



SEA-DOO®



2011
SHOP MANUAL

GTS/GTI™ / RXT™ /
GTX† / WAKE™
SERIES

219 100 53

2011 Shop Manual

**JET
STAR**

GTS/GTI™/RXT™/GTX†/WAKE™ SERIES

SEA-DOO.



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Technical Publications

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iControl™	RXT™	XPS™
iST™	GTX†	WAKE™
X-Steering™	GTI	WAKE™ PRO
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STAR

SAFETY NOTICE

SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2011 Sea-Doo® watercraft 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. Mechanical 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.

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.

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

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. WWW.JET-STAR.JP

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

INTRODUCTION

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

MODEL	MODEL NUMBER
GTI Limited	39BA, 39BB
GTI SE	24BA, 24BB, 24BC, 30BA, 30BB
GTI	23BA, 23BB
GTS	25BA, 43BA, 43BB
GTX Limited iS	18BA, 18BB
GTX iS	33BA
GTX	38BA, 38BB, 42BA, 42BB
RXT iS	34BA, 34BB
RXT-X aS	41BA
RXT-XRS aS	41BB
RXT X	31BA
RXT XRS	31BB
RXT	17BA, 17BB
WAKE	35BA, 35BB
WAKE PRO	26BA, 26BB

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.

VEHICLE INFORMATION

HULL IDENTIFICATION NUMBER (H.I.N.)

The hull identification number is composed of 12 digits:

YDV	12345	L	4	95	
					Model year
					Year of production
					Month of production
					Serial number (a letter may also be used as a digit)
					Manufacturer

It is located on the deck at the rear of watercraft.



smo2009-002-131_b

TYPICAL

1. Hull Identification Number (H.I.N.) - aS and iS models



smr2010-034-001_a

TYPICAL

1. Hull Identification Number (H.I.N.) - models without aS and iS

INTRODUCTION

ENGINE IDENTIFICATION NUMBER (E.I.N.)

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



F18D03A

TYPICAL

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

HOISTING A WATERCRAFT

To work on a watercraft, you should mount it securely on a stand.

The LIFTING STRAP (P/N 529 036 171) MUST be used to hoist and mount the watercraft on a stand.

NOTICE Using any lifting strap kit other than the one recommended may cause damage to the vehicle. Bumpers could be torn off.



3B12009-004-003

TYPICAL

ENGINE EMISSIONS INFORMATION

Manufacturer's Responsibility

Since production of the 1999 model year engines, PWC 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 watercrafts that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

Exceptions include manufacturers' 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.

INTRODUCTION

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 watercrafts 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 watercraft engines. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

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

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:

U.S. Environmental Protection Agency
Office of Transportation and Air Quality
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

INTERNET WEB SITE: <http://www.epa.gov/otaq>

E-Mail: otaqpublicweb@epa.gov

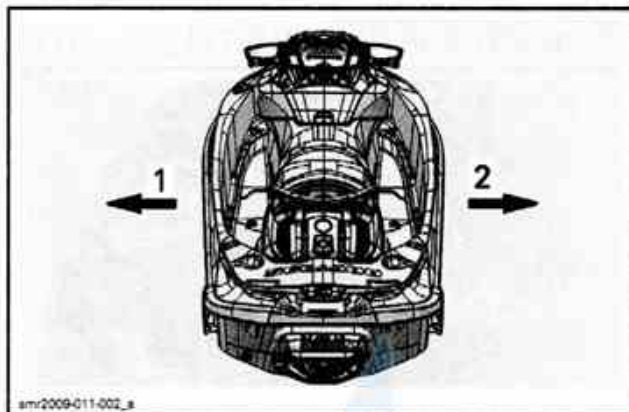
MANUAL INFORMATION

MANUAL PROCEDURES

Many of the procedures in this manual are inter-related. 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.

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



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

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

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

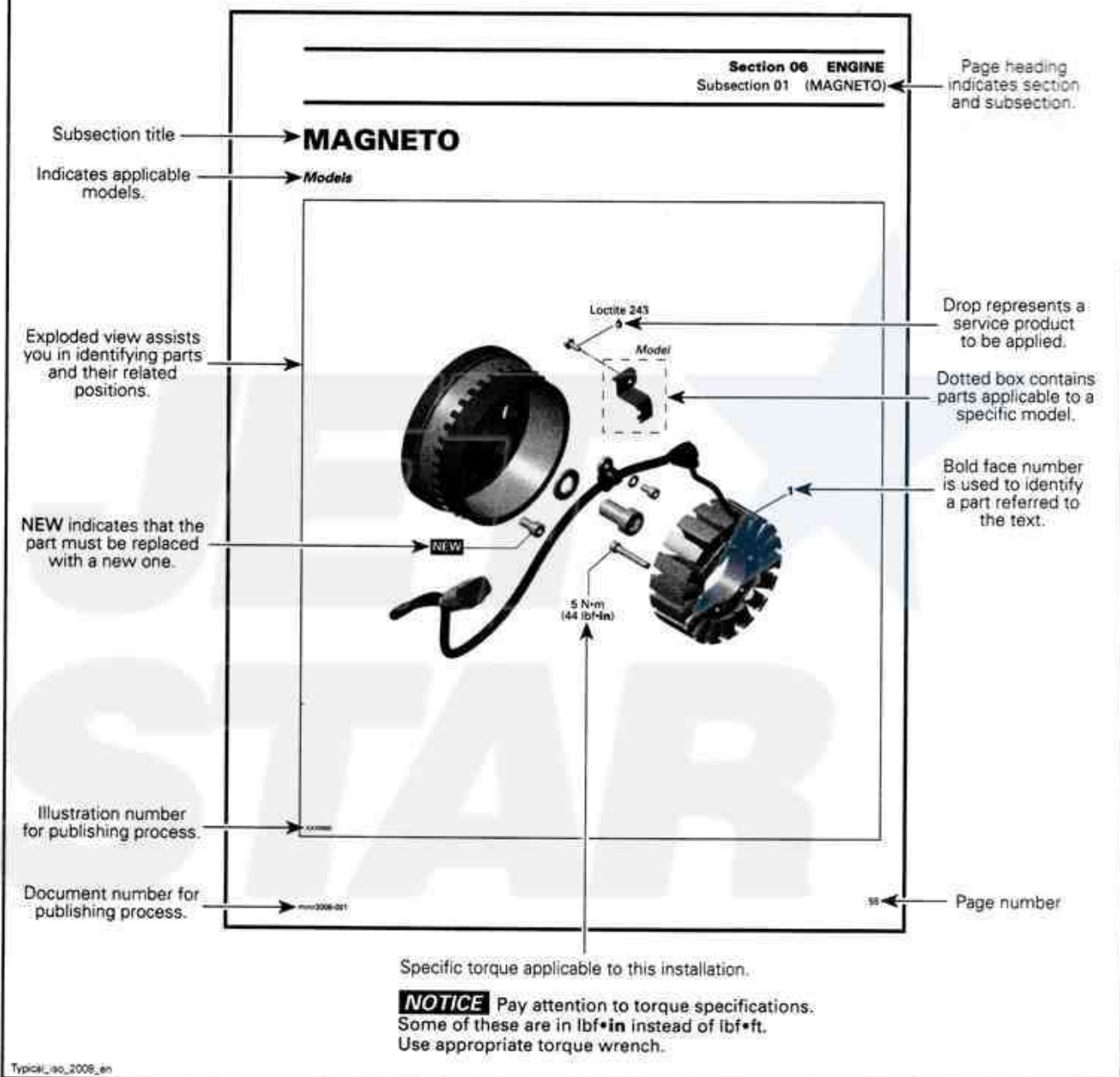
This manual is divided into many major sections as can be seen in the main table of contents at the beginning of the manual.

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.

INTRODUCTION

TYPICAL PAGE



Typical_ico_2008_en

INTRODUCTION

TYPICAL PAGE

Typical page layout showing a technical manual page with annotations explaining various formatting and content elements.

Section 03 ENGINE
Subsection 09 (MAGNETO SYSTEM)

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 **LOC-TITE APPLICATION** sections at the beginning of this manual for complete procedure.

WARNING

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

PROCEDURES

MAGNETO FLYWHEEL

Magneto Flywheel Cleaning
Clean all metal components in a non-ferrous metal cleaner.
CAUTION: Clean magneto flywheel using only a clean cloth.

Magneto Flywheel Removal
Remove muffler; refer to the **EXHAUST SYSTEM** section.
Remove acoustic panel.
Remove rewind starter.
Remove starting pulley no. 2.

Illustration 1: A photograph of the magneto flywheel assembly. A callout points to the starting pulley with the text: "TYPICAL 1. Starting pulley".

Illustration 2: A photograph showing the removal of the starting pulley using a socket. A callout points to the pulley with the text: "TYPICAL 2. Starting pulley".

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

Annotations:

- Title in bold indicates category of information to be carried out.
- Reference to a specific section or subsection.
- Indicates component procedures apply to.
- Indicates specific procedure to be carried out.
- "TYPICAL" indicates a general view which may not represent exact details.
- Call-outs pertaining to above illustration.
- Illustration always follows text to which it applies.
- Italic bold face type-setting indicates a procedure applicable to a specific model(s).
- Bold face number following part name refers to exploded view at beginning of subsection.

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INTRODUCTION

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:

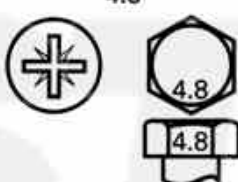
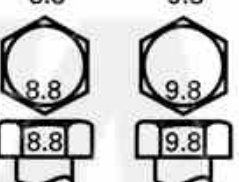
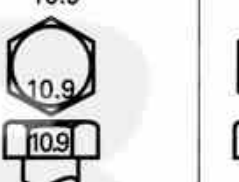
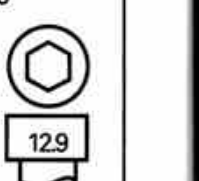
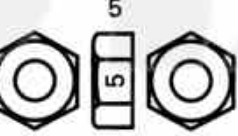
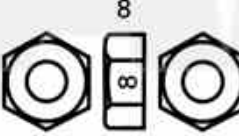


1. Manually screw all screws, bolts and/or nuts.
2. Apply half the recommended torque value.

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

NOTE: Whenever 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 (e.g. a cylinder head). Some parts must be torqued according to a specific sequence and torque pattern as detailed in the installation procedure.

Property class and head markings				
Property class and nut markings				

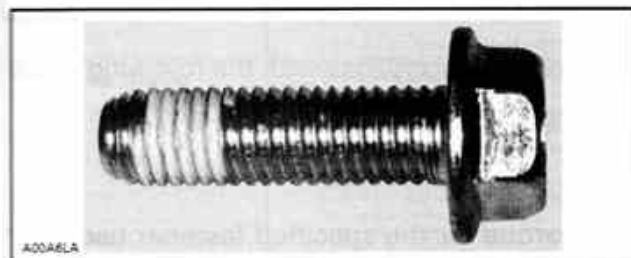
FASTENER SIZE	FASTENER GRADE/TORQUE			
	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 – 2 N•m (13 – 18 lbf•in)	2.5 – 3 N•m (22 – 27 lbf•in)	3.5 – 4 N•m (31 – 35 lbf•ft)	4 – 5 N•m (35 – 44 lbf•ft)
M5	3 – 3.5 N•m (27 – 31 lbf•ft)	4.5 – 5.5 N•m (40 – 47 lbf•ft)	7 – 8.5 N•m (62 – 75 lbf•ft)	8 – 10 N•m (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)

INTRODUCTION

FASTENER INFORMATION

NOTICE Most fasteners are metric. Mismatched or incorrect fasteners could cause damage to the vehicle.

SELF-LOCKING FASTENER PROCEDURE



TYPICAL — SELF-LOCKING FASTENER

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

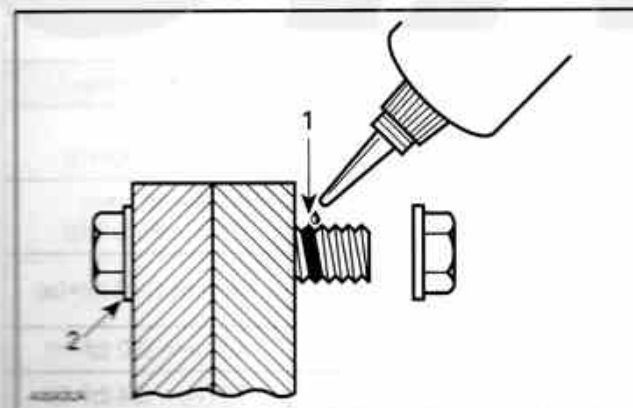
Use a metal brush or a tap to clean the hole properly, then use a solvent. Allow the solvent time to act, approximately 30 minutes, then wipe off. Solvent utilization is to ensure proper adhesion of the product used for locking the fastener.

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)

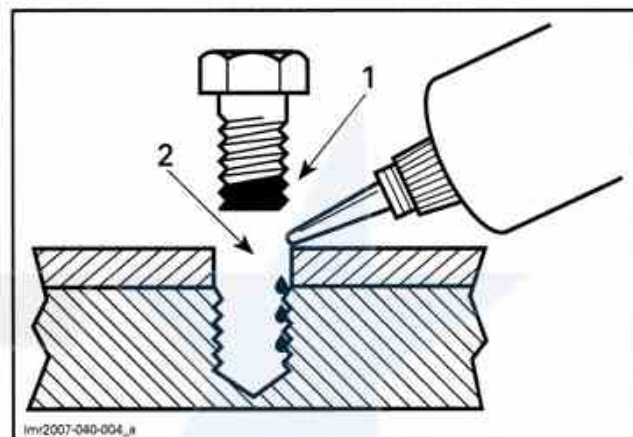


1. Apply here
2. Do not apply

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

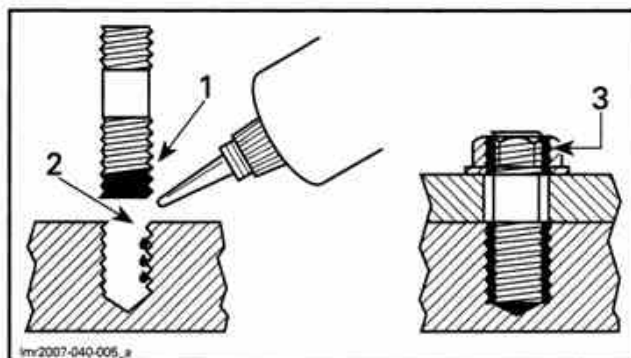


1. On fastener threads.
2. On threads and at the bottom of hole

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.

INTRODUCTION

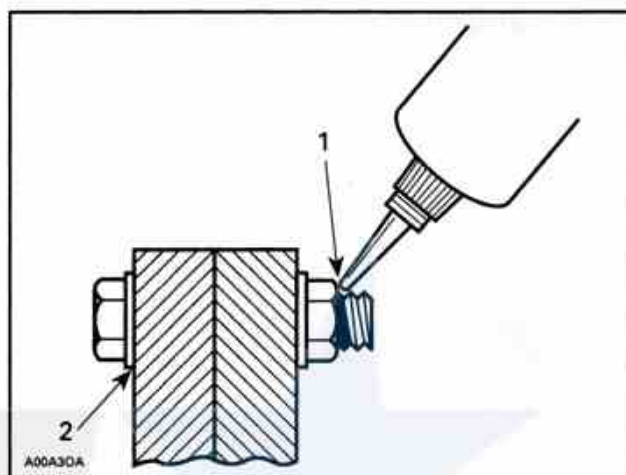
Threadlocker Application for Stud Installation in Blind Holes



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.

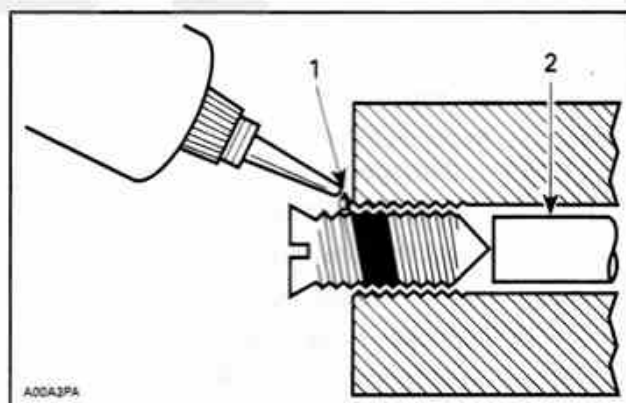
Threadlocker Application for Pre-Assembled Parts



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



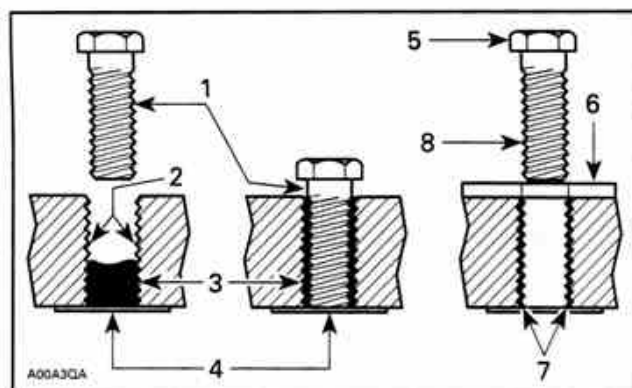
1. Apply here
2. Plunger

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.

INTRODUCTION

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. Tape
5. Cleaned bolt
6. Plate
7. New threads
8. Threadlocker

Standard Thread Repair

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

If a plate is used to align bolt:

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

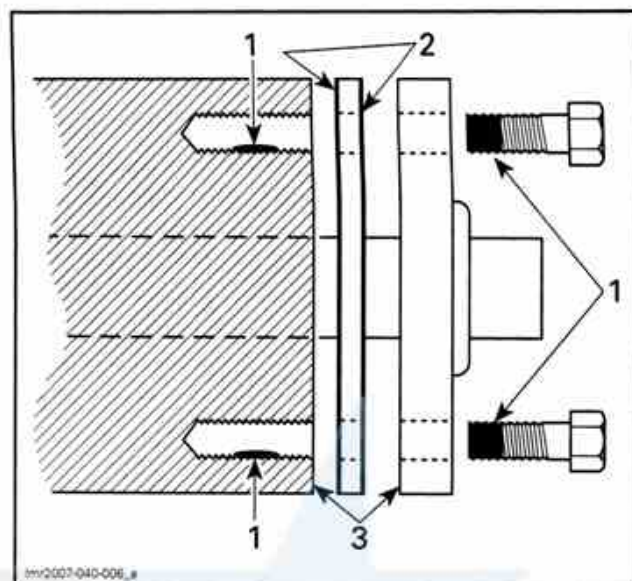
Option 1: Enlarge damaged hole, then follow **STANDARD THREAD REPAIR** procedure.

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.

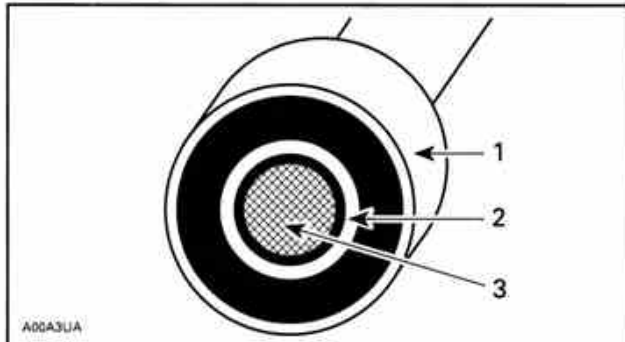
If holes are sunken, apply proper strength Loctite on bolt threads.

6. Tighten as usual.

Threadlocker Application for Mounting on a Shaft

Mounting with a Press

INTRODUCTION



- 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.

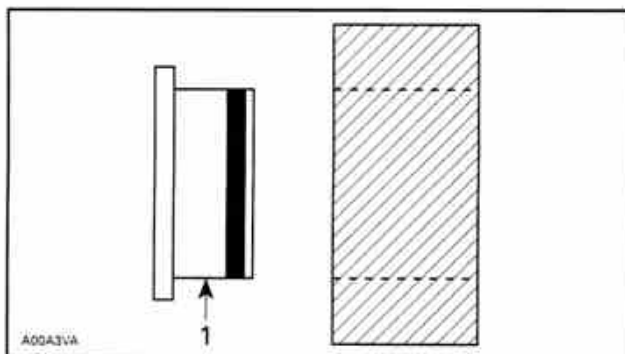
NOTE: Retaining compound is always forced out when applied on shaft.

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



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



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ADAPTER HOSE
(P/N 529 035 652)



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ALIGNMENT SHAFT ADAPTER
(P/N 529 035 719)



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ALIGNMENT SHAFT SUPPORT
(P/N 529 035 506)



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ALIGNMENT SHAFT
(P/N 295 000 141)



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



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



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CAMSHAFT LOCKING TOOL
(P/N 529 035 839)



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CRANKSHAFT LOCKING TOOL
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CRIMPING TOOL (HEAVY GAUGE
WIRE)
(P/N 529 035 730)



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DIGITAL INDUCTION TACHOMETER
(P/N 529 014 500)



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DRIVE SHAFT ADAPTER
(P/N 529 035 985)



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DRIVE SHAFT C-CLIP REMOVER
(P/N 529 036 026)



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ECM ADAPTER TOOL
(P/N 529 036 166)



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ECM TERMINAL REMOVER 2.25
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ECM TERMINAL REMOVER 3.36
(P/N 529 036 174)



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ENGINE ALIGNMENT TOOL
(P/N 529 036 197)



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ENGINE LEAK DOWN TEST KIT
(P/N 529 035 661)



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FLOATING RING TOOL (TYPE I)
(P/N 529 035 841)



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FLUKE 115 MULTIMETER
(P/N 529 035 868)



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FLUSHING CONNECTOR ADAPTER
(P/N 295 500 473)



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FUEL HOSE ADAPTER
(P/N 529 036 023)



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FUEL HOSE DISCONNECT TOOL
(P/N 529 036 037)



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FUEL PUMP MODULE SOCKET
(P/N 529 036 125)



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HANDLE
(P/N 420 877 650)



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



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IMPELLER REMOVER/INSTALLER
(P/N 529 035 956)



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IMPELLER SHAFT BEARING TOOL
(P/N 529 036 168)



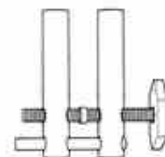
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IMPELLER SHAFT PUSHER
(P/N 529 035 955)



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LARGE HOSE PINCHER
(P/N 529 032 500)



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MAGNETO HARNESS 6 PINS
(P/N 295 000 136)



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



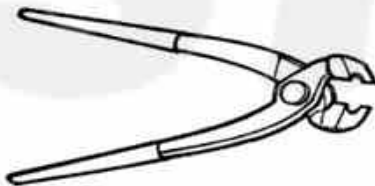
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MPI-2 INTERFACE CARD
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PISTON CIRCLIP INSTALLER
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PRESSURE CAP
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SMALL HOSE PINCHER
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STARTER DRIVE SEAL PUSHER
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STEERING CABLE TOOL
(P/N 295 000 145)



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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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THRU-HULL ADAPTER
(P/N 529 036 193)



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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 watercraft model (iS, aS, iBR and supercharger components). Follow maintenance schedule as applicable to watercraft model.

BREAK-IN INSPECTION CHART	REPLACE				
	ADJUST				
	LUBRICATE				
	CLEAN				
	INSPECT				
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 cap, filler neck, fuel tank, fuel tank straps, fuel lines and connections	X				
Fuel system leak test	X				
Throttle body	X				
AIR INTAKE SYSTEM					
Air intake silencer	X				
ELECTRONIC MANAGEMENT SYSTEM					
EMS sensors	X				
Fault codes (ECM, iBR, iS, cluster)	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				
Monitoring beeper	X				
Battery and fasteners	X				
STEERING SYSTEM					
Steering cable and connections	X				
Steering nozzle bushings	X				
O.T.A.S. (see NOTE 1 after break-in inspection chart)	X				

Section 01 MAINTENANCE
Subsection 01 (BREAK-IN INSPECTION)

BREAK-IN INSPECTION CHART	REPLACE				
	ADJUST				
	LUBRICATE				
	CLEAN				
	INSPECT				
PROPULSION SYSTEM					
Carbon ring and rubber boot (drive shaft)	X				
Impeller boot	X				
Sacrificial anode (if so equipped)	X				
Impeller and impeller wear ring clearance	X				
Pump mounts	X				
iBR SYSTEM (intelligent Brake and Reverse)					
iBR gate backlash	X				
iBR support plates	X				
iBR friction sleeves	X				
iBR connecting arms, sleeves and bushings	X				
iBR U lever, VTS trim ring, iBR gate and bushings	X				
iBR U arm to actuator shaft retaining screw torque (see NOTE 2 after break-in inspection chart)	X				
iBR protective guard	X				
iS SYSTEM (intelligent Suspension)					
iS oil	X				
iS position sensor	X				
aS SYSTEM (adjustable Suspension)					
Nitrogen remote reservoir (adjustment knob, mounts)					X
HULL/BODY					
Hull	X				
Ride plate and water intake grate	X				

(1) Inspect operation.

(2) Ensure proper torque of screws retaining iBR U arm to iBR actuator shaft. If retaining screws found loose, do not re-torque them. Replace them with new ones.

MAINTENANCE SCHEDULE

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

When maintenance is completed, the maintenance reminders must be cleared using B.U.D.S. Refer to the (INFORMATION CENTER GAUGE) subsection.

NOTE: Some maintenance or inspection items listed in the following maintenance schedule may not be applicable to every watercraft model (iS, aS, iBR and supercharger components). Follow maintenance schedule as applicable to watercraft model.

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE O: OPERATOR D: DEALER	25 HOURS OR 3 MONTHS					TO BE PERFORMED BY	NOTE
PART/TASK	50 HOURS OR 6 MONTHS						
	100 HOURS OR 1 YEAR						
	200 HOURS OR 2 YEAR						
ENGINE							
Engine oil and filter			R		D	(1) See NOTE 1 after maintenance schedule.	
Rubber mounts			I		D		
Corrosion protection		L			O		
Supercharger clutch			R (1)		D		
EXHAUST SYSTEM							
Exhaust system			I, C (2)		O/D	(2) Daily flushing in salt water or foul water use.	
COOLING SYSTEM							
Coolant				R	D	—	
FUEL SYSTEM							
iTC lever (3)			I, L		O/D	(3) See NOTE 2 after maintenance schedule.	
Fuel cap, filler neck, fuel tank, fuel tank straps, fuel lines and connections			I (4)		D	(4) At storage period or after 100 hours of use whichever comes first.	
Fuel system leak test			I		D		
Throttle body			I		D		
AIR INTAKE SYSTEM							
Air intake silencer			I, C		D	—	
Blow-by valve hose			I, C		D		
ELECTRONIC MANAGEMENT SYSTEMS							
EMS sensors			I		D	—	
Fault codes (ECM, iBR, iS, Cluster)			I		D		

Section 01 MAINTENANCE
Subsection 02 (MAINTENANCE SCHEDULE)

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE O: OPERATOR D: DEALER	25 HOURS OR 3 MONTHS					NOTE
PART/TASK	50 HOURS OR 6 MONTHS					
	100 HOURS OR 1 YEAR					
	200 HOURS OR 2 YEAR					
	TO BE PERFORMED BY					
ELECTRICAL SYSTEM						
Spark plugs			I	R	D	(5) Inspect once a month. Add electrolyte as required.
Ignition coils			I, L		D	
Electrical connections and fastening (ignition system, starting system, fuel injectors, fuse boxes etc.)			I		D	
Engine cut-off switch			I		D	
Monitoring beeper			I		D	
Battery and fasteners			I (5)		D	
STEERING SYSTEM						
Steering cable and connections			I		D	(6) Inspect operation.
Steering nozzle bushings			I		D	
O.T.A.S. (6)			I		D	
PROPULSION SYSTEM						
Carbon ring and rubber boot (drive shaft)			I		D	(4) At storage period or after 100 hours of use whichever comes first. (7) Inspect each month (more often in salt water use) and change when necessary.
Impeller boot			I		D	
Impeller shaft seal, sleeve and O-ring			I (4)		D	
Drive shaft/impeller splines			I, L		D	
Sacrificial anode (if so equipped)			I (7)		D	
Impeller and impeller wear ring clearance			I		D	
Pump mounts			I		D	
iBR SYSTEM (intelligent Brake and Reverse)						
iBR control lever (3)			I, L		O/D	(3) See NOTE 2 after maintenance chart. (4) At storage period or after 100 hours of use whichever comes first. (8) See NOTE 3 after maintenance schedule.
iBR gate backlash			I		D	
iBR support plates			I		D	
iBR friction sleeves			R		D	
iBR connecting arms, sleeves and bushings			I		D	
iBR U lever, VTS trim ring, iBR gate and bushings			I		D	
iBR U arm to actuator shaft retaining screw torque			I (4) (8)		D	
iBR protective guard			I		D	
iS SYSTEM (intelligent Suspension)						
iS oil (9)			I		D	(9) Check pump reservoir oil level and for system leaks.
iS position sensor			I		D	

Section 01 MAINTENANCE

Subsection 02 (MAINTENANCE SCHEDULE)

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE O: OPERATOR D: DEALER	25 HOURS OR 3 MONTHS					
PART/TASK	50 HOURS OR 6 MONTHS					
	100 HOURS OR 1 YEAR					
	200 HOURS OR 2 YEAR					
	TO BE PERFORMED BY					
	NOTE					
aS SYSTEM (adjustable Suspension)						
Nitrogen remote reservoir (adjustment knob, mounts)			I		D	—
HULL AND BODY						
Hull			I		O	—
Ride plate and water intake grate			I		O	

- (1) The supercharger clutch requires replacement when the SUPERCHARGER MAINTENANCE REQUIRED message is displayed on the information center every 100 hours of operation or earlier depending on the riding style (speed, engine's RPM, water conditions). This is determined by the engine management system. The supercharger clutch will need to be replaced within 5 hours of the message display. The supercharger maintenance reminder must be reset using B.U.D.S. in order to reset the supercharger maintenance hour counter, even if the maintenance was carried out before the reminder appeared in the information center.
- (2) The iTC and iBR levers should be inspected by depressing and releasing the levers to check for freedom of movement. If any friction is felt, the lever must be taken apart, cleaned, inspected for wear and lubricated.
- (3) Ensure proper torque of screws retaining iBR U arm to iBR actuator shaft. If retaining screws are found loose, do not re-torque them. Replace them with new ones.

STORAGE PROCEDURE

SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	14
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	13
XPS FUEL STABILIZER.....	413 408 601	11
XPS LUBE.....	293 600 016	11, 13-14

PROCEDURES

PROPULSION SYSTEM

XPS Lube 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

XPS FUEL STABILIZER (P/N 413 408 601) (or equivalent) should be added in the 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 completely. Ensure there is no water inside 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 watercraft level. Do not overfill or top off the fuel tank and leave watercraft in the sun. As temperature increases, fuel expands and might overflow. Always wipe off any fuel spillage from the watercraft. Periodically inspect fuel system.

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

ENGINE

Engine Oil and Filter Replacement

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

Exhaust System Flushing

Flush the exhaust system. Refer to *EXHAUST SYSTEM* subsection.

Intercooler Draining (260 Engine)

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

NOTICE Failure to drain the intercooler may cause severe damage to this component.

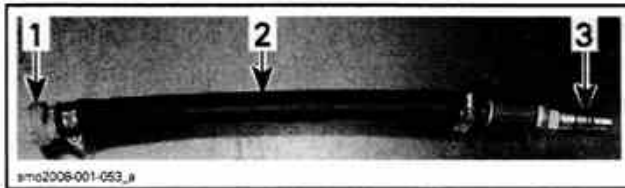
Proceed as follows:

iS and aS Models

1. Open the boarding platform and remove the RH storage bin.

Section 01 MAINTENANCE

Subsection 03 (STORAGE 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. Open seat.

iS and aS Models

2. Remove the rear ventilation box.

All Models

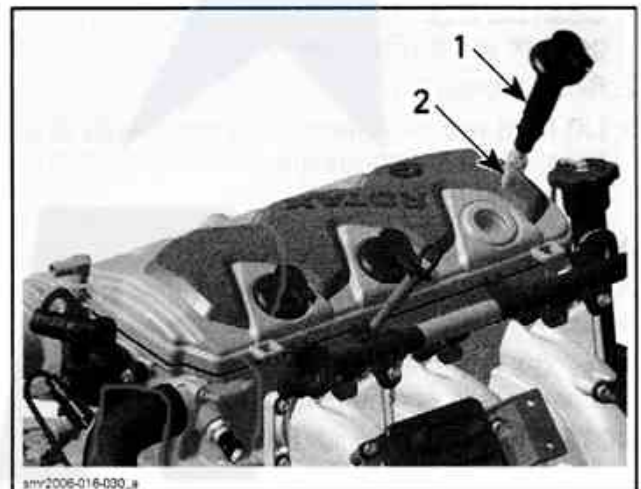
3. Disconnect ignition coil connectors.

⚠ 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.

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



1. Ignition coil
2. Spark plug

8. Spray XPS LUBE (P/N 293 600 016) into each spark plug hole.
9. 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. Fully depress throttle lever and hold for cranking engine.

10. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on spark plug threads then reinstall them.

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

Section 01 MAINTENANCE

Subsection 03 (STORAGE PROCEDURE)

11. Prior to inserting the ignition coil onto its spark plug, apply some DOW CORNING 111 (P/N 413 707 000) around the seal area that touches the spark plug hole.
12. Reinstall ignition coils.
13. Ensure the seal seats properly with the engine top surface.
14. Reconnect ignition coil connectors.
15. 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 watercraft to completely drain bilge. Refer to appropriate *HULL* subsection for bilge drain plug removal.

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.

NOTE: The seat should be left partially open during storage. This will prevent engine compartment condensation and possible corrosion.

BODY AND HULL

Body and Hull Cleaning

Wash the body 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.

Replace damaged labels/decals.

Body Repair

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

Hull Repair

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

Body and Hull Protection

Apply a good quality marine wax on body and hull. If the watercraft is to be stored outside, cover it with an opaque tarpaulin to prevent sun rays and grime from affecting the plastic components, watercraft finish as well as preventing dust accumulation.

NOTICE The watercraft should never be left in water for storage, stored in direct sunlight or stored in a plastic bag.

PRESEASON PREPARATION

Proper vehicle preparation is necessary after the winter months or when a watercraft 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.

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE O: OPERATOR D: DEALER	25 HOURS OR 3 MONTHS		
	50 HOURS OR 6 MONTHS		
	100 HOURS OR 1 YEAR		
	200 HOURS OR 2 YEAR		
	TO BE PERFORMED BY		
PART/TASK		NOTE	
ENGINE			
Engine oil and filter		R	D
Rubber mounts		L	O
Corrosion protection		L	D
Supercharger clutch		R (1)	U
EXHAUST SYSTEM			
Fuel tank system		L C I	O D
		(1) See NOTE 1 after maintenance chart.	
		(2) Daily flushing in salt water or fresh water use.	

1. Use these columns:

Furthermore, proceed with the following:

Watercraft Prepared as per Storage Procedure

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

Watercraft Not Prepared as per Storage Procedure

- Ensure battery is fully charged.
- Replace engine oil and filter.
- Drain fuel tank and fill with fresh fuel.
- Reinstall the battery.
- Test ride watercraft to confirm proper operation.

SPECIAL PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
LARGE HOSE PINCHER.....	529 032 500	19
SUCTION PUMP	529 035 880	18

GENERAL

Refer to the following special procedures according to the specific event. Procedures described may not be applicable to every watercraft model.

PROCEDURES

TOWING THE WATERCRAFT IN WATER

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

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

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

NOTICE Failure to follow these instructions may result in damage to the engine. If you must tow a stranded watercraft in water, be sure not to exceed the maximum towing speed of 24 km/h (15 MPH).

SUBMERGED WATERCRAFT

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

1. Drain bilge.
2. If the watercraft 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.
3. 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 tank for water contamination. If necessary, siphon and refill with fresh fuel.

WATER-FLOODED ENGINE

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

NOTICE

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

Exhaust System Draining

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

Intake System Draining

1. If water is present in the air intake silencer, empty it. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove the air intake silencer and check for water in the supercharger inlet hose. Remove hose to empty it.
3. Remove the water from blow-by valve hose.
4. 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.

Section 01 MAINTENANCE

Subsection 05 (SPECIAL PROCEDURES)

Throttle Body Lubrication

The throttle body should be lubricated to flush out any water infiltration and to prevent corrosion.

Supercharger Servicing

215 and 260 Engines

If there is water in the oil or in the supercharger inlet hose, the supercharger should be taken apart, all the components dried, and the slip clutch needle bearings and shaft ball bearings replaced. 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.

iS and aS Models

Remove the deck extension. Refer to *BODY* subsection.

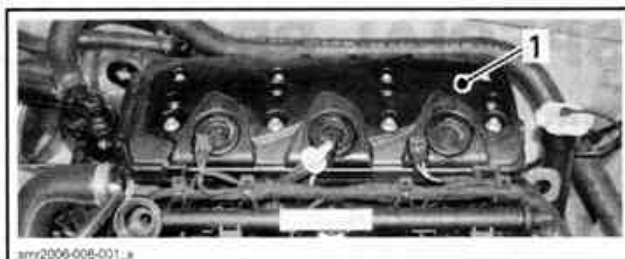
All Models

1. Using the SUCTION PUMP (P/N 529 035 880), siphon the contaminated oil from the engine reservoir through the dipstick hole.



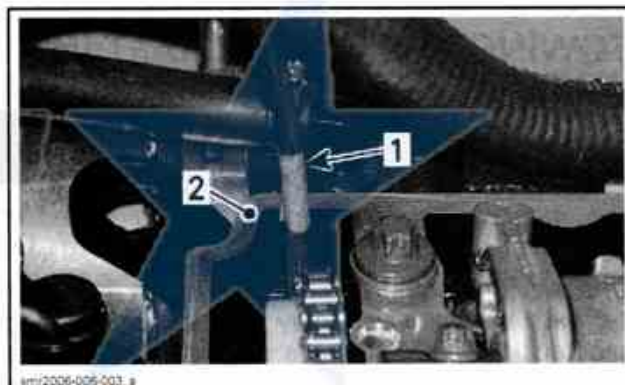
NOTICE Never crank or start engine when siphon tube is in dipstick hole. Never start engine when there is no oil in engine.

2. Remove the suction pump tube from the dipstick hole.
3. Fully depress throttle lever and HOLD it for cranking.
4. Crank the engine for 5 seconds.
5. Remove the oil filter cap and the oil filter. Refer to *LUBRICATION SYSTEM* subsection.
6. Again, siphon the contaminated oil from the oil filter reservoir.
7. Remove valve cover. Refer to *CYLINDER HEAD* subsection.



TYPICAL
1. Valve cover

8. Wrap a piece of tape around the suction pump tube 400 mm (16 in) from the end of the tube.
9. Insert the tube in the PTO area until the tape is even with the cylinder-block edge.
10. Siphon contaminated oil out.



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

11. Remove the suction pump tube.
12. Reinstall valve cover.
13. Install a **NEW** oil filter and reinstall the oil filter cap.
14. Replenish the engine with appropriate amount of the recommended engine oil. Refer to *LUBRICATION SYSTEM* subsection.
15. Proceed with the *BOIL OUT PROCEDURE* that follows.

NOTE: The boil out procedure is intended to evaporate a small quantity of water contained in the oil system.

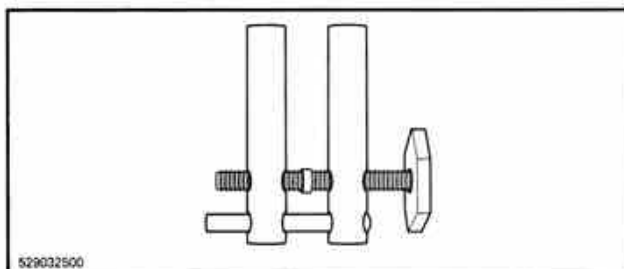
Boil Out Procedure in a Test Tank or Tied to a Trailer with Watercraft in Water

1. Connect the vehicle to latest applicable B.U.D.S. version to monitor the coolant temperature. Coolant temperature must exceed 100°C (212°F) in order for the water to boil out. Once the boiling point is attained, the water will evaporate quickly.
2. Run the engine for 5 minutes at 3500 RPM.

⚠ WARNING

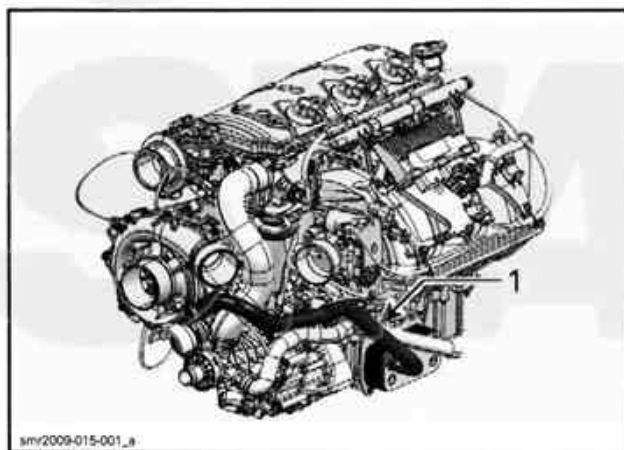
Be sure to safely secure the watercraft.

3. With the engine still running at 3500 RPM, install a LARGE HOSE PINCHER (P/N 529 032 500) on the coolant line going to the oil cooler.



⚠ WARNING

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



TYPICAL

1. Oil cooler coolant inlet hose

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

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

7. Change the oil and filter again.
8. Procedure is now complete.

CAPSIZED WATERCRAFT

Capsized for More than 5 Minutes

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

ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ALIGNMENT SHAFT ADAPTER	529 035 719	26-28
ALIGNMENT SHAFT SUPPORT	529 035 506	26
ALIGNMENT SHAFT	295 000 141	26-29
ENGINE ALIGNMENT TOOL	529 036 197	27
PUMP PLATE	529 036 224	26
THRU-HULL ADAPTER	529 036 193	28

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	26, 30
PULLEY FLANGE CLEANER	413 711 809	26

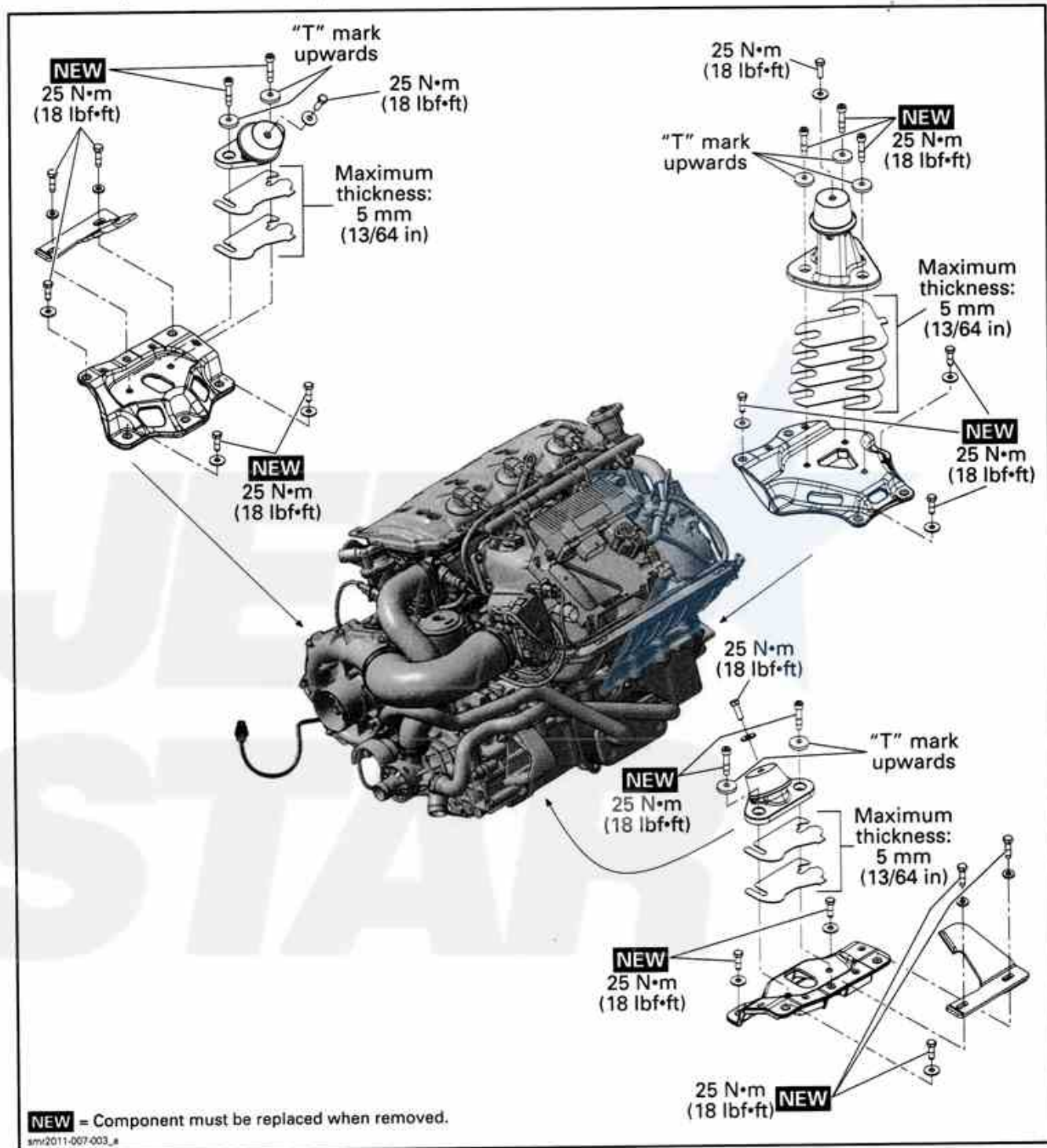
Section 01 (ENGINE REMOVAL AND INSTALLATION)

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Section 02 ENGINE

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

RXT Series, GTX Series (except GTX 155) and WAKE PRO 215



GENERAL

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

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 pin, etc.) must be replaced.

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

PROCEDURES

ENGINE

Engine Removal Guideline

PROCEDURES ACCORDING TO MODEL
ALL IS AND aS
<ul style="list-style-type: none"> Remove moving deck and deck extension. Refer to <i>BODY</i>. Remove the air intake silencer and its support. Refer to <i>AIR INTAKE SILENCER (IS AND aS models)</i>.
RXT SERIES AND GTX LTD IS 260
<ul style="list-style-type: none"> Unplug air intake hose from the throttle body.
RXT 260, RXT X 260, RXT XRS 260, GTX 215 AND WAKE PRO 215
<ul style="list-style-type: none"> Remove the supercharger. Refer to <i>SUPERCHARGER</i>.
GTX 215, GTX IS 215 AND WAKE PRO 215
<ul style="list-style-type: none"> Unplug both hoses from the supercharger.
ALL EXCEPT IS AND aS
<ul style="list-style-type: none"> Disconnect all fuel injector connectors and the following sensors (CTS, CPS, TOPS, CAPS and OPS). Remove the intake manifold. Refer to <i>INTAKE MANIFOLD</i>.

COMMON PROCEDURE FOR ALL MODELS

- Remove the seat. Refer to *BODY*.
- Disconnect the battery. Refer to *CHARGING SYSTEM*.
- Unplug fuel hose from fuel rail. Refer to *ELECTRONIC FUEL INJECTION (EFI)*.
- Drain coolant. Refer to *COOLING SYSTEM*.
- Disconnect the "B" connector from the ECM.
- Disconnect the engine connector.
- Disconnect the knock sensor and magneto connectors (remove connector housings from the ECM support).
- Disconnect the EGTS sensor from the muffler.
- Disconnect the three ground cables on the front end of engine.
- Unplug the front exhaust hose from the muffler.
- Unplug the blow-by valve hose.
- Unplug the ride plate hoses from water pump housing.
- Move muffler backward. Refer to *EXHAUST SYSTEM*.
- Remove the drive shaft. Refer to *DRIVE SHAFT*.
- 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.



- Unplug water hoses from exhaust manifold.
- Disconnect the starter cable from the starter.
- Disconnect the engine ground cable located under the exhaust manifold.
- Carry on engine lifting to remove it from the body opening.

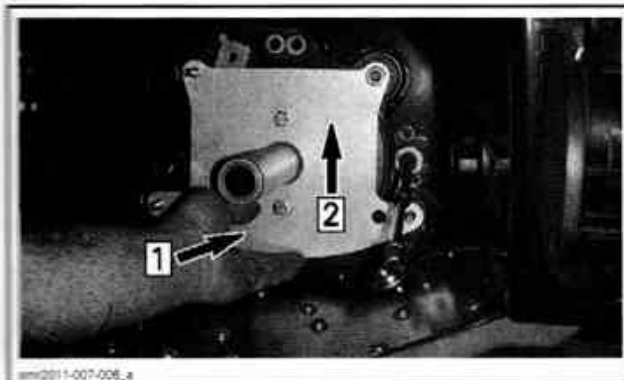
NOTICE Be careful not to scratch body or to hit any engine component during engine removal.

Engine Installation

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

Section 02 ENGINE

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

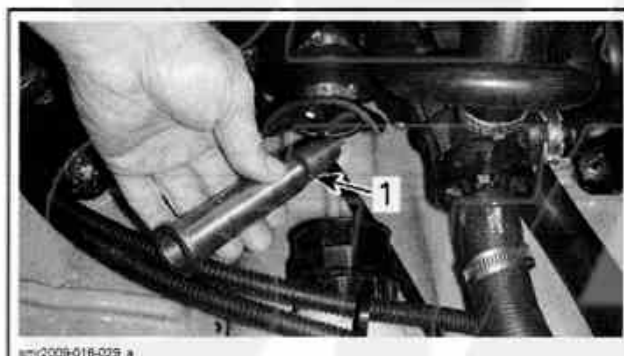


Step 1: Place alignment tool against pump support
Step 2: Push alignment tool upward

TORQUE	
Alignment tool nuts	24 N•m (18 lbf•ft)

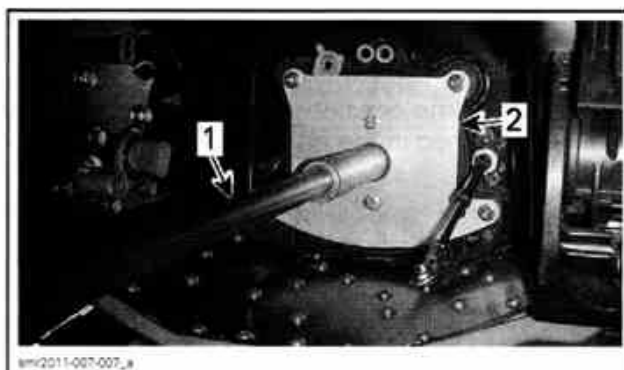
5. Install the ALIGNMENT SHAFT ADAPTER (P/N 529 035 719) in the engine PTO housing.

NOTICE Ensure alignment shaft adapter is fully inserted into the engine PTO housing.



TYPICAL
1. Alignment shaft adapter

6. Carefully slide the ALIGNMENT SHAFT (P/N 295 000 141) through the engine alignment tool.



1. Alignment shaft (P/N 295 000 141)
2. Alignment tool

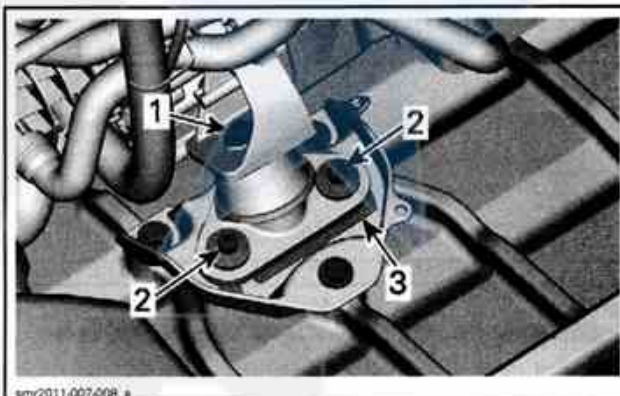
7. Insert alignment shaft end into alignment shaft adapter. If the alignment is correct, the alignment shaft end should slide through the adapter.

NOTE: A small resistance during shaft insertion is normal.

8. If the alignment is incorrect, loosen engine mount retaining screws (Allen socket screws).
9. Add or remove shims as required.

NOTE: Shims location is between engine mount and engine mount plate.

NOTICE Whenever shims are used to correct alignment, never install more than 5 mm (13/64 in) of shims.



REAR STARBOARD ENGINE MOUNT SHOWN
1. Engine mounting screw
2. Engine mount retaining screws
3. Shim(s)

When alignment of engine is correct, tighten all engine mount screws. Refer to *ENGINE MOUNTS* in this subsection.

Recheck engine alignment.

RXT, GTX and WAKE PRO 215

To verify alignment proceed as follows:

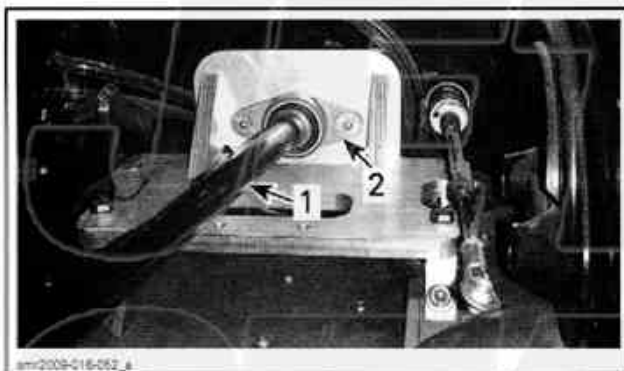
1. Remove jet pump and drive shaft. Refer to *STEERING AND PROPULSION* section.
2. Remove the sealing ring and the drive shaft boot. Refer to *DRIVE SHAFT* subsection.
3. Secure the ENGINE ALIGNMENT TOOL (P/N 529 036 197) on ride plate using jet pump socket screws.

