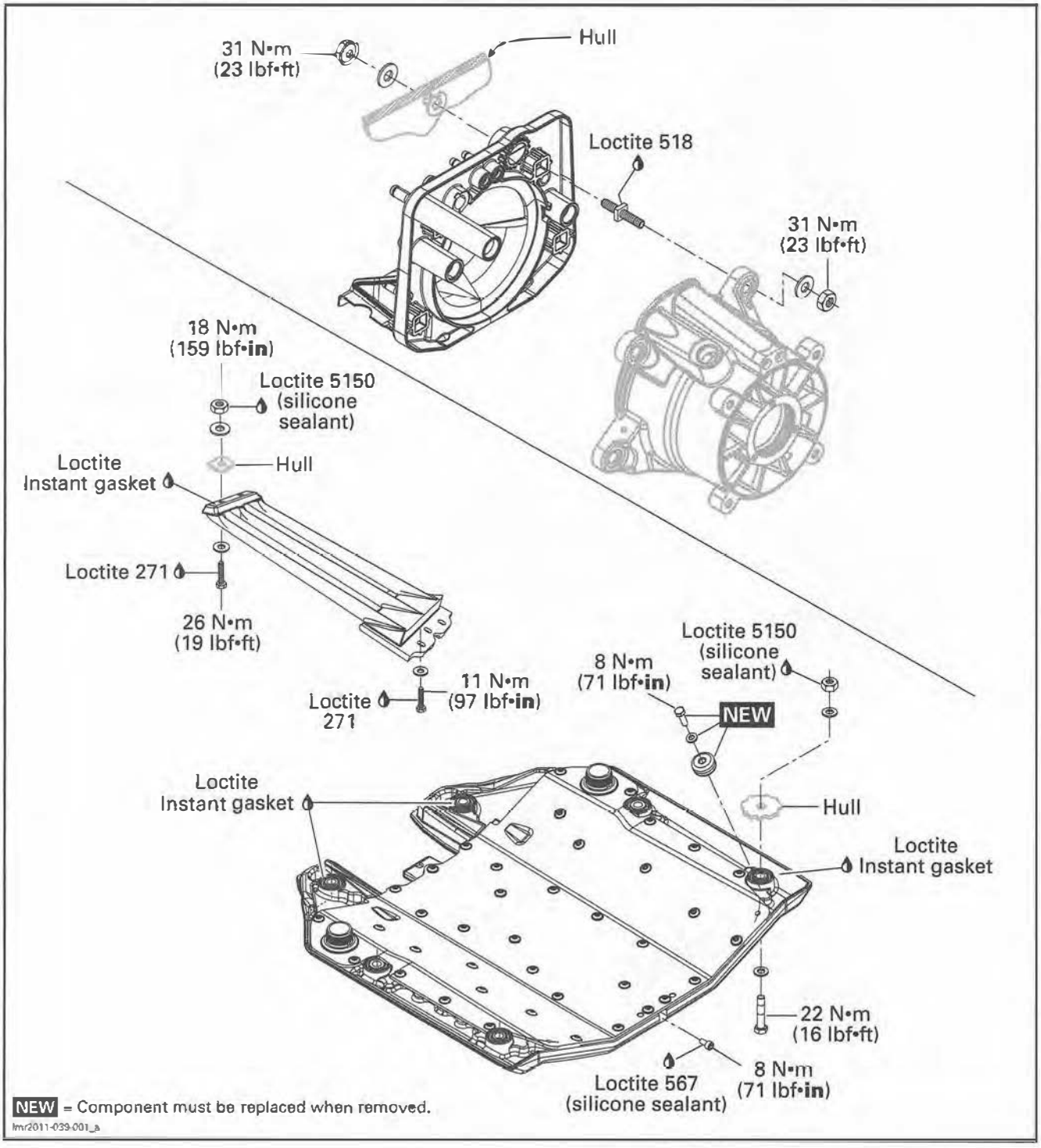
180 Series


Hull
4 N•m
(35 lbf•in)
2 N•m
(18 lbf•in)
15 N•m
(133 lbf•in)
Loctite 5150
(silicone sealant)
Hull
Loctite 271
Hull
Loctite 5150
(silicone sealant)
1.2 N•m
(11 lbf•in)
15 N•m
(133 lbf•in)
Loctite 5150
(silicone sealant)
Hull
Loctite 271
lmr2007-073-004_a

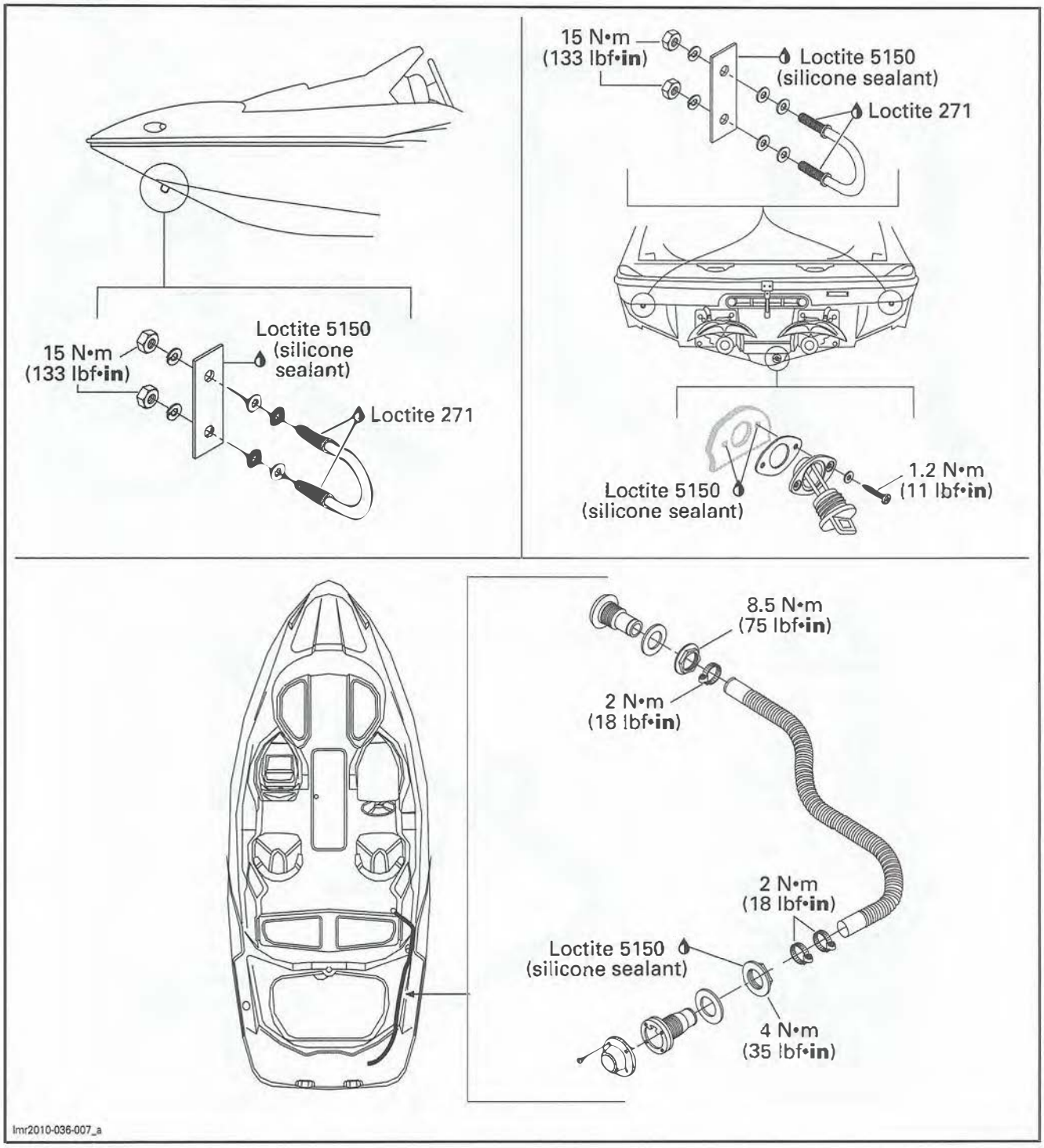
180 Series (cont'd)



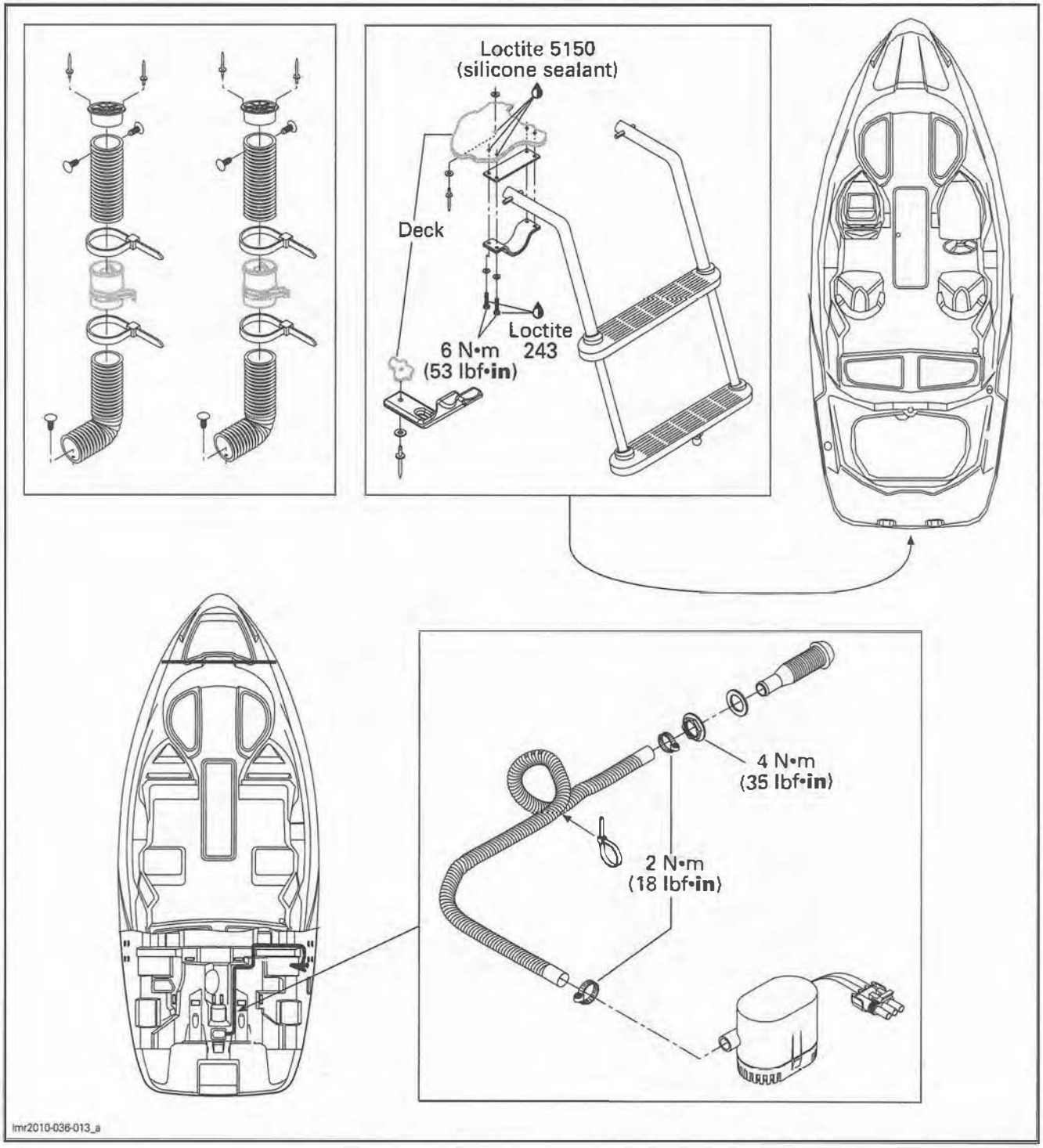
180 Series (cont'd)



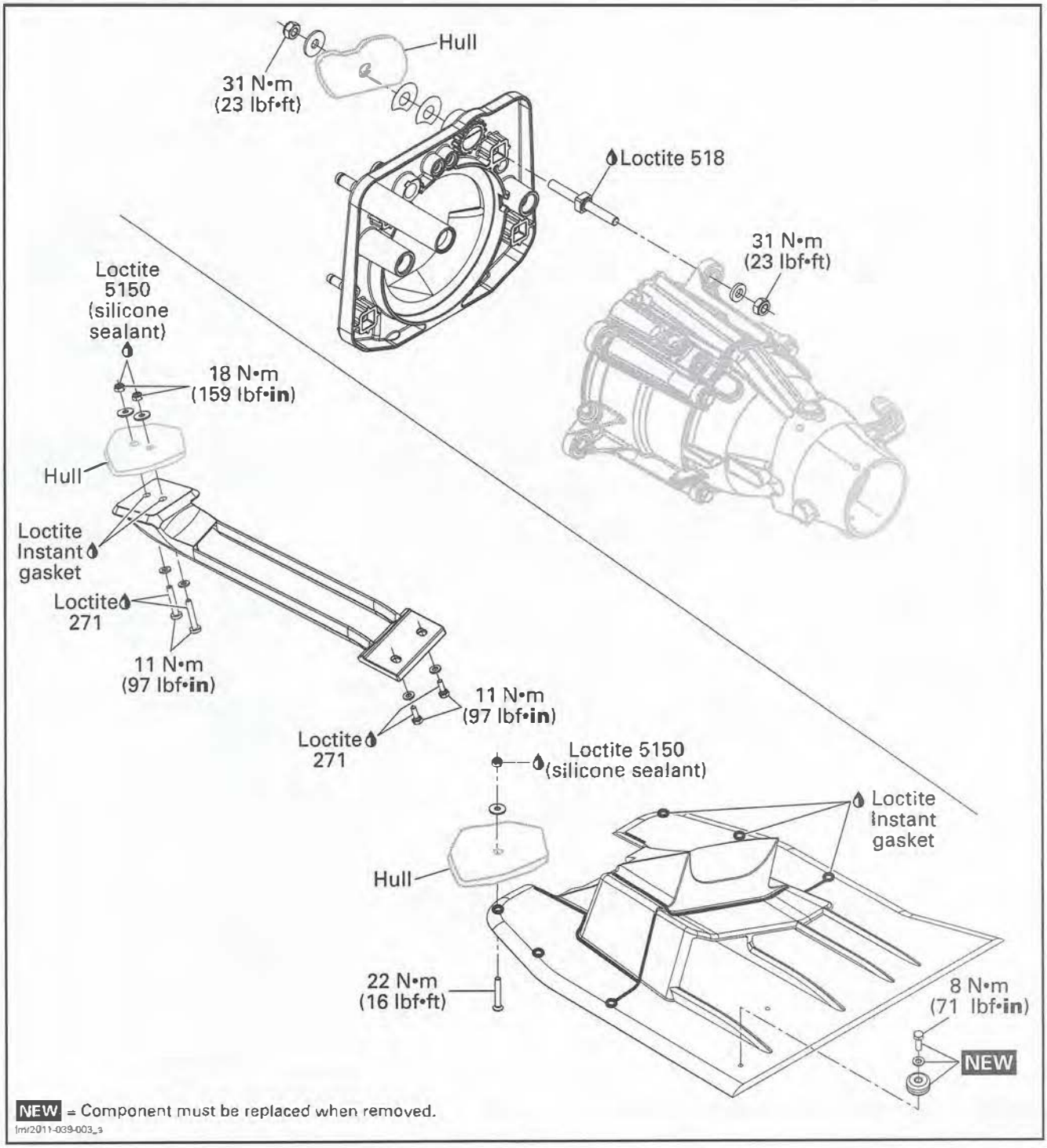
200 Series


15 N•m
(133 lbf•in)
Loctite 5150
(silicone
sealant)
Loctite 271
15 N•m
(133 lbf•in)
Loctite 5150
(silicone sealant)
Loctite 271
Loctite 5150
(silicone sealant)
1.2 N•m
(11 lbf•in)
8.5 N•m
(75 lbf•in)
2 N•m
(18 lbf•in)
2 N•m
(18 lbf•in)
Loctite 5150
(silicone sealant)
4 N•m
(35 lbf•in)
lmr2010-036-007_a

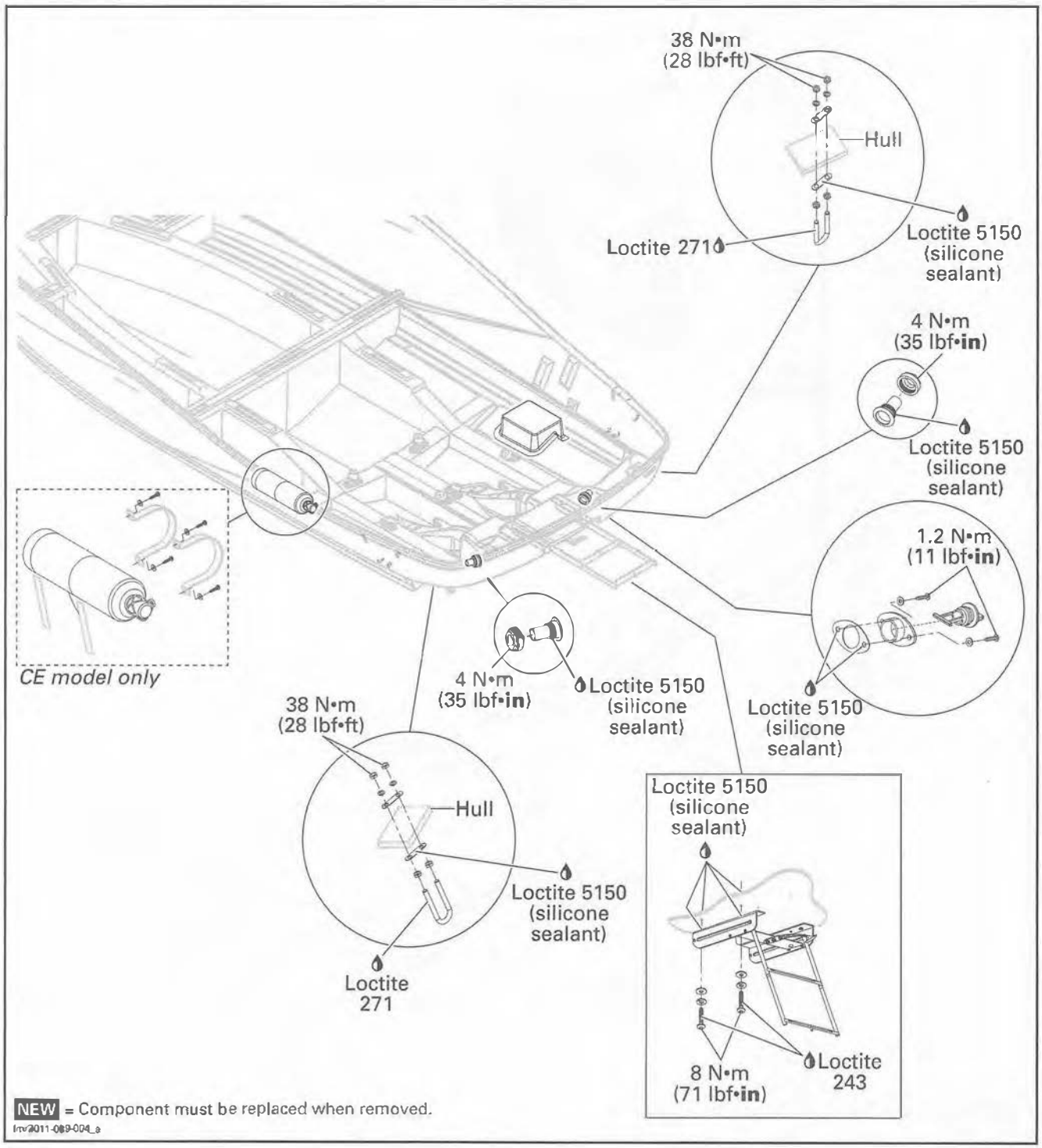
200 Series (cont'd)



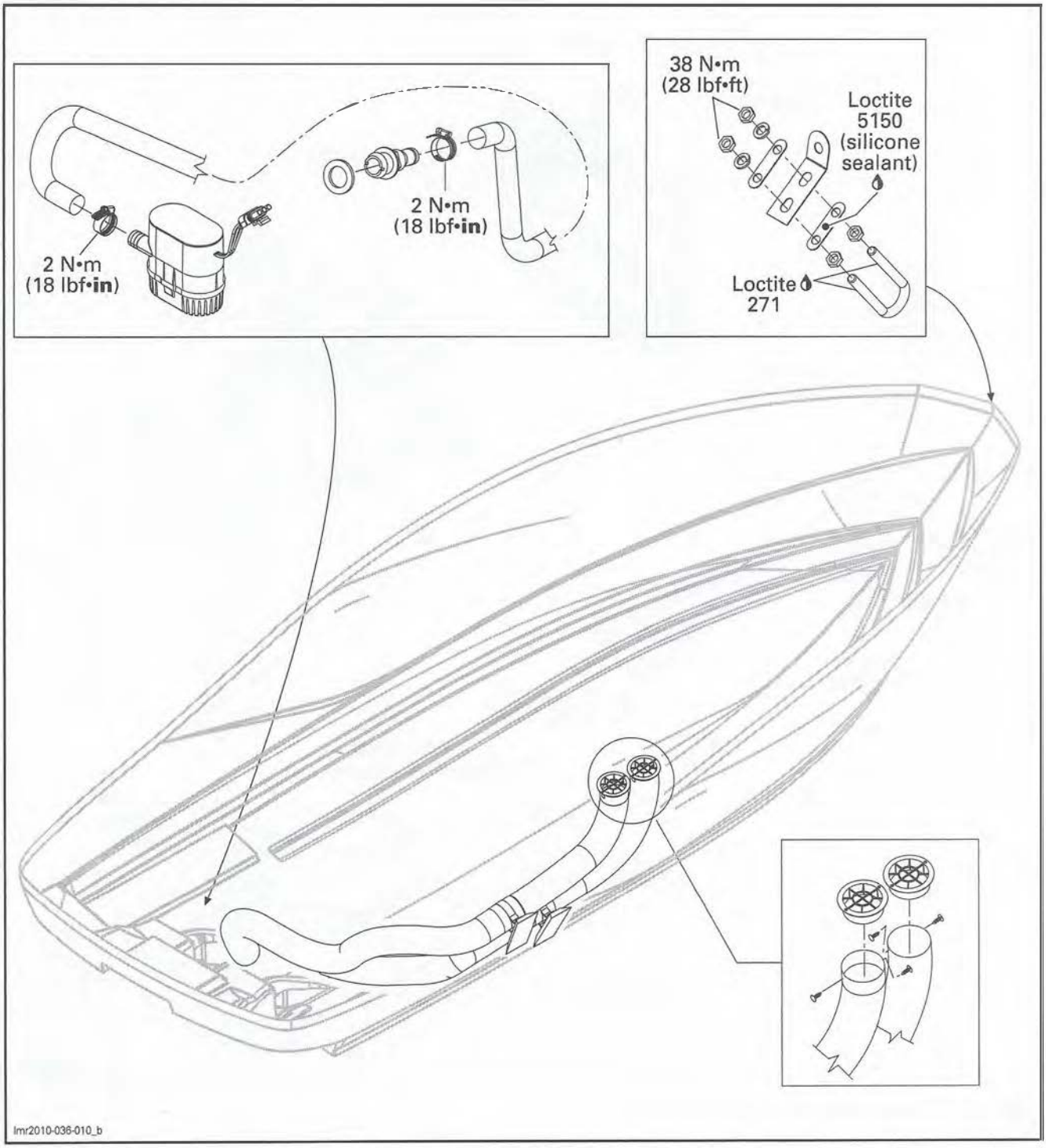
200 Series (cont'd)



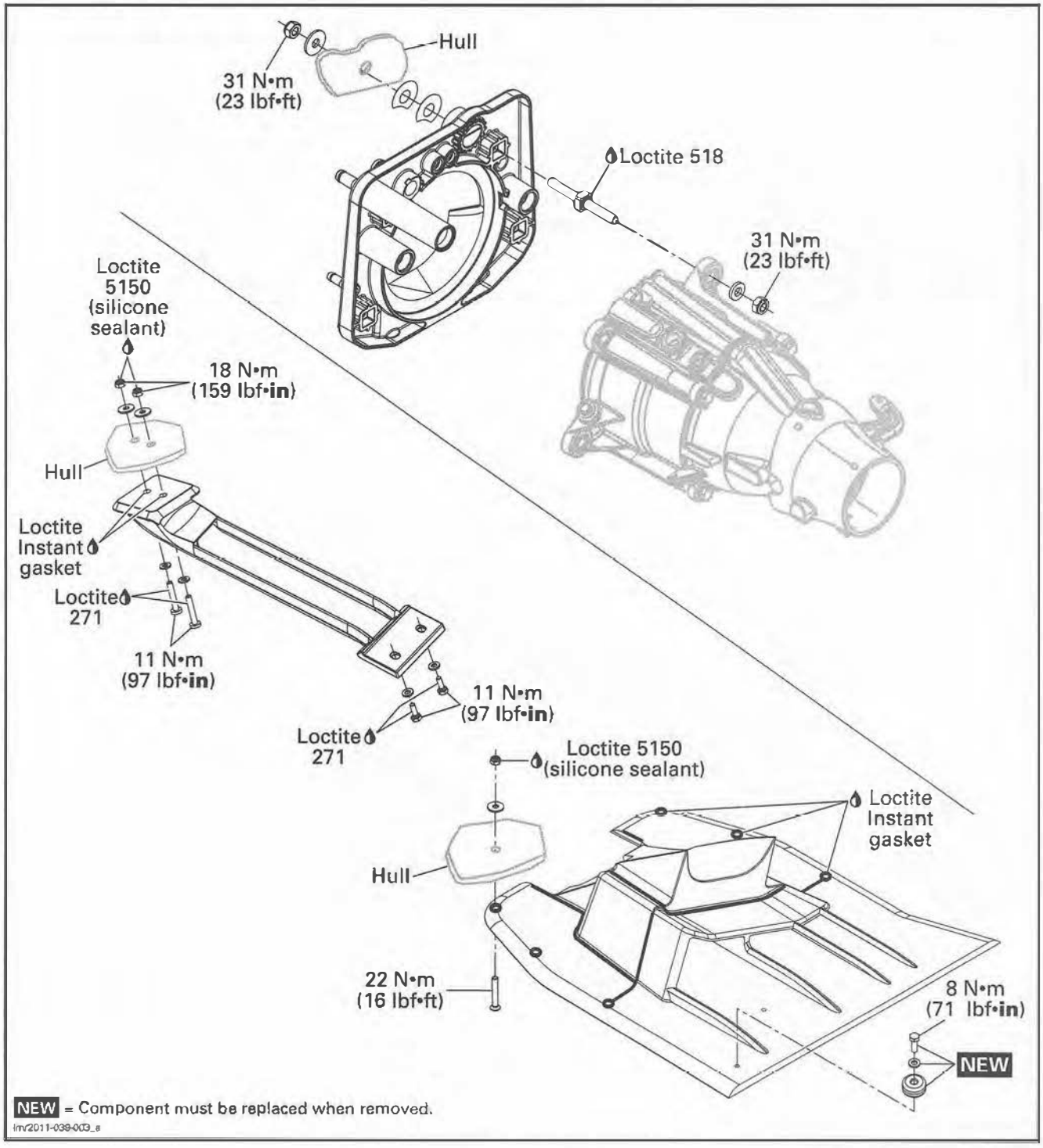
210 Series


38 N•m
(28 lbf•ft)
Hull
Loctite 271
Loctite 5150
(silicone
sealant)
4 N•m
(35 lbf•in)
Loctite 5150
(silicone
sealant)
1.2 N•m
(11 lbf•in)
Loctite 5150
(silicone
sealant)
CE model only
4 N•m
(35 lbf•in)
Loctite 5150
(silicone
sealant)
38 N•m
(28 lbf•ft)
Hull
Loctite 5150
(silicone
sealant)
Loctite
271
Loctite 5150
(silicone
sealant)
8 N•m
(71 lbf•in)
Loctite
243
NEW = Component must be replaced when removed.
lmr2011-089-004_a