Section 02 ENGINE

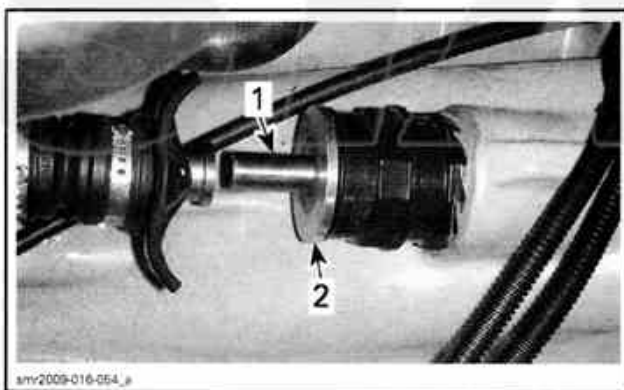
Subsection 01 (ENGINE REMOVAL AND INSTALLATION)



6. Carefully slide the ALIGNMENT SHAFT (P/N 295 000 141) through the engine alignment tool and the thru-hull adapter.

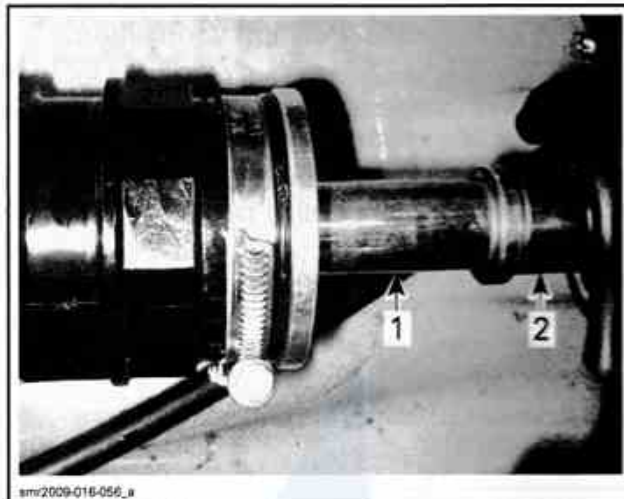


1. Alignment shaft
2. Engine alignment tool



1. Alignment shaft
2. Thru-hull adapter

7. Insert alignment shaft end into alignment shaft adapter. If the alignment is correct, the alignment shaft end should slide through the adapter.



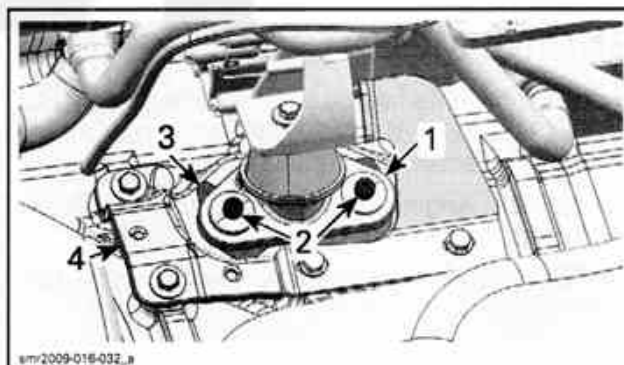
1. Alignment shaft
2. Alignment shaft adapter

NOTE: A small resistance during shaft insertion is normal.

8. If the alignment is correct, check the longitudinal position of engine. See procedure further.
9. If the alignment is incorrect, loosen engine mount screws to align engine.
10. Add or remove shims as required.

NOTE: Use shim(s) (P/N 270 000 770) for the front engine mount and shim(s) (P/N 270 000 762) for the rear engine mounts. Shims location is between engine mount and engine mount plate.

NOTICE Whenever shims are used to correct alignment, never install more than 5 shims.



REAR STARBOARD ENGINE MOUNT SHOWN

1. Engine mount
2. Engine mount screws
3. Shim
4. Engine mount plate

11. When engine alignment is correct, check the longitudinal position of engine.

Section 02 ENGINE

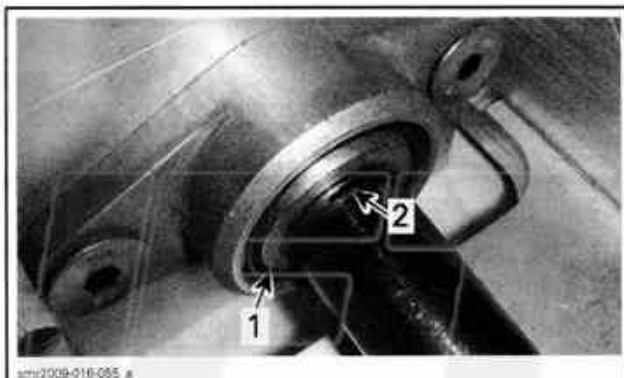
Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

Engine Longitudinal Position Verification

With alignment shaft installed, check the location of the marks (previously drawn at the beginning of the engine alignment procedure).

Engine is properly positioned longitudinally when the engine alignment tool is between both shaft marks.

- If **one** mark is visible, the engine is properly positioned.
- If **both** marks are visible, the engine must be moved forward.
- If **no** mark is visible, the engine must be moved rearward.



PROPER POSITION

1. Engine alignment tool
2. Mark at 610.5 mm (24.035 in)

When alignment and longitudinal position of engine are correct, tighten engine mount screws. Refer to *ENGINE MOUNTS* in this subsection.

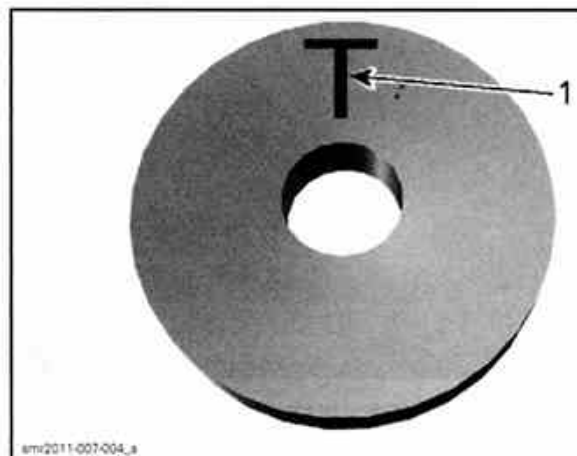
Recheck engine alignment.

ENGINE MOUNTS

If engine mounts have been removed, apply LOC-TITE 243 (BLUE) (P/N 293 800 060) on screw threads or use new screws with self-locking product.

Torque all engine mount screws to 25 N•m (18 lbf•ft).

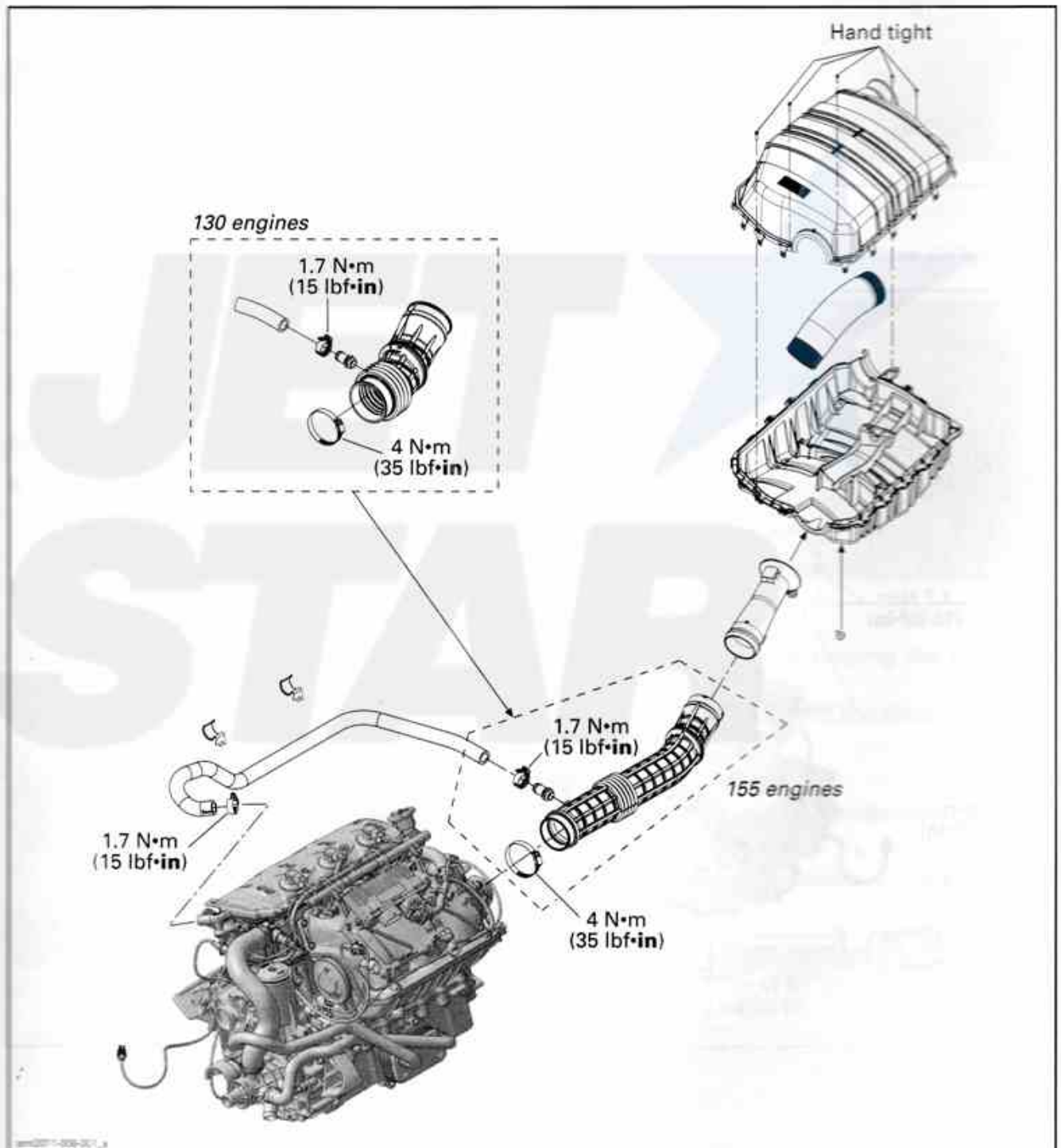
NOTE: Position conical spring washer with the "T" mark upwards.



1. T mark.

AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS)

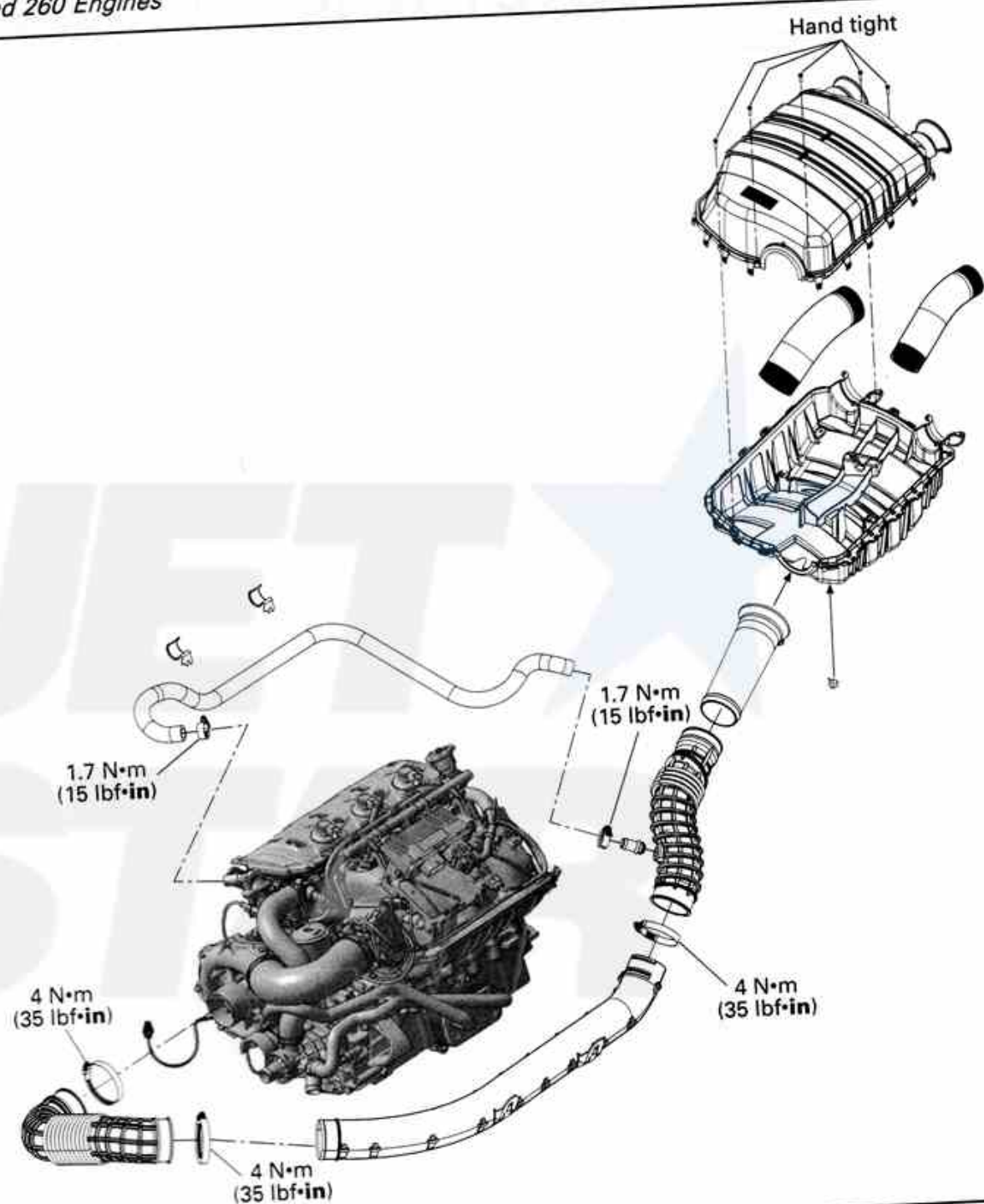
130 and 155 engines



Section 02 ENGINE

Subsection 02 (AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS))

215 and 260 Engines



brm/2011-008-002_#

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.

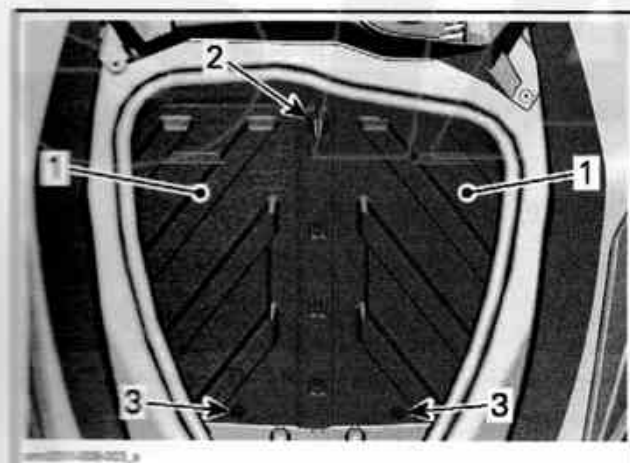
PROCEDURES

AIR INTAKE SILENCER

Air Intake Silencer Access

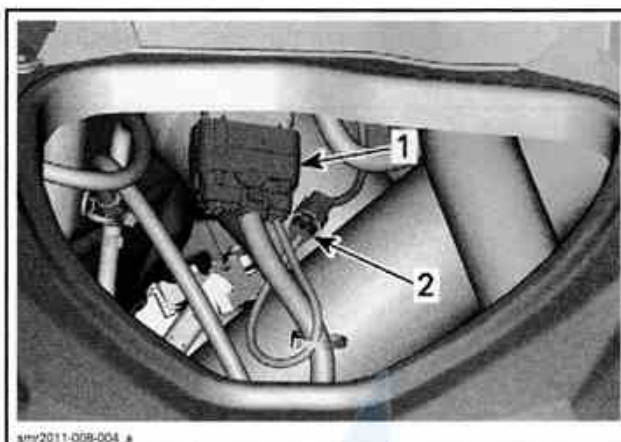
GTS and GTI Models

1. Open the front storage compartment cover.
2. Remove partitions. Refer to **BODY** subsection.



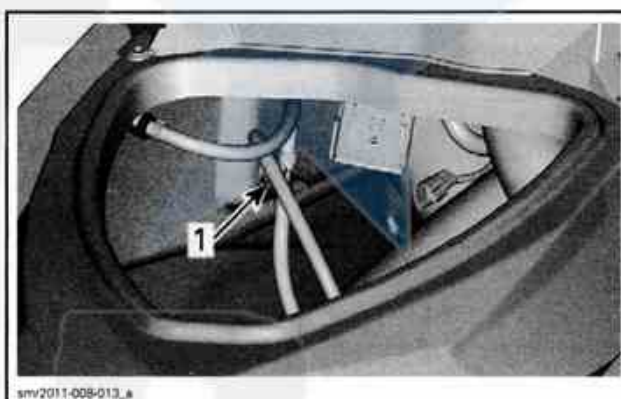
1. Partitions
2. Retaining strap
3. Plastic rivets

3. Disconnect gauge and OTAS connectors.



1. Gauge connector
2. OTAS connector

4. Cut locking tie retaining fuel hose on body.

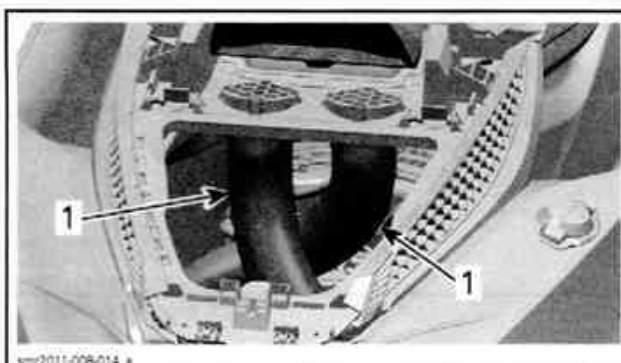


1. Cut this locking tie

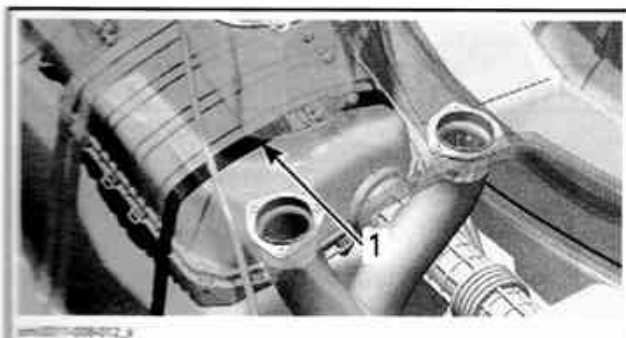
5. Remove plastic darts securing the top of the ventilation tubes.
6. Unplug ventilations tubes and place them lower in hull.

RXT and GTX Models

1. Open the front storage compartment cover.
2. Remove the storage bin.
3. Unplug the top of ventilations tubes and place them lower in hull.



1. Ventilation tubes



TYPICAL - RXT AND GTX

1. Rear retaining strap - under glove box

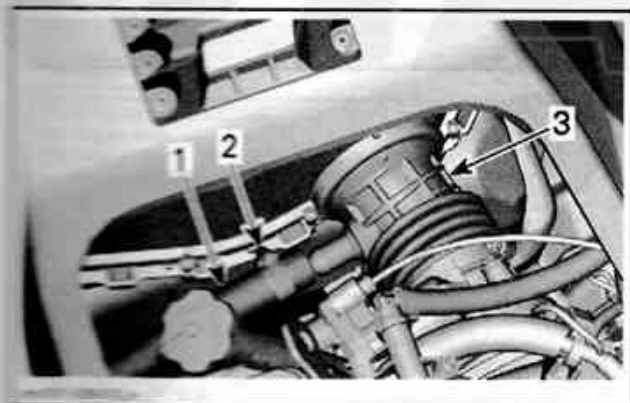
4. Loosen clamp securing the air intake silencer outlet hose to throttle body.



TYPICAL - GTI SHOWN

1. Air intake silencer outlet hose
2. Loosen this clamp

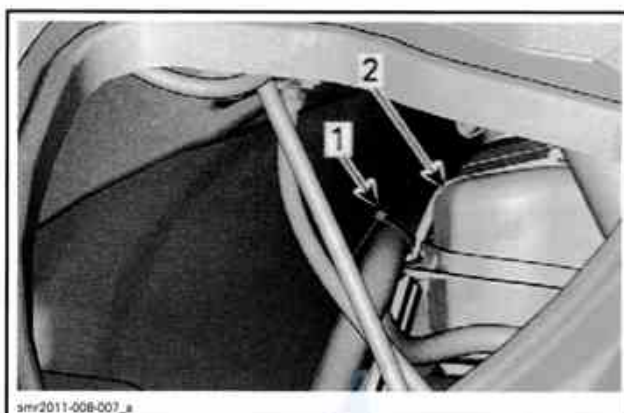
5. Detach the breather hose from the air intake silencer outlet hose.



TYPICAL - GTI SHOWN

1. Breather hose
2. Breather hose clamp
3. Air intake silencer outlet hose

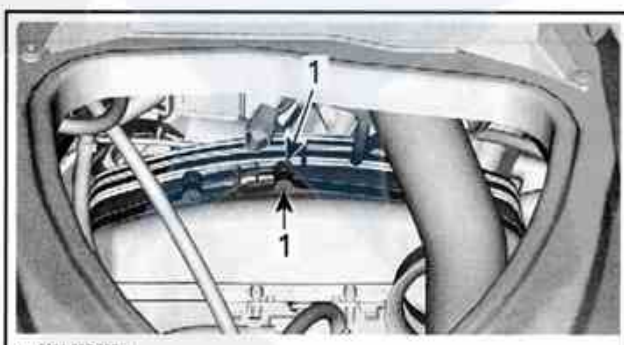
6. From the front storage compartment, cut locking tie securing the wiring harness and the fuel hose to air intake silencer.



THROUGH FRONT STORAGE COMPARTMENT OPENING

1. Cut this locking tie
2. Front of air intake silencer

7. Detach the front retaining straps.

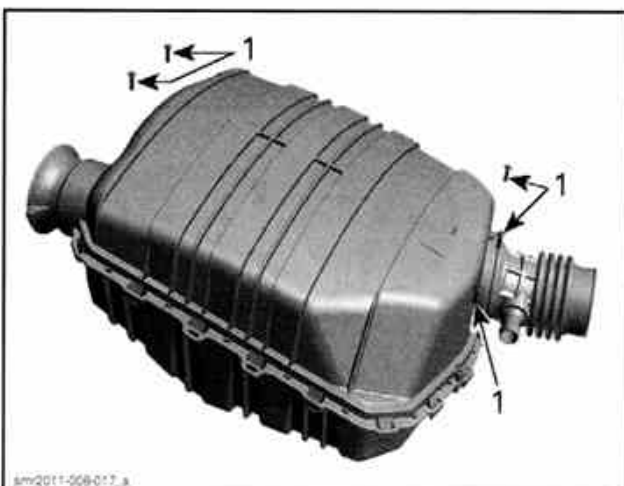


1. Front retaining straps

8. Carefully pull the air intake silencer forward to remove it from the vehicle.

Air Intake Silencer Disassembly

1. Remove screws retaining both parts of air intake silencer together.



1. Retaining screws (5x)

2. Unlatch air intake silencer and remove the upper section.

Subsection 1 AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS)

Section 02 ENGINE

TORQUE	
Air intake silencer screws	Hand tight

Air Intake Silencer Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Ensure wiring harness and fuel hoses are properly route.

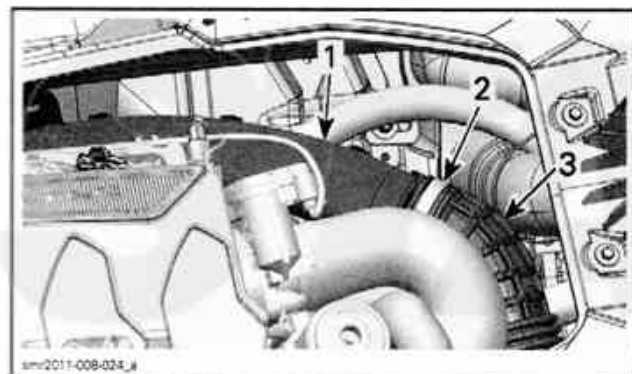
Tighten all gear clamp as specified in exploded views.

AIR INTAKE TUBE

Air Intake Tube Removal

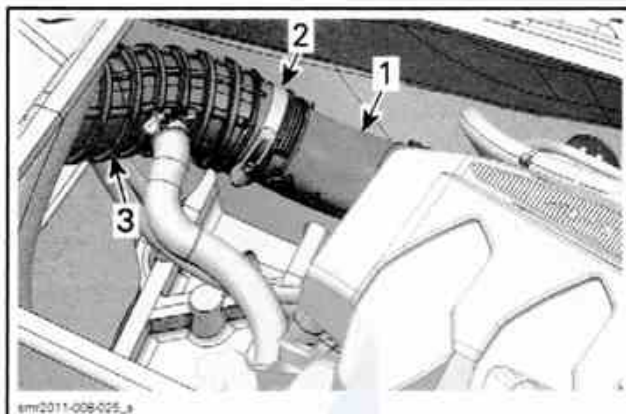
215 and 260 Models

1. Open seat.
2. Detach the seat bridge from the body and move it aside to make room.
3. Loosen clamps retaining the air intake tube to supercharger inlet hose and air intake silencer outlet hose.



AT THE REAR OF ENGINE

1. Air intake tube
2. Retaining clamp
3. Supercharger inlet hose



AT THE FRONT OF ENGINE

1. Air intake tube
2. Retaining clamp
3. Air intake silencer outlet hose

4. Detach the air intake tube from both hoses.
5. Open the front compartment storage cover and remove the storage bin.
6. Slide the air intake tube over the air intake silencer and through the front compartment opening.

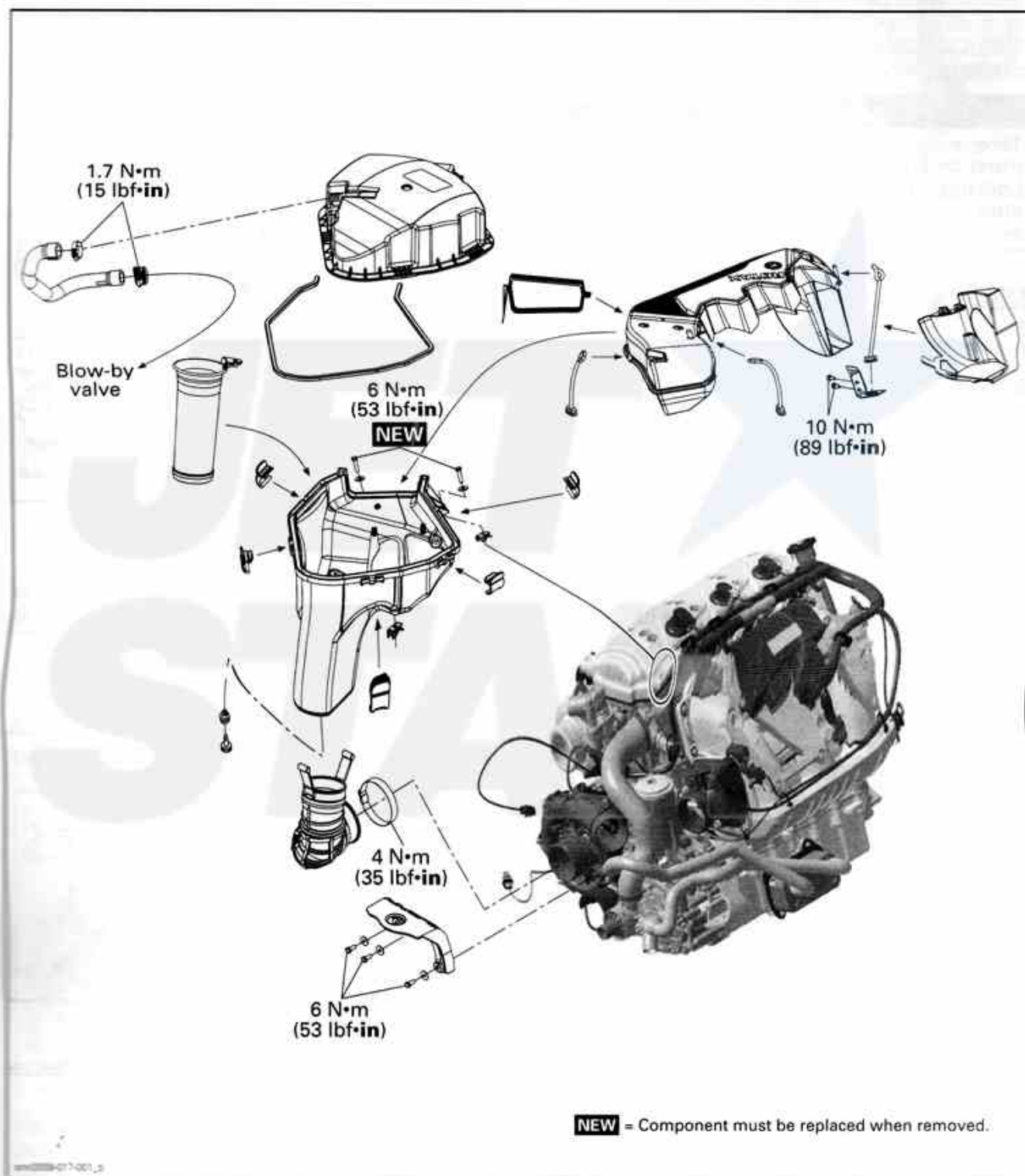
Air Intake Tube Installation

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

Make sure hoses are perfectly inserted into air intake tube before tightening the clamps.

TORQUE	
Retaining clamps	4 N•m (35 lbf•in)

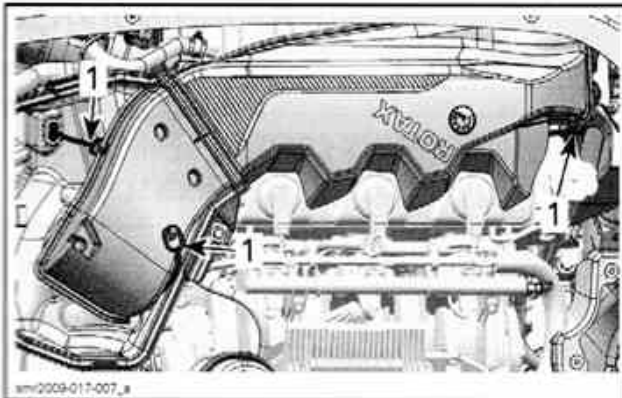
AIR INTAKE SYSTEM (iS AND aS MODELS)



Section 02 ENGINE

Subsection 03 (AIR INTAKE SYSTEM (iS AND aS MODELS))

Release the three rubber latches securing the air intake tube.



1. Rubber latches

Remove air intake tube from vehicle.

Air Intake Tube Installation

The installation is the reverse of the removal procedure.

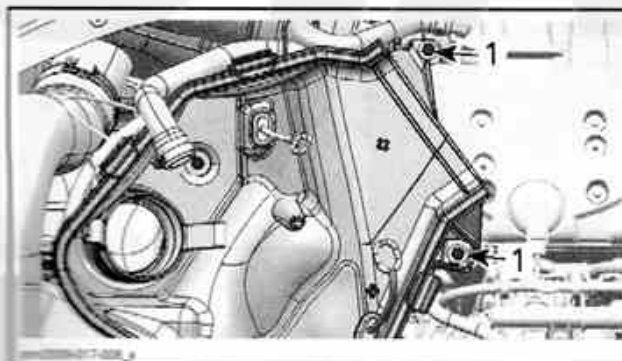
AIR INTAKE SILENCER

Air Intake Silencer Removal

Remove:

- Deck extension, see *BODY* subsection for procedure
- Air intake cover
- Air intake tube.

Remove and discard both screws securing air intake silencer.



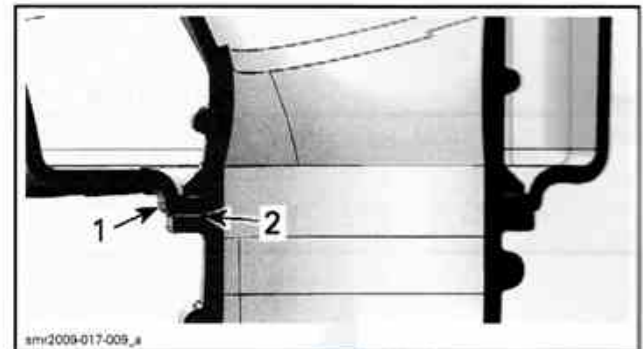
1. Air intake silencer screws

Inside air intake silencer, squeeze the top of its 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)

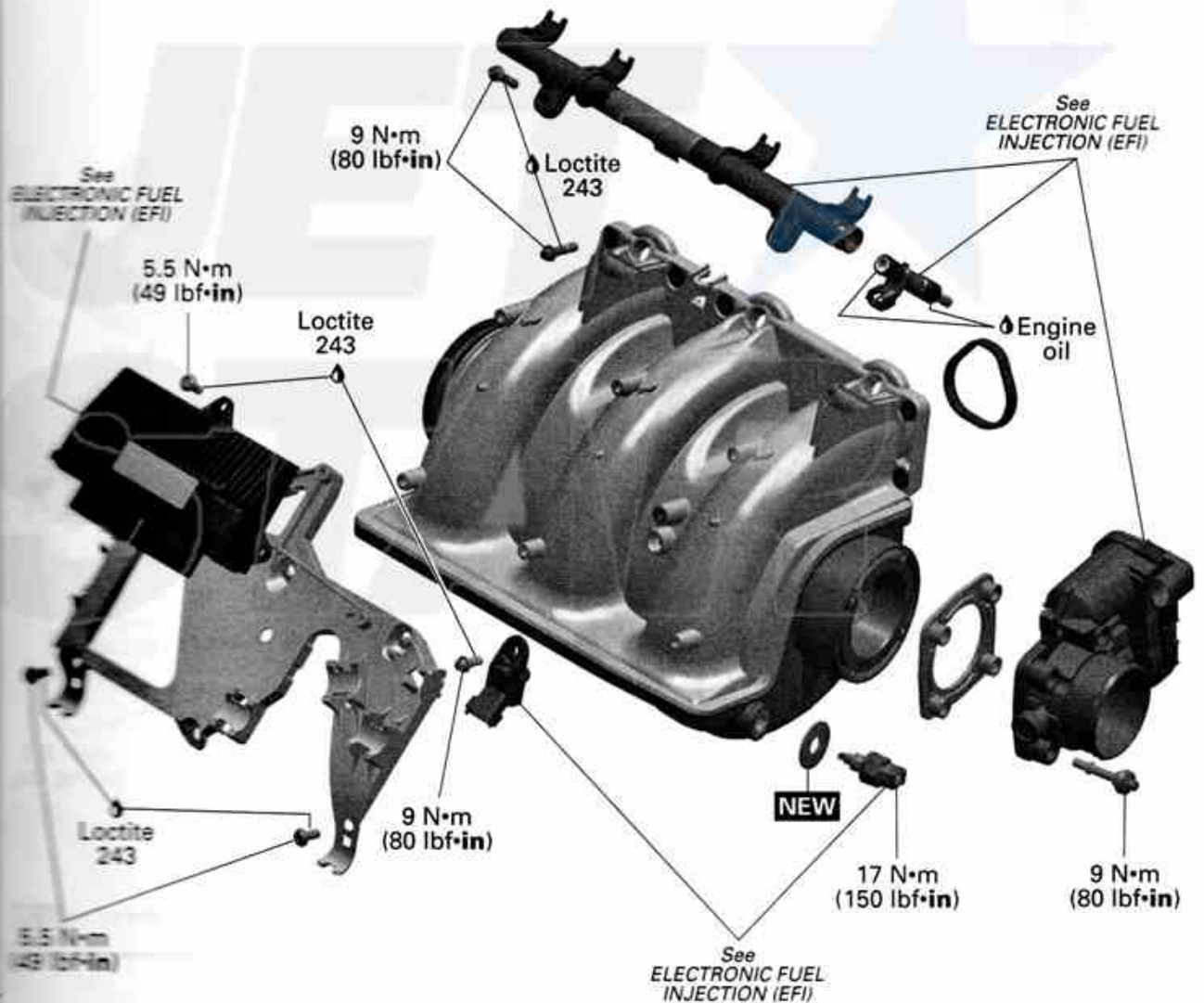
Install all other removed parts.

INTAKE MANIFOLD

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	49

130 and 155 Engines

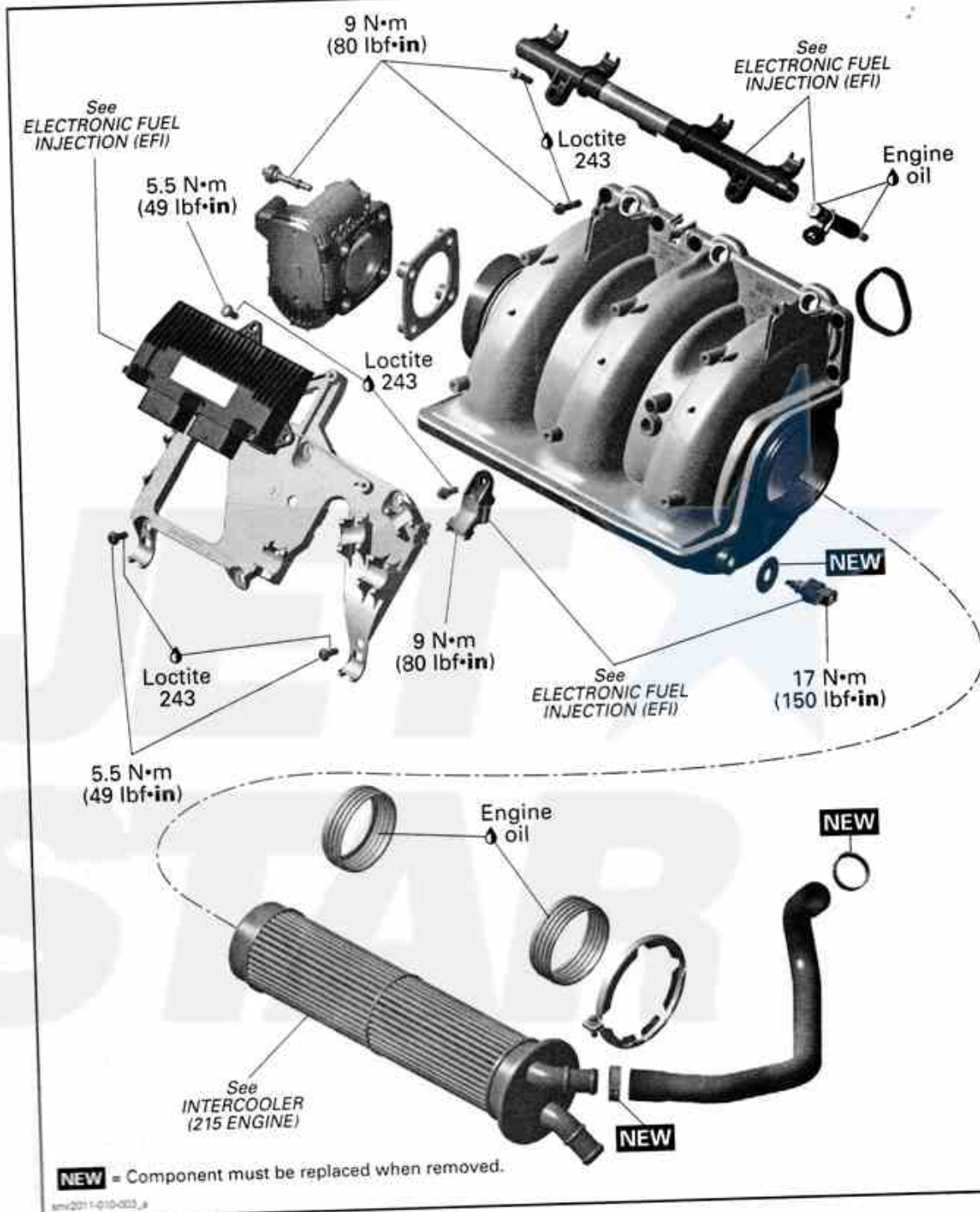


NEW - Component must be replaced when removed.

Section 02 ENGINE

Subsection 04 (INTAKE MANIFOLD)

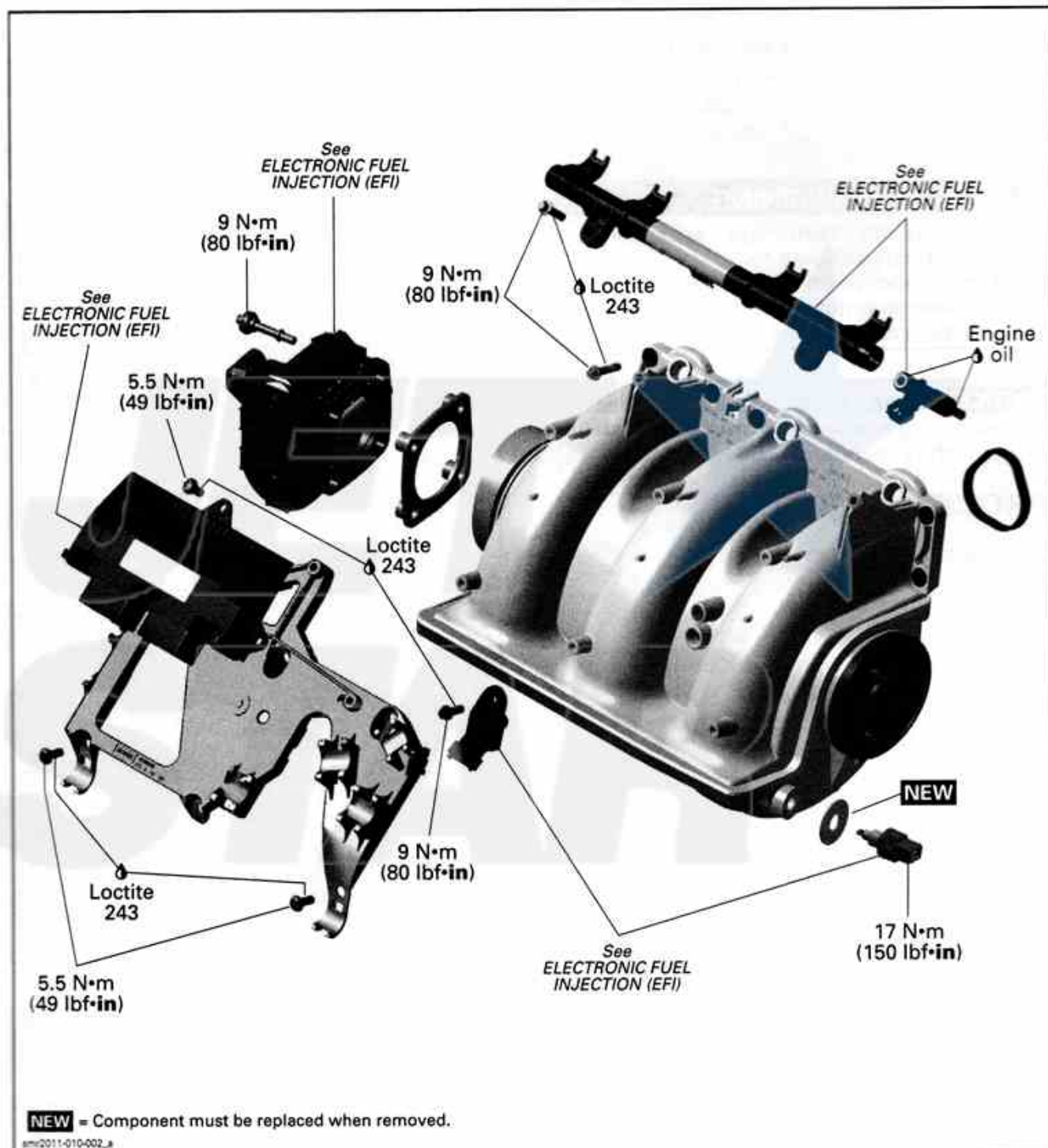
215 Engine



Section 02 ENGINE

Subsection 04 (INTAKE MANIFOLD)

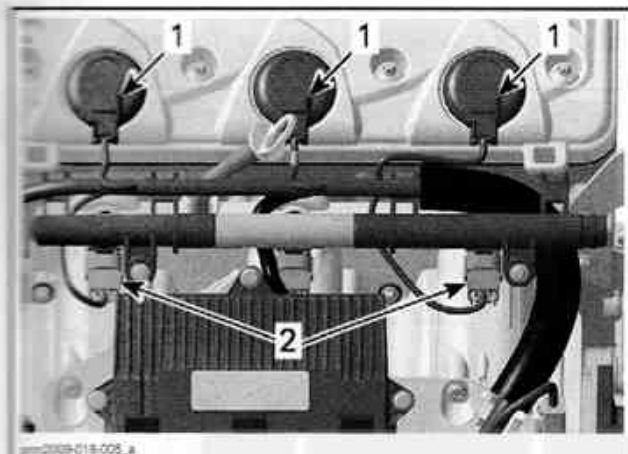
260 Engine



Section 02 ENGINE

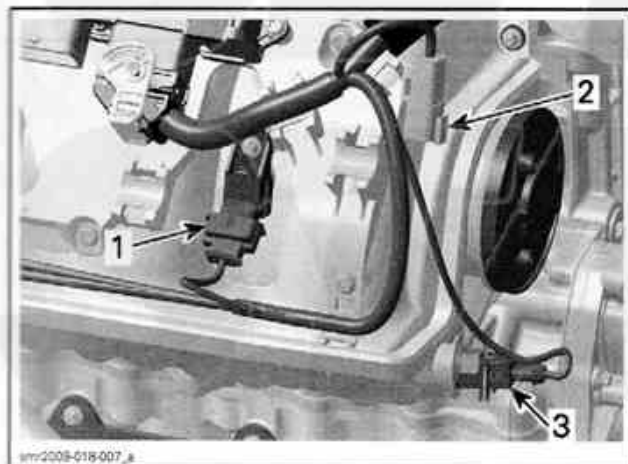
Subsection 04 (INTAKE MANIFOLD)

Unplug the ignition coil and fuel injector connectors.



1. Ignition coil connectors
2. Fuel injector connectors

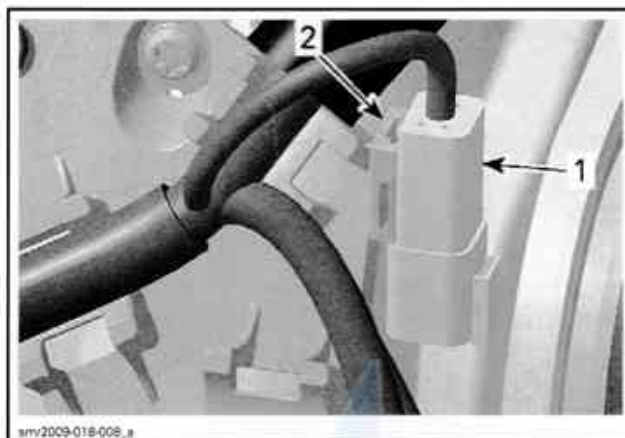
Unplug the manifold air pressure sensor (MAPS), the engine connector and the manifold air temperature sensor (MATS).



TYPICAL

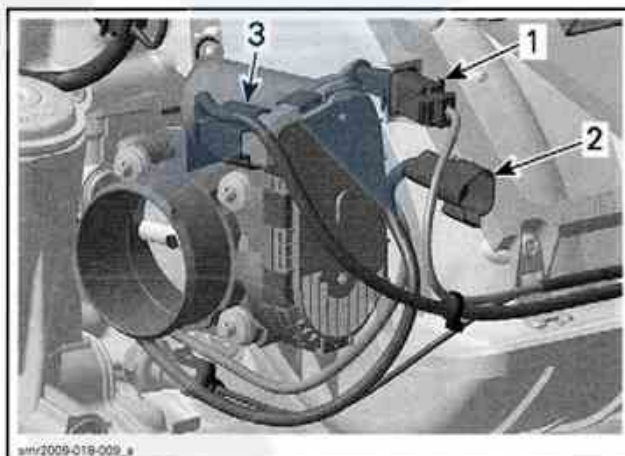
1. MAPS connector
2. Engine connector location
3. MATS connector

Detach the engine connector housing from the ECM support.



1. Engine connector
2. ECM support

Unplug the knock sensor (KS), the magneto and the throttle actuator connectors.



1. KS connector
2. Magneto connector location
3. Throttle actuator connector

Detach the knock sensor (KS) and magneto connector housings from the ECM support. For more details, refer to *CONNECTOR INFORMATION* subsection.

Section 02 ENGINE

Subsection 04 (INTAKE MANIFOLD)

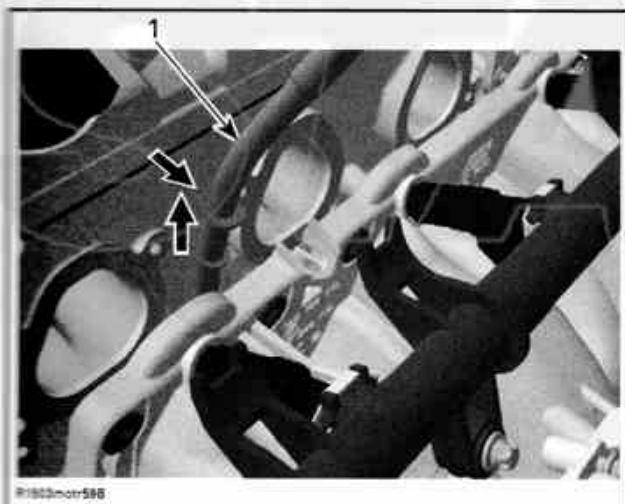
Ensure that all gaskets are properly installed and in good condition.



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 to fit in the slot of the manifold.

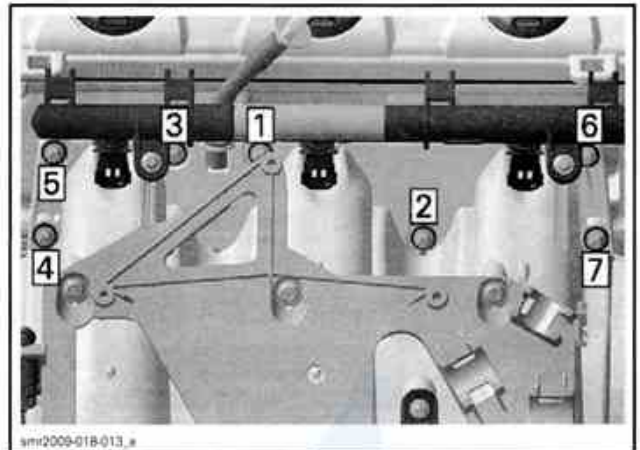


1. Oil dipstick tube

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)



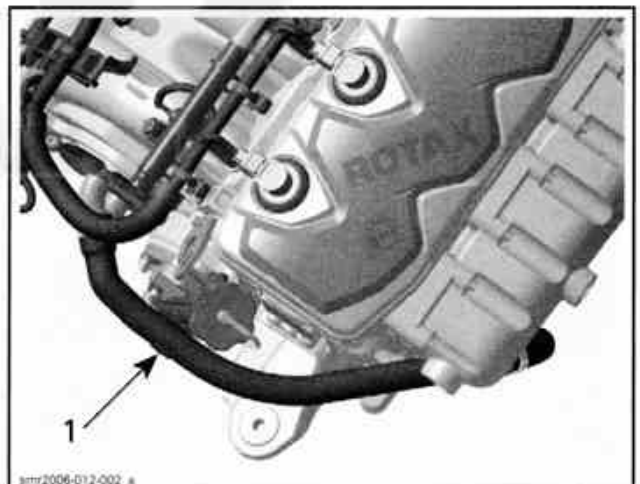
Ensure to properly route and secure wiring harness with locking ties.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the ECM retaining screws and tighten them to specification.

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

Install all other removed parts.

NOTE: Make sure the outlet hose of the inter-cooler is installed in its holding device (located on the oil filler tube) otherwise the hose will scuff on the engine block.



1. Intercooler outlet hose holding device

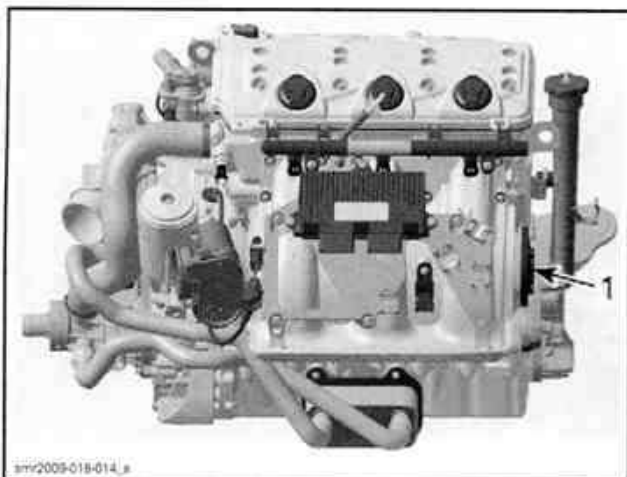
FLAME ARRESTER

Flame Arrester Location

The flame arrester is integrated in the intake manifold.