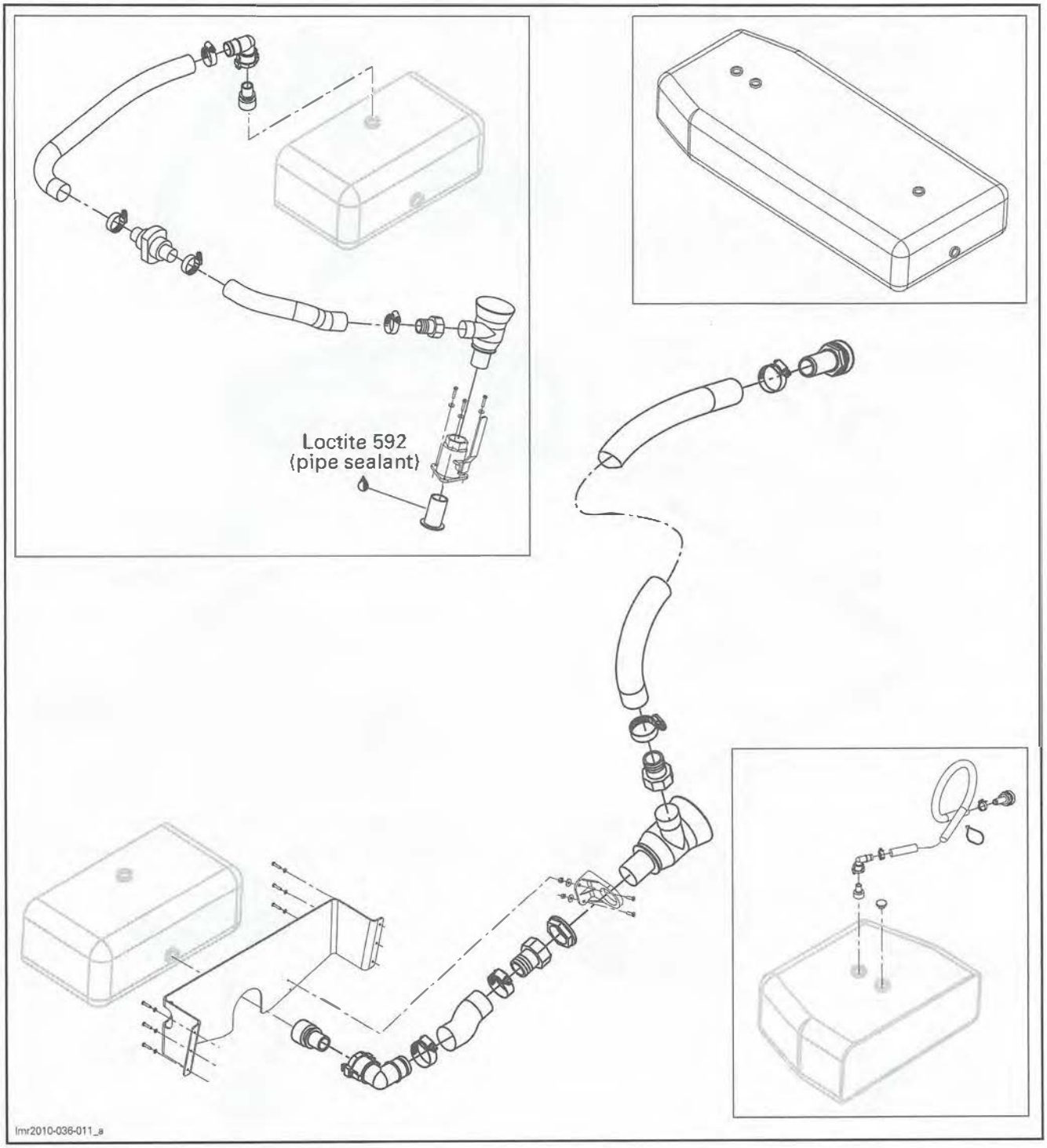
210 Series (cont'd)



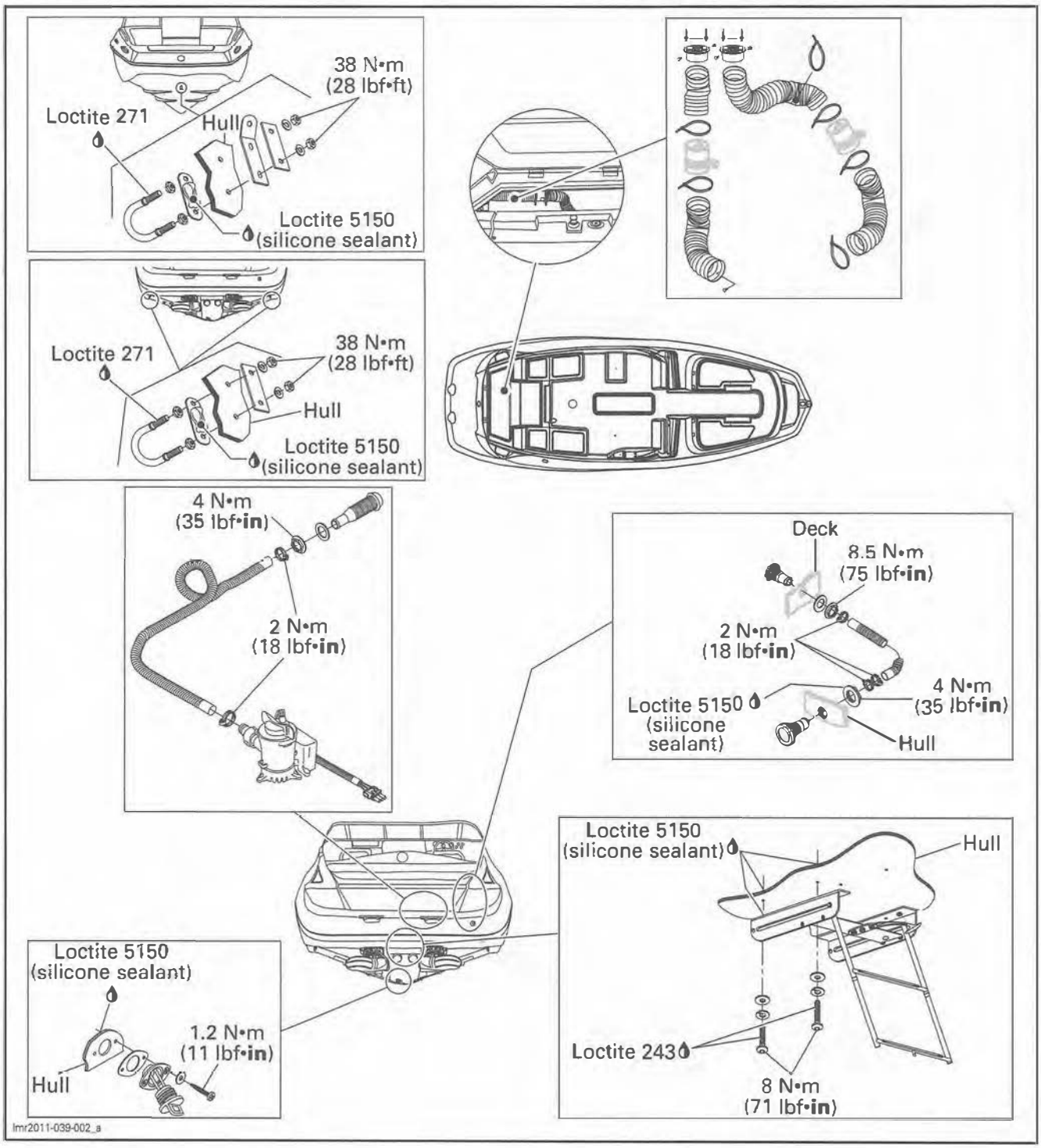
210 Series (cont'd)



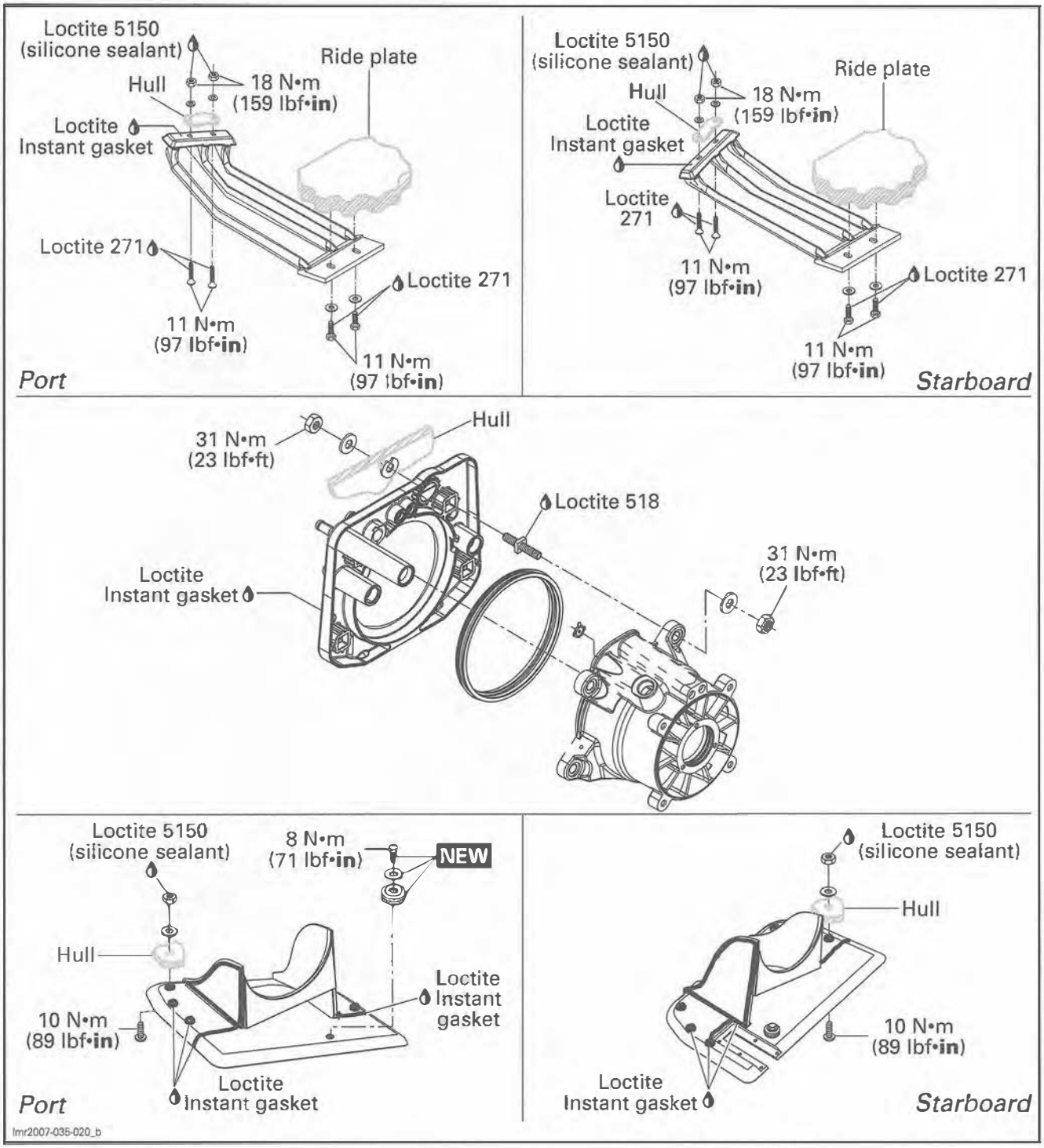
210 WAKE



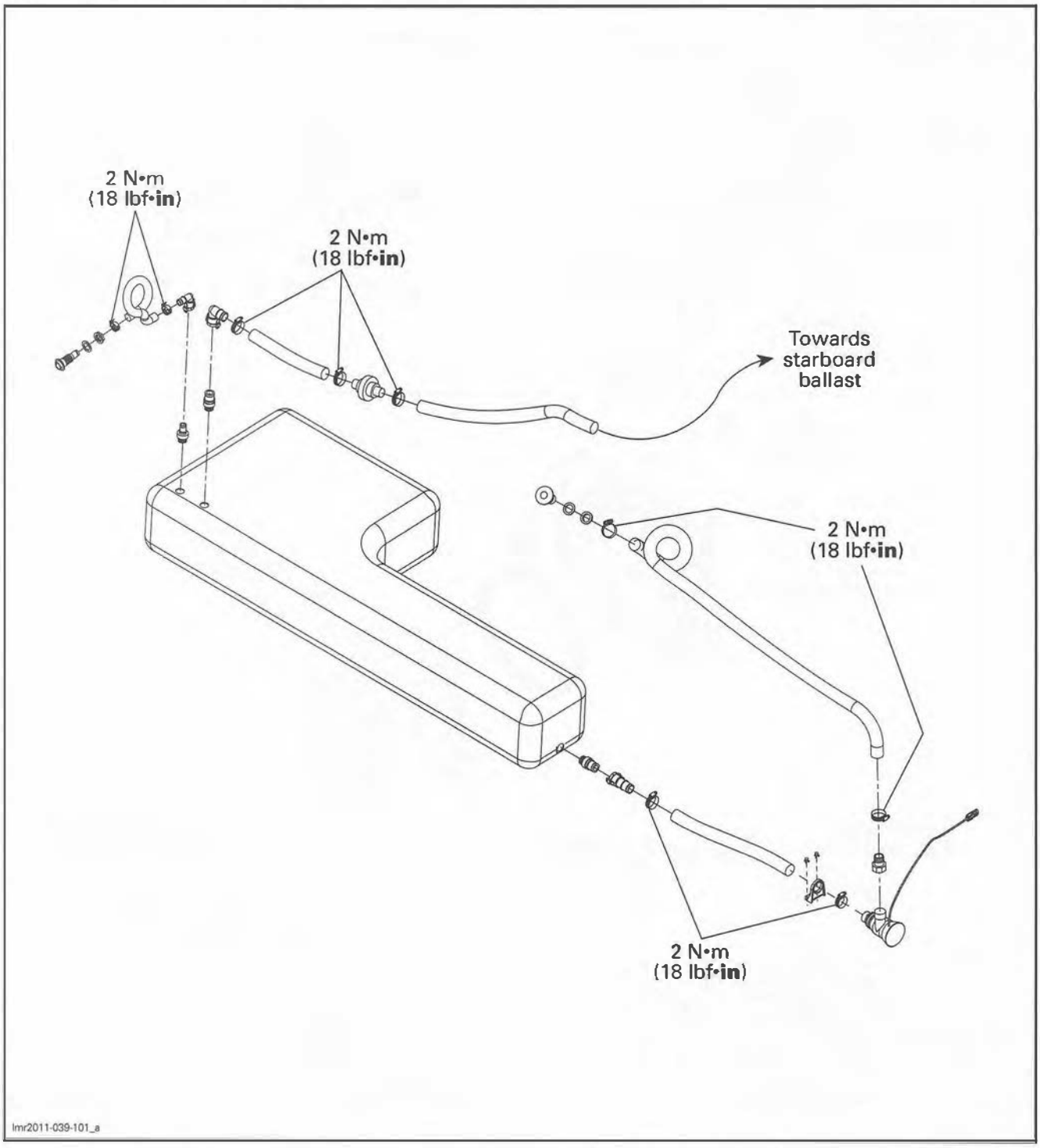
230 Series


38 N•m
(28 lbf•ft)
Loctite 271
Hull
Loctite 5150
(silicone sealant)
38 N•m
(28 lbf•ft)
Loctite 271
Hull
Loctite 5150
(silicone sealant)
4 N•m
(35 lbf•in)
2 N•m
(18 lbf•in)
Deck
8.5 N•m
(75 lbf•in)
2 N•m
(18 lbf•in)
4 N•m
(35 lbf•in)
Loctite 5150
(silicone
sealant)
Hull
Loctite 5150
(silicone sealant)
Hull
Loctite 243
8 N•m
(71 lbf•in)
Loctite 5150
(silicone sealant)
1.2 N•m
(11 lbf•in)
Hull
lmr2011-039-002_a

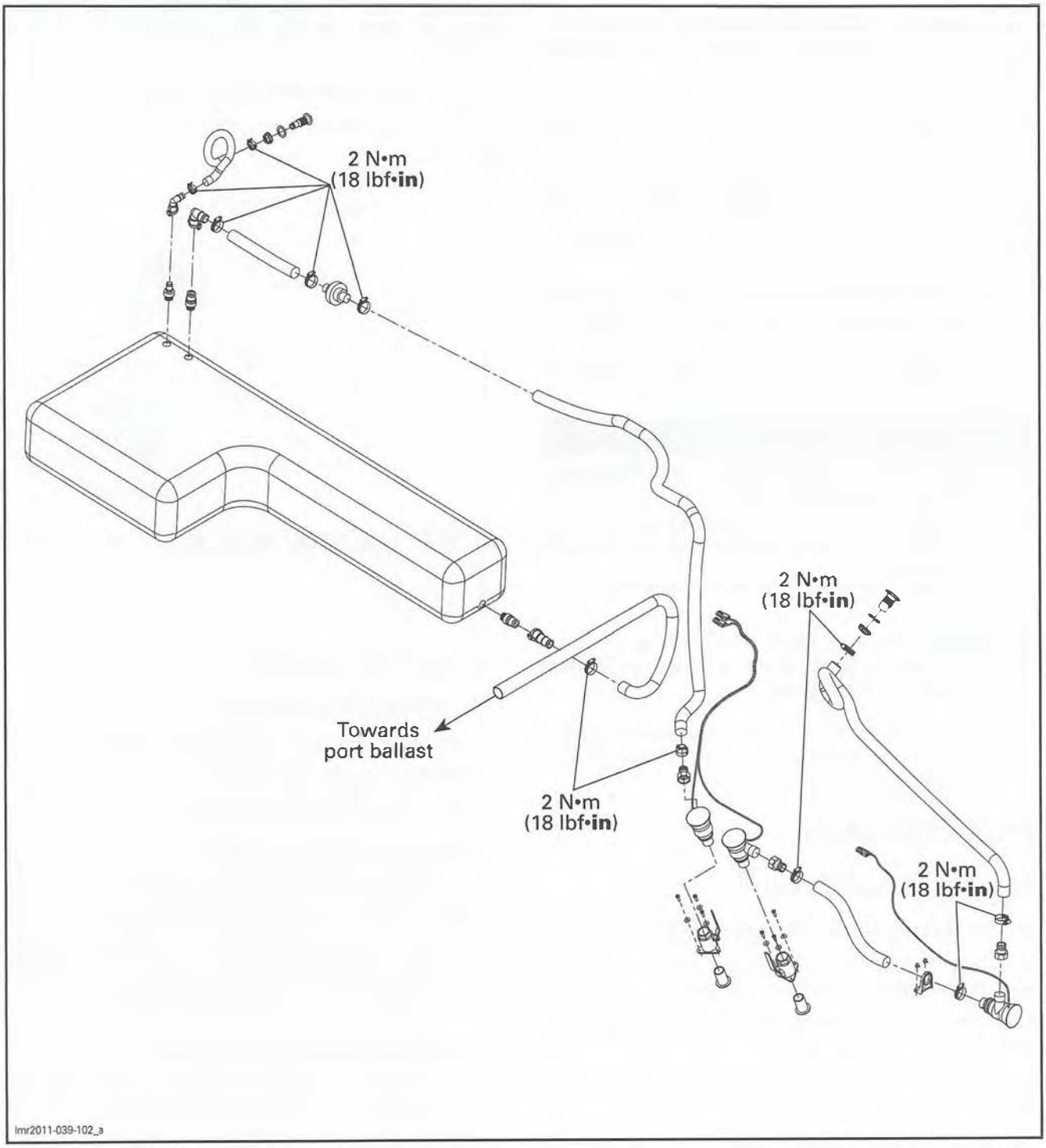
230 Series (cont'd)



230 Wake (Ballast – Port side)



230 Wake (Ballast – Starboard side)



GENERAL

Verify hinges condition and latching mechanisms condition and operation. Replace any damaged components.

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

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

When applying threadlocker Loctite products (anaerobic products), pay attention so that it does not come in contact with ABS plastic parts (painted parts). It could lead to plastic cracks or other damage.

⚠ WARNING

Torque wrench tightening specifications must strictly be adhered to.
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pin, etc.) must be replaced.

NOTICE **Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.**

When working in bilge, make sure end of ventilation hose is opened, not obstructed and no sagging occurs in its routing.

PROCEDURES

BILGE PUMP DRAIN

Bilge Pump Drain Replacement

Disconnect drain tube from hull fitting. Note the loop there, you will have to remake it.

Cut locking ties all along drain tube from transom toward bilge pump.

Disconnect drain tube from bilge pump and remove tube.

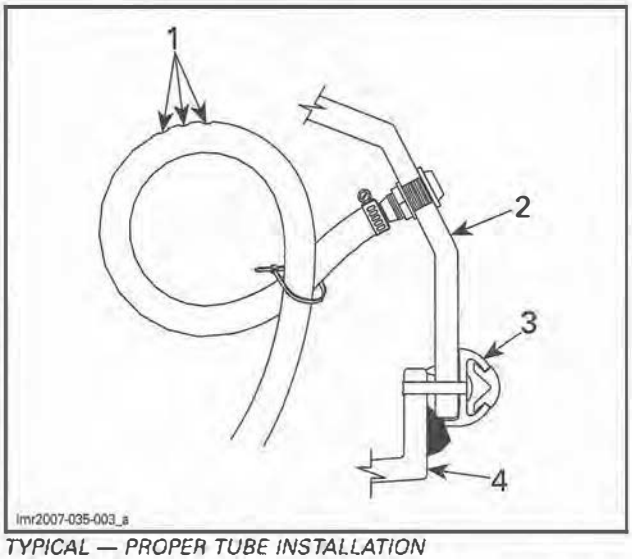
Cut new tube to proper length.

Reconnect tube at each end and resecure tube with locking ties.

TIGHTENING TORQUE	
Bilge pump tube clamps	2 N•m (18 lbf•**in**)

Drill three (3) 1.5 mm (1/16 in) holes where the tube is formed into a loop. This will prevent any type of siphoning that could occur in certain situations.

Ensure tube does not leak in bilge.



TYPICAL — PROPER TUBE INSTALLATION
1. *Drill here*
2. *Deck*
3. *Bumper*
4. *Hull*

SCUPPER VALVE

Scupper Valve Removal

From inside hull, unplug hose from scupper valve.

Unscrew scupper valve nut.

Push the scupper valve outside.

Scupper Valve Cleaning

Check that ball is clean and moves freely.

Scrape off all excess of silicone sealant from hull.

Clean hull surface with BRP HEAVY DUTY CLEANER (P/N 293 110 001) or an equivalent to eliminate grease, dust and any residue of sealant.

Scupper Valve Installation

Apply LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) on back of the outside of valve.

Position scupper valve into hull hole.

From inside of hull, install nut and torque it to 4 N•m (35 lbf•**in**).

Install hose on scupper valve and torque both clamps to specification.

NOTE: Make sure hose is tied up sufficiently and does not sag.

TIGHTENING TORQUE	
Scupper valve hose clamps	2 N•m (18 lbf•**in**)

INLET GRATE

Inlet Grate Removal

Using a heat gun, heat screws to break thread-locker.

Loosen screws and remove inlet grate.

NOTE: An impact driver should be used to loosen screws.

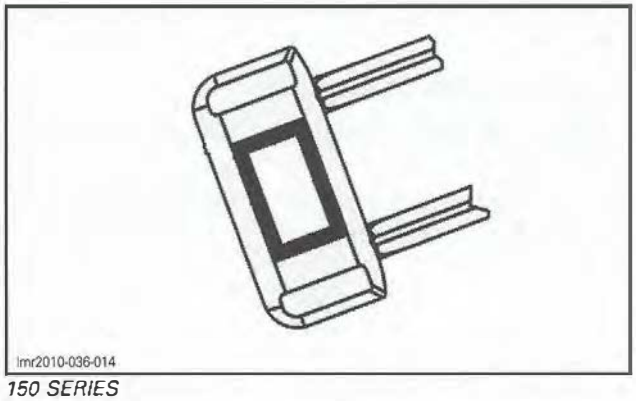
Inlet Grate Cleaning

Scrape off all excess of sealant from inlet grate and hull.

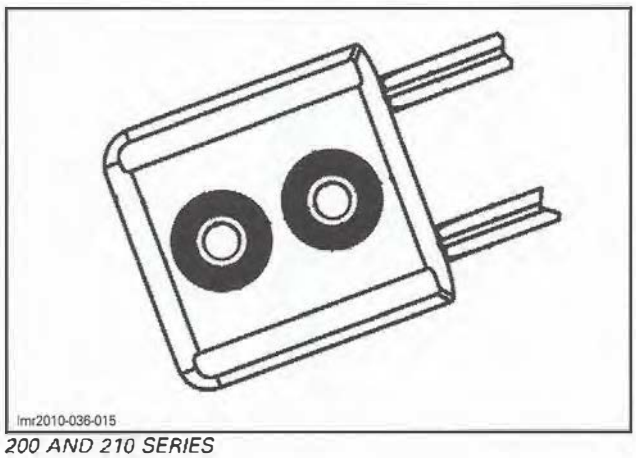
Clean hull surface with BRP HEAVY DUTY CLEANER (P/N 293 110 001) or an equivalent to eliminate grease, dust and any residue of sealant.

Inlet Grate Installation

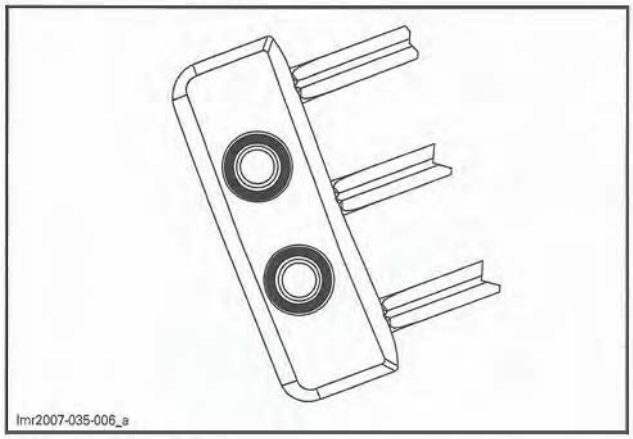
Apply LOCTITE INSTANT GASKET (P/N 219 701 421) as indicated by the shaded area in the next illustrations.



150 SERIES



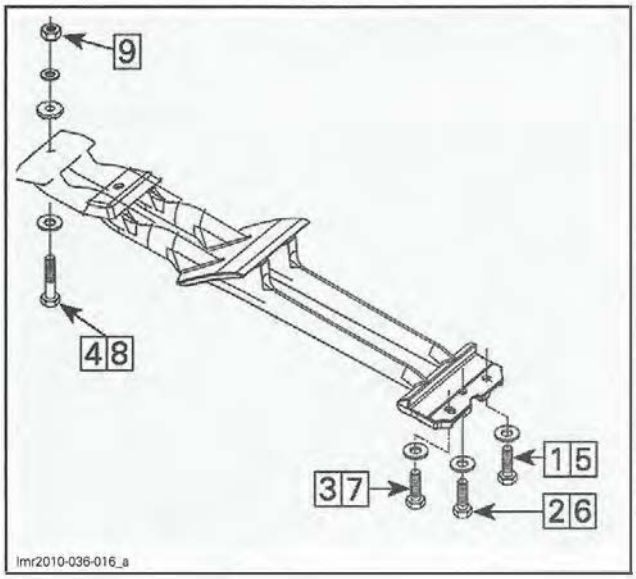
200 AND 210 SERIES



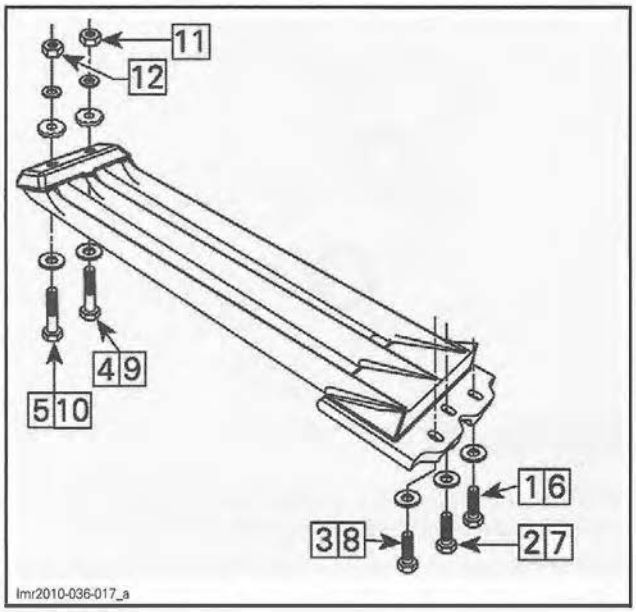
180 AND 230 SERIES

When installing inlet grate, apply LOCTITE 271 (RED) (P/N 293 800 005) on threads of screws.

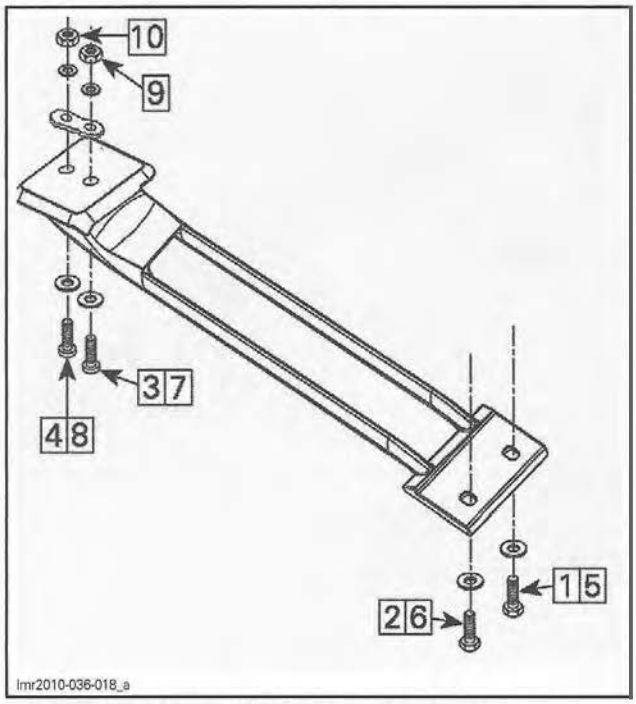
Tighten screws. Follow the torquing sequence shown.



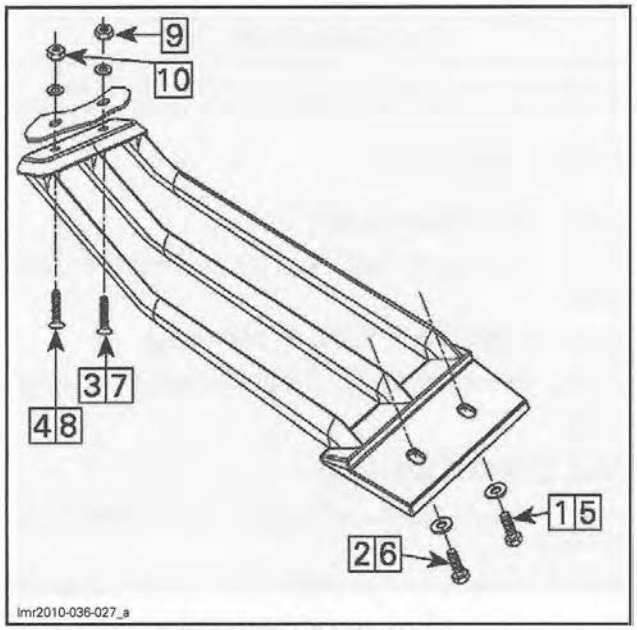
150 SERIES
Step 1: 1 to 4: hand tighten
*Step 2: 5 to 7: 11 N•m (97 lbf•**in**)*
Step 3: 8: 25 N•m (18 lbf•ft)
*Step 4: 9: 18 N•m (159 lbf•**in**)*



180 SERIES
Step 1: 1 to 4: hand tighten
Step 2: 5 to 7: 11 N•m (97 lbf•in)
Step 3: 9 and 10: 25 N•m (18 lbf•ft)
Step 4: 11 and 12: 18 N•m (159 lbf•in)



200 AND 210 SERIES – STARBOARD SIDE SHOWN
Step 1: 1 to 4: hand tighten
Step 2: 5 to 8: 11 N•m (97 lbf•in)
Step 3: 9 and 10: 18 N•m (159 lbf•in)



230 SERIES — STARBOARD SIDE SHOWN
Step 1: 1 to 4: hand tighten
Step 2: 5 to 8: 11 N•m (97 lbf•in)
Step 3: 9 and 10: 18 N•m (159 lbf•in)

RIDE PLATE

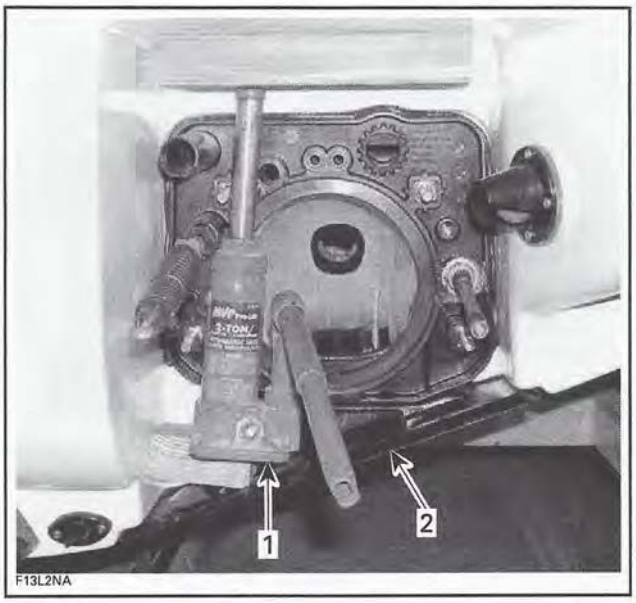
Ride Plate Removal

Remove jet pump. Refer to *JET PUMP* subsection.

Loosen ride 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 ride plate.



TYPICAL
1. *Hydraulic bottle jack*
2. *Steel plates*

Ride Plate Cleaning

Scrape off all excess of sealant from ride plate and hull.

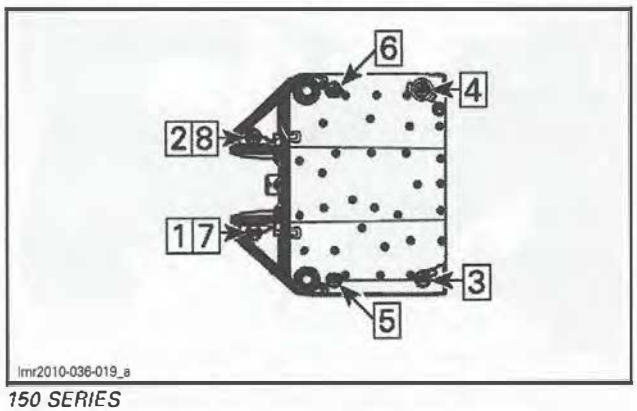
Clean hull surface with BRP HEAVY DUTY CLEANER (P/N 293 110 001) or an equivalent to eliminate grease, dust and any residue of sealant.

Ride Plate Installation

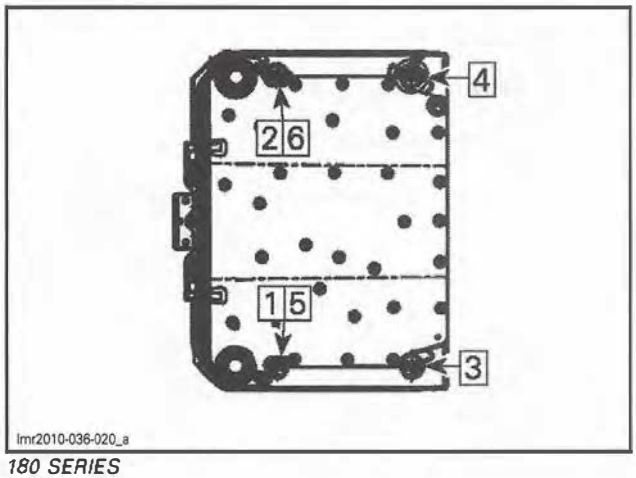
Apply LOCTITE INSTANT GASKET (P/N 219 701 421) as indicated by the shaded areas in the next illustrations. The bead size should be 9.5 mm (3/8 in) minimum.

Tighten screws to specification following the torquing sequence shown.

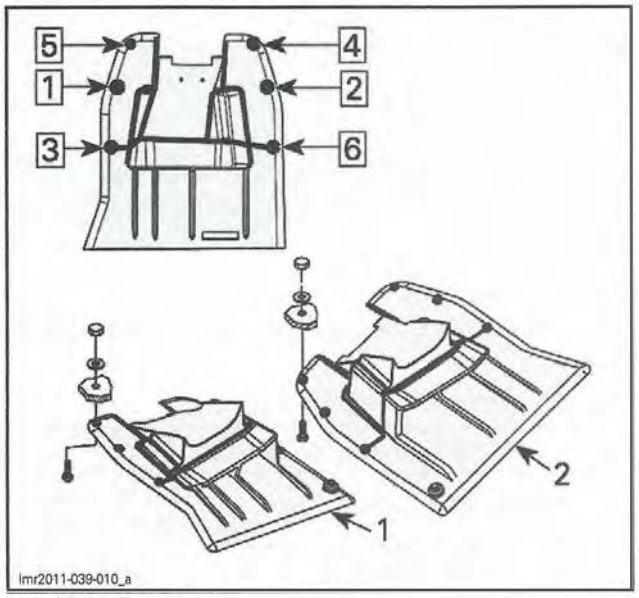
TIGHTENING TORQUE	
Ride plate screws	10 N•m (89 lbf•in)



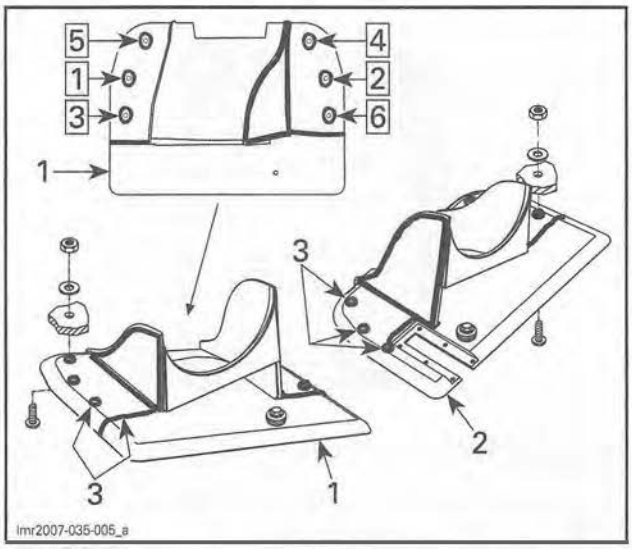
150 SERIES



180 SERIES



200 AND 210 SERIES
1. *Ride plate, port side*
2. *Ride plate, starboard side*



230 SERIES
1. *Ride plate, port side*
2. *Ride plate, starboard side*
3. *Loctite Instant Gasket*

Inside hull, apply LOCTITE 5150 (SILICONE SEALANT) (P/N 296 000 309) on the end of ride plate screws.

230 Series

Install the blocking plate on the starboard ride plate.

Tighten screws to specification.

BLOCKING PLATE SCREWS	
THREADLOCKER	LOCTITE 243 (BLUE) (P/N 293 800 060)
TIGHTENING TORQUE	4.5 N•m (40 lbf•**in**)

JET PUMP SUPPORT

Jet Pump Support Removal

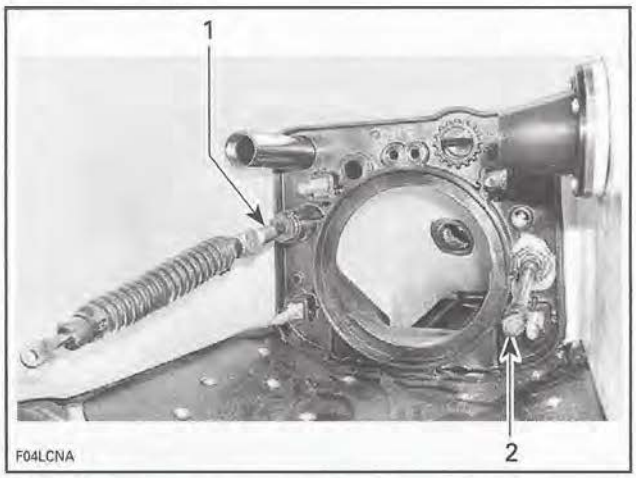
Starboard Engine

Remove jet pump. Refer to *JET PUMP* subsection.

Remove inlet grate and ride plate.

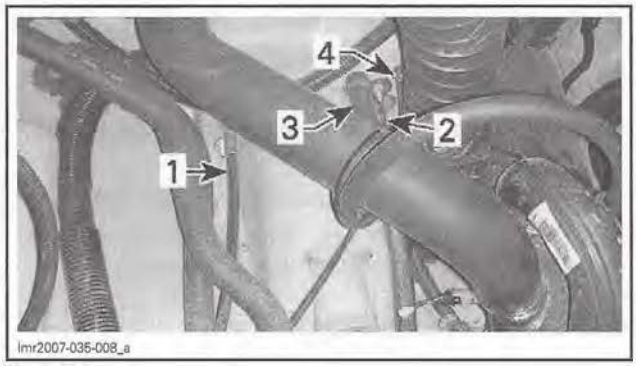
Remove ball joint, nut and washer from steering cable. Remove from transom.

Remove boot, pivot and lock nut from reverse cable. Remove from transom.



TYPICAL
1. *Reverse cable*
2. *Steering cable*

Inside hull, disconnect water hoses.



TYPICAL
1. *Steering cable*
2. *Reverse cable*
3. *Exhaust water supply hose*
4. *Exhaust water return hose*

Remove nuts, lock washers and flat washers retaining jet pump support from inside hull.

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.

Port Engine

Remove jet pump. Refer to *JET PUMP* subsection.

Remove inlet grate and ride plate.

Inside hull, disconnect both engine cooling hoses and both exhaust water hoses.

Remove nuts, lock washers and flat washers retaining jet pump support from inside hull.

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.

Jet Pump Support Cleaning

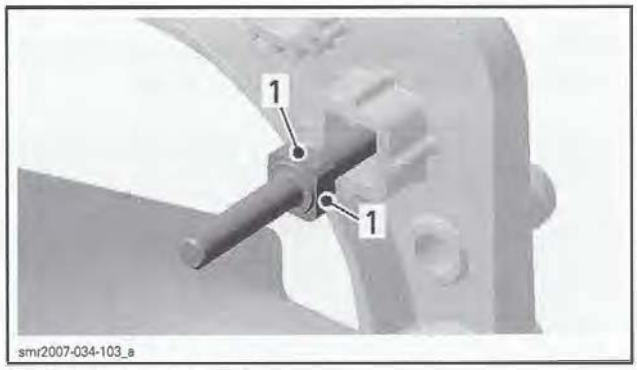
Scrape off all excess of sealant from jet pump support and hull.

Clean hull surface with BRP HEAVY DUTY CLEANER (P/N 293 110 001) or an equivalent to eliminate grease, dust and any residue of sealant.

Jet Pump Support Installation

All Models Except 150 Speedster with 255 engine

Apply LOCTITE 518 (P/N 293 800 038) against contact surface of studs with jet pump support.



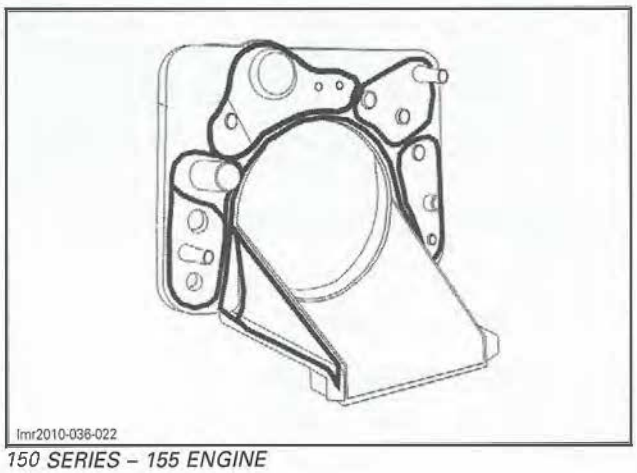
1. Apply Loctite 518 here

150 Speedster with 255 engine

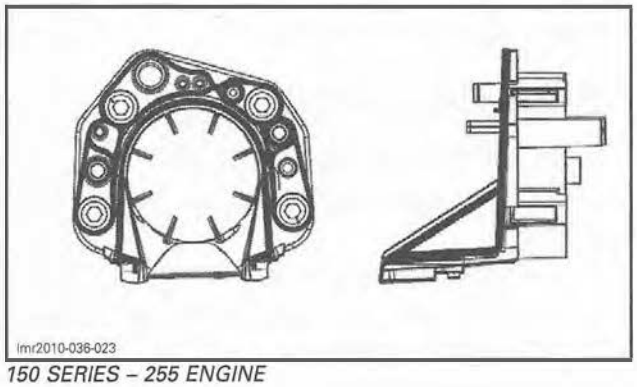
Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on jet pump screw threads.

All Models

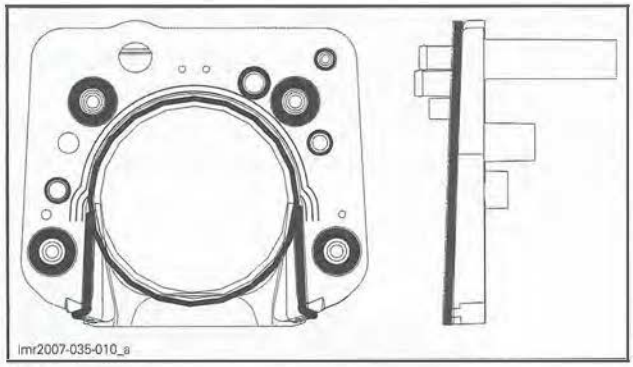
Apply LOCTITE INSTANT GASKET (P/N 219 701 421) as indicated by the shaded areas in the next illustrations. The bead size should be 6.35 mm (1/4 in) minimum.



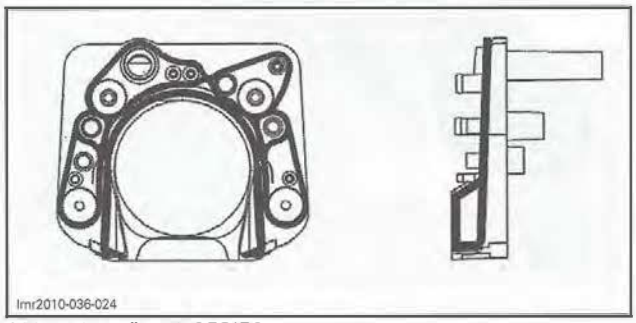
150 SERIES – 155 ENGINE



150 SERIES – 255 ENGINE



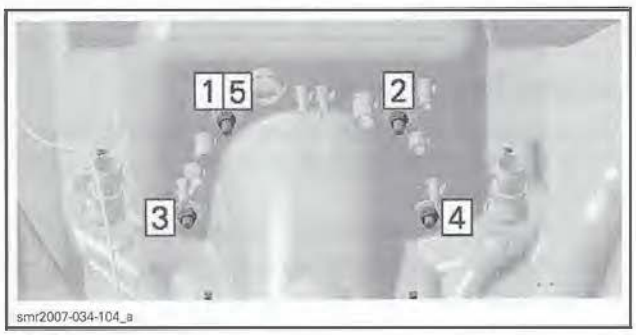
180 SERIES



200, 210 AND 230 SERIES

Install jet pump support on transom and tighten screws or nuts to specification using the following sequence.

TIGHTENING TORQUE	
Jet pump support screws or nuts	31 N•m (23 lbf•ft)



TYPICAL

Reinstall all removed parts.

THRU-HULL FITTING

Thru-Hull Fitting Replacement

Remove the drive shaft. Refer to *DRIVE SHAFT* subsection.

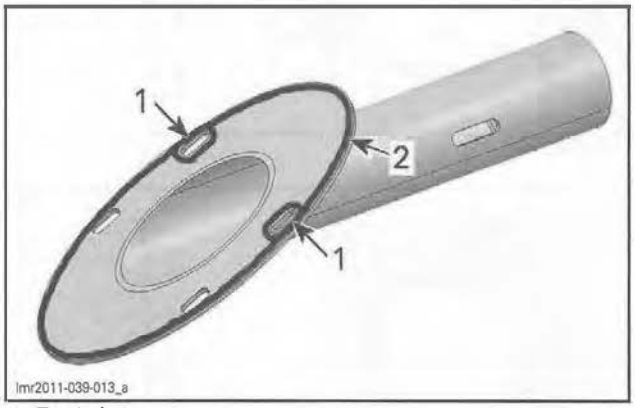
Remove fasteners securing the thru-hull fitting.

Using a heat gun, heat thru-hull fitting flange to soften the sealing product.

Remove thru-hull fitting.

Clean hull surface with BRP HEAVY DUTY CLEANER (P/N 293 110 001) or an equivalent to eliminate grease, dust and any residue of sealant.

Apply LOCTITE INSTANT GASKET (P/N 219 701 421) around perimeter of part and upper holes, and also around holes in hull.



1. *Top holes*
2. *Sealing product*

Secure the thru-hull fitting. Insert bolts through top 2 holes only.

BALLAST BAG

Ballast Bag Location

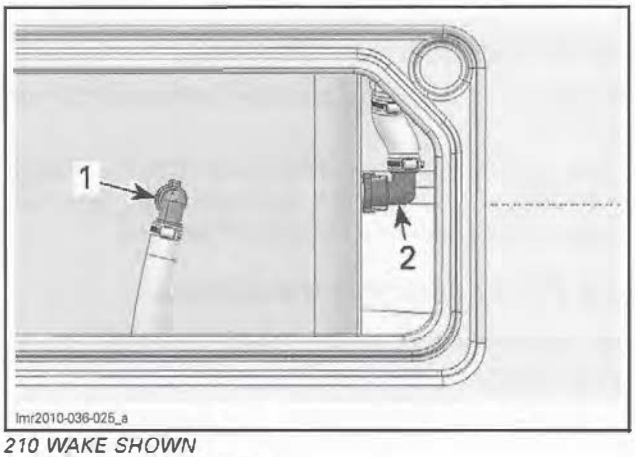
MODEL	LOCATION
210 WAKE	Inside deck storage compartment
230 WAKE	Under rear side seats

Ballast Bag Removal

If the boat is in water, close the ballast valve(s) before opening the ballast system. These valve(s) is (are) located:

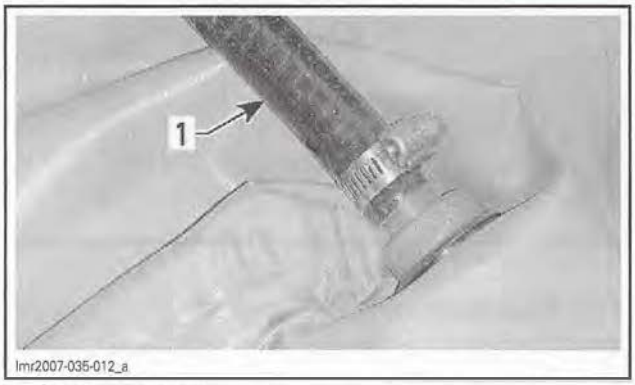
- 210 WAKE: inside deck storage compartment
- 230 WAKE: on the RH side of starboard engine, near battery.