Section 02 ENGINE

Subsection 04 (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 AND 260 ENGINES)

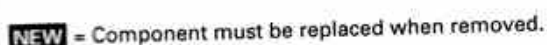
SERVICE TOOLS

Description	Part Number	Page
4-PIN SOCKET	529 035 948	59, 62
BEARING SUPPORT/PUSHER	529 035 950	61-62
CAMSHAFT LOCKING TOOL	529 035 839	54
SUPERCHARGER GEAR HOLDER	529 036 025	55
SUPERCHARGER RETAINING KEY	529 036 027	58-59, 64
SUPPORT PLATE	529 035 947	55, 58, 61-62
TORX ADAPTER	529 035 938	57, 65

SERVICE PRODUCTS

Description	Part Number	Page
ISOFLUX GREASE TOPAS NB 52	293 550 021	63
LOCTITE 243 (BLUE)	293 800 060	62-65
LOCTITE 5910	293 800 081	64
SUPER LUBE GREASE	293 550 030	64

Section 02 ENGINE
Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))



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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 brace, elastic stop nuts, cotter pins, etc.) must be replaced.

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

INSPECTION

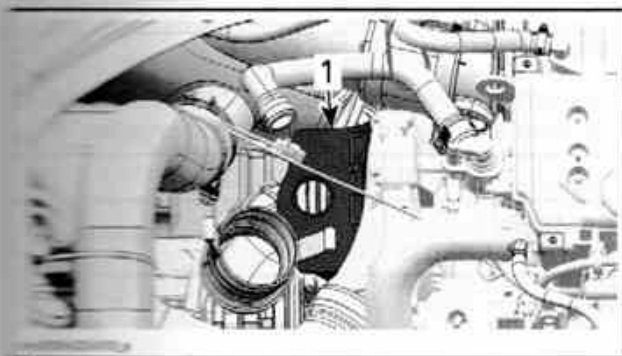
SUPERCHARGER INLET CLEANLINESS

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

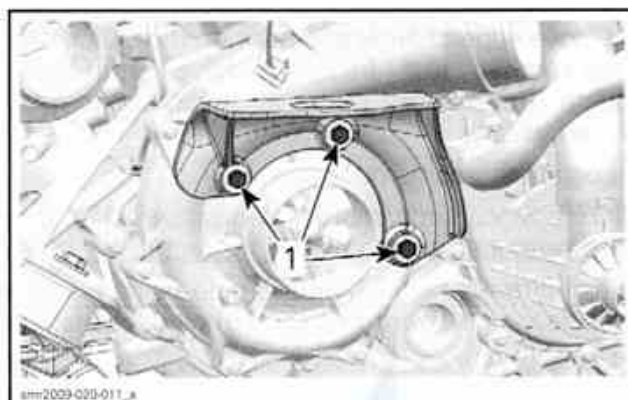
Remove the air intake silencer. Refer to the appropriate subsection according to model:

- AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS)
- AIR INTAKE SYSTEM (iS AND aS MODELS).

Remove the air intake silencer support.

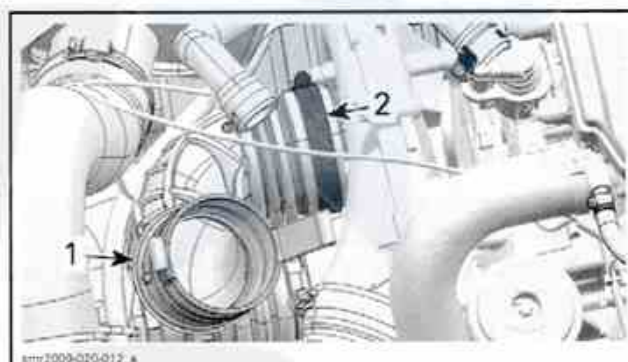


1. Air intake silencer support



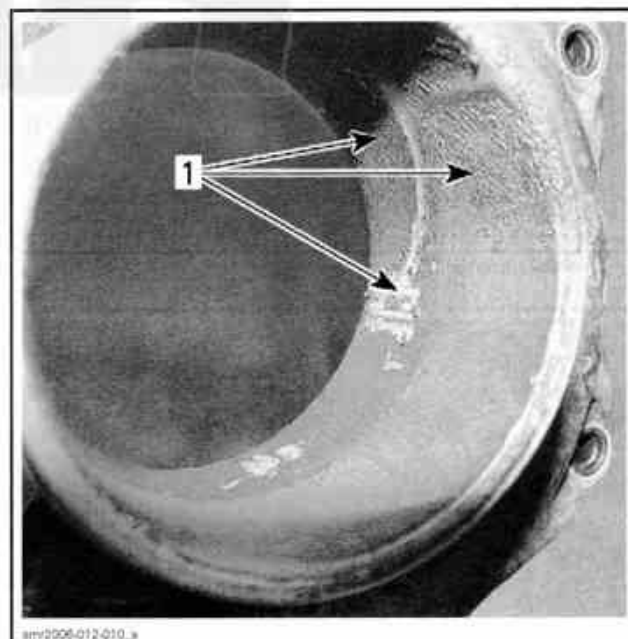
MANY PARTS REMOVED FOR CLARITY PURPOSE
1. Support screws

Remove the air inlet hose from supercharger.



1. Air inlet hose
2. Hose clamp

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



1. Dirt here

If dirt is found, proceed as follows.

Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))

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

Separate supercharger housing.

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

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

Blow dry with compressed air.

NOTICE Do not let turbine spin when using compressed air.

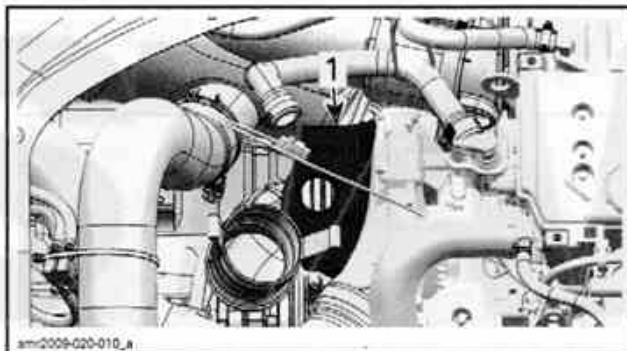
Complete usual assembly procedures as described in this subsection.

SUPERCHARGER CLUTCH SLIPPING MOMENT (ON ENGINE)

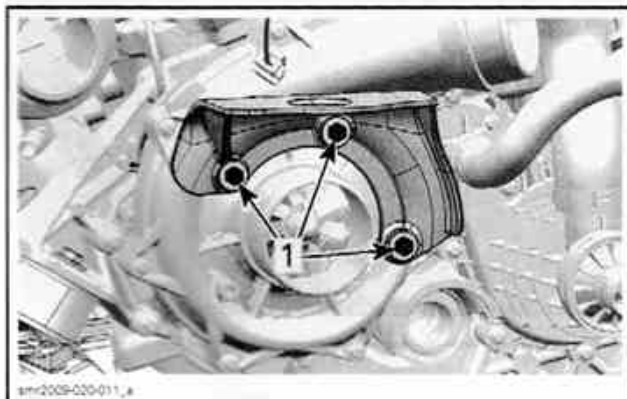
Remove the air intake silencer. Refer to the appropriate subsection according to model:

- AIR INTAKE SYSTEM (EXCEPT IS AND aS MODELS)
- AIR INTAKE SYSTEM (IS AND aS MODELS).

Remove the air intake silencer support.



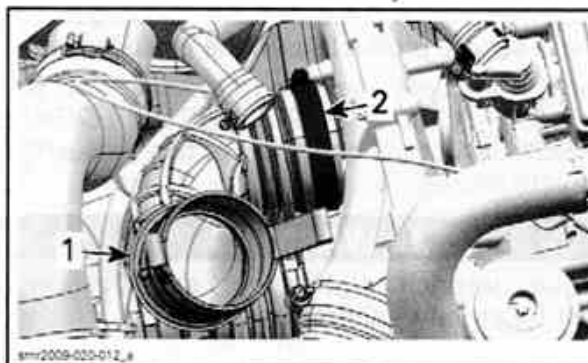
1. Air intake silencer support



MANY PARTS REMOVED FOR CLARITY PURPOSE

1. Support screws

Remove the air inlet hose from supercharger.

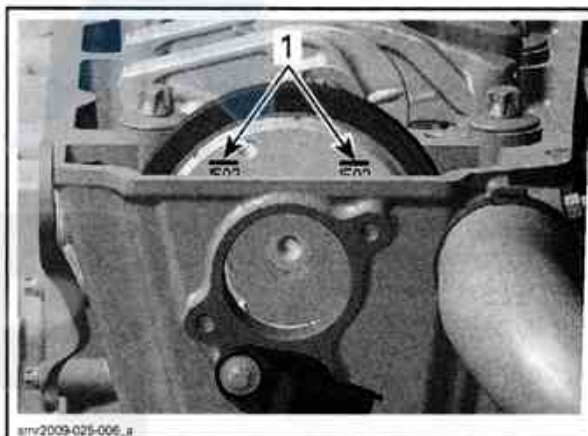


1. Air inlet hose
2. Hose clamp

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

Remove spark plugs.

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



1. Position lines

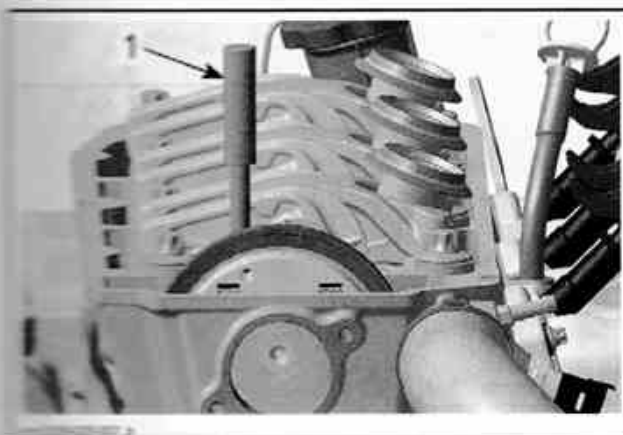
Lock camshaft to prevent camshaft rotation v checking slipping moment of supercharger.

REQUIRED TOOL

CAMSHAFT LOCKING TOOL
(P/N 529 035 839)

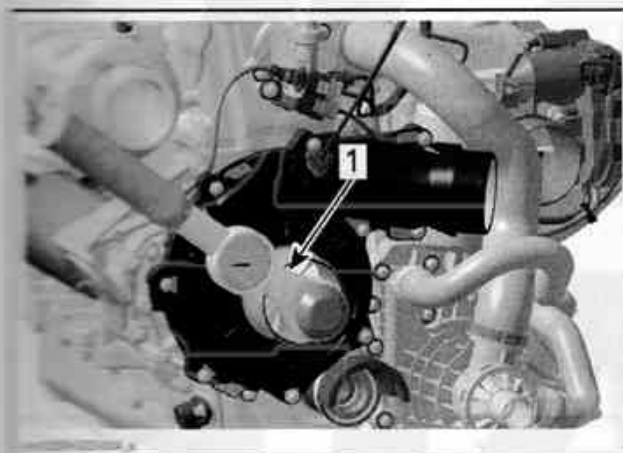
Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))



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)

9N•m to 14 N•m (80 lbf•in to 124 lbf•in)

SLIPPING MOMENT (BREAK-IN SUPERCHARGER)

8N•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.

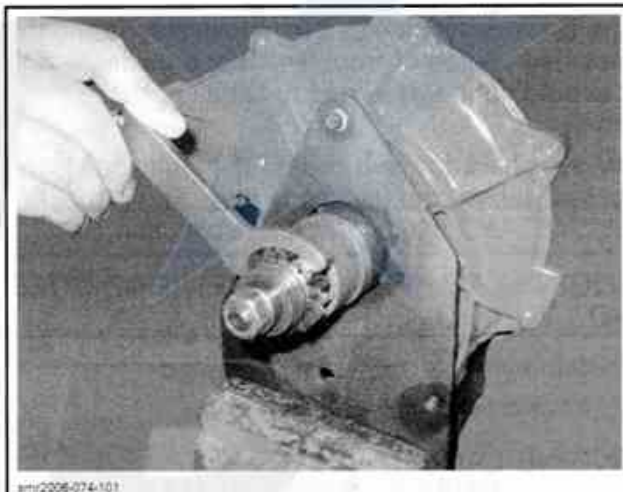
Hold supercharger gear with supercharger gear holder.

REQUIRED TOOLS

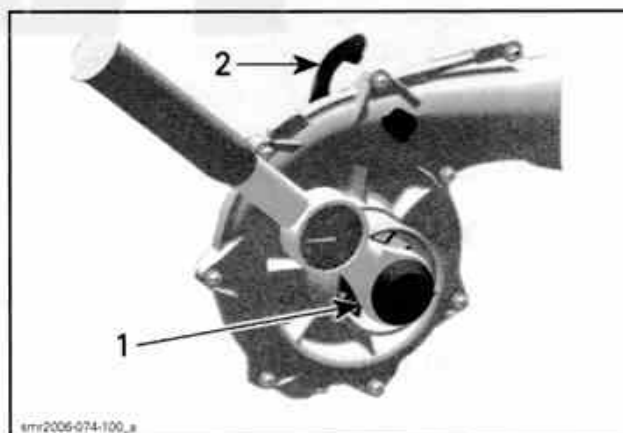
SUPPORT PLATE
(P/N 529 035 947)



SUPERCHARGER GEAR HOLDER
(P/N 529 036 025)



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

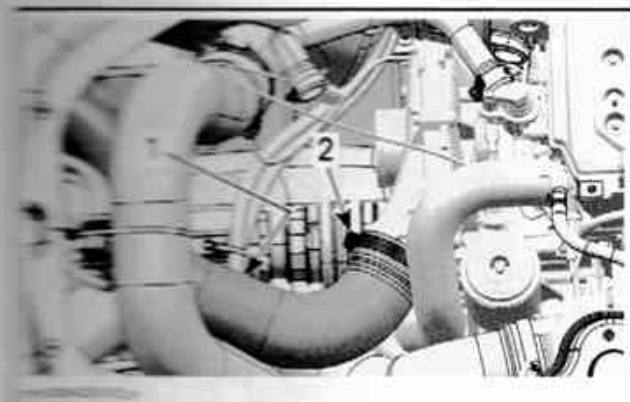


1. Torque wrench
2. Gear holder

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.

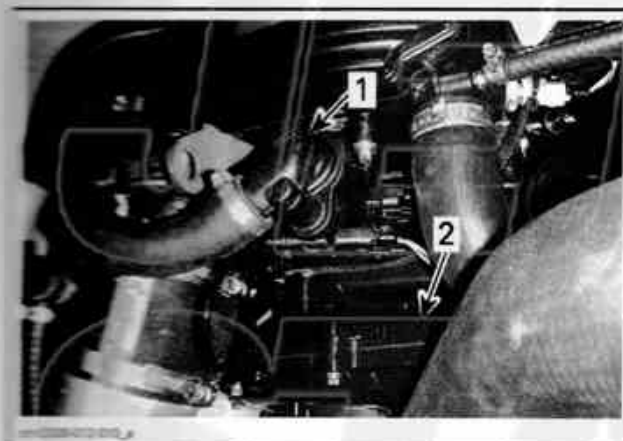
Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))



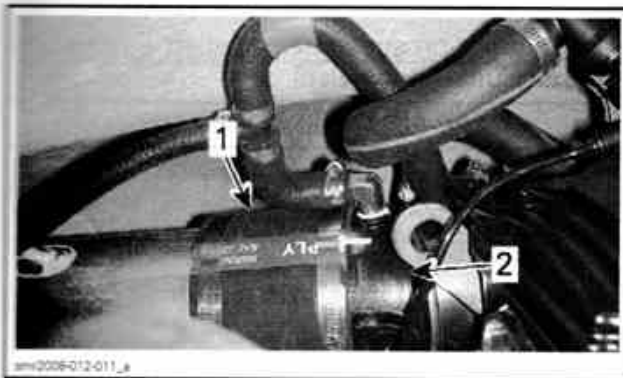
1. Air filter hose
2. Blow clamp

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.

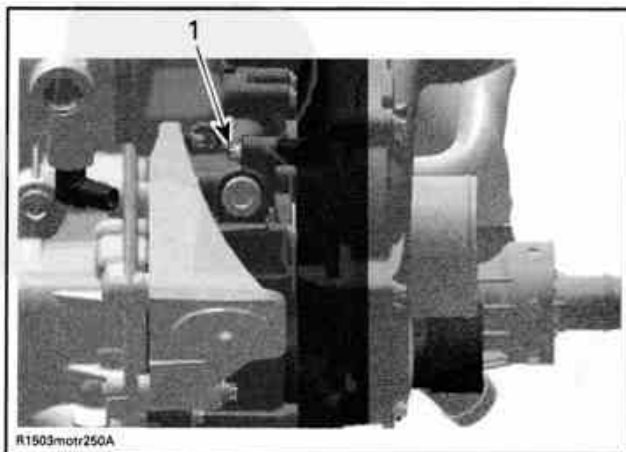


1. Retaining screws
2. Upper retaining screw (hidden behind the supercharger)

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.

Section 02 ENGINE

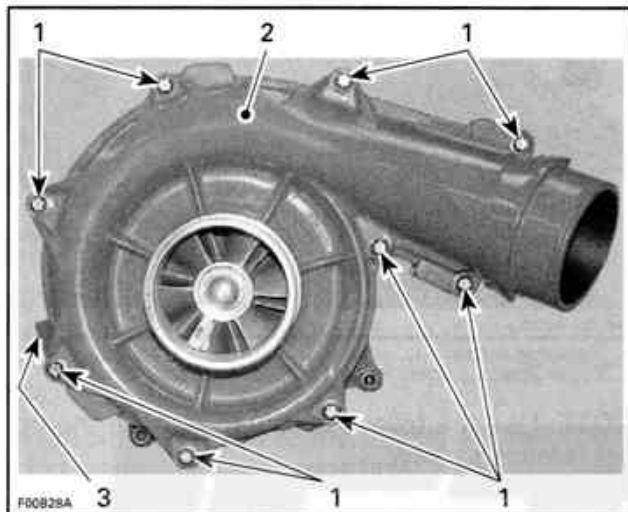
Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))

REQUIRED TOOL

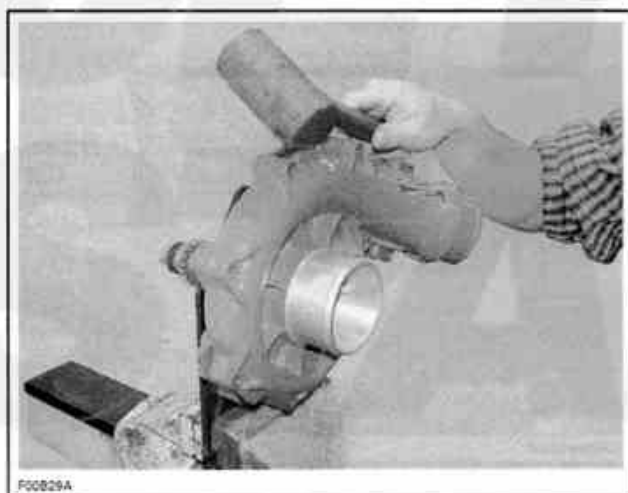
SUPPORT PLATE
(P/N 529 035 947)



2. Take apart supercharger housing.



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

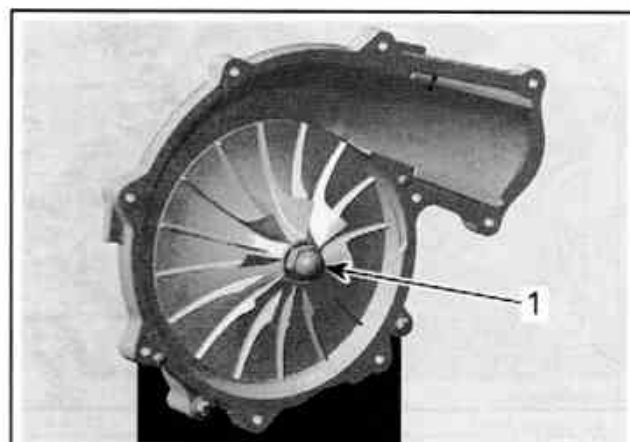


PLASTIC HAMMER

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

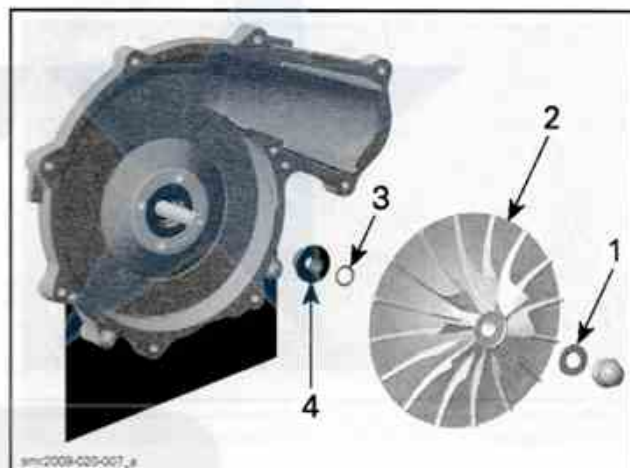
REQUIRED TOOL

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).

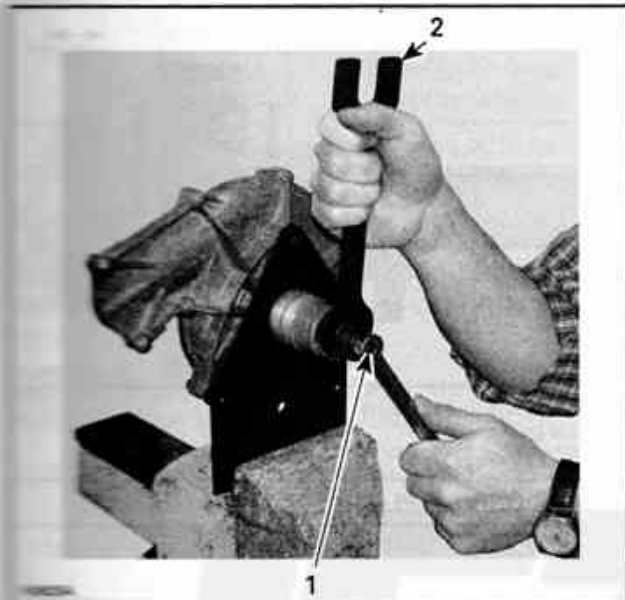
REQUIRED TOOL

SUPERCHARGER RETAINING KEY
(P/N 529 036 027)



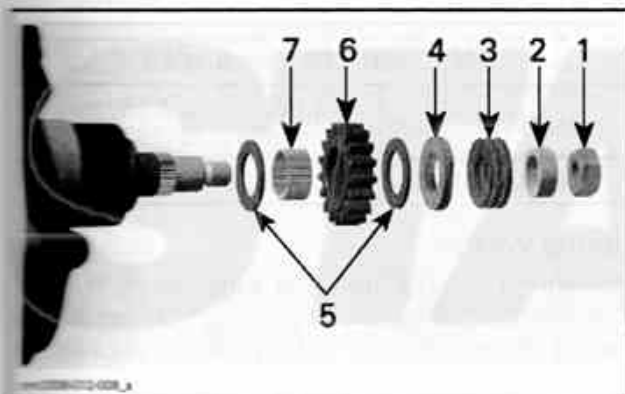
Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))



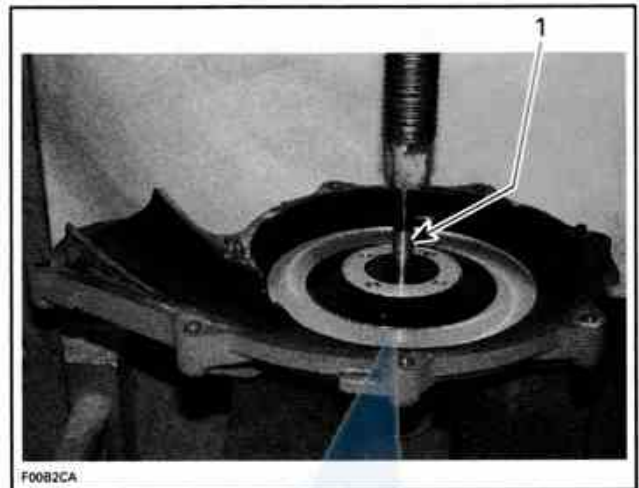
- 1. Nut
- 2. Retaining key

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



- 1. Needle pin
- 2. Needle pin
- 3. Needle pin
- 4. Needle pin
- 5. Drive gear
- 6. Spring washers (5x)
- 7. L-ring

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

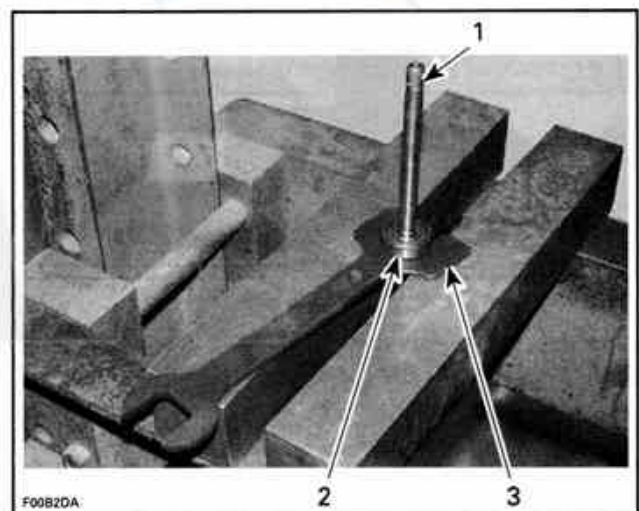


- 1. Supercharger shaft

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.

Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))

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.

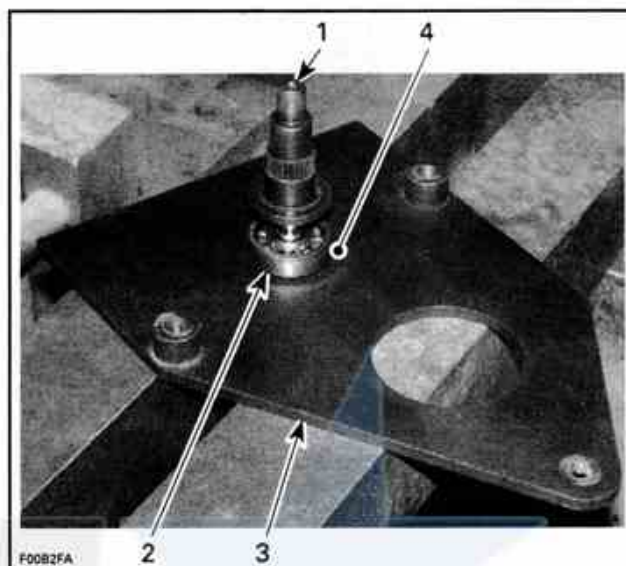
1.1 Apply enough engine oil on **NEW** ball bearing.

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.




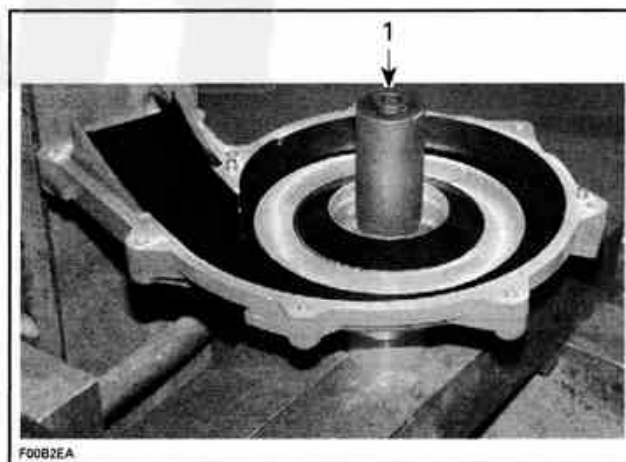
1. Supercharger shaft
2. Ball bearing
3. Bearing support plate
4. Protrusion of support plate on this side (underneath inner race)

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.

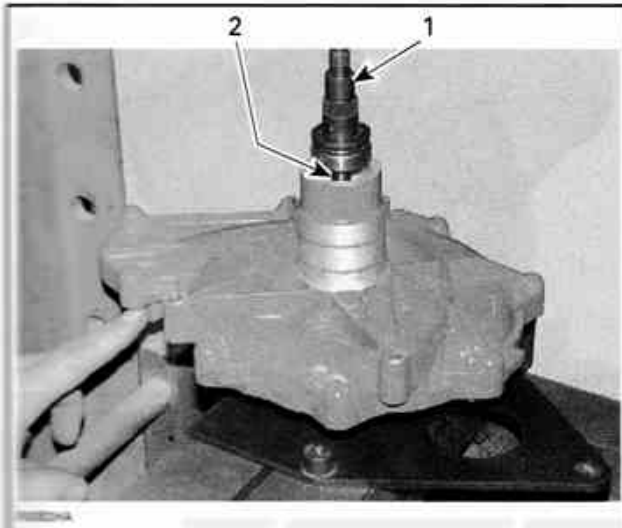
REQUIRED TOOL	
BEARING SUPPORT/PUSHER (P/N 529 035 950)	



1. Bearing support/pusher
3. Secure the supercharger housing plate (engine side) in a vice.

Section 02 ENGINE

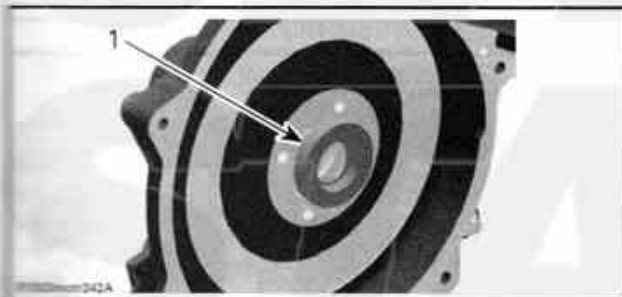
Section 05 (SUPERCHARGER (215 AND 260 ENGINES))



1. Supercharger shaft
2. Distance sleeve

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

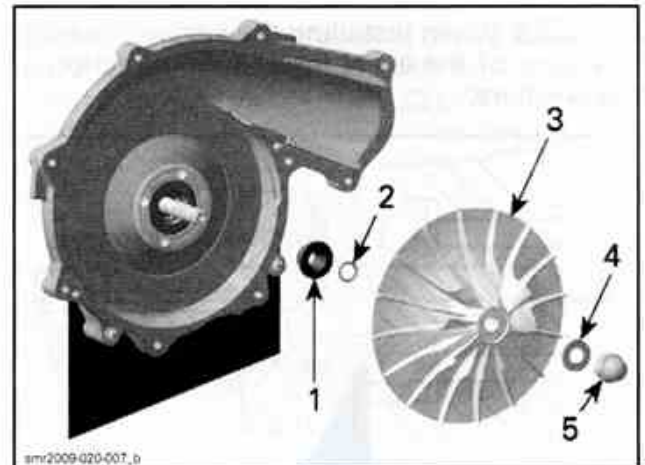
NOTE: Always use a NEW oil seal when assembling the supercharger.



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.

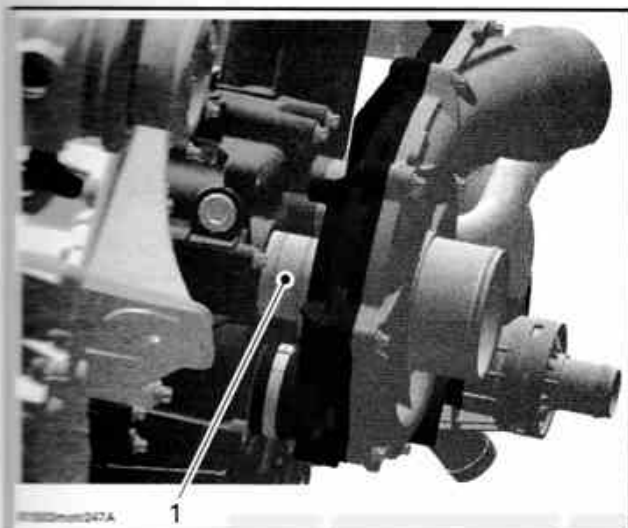
15. Install the lock washer.

16. Apply engine oil to the spring washers.

17. Position the spring washers as per illustration.

Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))




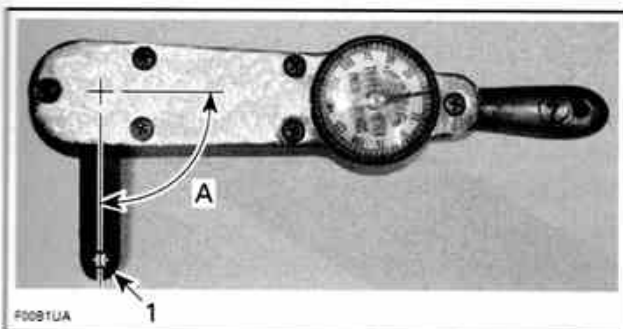
1. Super Lube grease

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°

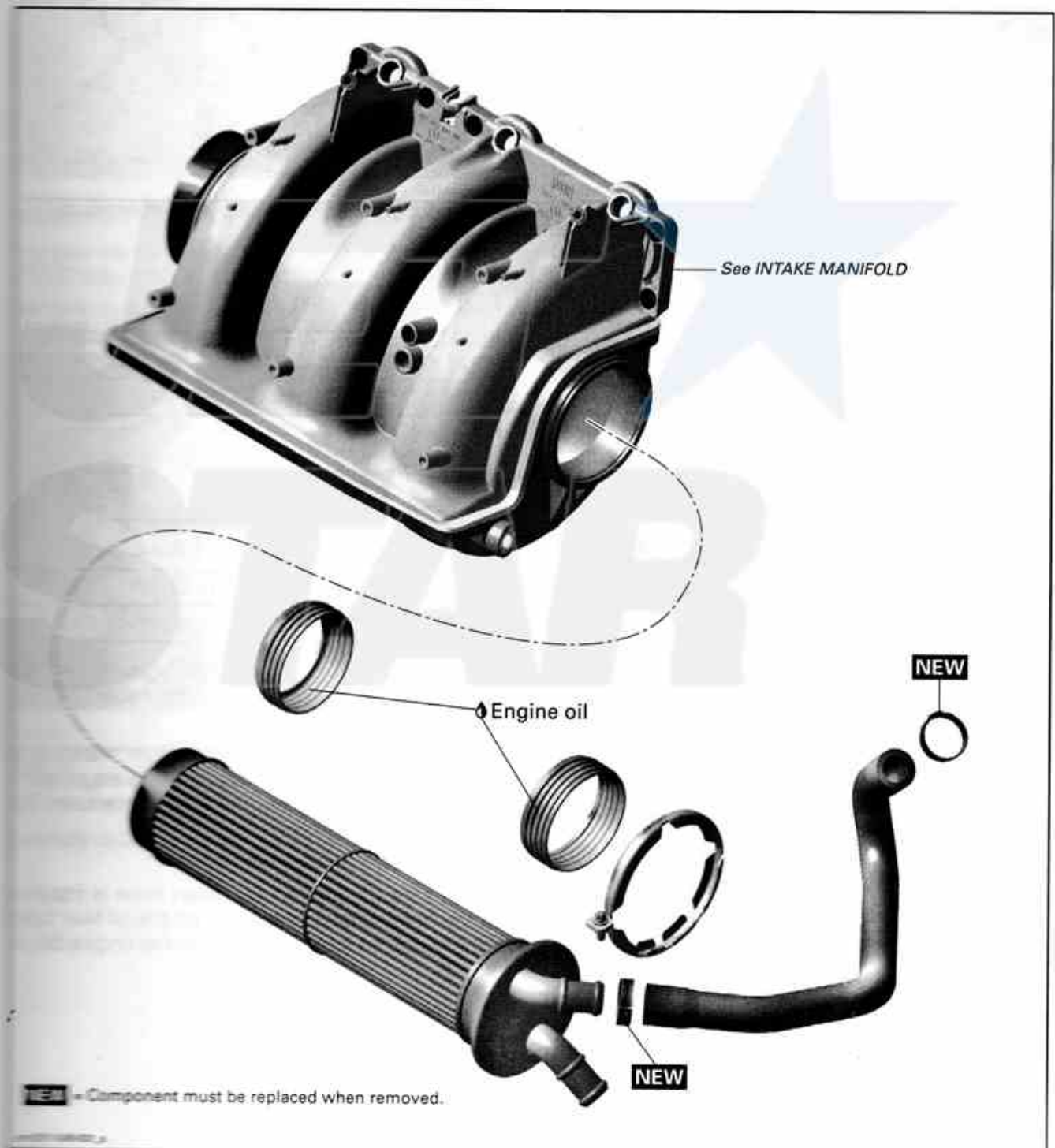
NOTICE Not installing the tool as shown will change the torque applied to the screw.

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)

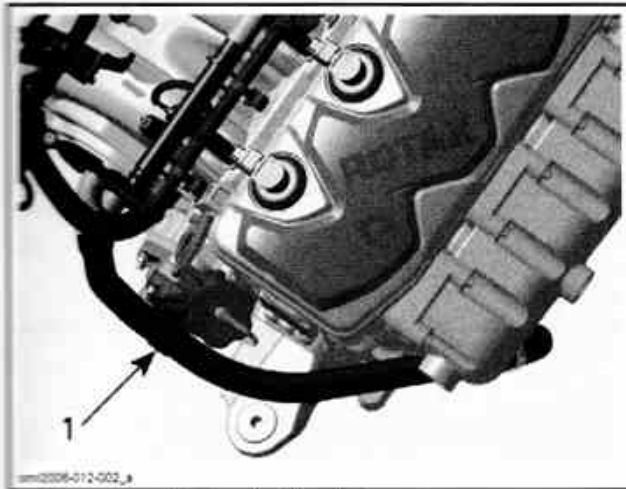
SERVICE TOOLS

Description	Part Number	Page
VACUUM/PRESSURE PUMP	529 021 800	68



Section 02 ENGINE

Subsection 06 (INTERCOOLER (215 ENGINE))

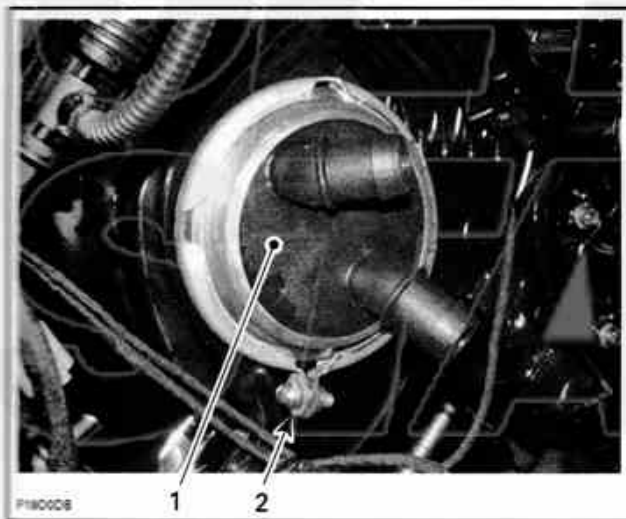


1. Intercooler outlet hose holding device

Intercooler Removal

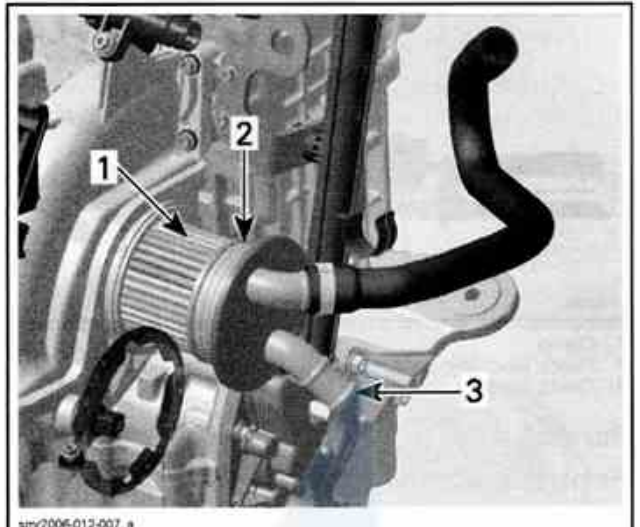
Remove intake manifold. Refer to *INTAKE MANIFOLD* subsection.

Remove collar from intercooler.



TYPICAL
1. Intercooler
2. Collar

Carefully pull intercooler out of intake manifold.



1. Intercooler
2. Profile ring
3. Collar

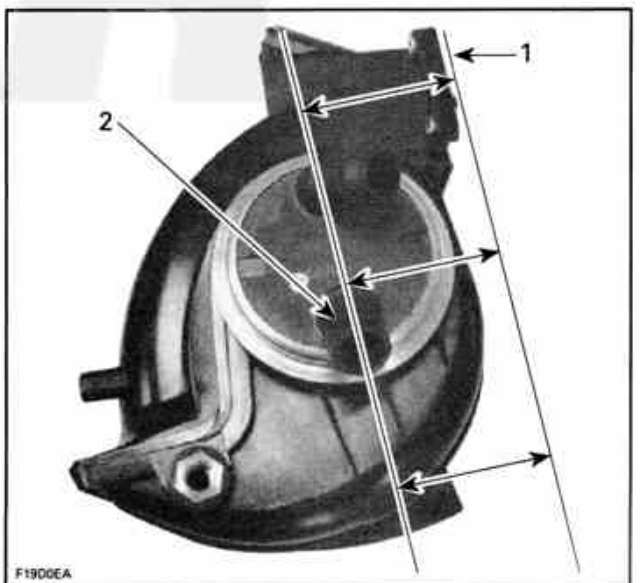
Intercooler Installation

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.

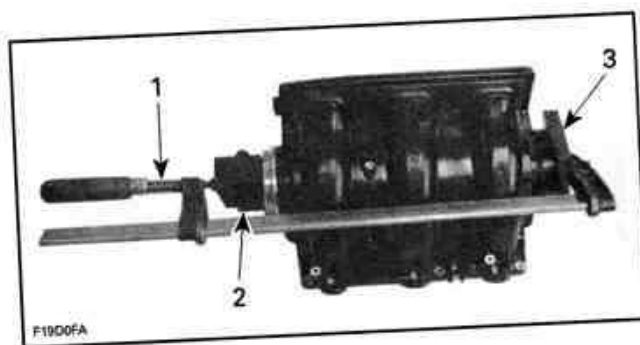


1. Intake manifold flange
2. Nipple parallel with manifold flange

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

Section 02 ENGINE

Subsection 06 (INTERCOOLER (215 ENGINE))



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

Reinstall collar.

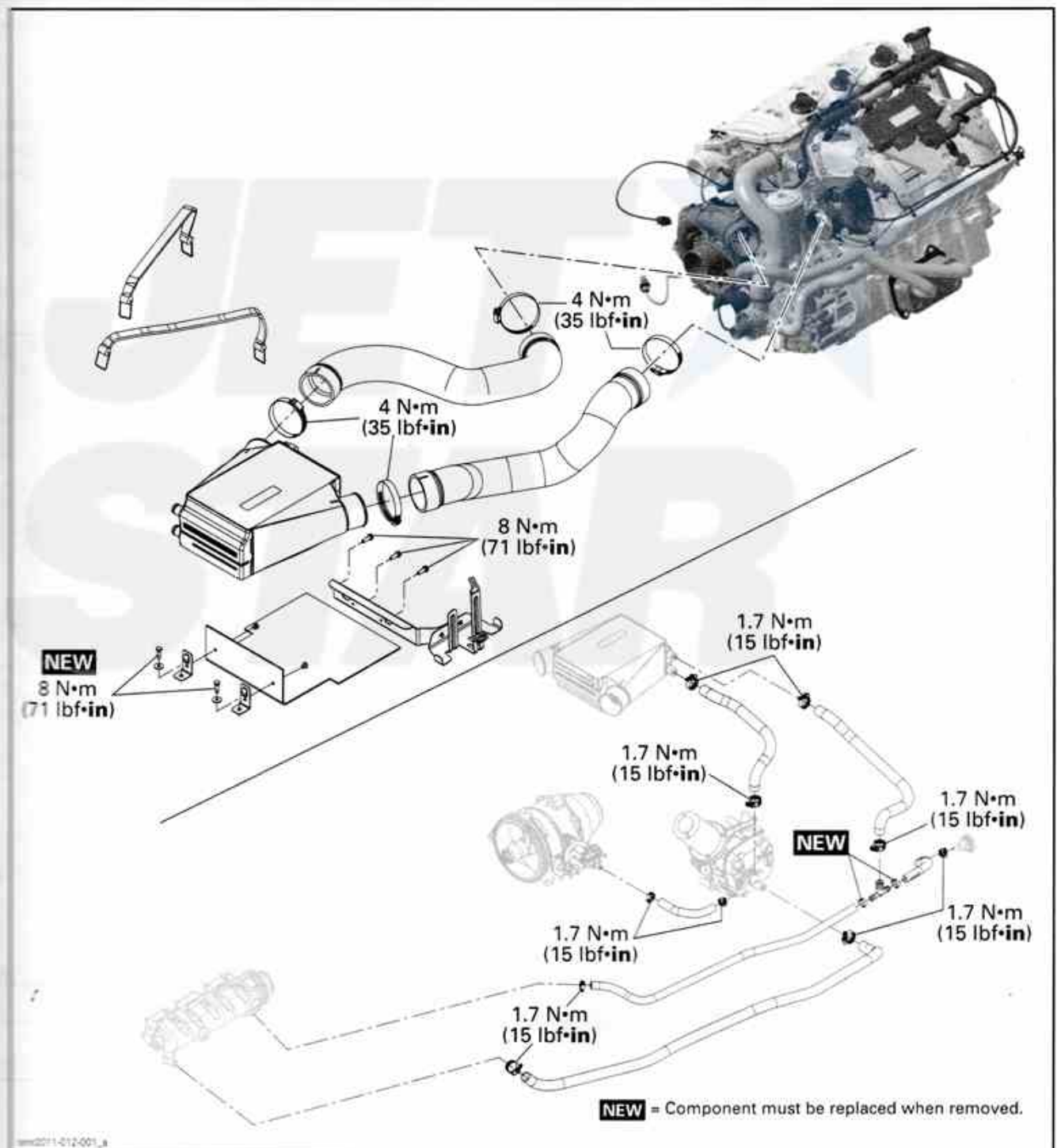
Reinstall intake manifold.

JET STAR

INTERCOOLER (260 ENGINE)

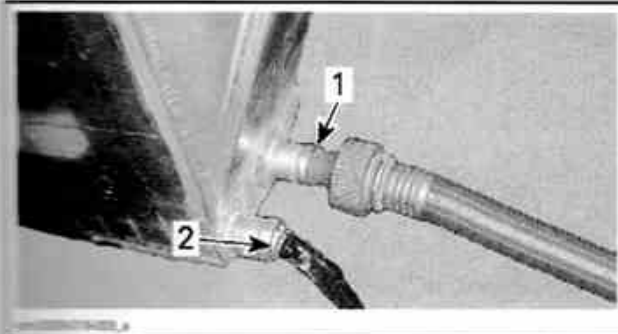
SERVICE TOOLS

Description	Part Number	Page
LARGE HOSE PINCHER.....	529 032 500	73
VACUUM/PRESSURE PUMP.....	529 021 800	73



Section 02 ENGINE

Subsection 07 (INTERCOOLER (260 ENGINE))



1. Garden hose installed on water outlet
2. High and regular water flow

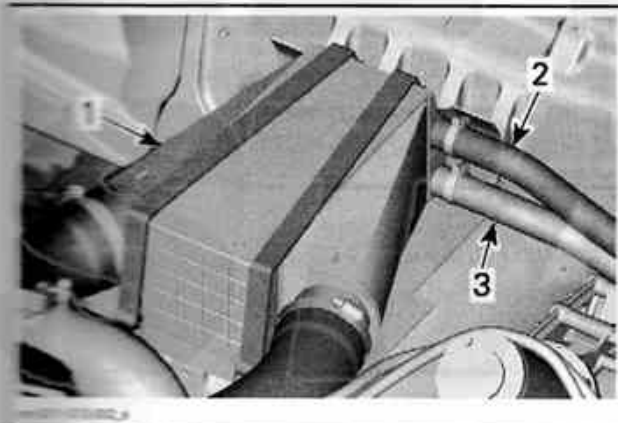
3. Perform a leak test before installing the intercooler in the watercraft.

Intercooler Leak Test

Block intercooler water outlet hose.

REQUIRED TOOL

LARGE HOSE PINCHER
(P/N 529 032 500)



MANY 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.



BLEED HOSE FITTING

Pressurize the intercooler.

PRESSURE TEST

69 kPa (10 PSI) for 10 minutes minimum

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

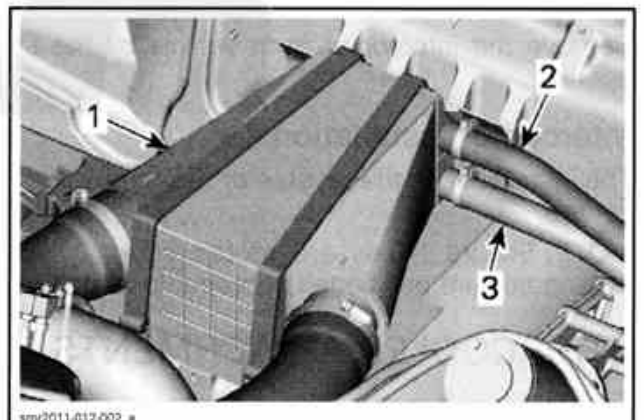
Otherwise, replace the intercooler.

Intercooler Removal

On iS and aS models, open the boarding platform and remove both storage baskets.

On models without iS and aS, open the seat and remove both rear access panels.

From the LH opening, disconnect the intercooler water hoses.



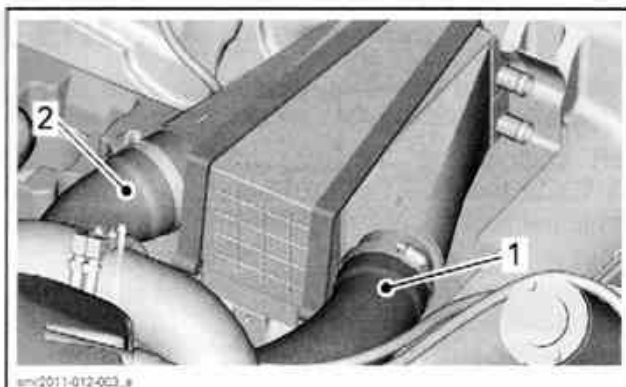
MANY PARTS REMOVED FOR CLARITY PURPOSE

1. Intercooler
2. Intercooler water outlet hose
3. Intercooler water inlet hose

Disconnect both air hoses.

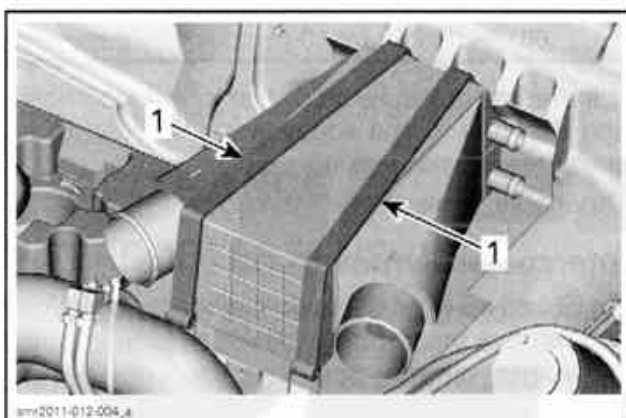
Section 02 ENGINE

Subsection 07 (INTERCOOLER (260 ENGINE))



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

Detach both intercooler straps.



1. Intercooler straps

Remove the iBR actuator. Refer to *iBR AND VTS* subsection.

Remove the intercooler from vehicle by the LH opening.

Intercooler Installation

The installation is the reverse of the removal procedure.

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

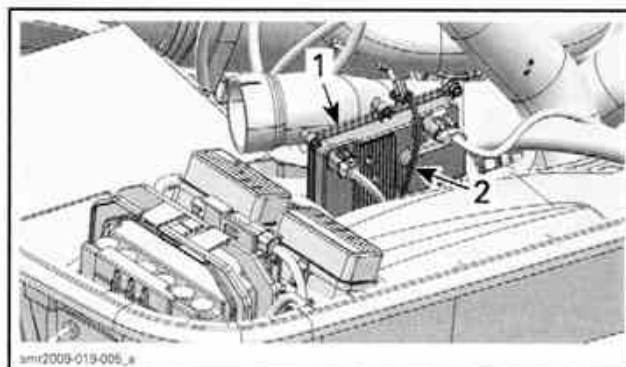
INTERCOOLER ATTACHMENTS

Front Attachment Replacement

Remove the *INTERCOOLER*, see procedure in this subsection.

iS Models

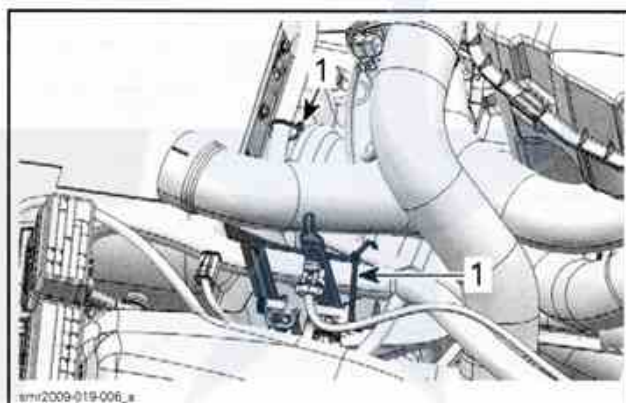
Detach iS module from its support and move the module aside to make room.