Unplug the inlet and outlet connectors from the ballast bag.



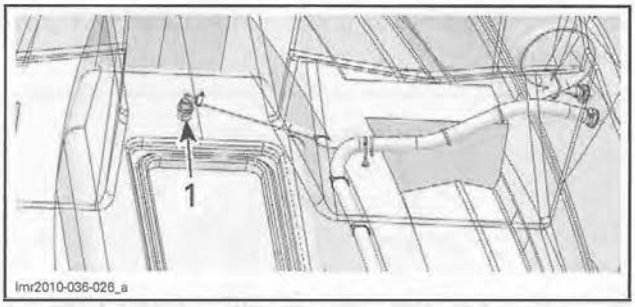
210 WAKE SHOWN
1. *Ballast inlet connector*
2. *Ballast outlet connector*

NOTE: On 230 WAKE, loosen clamp and remove outlet hose from the ballast bag adapter



1. *Ballast outlet hose*

At the front of bag, disconnect the overflow hose by pressing the RED collar.



210 WAKE SHOWN – DECK TRANSPARENT FOR CLARITY PURPOSE
1. *Overflow hose connector*

Remove the ballast bag.

Ballast Bag Installation

The installation is the reverse of the removal procedure.

GELCOAT

Gelcoat is the smooth and durable cosmetic finish which coats the fiberglass hull and body of a Sea-Doo Sport Boat. 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 sport boat are constructed of chopped fiberglass, saturated with resin. It is sprayed on the layer of gelcoat along with pieces of fiberglass mat, cloth and woven roving which are added at required areas. This type of construction is very accommodating for high quality repairs. With patience, the proper techniques and materials, a damaged area can be restored to an original finish.

NOTE: Fiberglass repair kit is available through automotive or marine suppliers. Gelcoat repair kits are available directly from Gelcote International Ltd.

Tools and Materials List For Gelcoat Repair

⚠ 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.

TOOLS	
Air mask	Power sander
Buffing pad	Putty knife
Cover sheets	Safety glasses
Heavy-duty polisher	Sanding block
Paint brush	Scissors
Plastic container (mixing)	Spray gun
Plastic film	Stirring stick
Plastic squeegee	White cloths

MATERIALS	
Acetone	Liquid gelcoat
Cabosil	Masking tape
Cardboard	Medium compound (white)
Epoxy filler	Polyester resin
Fiberglass cloth	Sanding disks (24-grit)
Fiberglass mat	Sandpaper*
Fine compound (white)	Wax
Gelcoat putty	

* Different grit sizes will be used during repair (100-grit, 220-grit, 320-grit, 400-grit, 600-grit, 1000-grit).

Air Bubble Repair

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.

Blister Repair

Possible causes:

- Insert catalyst
- Improper catalyst/gelcoat ratio.

A blister is a visible bump on the boat 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 Fracture Repair

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 Surface

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 boat from overspray.

Mix the needed quantity of gelcoat and catalyst according to suppliers recommendations. The gelcoat can be thinned with acetone up to 10%. If it needs more consistency you can add cabosil.

Make sure that the air supply is free of oil, dirt and water.

Test spray the gelcoat mixture on paper to verify its consistency and pattern. You may have to apply 5 or 6 coats to cover the area properly. Overlap each coat further than the last, leaving at least 30 seconds between passes. Avoid trying to coat the surface with only a few heavy coats, this will not allow the gelcoat to dry properly.

Apply a coat of polyvinyl alcohol (PVA) to seal off the air and protect the gelcoat surface from dust. PVA speeds up the curing process because gelcoat will not cure properly when exposed to air.

Sanding

Wash the polyvinyl alcohol off with water. Depending on the size of the area repaired, you can either block sand as per previous procedure or you may use an air sander. Sand the surface down with progressively finer grits of sandpaper until the desired finish is achieved.

Buffing and Waxing

Buff the surface using a heavy duty polisher with a buffing pad. Make sure the pad is free of dirt or you may damage the gelcoat. Carefully begin buffing with a white medium compound. Finish off using a fine compound. While buffing, pay close attention to avoid overheating the surface.

Compound Fracture Repair

Possible causes:

- Thickness of fiberglass laminate
- Direct result of impact.

Compound fractures are those that have gone past the gelcoated surface and in through the layers of fiberglass laminate. Two types of repairs have to be performed. The first is to restore the structural integrity of the damaged area. Fracture types can vary from a simple crack to a large hole. Usually, fiberglass reinforcement becomes necessary, especially if the fracture can be attributed to weakness. The final part of the repair is the gelcoating, which cannot be done until the interior and exterior laminate surfaces have been repaired.

Outside: Remove the damaged gelcoat and fiberglass with a 24-grit disk using a power sander. Grind outward at least 2 inches from the fracture to allow the patch to bond to strong material.

Cut enough pieces of fiberglass mat necessary to build up the area. The pieces should be cut so they overlap each other by at least a half inch. For a smoother finish, the last layer should be fiberglass cloth. If the fracture is small enough all you may have to do is fill the area with an epoxy filler.

Inside: For the interior repair, you can grind more. This will allow for more fiberglass material which will strengthen the area. If the fracture opening is too large after surface preparation, you may need a backing support to cover the opening. Cut alternating pieces of fiberglass mat and cloth in overlapping sizes.

Patching the Repair Area

Outside: The outside should be done first. Wipe clean the area with acetone on a cloth, then mask off area. For a small crack use an epoxy filler in the same way you would use gelcoat repair putty. When laying up a larger area you will use mat, cloth and fiberglass resin and catalyst. Use a clean container to mix the resin, mix only what you will need. Follow the recommended catalyst ratio.

Using a clean paintbrush, brush the mixed resin on the surface. Place the smallest piece of mat over the fracture and then wet out the mat. Follow with the remaining pieces of mat and final layer of cloth. While wetting the pieces make sure you work the air bubbles out and saturate all the pieces evenly. Try to work quickly, you may only have 15 or 20 minutes. You may clean the brush with acetone.

Wait until the repair has hardened before moving on to the interior repair. If the size of the opening is too large for the pieces to maintain the proper shape, you will have to use a backing support. It is a shaped piece of cardboard that fits flush to the interior surface and has a plastic layer on the repair side. It is held in place by tape or a support.

Inside: Wipe down the area with acetone on a cloth. Apply the same procedure as for outside repair when laminating the alternating pieces of fiberglass material. If a backing support was used, remove it before starting the repair. After the area has hardened, remove sharp edges of material from surface. If required paint the surface.

Sanding

Outside: This surface will have to be prepared for application of gelcoat. The size of the area will determine the gelcoating procedure to be used. Refer to the *REPAIR PROCEDURE FOR MINOR GELCOAT FRACTURES*.

Buffing and Waxing

Refer to the *BUFFING AND WAXING FOR MINOR GELCOAT FRACTURES*.

150 SPEEDSTER

MODEL			155 ENGINE	255 ENGINE
ENGINE				
Engine type			ROTAX® 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)	
Induction			Naturally-aspirated	Supercharged intercooled
Number of cylinders			3	
Number of valves			12 valves with hydraulic lifters (no adjustment)	
Bore		Standard	100 mm (3.9 in)	
		1st Oversize	100.25 mm (3.95 in)	
Stroke			63.4 mm (2.5 in)	
Displacement			1 493.8 cm³ (91 in³)	
Compression ratio			10.6:1	8.4:1
Maximum RPM			7300 RPM	8000 RPM
Lubrication		Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler	
		Oil type	XPS synthetic blend oil (summer grade) (P/N 293 600 121). Refer to *LUBRICATION SYSTEM* subsection	
		Capacity	3 L (3.2 qt (U.S. liq.)) oil change w/filter 4.5 L (4.8 qt (U.S. liq.)) total	
Intake valve opening			0° BTDC	
Intake valve closing			50° ABDC	
Exhaust valve opening			50° BBDC	
Exhaust valve closing			0° ATDC	
Valve stem diameter	Intake	New	5.961 mm to 5.975 mm (.2347 in to .2352 in)	
		Wear limit	5.930 mm (.233 in)	
	Exhaust	New	5.946 mm to 5.960 mm (.2341 in to .2346 in)	
		Wear limit	5.930 mm (.233 in)	
Valve guide diameter		New	5.994 mm to 6.018 mm (.236 in to .2369 in)	
		Wear limit	6.060 mm (.2386 in)	
Valve spring free length	Inner	New	41.02 mm (1.615 in)	
		Wear limit	38.80 mm (1.528 in)	
	Outer	New	45.45 mm (1.789 in)	
		Wear limit	43.00 mm (1.693 in)	
Valve seat contact width	Intake	New	1.10 mm to 1.30 mm (.043 in to .051 in)	
		Wear limit	1.60 mm (.063 in)	
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)	
		Wear limit	1.80 mm (.071 in)	
Rocker arm inner diameter		New	20.007 mm to 20.020 mm (.7877 in to .7882 in)	
		Wear limit	20.050 mm (.7894 in)	
Rocker arm shaft diameter		New	19.980 mm to 19.993 mm (.7866 in to .7871 in)	
		Wear limit	19.970 mm (.7862 in)	
Cylinder head maximum warpage		Service limit	0.15 mm (.006 in)	

MODEL			155 ENGINE	255 ENGINE
ENGINE (cont'd)				
Piston ring type and quantity		1st	Upper compression ring, rectangular	
		2nd	Lower compression ring, tapered face	
		3rd	Oil scraper ring	
Ring end gap	Rectangular	New	0.30 mm to 0.50 mm (.012 in to .02 in)	
	Taper-face	New	0.35 mm to 0.55 mm (.014 in to .022 in)	
	Oil scraper ring	New	0.35 mm to 0.50 mm (.014 in to .02 in)	
	All	Wear limit	1.50 mm (.059 in)	
Ring/piston groove clearance	Rectangular	New	0.025 mm to 0.070 mm (.001 in to .003 in)	
	Taper-face	New	0.015 mm to 0.06 mm (.0006 in to .0024 in)	
	Oil scraper ring	New	0.020 mm to 0.055 mm (.001 in to .002 in)	
	All	Wear limit	0.15 mm (.006 in)	
Piston/cylinder wall clearance		New	0.024 mm to 0.056 mm (.0009 in to .0022 in)	0.04 mm to 0.08 mm (.0016 in to .0031 in)
		Wear limit	0.100 mm (.0039 in)	
Cylinder taper		Wear limit	0.100 mm (.0039 in)	
Cylinder out of round (maximum)			0.015 mm (.0006 in)	
Camshaft bearing journal diameter	Front	New	24.939 mm to 24.960 mm (.9819 in to .9827 in)	
		Wear limit	24.910 mm (.9807 in)	
	PTO and center	New	39.892 mm to 39.905 mm (1.5706 in to 1.5711 in)	
		Wear limit	39.880 mm (1.5701 in)	
Camshaft bearing inner diameter	Front	New	25.000 mm to 25.013 mm (.9843 in to .9848 in)	
		Wear limit	25.050 mm (.9862 in)	
	PTO and center	New	40.000 mm to 40.020 mm (1.5748 in to 1.5756 in)	
		Wear limit	40.050 mm (1.5768 in)	
Cam lobe height	Intake	New	31.540 mm to 31.740 mm (1.2417 in to 1.2496 in)	
		Wear limit	31.50 mm (1.2402 in)	
	Exhaust	New	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)	
		Wear limit	31.380 mm (1.2354 in)	
Crankshaft deflection		Maximum	0.05 mm (.002 in)	
Crankshaft axial clearance		New	0.080 mm to 0.220 mm (.0031 in to .0087 in)	
		Wear limit	0.35 mm (.014 in)	
Crankshaft bearing journal diameter		New	49.991 mm to 50.000 mm (1.9681 in to 1.9685 in)	
		Wear limit	49.950 mm (1.9665 in)	
Crankshaft radial clearance		Wear limit	0.07 mm (.0028 in)	
Connecting rod big end diameter		Service limit	45.080 mm (1.7748 in)	
Connecting rod big end radial play		Service limit	0.090 mm (.0035 in)	
Cylinder head maximum warpage		Service limit	0.15 mm (.006 in)	
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.004 in to .014 in)	
		Wear limit	0.500 mm (.0197 in)	

MODEL		155 ENGINE	255 ENGINE
ENGINE (cont'd)			
Connecting rod small end diameter	New	23.010 mm to 23.020 mm (.9059 in to .9063 in)	
	Wear limit	23.070 mm (.9083 in)	
Piston pin diameter	New	22.996 mm to 23.000 mm (.9054 in to .9055 in)	
	Wear limit	22.990 mm (.9051 in)	
Connecting rod small end radial play	Wear limit	0.080 mm (.0031 in)	
Balance shaft journal diameter	New	31.984 mm to 32.000 mm (1.2592 in to 1.2598 in)	
	Wear limit	31.950 mm (1.2579 in)	
Balance shaft radial clearance	Wear limit	0.070 mm (.0028 in)	
Balance shaft axial clearance	New	0.020 mm to 0.250 mm (.0008 in to .0098 in)	
Supercharger shaft driven plate journal depth	New	—	14.460 mm to 14.500 mm (.5693 in to .5709 in)
	Wear limit	—	14.600 mm (.5748 in)
Supercharger drive gear thickness	New	—	11.000 mm to 11.050 mm (.4331 in to .435 in)
	Wear limit	—	10.900 mm (.4291 in)
Supercharger lock washer thickness	New	—	4.050 mm to 4.150 mm (.1594 in to .1634 in)
	Wear limit	—	3.950 mm (.1555 in)
Supercharger spring washer package height (not compressed)	New	—	10.900 mm to 10.700 mm (.4291 in to .4213 in)
	Wear limit	—	10.200 mm (.4016 in)
AIR INTAKE SYSTEM			
Intake spark arrester		Tubular, wire screen	
ENGINE COOLING SYSTEM			
Type		Closed loop cooling system	
Coolant		Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines	
Cooling system capacity		5.5 L (5.8 qt (U.S. liq.)) total	
Thermostat		87°C (189°F)	
Monitoring beeper setting		100°C (212°F)	
EXHAUST SYSTEM			
Type		Water cooled/water injected (opened loop). Direct flow from jet pump	
Water injection in muffler		3 x 3.5 mm (.138 in) on exhaust pipe and 1 x 3.5 mm (.138 in) on muffler	

MODEL		155 ENGINE	255 ENGINE
ELECTRICAL SYSTEM			
Fuse box 1	F1: Gauge	3 A	
	F2: Beeper	3 A	
	F3: Depth sounder	3 A	
	F4: Fuel level	3 A	
	F5: Unused	—	
	F6: Fuel pump	10 A	
	F7: Cylinder 1	10 A	
	F8: Cylinder 2	10 A	
	F9: Cylinder 3	10 A	
	F11: Diagnostic tool	15 A	
	F13: Starter relay	10 A	
	F14: CAPS	3 A	
Fuse box 2	F15: Charge	30 A	
	F16: Battery	30 A	
Front fuse box	F1: Blower	5 A	
	F2: Bilge pump	3 A CE model: 7.5 A	
	F3: Navigation/anchor light	3 A	
	F4: Unused	—	
	F5: Stereo	10 A	
	F6: 12-Volt power outlet	10 A	
Automatic bilge pump		3 A CE model: 7.5 A	
Automatic extinguisher		3 A (CE model only)	
Magneto generator output		360 W @ 6000 RPM	
Stator		0.1 to 1.0 Ω	
Battery		Not supplied. Refer to *BATTERY* subsection for recommended models. 12 V group 24, marine starting battery with top-mounted, round taper type battery post	
Ignition system type		DI (Digital Inductive)	
Ignition timing		Variable (electronically controlled)	
Spark plug	Make and type	NGK DCPR8E	
	Gap	0.7 mm to 0.8 mm (.028 in to .031 in)	
Ignition coil	Primary	0.85 to 1.15 Ω	
	Secondary	9.5 to 13.5 KΩ	
Engine RPM limiter setting		7300 RPM	8000 RPM

MODEL			155 ENGINE	255 ENGINE
FUEL SYSTEM				
Fuel injection type			Multipoint Fuel Injection. Single throttle body (52 mm)	
Fuel pressure			290 kPa to 310 kPa (42 PSI to 45 PSI)	386 kPa to 414 kPa (56 PSI to 60 PSI)
Fuel injector		Quantity	3	
Fuel	Type		Unleaded gasoline	
	Octane rating (minimum)		Inside North America: 87 (RON + MON)/2 Outside North America: 92 RON	
	Octane rating (optimum performance)		—	Inside North America: 91 (RON + MON)/2 Outside North America: 95 RON
Fuel tank (including reserve)			79.5 L (21 U.S. gal.)	
Idle speed			1800 ± 50 RPM (not adjustable)	
PROPULSION SYSTEM				
Jet pump	Type		Axial flow single stage	
	Grease type		Jet pump bearing grease (P/N 293 550 032) sold by BRP	
Impeller	Rotation (seen from rear)		Counterclockwise	
	Pitch		10°/21°	14°/24°
	Outside diameter		155mm ± 0.06mm (6.102 in ± .002 in)	159mm ± 0.06mm (6.26 in ± .002 in)
Impeller/wear ring clearance	New		0 mm to 0.23 mm (0 in to .009 in)	
	Wear limit		0.35 mm (.0138 in)	
Impeller shaft	End play (new)		0	
	Side play		0	
Drive shaft	Coupling type		Crowned splines, direct drive	
	Deflection (maximum)		0.5 mm (.02 in)	
Steering nozzle pivoting angle			20°	
Minimum required water level for propulsion system			90 cm (3 ft) underneath the lowest rear portion of hull	
WEIGHT AND LOADING CAPACITY				
Dry weight	No tower		659 kg (1,453 lb)	
	With tower		669 kg (1,475 lb)	
Number of passenger (driver incl.)			4	
Load limit (passenger and luggage) (based on calm water operation)			4 passengers OR 324 kg (715 lb)	
Gross weight (on trailer)			952 kg (2,100 lb)	
DIMENSIONS				
Overall length			4.67 m (15.3 ft)	
Beam			2.16 m (7.1 ft)	
Draft			30.5 cm (1 ft)	
Dead rise			20°	

MODEL		155 ENGINE	255 ENGINE
DIMENSIONS (ON TRAILER)			
Overall length		5.6 m (18.4 ft)	
Width		2.16 m (7.1 ft)	
Height	No tower	1.5 m (4.9 ft)	
	Tower down	2.08 m (6.8 ft)	
	Tower up	2.59 m (8.5 ft)	

180 CHALLENGER

MODEL			215 ENGINE	255 ENGINE
ENGINE				
Engine type			ROTAX® 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)	
Induction			Supercharged intercooled	
Number of cylinders			3	
Number of valves			12 valves with hydraulic lifters (no adjustment)	
Bore		Standard	100 mm (3.9 in)	
		1st Oversize	100.25 mm (3.95 in)	
Stroke			63.4 mm (2.5 in)	
Displacement			1 493.8 cm³ (91 in³)	
Compression ratio			8.4:1	
Maximum RPM			8000 ± 50 RPM	
Lubrication		Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler	
		Oil type	XPS synthetic blend oil (summer grade) (P/N 293 600 121). Refer to *LUBRICATION SYSTEM* subsection	
		Capacity	3 L (3.2 qt (U.S. liq.)) oil change w/filter 4.5 L (4.8 qt (U.S. liq.)) total	
Intake valve opening			0° BTDC	
Intake valve closing			50° ABDC	
Exhaust valve opening			50° BBDC	
Exhaust valve closing			0° ATDC	
Valve stem diameter	Intake	New	5.961 mm to 5.975 mm (.2347 in to .2352 in)	
		Wear limit	5.930 mm (.233 in)	
	Exhaust	New	5.946 mm to 5.960 mm (.2341 in to .2346 in)	
		Wear limit	5.930 mm (.233 in)	
Valve guide diameter		New	5.994 mm to 6.018 mm (.236 in to .2369 in)	
		Wear limit	6.060 mm (.2386 in)	
Valve spring free length	Inner	New	41.02mm (1.615in)	
		Wear limit	38.80 mm (1.528 in)	
	Outer	New	45.45 mm (1.789 in)	
		Wear limit	43.00 mm (1.693 in)	
Valve seat contact width	Intake	New	1.10 mm to 1.30 mm (.043 in to .051 in)	
		Wear limit	1.60 mm (.063 in)	
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)	
		Wear limit	1.80 mm (.071 in)	
Rocker arm inner diameter		New	20.007 mm to 20.020 mm (.7877 in to .7882 in)	
		Wear limit	20.050 mm (.7894 in)	
Rocker arm shaft diameter		New	19.980 mm to 19.993 mm (.7866 in to .7871 in)	
		Wear limit	19.970 mm (.7862 in)	
Cylinder head maximum warpage		Service limit	0.15 mm (.006 in)	

MODEL			215 ENGINE	255 ENGINE
ENGINE (cont'd)				
Piston ring type and quantity		1st	Upper compression ring, rectangular	
		2nd	Lower compression ring, tapered face	
		3rd	Oil scraper ring	
Ring end gap	Rectangular	New	0.30 mm to 0.50 mm (.012 in to .02 in)	
	Taper-face	New	0.35 mm to 0.55 mm (.014 in to .022 in)	
	Oil scraper ring	New	0.35 mm to 0.50 mm (.014 in to .02 in)	
	All	Wear limit	1.50 mm (.059 in)	
Ring/piston groove clearance	Rectangular	New	0.025 mm to 0.070 mm (.001 in to .003 in)	
	Taper-face	New	0.015 mm to 0.06 mm (.0006 in to .0024 in)	
	Oil scraper ring	New	0.020 mm to 0.055 mm (.001 in to .002 in)	
	All	Wear limit	0.15 mm (.006 in)	
Piston/cylinder wall clearance		New	0.04 mm to 0.08 mm (.0016 in to .0031 in)	
		Wear limit	0.100 mm (.0039 in)	
Cylinder taper		Wear limit	0.100 mm (.0039 in)	
Cylinder out of round (maximum)			0.015 mm (.0006 in)	
Camshaft bearing journal diameter	Front	New	24.939 mm to 24.960 mm (.9819 in to .9827 in)	
		Wear limit	24.910 mm (.9807 in)	
	PTO and center	New	39.892 mm to 39.905 mm (1.5706 in to 1.5711 in)	
		Wear limit	39.880 mm (1.5701 in)	
Camshaft bearing inner diameter	Front	New	25.000 mm to 25.013 mm (.9843 in to .9848 in)	
		Wear limit	25.050 mm (.9862 in)	
	PTO and center	New	40.000 mm to 40.020 mm (1.5748 in to 1.5756 in)	
		Wear limit	40.050 mm (1.5768 in)	
Cam lobe height	Intake	New	31.540 mm to 31.740 mm (1.2417 in to 1.2496 in)	
		Wear limit	31.50 mm (1.2402 in)	
	Exhaust	New	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)	
		Wear limit	31.380 mm (1.2354 in)	
Crankshaft deflection		Maximum	0.05 mm (.002 in)	
Crankshaft axial clearance		New	0.080 mm to 0.220 mm (.0031 in to .0087 in)	
		Wear limit	0.35 mm (.014 in)	
Crankshaft bearing journal diameter		New	49.991 mm to 50.000 mm (1.9681 in to 1.9685 in)	
		Wear limit	49.950 mm (1.9665 in)	
Crankshaft radial clearance		Wear limit	0.07 mm (.0028 in)	
Connecting rod big end diameter		Service limit	45.080 mm (1.7748 in)	
Connecting rod big end radial play		Service limit	0.090 mm (.0035 in)	
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.004 in to .014 in)	
		Wear limit	0.500 mm (.0197 in)	
Connecting rod small end diameter		New	23.010 mm to 23.020 mm (.9059 in to .9063 in)	
		Wear limit	23.070 mm (.9083 in)	

MODEL			215 ENGINE	255 ENGINE
ENGINE (cont'd)				
Piston pin diameter		New	22.996 mm to 23.000 mm (.9054 in to .9055 in)	
		Wear limit	22.990 mm (.9051 in)	
Connecting rod small end radial play		Wear limit	0.080 mm (.0031 in)	
Balance shaft journal diameter		New	31.984 mm to 32.000 mm (1.2592 in to 1.2598 in)	
		Wear limit	31.950 mm (1.2579 in)	
Balance shaft radial clearance		Wear limit	0.070 mm (.0028 in)	
Balance shaft axial clearance		New	0.020 mm to 0.250 mm (.0008 in to .0098 in)	
Supercharger shaft driven plate journal depth		New	14.460 mm to 14.500 mm (.5693 in to .5709 in)	
		Wear limit	14.600 mm (.5748 in)	
Supercharger drive gear thickness		New	11.000 mm to 11.050 mm (.4331 in to .435 in)	
		Wear limit	10.900 mm (.4291 in)	
Supercharger lock washer thickness		New	4.050 mm to 4.150 mm (.1594 in to .1634 in)	
		Wear limit	3.950 mm (.1555 in)	
Supercharger spring washer package height (not compressed)		New	10.900 mm to 10.700 mm (.4291 in to .4213 in)	
		Wear limit	10.200 mm (.4016 in)	
AIR INTAKE SYSTEM				
Intake spark arrester			Tubular, wire screen	
ENGINE COOLING SYSTEM				
Type			Closed loop cooling system	
Coolant			Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines	
Cooling system capacity			5.5 L (5.8 qt (U.S. liq.)) total	
Thermostat			87°C (189°F)	
Monitoring beeper setting			100°C (212°F)	
EXHAUST SYSTEM				
Type			Water cooled/water injected (opened loop). Direct flow from jet pump	
Water injection in muffler			3 x 3.5 mm (.138 in) on exhaust pipe and 1 x 3.5 mm (.138 in) on muffler	
ELECTRICAL SYSTEM				
Fuse box 1	F1: Gauge		3 A	
	F2: Beeper		3 A	
	F3: Depth sounder		3 A	
	F4: Fuel level		3 A	
	F5: Unused		—	
	F6: Fuel pump		10 A	
	F7: Cylinder 1		10 A	
	F8: Cylinder 2		10 A	
	F9: Cylinder 3		10 A	
	F11: Diagnostic tool		15 A	
	F13: Starter relay		10 A	
	F14: CAPS		3 A	

MODEL			215 ENGINE	255 ENGINE
ELECTRICAL SYSTEM (cont'd)				
Fuse box 2	F15: Charge		30 A	
	F16: Battery		30 A	
Front fuse box	F1: Blower		5 A	
	F2: Bilge pump		3 A	
	F3: Navigation/anchor light		3 A	
	F4: Courtesy lights		3 A	
	F5: Stereo		10 A	
	F6: 12-Volt power outlet		10 A	
	F7: Horn		7.5 A	
Automatic bilge pump			3 A	
Clock			3 A	
Main circuit breaker			35 A	
Magneto generator output			360 W @ 6000 RPM	
Stator			0.1 to 1.0 Ω	
Battery			Not supplied. Refer to *BATTERY* subsection for recommended models. 12 V group 24, marine starting battery with top-mounted, round taper type battery post	
Ignition system type			DI (Digital Inductive)	
Ignition timing			Variable (electronically controlled)	
Spark plug		Make and type	NGK DCPR8E	
		Gap	0.7 mm to 0.8 mm (.028 in to .031 in)	
Ignition coil		Primary	0.85 to 1.15 Ω	
		Secondary	9.5 to 13.5 KΩ	
Engine RPM limiter setting			8000 RPM	
FUEL SYSTEM				
Fuel injection type			Multipoint Fuel Injection. Single throttle body (52 mm)	
Fuel pressure			386 kPa to 414 kPa (56 PSI to 60 PSI)	
Fuel injector		Quantity	3	
Fuel	Type		Unleaded gasoline	
	Octane rating (minimum)		Inside North America: 87 (RON + MON)/2 Outside North America: 92 RON	
	Octane rating (optimum performance)		Inside North America: 91 (RON + MON)/2 Outside North America: 95 RON	
Fuel tank (including reserve)			121 L (32 U.S. gal.)	
Idle speed			1800 ± 50 RPM (not adjustable)	

MODEL			215 ENGINE	255 ENGINE
PROPULSION SYSTEM				
Jet pump	Type		Axial flow single stage	
	Grease type		Jet pump bearing grease (P/N 293 550 032) sold by BRP	
Impeller	Rotation (seen from rear)		Counterclockwise	
	Pitch		10°/20°	14°/23°
	Outside diameter		159 mm ± 0.06 mm (6.26 in ± .002 in)	
Impeller/wear ring clearance	New		0 mm to 0.23 mm (0 in to .009 in)	
	Wear limit		0.35 mm (.0138 in)	
Impeller shaft	End play (new)		0	
	Side play		0	
Drive shaft	Coupling type		Crowned splines, direct drive	
	Deflection (maximum)		0.5 mm (.02 in)	
Steering nozzle pivoting angle			20°	
Minimum required water level for propulsion system			90 cm (3 ft) underneath the lowest rear portion of hull	
WEIGHT AND LOADING CAPACITY				
Dry weight	No tower		868 kg (1,914 lb)	
	With tower		SE: 884 kg (1,949 lb)	
Number of passenger (driver incl.)			8	
Load limit (passenger and luggage) (based on calm water operation)			8 passengers OR 627 kg (1,382 lb)	
Gross weight (on trailer)	No tower		1 290 kg (2,844 lb)	
	With tower		1 306 kg (2,879 lb)	
DIMENSIONS				
Overall length			5.36 m (17.6 ft)	
Beam			2.49 m (8.2 ft)	
Draft			30.5 cm (1 ft)	
Dead rise			20°	
DIMENSIONS (ON TRAILER)				
Overall length (with swing-away tongue folded)			5.86 m (19.2 ft)	
Width			2.49 m (8.2 ft)	
Height		No tower	1.98 m (6.5 ft)	
		Tower down	SE: 2.29 m (7.5 ft)	
		Tower up	SE: 2.8 m (9.2 ft)	

200 SPEEDSTER

MODEL			TWIN 255 ENGINE
ENGINE			
Engine type			ROTAX® 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)
Number of engines			2
Induction			Supercharged intercooled
Number of cylinders			3
Number of valves			12 valves with hydraulic lifters (no adjustment)
Bore		Standard	100 mm (3.9 in)
		1st Oversize	100.25 mm (3.95 in)
Stroke			63.4 mm (2.5 in)
Displacement			1 493.8 cm^3 (91 in^3)
Compression ratio			8.4:1
Maximum RPM			8000 ± 50 RPM
Lubrication		Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler
		Oil type	XPS synthetic blend oil (summer grade) (P/N 293 600 121). Refer to *LUBRICATION SYSTEM* subsection
		Capacity	3 L (3.2 qt (U.S. liq.)) oil change w/filter 4.5 L (4.8 qt (U.S. liq.)) total
Intake valve opening			0° BTDC
Intake valve closing			50° ABDC
Exhaust valve opening			50° BBDC
Exhaust valve closing			0° ATDC
Valve stem diameter	Intake	New	5.961 mm to 5.975 mm (.2347 in to .2352 in)
		Wear limit	5.930 mm (.233 in)
	Exhaust	New	5.946 mm to 5.960 mm (.2341 in to .2346 in)
		Wear limit	5.930 mm (.233 in)
Valve guide diameter		New	5.994 mm to 6.018 mm (.236 in to .2369 in)
		Wear limit	6.060 mm (.2386 in)
Valve spring free length	Inner	New	41.02mm (1.615 in)
		Wear limit	38.80 mm (1.528 in)
	Outer	New	45.45 mm (1.789 in)
		Wear limit	43.00 mm (1.693 in)
Valve seat contact width	Intake	New	1.10 mm to 1.30 mm (.043 in to .051 in)
		Wear limit	1.60 mm (.063 in)
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)
		Wear limit	1.80 mm (.071 in)
Rocker arm inner diameter		New	20.007 mm to 20.020 mm (.7877 in to .7882 in)
		Wear limit	20.050 mm (.7894 in)
Rocker arm shaft diameter		New	19.980 mm to 19.993 mm (.7866 in to .7871 in)
		Wear limit	19.970 mm (.7862 in)

MODEL			TWIN 255 ENGINE
ENGINE (cont'd)			
Cylinder head maximum warpage		Service limit	0.15 mm (.006 in)
Piston ring type and quantity		1st	Upper compression ring, rectangular
		2nd	Lower compression ring, tapered face
		3rd	Oil scraper ring
Ring end gap	Rectangular	New	0.30 mm to 0.50 mm (.012 in to .02 in)
	Taper-face	New	0.35 mm to 0.55 mm (.014 in to .022 in)
	Oil scraper ring	New	0.35 mm to 0.50 mm (.014 in to .02 in)
	All	Wear limit	1.50 mm (.059 in)
Ring/piston groove clearance	Rectangular	New	0.025 mm to 0.070 mm (.001 in to .003 in)
	Taper-face	New	0.015 mm to 0.06 mm (.0006 in to .0024 in)
	Oil scraper ring	New	0.020 mm to 0.055 mm (.001 in to .002 in)
	All	Wear limit	0.15 mm (.006 in)
Piston/cylinder wall clearance		New	0.04 mm to 0.08 mm (.0016 in to .0031 in)
		Wear limit	0.100 mm (.0039 in)
Cylinder taper		Wear limit	0.100 mm (.0039 in)
Cylinder out of round (maximum)			0.015 mm (.0006 in)
Camshaft bearing journal diameter	Front	New	24.939 mm to 24.960 mm (.9819 in to .9827 in)
		Wear limit	24.910 mm (.9807 in)
	PTO and center	New	39.892 mm to 39.905 mm (1.5706 in to 1.5711 in)
		Wear limit	39.880 mm (1.5701 in)
Camshaft bearing inner diameter	Front	New	25.000 mm to 25.013 mm (.9843 in to .9848 in)
		Wear limit	25.050 mm (.9862 in)
	PTO and center	New	40.000 mm to 40.020 mm (1.5748 in to 1.5756 in)
		Wear limit	40.050 mm (1.5768 in)
Cam lobe height	Intake	New	31.540 mm to 31.740 mm (1.2417 in to 1.2496 in)
		Wear limit	31.50 mm (1.2402 in)
	Exhaust	New	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)
		Wear limit	31.380 mm (1.2354 in)
Crankshaft deflection		Maximum	0.05 mm (.002 in)
Crankshaft axial clearance		New	0.080 mm to 0.220 mm (.0031 in to .0087 in)
		Wear limit	0.35 mm (.014 in)
Crankshaft bearing journal diameter		New	49.991 mm to 50.000 mm (1.9681 in to 1.9685 in)
		Wear limit	49.950 mm (1.9665 in)
Crankshaft radial clearance		Wear limit	0.07 mm (.0028 in)
Connecting rod big end diameter		Service limit	45.080 mm (1.7748 in)
Connecting rod big end radial play		Service limit	0.090 mm (.0035 in)
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.004 in to .014 in)
		Wear limit	0.500 mm (.0197 in)
Connecting rod small end diameter		New	23.010 mm to 23.020 mm (.9059 in to .9063 in)
		Wear limit	23.070 mm (.9083 in)

MODEL		TWIN 255 ENGINE
ENGINE (cont'd)		
Piston pin diameter	New	22.996 mm to 23.000 mm (.9054 in to .9055 in)
	Wear limit	22.990 mm (.9051 in)
Connecting rod small end radial play	Wear limit	0.080 mm (.0031 in)
Balance shaft journal diameter	New	31.984 mm to 32.000 mm (1.2592 in to 1.2598 in)
	Wear limit	31.950 mm (1.2579 in)
Balance shaft radial clearance	Wear limit	0.070 mm (.0028 in)
Balance shaft axial clearance	New	0.020 mm to 0.250 mm (.0008 in to .0098 in)
Supercharger shaft driven plate journal depth	New	14.460 mm to 14.500 mm (.5693 in to .5709 in)
	Wear limit	14.600 mm (.5748 in)
Supercharger drive gear thickness	New	11.000 mm to 11.050 mm (.4331 in to .435 in)
	Wear limit	10.900 mm (.4291 in)
Supercharger lock washer thickness	New	4.050 mm to 4.150 mm (.1594 in to .1634 in)
	Wear limit	3.950 mm (.1555 in)
Supercharger spring washer package height (not compressed)	New	10.900 mm to 10.700 mm (.4291 in to .4213 in)
	Wear limit	10.200 mm (.4016 in)
AIR INTAKE SYSTEM		
Intake spark arrester		Tubular, wire screen
ENGINE COOLING SYSTEM		
Type		Closed loop cooling system
Coolant		Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines
Cooling system capacity		5.5 L (5.8 qt (U.S. liq.)) total
Thermostat		87°C (189°F)
Monitoring beeper setting		100°C (212°F)
EXHAUST SYSTEM		
Type		Water cooled/water injected (opened loop). Direct flow from jet pump
Water injection in muffler		3 x 3.5 mm (.138 in) on exhaust pipe and 1 x 3.5 mm (.138 in) on muffler
ELECTRICAL SYSTEM		
Fuses (engines)	F1: Fuel pump	10 A
	F2: Cylinder 3, ignition coil and injection	10 A
	F3: ECM	5 A
	F4: Cylinder 1, ignition coil and injection	10 A
	F5: Cylinder 2, ignition coil and injection	10 A
	F6: Gauges	2 A

MODEL			TWIN 255 ENGINE
ELECTRICAL SYSTEM (cont'd)			
Fuses (VCM)	F1: Accessories		10 A
	F2: Radio		10 A
	F3: Blower		10 A
	F4: Bilge pump		3 A CE model: 7.5 A
	F5: NAV lights		3 A
	F6: Courtesy lights		5 A
Fuses (boat)	VCM		2 x 20 A
	Charging system		2 x 30 A
	Automatic bilge pump		3 A CE model: 7.5 A
	EFB		2 x 15 A
	Blower motor		2 x 5 A
Automatic extinguisher			3 A (CE model only)
Magneto generator output			360 W @ 6000 RPM
Stator			0.1 to 1.0 Ω
Battery			Not supplied. Refer to *BATTERY* subsection for recommended models. 12 V group 24, marine starting battery with top-mounted, round taper type battery post
Ignition system type			DI (Digital Inductive)
Ignition timing			Variable (electronically controlled)
Spark plug		Make and type	NGK DCPR8E
		Gap	0.7 mm to 0.8 mm (.028 in to .031 in)
Ignition coil		Primary	0.85 to 1.15 Ω
		Secondary	9.5 to 13.5 KΩ
Engine RPM limiter setting			8000 RPM
FUEL SYSTEM			
Fuel injection type			Multipoint Fuel Injection. Single throttle body (52 mm)
Fuel pressure			386 kPa to 414 kPa (56 PSI to 60 PSI)
Fuel injector		Quantity	3
Fuel type	Type		Unleaded gasoline
	Octane rating (minimum)		Inside North America: 87 (RON + MON)/2 Outside North America: 92 RON
	Octane rating (optimum performance)		Inside North America: 91 (RON + MON)/2 Outside North America: 95 RON
Fuel tank (including reserve)			166 L (44 U.S. gal.)
Idle speed			1800 ± 50 RPM (not adjustable)

MODEL			TWIN 255 ENGINE
PROPULSION SYSTEM			
Jet pump	Type		Axial flow single stage
	Grease type		Jet pump bearing grease (P/N 293 550 032) sold by BRP
Impeller	Rotation (seen from rear)		Counterclockwise
	Pitch	Port	14°/24°
		Starboard	14°/23°
	Outside diameter		159 mm ± 0.06 mm (6.26 in ± .002 in)
Impeller/wear ring clearance	New		0 mm to 0.23 mm (0 in to .009 in)
	Wear limit		0.35 mm (.0138 in)
Impeller shaft	End play (new)		0
	Side play		0
Drive shaft	Coupling type		Crowned splines, direct drive
	Deflection (maximum)		0.5 mm (.02 in)
Steering nozzle pivoting angle			20°
Minimum required water level for propulsion system			90 cm (3 ft) underneath the lowest rear portion of hull
WEIGHT AND LOADING CAPACITY			
Dry weight		No tower	1 256 kg (2,769 lb)
		With tower	1 284 kg (2,831 lb)
Number of passenger (driver incl.)			7
Load limit (passenger and luggage) (based on calm water operation)			7 passengers OR 619 kg (1,365 lb)
Gross weight (on trailer)		No tower	1 857.5 kg (4,095 lb)
		With tower	1 885 kg (4,156 lb)
DIMENSIONS			
Overall length			6.02 m (19.8 ft)
Beam			2.44 m (8ft)
Draft			30.5 cm (1 ft)
Dead rise			21°
DIMENSIONS (ON TRAILER)			
Overall length (with swing-away tongue folded)			6.25 m (20.5 ft)
Width			2.59 m (8.5 ft)
Height		No tower	1.98 m (6.5 ft)
		Tower down	2.16 m (7.1 ft)
		Tower up	3.02 m (9.9 ft)

210 CHALLENGER/210 SP/210 WAKE

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE
ENGINE				
Engine type			ROTAX® 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)	
Number of engines			2	
Induction			Naturally-aspirated	Supercharged intercooled
Number of cylinders			3	
Number of valves			12 valves with hydraulic lifters (no adjustment)	
Bore		Standard	100 mm (3.9 in)	
		1st Oversize	100.25 mm (3.95 in)	
Stroke			63.4 mm (2.5 in)	
Displacement			1 493.8 cm³ (91 in³)	
Compression ratio			10.6:1	8.4:1
Maximum RPM			7300 ± 50 RPM	8000 ± 50 RPM
Lubrication		Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler	
		Oil type	XPS synthetic blend oil (summer grade) (P/N 293 600 121). Refer to *LUBRICATION SYSTEM* subsection	
		Capacity	3 L (3.2 qt (U.S. liq.)) oil change w/filter 4.5 L (4.8 qt (U.S. liq.)) total	
Intake valve opening			0° BTDC	
Intake valve closing			50° ABDC	
Exhaust valve opening			50° BBDC	
Exhaust valve closing			0° ATDC	
Valve stem diameter	Intake	New	5.961 mm to 5.975 mm (.2347 in to .2352 in)	
		Wear limit	5.930 mm (.233 in)	
	Exhaust	New	5.946 mm to 5.960 mm (.2341 in to .2346 in)	
		Wear limit	5.930 mm (.233 in)	
Valve guide diameter		New	5.994 mm to 6.018 mm (.236 in to .2369 in)	
		Wear limit	6.060 mm (.2386 in)	
Valve spring free length	Inner	New	41.02 mm (1.615 in)	
		Wear limit	38.80 mm (1.528 in)	
	Outer	New	45.45 mm (1.789 in)	
		Wear limit	43.00 mm (1.693 in)	
Valve seat contact width	Intake	New	1.10 mm to 1.30 mm (.043 in to .051 in)	
		Wear limit	1.60 mm (.063 in)	
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)	
		Wear limit	1.80 mm (.071 in)	
Rocker arm inner diameter		New	20.007 mm to 20.020 mm (.7877 in to .7882 in)	
		Wear limit	20.050 mm (.7894 in)	

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE
ENGINE (cont'd)				
Rocker arm shaft diameter		New	19.980 mm to 19.993 mm (.7866 in to .7871 in)	
		Wear limit	19.970 mm (.7862 in)	
Cylinder head maximum warpage		Service limit	0.15 mm (.006 in)	
Piston ring type and quantity		1st	Upper compression ring, rectangular	
		2nd	Lower compression ring, tapered face	
		3rd	Oil scraper ring	
Ring end gap	Rectangular	New	0.30 mm to 0.50 mm (.012 in to .02 in)	
	Taper-face	New	0.35 mm to 0.55 mm (.014 in to .022 in)	
	Oil scraper ring	New	0.35 mm to 0.50 mm (.014 in to .02 in)	
	All	Wear limit	1.50 mm (.059 in)	
Ring/piston groove clearance	Rectangular	New	0.025 mm to 0.070 mm (.001 in to .003 in)	
	Taper-face	New	0.015 mm to 0.06 mm (.0006 in to .0024 in)	
	Oil scraper ring	New	0.020 mm to 0.055 mm (.001 in to .002 in)	
	All	Wear limit	0.15 mm (.006 in)	
Piston/cylinder wall clearance		New	0.024 mm to 0.056 mm (.0009 in to .0022 in)	0.04 mm to 0.08 mm (.0016 in to .0031 in)
		Wear limit	0.100 mm (.0039 in)	
Cylinder taper		Wear limit	0.100 mm (.0039 in)	
Cylinder out of round (maximum)			0.015 mm (.0006 in)	
Camshaft bearing journal diameter	Front	New	24.939 mm to 24.960 mm (.9819 in to .9827 in)	
		Wear limit	24.910 mm (.9807 in)	
	PTO and center	New	39.892 mm to 39.905 mm (1.5706 in to 1.5711 in)	
		Wear limit	39.880 mm (1.5701 in)	
Camshaft bearing inner diameter	Front	New	25.000 mm to 25.013 mm (.9843 in to .9848 in)	
		Wear limit	25.050 mm (.9862 in)	
	PTO and center	New	40.000 mm to 40.020 mm (1.5748 in to 1.5756 in)	
		Wear limit	40.050 mm (1.5768 in)	
Cam lobe height	Intake	New	31.540 mm to 31.740 mm (1.2417 in to 1.2496 in)	
		Wear limit	31.50 mm (1.2402 in)	
	Exhaust	New	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)	
		Wear limit	31.380 mm (1.2354 in)	
Crankshaft deflection		Maximum	0.05 mm (.002 in)	
Crankshaft axial clearance		New	0.080 mm to 0.220 mm (.0031 in to .0087 in)	
		Wear limit	0.35 mm (.014 in)	
Crankshaft bearing journal diameter		New	49.991 mm to 50.000 mm (1.9681 in to 1.9685 in)	
		Wear limit	49.950 mm (1.9665 in)	
Crankshaft radial clearance		Wear limit	0.07 mm (.0028 in)	
Connecting rod big end diameter		Service limit	45.080 mm (1.7748 in)	
Connecting rod big end radial play		Service limit	0.090 mm (.0035 in)	

MODEL		TWIN 155 ENGINE	TWIN 215 ENGINE
ENGINE (cont'd)			
Connecting rod big end axial play	New	0.100 mm to 0.352 mm (.004 in to .014 in)	
	Wear limit	0.500 mm (.0197 in)	
Connecting rod small end diameter	New	23.010 mm to 23.020 mm (.9059 in to .9063 in)	
	Wear limit	23.070 mm (.9083 in)	
Piston pin diameter	New	22.996 mm to 23.000 mm (.9054 in to .9055 in)	
	Wear limit	22.990 mm (.9051 in)	
Connecting rod small end radial play	Wear limit	0.080 mm (.0031 in)	
Balance shaft journal diameter	New	31.984 mm to 32.000 mm (1.2592 in to 1.2598 in)	
	Wear limit	31.950 mm (1.2579 in)	
Balance shaft radial clearance	Wear limit	0.070 mm (.0028 in)	
Balance shaft axial clearance	New	0.020 mm to 0.250 mm (.0008 in to .0098 in)	
Supercharger shaft driven plate journal depth	New	—	14.460 mm to 14.500 mm (.5693 in to .5709 in)
	Wear limit	—	14.600 mm (.5748 in)
Supercharger drive gear thickness	New	—	11.000 mm to 11.050mm (.4331 in to .435 in)
	Wear limit	—	10.900 mm (.4291 in)
Supercharger lock washer thickness	New	—	4.050 mm to 4.150 mm (.1594in to .1634 in)
	Wear limit	—	3.950 mm (.1555 in)
Supercharger spring washer package height (not compressed)	New	—	10.900 mm to 10.700 mm (.4291 in to .4213 in)
	Wear limit	—	10.200 mm (.4016 in)
AIR INTAKE SYSTEM			
Intake spark arrester		Tubular, wire screen	
ENGINE COOLING SYSTEM			
Type		Closed loop cooling system	
Coolant		Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines	
Cooling system capacity		5.5 L (5.8 qt (U.S. liq.)) total	
Thermostat		87°C (189°F)	
Monitoring beeper setting		100°C (212°F)	
EXHAUST SYSTEM			
Type		Water cooled/water injected (opened loop). Direct flow from jet pump	
Water injection in muffler		3 x 3.5 mm (.138 in) on exhaust pipe and 1 x 3.5 mm (.138 in) on muffler	

MODEL		TWIN 155 ENGINE	TWIN 215 ENGINE
ELECTRICAL SYSTEM			
Fuse box 1	F1: Gauge	3 A	
	F2: Ignition switch	3 A	
	F3: Depth sounder	3 A	
	F4: Unused	3 A	
	F5: Unused	3 A	
	F6: Fuel pump	10 A	
	F7: Cylinder 1	10 A	
	F8: Cylinder 2	10 A	
	F9: Cylinder 3	10 A	
	F10: Unused	—	
	F11: Diagnostic tool	15 A	
	F13: Starter relay	10 A	
	F14: CAPS	3 A	
Fuse box 2	F15: Charge	30 A	
	F16: Battery	30 A	
Circuit Breakers (panel)	CB1: Bilge pump	3 A CE model: 7.5 A	
	CB2: Bilge blower	10 A	
	CB3: Courtesy lights	3 A	
	CB4: navigation/ anchor lights	3 A	
	CB5: 12-volt power outlets	10 A	
	CB6: Horn	7.5 A	
	CB7: Stereo	10 A	
	CB8: Heater (210 WAKE)	10 A	
	CB9: Ballast pumps (210 WAKE)	15 A	
	CB10: Unused	15 A	
Fuses (fuse holders)	Automatic bilge pump	3 A CE model: 7.5 A	
	Bilge blowers	2 x 5 A	
	Gauge power	3 A	
Main circuit breaker		40 A	
Stereo amplifier circuit breaker		30 A	
Automatic extinguisher		3 A (CE model only)	
Magneto generator output		360 W @ 6000 RPM	
Stator		0.1 to 1.0 Ω	
Battery		Not supplied. Refer to *BATTERY* subsection for recommended models. 12 V group 24, marine starting battery with top-mounted, round taper type battery post	
Ignition system type		DI (Digital Inductive)	
Ignition timing		Variable (electronically controlled)	

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE
ELECTRICAL SYSTEM (cont'd)				
Spark plug		Make and type	NGK DCPR8E	
		Gap	0.7 mm to 0.8 mm (.028 in to .031 in)	
Ignition coil		Primary	0.85 to 1.15 Ω	
		Secondary	9.5 to 13.5 KΩ	
Engine RPM limiter setting			7300 RPM	8000 RPM
FUEL SYSTEM				
Fuel injection type			Multipoint Fuel Injection with intelligent Throttle Control (iTC). Single throttle body (60 mm) with an integrated actuator	
Fuel pressure			386 kPa to 414 kPa (56 PSI to 60 PSI)	
Fuel injector		Quantity	3	
Fuel	Type		Unleaded gasoline	
	Octane rating (minimum)		Inside North America: 87 (RON + MON)/2 Outside North America: 92 RON	
	Octane rating (optimum performance)		—	Inside North America: 91 (RON + MON)/2 Outside North America: 95 RON
Fuel tank (including reserve)			166.5 L (44 U.S. gal.)	
Idle speed			1800 ± 50 RPM (not adjustable)	
PROPULSION SYSTEM				
Jet pump	Type		Axial flow single stage	
	Grease type		Jet pump bearing grease (P/N 293 550 032) sold by BRP	
Impeller	Rotation (seen from rear)		Counterclockwise	
	Pitch	Port	10°/20°	10°/22°
		Starboard	11°/17°	10°/21°
	Outside diameter		155 mm ± 0.06 mm (6.102 in ± .002 in)	159 mm ± 0.06 mm (6.26 in ± .002 in)
Impeller/wear ring clearance	New		0 mm to 0.23 mm (0 in to .009 in)	
	Wear limit		0.35 mm (.0138 in)	
Impeller shaft	End play (new)		0	
	Side play		0	
Drive shaft	Coupling type		Crowned splines, direct drive	
	Deflection (maximum)		0.5 mm (.02 in)	
Steering nozzle pivoting angle			21°	
Minimum required water level for propulsion system			90 cm (3 ft) underneath the lowest rear portion of hull	