FIXED DECK REMOVED FOR CLARITY PURPOSE

1. iS module
2. Retaining latch

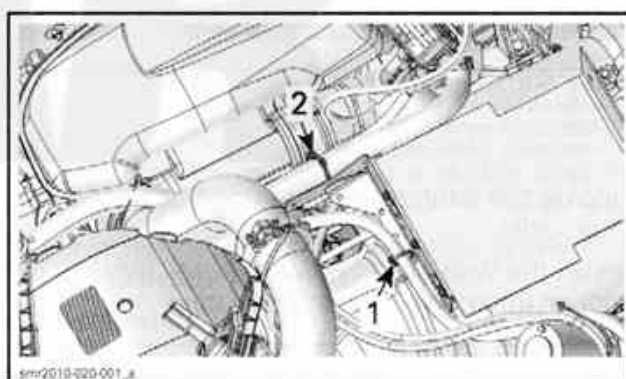
Cut locking ties securing wiring harnesses to iS module support and front attachment.



1. Cut these locking ties

Models Without iS and aS

Cut locking ties securing the iBR harness and the battery harness.



DECK REMOVED FOR CLARITY PURPOSE

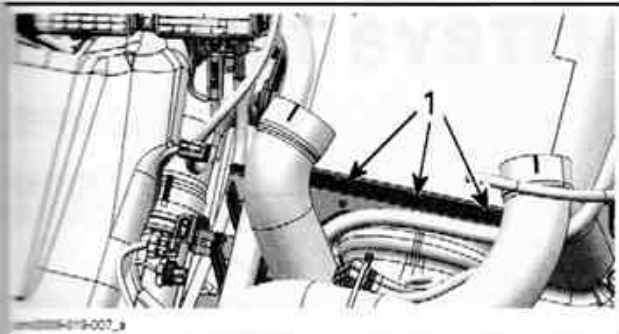
1. Locking tie retaining the iBR harness
2. Locking tie retaining the battery harness

All Models

Remove screws securing the front attachment to the hull.

Section 02 ENGINE

Subsection 07 (INTERCOOLER (260 ENGINE))



1. Retaining screws

Remove the front attachment from vehicle.

NOTE: On iS models, the front attachment and the iS module support are attached together with rivets.

When reinstalling, tighten front attachment screws to specification.

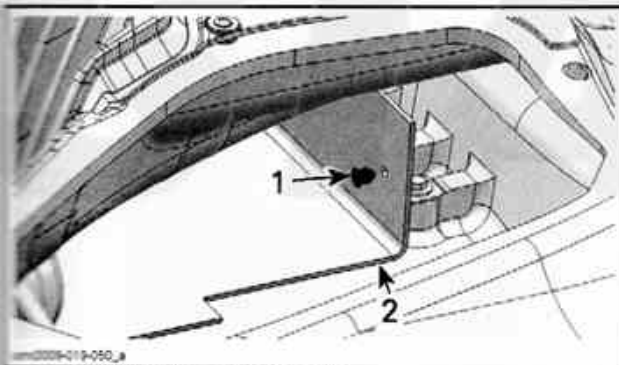
TORQUE	
Front attachment screw	8 N•m (71 lbf•in)

Install all other removed parts.

Rear Attachment Replacement

Remove the intercooler, see procedure in this subsection.

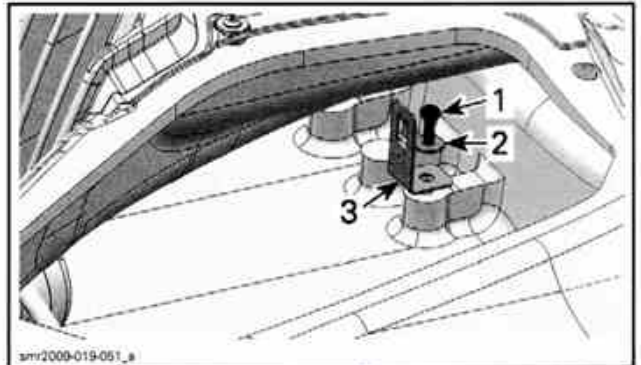
Remove darts and rubber pad.



THROUGH THE LH REAR OPENING

1. Dart
2. Rubber pad

Remove and discard screw securing the attachment to the hull.



THROUGH THE LH REAR OPENING

1. Retaining screw
2. Washer
3. LH rear attachment

Install a new attachment using a NEW screw.
Tighten rear attachment screw to specification.

TORQUE	
Rear attachment screw	8 N•m (71 lbf•in)

Install all other removed parts.

EXHAUST SYSTEM

SERVICE TOOLS

Description	Part Number	Page
FLUSHING CONNECTOR ADAPTER	295 500 473	83

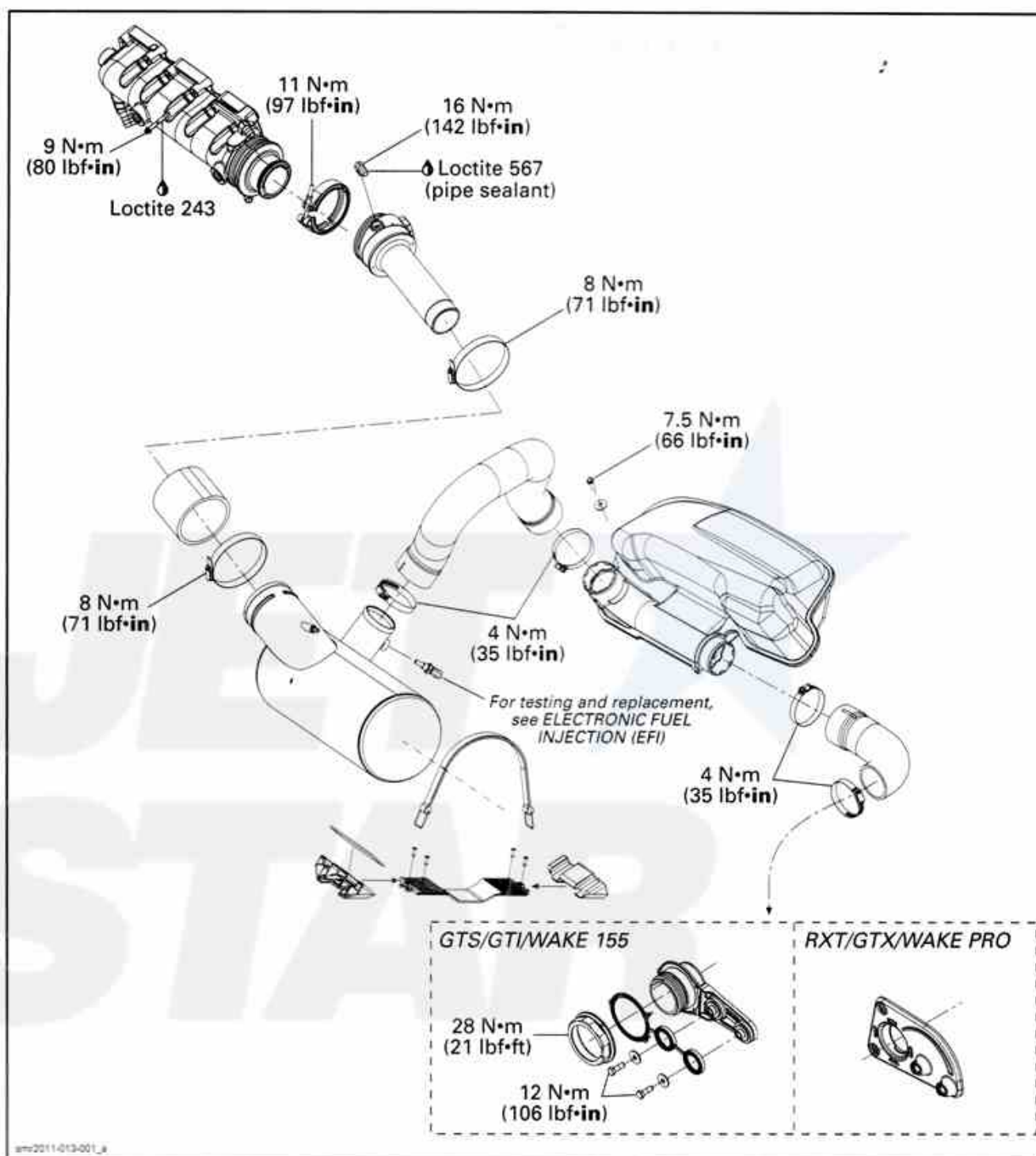
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	90

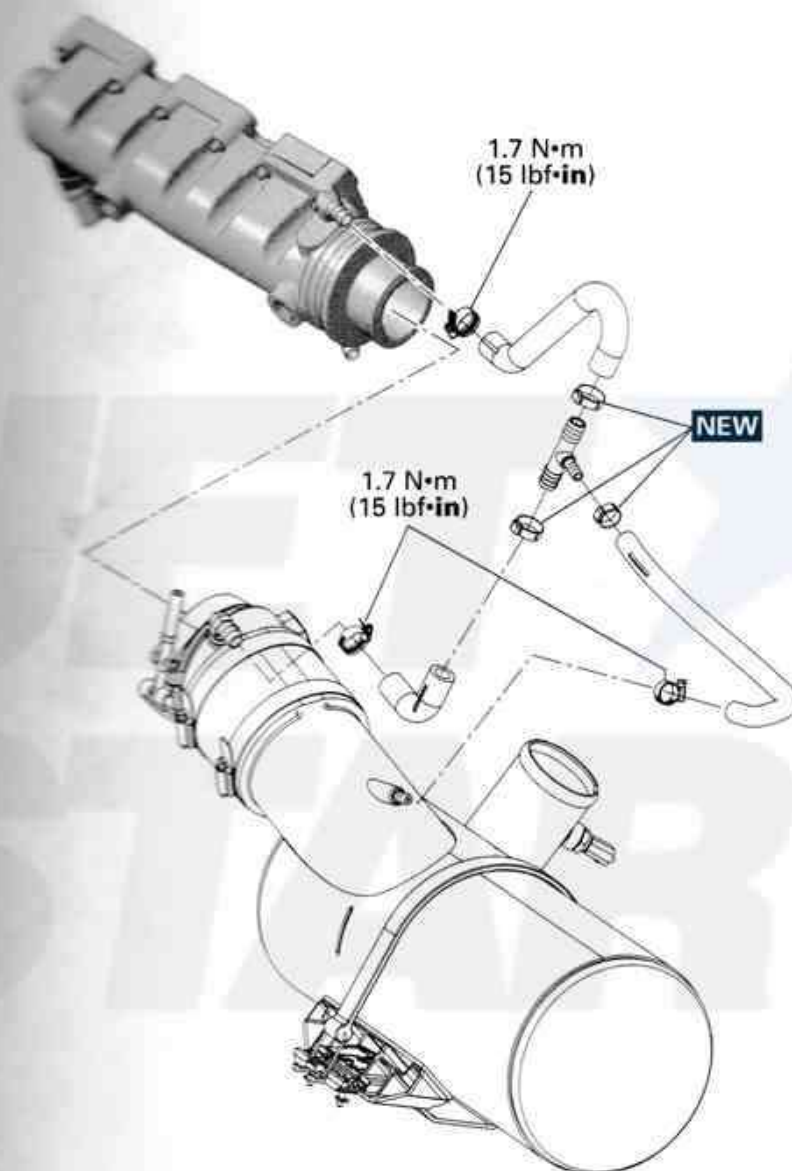
JET 
STAR

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)



Section 02 ENGINE
Subsection 08 (EXHAUST SYSTEM)

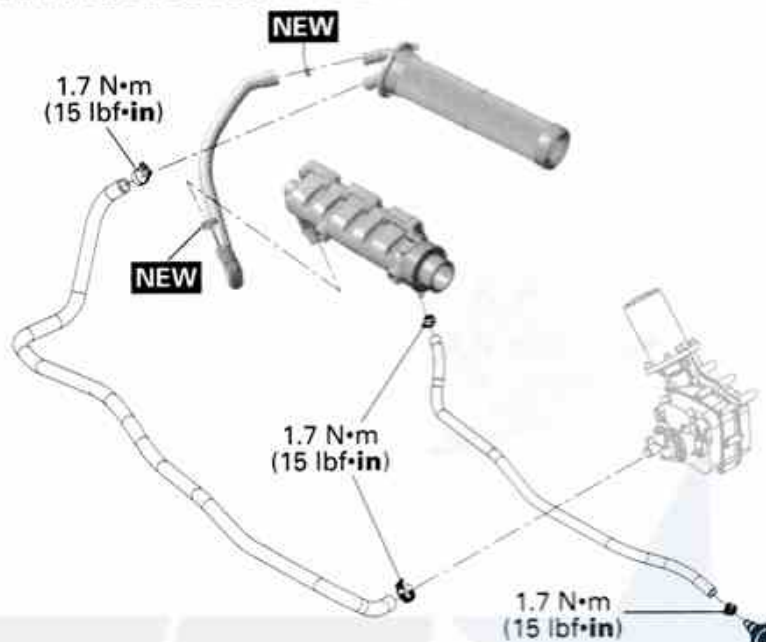


 Component must be replaced when removed.

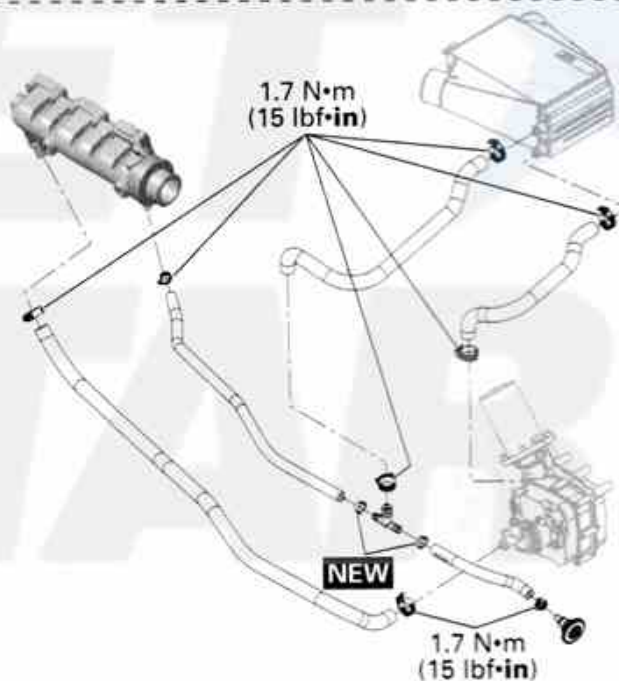
Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)

GTX 215
GTX iS 215
WAKE PRO 215



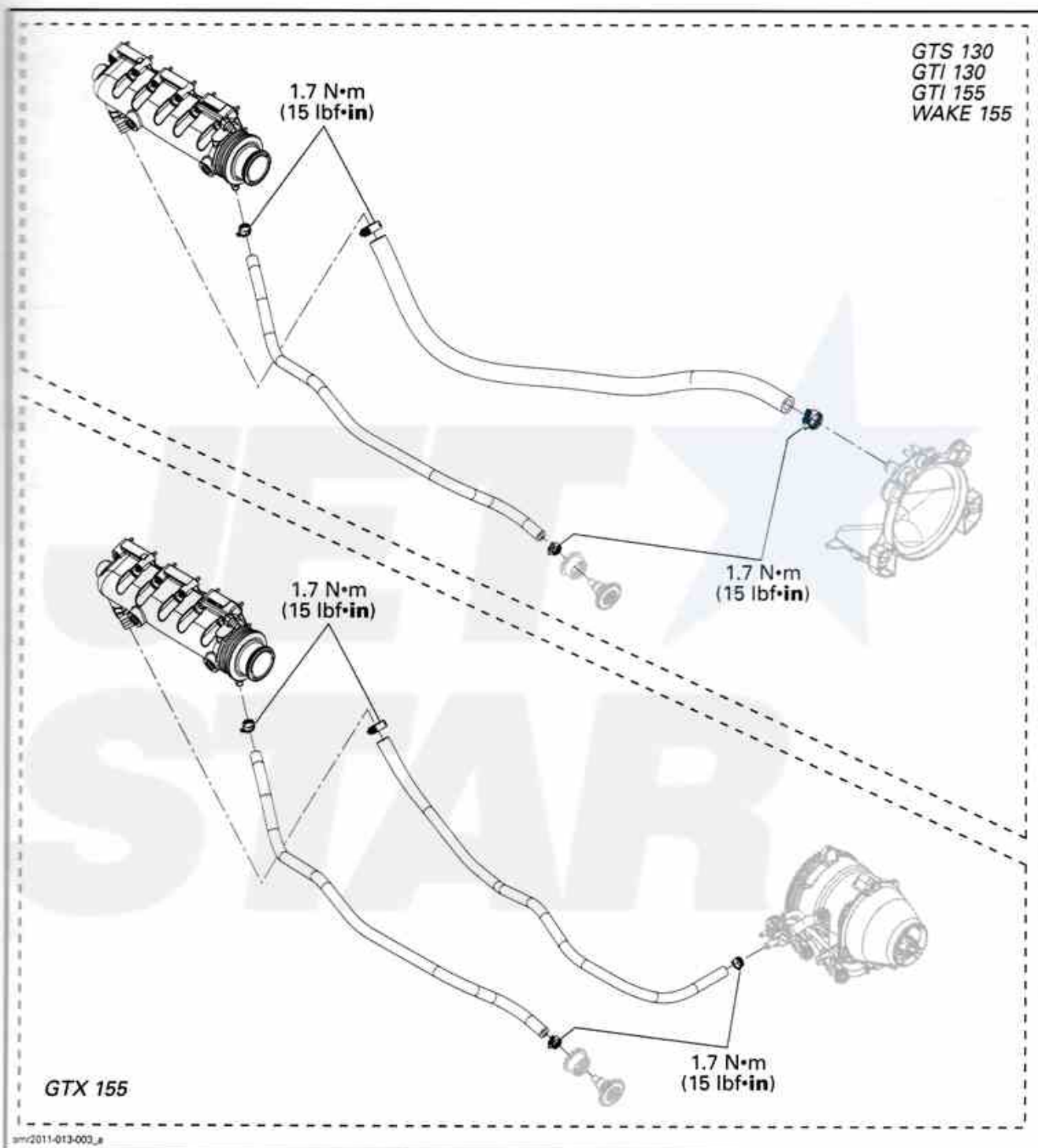
RXT SERIES
GTX LTD iS 260



NEW = Component must be replaced when removed.

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Section 02 ENGINE
Subsection 08 (EXHAUST SYSTEM)



Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)

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.

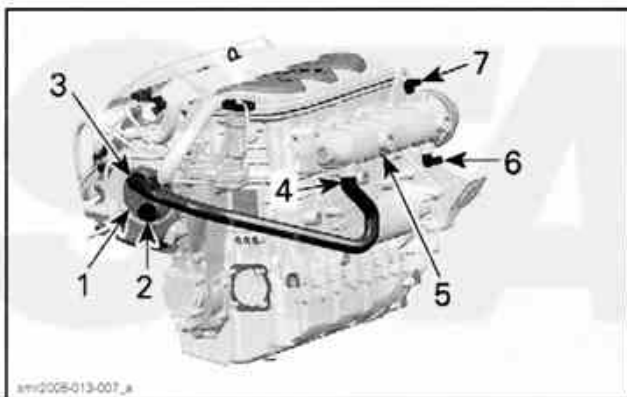
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

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

SYSTEM DESCRIPTION

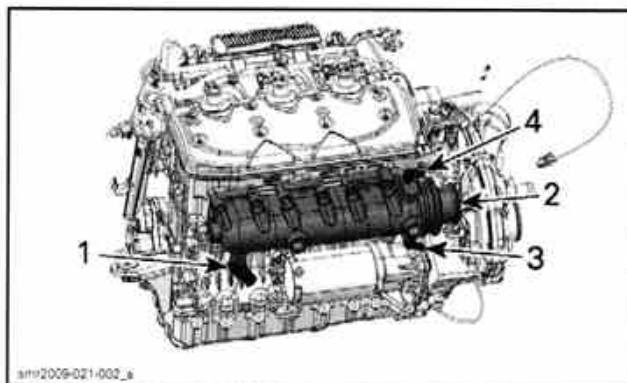
The exhaust system is cooled by water provided by a pressurized area in the jet pump (open loop system).

The same water is also used to cool the intercooler (supercharged engines) and the iBR actuator (models with iBR).



215 ENGINE

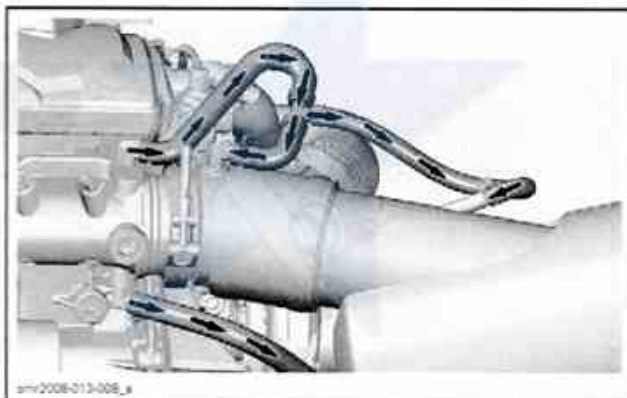
1. Intercooler
2. Intercooler water inlet
3. Intercooler water outlet
4. Exhaust manifold water inlet
5. Exhaust manifold
6. Exhaust manifold water outlet (to pump support)
7. Exhaust manifold water outlet (to exhaust pipe and muffler)



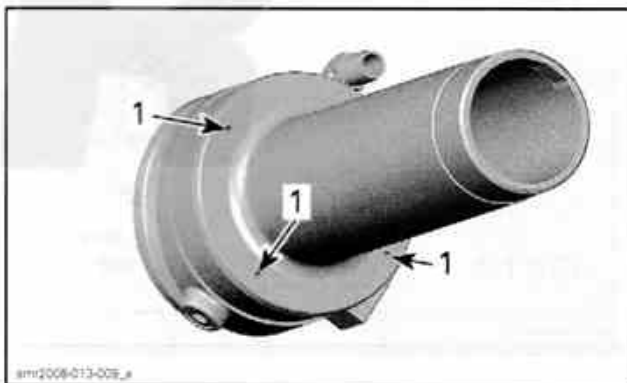
130, 155 AND 260 ENGINES

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.



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



1. Water packet holes

Water is evacuated through the exhaust outlet in transom area.

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)

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 clean up sand, salt, shells or other particles in water jackets (exhaust system, intercooler supercharged engines) and hoses).

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

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

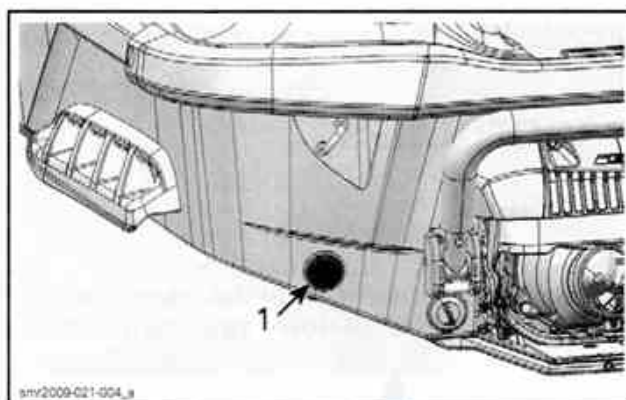
⚠ WARNING

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

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

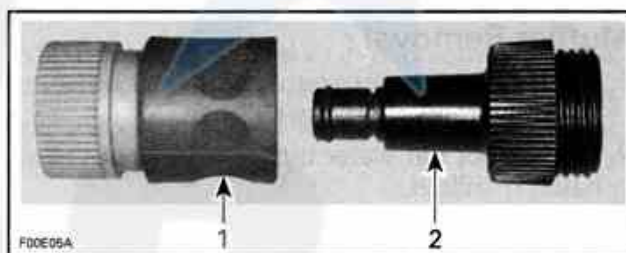


1. Water inlet connector

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

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 watercraft is out of water.

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 watercraft is out of water.

Ensure water flows out of jet pump while flushing. Close the water tap, then stop the engine.

NOTICE Always close the water tap before stopping the engine.

Disconnect the garden hose.

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)

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

iS and aS Models

Open seat.

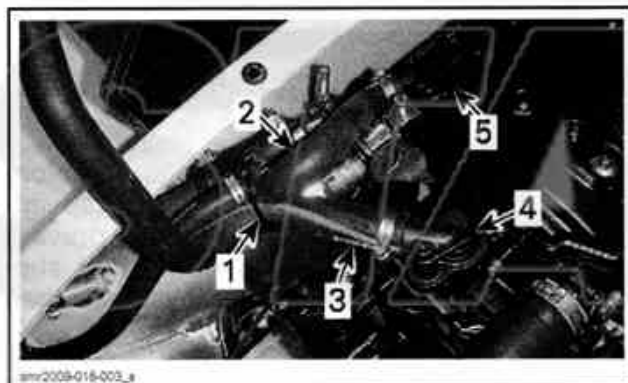
Remove the air intake silencer. Refer to *AIR INTAKE SILENCER (iS AND aS MODELS)* subsection.

All Other Models

Remove seat.

Muffler Removal

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



TYPICAL

1. Cut this locking tie
2. Water outlet hose (exhaust system)
3. Blow-by hose
4. Blow-by valve
5. Exhaust manifold

4. Unscrew exhaust clamp.

NOTICE Do not use pneumatic or electrical tools as seizure may occur.



TYPICAL

1. Exhaust clamp

5. Unplug the exhaust gas temperature sensor (EGTS).



TYPICAL

1. EGTS sensor
2. Exhaust hose

6. Disconnect the exhaust hose from muffler.



TYPICAL

1. Exhaust hose clamp

7. Detach retaining strap.

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)



TYPICAL
1. Muffler retaining strap

B. Remove the muffler.

- On iS and aS models, remove the LH rear storage basket then move the muffler backwards and slide it through the rear opening.
- On models without iS and aS, move the muffler back then slide it forward through the deck opening.

Muffler Inspection

Check muffler for:

- Cracks
- Corrosion
- Other damages.

Check if exhaust hose is:

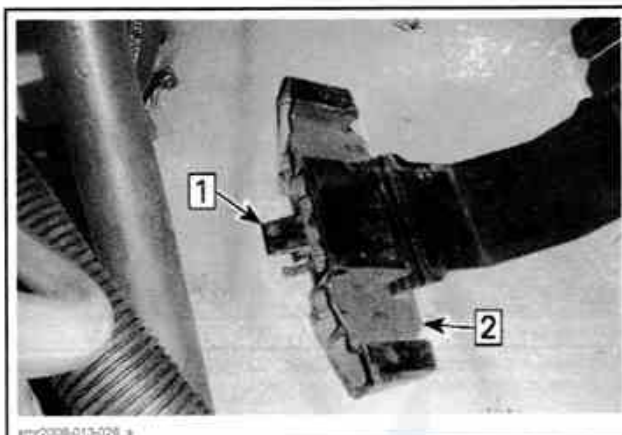
- Brittle
- Hard
- Cracked
- Otherwise damaged.

Replace any defective part.

Muffler Installation

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

Open muffler adjusters by sliding adjuster blocks.



Step 1: Lift adjuster tab
Step 2: Move adjuster outward

Insert the muffler in hull.

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.

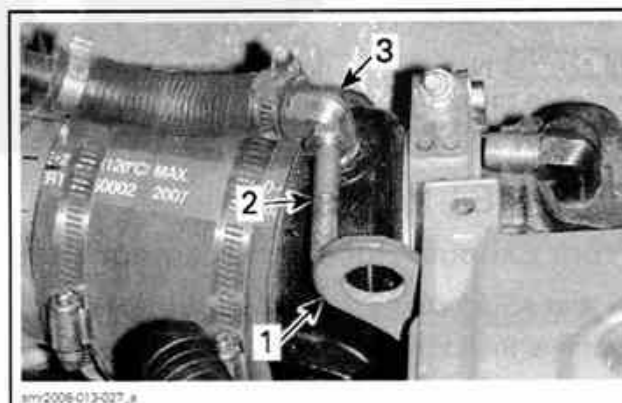
Slide both adjuster blocks against muffler to support it in position.

NOTE: Ensure muffler is in contact with both adjuster blocks. Readjust as required.

Install exhaust clamp with the nut upward.

Tighten clamp loosely.

Using a 50 mm (2 in) spacer (in this case a bolt), position the exhaust pipe.

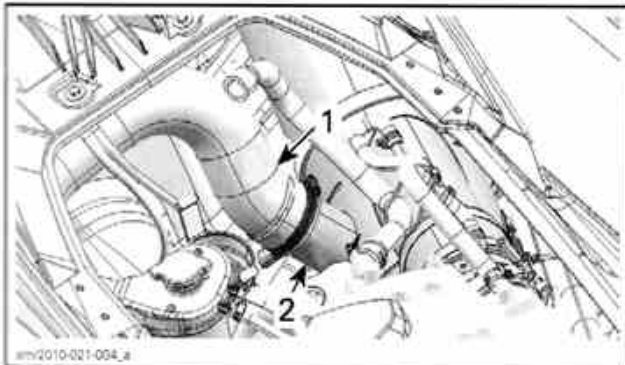


1. Engine lifting ring
2. Spacer
3. Exhaust pipe fitting

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

Section 02 ENGINE

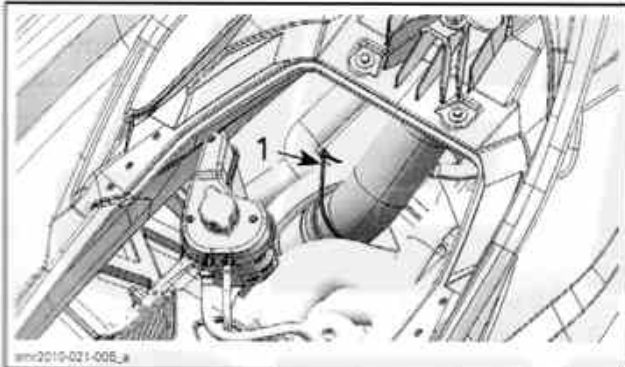
Subsection 08 (EXHAUST SYSTEM)



TYPICAL

- 1. Front exhaust hose
- 2. Muffler outlet

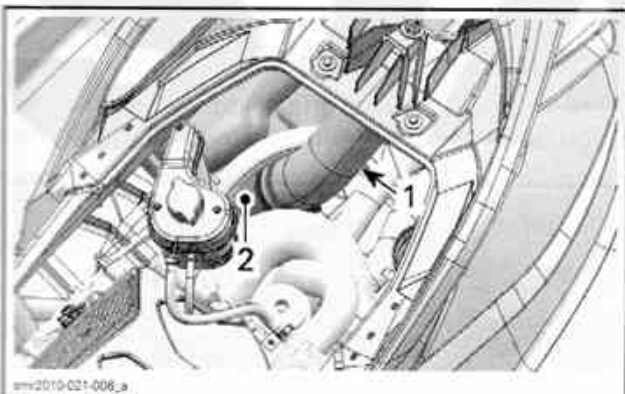
Cut the locking tie securing the electrical harness to the front exhaust hose.



TYPICAL

- 1. Cut this locking tie

Detach the end of the hose from the resonator.



TYPICAL

- 1. Front exhaust hose
- 2. Resonator

All Models

Remove front exhaust hose from vehicle.

When reinstalling exhaust hose, make sure to attach elbow fittings at the highest position that you can on the exhaust hose.

Tighten retaining clamps to specification.

TORQUE	
Front exhaust hose clamp	4 N•m (35 lbf•in)

Install all other removed parts.

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

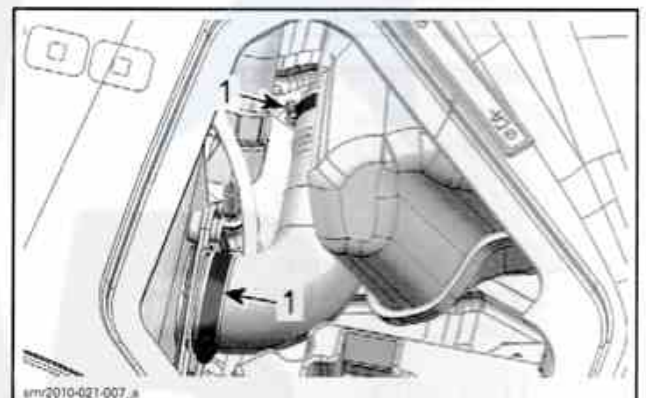
NOTICE Never run engine without supplying water to the exhaust system when watercraft is out of water.

Rear Exhaust Hose Replacement

iS and aS Models

Remove battery and battery holder. Refer to **CHARGING SYSTEM** subsection.

Loosen clamps securing rear exhaust hose to resonator and iBR support plate.



- 1. Retaining clamps

Remove the rear exhaust hose from vehicle.

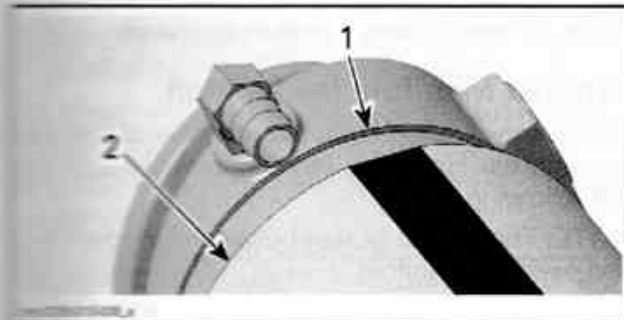
Models Without iS and aS

Remove the resonator. See procedure in this subsection.

Loosen clamp securing the rear exhaust hose to RH fixing plate.

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)

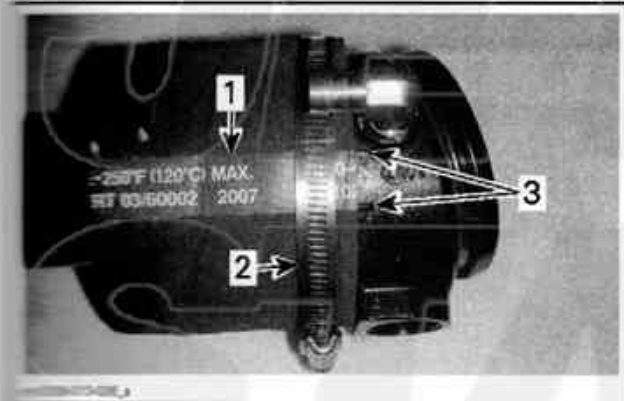


1 Exhaust pipe shoulder
2 Rubber adapter

Center the rubber adapter strip of the rubber adapter between both exhaust pipe marks.

Tighten retaining clamp.

TORQUE	
Rubber adapter retaining clamp	8 N•m (71 lbf•in)



1 Rubber adapter strip
2 Retaining clamp
3 Exhaust pipe marks

Slide the other clamp on the rubber adapter.

Insert the exhaust pipe into the muffler.

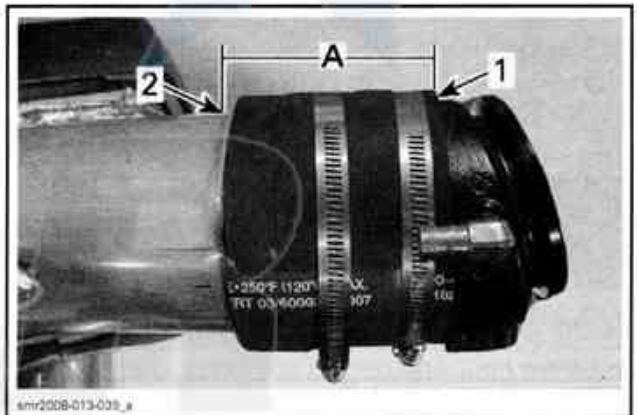
Align the center of the rubber adapter strip with the mark previously traced on muffler.



1 Middle of rubber adapter strip
2 Center of the muffler bulge opening

Using a caliper, measure the distance between the exhaust pipe shoulder and the outside of the muffler bulge.

Position the muffler to $95 \text{ mm} \pm 2 \text{ mm}$ ($3.74 \text{ in} \pm .079 \text{ in}$). Check the distance in several places.



1 Rubber adapter end
2 Outside of the muffler bulge
A: $95 \text{ mm} \pm 2 \text{ mm}$ ($3.74 \text{ in} \pm .079 \text{ in}$)

Tighten retaining clamp.

TORQUE	
Rubber adapter retaining clamp	8 N•m (71 lbf•in)

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

EXHAUST MANIFOLD

Exhaust Manifold Removal

1. On iS and aS models, remove the moving deck and the deck extension. Refer to *BODY* subsection.

Section 01 MAINTENANCE

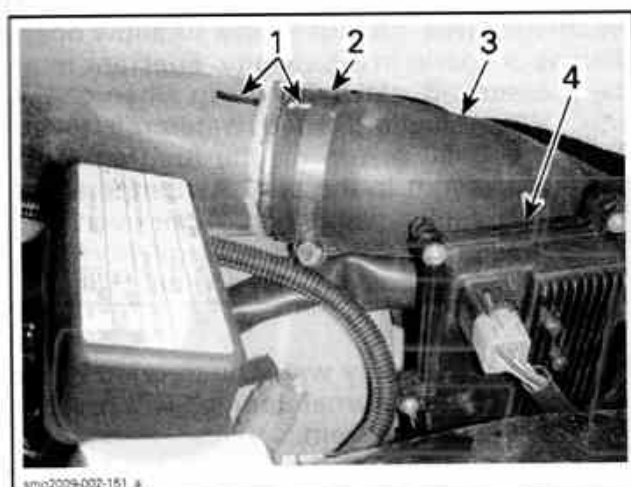
Subsection 03 (STORAGE PROCEDURE)

2. Ensure there is an alignment line drawn on the intercooler outlet hose. This will ensure the hose is not twisted or kinked on reinstallation.
3. Loosen the clamp retaining the intercooler outlet hose.
4. Remove the intercooler outlet hose from the intercooler.

NOTE: This hose feeds the inlet of the throttle body.

iS Models

5. Drape a couple of shop rags over the iS module to protect it from any expelled water from the intercooler.



TYPICAL

1. Hose alignment lines
2. Hose clamp
3. Intercooler outlet hose
4. iS module

All Models

6. Start engine and rev up to 4000 RPM several times. Water will be expelled from the intercooler.

NOTE: Prevent air intake system from aspirating foreign objects which may cause severe engine or damage.

7. Stop engine.
8. Properly align and reinstall hose on intercooler.
9. Torque intercooler hose clamp as specified.

INTERCOOLER HOSE CLAMP TORQUE

4 N•m (35 lbf•in)

Models Without iS or aS

1. Open the seat.

2. Ensure there is an alignment line drawn on the throttle body inlet hose. This will ensure the hose is not twisted or kinked on reinstallation.
3. Loosen the clamp retaining the hose to the throttle body.
4. Remove the hose from the throttle body and direct it away from the throttle body and other components.
5. Start engine and rev up to 4000 RPM several times. Water will be expelled from the intercooler.

NOTE: Prevent air intake system from aspirating foreign objects which may cause severe engine or damage.

6. Stop engine.
7. Properly align and reinstall hose on throttle body.
8. Torque intercooler hose clamp as specified.

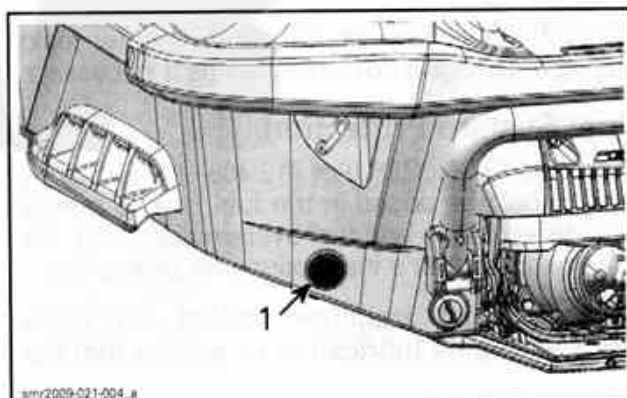
INTERCOOLER HOSE CLAMP TORQUE

4 N•m (35 lbf•in)

Exhaust System Protection

The exhaust system is self draining, but the exhaust manifold and intercooler (215 engine) need to be drained to avoid damages should the watercraft be stored in an area where the temperature attains the freezing point of water.

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

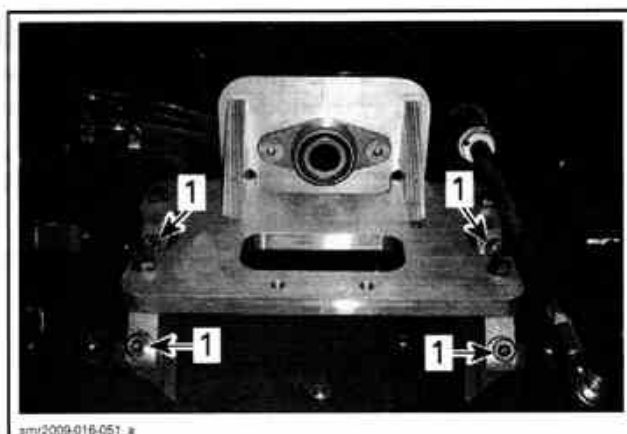


1. Flushing connector

The following hose can be fabricated to ease draining procedure.

Section 02 ENGINE

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

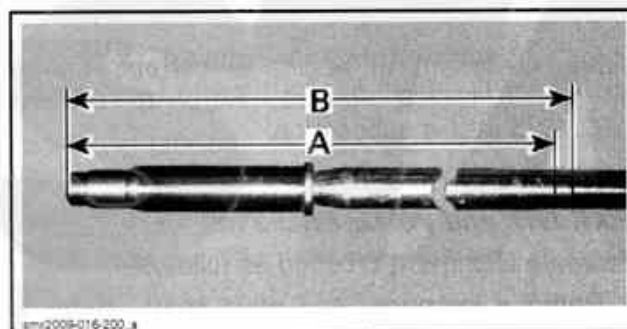


1. Jet pump socket screws

Install the ALIGNMENT SHAFT ADAPTER (P/N 529 035 719) on the end of the ALIGNMENT SHAFT (P/N 295 000 141).



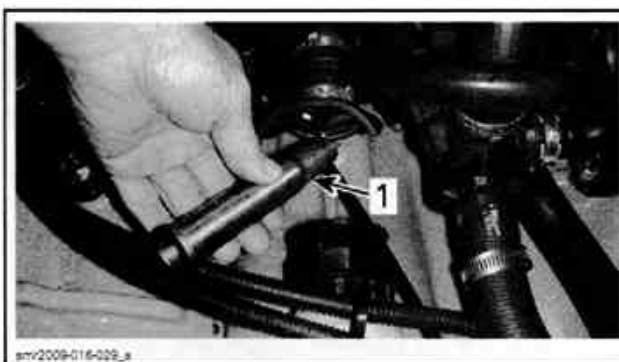
Trace two thin lines on alignment shaft.



LINES	DISTANCE
Line A	at 607.5 mm (23.917 in)
Line B	at 610.5 mm (24.035 in)

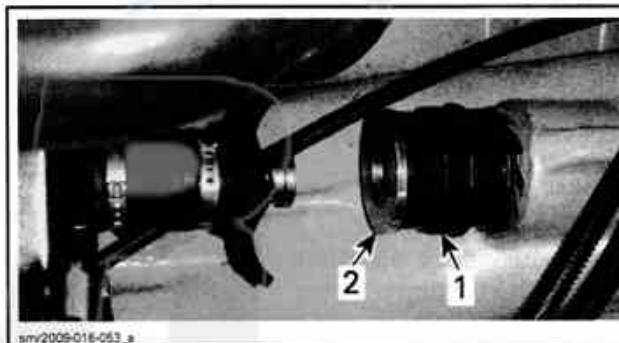
4. Remove the ALIGNMENT SHAFT ADAPTER (P/N 529 035 719) from the end of the alignment shaft and install it in engine PTO housing.

NOTICE Ensure alignment shaft adapter is fully inserted into the engine PTO housing.



1. Alignment shaft adapter

5. Install the THRU-HULL ADAPTER (P/N 529 036 193) into the thru-hull fitting. Ensure the adapter is properly seated against the fitting.

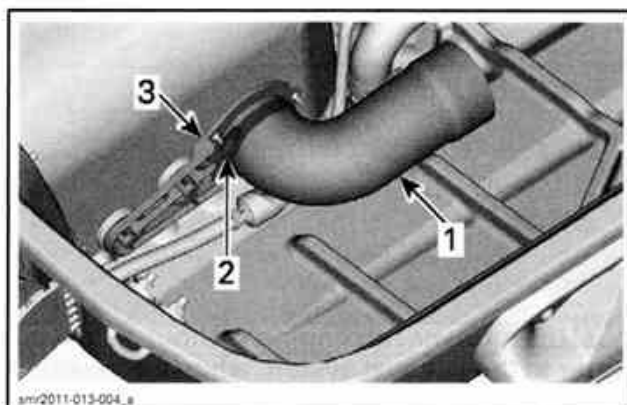


1. Thru-hull fitting
2. Thru-hull adapter

NOTE: On some occasions, the thru-hull adapter must be retained in the fitting using a hose clamp.

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)



DECK REMOVED FOR CLARITY

1. Rear exhaust hose
2. Hose clamp
3. RH fixing plate

All Models

When reinstalling rear exhaust hose, tighten clamps to specification.

TORQUE	
Rear exhaust hose clamp	4 N•m (35 lbf•in)

Reinstall all other removed parts.

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

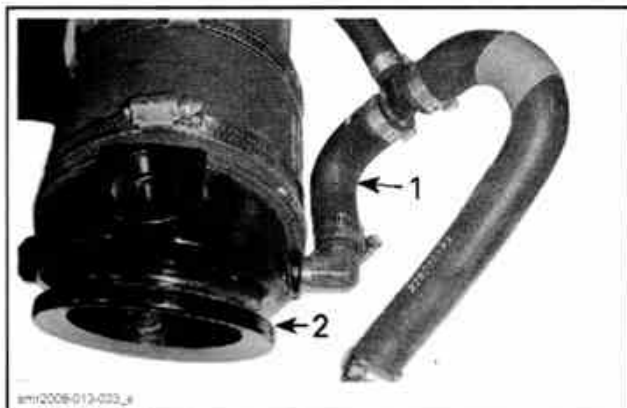
NOTICE Never run engine without supplying water to the exhaust system when watercraft is out of water.

EXHAUST PIPE

Exhaust Pipe Removal

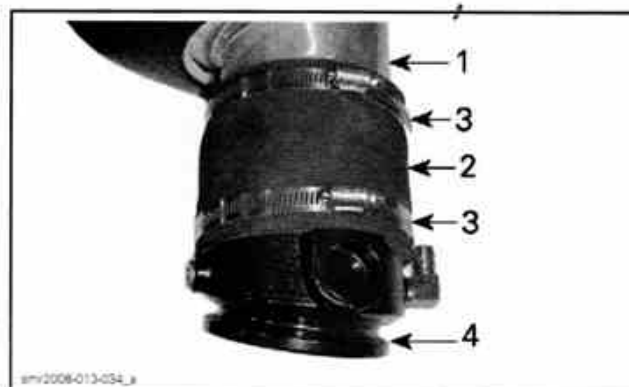
Remove **MUFFLER**, see procedure in this subsection.

Disconnect water inlet hose from exhaust pipe fitting.



1. Water inlet hose
2. Exhaust pipe

Loosen rubber adapter clamps.



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

Remove exhaust pipe and the rubber adapter.

Exhaust Pipe Inspection

Inspect exhaust pipe for:

- Cracks
- Flange damages
- Other damages.

Replace exhaust pipe as required.

Check if the rubber adapter is:

- Brittle
- Hard
- Otherwise damaged.

Replace rubber adapter if necessary.

Exhaust Pipe Installation

Trace a mark to locate the middle of the muffler bulge opening.

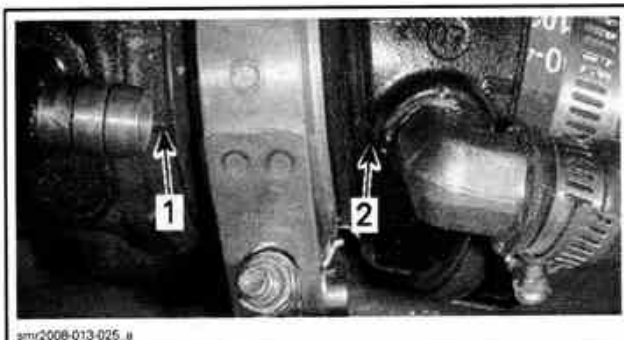


1. Bulge
2. Middle of the opening

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

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)



1. Exhaust manifold mark
2. Exhaust pipe mark

Tighten exhaust clamp.

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

NOTICE Do not use pneumatic or electric tools as seizure may occur.

Install the muffler strap.

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

Install all other removed parts.

After installation, ensure there is no water or exhaust gas leak when engine is running.

Test run the engine while supplying water to the exhaust system.

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

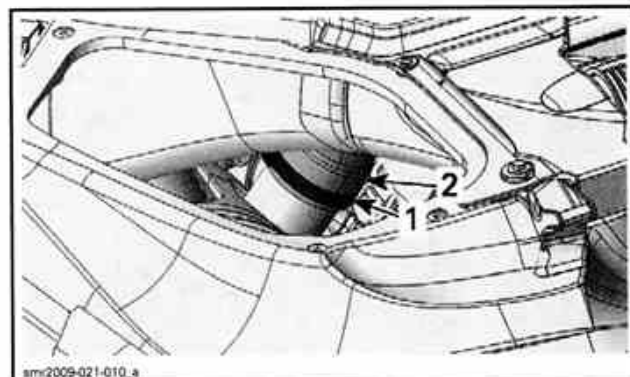
EXHAUST HOSES

Front Exhaust Hose Replacement

iS and aS Models

Remove the LH rear storage basket.

Remove exhaust hose from muffler outlet.



1. Retaining clamp
2. Exhaust hose

Remove the deck extension. Refer to *BODY* subsection.

Move the coolant expansion tank aside and cut locking tie retaining the starter cable (RED) to exhaust hose.

Remove exhaust hose from resonator.

Cut locking tie retaining bailer hose elbow fittings to exhaust hose.

Models Without iS and aS

Cut locking tie securing bailers on the top of the front exhaust hose.



TYPICAL

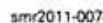
1. Cut this locking tie

On GTS and GTI models, cut locking ties securing wiring harness to exhaust hose.

Remove exhaust hose from the muffler outlet.

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

GTS 130, GTI 130, GTI 155 and WAKE 155



Section 02 ENGINE

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

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

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

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

Before completely lowering engine, install ground cable, starter cable and water hoses on exhaust manifold. Follow these guide lines.

- Ensure contact surface is perfectly clean then reconnect ground 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 to 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 vehicle.

Install engine support screws. 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 other removed parts.

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

⚠ WARNING

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





Verify all electrical connections (ground wires and battery).

Run engine and ensure there is no leakage.

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

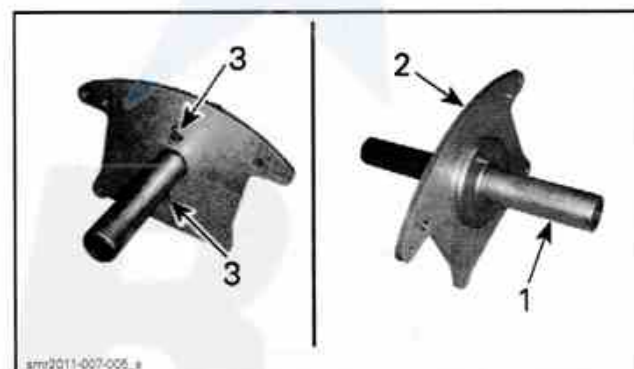
Engine Alignment

GTS, GTI and WAKE 155

REQUIRED TOOLS	
PUMP PLATE (P/N 529 036 224)	
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 of engine proceed as follows:

1. Remove jet pump and drive shaft. Refer to *STEERING AND PROPULSION* section.
2. Remove drive shaft boot.
3. Assemble alignment tool.
 - 3.1 Install the alignment shaft support on pump plate.
 - 3.2 Secure using M8 x 25 x 1.25 hexagonal screws.



- smr2011-007-006_a
1. Alignment shaft support (P/N 529 035 506)
 2. Support plate (P/N 529 036 224)
 3. M8 x 25 x 1.25 hexagonal screws

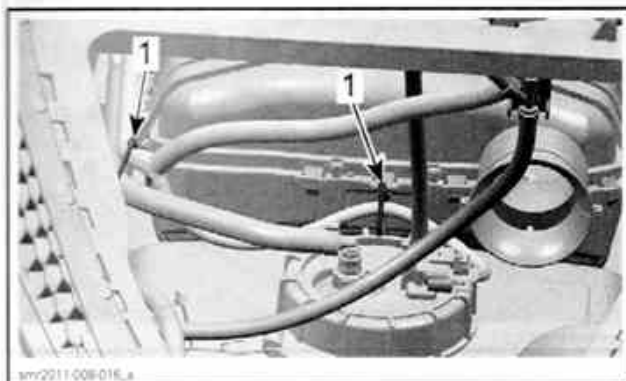
TORQUE	
Alignment tool screws	24 N•m (18 lbf•ft)

4. Install the alignment tool as follows.
 - 4.1 Position the alignment tool against the pump support.
 - 4.2 Push the alignment tool upward and hold it in this position.