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE
WEIGHT AND LOADING CAPACITY				
Dry weight	210 Challenger 210 Challenger SE (no tower)		1 406 kg (3,100 lb)	
	210 Challenger SE (with tower) 210 SP		1 442 kg (3,179 lb)	
	210 WAKE		1 474 kg (3,250 lb)	
Number of passenger (driver incl.)			10 For European Community: 9	
Load limit (passenger and luggage) (based on calm water operation)			10 passengers OR 692 kg (1,525 lb)	10 passengers OR 669 kg (1,475 lb)
			For European Community	
			9 passengers OR 692 kg (1,525 lb)	9 passengers OR 669 kg (1,475 lb)
Gross weight (on trailer)	210 Challenger 210 Challenger SE (no tower)		1 846 kg (4,070 lb)	
	210 Challenger SE (with tower) 210 SP		1 882 kg (4,149 lb)	
	210 WAKE		1 914 kg (4,220 lb)	
Pulling weight limit		Tower	114 kg (250 lb)	
		Ski pole	225 kg (500 lb)	
DIMENSIONS				
Overall length			6.25 m (20.5 ft)	
Beam			2.59 m (8.5 ft)	
Draft			30.5 cm (1 ft)	
Dead rise			21°	
DIMENSIONS (ON TRAILER)				
Overall length			6.35 m (20.8 ft)	
Width			2.59 m (8.5 ft)	
Height	No tower		2.11 m (6.9 ft)	
	Tower down		2.44 m (8 ft)	
	Tower up		2.98 m (9.8 ft)	

230 CHALLENGER/230 SP/230 WAKE

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE TWIN 260 ENGINE
ENGINE				
Engine type			ROTAX® 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC)	
Number of engines			2	
Induction			Naturally-aspirated	Supercharged intercooled
Number of cylinders			3	
Number of valves			12 valves with hydraulic lifters (no adjustment)	
Bore		Standard	100 mm (3.9 in)	
		1st Oversize	100.25 mm (3.95 in)	
Stroke			63.4 mm (2.5 in)	
Displacement			1 493.8 cm³ (91 in³)	
Compression ratio			10.6:1	8.4:1
Maximum RPM			7300 ± 50 RPM	8000 ± 50 RPM
Lubrication		Type	Dry sump (2 oil pumps). Replaceable oil filter. Water-cooled oil cooler	
		Oil type	XPS synthetic blend oil (summer grade) (P/N 293 600 121). Refer to *LUBRICATION SYSTEM* subsection	
		Capacity	3 L (3.2 qt (U.S. liq.)) oil change w/filter 4.5 L (4.8 qt (U.S. liq.)) total	
Intake valve opening			0° BTDC	
Intake valve closing			50° ABDC	
Exhaust valve opening			50° BBDC	
Exhaust valve closing			0° ATDC	
Valve stem diameter	Intake	New	5.961 mm to 5.975 mm (.2347 in to .2352 in)	
		Wear limit	5.930 mm (.233 in)	
	Exhaust	New	5.946 mm to 5.960 mm (.2341 in to .2346 in)	
		Wear limit	5.930 mm (.233 in)	
Valve guide diameter		New	5.994 mm to 6.018 mm (.236 in to .2369 in)	
		Wear limit	6.060 mm (.2386 in)	
Valve spring free length	Inner	New	41.02 mm (1.615 in)	
		Wear limit	38.80 mm (1.528 in)	
	Outer	New	45.45 mm (1.789 in)	
		Wear limit	43.00 mm (1.693 in)	
Valve seat contact width	Intake	New	1.10 mm to 1.30 mm (.043 in to .051 in)	
		Wear limit	1.60 mm (.063 in)	
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)	
		Wear limit	1.80 mm (.071 in)	
Rocker arm inner diameter		New	20.007 mm to 20.020 mm (.7877 in to .7882 in)	
		Wear limit	20.050 mm (.7894 in)	

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE TWIN 260 ENGINE
ENGINE (cont'd)				
Rocker arm shaft diameter		New	19.980 mm to 19.993 mm (.7866 in to .7871 in)	
		Wear limit	19.970 mm (.7862 in)	
Cylinder head maximum warpage		Service limit	0.15 mm (.006 in)	
Piston ring type and quantity		1st	Upper compression ring, rectangular	
		2nd	Lower compression ring, tapered face	
		3rd	Oil scraper ring	
Ring end gap	Rectangular	New	0.30 mm to 0.50 mm (.012 in to .02 in)	
	Taper-face	New	0.35 mm to 0.55 mm (.014 in to .022 in)	
	Oil scraper ring	New	0.35 mm to 0.50 mm (.014 in to .02 in)	
	All	Wear limit	1.50 mm (.059 in)	
Ring/piston groove clearance	Rectangular	New	0.025 mm to 0.070 mm (.001 in to .003 in)	
	Taper-face	New	0.015 mm to 0.06 mm (.0006 in to .0024 in)	
	Oil scraper ring	New	0.020 mm to 0.055 mm (.001 in to .002 in)	
	All	Wear limit	0.15 mm (.006 in)	
Piston/cylinder wall clearance		New	0.024 mm to 0.056 mm (.0009 in to .0022 in)	0.04 mm to 0.08 mm (.0016 in to .0031 in)
		Wear limit	0.100 mm (.0039 in)	
Cylinder taper		Wear limit	0.100 mm (.0039 in)	
Cylinder out of round (maximum)			0.015 mm (.0006 in)	
Camshaft bearing journal diameter	Front	New	24.939 mm to 24.960 mm (.9819 in to .9827 in)	
		Wear limit	24.910 mm (.9807 in)	
	PTO and center	New	39.892 mm to 39.905 mm (1.5706 in to 1.5711 in)	
		Wear limit	39.880 mm (1.5701 in)	
Camshaft bearing inner diameter	Front	New	25.000 mm to 25.013 mm (.9843 in to .9848 in)	
		Wear limit	25.050 mm (.9862 in)	
	PTO and center	New	40.000 mm to 40.020 mm (1.5748 in to 1.5756 in)	
		Wear limit	40.050 mm (1.5768 in)	
Cam lobe height	Intake	New	31.540 mm to 31.740 mm (1.2417 in to 1.2496 in)	
		Wear limit	31.50 mm (1.2402 in)	
	Exhaust	New	31.430 mm to 31.630 mm (1.2374 in to 1.2453 in)	
		Wear limit	31.380 mm (1.2354 in)	
Crankshaft deflection		Maximum	0.05 mm (.002 in)	
Crankshaft axial clearance		New	0.080 mm to 0.220 mm (.0031 in to .0087 in)	
		Wear limit	0.35 mm (.014 in)	
Crankshaft bearing journal diameter		New	49.991 mm to 50.000 mm (1.9681 in to 1.9685 in)	
		Wear limit	49.950 mm (1.9665 in)	
Crankshaft radial clearance		Wear limit	0.07 mm (.0028 in)	
Connecting rod big end diameter		Service limit	45.080 mm (1.7748 in)	
Connecting rod big end radial play		Service limit	0.090 mm (.0035 in)	

MODEL		TWIN 155 ENGINE	TWIN 215 ENGINE TWIN 260 ENGINE
ENGINE (cont'd)			
Connecting rod big end axial play	New	0.100 mm to 0.352 mm (.004 in to .014 in)	
	Wear limit	0.500 mm (.0197 in)	
Connecting rod small end diameter	New	23.010 mm to 23.020 mm (.9059 in to .9063 in)	
	Wear limit	23.070 mm (.9083 in)	
Piston pin diameter	New	22.996 mm to 23.000 mm (.9054 in to .9055 in)	
	Wear limit	22.990 mm (.9051 in)	
Connecting rod small end radial play	Wear limit	0.080 mm (.0031 in)	
Balance shaft journal diameter	New	31.984 mm to 32.000 mm (1.2592 in to 1.2598 in)	
	Wear limit	31.950 mm (1.2579 in)	
Balance shaft radial clearance	Wear limit	0.070 mm (.0028 in)	
Balance shaft axial clearance	New	0.020 mm to 0.250 mm (.0008 in to .0098 in)	
Supercharger shaft driven plate journal depth	New	—	14.460 mm to 14.500 mm (.5693 in to .5709 in)
	Wear limit	—	14.600 mm (.5748 in)
Supercharger drive gear thickness	New	—	11.000 mm to 11.050 mm (.4331 in to .435 in)
	Wear limit	—	10.900 mm (.4291 in)
Supercharger lock washer thickness	New	—	4.050 mm to 4.150 mm (.1594 in to .1634 in)
	Wear limit	—	3.950 mm (.1555 in)
Supercharger spring washer package height (not compressed)	New	—	10.900 mm to 10.700 mm (.4291 in to .4213 in)
	Wear limit	—	10.200 mm (.4016 in)
AIR INTAKE SYSTEM			
Intake spark arrester		Tubular, wire screen	
ENGINE COOLING SYSTEM			
Type		Closed loop cooling system	
Coolant		Ethylene-glycol and distilled water (50%/50%). Use premix coolant from BRP or a coolant specially formulated for aluminum engines	
Cooling system capacity		5.5 L (5.8 qt (U.S. liq.)) total	
Thermostat		87°C (189°F)	
Monitoring beeper setting		100°C (212°F)	
EXHAUST SYSTEM			
Type		Water cooled/water injected (opened loop). Direct flow from jet pump	
Water injection in muffler		3 x 3.5 mm (.138 in) on exhaust pipe and 1 x 3.5 mm (.138 in) on muffler	

MODEL		TWIN 155 ENGINE	TWIN 215 ENGINE TWIN 260 ENGINE
ELECTRICAL SYSTEM			
Fuses (fuse box 1)	F1: Cylinder 3 – ignition coil and injector	10 A	
	F2: Cylinder 2 – ignition coil and injector	10 A	
	F3: Cylinder 1 – ignition coil and injector	10 A	
	F4: Unused	15 A	
	F5: Starter relay	5 A	
	F6: Depth sounder	3 A	
	F7: Battery	30 A	
	F8: CAPS	3 A	
	F9: Gauge	3 A	
	F10: Charge	30 A	
	F11: Fuel pump	10 A	
Fuses (fuse box 2)	F1: Cylinder 3 – ignition coil and injector	10 A	
	F2: Cylinder 2 – ignition coil and injector	10 A	
	F3: Cylinder 1 – ignition coil and injector	10 A	
	F4: Unused	15 A	
	F5: Starter relay	5 A	
	F6: Battery	30 A	
	F7: CAPS	3 A	
	F8: Diagnostic tool	15 A	
	F9: Blower no. 1	5 A	
	F10: Charge	30 A	
	F11: Blower no. 2	5 A	
	F12: Ignition	5 A	
	F13: Fuel pump	10 A	
Circuit breakers (panel)	CB1: Bilge pump	3 A CE Models: 7.5 A	
	CB2: Bilge blower	10 A	
	CB3: Courtesy lights	3 A	
	CB4: Navigation / anchor lights	3 A	
	CB5: 12-volt power outlets	10 A	
	CB6: Horn	7.5 A	
	CB7: Stereo	10 A	
	CB8: Heater (230 WAKE)	–	10 A
	CB9: Unused	15 A	
	CB10: Unused	15 A	
Fuses (fuse holders)	Automatic bilge pump	3 A CE Models: 7.5 A	
	Bilge pump	3 x 3 A (CE Models only)	
	Ignition	3 A	
	Gauge	3 A	
	GPS	3 A	
	Ballast	2 x 5 A	

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE TWIN 260 ENGINE
ELECTRICAL SYSTEM (cont'd)				
Main circuit breaker			40 A	
Stereo amplifier circuit breaker			30 A	
Automatic extinguisher			3 A (CE model only)	
Magneto generator output			360 W @ 6000 RPM	
Stator			0.1 to 1.0 Ω	
Battery			Not supplied. Refer to *BATTERY* subsection for recommended models. 12 V group 24, marine starting battery with top-mounted, round taper type battery post	
Ignition system type			DI (Digital Inductive)	
Ignition timing			Variable (electronically controlled)	
Spark plug		Make and type	NGK DCPR8E	
		Gap	0.7 mm to 0.8 mm (.028 in to .031 in)	
Ignition coil		Primary	0.85 to 1.15 Ω	
		Secondary	9.5 to 13.5 KΩ	
Engine RPM limiter setting			7300 RPM	8000 RPM
FUEL SYSTEM				
Fuel injection type			Multipoint Fuel Injection. Single throttle body (52 mm)	
Fuel pressure			386 kPa to 414 kPa (56 PSI to 60 PSI)	
Fuel injector		Quantity	3	
Fuel type	Type		Unleaded gasoline	
	Octane rating (minimum)		Inside North America: 87 (RON + MON)/2 Outside North America: 92 RON	
	Octane rating (optimum performance)		—	Inside North America: 91 (RON + MON)/2 Outside North America: 95 RON
Fuel tank (including reserve)			200 L (53 U.S. gal.)	
Idle speed			1800 ± 50 RPM (not adjustable)	
PROPULSION SYSTEM				
Jet pump	Type		Axial flow single stage	
	Grease type		Jet pump bearing grease (P/N 293 550 032) sold by BRP	
Impeller	Rotation (seen from rear)		Counterclockwise	
	Pitch	Port	10°/20°	215 engine: 10°/21° 260 engine: 14°/25°
		Starboard	11°/18°	215 engine: 10°/20° 260 engine: 14°/23°
	Outside diameter		155 mm ± 0.06 mm (6.102 in ± .002 in)	159 mm ± 0.06 mm (6.26 in ± .002 in)
Impeller/wear ring clearance	New		0 mm to 0.23 mm (0 in to .009 in)	
	Wear limit		0.35 mm (.0138 in)	
Impeller shaft	End play (new)		0	
	Side play		0	

MODEL			TWIN 155 ENGINE	TWIN 215 ENGINE TWIN 260 ENGINE
PROPULSION SYSTEM (cont'd)				
Drive shaft	Coupling type		Crowned splines, direct drive	
	Deflection (maximum)		0.5 mm (.02 in)	
Steering nozzle pivoting angle			20°	
Minimum required water level for propulsion system			90 cm (3 ft) underneath the lowest rear portion of hull	
WEIGHT AND LOADING CAPACITY				
Dry weight	230 Challenger		1 558 kg (3,435 lb)	
	230 Challenger SE	No tower	1 558 kg (3,435 lb)	
		With tower	1 588 kg (3,500 lb)	
	230 SP		–	1 588 kg (3,500 lb)
	230 WAKE		–	1 742 kg (3,840 lb)
Number of passenger (driver incl.)			12	
Load limit (passenger and luggage) (based on calm water operation)	230 Challenger/SE/SP		12 passengers OR 1 081 kg (2,383 lb)	
	230 WAKE		–	12 passengers OR 1 025 kg (2,260 lb)
Gross weight (on trailer)	230 Challenger		2 344 kg (5,168 lb)	
	230 Challenger SE	No tower	2 344 kg (5,168 lb)	
		With tower	2 374 kg (5,234 lb)	
	230 SP		–	2 374 kg (5,234 lb)
	230 WAKE		–	2 529 kg (5,575 lb)
Pulling weight limit		Tower	114 kg (250 lb)	
DIMENSIONS				
Overall length			7.16 m (23.5 ft)	
Beam			2.67 m (8.8 ft)	
Draft			30.5 cm (1 ft)	
Dead rise			21°	
DIMENSIONS (ON TRAILER)				
Overall length			7.49 m (24.6 ft)	
Width			2.67 m (8.8 ft)	
Height	No tower		2.16 m (7.1 ft)	
	Tower Down		2.6 m (8.5 ft)	
	Tower up		3.05 m (10 ft)	

WIRING DIAGRAM INFORMATION

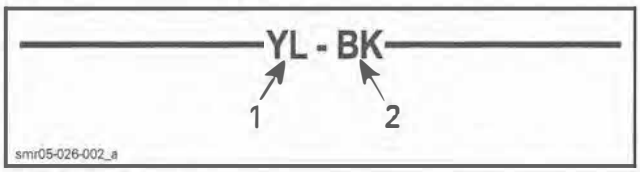
GENERAL

WIRING DIAGRAM LOCATION

The wiring diagrams are in the *WIRING DIAGRAM BOOKLET (P/N 219 100 547)*.

WIRING DIAGRAM CODES

Wire Color Codes



1. *Wire main color*
2. *Tracer (thin colored line)*

Refer to *WIRING DIAGRAM* for legend of wire colors.

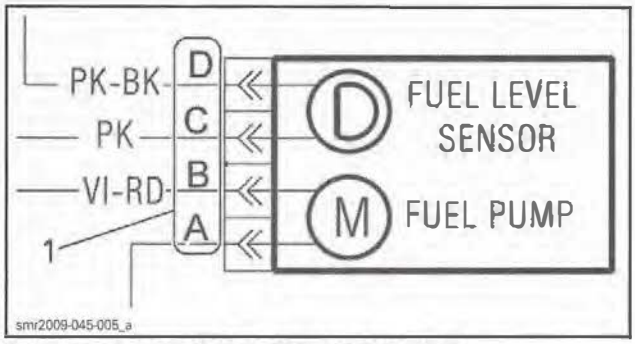
General Wire Color Use

COLOR	USE
RED	12 Vdc power (from battery, not usually switched or fused)
RED + tracer	12 Vdc power (from battery, normally switched or fused)
PURPLE	Continuous power (when there is a programmed key on Engine Cut-Off Switch)
PURPLE + tracer	Switched power (when there is a programmed key on Engine Cut-Off Switcht)
YELLOW	Alternating current (AC) from magneto
BLACK	Ground
BLACK + tracer	Switched ground (by Engine Cut-Off Switch, ECM)
WHITE/RED WHITE/BLACK	CAN HI wires CAN LO wires

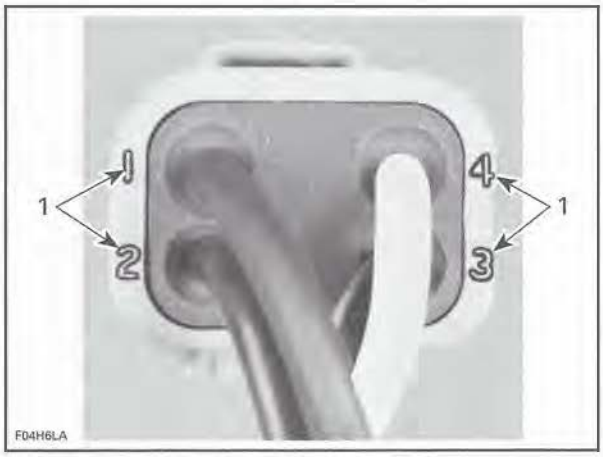
Wiring Harness Connectors

Connectors are identified on the *WIRING DIAGRAM*. The identification code of the connector is written next to it, and may be accompanied by the name of the component or system it is connected to (ex: C-223, FUEL LEVEL STBD).

The position of the connector terminals is identified either by a number or a letter depending on the connector. Usually, it is stamped/molded on the connector.



TYPICAL - FUEL PUMP MODULE CONNECTOR
1. *Terminal identification on the schematic*



TYPICAL
1. *Terminal identification on a connector*

Refer to *ELECTRICAL CONNECTORS* to repair or inspect the connectors.

EFB, VCM and ECM Connectors

EFB, VCM and ECM connectors are identified by letters (A, B or C) on the *WIRING DIAGRAM*.

The position of the terminals is identified by a number for the ECM, and can be a letter or a number for the EFB and VCM. Usually, it is stamped/molded on the connector.

Example

MODULE	CODE	IDENTIFICATION	
		CONNECTOR	TERMINAL
ECM	A-3	A	3
ECM	B-5	B	5
EFB and VCM	C-B	C	B

Refer to *ELECTRICAL CONNECTORS* to repair or inspect the connectors.

CONNECTOR INFORMATION

SERVICE TOOLS

Description	Part Number	Page
CRIMPING TOOL (HEAVY GAUGE WIRE)	529 035 730	577
CRIMPING TOOL (KOSTAL)	529 035 909	572
ECM ADAPTER TOOL	529 036 166	574
ECM TERMINAL REMOVER 2.25	529 036 175	575
ECM TERMINAL REMOVER 3.36	529 036 174	575
KOSTAL DIE	529 035 906	572

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
DELPHI TERMINAL EXTRACTOR	12094429	576
GM TERMINAL EXTRACTOR	12094430	577
SNAP-ON TERMINAL REMOVER TOOL	TT600-1	571
SNAP-ON TERMINAL REMOVER TOOL	TT600-4	568

GENERAL

DEUTSCH CONNECTORS

Deutsch Connector Application

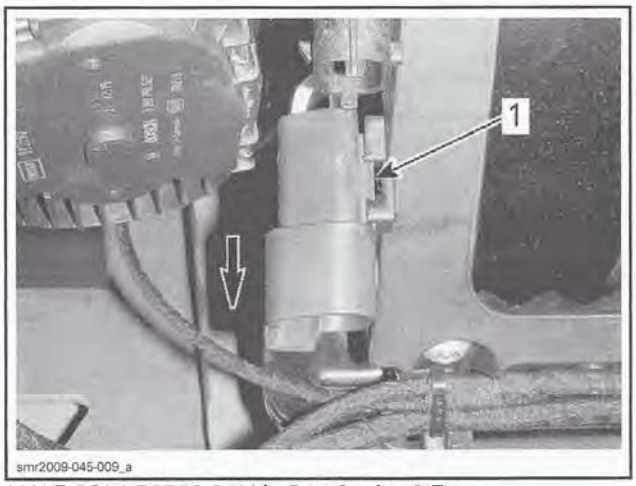
A variety of Deutsch connectors are used on various systems:

- Engine connector
- Magneto connector.

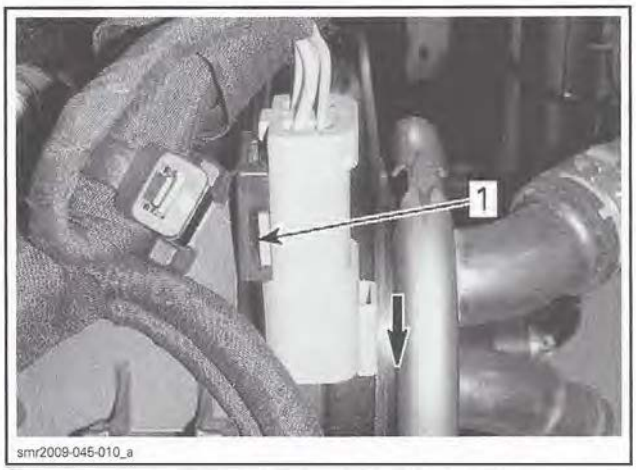
The following procedures may be used on each as they are similar in construction.

Deutsch Connector Removal from its Support

1. Insert a small flat screwdriver between the support and the Deutsch connector.
2. Pry the connector away from the support slightly while sliding it out in the direction shown.



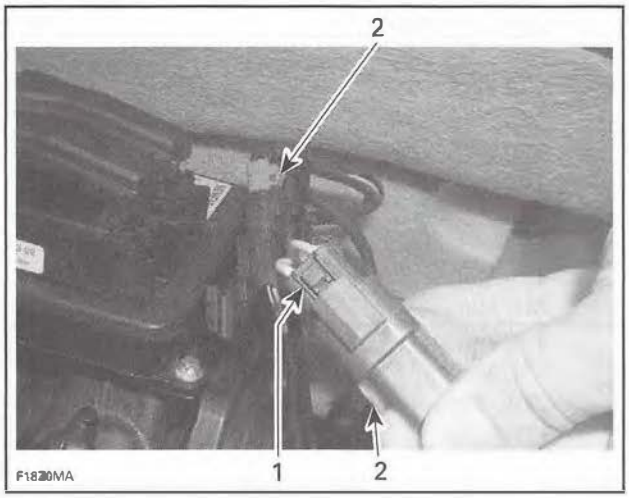
MALE CONNECTOR REMOVED FOR CLARITY
1. Insert screwdriver here



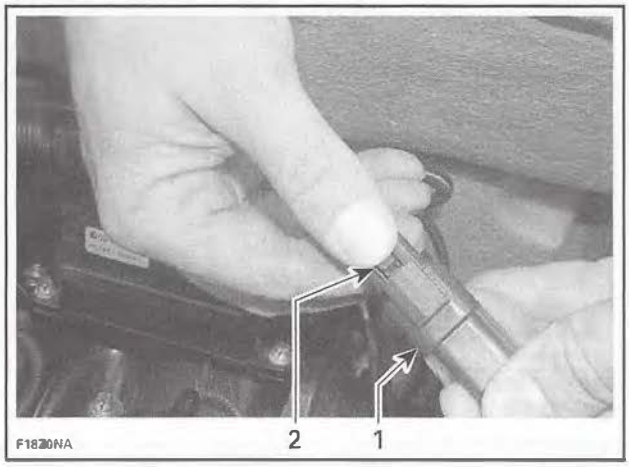
TYPICAL - MALE CONNECTOR REMOVED FOR CLARITY
1. Insert screwdriver here

Deutsch Connector Disconnect

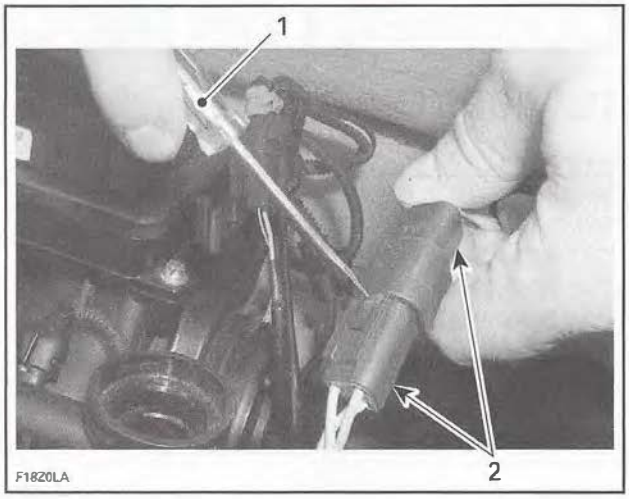
1. To disconnect a Deutsch connector, press the release tab and twist a small flat screwdriver between the male and female housing to disengage and disconnect them.



TYPICAL
1. Release tab
2. Deutsch connector

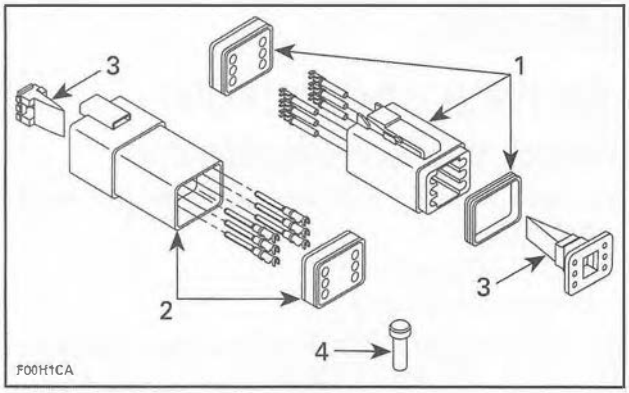


TYPICAL
1. Deutsch connector
2. Press release button



TYPICAL
1. Flat screwdriver
2. Deutsch connector

Deutsch Connector Disassembly and Reassembly



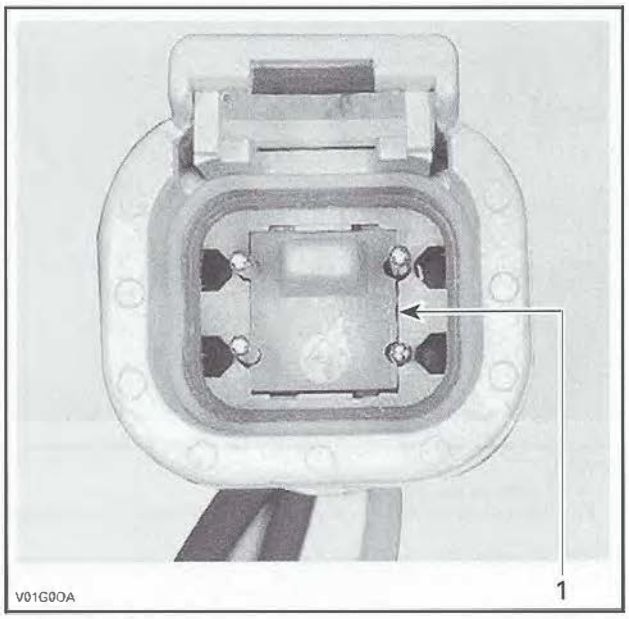
TYPICAL - DEUTSCH CONNECTOR
1. Male connector
2. Female connector
3. Secondary lock
4. Sealing cap

NOTICE Do not apply dielectric grease on terminal inside connector.

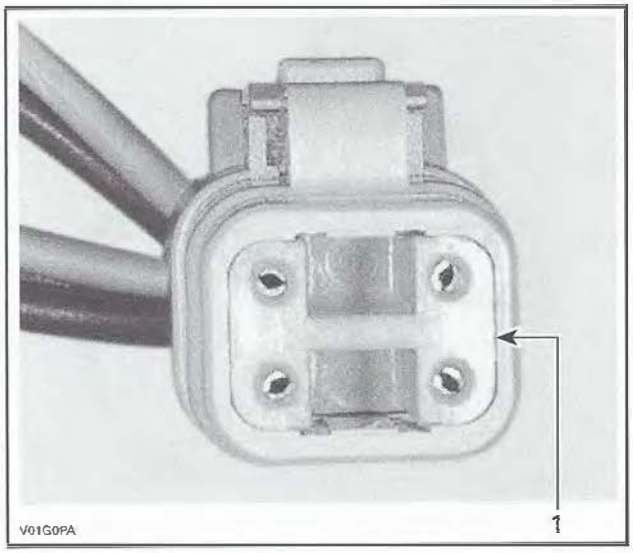
Terminal Removal

To remove terminals from connector, proceed as follows:

1. Using long nose pliers, pull out the secondary plastic lock from between the terminals.



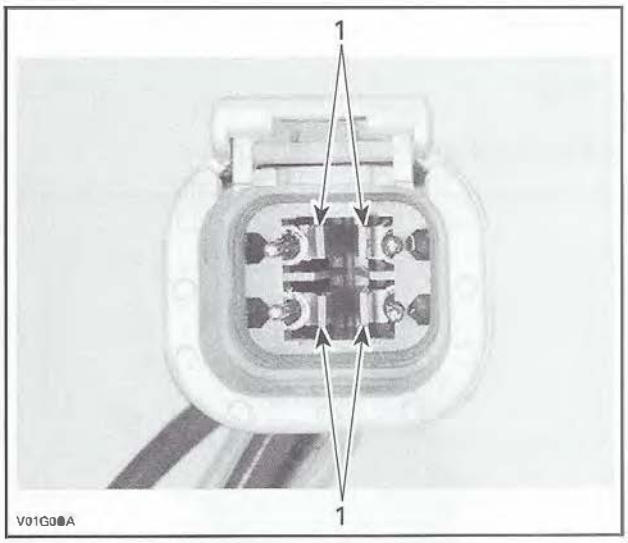
FEMALE CONNECTOR
1. Female lock



MALE CONNECTOR
1. Male lock

NOTE: Before pin extraction, push wire forward to relieve pressure on retaining tab.

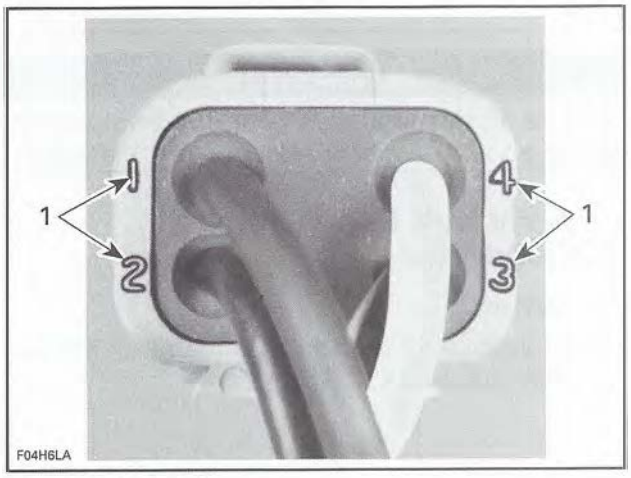
2. Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
3. Pry the retaining tab away from the terminal while gently pulling the wire and terminal out of the back of the connector.



FEMALE CONNECTOR
1. Retaining tab

Terminal Insertion

1. For insertion of a terminal, ensure the secondary plastic lock is removed.
2. Insert terminal through the back of the connector in the appropriate position, and push it in as far as it will go. You should feel or hear the terminal lock engage.
3. Pull back on the terminal wire to be sure the retention fingers are holding the terminal.
4. After all required terminals have been inserted, the lock must be installed.



CONNECTOR PIN-OUT
1. Terminal position identification numbers

PACKARD CONNECTORS

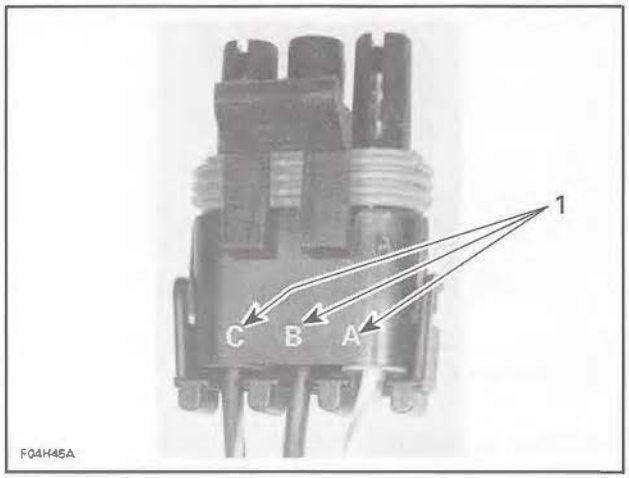
Packard Connector Application

Packard connectors are used to connect:

– Electrical harnesses

- Gauges
- VCM
- EFB.

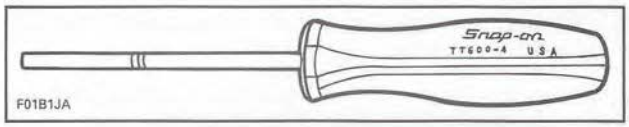
3-Pin Packard Connector



VIEW OF A 3-PIN PACKARD CONNECTOR
1. Identification letters

NOTE: This type of connector also comes in other pin configurations.

To remove a terminal from a 3-pin Packard connector, use the SNAP-ON TERMINAL REMOVER TOOL (P/N TT600-4).



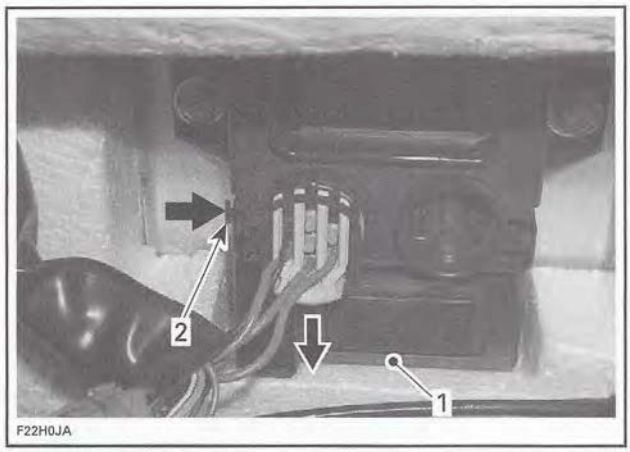
⚠ WARNING

Ensure all terminals are properly crimped on wires and connectors are properly fastened.

7-Pin Packard Connector (EFB and VCM)

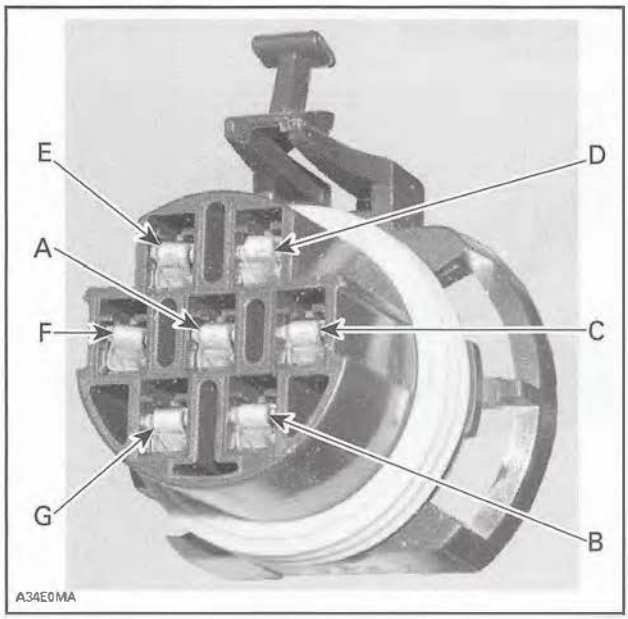
200 Series

Firmly push down tab and hold to unlock connector while pulling it out.



TYPICAL
1. VCM (Vehicle Control Module)
2. Firmly push down this tab and hold while pulling out connector

Refer to the illustration for the connector pinout.

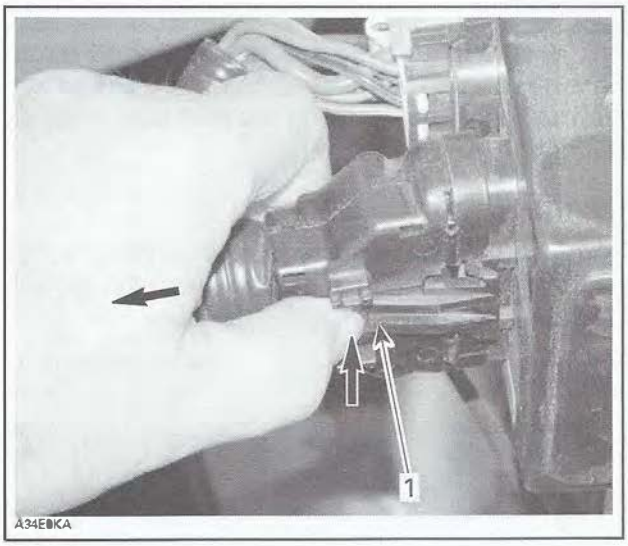


NOTE: This type of connector also comes in other pin configurations.

32-Pin PACKARD Connector (EFB and VCM)

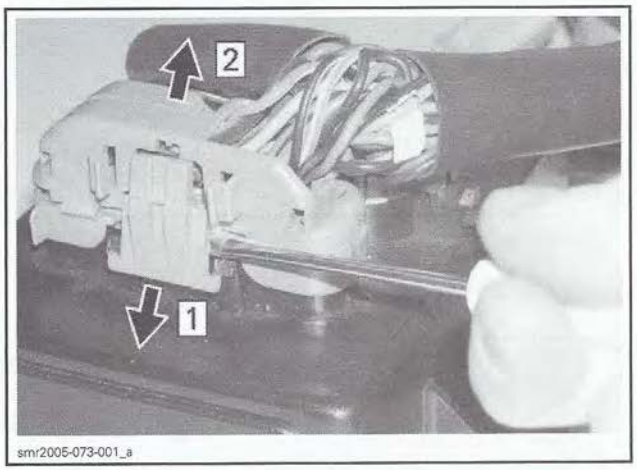
200 Series

1. Firmly push down tab and hold to unlock connector while pulling it out.

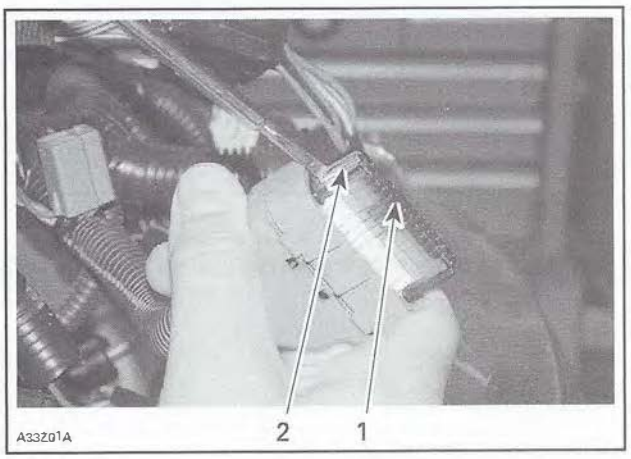


TYPICAL
1. Firmly push tab and hold while pulling connector out

NOTE: A small screw driver may be used to release locking tab while pulling connector out.

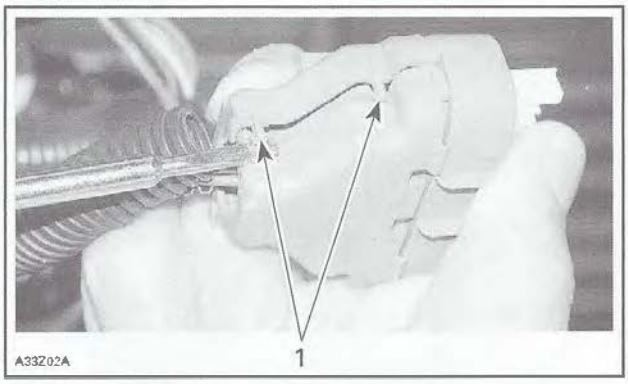


2. Push on both tabs to remove retainer.



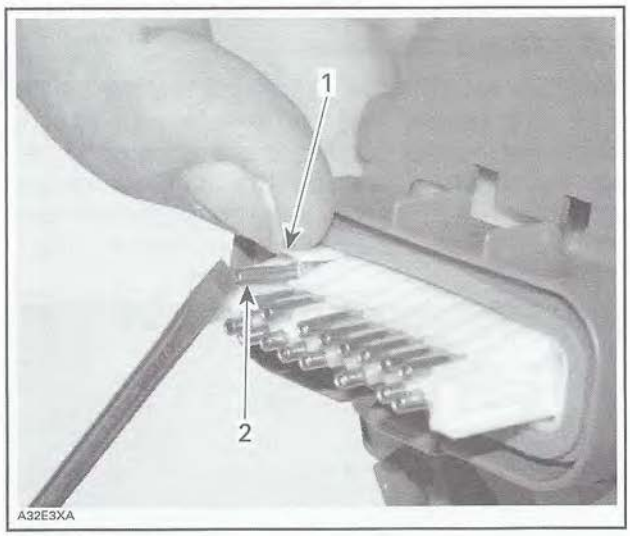
TYPICAL
1. Retainer
2. Tab (one on each side)

3. Open housing by lifting 4 tabs.



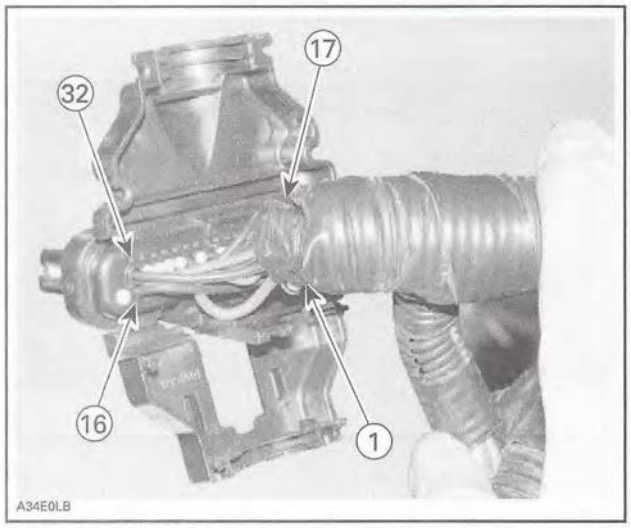
TYPICAL
1. Tabs (2 on each side)

4. Lift the top plastic lock of the female terminal to be removed and hold in position. Then lift the female terminal to unlock from the housing and push out of housing.



TYPICAL
1. Lift and hold plastic lock
2. Lift to unlock and push out

Refer to the following illustration for the connector pinout.



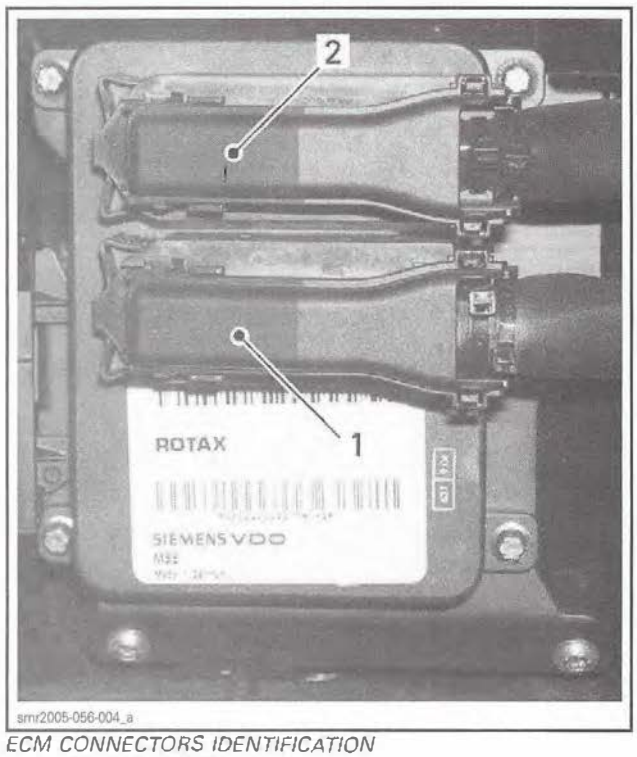
TYPICAL - CONNECTOR PIN-OUT

KOSTAL CONNECTOR

Kostal Connector Application

150, 180 and 200 Series

There are two KOSTAL connectors used on the ECM. The engine harness female connector is connected on the module male connector "A" and the boat system control harness female connector is connected to the module male connector "B". The ECM connectors have 41 pins.

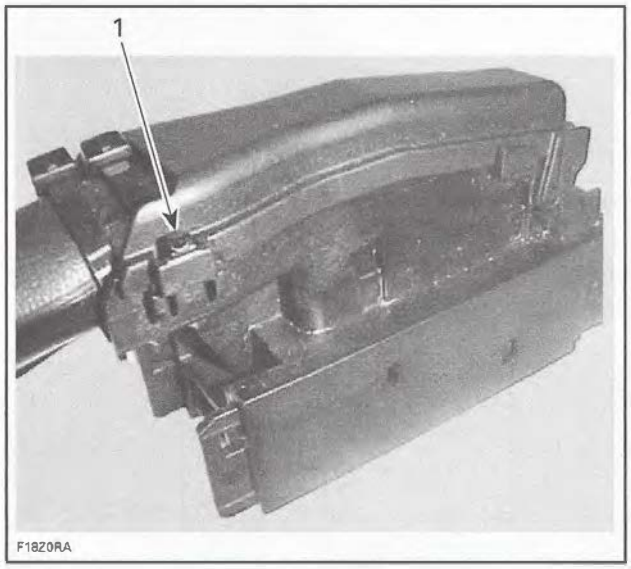


ECM CONNECTORS IDENTIFICATION
1. *Engine components*
2. *Vehicle components*

NOTICE Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected frequently. For appropriate probing techniques and tool, refer to *ENGINE MANAGEMENT.*

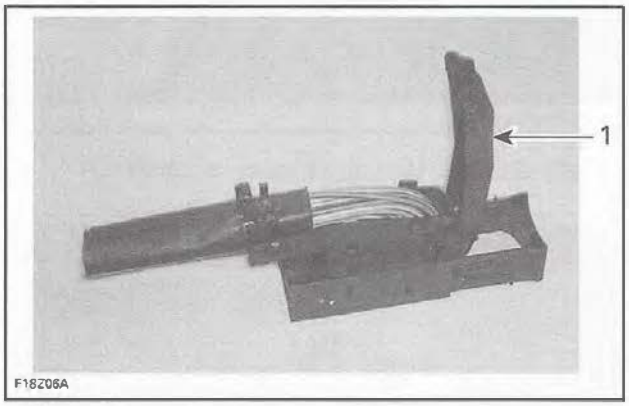
Terminal Removal

1. Unlock the connector cover by pushing in the tabs on top of the connector with a flat screwdriver to be able to flip the top cover up.



1. Push in tab

2. Lift the cover by pushing it forward.

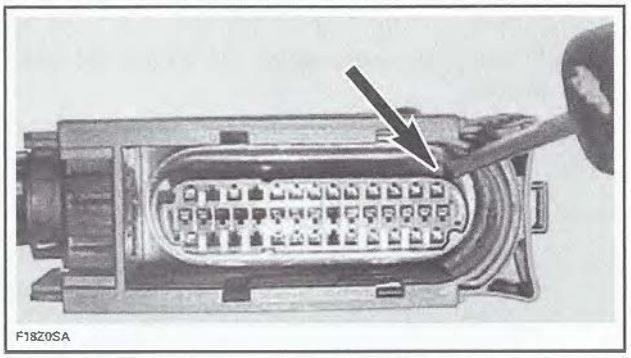


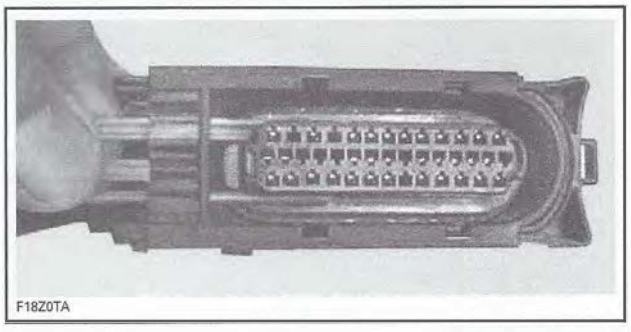
1. Cover

3. Cut both tie raps that secure the harness to the connector.

1. Tie raps

4. Turn the connector over and remove the orange secondary locking tab by pushing it with a small screwdriver at one end, then pulling toward the wire harness at the other end. See following two illustrations.

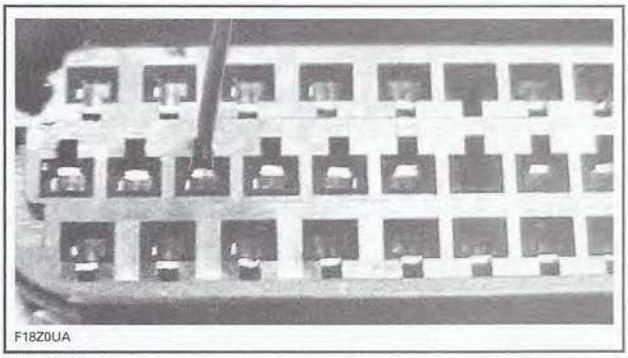


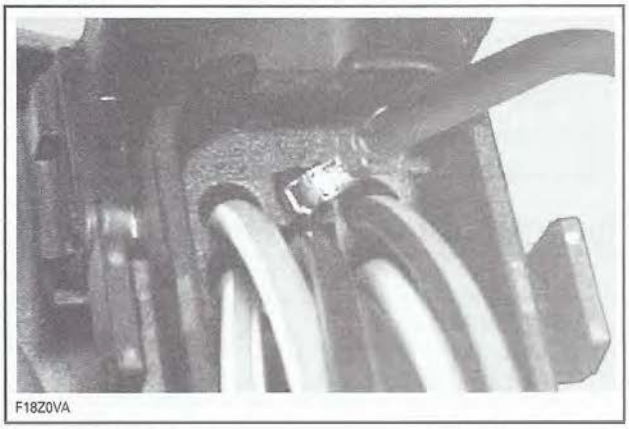


To unlock the terminals (pins), a SNAP-ON TERMINAL REMOVER TOOL (P/N TT600-1) or equivalent (a 0.76 mm (.03 in) oxyacetylene torch tip cleaner or a no. 68 drill bit) must be inserted into the terminal cavity to release the locking tab from the connector.

NOTICE **Using a tool tip larger than 0.76 mm (.03 in) may damage the terminal.**

5. Insert the tool tip into the terminal cavity as shown, and locate its wire in the back of the connector. You may have to pry the tool tip against the locking tab to release it, then remove the terminal from the connector.





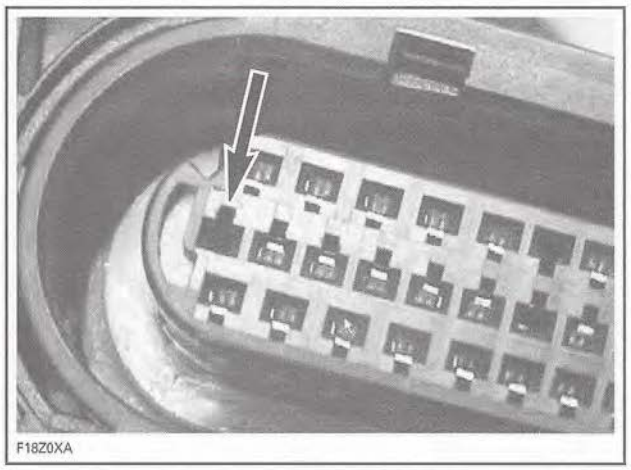
Terminal Insertion

1. Check the locking tab on the terminal, it may have to be bent out a little so it will lock in its cavity when it is re-inserted. .

If the wire is in good condition but the terminal is rusted or corroded, remove defective terminal and crimp a new one. If wire and terminal are defective, replace with a new genuine wire and new terminal and crimp them together as explained below.

IMPORTANT: Use genuine wires only. Otherwise wires will not fit properly.

NOTE: When re-inserting the terminal, the locking tab must be installed facing the smaller cutout of the terminal cavity.