Section 02 ENGINE

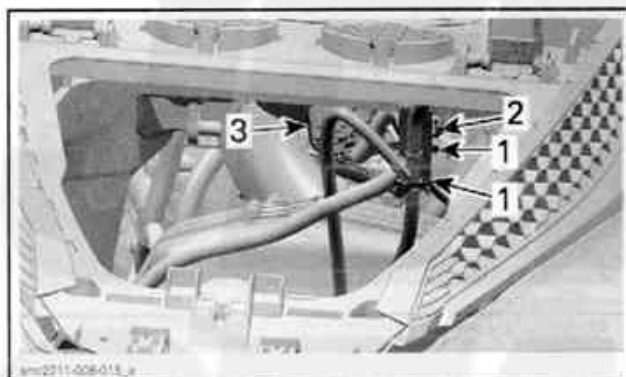
Subsection 02 (AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS))

4. Cut locking ties securing wiring harness and fuel hoses to air intake silencer.



1. Cut these locking ties

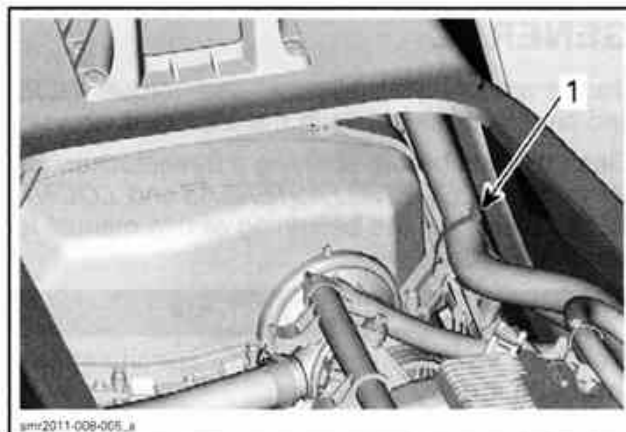
5. Cut locking ties securing fuel hoses and wiring harness to upper bracket
6. Disconnect gauge and OTAS connectors.



1. Cut these locking ties
2. Disconnect the OTAS connector
3. Disconnect the gauge connector

Air Intake Silencer Removal

1. Open or remove the seat.
2. From seat opening, cut locking tie securing the wiring harness and the fuel supply hose to air intake silencer.



TYPICAL - GTS AND GTI

1. Cut this locking tie



TYPICAL - RXT AND GTX

1. Cut this locking tie

3. Detach rear retaining strap retaining air intake silencer and fuel tank.

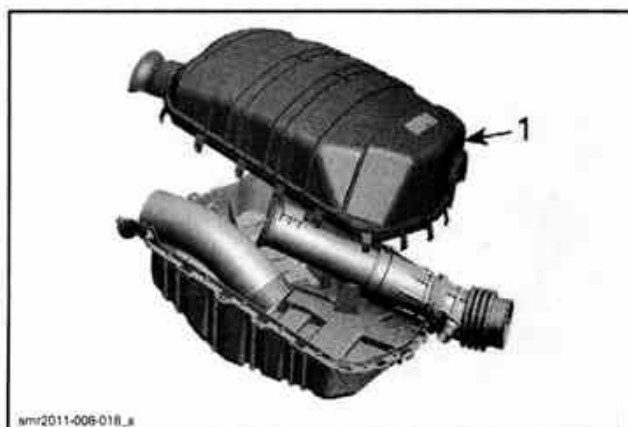


TYPICAL - GTS AND GTI

1. Rear retaining strap

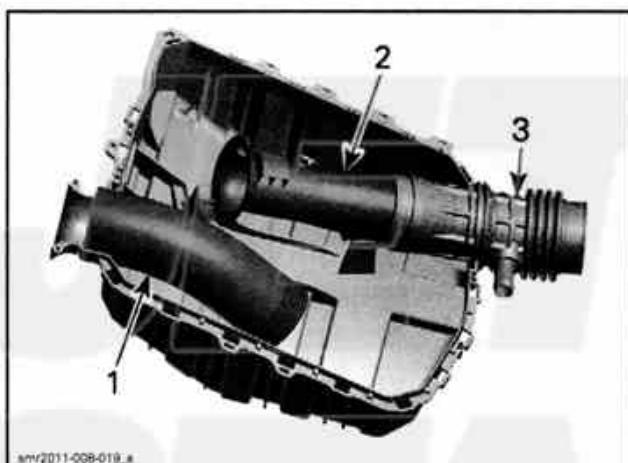
Section 02 ENGINE

Subsection 02 (AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS))



1. Remove upper section of air intake silencer

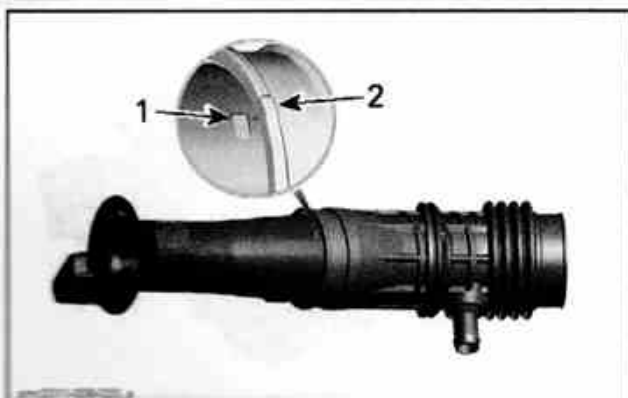
3. Remove the inlet tube (2 inlet tubes on 215 and 260 models), the baffle and the outlet hose from the air intake silencer.



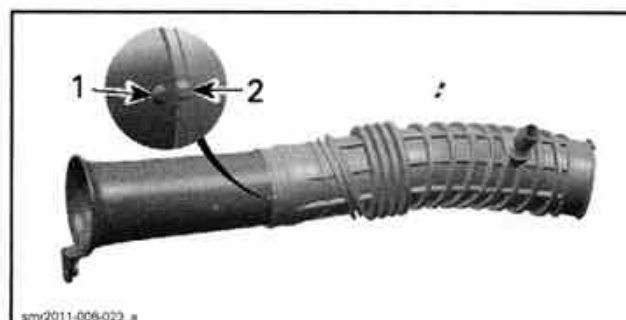
1. Inlet tube
2. Baffle
3. Outlet hose

Air Intake Silencer Assembly

Install the baffle into the outlet hose. Ensure marks are aligned.

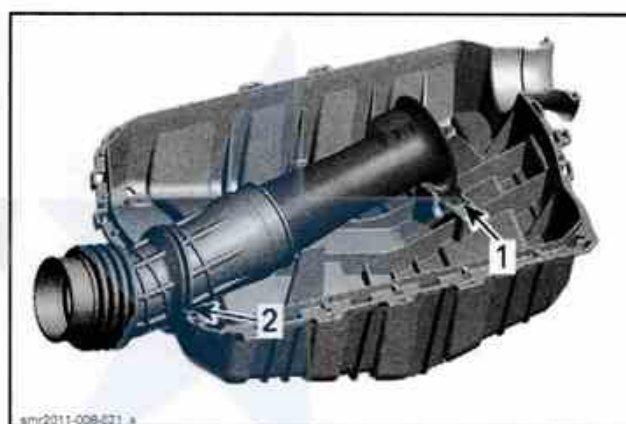


TYPICAL - GTI SHOWN
1. Baffle mark
2. Outlet hose mark



TYPICAL - GTX SHOWN
1. Baffle mark
2. Outlet hose mark

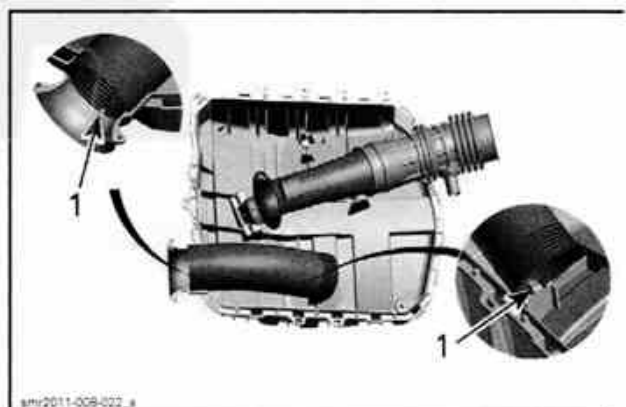
Install the assembly in the air intake silencer.



TYPICAL - GTI SHOWN
1. Baffle tab into air intake silencer slot
2. Air intake silencer rib into the outlet hose groove

Install the inlet tube. Ensure each end is properly attach.

NOTE: On 215 and 260 models, both inlet tubes are attached as shown.



1. Retaining tabs

Press both halves of the air intake silencer together until all tabs are locked. Do not force. Make sure all tubes are properly installed.

Section 02 ENGINE

Subsection 03 (AIR INTAKE SYSTEM (iS AND aS MODELS))

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 (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced with new ones.

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

PROCEDURES

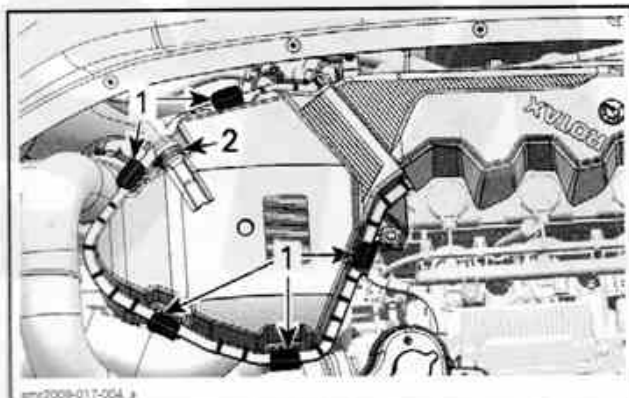
AIR INTAKE SILENCER COVER

Air Intake Silencer Cover Removal

Remove the deck extension. Refer to *BODY* subsection for procedure.

Release retaining latches.

Loosen clamp securing blow-by hose to cover.



1. Retaining latches
2. Loosen this 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 seal cover. Replace seal as required.

Tighten blow-by hose clamp.

TORQUE

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

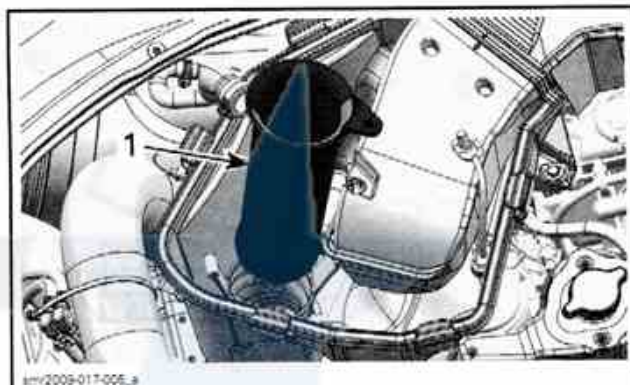
Refer to *BODY* subsection for the proper installation procedure.

AIR INTAKE SILENCER BAFFLE

Air Intake Silencer Baffle Removal

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

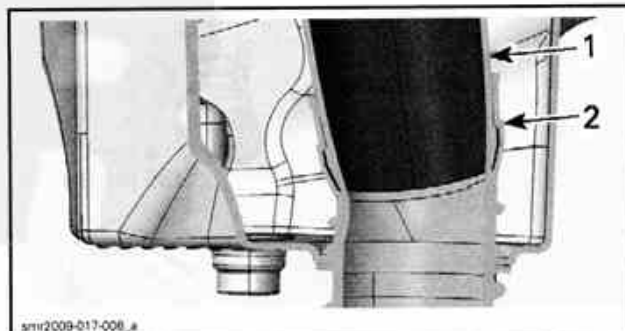
Pull the baffle out of the air intake silencer.



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

Air Intake Tube Removal

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

Section 02 ENGINE

Subsection 04 (INTAKE MANIFOLD)

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

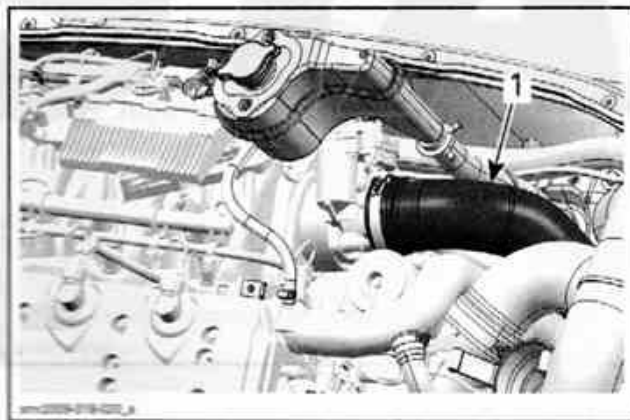
Intake Manifold Removal

On iS models, remove the moving deck and the deck extension. Refer to *BODY* subsection.

Remove the air intake silencer. Refer to the appropriate subsection according to model:

- *AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS)*
- *AIR INTAKE SYSTEM (iS AND aS MODELS)*

Disconnect the intake hose at intake manifold.



TYPICAL - SUPERCHARGED ENGINE SHOWN
1. Intake hose

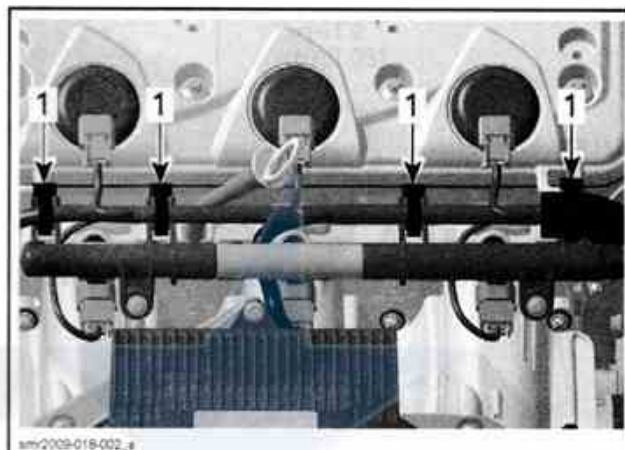
Move the coolant expansion tank aside to make room.

Remove the oil dipstick.

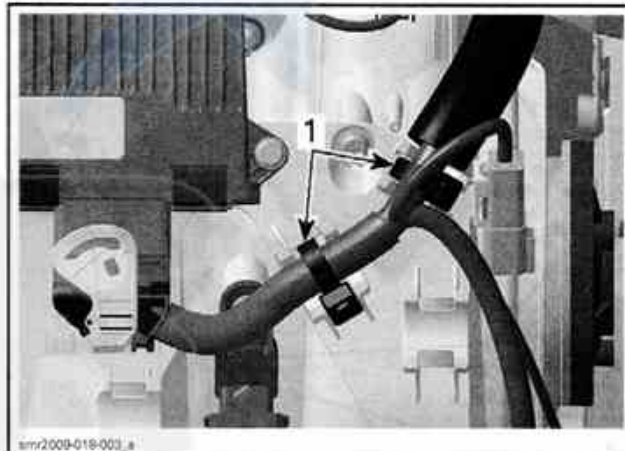
Disconnect fuel hose connector at fuel rail. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Unplug the "B" connector from the ECM by pulling the lock. Refer to *CONNECTOR INFORMATION* subsection for procedure.

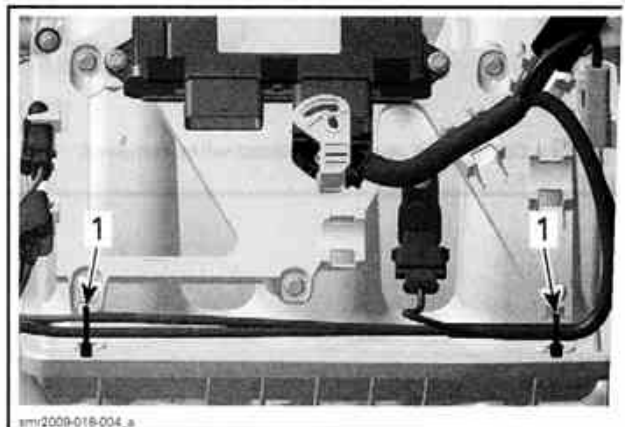
Cut all locking ties securing the wiring harnesses to the intake manifold.



1. Cut these locking ties to release harness



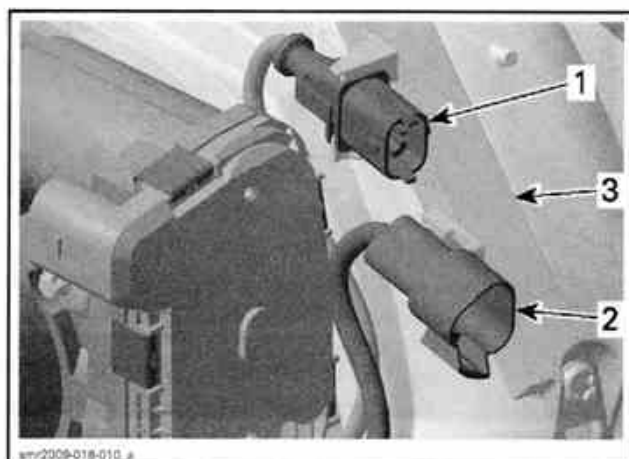
1. Cut these locking ties to release harness



1. Cut these locking ties to release harness

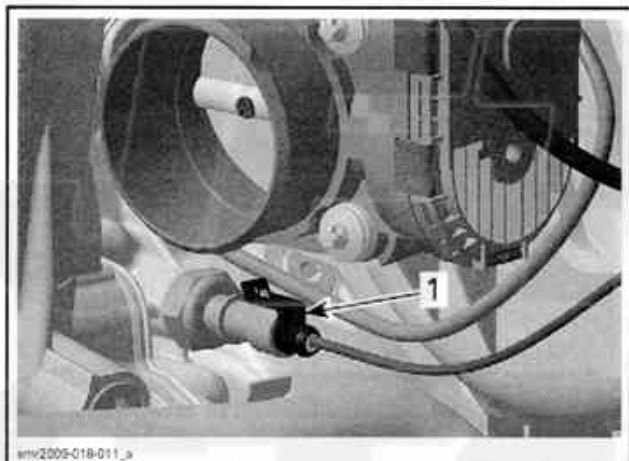
Section 02 ENGINE

Subsection 04 (INTAKE MANIFOLD)



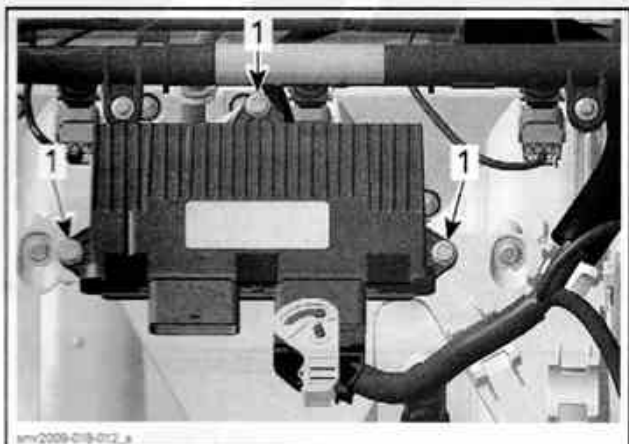
- 1. KS connector
- 2. Magneto connector
- 3. ECM support

Unplug the oil pressure switch (OPS).



- 1. Oil pressure switch (OPS)

Unscrew ECM retaining screws and remove ECM from its support.



- 1. ECM retaining screws

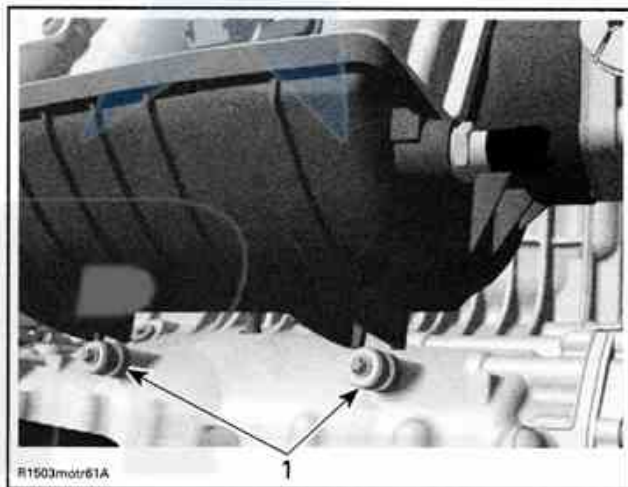
Pull the engine wiring harness with the ECM plugged away from intake manifold.

On 215 engine, disconnect both hoses at the front end of intercooler.

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



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



- 1. Mounting brackets

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. Pay attention to following details.

Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))

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

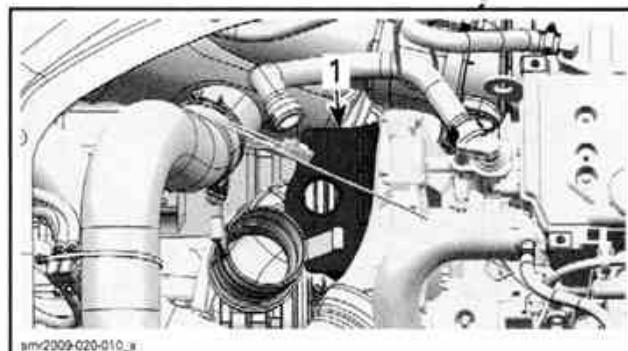
Supercharger Removal

On iS models, remove the moving deck. Refer to *BODY (RXT, GTX AND WAKE PRO)* subsection for proper procedure.

Remove the air intake silencer. Refer to appropriate subsection according to model:

- AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS)
- AIR INTAKE SYSTEM (iS AND aS MODELS).

Remove the air intake silencer support.

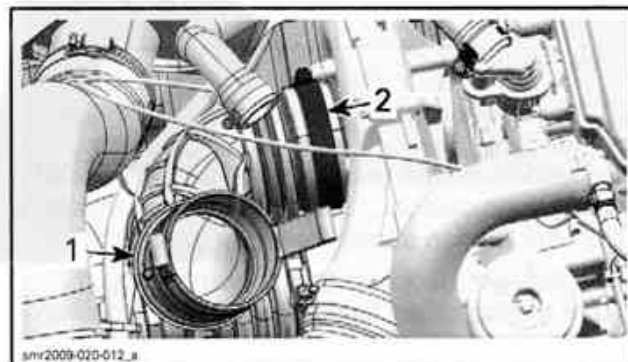


1. Air intake silencer support



MANY PARTS REMOVED FOR CLARITY PURPOSE
1. Support screws

Remove the air inlet hose from supercharger.

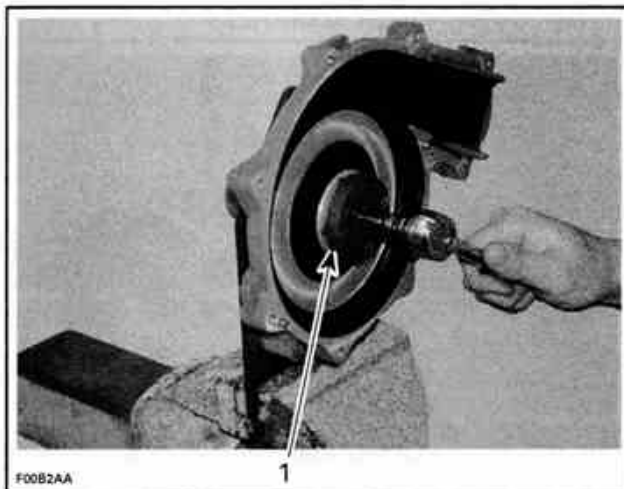


1. Air inlet hose
2. Hose clamp

Remove air outlet hose from supercharger.

Section 02 ENGINE

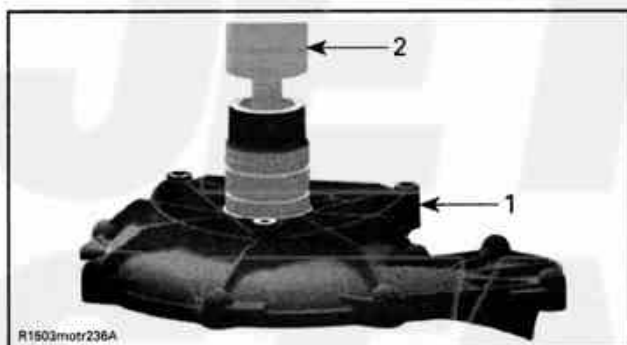
Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))



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.



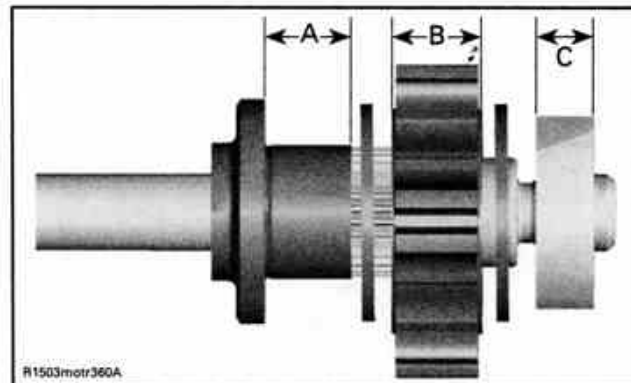
1. Supercharger housing half (engine side)
2. Bearing pusher

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

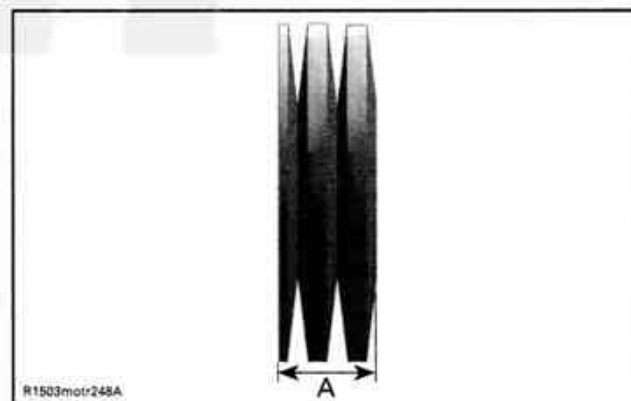
NEW	11.000 mm to 11.050 mm (.4331 in to .435 in)
SERVICE LIMIT	10.900 mm (.4291 in)

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

Section 02 ENGINE

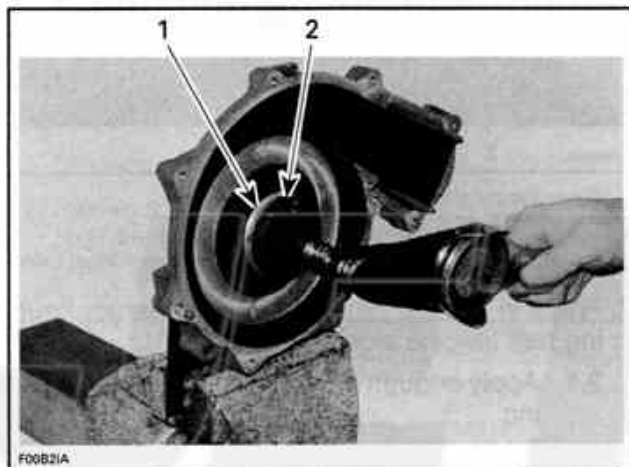
Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))

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)
----------------	--------------------

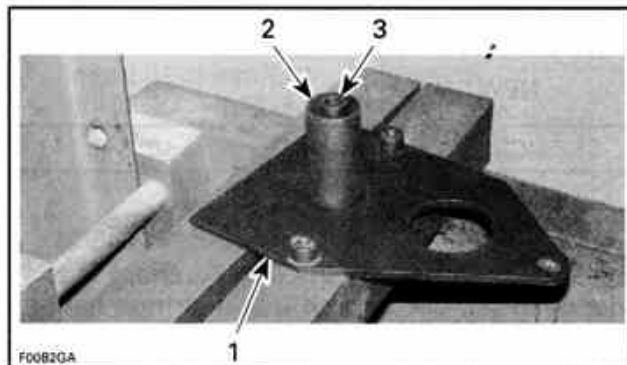
6. Press supercharger shaft in housing half (engine side).
- 6.1 Properly support bearing using the following tools under supercharger housing half.

REQUIRED TOOLS

SUPPORT PLATE
(P/N 529 035 947)



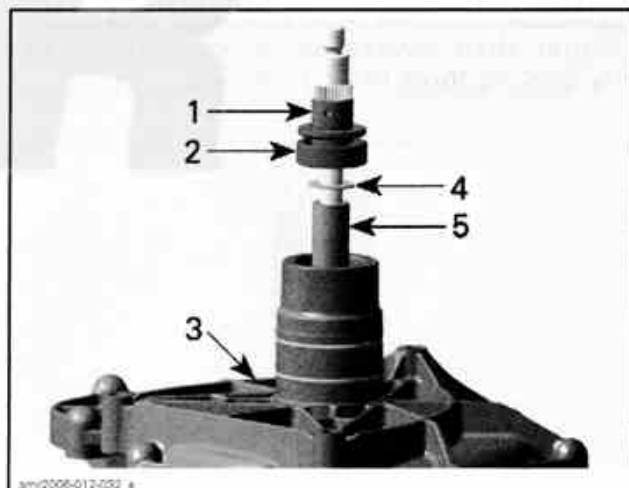
BEARING
SUPPORT/PUSHER
(P/N 529 035 950)



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.

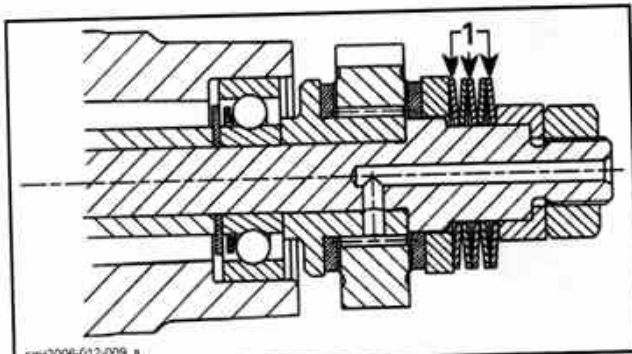


1. Compressor shaft
2. Ball bearing
3. Supercharger housing half
4. Thrust washer
5. Distance sleeve

Section 02 ENGINE

Subsection 05 (SUPERCHARGER (215 AND 260 ENGINES))

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

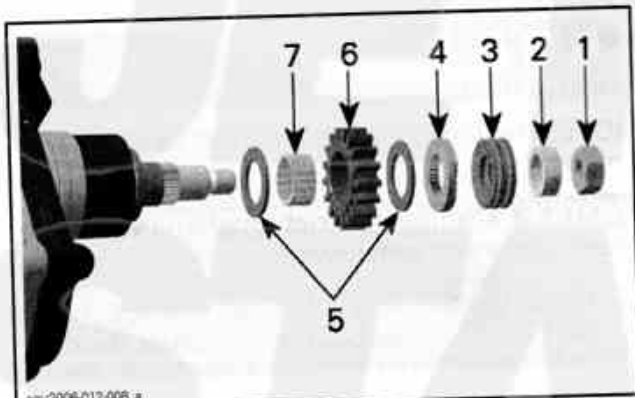


1. Spring washers

18. Install the L-ring on the compressor shaft.

19. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the hexagonal nut threads.

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



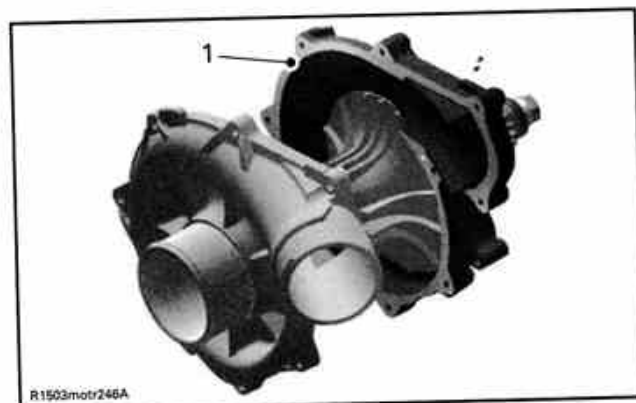
1. Nut
2. L-ring
3. Spring washers
4. Lock washer
5. Friction shims
6. Drive gear
7. Needle bearing

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.



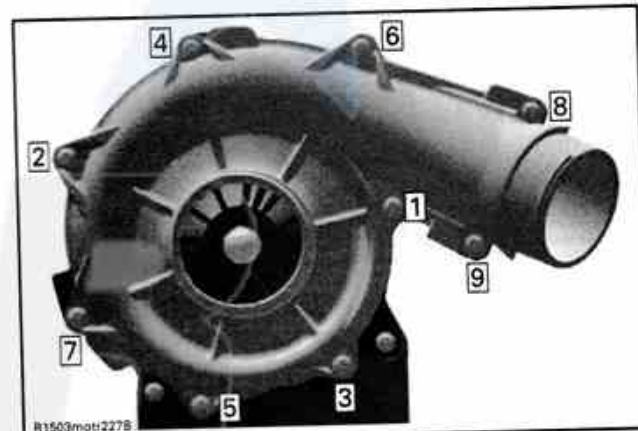
1. Apply Loctite 5910 on sealing surface

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.

Section 02 ENGINE

Subsection 06 (INTERCOOLER (215 ENGINE))

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 loses performance, when there is white exhaust smoke or when temperature in exhaust system is too high.

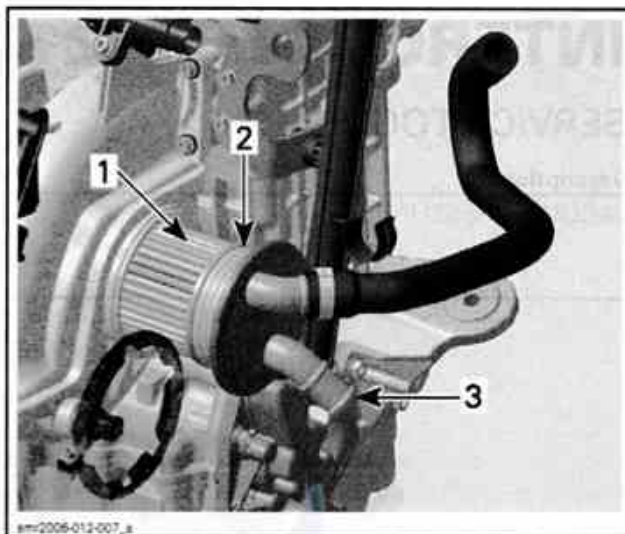
⚠ WARNING

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

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

Remove:

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



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.

Section 02 ENGINE

Subsection 07 (INTERCOOLER (260 ENGINE))

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, cotter pins, etc.) must be replaced.

NOTICE Hose, 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:

- Watercraft is used in salt water and is not expected to be used further the same day.
- Watercraft is used in foul water.
- Watercraft 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 and/or exhaust system.

PROCEDURES

INTERCOOLER

⚠ WARNING

Let engine cool down prior to work on or near intercooler.

Intercooler Cleaning

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

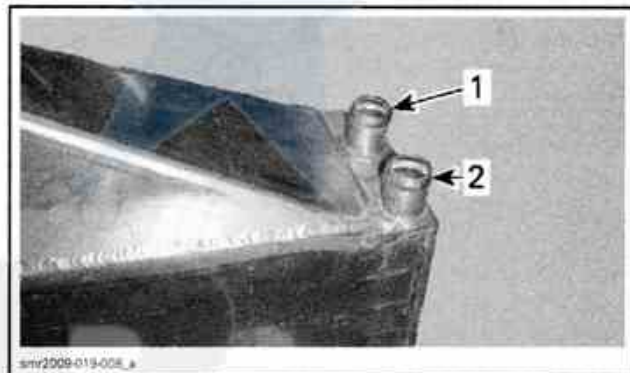
The exhaust system should be flushed first, as it may unclogged the intercooler. If not, then proceed with the intercooler cleaning procedure as detailed here.

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 watercraft. See procedure further in this subsection.
2. Pour fresh water into the water outlet fitting.



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

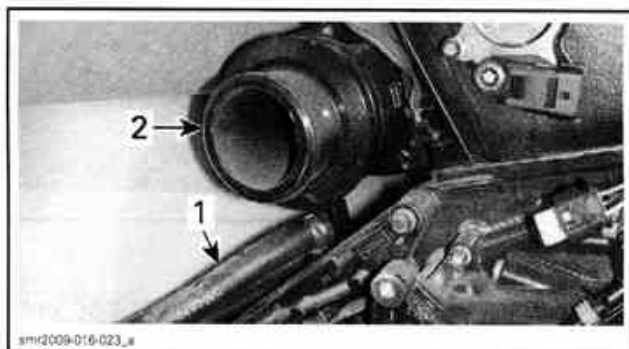
3. Let water into intercooler for many hours. Occasionally, shake the intercooler to soak off deposits.
4. Rinse the intercooler using a garden hose installed on water outlet.
5. Let water flows out of intercooler a few minutes to evacuate internal deposits.
6. Check water flow.

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

Section 02 ENGINE

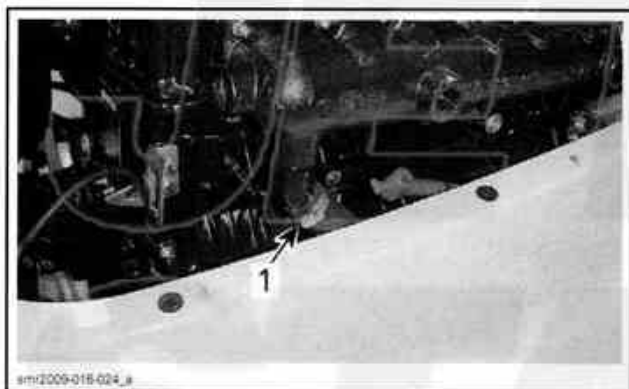
Subsection 08 (EXHAUST SYSTEM)

2. Move muffler rearwards to make room. Refer to *MUFFLER REMOVAL* in this subsection to know how separate muffler from exhaust manifold.
3. Disconnect the exhaust manifold water outlet hose.



1. Water outlet hose
2. Exhaust manifold

4. Disconnect exhaust manifold water inlet hose from exhaust manifold.



TYPICAL - iS MODEL SHOWN

1. Exhaust manifold water inlet hose

5. Unscrew the exhaust manifold beginning with the bottom screws. This will help holding the manifold while you remove the screws.
6. Remove the exhaust manifold from vehicle.
 - On iS and aS models, move the exhaust manifold rearwards to remove it.
 - On models without iS and aS, lift up the exhaust manifold to remove it.

Exhaust Manifold Inspection

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

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

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.

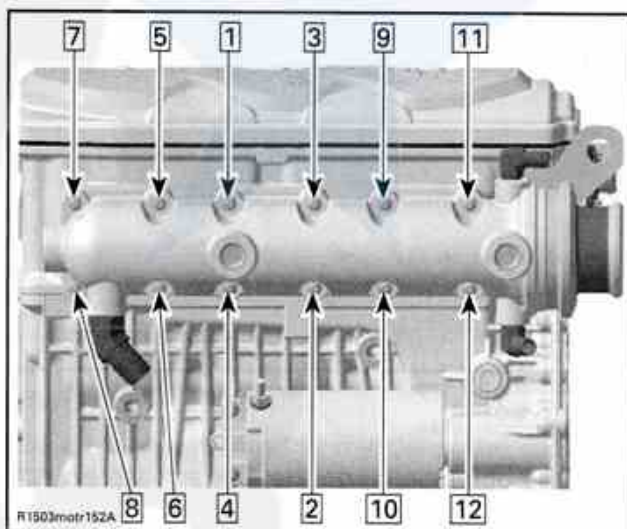
NOTE: There is no gasket between cylinder block and exhaust manifold.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of screws.

To help holding the manifold while installing screws, first insert the exhaust manifold into the exhaust pipe then, install the upper front screw. Continue with the remaining screws.

Torque screws to specification as per following illustrated sequence. Repeat the procedure twice.

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



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

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

RESONATOR

Resonator Removal

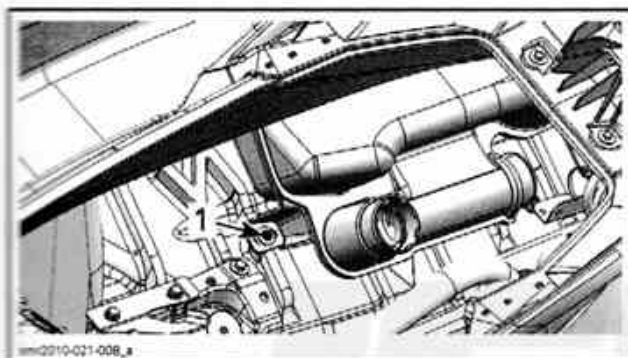
iS and aS Models

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Section 02 ENGINE

Subsection 08 (EXHAUST SYSTEM)

2. Remove battery and battery holder. Refer to **CHARGING SYSTEM** subsection.
3. Loosen clamp securing rear exhaust hose to resonator.
4. Remove the screw securing the front of the resonator.

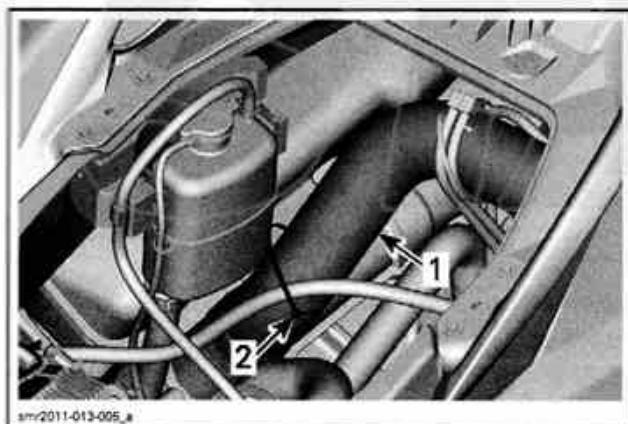


TYPICAL - MODEL WITHOUT iS SHOWN
1. Resonator retaining screw

5. Remove the front exhaust hose from resonator.
6. Remove resonator from vehicle.

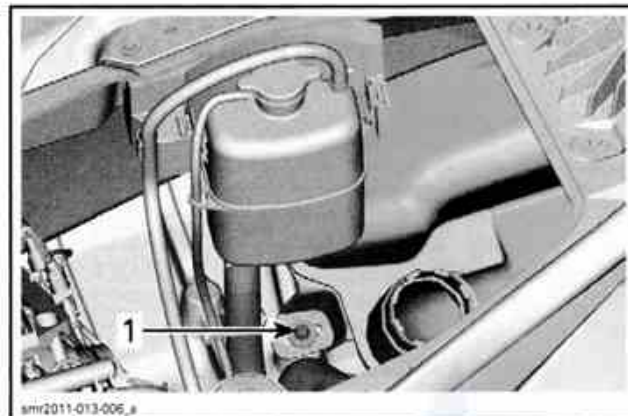
Models Without iS and aS

1. Remove seat.
2. Cut locking tie securing wiring harness to front exhaust hose.



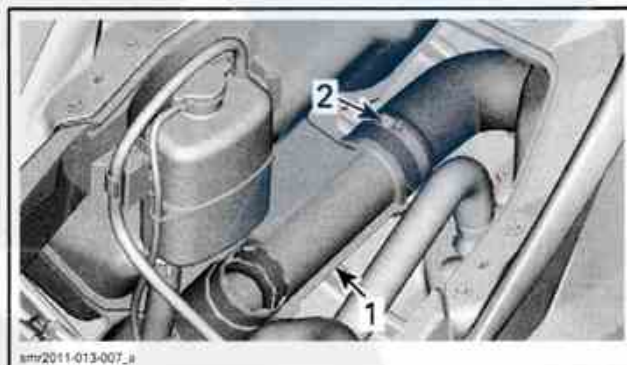
1. Front exhaust hose
2. Cut this locking tie

3. Detach the front exhaust hose from the resonator.
4. Remove screw and washer securing the front of the resonator.



1. Resonator retaining screw

5. Loosen clamp securing the rear exhaust hose to resonator.



1. Resonator
2. Loosen this clamp

6. Slide resonator by the deck opening.

Resonator Inspection

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

Resonator Installation

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

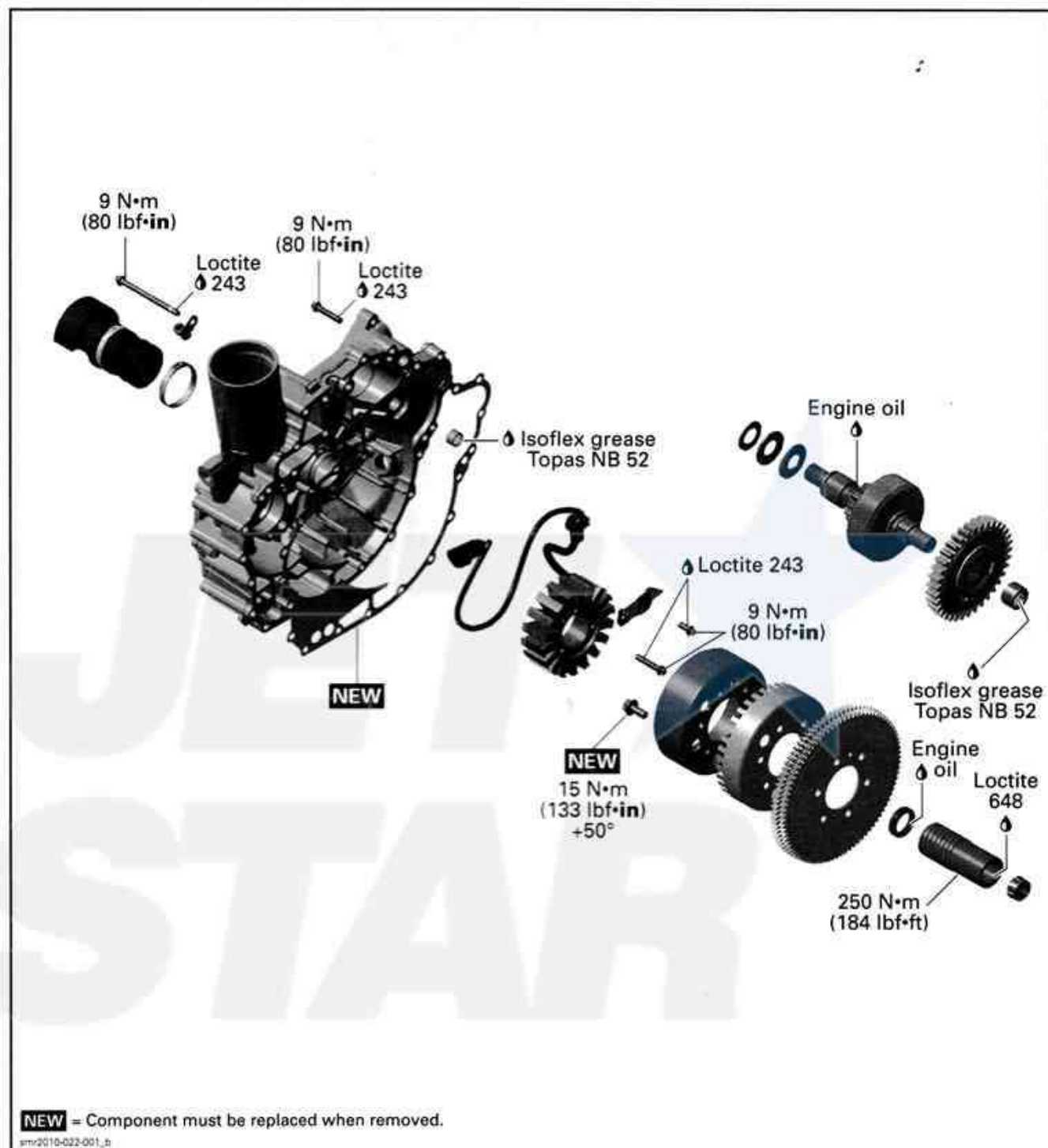
TORQUE	
Resonator retaining screw	7.5 N•m (66 lbf•in)

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

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

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)

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 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

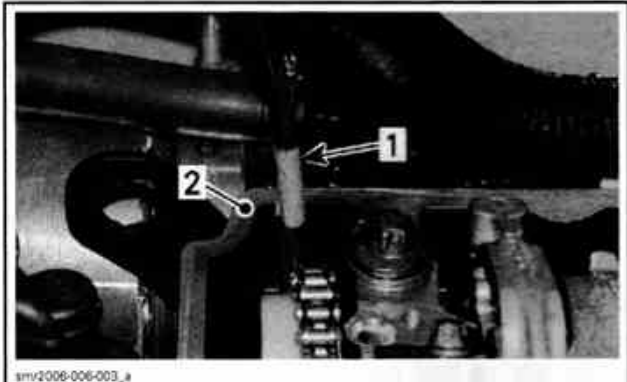
Before carrying out any inspection or maintenance procedure on the vehicle, wait until the engine and exhaust have cooled down to avoid potential burns.

PROCEDURES

PTO HOUSING

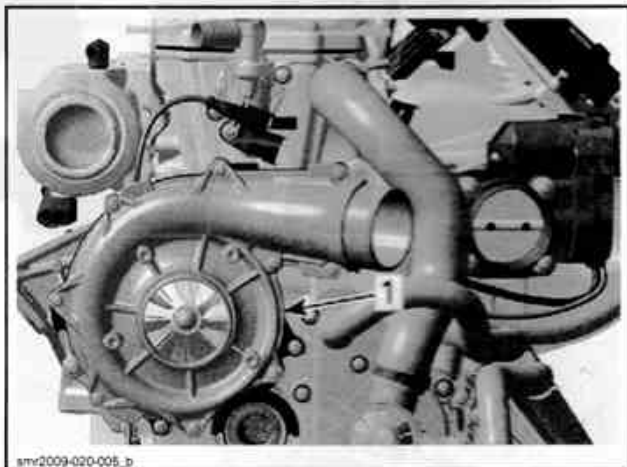
PTO Housing Removal

1. Disconnect the battery. Refer to *STARTING SYSTEM* subsection.
2. On iS models, remove the moving deck and the deck extension. Refer to *BODY* subsection.
3. Drain the engine oil. Refer to *LUBRICATION SYSTEM* subsection.
4. Remove the cylinder head cover. Refer to *CYLINDER HEAD* subsection.
5. Insert the tube of the SUCTION PUMP (P/N 529 035 880) in the lower area of the timing chain.



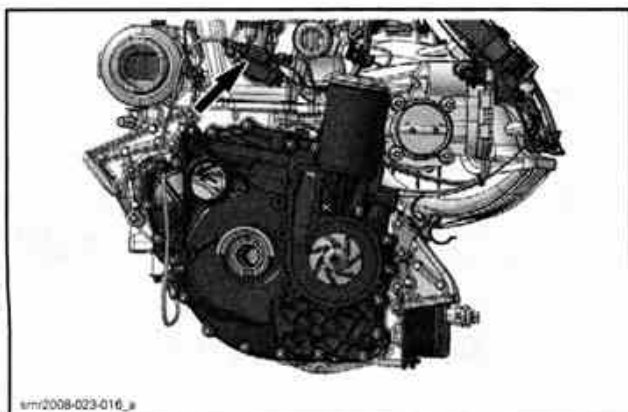
1. Suction pump tube
2. Edge of cylinder block

6. Syphon remaining oil out of the lower timing chain case.
7. Drain engine coolant, refer to the *COOLING SYSTEM* subsection.
8. Remove the air intake silencer. Refer to appropriate *AIR INTAKE SYSTEM* subsection.
9. Disconnect at throttle body the air intake hose.
10. Move muffler rearwards. Refer to *EXHAUST SYSTEM* subsection.
11. On 215 and 260 engines, remove the supercharger, refer to the *SUPERCHARGER* subsection.



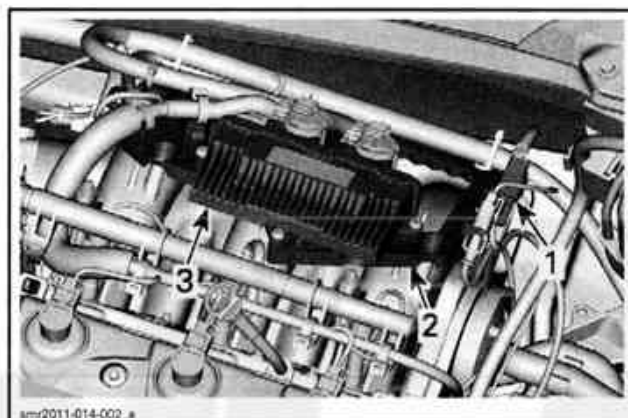
1. Supercharger

12. Refer to *STEERING AND PROPULSION* and remove the following:
 - Jet pump
 - Drive shaft
 - Drive shaft bellows.
13. Disconnect CPS connector from wiring harness.

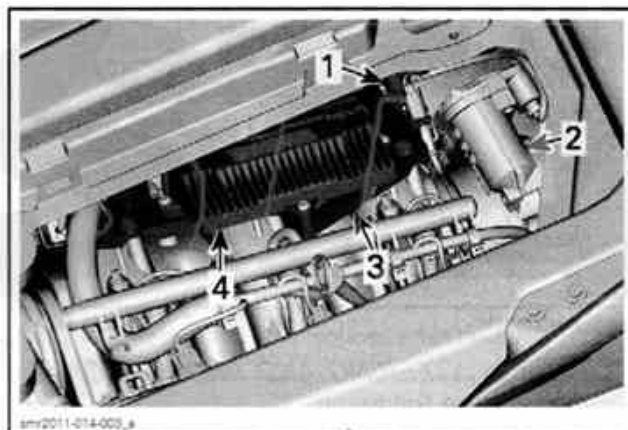


CPS CONNECTOR

14. Disconnect the magneto connector, located beside the ECM.



130/155 ENGINES
1. Magneto connector
2. ECM support
3. ECM

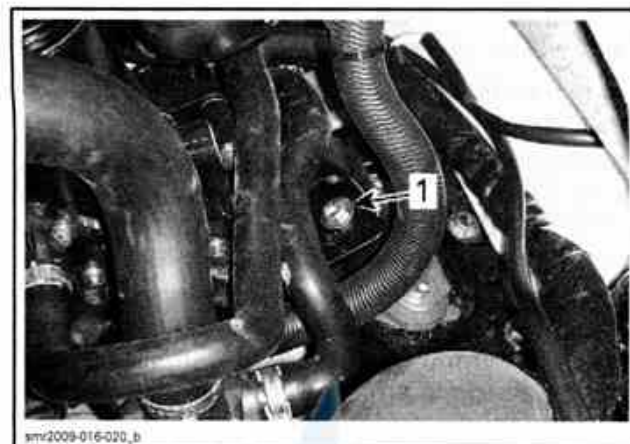


215/260 ENGINES
1. Magneto connector
2. Throttle body
3. ECM support
4. ECM

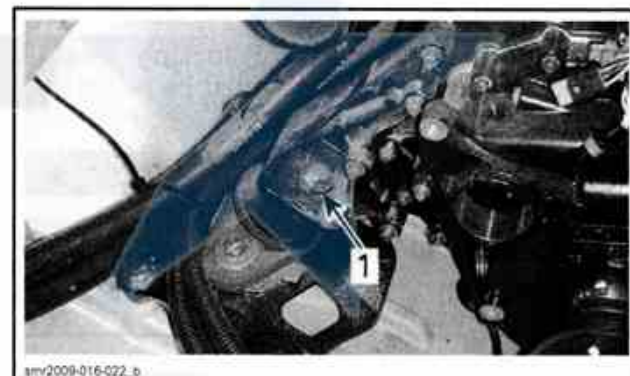
15. Place rags under PTO housing to prevent oil spillage.

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

16. Remove both rear engine support screws.



RIGHT SIDE OF VEHICLE
1. Rear engine support screw



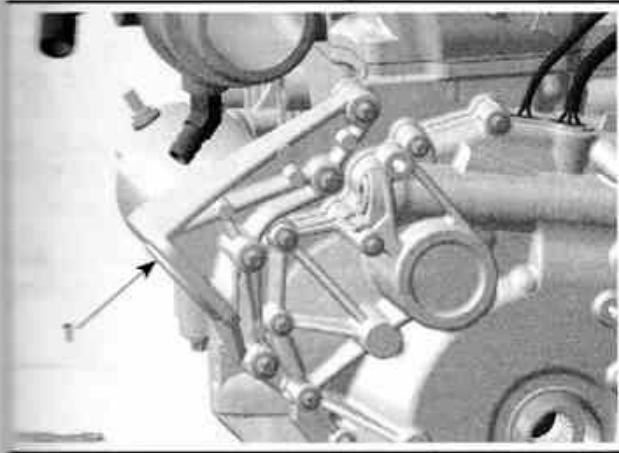
LEFT SIDE OF VEHICLE
1. Rear engine support screw

17. Slightly lift aft end of engine and insert a safely block under the engine to secure it in this position.

18. Remove LH rear engine support.

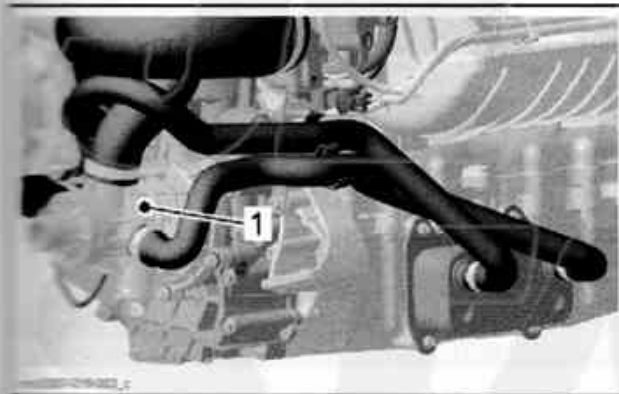
Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



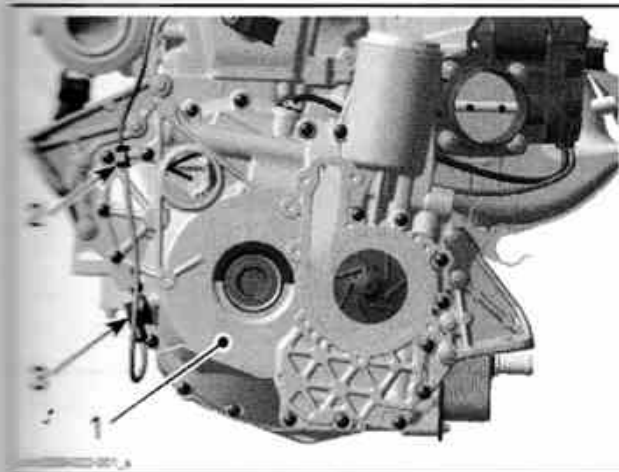
TYPICAL
1. Engine support

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



1. Water pump housing

20. Remove PTO housing retaining screws.



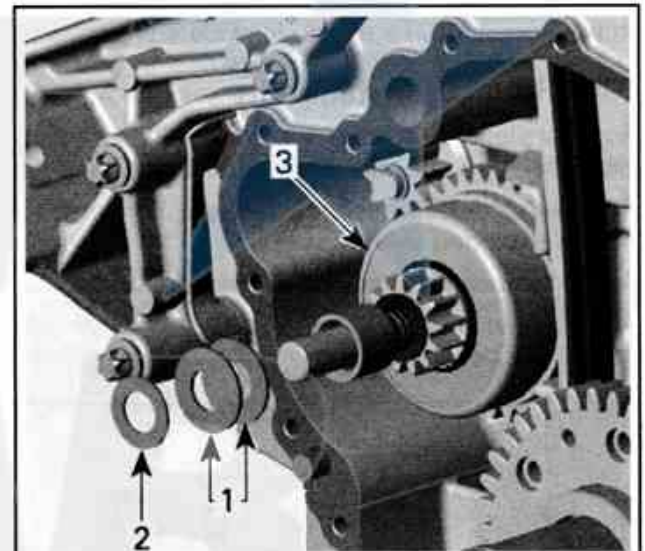
1. PTO housing
2. CPS harness retaining clamp
3. CPS

NOTE: Note position of the CPS harness retaining clamp position as illustrated above for reinstallation.

21. 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 disc springs and thrust washer from falling down into bilge area.



1. Disc springs
2. Thrust washer
3. Starter drive

22. Remove PTO housing gasket and discard it.

PTO Housing Inspection

Inspect PTO housing for cracks or any other damages. Replace if necessary.

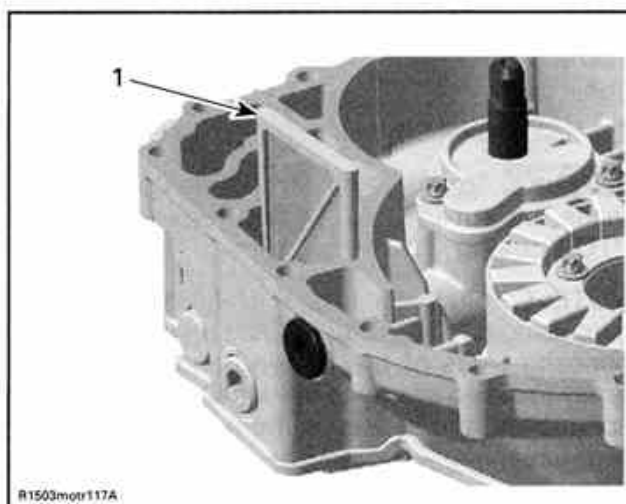
Inspect the needle bearing in the PTO housing used to support the starter drive shaft.

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

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

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



1. PTO oil strainer

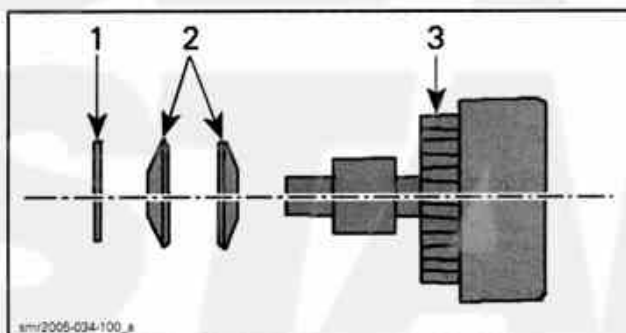
PTO Housing Installation

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

Apply lubricants, sealers or threadlocker as specified in exploded view.

Apply torques as specified in exploded view.

Position the disc springs and thrust washer onto the starter drive shaft as per following illustration.



TYPICAL

- 1. Thrust washer
- 2. Disc springs
- 3. Starter drive

NOTE: When installing a **NEW** starter drive, oil the shaft and gear splines with engine oil.

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.

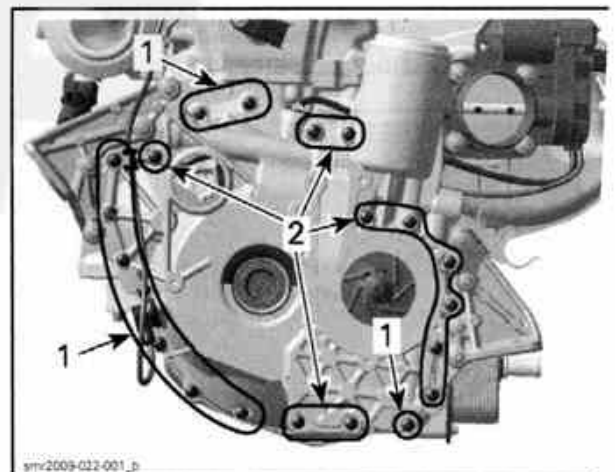
NOTICE Pay particular attention to the PTO housing gasket alignment to ensure that it does not get pinched, or slide out of its surface contact area. Never force housing when installing it. If there is a strong resistance, remove housing and check oil/water pump shaft alignment and starter drive gear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

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



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

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

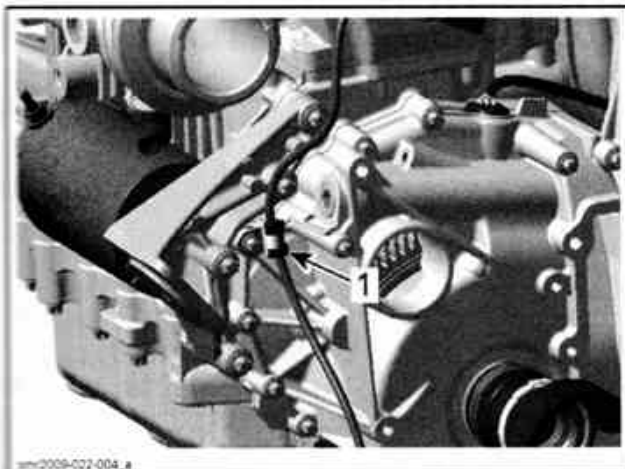


- 1. Screws M6 x 35
- 2. Screws M6 x 85

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

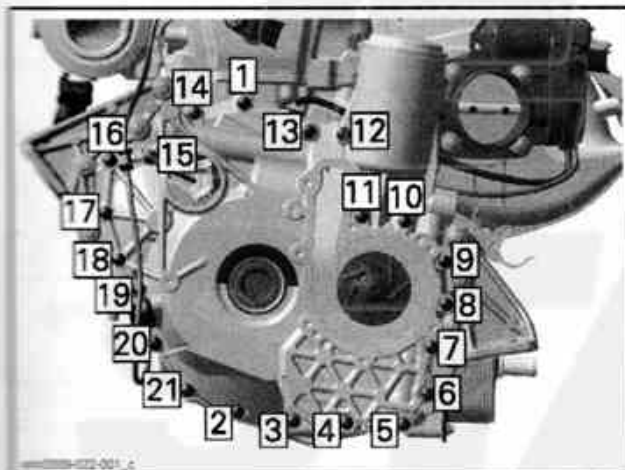
Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



1. CPS harness retaining clamp

Install the PTO housing screws finger tight, then torque them to specification as per sequence numbered in the following illustration.



PTO HOUSING SCREWS TORQUE

9 N•m (80 lbf•in)

Reinstall LH engine support.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on engine support screw threads then torque them to specification.

ENGINE SUPPORT SCREWS TORQUE

23 N•m (17 lbf•ft)

Remove block under engine.

Install both rear engine support screws loosely.

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.

Install all remaining parts, reconnect hoses and electrical connectors. Refer to applicable subsections for procedures and specific details (torques, service products or special instructions).

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

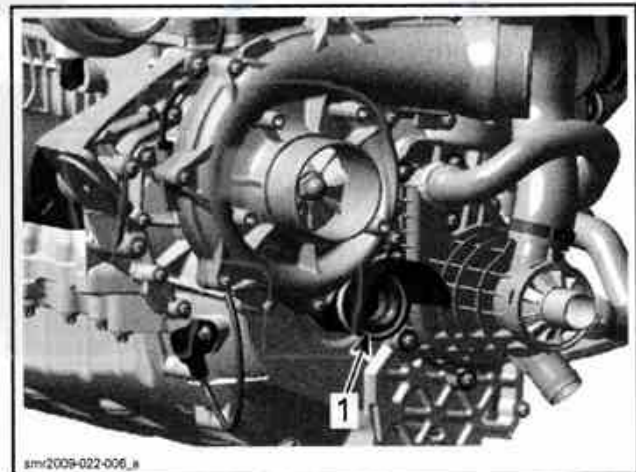
PTO SEAL

PTO Seal Inspection

Inspect the PTO seal on the PTO housing. If brittle, hard or damaged, or if you see a sign of oil leakage, replace it.

Inspect ball bearing within PTO seal for excessive play and smooth operation.

Replace PTO seal if oil seal or ball bearing is damaged.



1. PTO seal

PTO Seal Removal

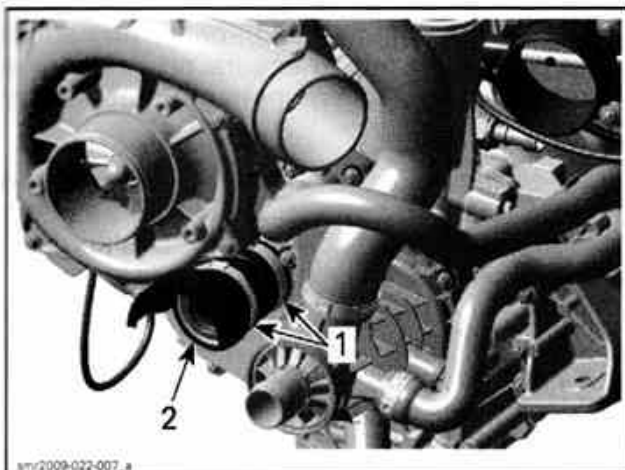
Place rags under PTO housing to prevent spillage. If spillage occurs, clean immediately with PULLEY FLANGE CLEANER (P/N 413 711 809) to prevent oil stains.

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

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

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



TYPICAL

- 1. Oetiker clamps
- 2. PTO seal

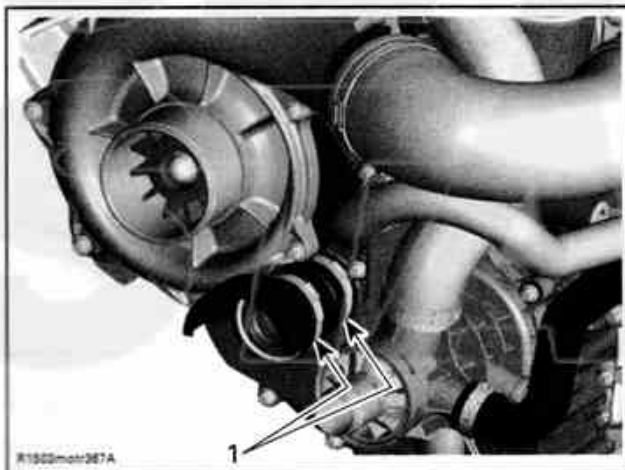
Pull seal from PTO housing.

PTO Seal Installation

Insert a NEW Oetiker clamp over the seal.

Push seal onto PTO housing. Be sure to align seal and clamp as noted at removal.

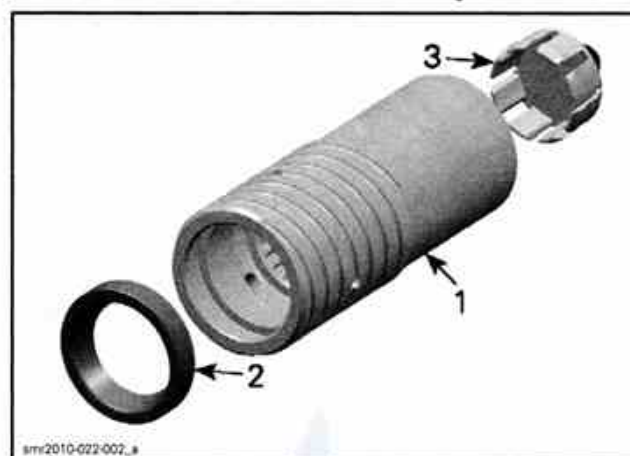
NOTICE When installing PTO seal on supercharged engines, make sure to position the Oetiker clamps as illustrated.



- 1. Oetiker clamps

Crimp Oetiker clamp using OETIKER PLIERS (P/N 295 000 070).

PTO COUPLING



- 1. PTO coupling
- 2. Seal
- 3. Stop sleeve

PTO Coupling Removal

Lock crankshaft. Refer to *CYLINDER BLOCK* subsection for the procedure.

Remove PTO seal as described in previous procedure.

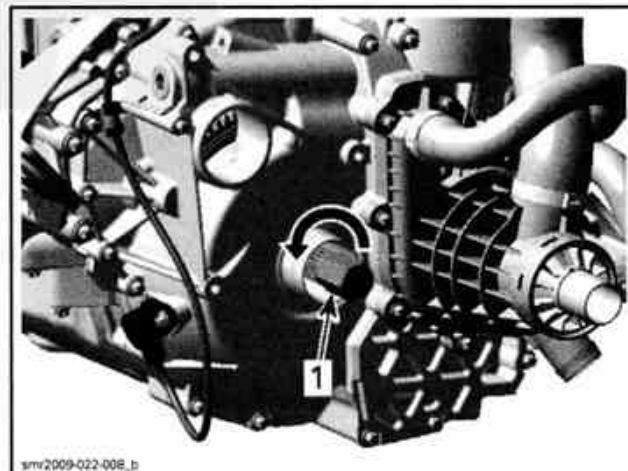
Unscrew coupling from crankshaft.

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 HOUSING AND MAGNETO

SERVICE TOOLS

Description	Part Number	Page
3-PIN MAGNETO HARNESS ADAPTER.....	529 036 016	101-102
BLIND HOLE BEARING PULLER SET.....	529 036 117	101
HANDLE	420 877 650	101
IMPELLER REMOVER/INSTALLER.....	529 035 820	100
OETIKER PLIERS.....	295 000 070	100
STARTER DRIVE SEAL PUSHER.....	420 876 502	101
SUCTION PUMP	529 035 880	95

SERVICE PRODUCTS

Description	Part Number	Page
ISOFLEX GREASE TOPAS NB 52	293 550 021	101, 106
LOCTITE 243 (BLUE).....	293 800 060	99, 104
LOCTITE 648 (GREEN).....	413 711 400	101
PULLEY FLANGE CLEANER	413 711 809	96, 99

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)

PTO Coupling Inspection

Inspect seal within coupling, if it is brittle, cracked or hard, replace it.

Check coupling for worn or damaged splines. Replace as required.

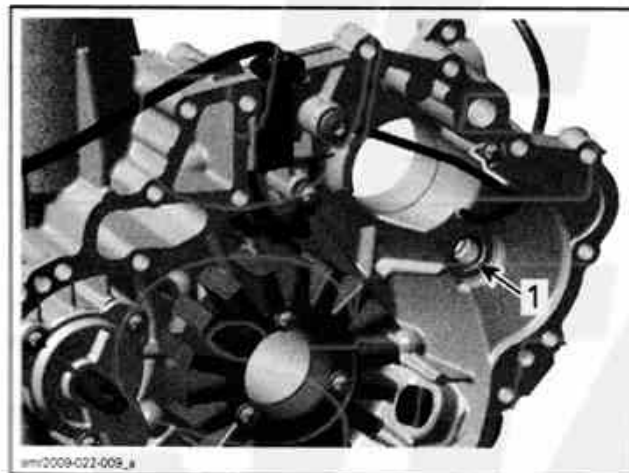
PTO Coupling Installation

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

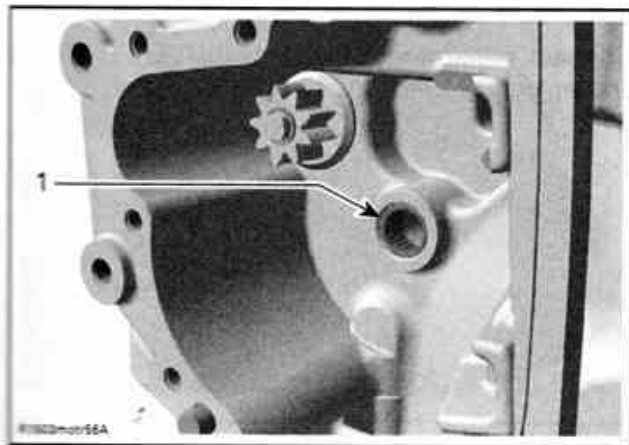
Apply LOCTITE 648 (GREEN) (P/N 413 711 400) on threads and torque PTO coupling to specification.

PTO COUPLING TORQUE
250 N•m (184 lbf•ft)

STARTER DRIVE BEARINGS



PTO HOUSING
1. Starter drive bearing



CYLINDER BLOCK
1. Starter drive bearing

Starter Drive Bearing Removal

Remove PTO housing, see procedure in this subsection.

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

Prior to assembly grease starter drive bearing with ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021).

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

Disconnect the magneto connector, located beside the ECM.

Install this 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)



Set multimeter to Vac scale.

Start engine.

Connect multimeter between each pair of YELLOW wires as per following table. Measure voltage between each pair of wires.

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



STATOR OUTPUT VOLTAGE TEST

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

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

Disconnect the magneto connector, located beside the ECM.

Install the 3-PIN MAGNETO HARNESS ADAPTER (P/N 529 036 016) onto the magneto connector.

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

Set multimeter to Ω .

Connect multimeter between each pair of YELLOW wires.



STATOR CONTINUITY TEST

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

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

Disconnect the magneto connector, located beside the ECM.

Install the 3-PIN MAGNETO HARNESS ADAPTER (P/N 529 036 016) onto the magneto connector.

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

Set multimeter to Ω .

Connect multimeter between any YELLOW wire and engine ground.

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



STATOR INSULATION TEST

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

Read resistance.

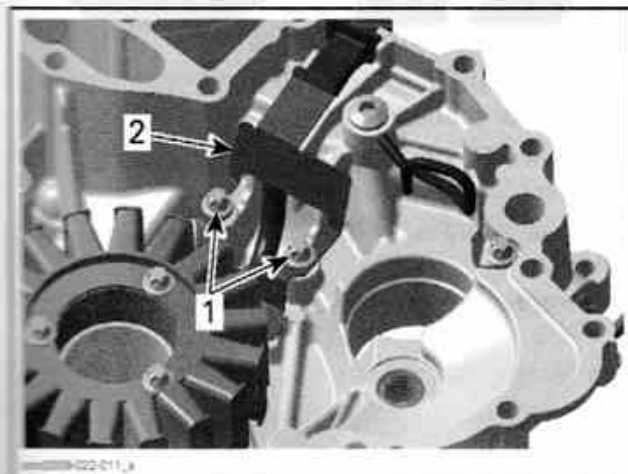
STATOR INSULATION TEST	
TERMINAL	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and engine ground	Infinity (open circuit)

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

Remove PTO housing, see procedure in this subsection.

Remove stator cable holding plate from PTO housing.



TYPICAL

1. Screws
2. Holding plate

Remove stator retaining screws.

Remove stator from PTO housing.

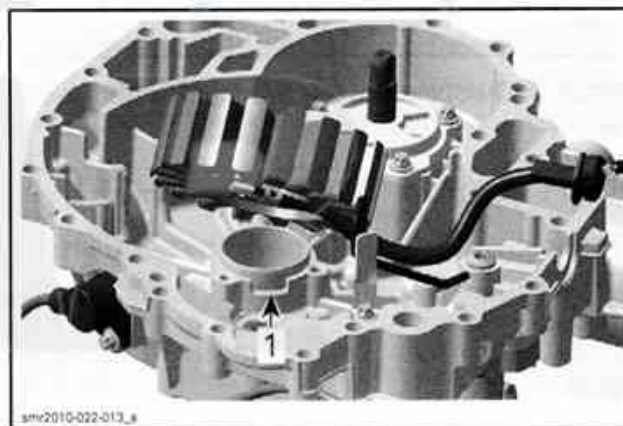


1. Stator screws
2. Stator

Stator Installation

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.



1. Notch for stator

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

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)



TYPICAL

1. Stator cable grommet

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the stator screw threads and stator cable holding plate screw threads.

Torque stator and cable holding plate screws to specification.

STATOR AND CABLE HOLDING PLATE SCREWS TORQUE
9 N•m (80 lbf•in)

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 or discoloration. If damaged, replace faulty part.

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

Install a dial indicator on crankcase casting.

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.

Draw a line on the tooth to indicate it as the first tooth measured (reference tooth).

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.

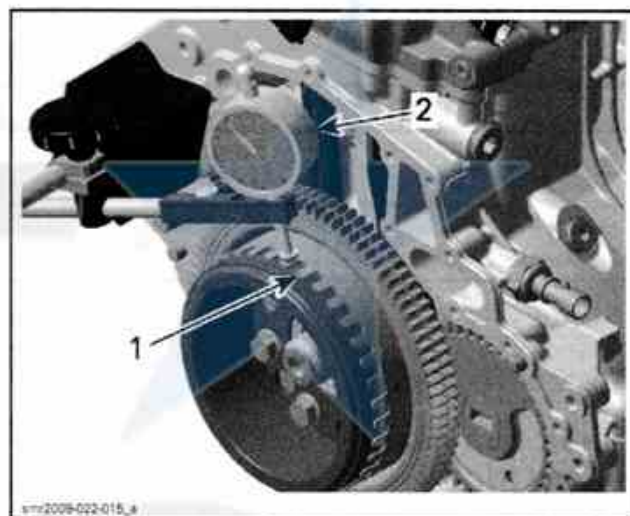
Gently set the gauge contact point on the next tooth and read the dial indicator.

Repeat this procedure taking a reading at each tooth.

Recheck reading on reference tooth to ensure gauge has not changed position (gauge should still read zero).

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

MAXIMUM ALLOWABLE TOLERANCE
0.15 mm (.006 in)



1. Trigger wheel
2. Dial indicator

Properly reinstall PTO housing.

Rotor and Trigger Wheel Removal

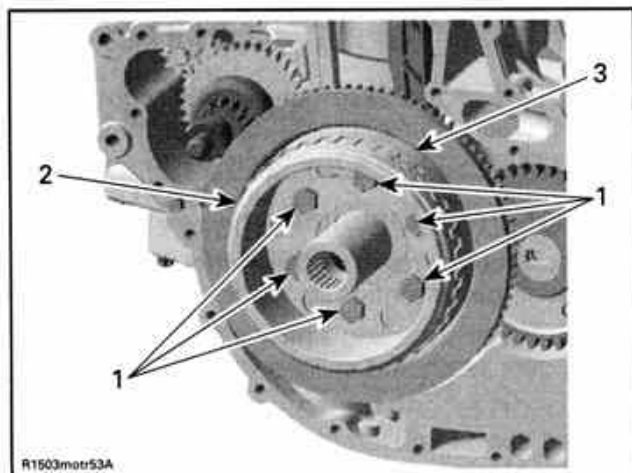
Lock crankshaft, refer to *CYLINDER BLOCK* subsection for procedure.

Remove PTO housing, see procedure in this subsection.

Remove and discard the magneto rotor retaining screws.

Pull rotor and trigger wheel off crankshaft end.

Section 02 ENGINE
Subsection 09 (PTO HOUSING AND MAGNETO)



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.

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

Install **NEW** OEM rotor screws and torque them to specification using a crisscross pattern.

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.

ROTOR SCREWS TORQUE
15 N•m (133 lbf•in) + an additional 50° rotation with a torque angle gauge

RING GEAR

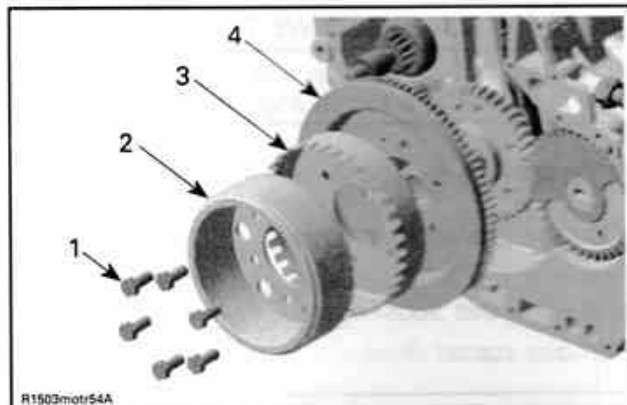
Ring Gear Removal

Lock crankshaft. Refer to *CYLINDER BLOCK* subsection for procedure.

Remove the PTO housing, see procedure in this subsection.

Remove and discard the magneto rotor retaining screws.

Pull rotor, trigger wheel, and ring gear off crankshaft end.



TYPICAL

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

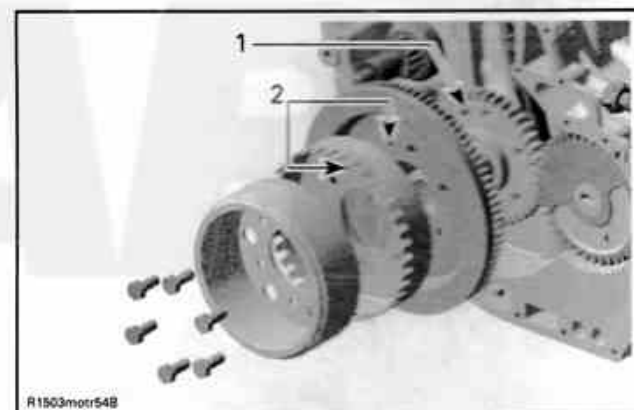
Ring Gear Inspection

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 to specification in a crisscross pattern.

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.

Section 02 ENGINE

Subsection 09 (PTO HOUSING AND MAGNETO)

ROTOR SCREWS TORQUE

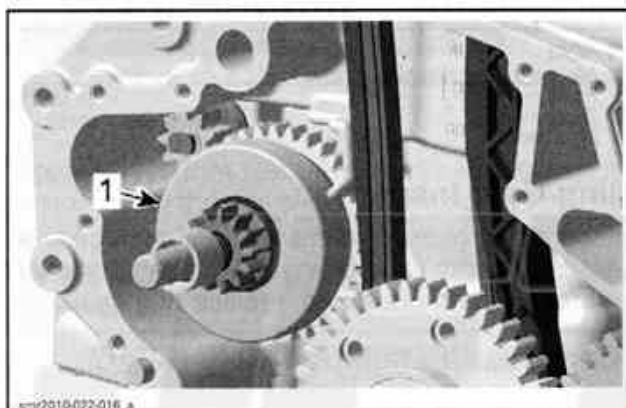
15 N•m (133 lbf•in) + an additional 50° rotation with a torque angle gauge

STARTER DRIVE

Starter Drive Removal

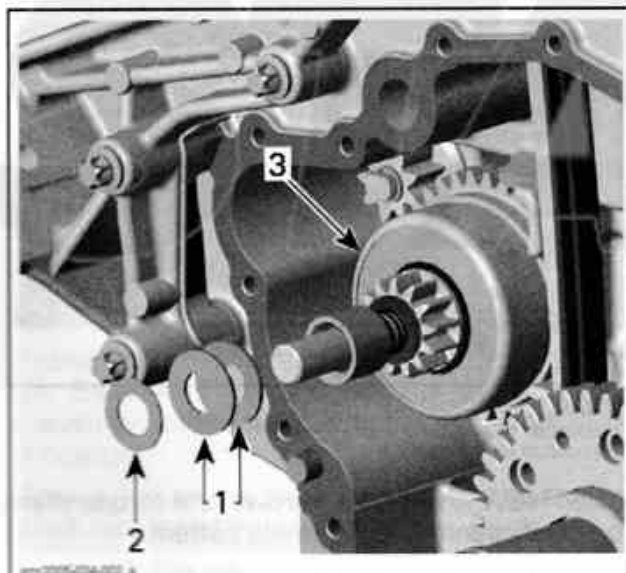
Remove the PTO housing and ring gear as described in this subsection.

Remove starter drive.



1. Starter drive

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



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.

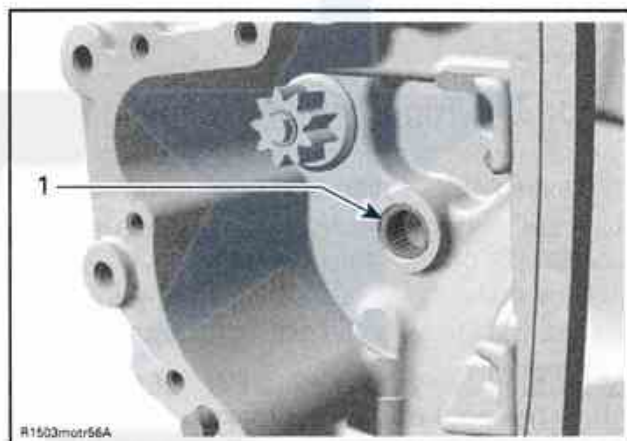
If any part of the assembly shows signs of abnormal wear, cracks, broken teeth or malfunction (sprag clutch), replace the faulty part.

Starter Drive Installation

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

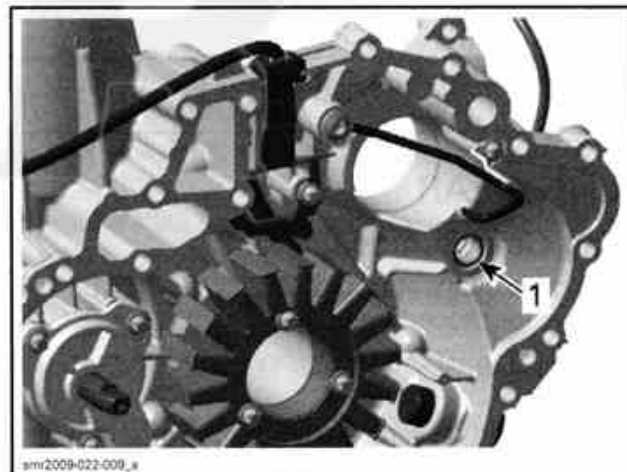
NOTE: When installing a new starter drive, oil the shaft, gear teeth and splines with engine oil.

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.



CYLINDER BLOCK

1. Starter drive bearing



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	115
ECM ADAPTER TOOL	529 036 166	117, 134
FLUKE 115 MULTIMETER	529 035 868	117, 134
OIL SEAL GUIDE	529 035 822	123
PRESSURE GAUGE	529 035 709	115
SUCTION PUMP	529 035 880	113
SUPERCHARGER OIL SPRAY NOZZLE TOOL	529 036 134	128
WATER PUMP SEAL PUSHER	529 035 823	123-124

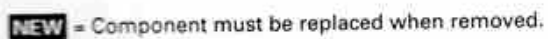
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	tp88	134

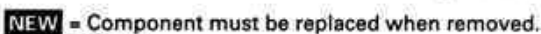
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	118-119, 121, 123, 127-128, 132, 135
LOCTITE 5910	293 800 081	119
PULLEY FLANGE CLEANER	413 711 809	114, 125
SUPER LUBE GREASE	293 550 030	115
XPS 4-STROKE BLEND OIL (SUMMER GRADE)	293 600 121	112

Subsection 10 (LUBRICATION SYSTEM)



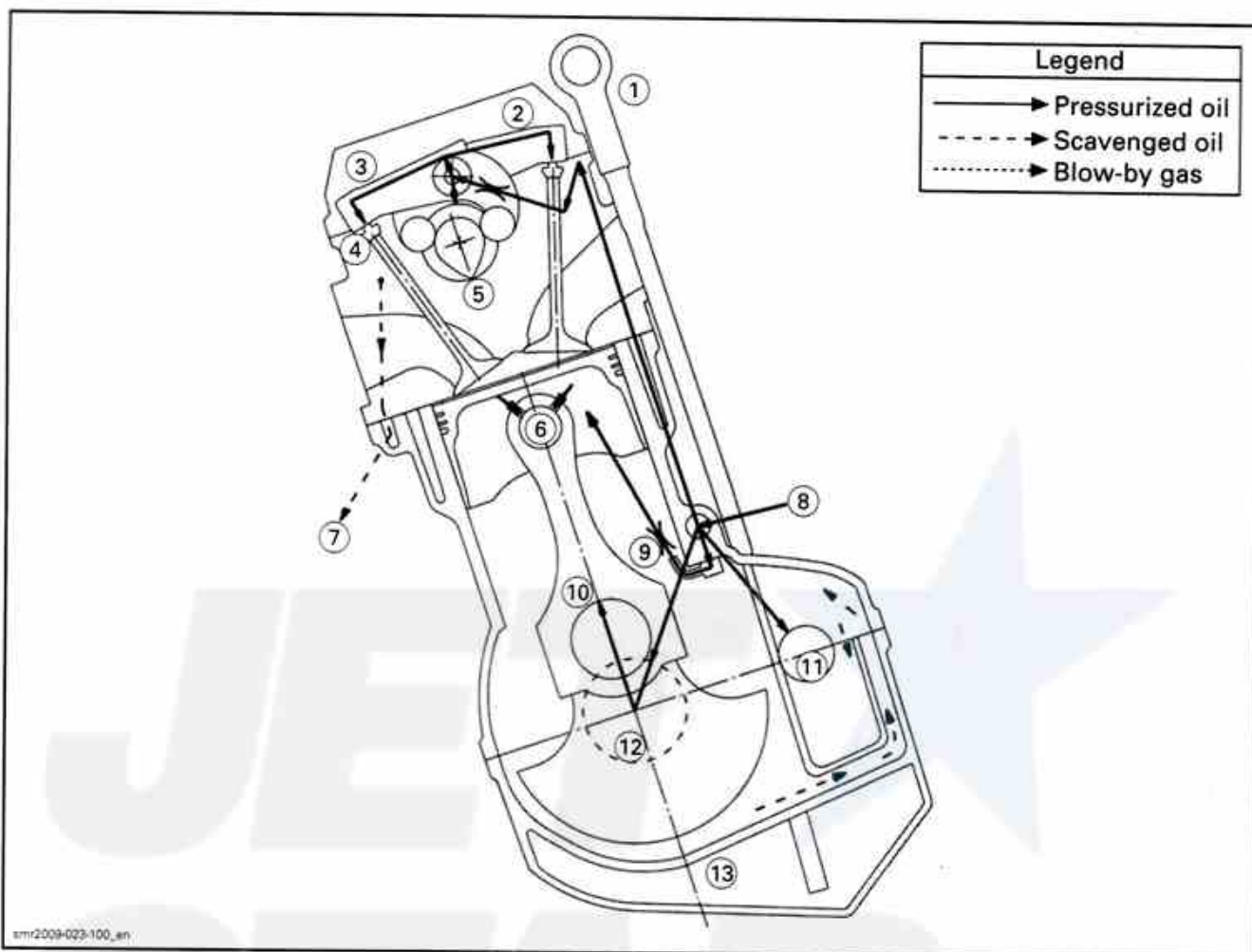
Subsection 10 (LUBRICATION SYSTEM)



Section 02 ENGINE

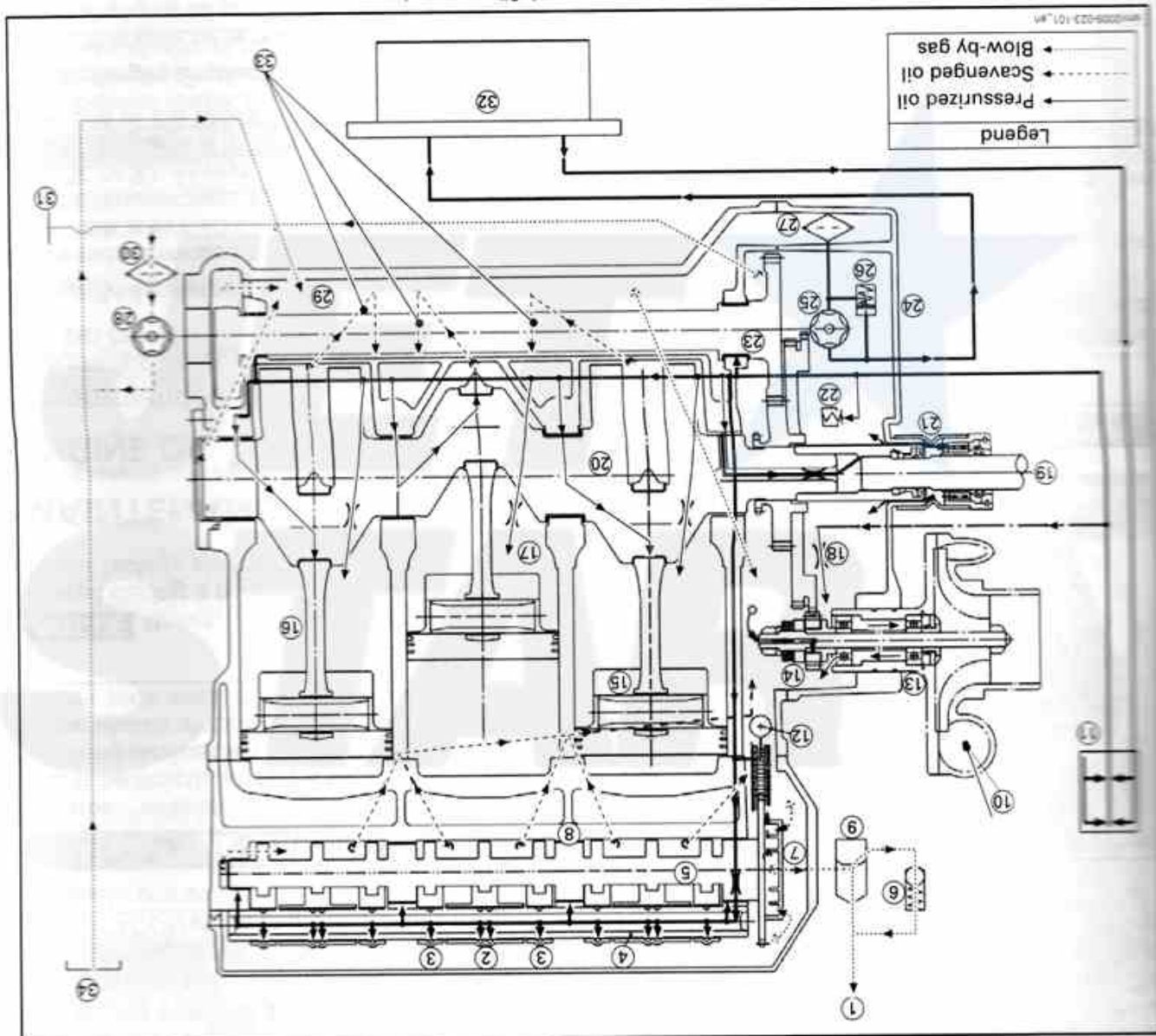
Subsection 10 (LUBRICATION SYSTEM)

ENGINE LUBRICATION CIRCUIT



Section 02 ENGINE Subsection 10 (LUBRICATION SYSTEM)

ENGINE LUBRICATION CIRCUIT (CONT'D)



Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)

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 Engines

If the recommended XPS™ engine oil is not available, use a 5W 40 or 10W 40 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.

Supercharger Engines

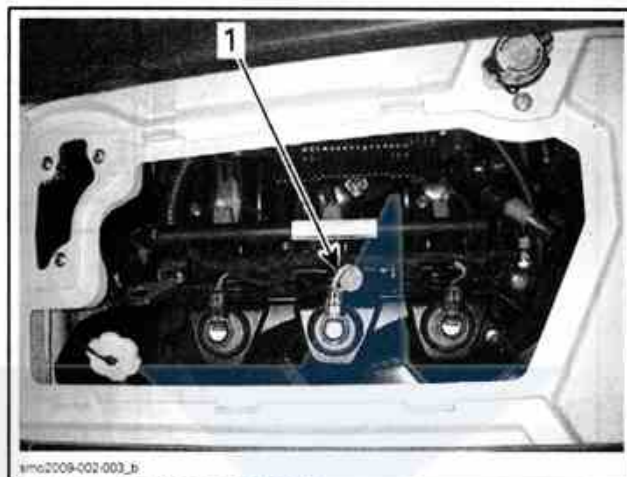
If XPS™ engine oil is not available, use a 10W40 mineral engine oil compatible with wet clutches.

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.



TYPICAL - iS MODELS SHOWN

1. Oil dipstick

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. Watercraft must be level. Check oil level either with watercraft in water or out of water.
2. If the watercraft is out of water, link a garden hose to the hose adapter. Refer to *EXHAUST SYSTEM FLUSHING* in the *EXHAUST SYSTEM* subsection.

NOTICE When watercraft is out of water:

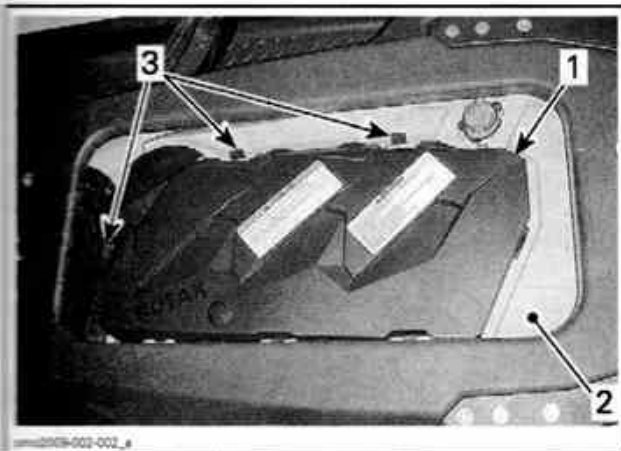
- Never run engine without supplying water to the exhaust system.
- Never run engine longer than 2 minutes. Drive line seal has no cooling when watercraft is out of water.

3. Warm-up engine then let idle for 30 seconds before stopping.
4. Stop engine.
5. Open seat.
6. On iS models, remove the ventilation box from the deck extension to gain partial access to engine compartment.

NOTE: To remove the rear ventilation box, simply release the 3 clips retaining it and lift it off the deck extension.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)

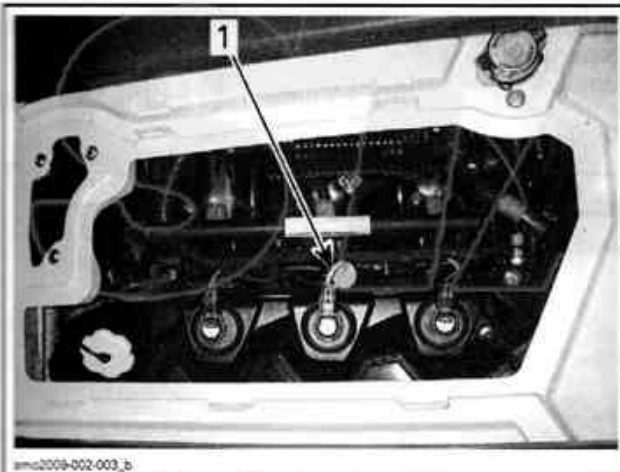


- 1. Rear ventilation box
- 2. Deck extension
- 3. Retaining clips

7. Wait at least 30 seconds for the oil to settle in the engine, then pull dipstick out and wipe clean.

⚠ WARNING

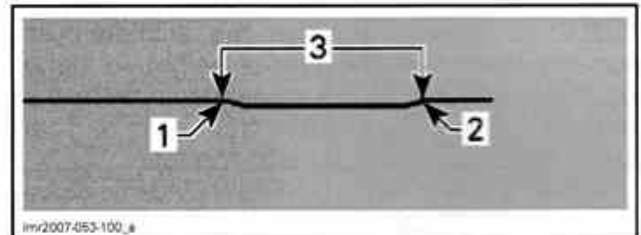
Engine oil may be hot. Certain components in the engine compartment may be very hot. Direct contact may result in skin burn.



TYPICAL - IS MODELS SHOWN

- 1. Oil dipstick

8. Reinstall dipstick, push in completely.
9. 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 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.

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)

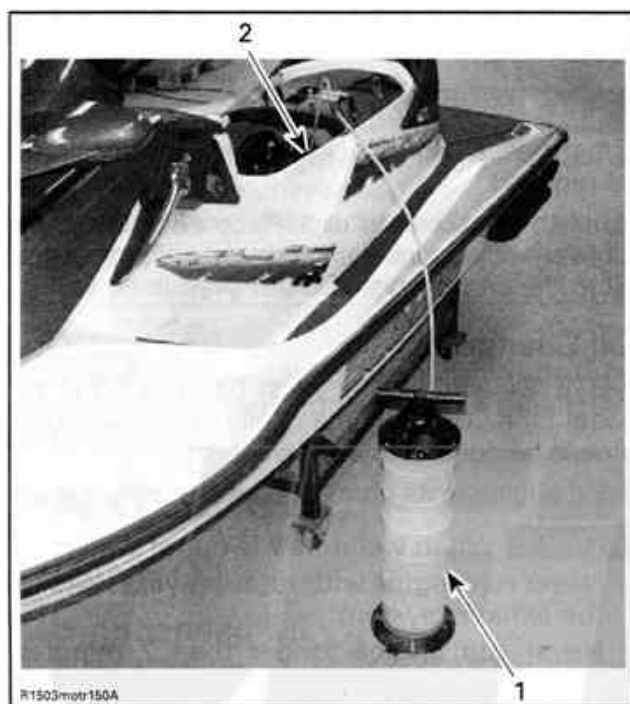


NOTICE Never crank or start engine when suction pump hose is in the dipstick tube. Never start engine when there is no oil in engine.

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Subsection 10 (LUBRICATION SYSTEM)

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.



TYPICAL

1. Suction pump
2. Suction pump hose in the dipstick tube

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.

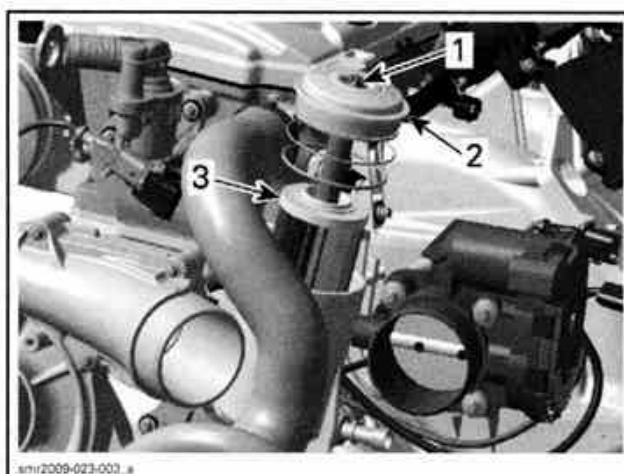
Replace **OIL FILTER**, see procedure in this subsection.

OIL FILTER

Oil Filter Removal

Remove:

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



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

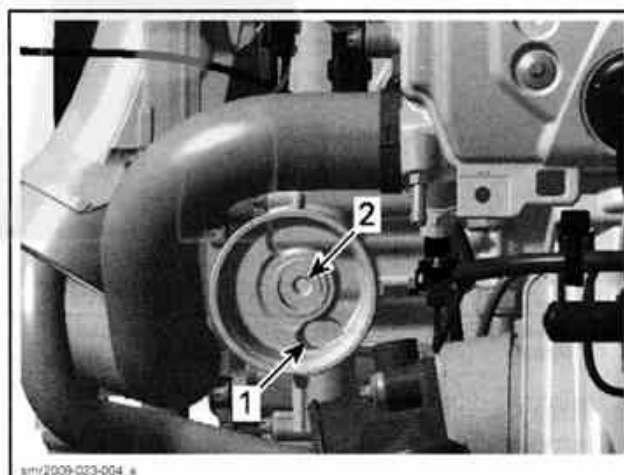
NOTE: No tools are required to remove the oil filter cover, as it will pull off when the oil filter screw is unscrewed.

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.

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Subsection 10 (LUBRICATION SYSTEM)

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.

OIL FILTER SCREW TORQUE
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.



INSTALLATION AT 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.