F18Z0XA

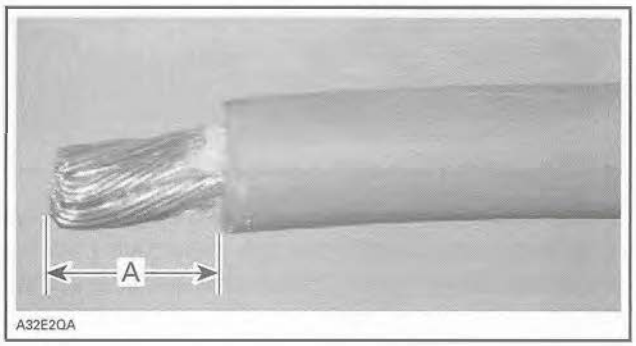
2. Insert the terminal, ensuring the locking tab snaps into its cavity.
3. Re-install the orange locking tab, attach the 2 locking ties, and close the connector cover.

Terminal Crimping (Kostal)

REQUIRED TOOLS	
CRIMPING TOOL (KOSTAL) (P/N 529 035 909)	
KOSTAL DIE (P/N 529 035 906)	

To properly crimp the wires, strictly follow this procedure.

1. Strip the wire to a maximum of 3 mm (1/8 in).



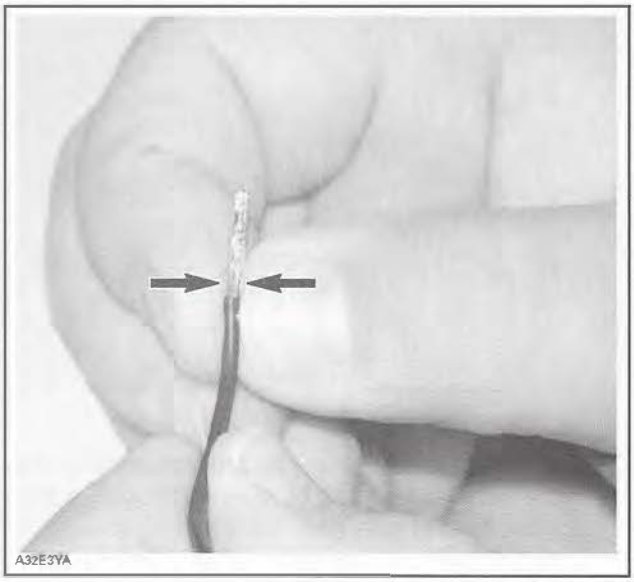
A32E2QA

TYPICAL
A. 3 mm (1/8 in) max.

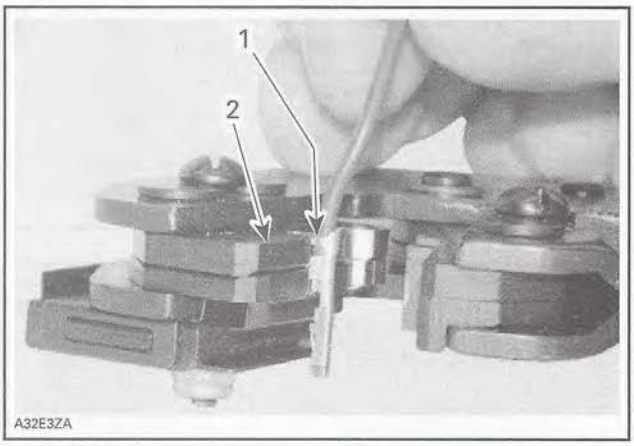
2. Position wire in terminal.

NOTE: Ensure no strand of wire is out of the terminal, otherwise electrical problems may occur.

3. Squeeze the terminal tabs with your fingers to temporarily retain terminal in place.


A32E3YA

4. Insert terminal with wire in crimping pliers and position it so the top of the terminal tabs are flush with the pliers edge, or a little bit lower as shown.



A32E3ZA

1. Top of terminal tabs
2. Align tabs with pliers edge

5. Crimp terminal.

Lubrication

Do not apply any product to the pins of the connector on the ECM.

MOLEX CONNECTOR

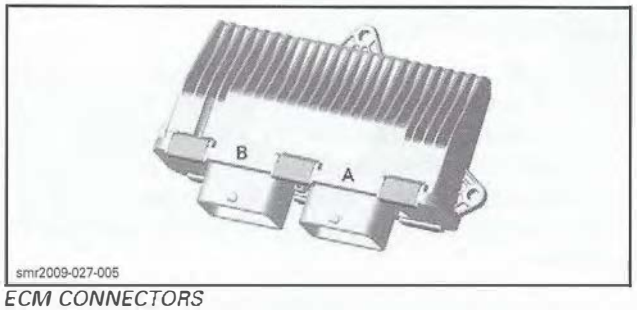
Molex Connector Application

The Molex connector is used on the ECM (210 and 230 series).

There are 2 MOLEX connectors on the ECM.

The engine wiring harness connector is connected to ECM connector "A". The vehicle wiring harness connector is connected to ECM connector "B".

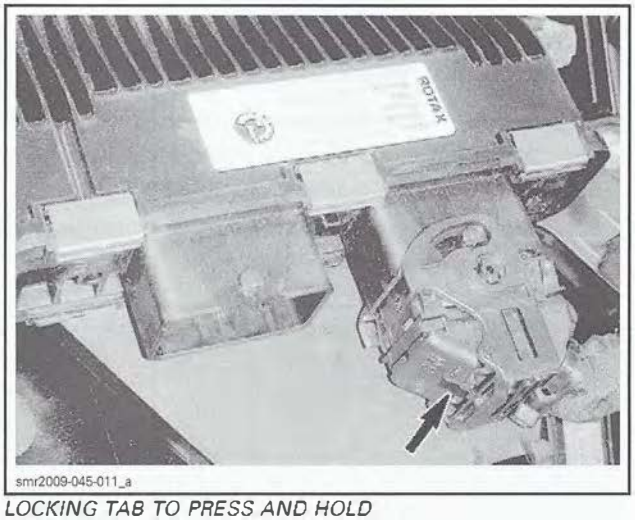
Each ECM connector has 48 pins.



ECM CONNECTORS

Connector Removal

1. To access the ECM, refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
2. Press and hold the locking tab on the connector to be disconnected.



LOCKING TAB TO PRESS AND HOLD

3. As you hold the locking tab, rotate the connector locking cam until it stops.

CONNECTOR LOCKING CAM ROTATION TO RELEASE

4. Pull connector off ECM.

Connector Installation

1. Fully open connector locking cam.

CONNECTOR LOCKING CAM IN RELEASE POSITION

2. Insert connector on ECM.

3. As you push the connector onto the ECM, rotate the connector locking cam until it snaps locked.

1. Locked here

4. Ensure the locking tab is fully out.

LOCKING TAB FULLY OUT

Connector Inspection

Before replacing an ECM, always check electrical connections.

1. Ensure connector locking mechanism is functioning properly.
2. Ensure all wire terminals (pins) are properly locked in the connector.
3. Ensure they are very tight, make good contact with the pins in the ECM.
4. Ensure the pins in the harness connector and the ECM connector are clean, shiny and corrosion-free.
5. Check wiring harness for signs of scoring.

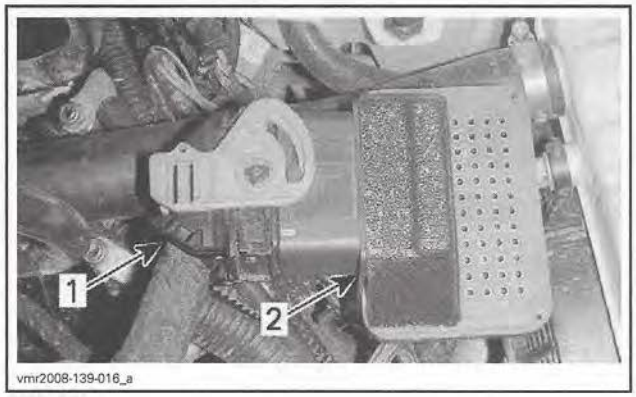
NOTE: A "defective ECM module" could possibly be repaired simply by disconnecting and reconnecting it.

NOTICE Do not apply any lubricant product to the pins of the ECM connector.

Connector Probing

The most recommended and safest method to probe the MOLEX (ECM) connector terminals is to use the ECM ADAPTER TOOL (P/N 529 036 166). This tool will prevent deforming or enlarging of the terminals, which would lead to bad ECM terminal contact creating intermittent or permanent problems.

1. Disconnect the ECM connector to be probed, and reconnect it on the ECM adapter.
2. Probe wire terminals of the circuit to be tested directly in the adapter holes.



TYPICAL
1. ECM connector
2. ECM adapter

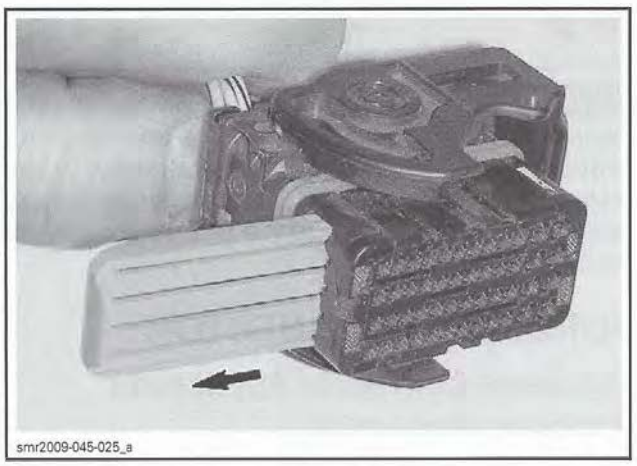
NOTICE Never probe directly on the ECM harness connector. This could change the shape or enlarge the terminals and create intermittent or permanent contact problems.

Connector Terminal Removal (Harness Connector)

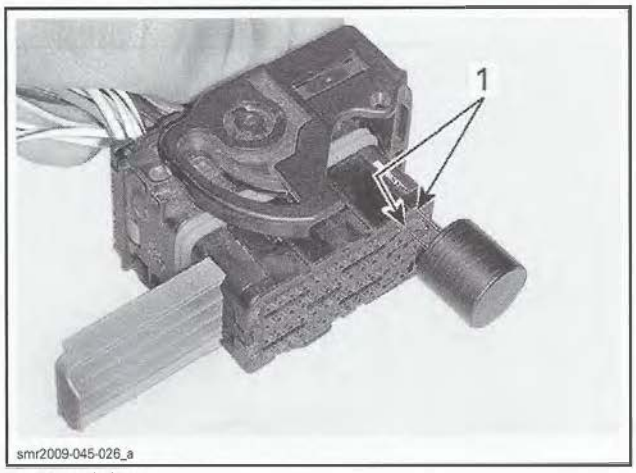
To remove a signal terminal from the ECM harness connector, use the ECM TERMINAL REMOVER 2.25 (P/N 529 036 175).

To remove a power terminal, use the ECM TERMINAL REMOVER 3.36 (P/N 529 036 174).

1. Remove rear protector from connector.
2. Pull out the connector lock.

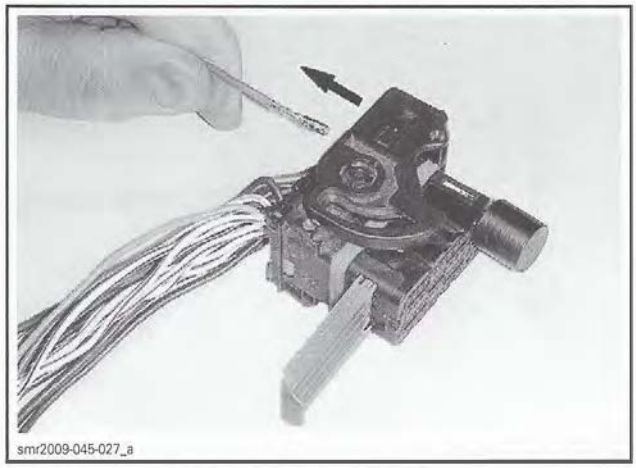


3. Insert tool to unlock terminal.



1. Unlock here

4. Gently pull on the wire to extract the terminal out the back of the connector.



NOTICE Before installing wire terminals in the connector, ensure all terminals are properly crimped on wires. After installation of wire terminals in the connectors, ensure they are properly locked by gently pulling on them as if to extract them.

DELPHI CONNECTOR

Delphi Connector Application

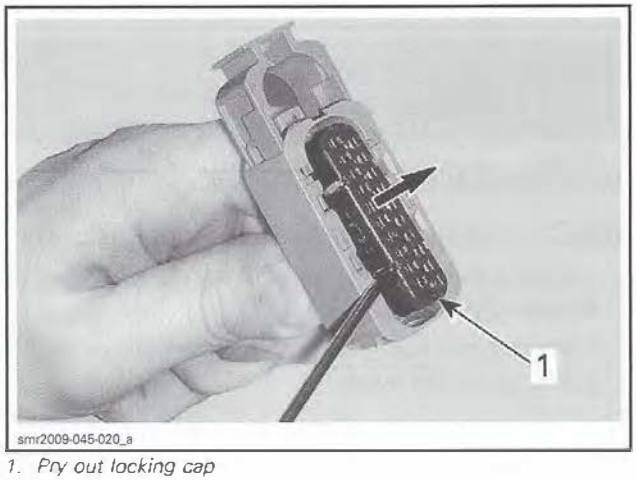
Delphi connectors come in various configurations. They are used for the:

- Information center
- TAS
- Starter solenoid.

Connector Terminal Removal

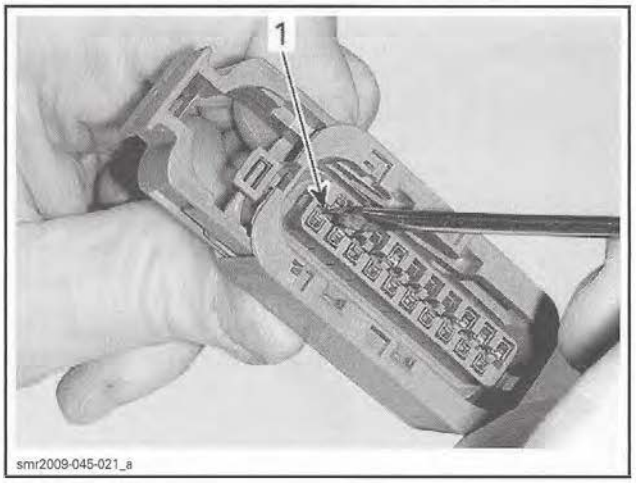
Information Center Connector

1. To remove a terminal from the connector, first remove the locking cap in the front of the connector.



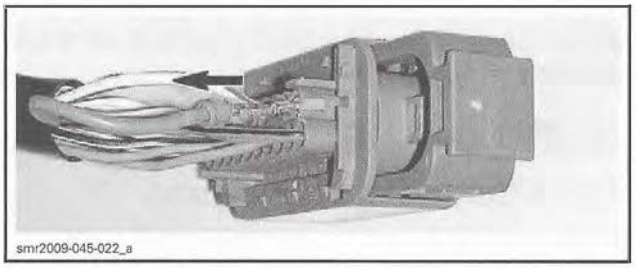
1. Pry out locking cap

2. Release the pin in the front of the connector.



1. Unlock here

3. Gently pull on the wire to extract the pin out the back of the connector.



NOTICE Before installing terminals in the connectors, ensure all terminals are properly crimped on the wires. After installation of the wire terminals in the connectors, ensure they are properly locked by gently pushing on them as if to extract them.

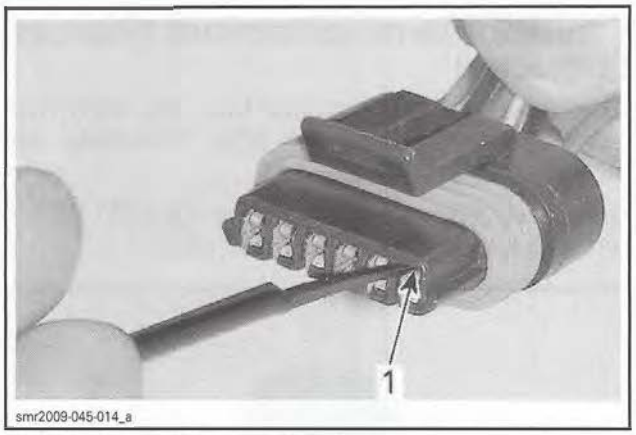
TAS and Starter Solenoid Connectors

To remove a terminal (pin) from the connector, use a special tool such as the DELPHI TERMINAL EXTRACTOR (P/N 12094429).

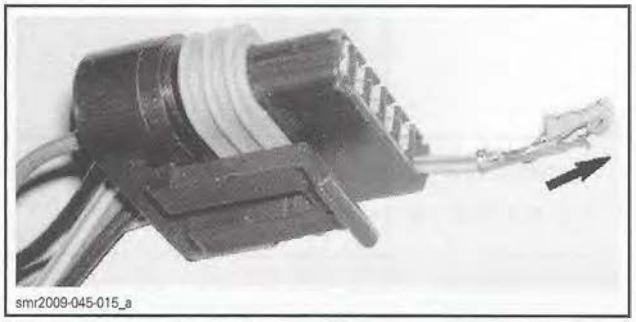
DELPHI TERMINAL EXTRACTOR (P/N 12094429)

NOTE: Grinding the tool end to a taper is required.

1. Carefully insert the tool in the space provided to release the pin lock.
2. Push the pin out the front of the connector by pushing on the wire.



1. Unlock terminal here



NOTICE Before installing terminals in the connectors, ensure all terminals are properly crimped on the wires. After installation of the wire terminals in the connectors, ensure they are properly locked by gently pushing on them as if to extract them.

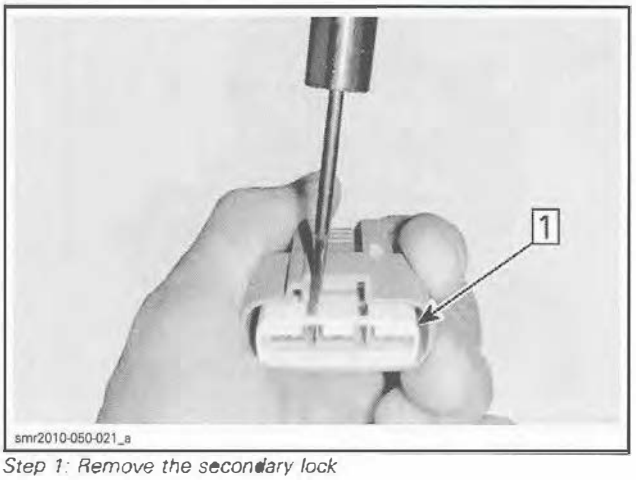
FURUKAWA CONNECTOR

Furukawa Connector Application

Voltage regulator/rectifier.

Terminal Removal

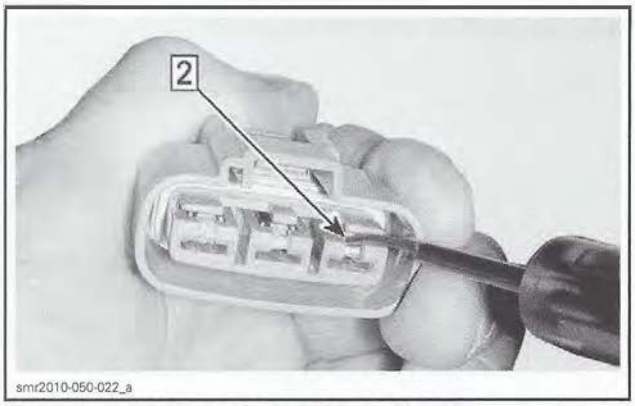
1. Remove the secondary lock (plastic insert).



Step 1: Remove the secondary lock

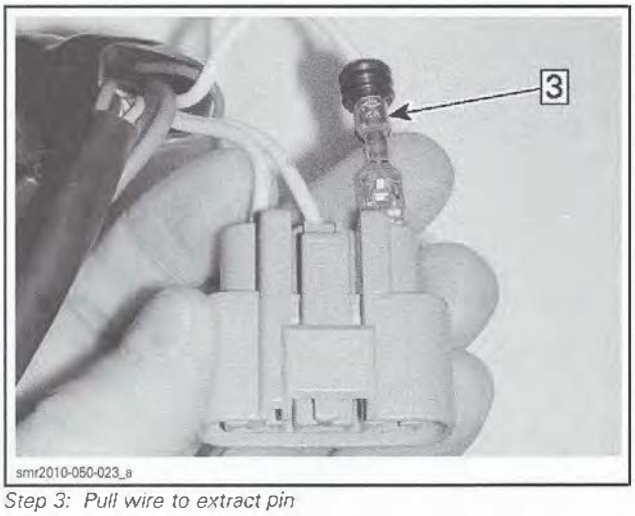
2. Carefully insert the GM TERMINAL EXTRACTOR (P/N 12094430) between the lock and the pin to release the pin.

GM TERMINAL EXTRACTOR (P/N 12094430)



Step 2: Insert GM extractor tool (P/N 12094430)

3. Gently pull on the wire to extract the pin out the back of the connector.



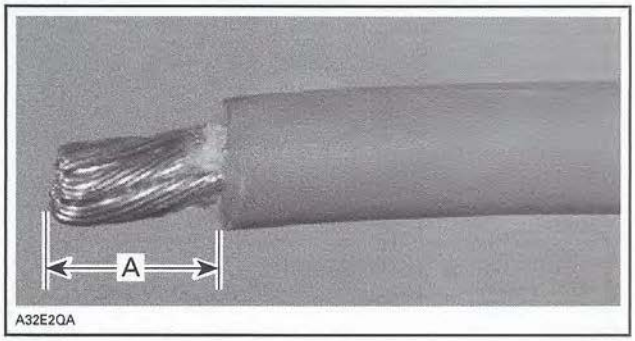
Step 3: Pull wire to extract pin

NOTICE Before installing terminals in the connectors, ensure all terminals are properly crimped on the wires. After installation of the wire terminals in the connectors, ensure they are properly locked by gently pushing on them as if to extract them.

BATTERY AND STARTER CABLE TERMINALS

Cable Crimping

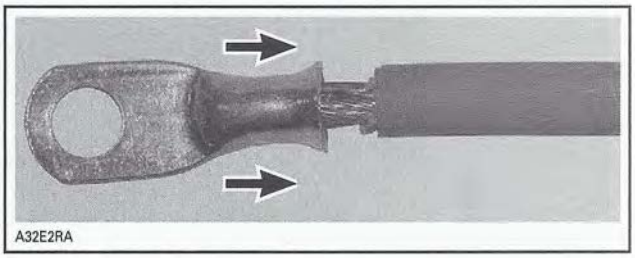
Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.



A. 10 mm (3/8 in)

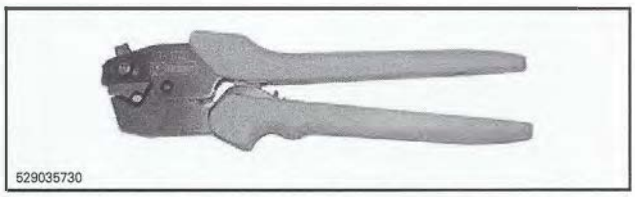
NOTE: Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate *PARTS CATALOG*.

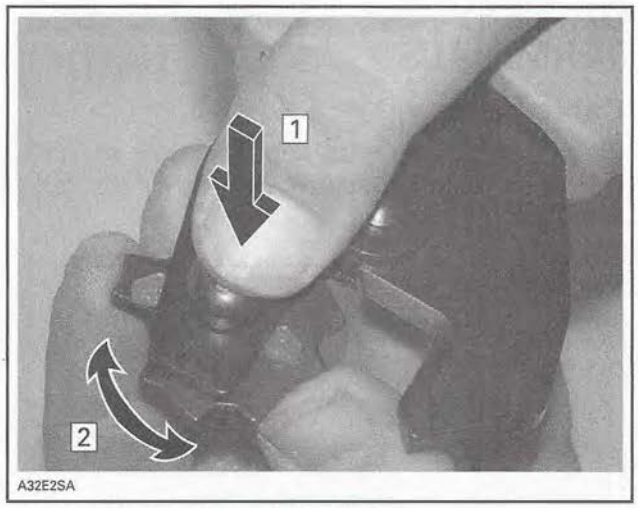


INSTALLATION OF TERMINAL

Follow the instructions provided with the CRIMPING TOOL (HEAVY GAUGE WIRE) (P/N 529 035 730) to select the proper position of the tool.

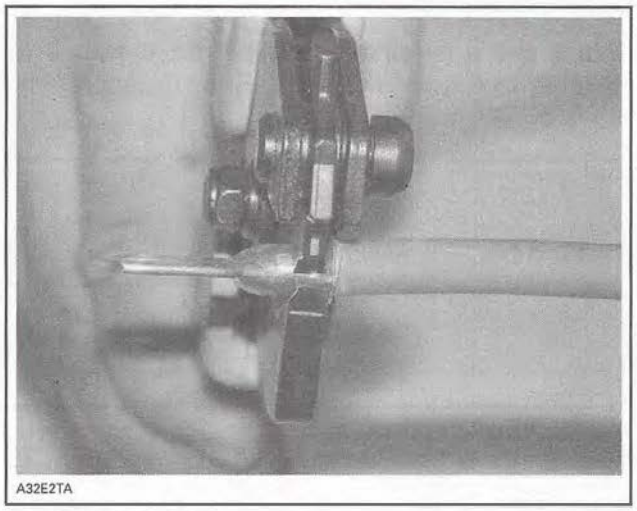


NOTE: Different wires require different crimping pliers settings.

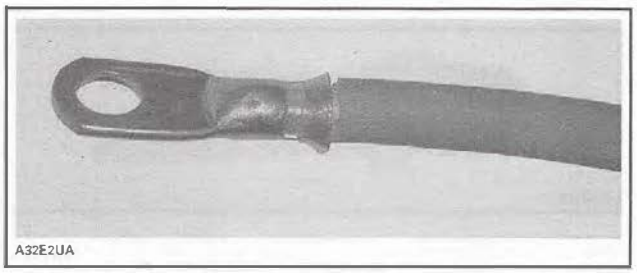


POSITIONING THE CRIMPING PLIERS
Step 1: Press
Step 2: Rotate

After positioning the crimping pliers, crimp the terminal already installed on wire.



CRIMPING OF WIRE



PROPERLY CRIMPED WIRE

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

NOTICE Never weld the wire to the terminal. Welding can change the property of the wire and it can become brittle and break.

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

NOTICE Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.

219 100 540 CA

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MANUEL DE RÉPARATION, Série150, 180, 200, 210, 230 / ANGLAIS

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