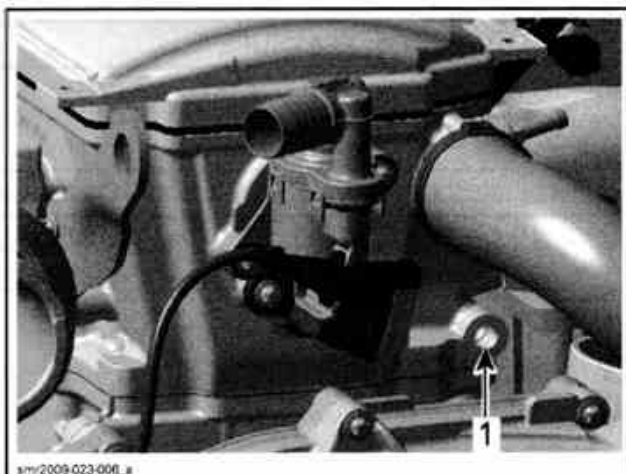
Test at the Cylinder Head Location

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

Remove plug located on cylinder head and install gauge.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



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)

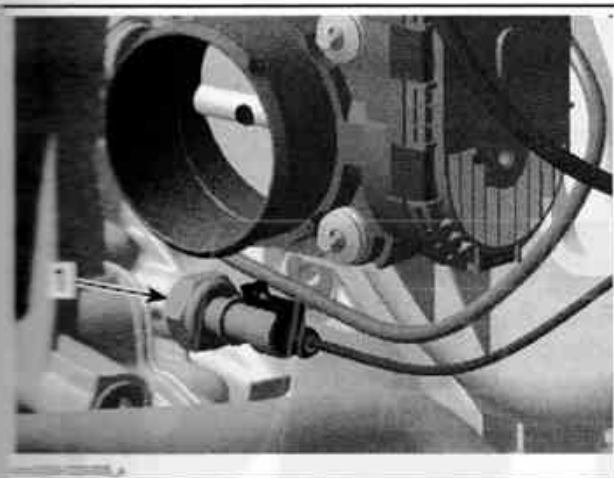
1. Water ingestion through drive shaft and floating ring
 - Check if water is leaking between drive shaft and floating ring. Repair or replace defective parts. Refer to *PTO HOUSING AND MAGNETO* subsection.
 - Change engine oil and filter.
2. Oil seal and rotary seal on water pump shaft leaking.
 - Replace 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).



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.

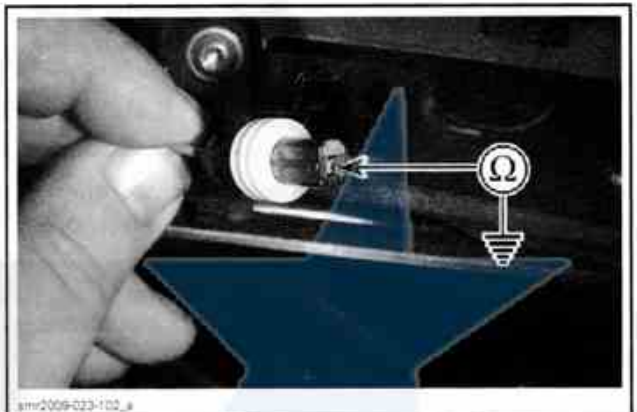
Oil Pressure Switch Resistance Test

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 (26.11 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

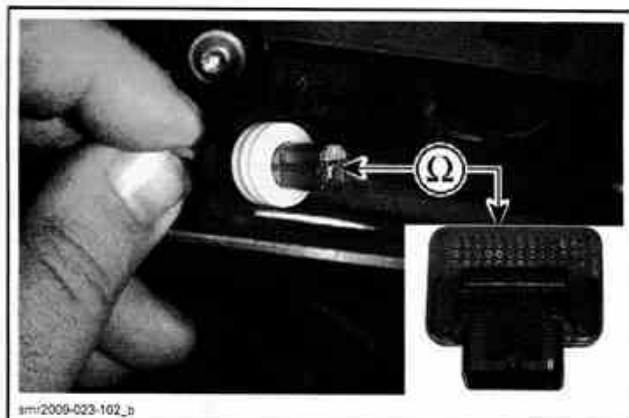
Disconnect the ECM connector "A" from the ECM. Check continuity of OPS circuit as per following table.

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

OPS CONNECTOR	ECM ADAPTER	RESISTANCE
Pin 1	Pin E3	Close to 0 Ω (continuity)

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Subsection 10 (LUBRICATION SYSTEM)



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.



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)

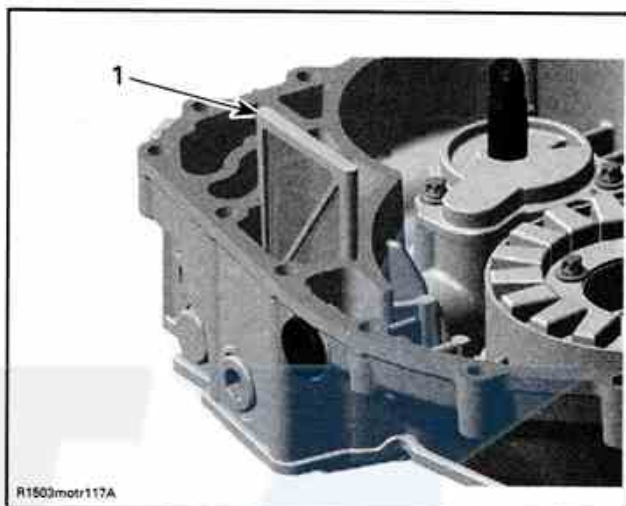
PTO OIL STRAINER

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.

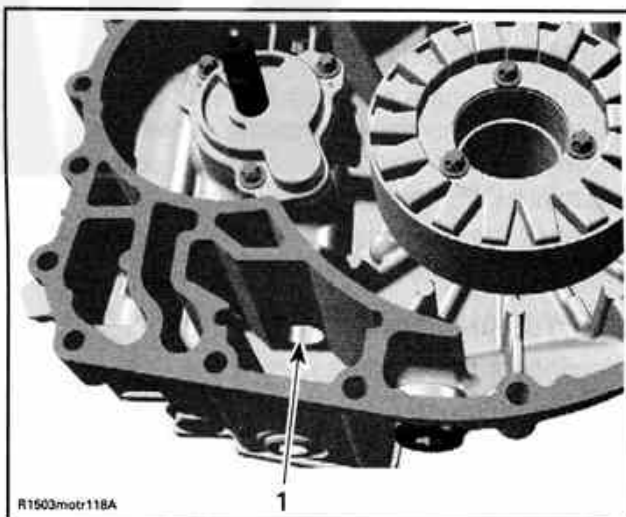


1. PTO oil strainer

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

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)

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.

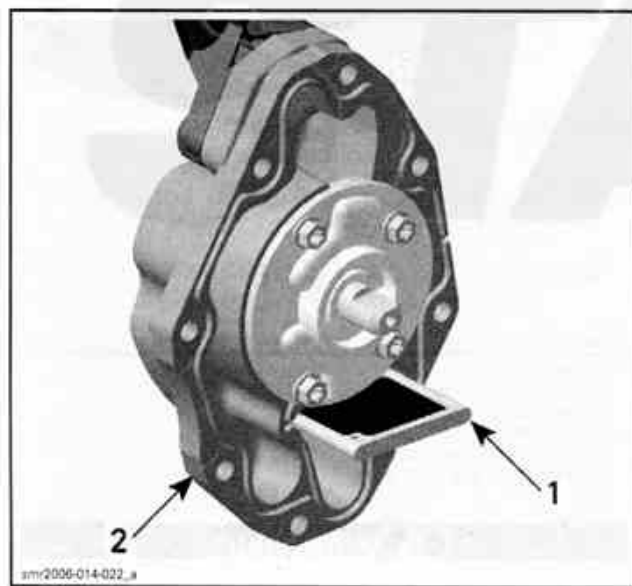
SUCTION PUMP OIL STRAINER

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.

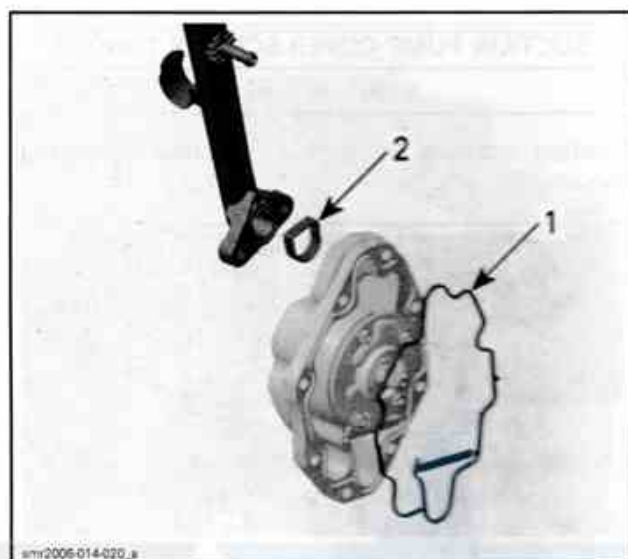


1. Oil strainer
2. Suction pump cover

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.

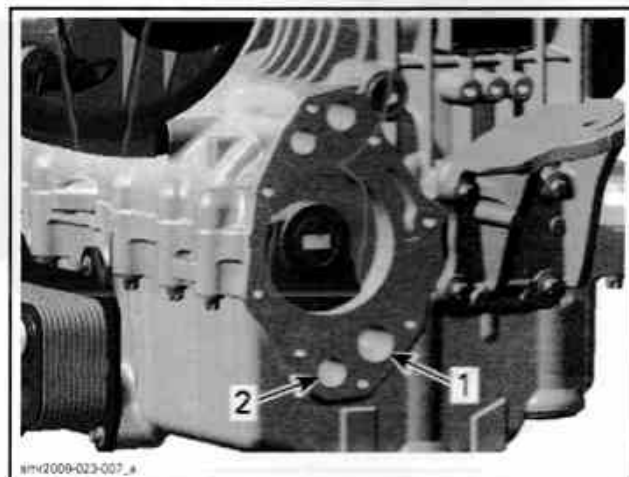


1. Suction pump cover gasket
2. Oil filler tube gasket

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.

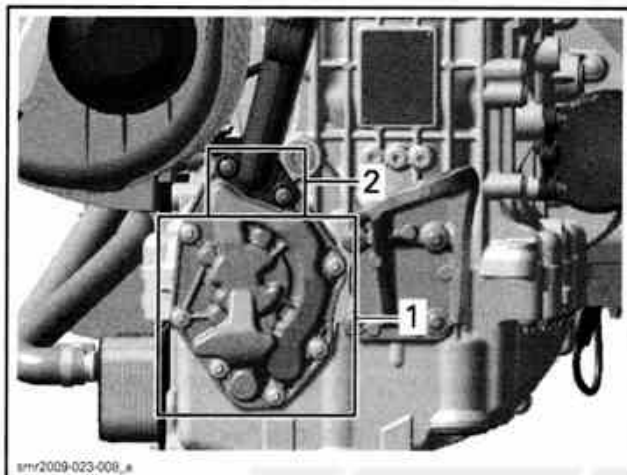
Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)

SUCTION PUMP COVER SCREWS TORQUE

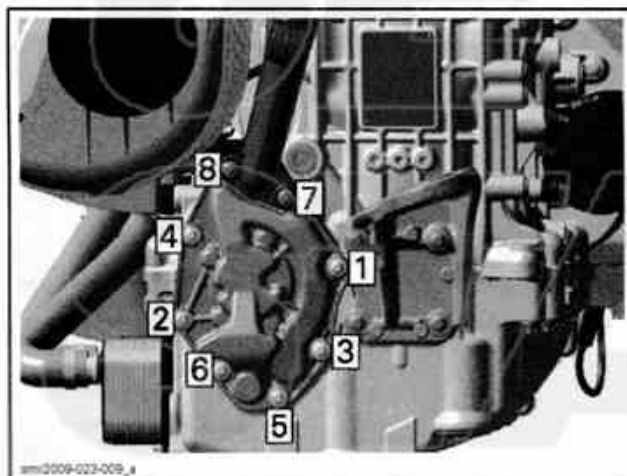
9 N•m (80 lbf•in)

Position screws according to their length as shown.



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

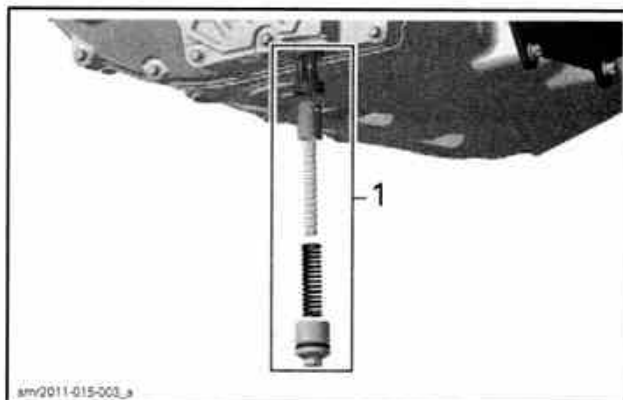
Torque suction pump cover screws as per sequence illustrated below.



TIGHTENING SEQUENCE

ENGINE OIL PRESSURE REGULATOR

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



TYPICAL

1. Oil pressure regulator

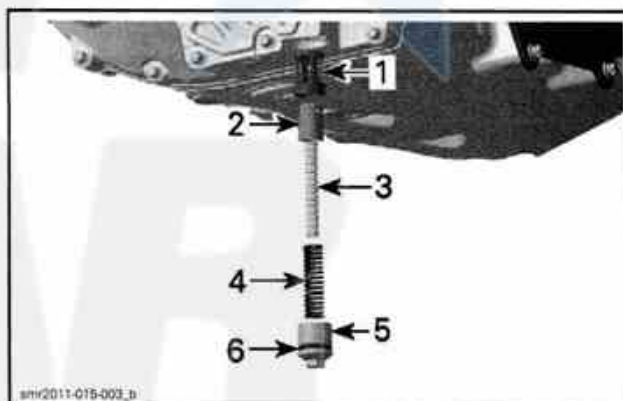
NOTE: The oil pressure regulator system opens when the oil pressure exceeds 400 kPa (58 PSI).

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 outer compression spring for free length.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)

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.

OIL PRESSURE REGULATOR PLUG TORQUE

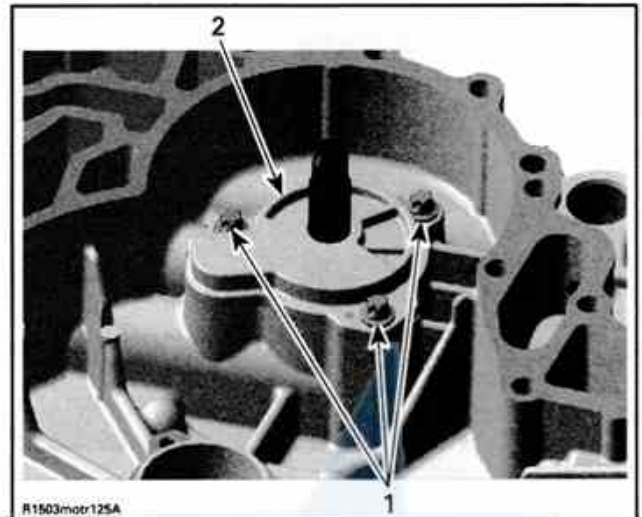
13 N•m (115 lbf•in)

OIL PRESSURE PUMP

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

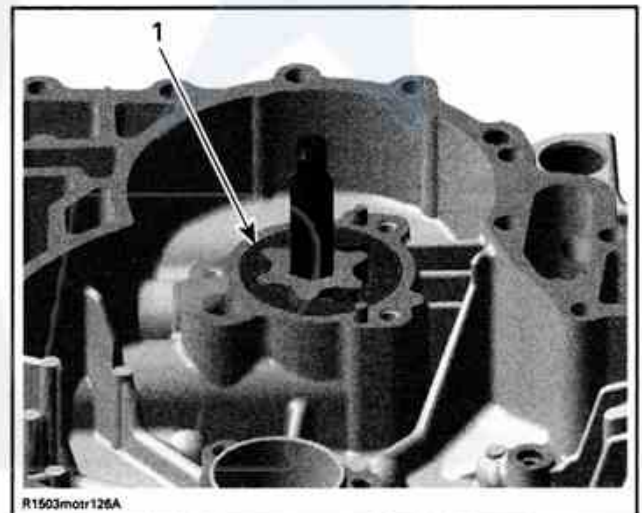
Oil Pressure Pump Removal

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.

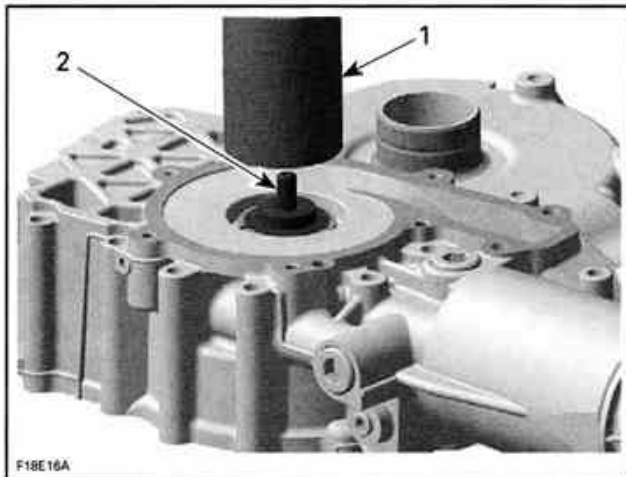


1. Outer oil pump rotor

6. Extract the coolant/oil pump shaft from outside PTO housing cover with a pusher.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



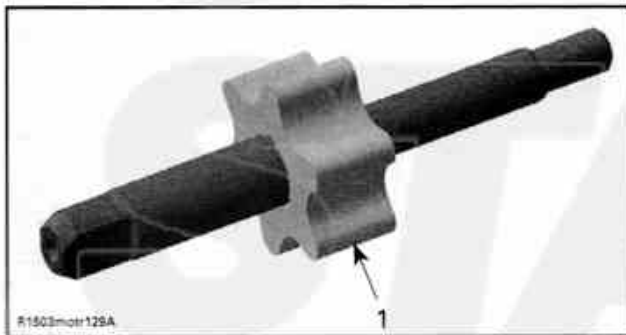
1. Pusher
2. Coolant/oil pump shaft

7. Remove rotary seal and oil seal. Refer to **ROTARY SEAL** further in this subsection.

Oil Pressure Pump Inspection

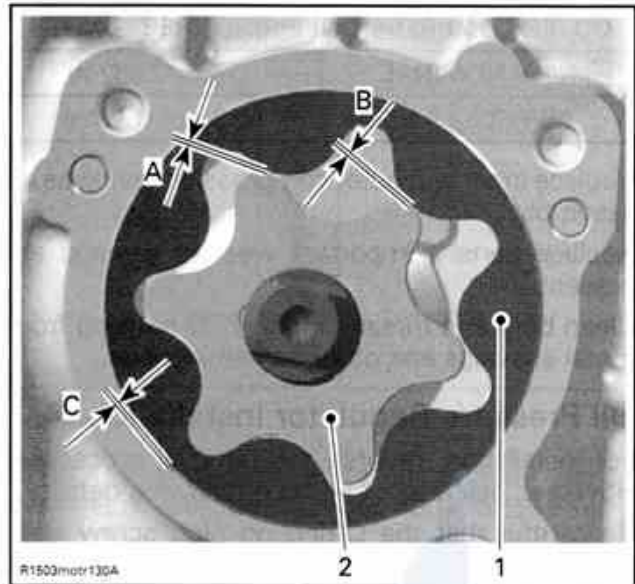
Inspect coolant/oil pump shaft, housing and cover for marks or other damages.

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

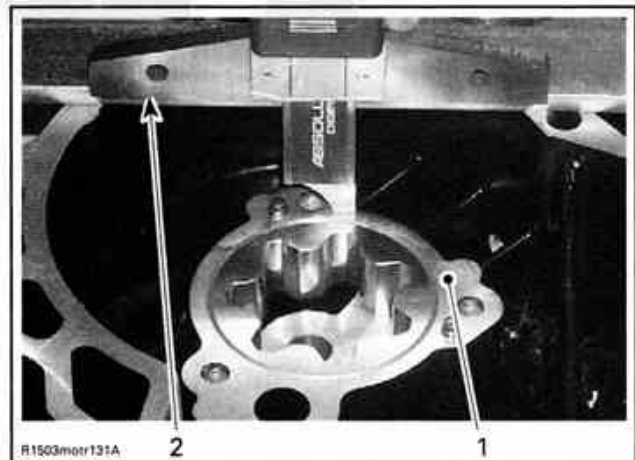
SERVICE LIMIT

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.

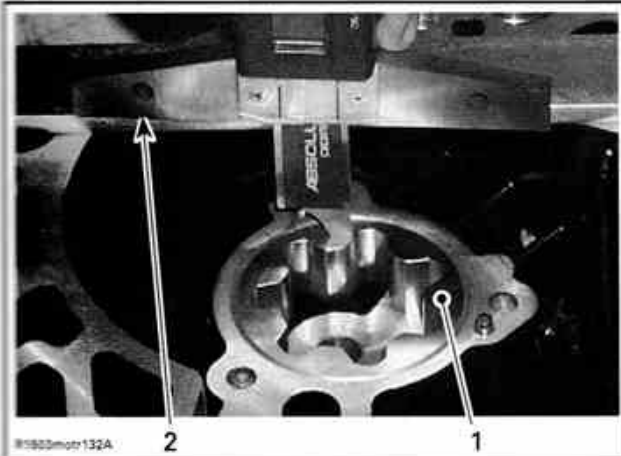
Using a vernier depth gauge, measure side wear as shown.



1. PTO housing surface
2. Vernier depth gauge

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



1. Oil pump outer rotor surface
2. Vernier depth gage

Difference between pump housing and outer rotor should not exceed the following specification. If so, replace the complete oil pump assembly.

DIFFERENCE BETWEEN PUMP HOUSING AND OUTER ROTOR

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.

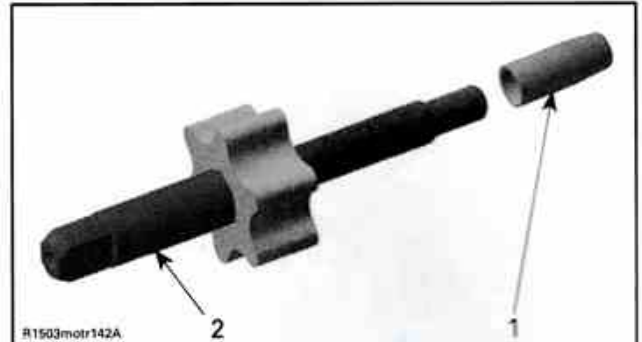
NOTICE Never use a hammer for the coolant/oil pump shaft installation. Only use a press to avoid damaging the ceramic component of the rotary seal.

REQUIRED TOOL

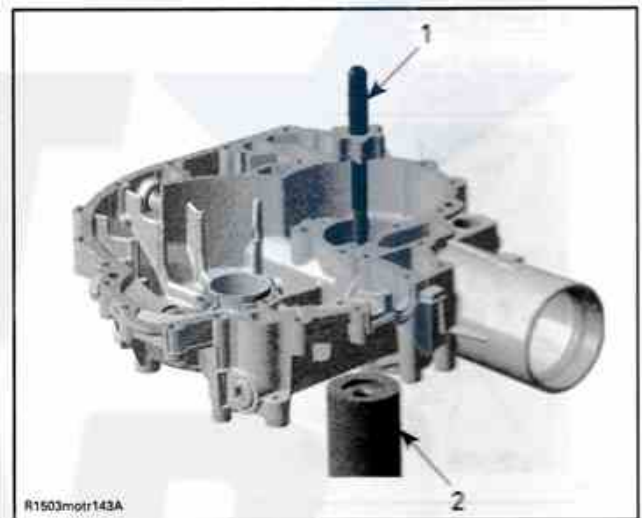
OIL SEAL GUIDE
(P/N 529 035 822)



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 and torque to specification.

OIL PUMP COVER SCREWS TORQUE

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.

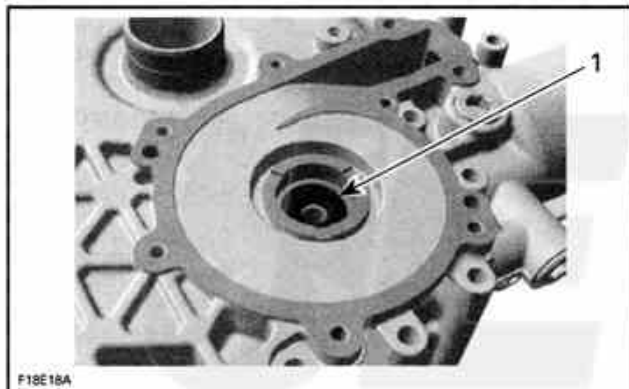
Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



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

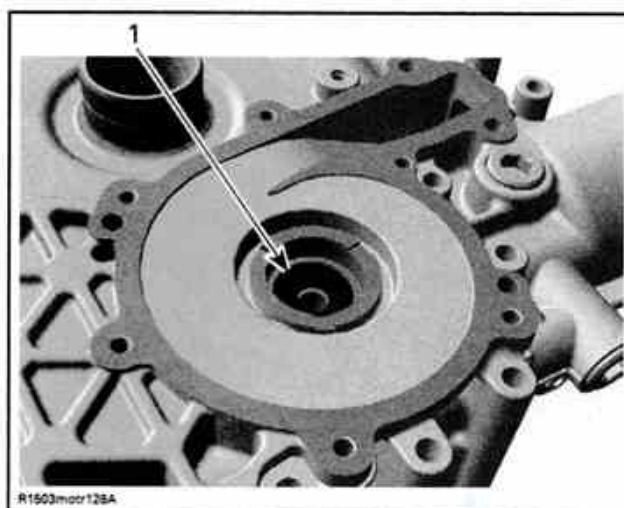
Discard rotary seal and oil seal.

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

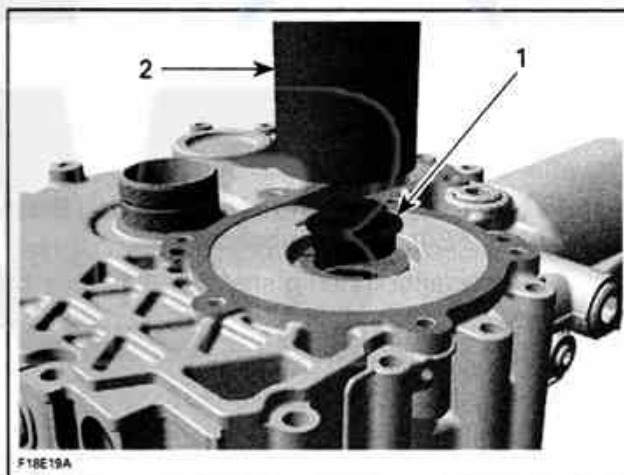
Install the NEW rotary seal.

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.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)

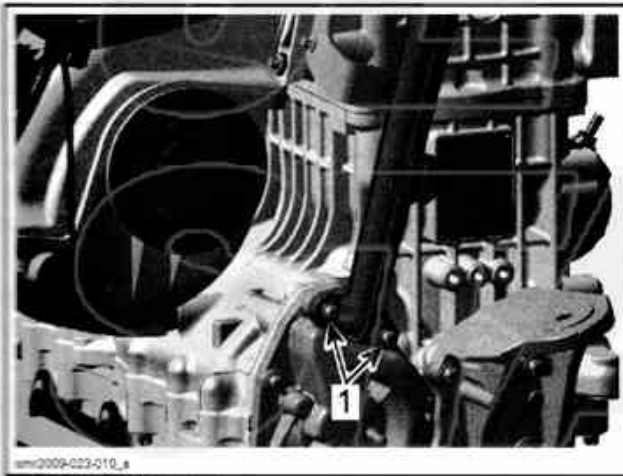
Oil Suction Pump Removal

iS Models

1. Remove jet pump and drive shaft. Refer to *STEERING AND PROPULSION* section.
2. Remove the moving deck. Refer to *BODY (GTX, RXT AND WAKE PRO)* subsection.
3. Remove the air intake silencer. Refer to *AIR INTAKE SYSTEM (iS AND aS MODELS)* subsection.
4. Detach the muffler from the exhaust manifold and move muffler backwards. Refer to *EXHAUST SYSTEM* subsection.
5. Remove engine support mount screws.
6. Move engine backwards, just enough to reach oil suction pump cover screws.

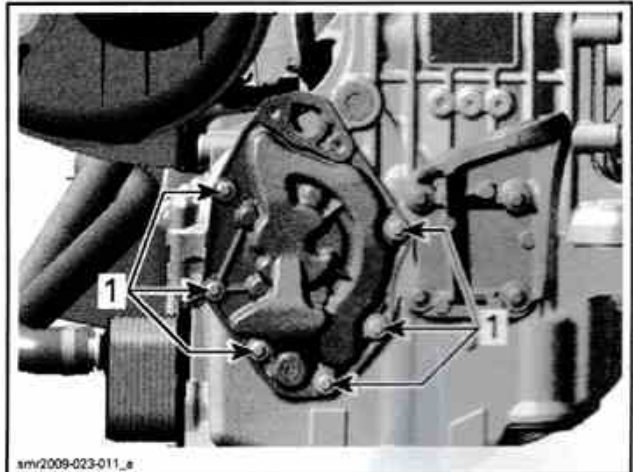
All Models

1. Remove retaining screws from oil filler tube.



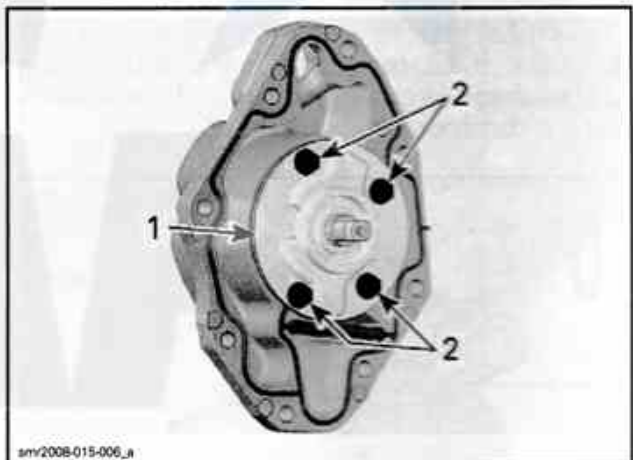
1. Oil filler tube screws

2. Remove oil filler tube.
3. Remove retaining screws.



1. Suction pump cover screws

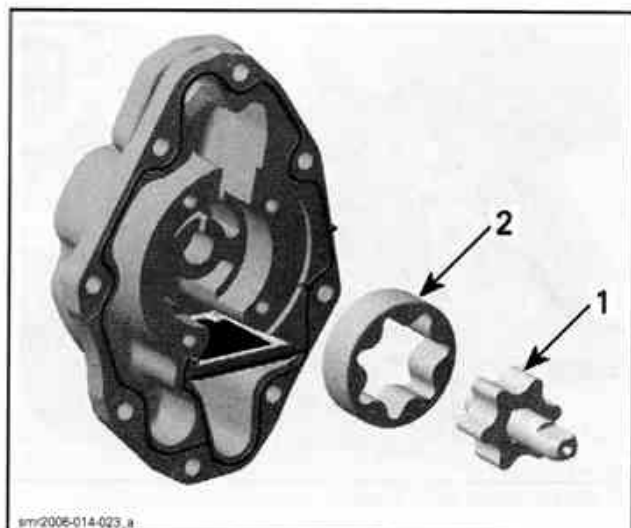
4. Place rags under cover to prevent spillage. If spillage occurs, clean with the PULLEY FLANGE CLEANER (P/N 413 711 809).
5. Remove the oil suction pump housing.
6. Remove oil pump screws and cover.



1. Oil pump cover

2. Oil pump screws

7. Remove oil pump shaft.
8. Remove outer rotor.

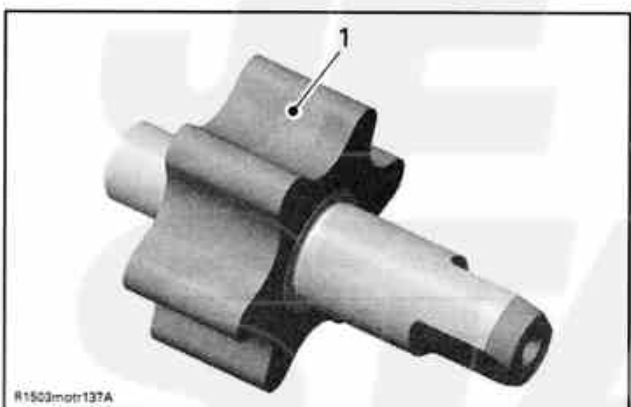


TYPICAL
1. Oil pump shaft
2. Outer rotor

Oil Suction Pump Inspection

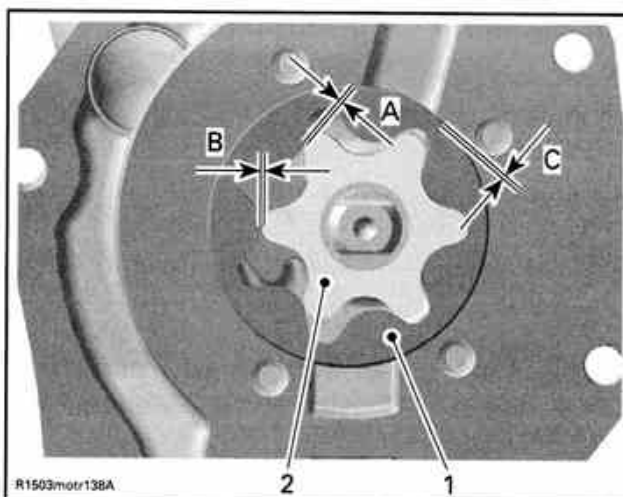
Inspect oil pump shaft, housing and cover for marks or other damages.

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

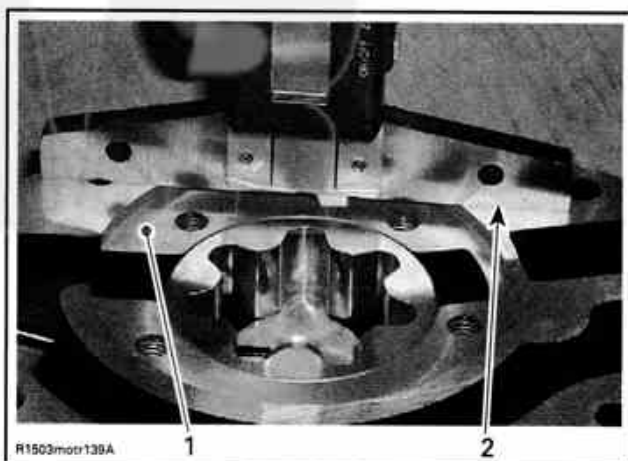
OUTER AND INNER ROTOR CLEARANCE

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.

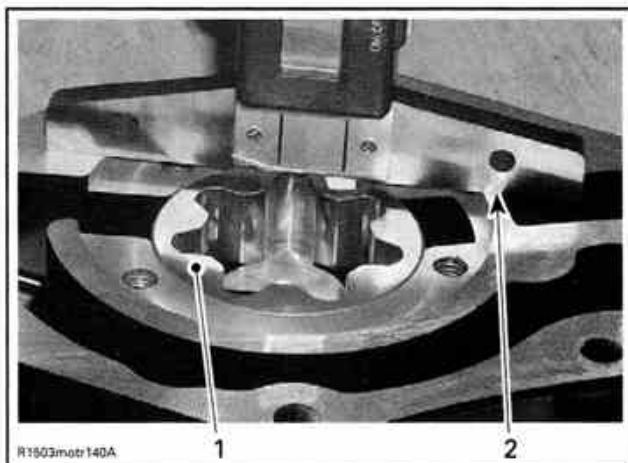
Using a vernier depth gage, measure side wear as shown.



1. Oil pump housing surface
2. Vernier depth gage

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



1. Oil pump outer rotor surface
2. Vernier depth gage

Difference between pump housing and outer rotor should not exceed the following specification. If so, replace the complete oil pump assembly.

DIFFERENCE BETWEEN PUMP HOUSING AND OUTER ROTOR

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

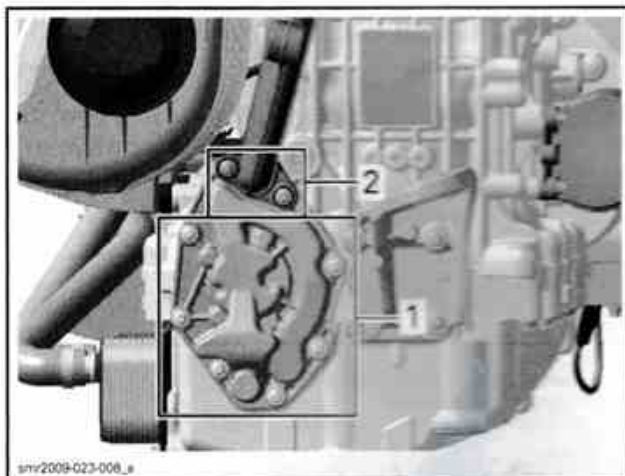
For installation, reverse the removal procedure. Pay attention to the following details.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of the suction pump cover screws and tighten them to specification.

SUCTION PUMP COVER SCREWS TORQUE

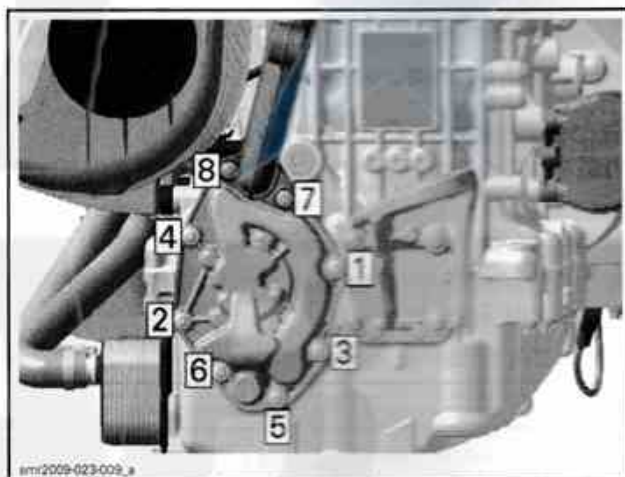
9 N•m (80 lbf•in)

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

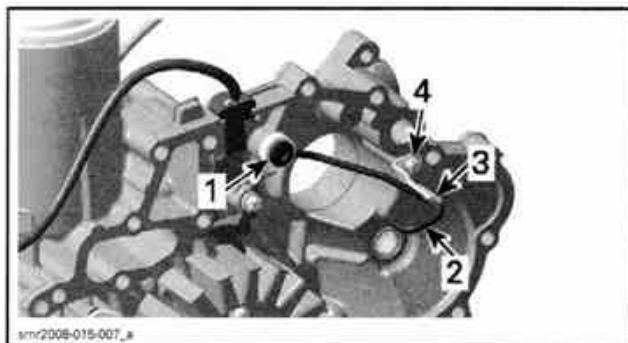
Remove the PTO housing. Refer to *PTO HOUSING AND MAGNETO* subsection.

Remove the Torx screw securing the oil spray nozzle support.

Unscrew the Banjo bolt.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



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 (Torx screw)	11 N•m (97 lbf•in)

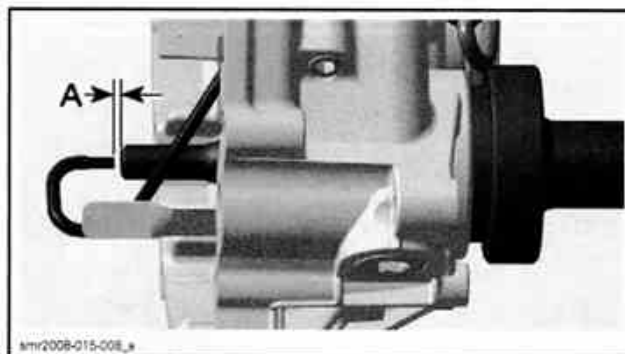
Install oil spray nozzle with Banjo bolt.

TORQUE	
Oil spray nozzle Banjo bolt	19 N•m (168 lbf•in)

Adjust the position of the oil spray nozzle.

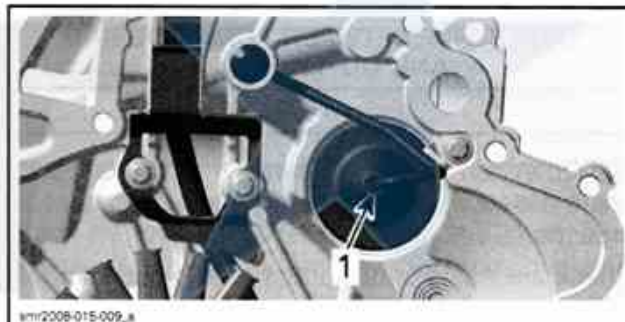
REQUIRED TOOL	
SUPERCHARGER OIL SPRAY NOZZLE TOOL (P/N 529 036 134)	

The distance between the adjustment tool and oil spray nozzle must be within 1 mm (.039 in).



A. 1 mm (.039 in)

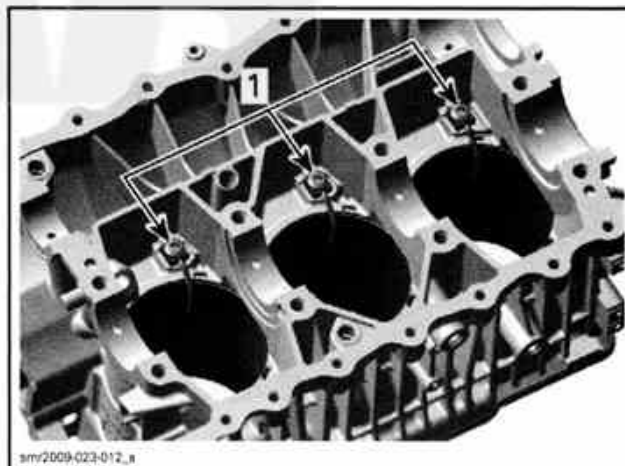
NOTE: Make sure that the oil spray nozzle is facing to the center of the tool. Not following this procedure will lead to an insufficient oiling of the supercharger and a supercharger failure can occur. Adjust the oil spray nozzle if necessary by slightly bending it, take care not to over bend the oil 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

Section 02 ENGINE

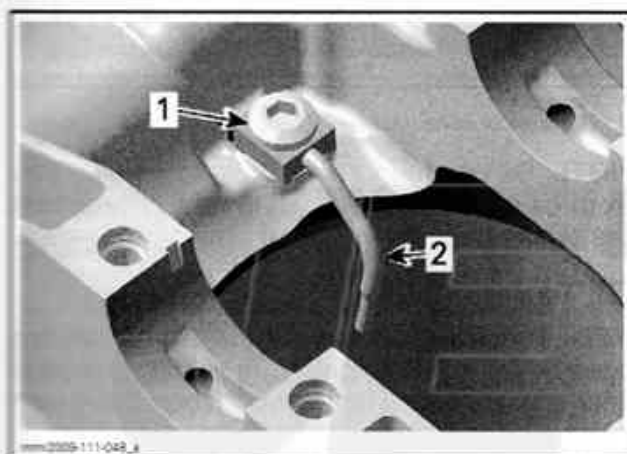
Subsection 10 (LUBRICATION SYSTEM)

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.

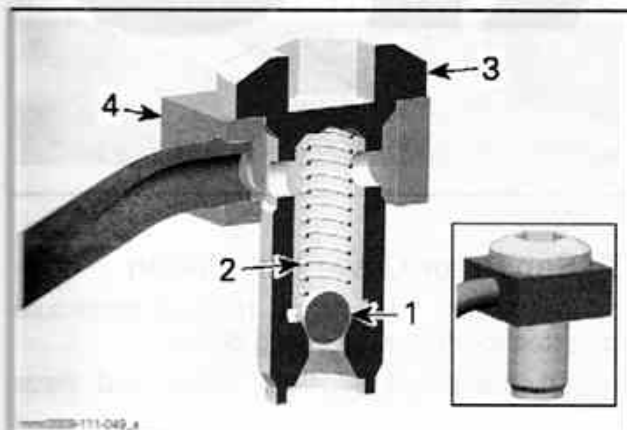


- 1. Banjo fitting
- 2. Oil spray nozzle

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.

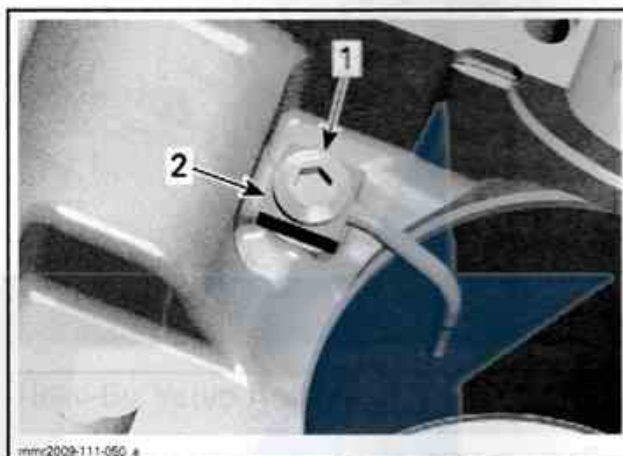


- 1. Ball
- 2. Spring
- 3. Banjo fitting
- 4. Oil spray nozzle

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.



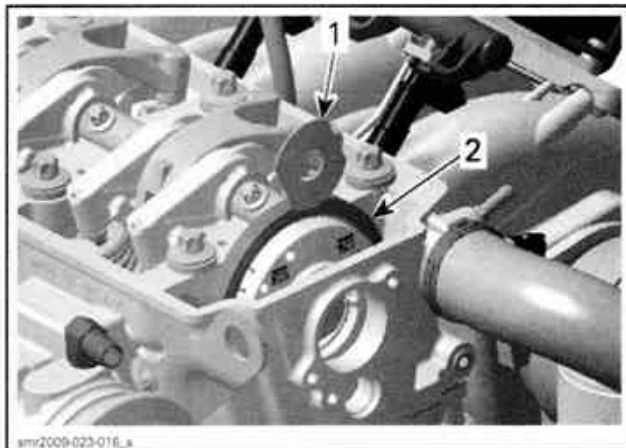
- 1. Camshaft position sensor
- 2. Screw

3. Remove cylinder head cover, refer to *CYLINDER HEAD* subsection.
4. Remove thrust washer from oil separator cover.

Section 02 ENGINE

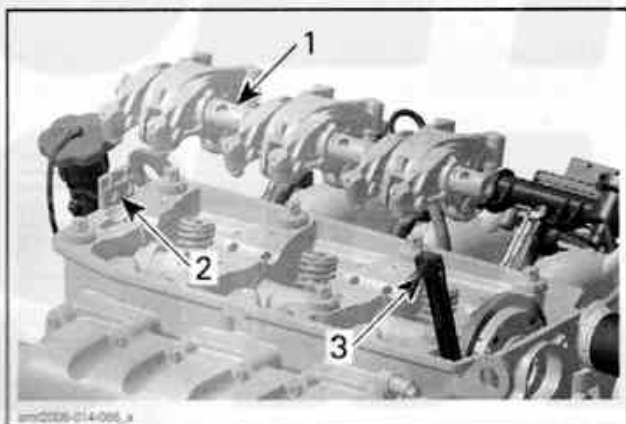
Subsection 10 (LUBRICATION SYSTEM)

NOTE: Make sure not to loose thrust washer when removing it from oil separator cover, otherwise thrust washer would fall into the PTO housing.



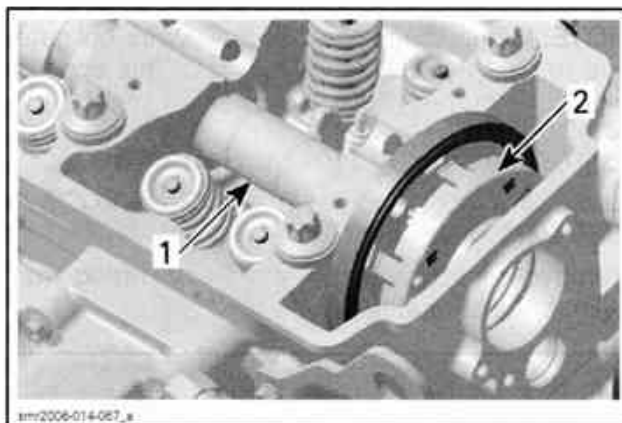
1. Thrust washer
2. Oil separator cover

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.

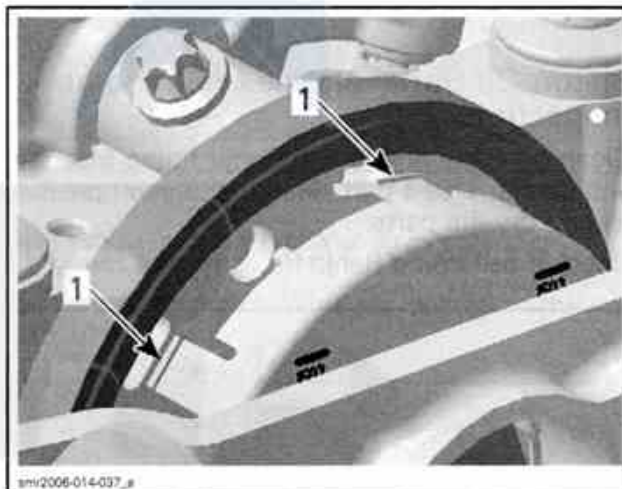


1. Camshaft
2. Oil separator cover

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

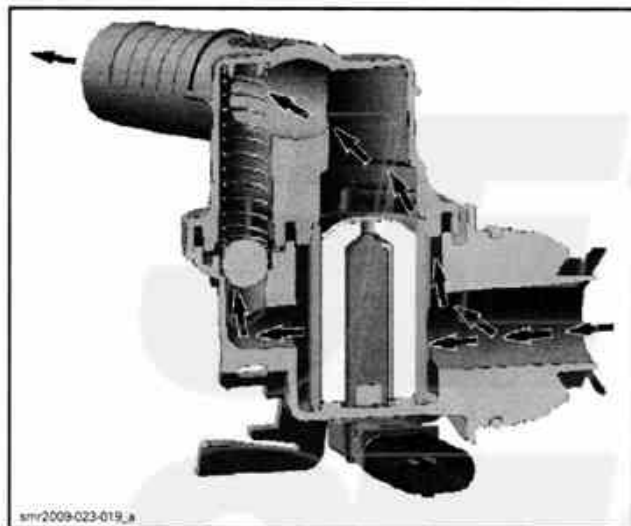
Blow-By Valve Description

The function of the blow-by valve is the circulation of the oil vapors.

Blow-By Valve Operation

Normal Operation

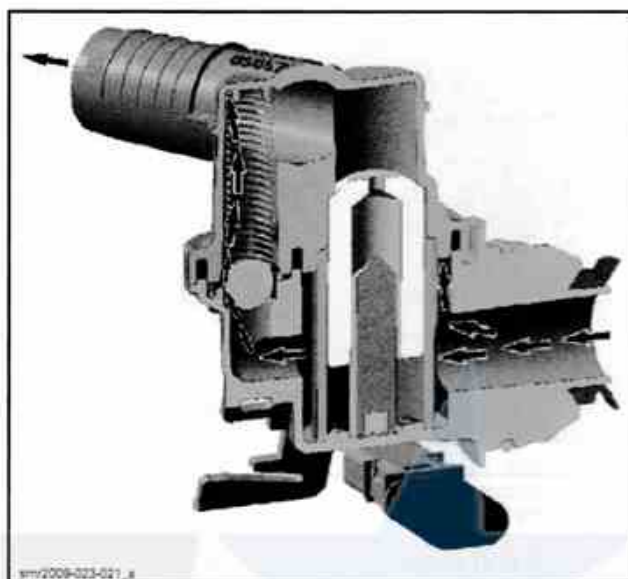
During its normal operation, the blow-by valve allows crankcase vapors to return in the intake system where they are harmlessly burned.



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.



BY-PASS FUNCTION

Blow-By Valve Removal

iS and aS Models

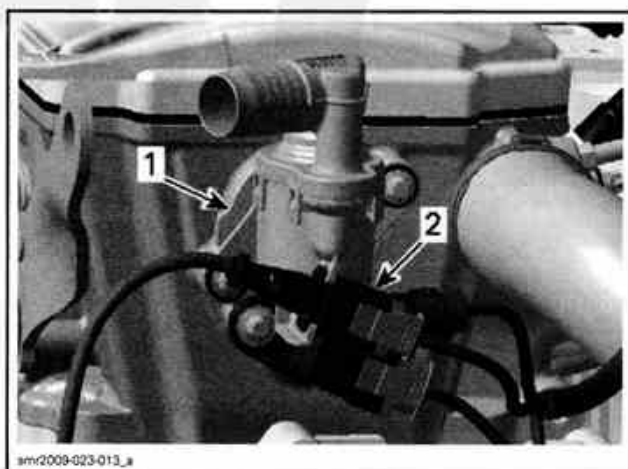
Remove:

- Deck extension, refer to *BODY (GTX, RXT AND WAKE PRO)* subsection
- Air intake silencer, refer to *AIR INTAKE SYSTEM (WITH iS AND aS)* subsection.

All Models

Remove ventilation hose from blow-by valve.

Remove the CPS connector from its support on blow-by valve.



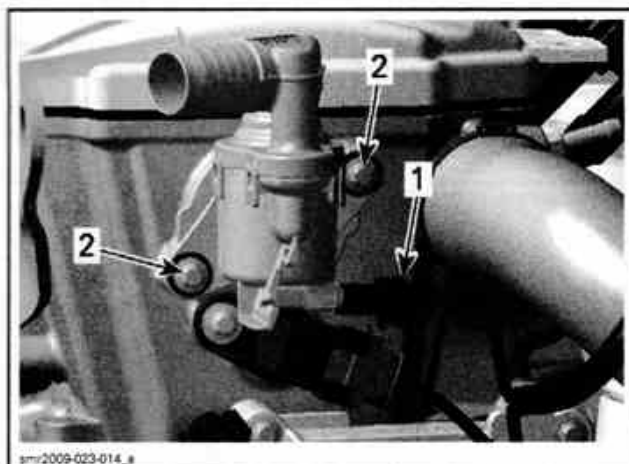
1. Blow-by valve
2. CPS connector

Disconnect the TOPS switch connector of the blow-by valve.

Unscrew and remove the blow-by valve.

Section 02 ENGINE

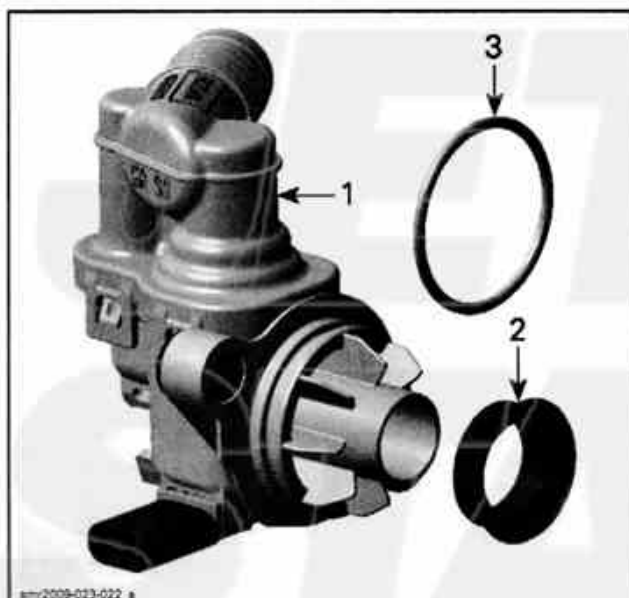
Subsection 10 (LUBRICATION SYSTEM)



- 1. TOPS switch connector
- 2. Retaining screws

Remove and discard O-ring and V-ring.

NOTE: The blow-by valve can not be disassembled.



- 1. Blow-by valve
- 2. V-ring
- 3. O-ring

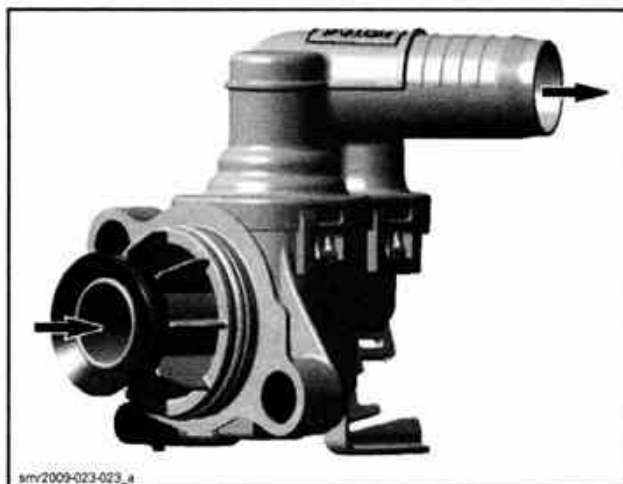
Blow-By Valve Inspection

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.

BLOW-BY VALVE SCREWS TORQUE
9 N•m (80 lbf•in)

Reinstall remaining removed parts.

TOPS SWITCH

Tip Over Protection Switch (TOPS Switch) Function

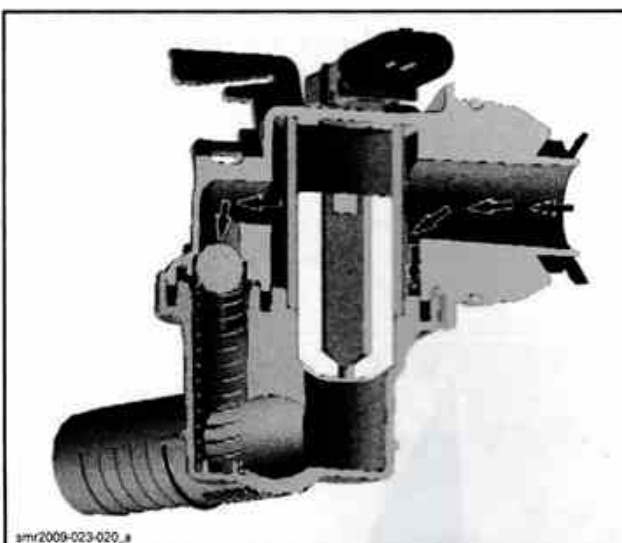
The function of the TOPS switch is the engine protection in the event the watercraft tip over.

During normal operation the TOPS switch state is OFF, no signal to the ECM.

If the watercraft 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.



TIP OVER FUNCTION

TOPS Switch Input Voltage Test

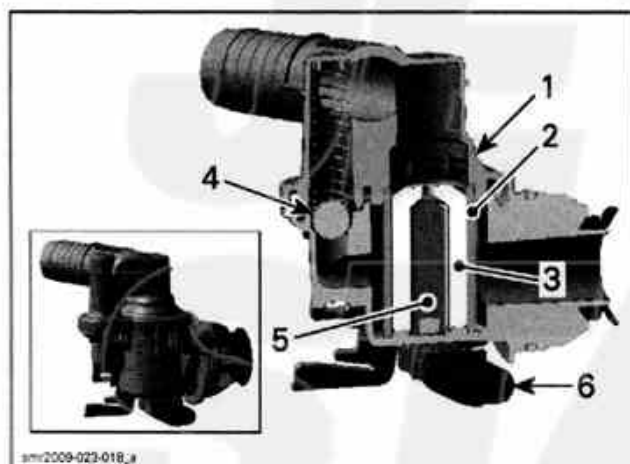
Remove:

- Deck extension, refer to *BODY (GTX, RXT AND WAKE PRO)* subsection.
- Air intake silencer, refer to appropriate *AIR INTAKE SYSTEM* subsection.

Disconnect the TOPS switch connector of the blow-by valve.

Briefly press the START/STOP button to wake-up the ECM.

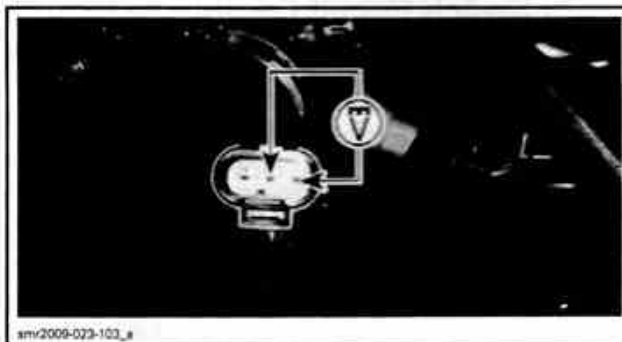
Probe terminals as shown to check the voltage output from the ECM.



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

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.

Section 02 ENGINE

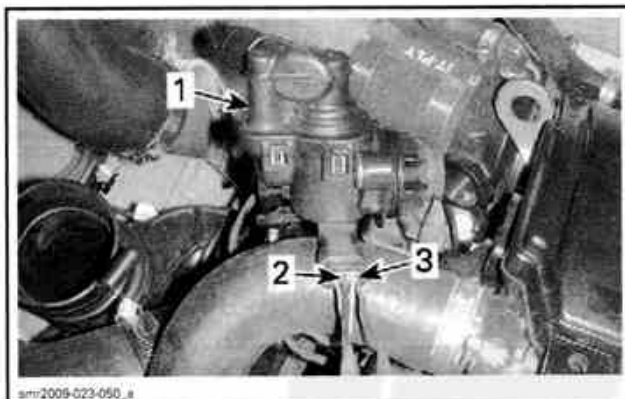
Subsection 10 (LUBRICATION SYSTEM)

TOPS Switch Output Voltage Test

Remove the blow-by valve.

Back-probe TOPS connector and check voltage using the 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

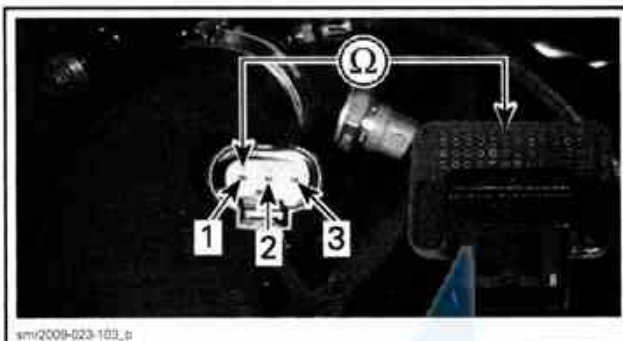
Disconnect the TOPS switch connector of the blow-by valve.

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

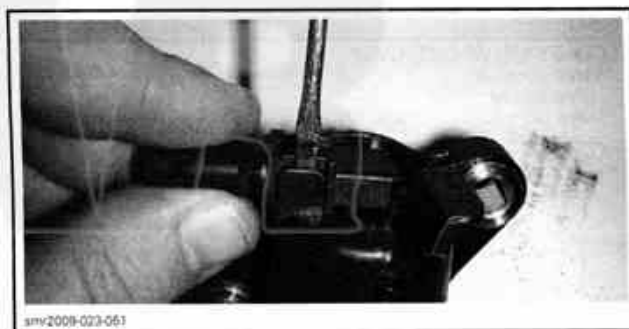
If continuity test is good, check ECM. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

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.

Section 02 ENGINE

Subsection 10 (LUBRICATION SYSTEM)



1. TOPS valve inscriptions

OIL COOLER

The oil cooler is located below the air intake manifold.



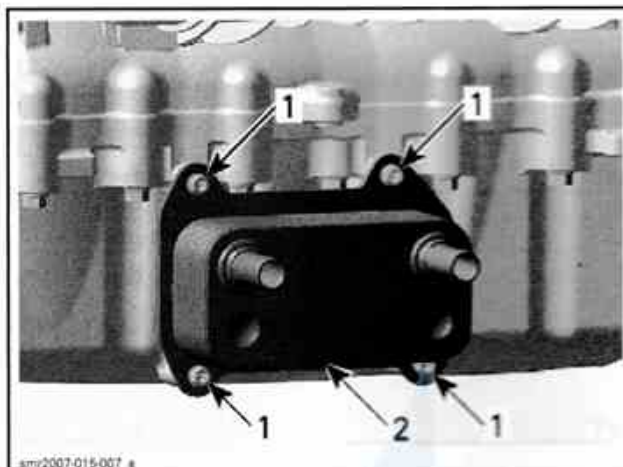
1. Oil cooler

Oil Cooler Removal

Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

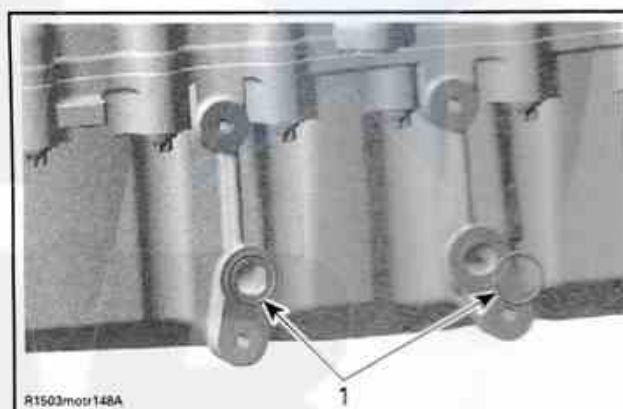
Disconnect cooling hoses from oil cooler.

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.

OIL COOLER SCREWS TORQUE

9 N•m (80 lbf•in)

COOLING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
OETIKER PLIERS.....	295 000 070	146
TEST CAP	529 035 991	145
VACUUM/PRESSURE PUMP	529 021 800	146

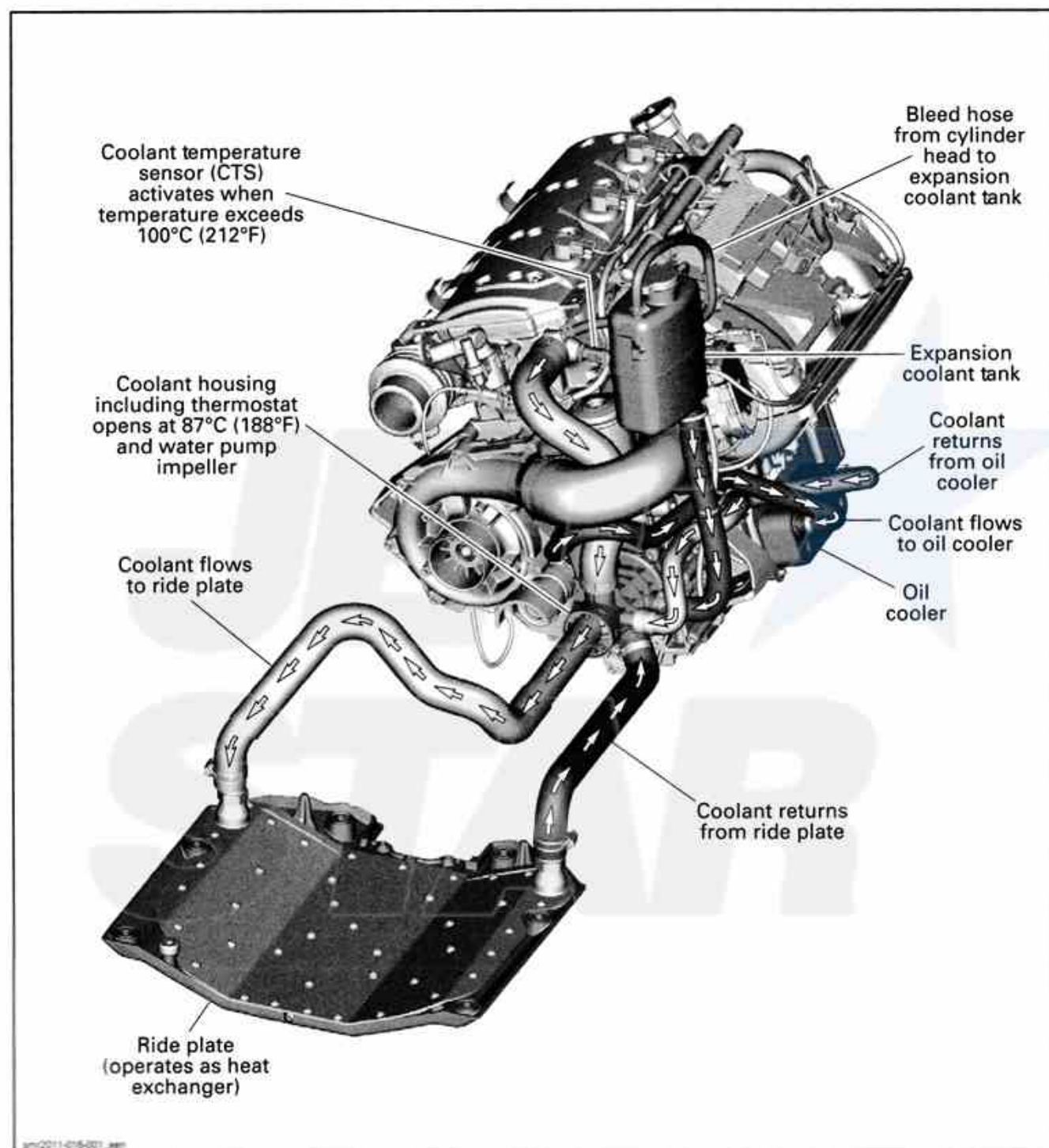
SERVICE PRODUCTS

Description	Part Number	Page
BRP PREMIXED COOLANT	219 700 362	143
LOCTITE 243 (BLUE).....	293 800 060	149
LOCTITE 567 (PIPE SEALANT)	293 800 013	144

Section 02 ENGINE

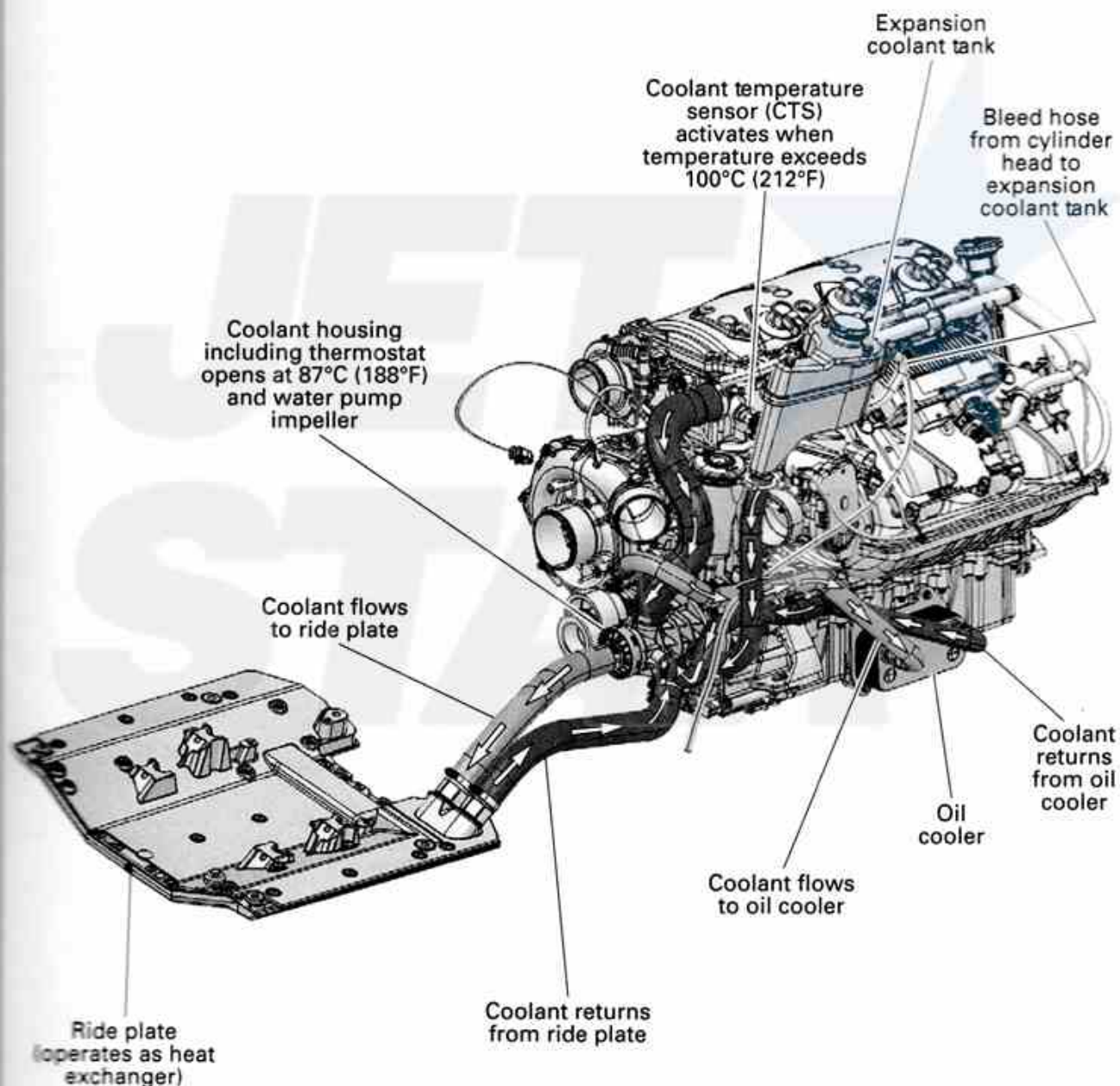
Subsection 11 (COOLING SYSTEM)

COOLING SYSTEM (CLOSED LOOP) (GTI SERIES, GTS SERIES AND WAKE 155)



Section 02 ENGINE
Subsection 11 (COOLING SYSTEM)

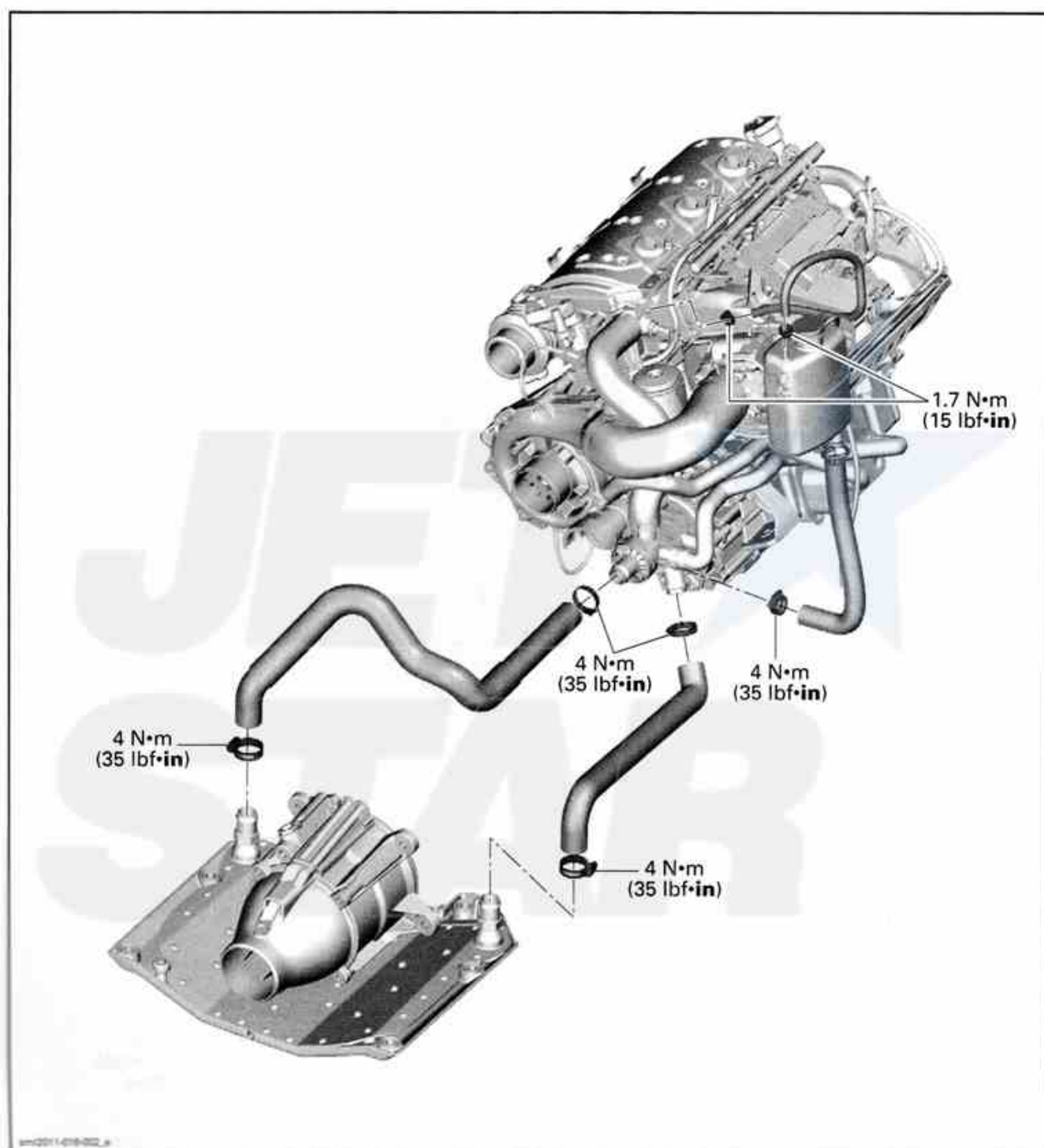
COOLING SYSTEM (CLOSED LOOP)
(GTX SERIES, RXT SERIES AND WAKE PRO 215)



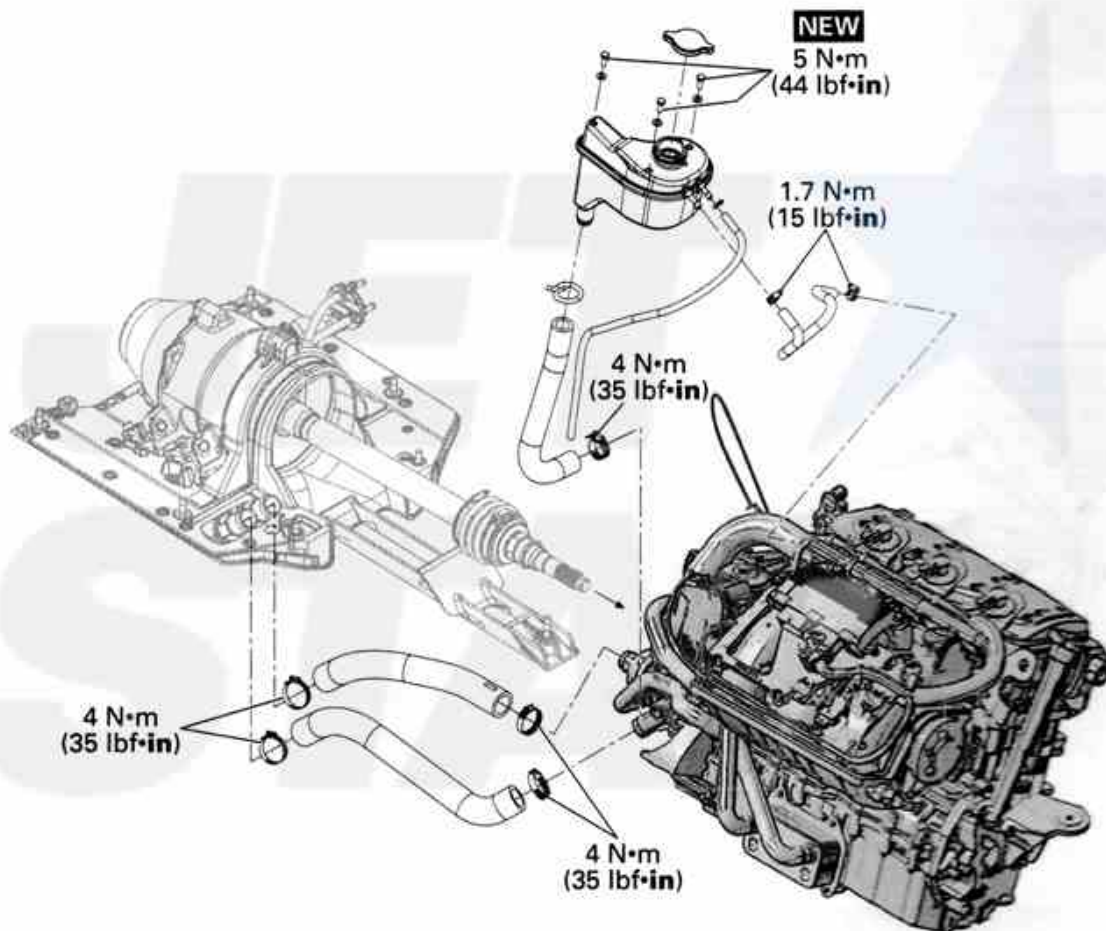
Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)

COOLING SYSTEM COMPONENTS (GTI SERIES, GTS SERIES AND WAKE 155)



COOLING SYSTEM COMPONENTS
(GTX SERIES, RXT SERIES AND WAKE PRO 215)



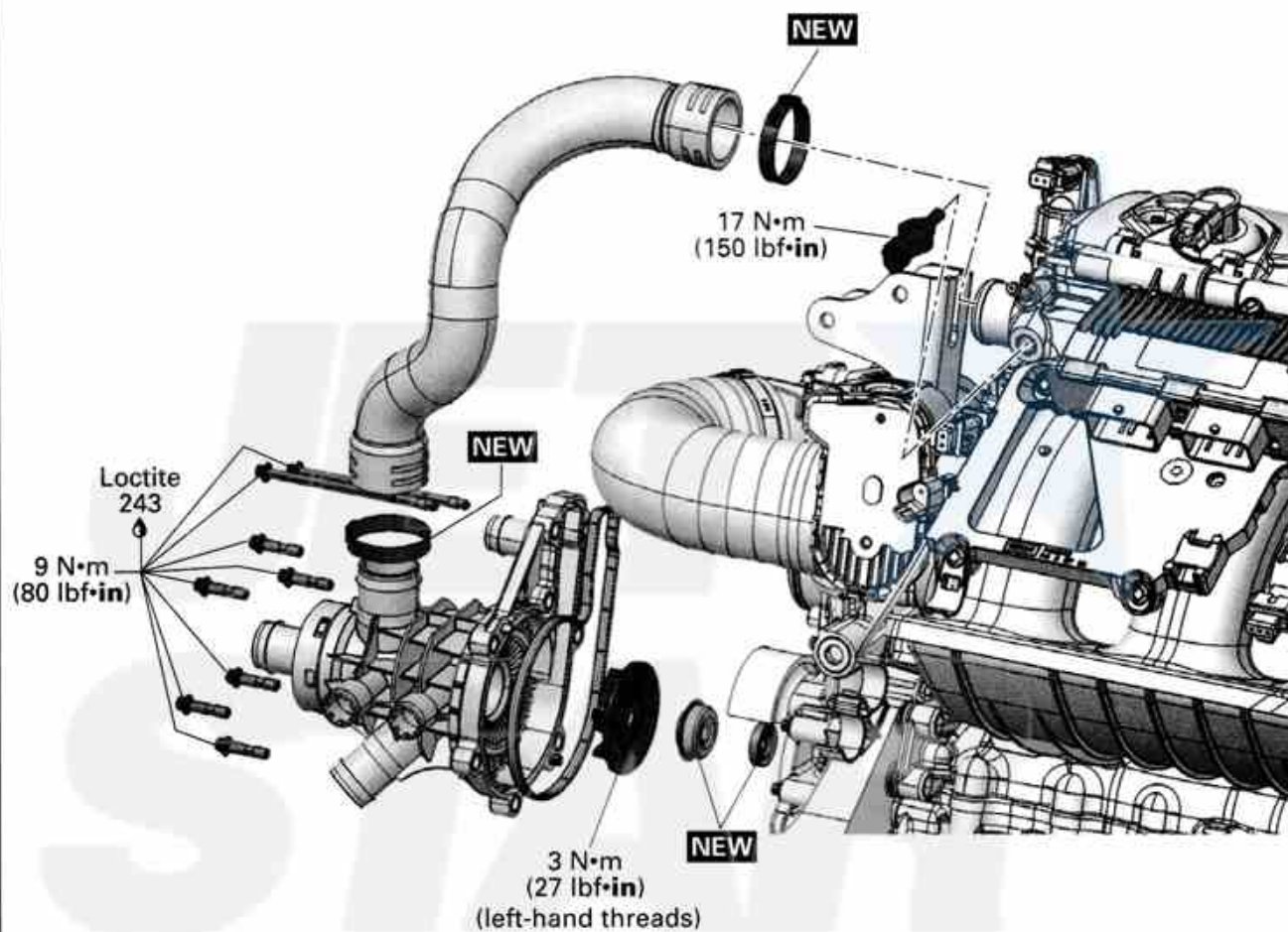
NEW = Component must be replaced when removed.

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Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)

COOLING SYSTEM COMPONENTS (ENGINE)



NEW = Component must be replaced when removed.

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

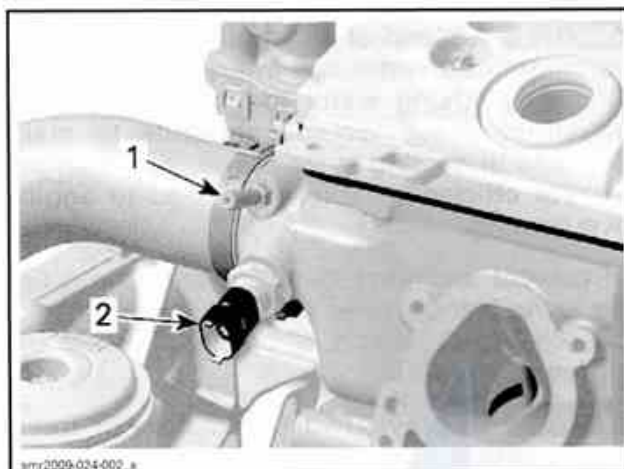
A closed loop cooling system is utilized on the 1503 4-TEC engines, which offers an efficient engine cooling while keeping dirt and salt water out of the cooling system. This system keeps the temperature constant and prevents internal engine corrosion.

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 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 watercraft is used in particularly hot weather and/or hot water condition.

Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)

NOTICE A blend of 40% antifreeze with 60% demineralized water will improve the cooling efficiency. Using water tap instead of demineralized water, would contribute to make deposits in cooling system and to reduce antifreeze efficiency. This could lead to engine overheating.

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.

Open seat.

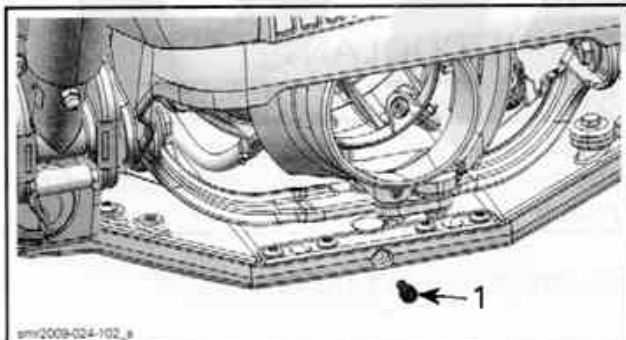
On iS models, remove the rear ventilation box.

Remove the coolant tank cap.

Install a drain pan underneath the ride plate.

Unscrew the drain plug on ride plate.

NOTE: Raising the front of the watercraft will contribute to drain the cooling system.



1. Cooling drain plug

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.

Install watercraft in a test basin or ride on a water plane. Start engine and run for approximately 15 minutes.

IMPORTANT: Ensure thermostat opens so that the cleaning product flows in ride plate properly.

Stop engine and let the cleaning product work for 12 to 16 hours.

Thereafter, engine can be run one last time to soak off deposits.

Drain and thoroughly rinse the cooling system with clean fresh water.

Refill cooling system as described below.

Refilling the System

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

Place a container under drain plug to collect antifreeze.

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 drain hole, reinstall drain plug. Torque drain plug to specification.

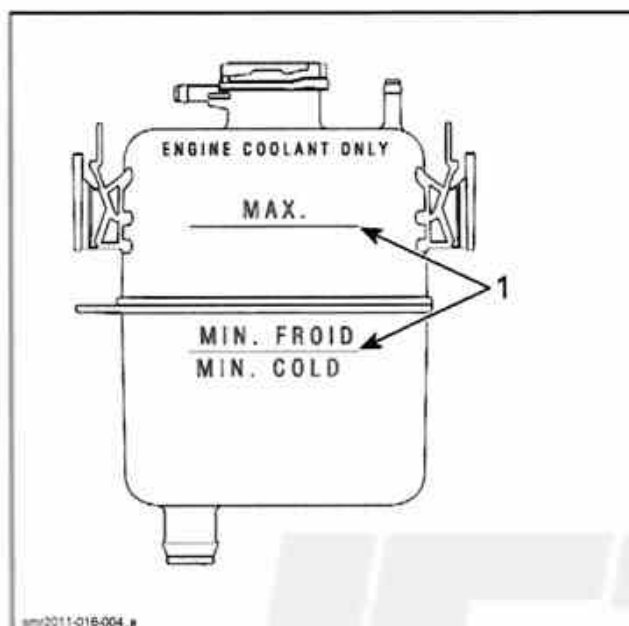
DRAIN PLUG TIGHTENING TORQUE

8.5 N•m (75 lbf•in)

Continue to pour and fill coolant tank between marks.

Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)



TYPICAL - GTI SERIES, GTS SERIES AND WAKE 155
1. Level between marks when engine is cold



TYPICAL - GTX SERIES, RXT SERIES AND WAKE PRO 215
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 watercraft. 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 cool down. Refill tank as necessary.

NOTICE Never run engine longer than 2 minutes. Drive line seal has no cooling when watercraft 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 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 drain plug if the engine is hot.

Open seat.

On **iS** models, remove the deck extension. Refer to **BODY** subsection.

Install the TEST CAP (P/N 529 035 991) on the coolant tank.

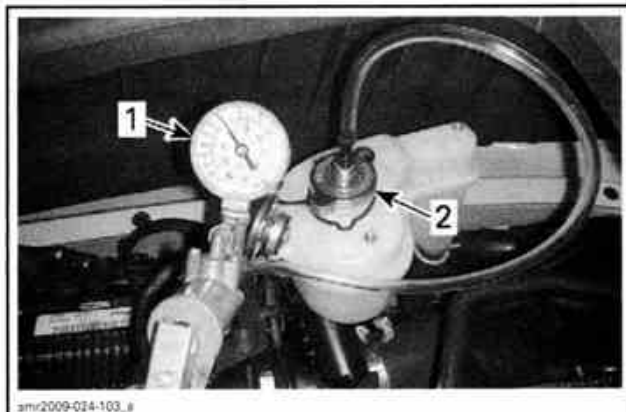


NOTE: It is not necessary to install a hose pincher on overflow hose.

Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)

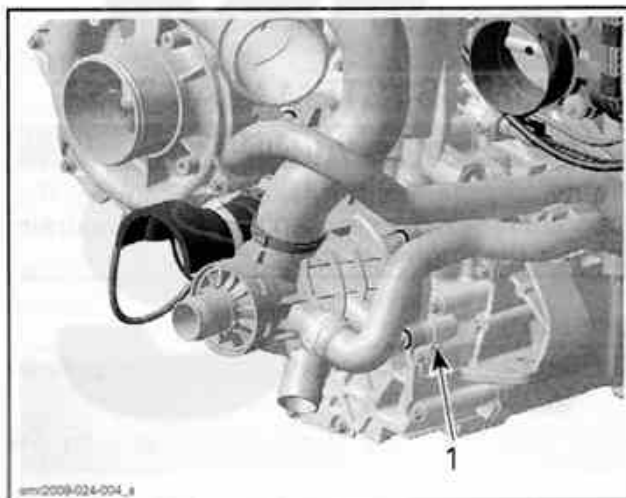
Connect the VACUUM/PRESSURE PUMP (P/N 529 021 800) to test cap and pressurize system through coolant tank to 90 kPa (13 PSI).



1. Vacuum/pressure pump
2. Test cap

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

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 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 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).

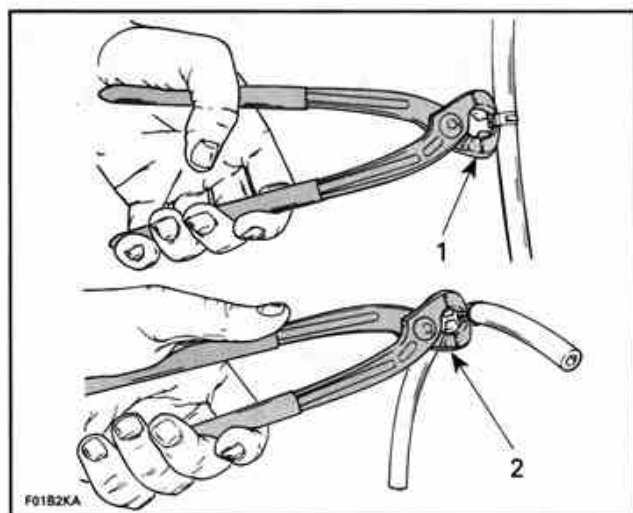
CLAMPS

Clamp Replacement

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

Section 02 ENGINE

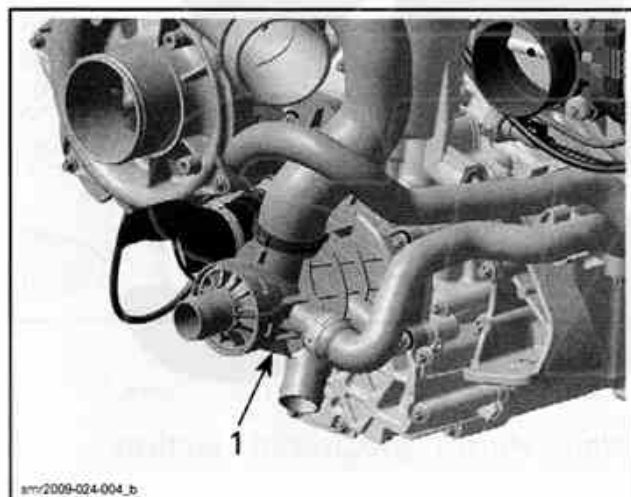
Subsection 11 (COOLING SYSTEM)



1. Cutting clamp
2. Securing clamp

NOTE: Always check general condition of hoses and clamp tightness.

WATER PUMP HOUSING



1. Water pump housing

Water Pump Housing Access

GTI Series, GTS Series and WAKE 155

Remove the seat.

GTX Series, RXT Series and WAKE PRO 215

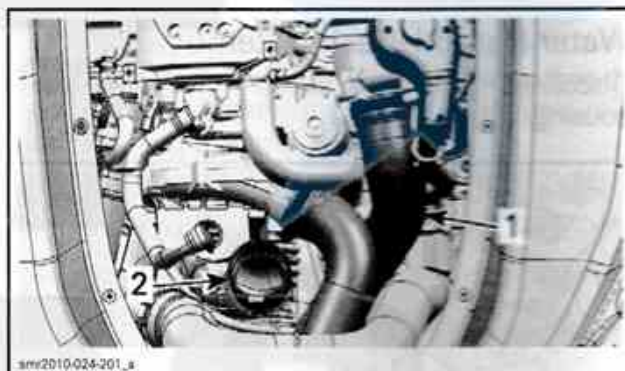
1. On **iS** models, remove moving deck and deck extension. Refer to **BODY** subsection.
2. Remove the air intake silencer. Refer to the appropriate subsection according to model:
 - **AIR INTAKE SYSTEM (EXCEPT iS AND aS MODELS)**
 - **AIR INTAKE SYSTEM (iS AND aS MODELS).**

3. Detach the air intake hose from the throttle body.



NATURALLY-ASPIRATED ENGINE

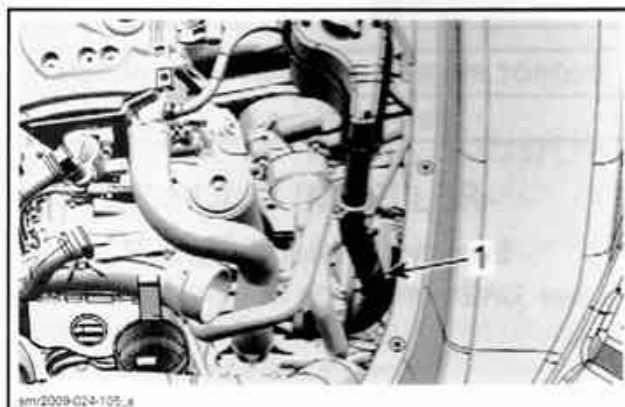
1. Detach intake hose at throttle body



SUPERCHARGED ENGINE

1. Detach intake hose at throttle body
2. Supercharger hose

4. On supercharged engines, remove also the hose from the supercharger.
5. Drain cooling system and engine oil.
6. Disconnect the coolant tank hose from water pump housing and move coolant tank aside to make room.

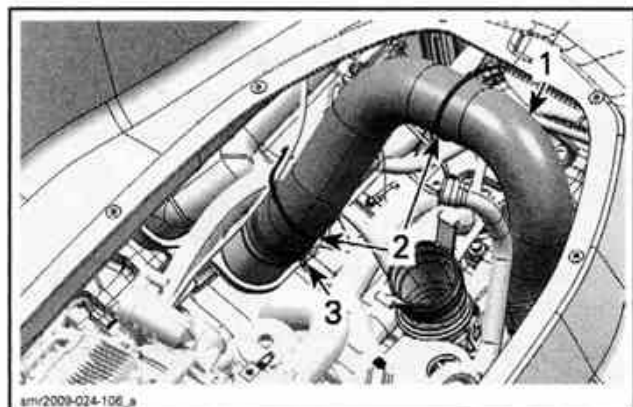


1. Coolant tank hose

Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)

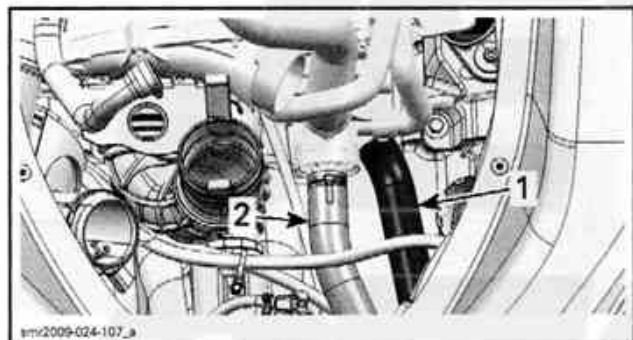
7. Disconnect exhaust hose from the resonator. Place hose over muffler.



1. Exhaust hose
2. Cut these locking ties
3. Retaining clamp

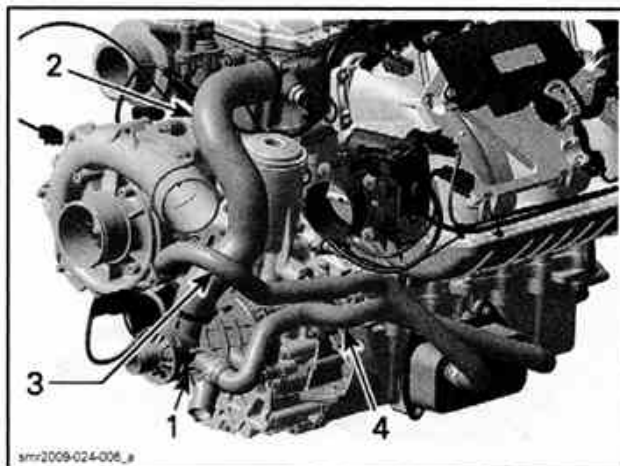
Water Pump Housing Removal

Disconnect ride plate hoses from water pump housing.



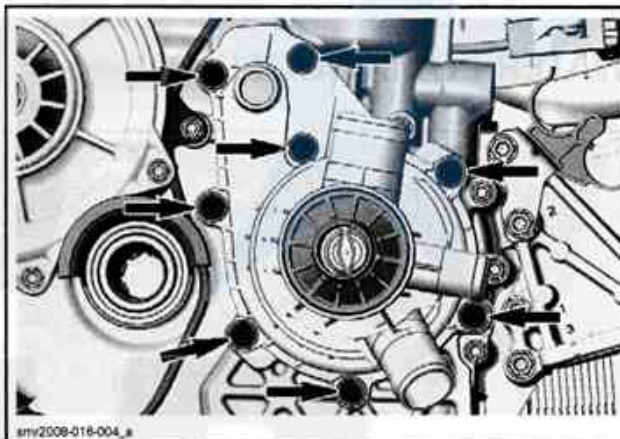
- TYPICAL
1. Ride plate outlet hose
2. Ride plate inlet hose

Disconnect the cylinder head outlet hose and oil cooler hoses.



- TYPICAL
1. Water pump housing
2. Cylinder head hose
3. Oil cooler inlet hose
4. Oil cooler outlet hose

Remove water pump housing screws.



TYPICAL

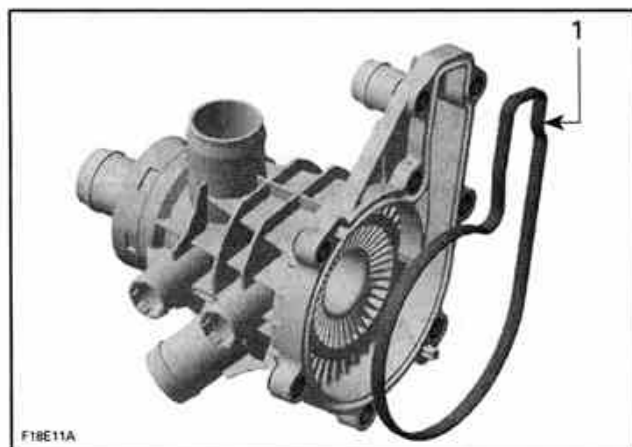
Pull the water pump housing to remove it.

Water Pump Housing Inspection

Check if gasket is brittle, hard or damaged and replace as necessary.

Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)

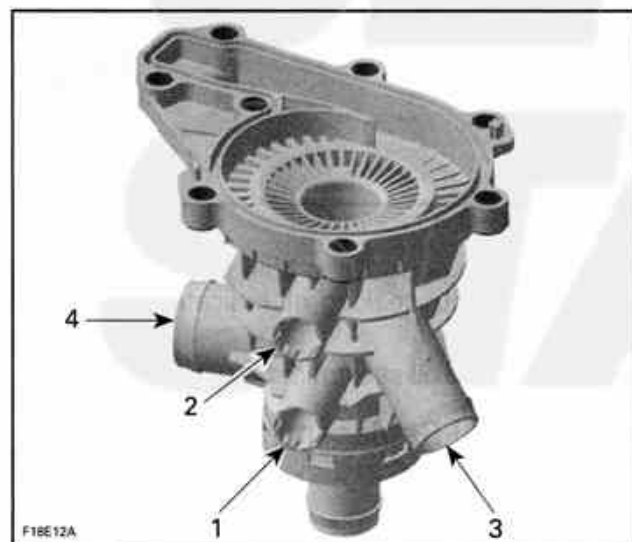


1. Water pump housing gasket

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 return hose and cylinder head return hose with a rag.



1. Oil cooler return connection
2. Coolant tank hose connection
3. Ride plate 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 outlet connection, replace the water pump housing.

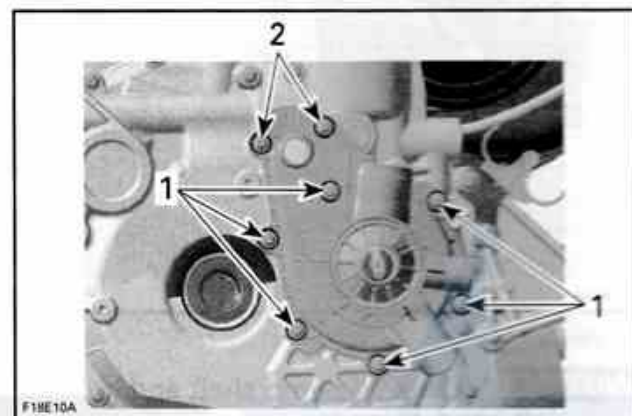
If there is no leak, check the operation of the thermostat.

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.

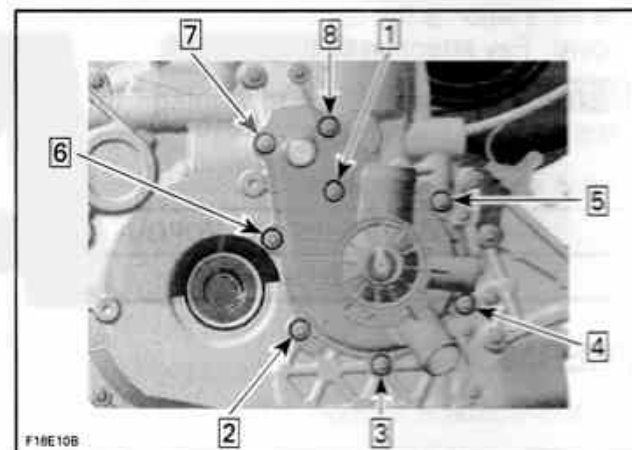
Install screws as per the following illustration.



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 following sequence.



WATER PUMP HOUSING SCREWS TORQUE

9 N•m (80 lbf•in)

WATER PUMP IMPELLER

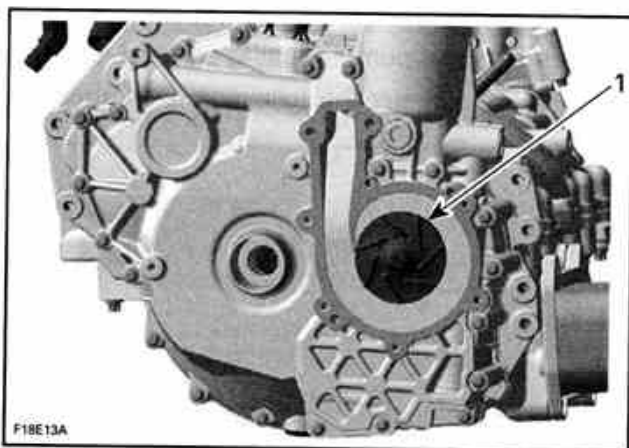
Water Pump Impeller Removal

Remove the **WATER PUMP HOUSING**, see procedure in this subsection.

Unscrew the impeller clockwise.

Section 02 ENGINE

Subsection 11 (COOLING SYSTEM)



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.

Torque impeller to specification.

WATER PUMP IMPELLER TORQUE
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

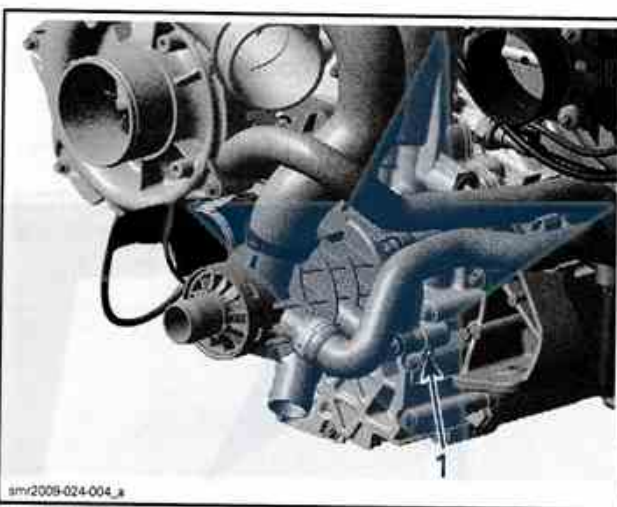
For installation, reverse the removal procedure, paying attention to the following details.

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.

CYLINDER HEAD

SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT LOCKING TOOL.....	529 035 839	161
DRIVE SHAFT ADAPTER.....	529 035 985	154
ENGINE LEAK DOWN TEST KIT.....	529 035 661	154
VALVE GUIDE PUSHER (6 MM).....	529 036 087	170
VALVE GUIDE REMOVER (6 MM).....	529 036 086	170
VALVE SPRING COMPRESSOR CUP.....	529 036 073	165
VALVE SPRING COMPRESSOR.....	529 035 724	165

SERVICE TOOLS – OTHER SUPPLIER

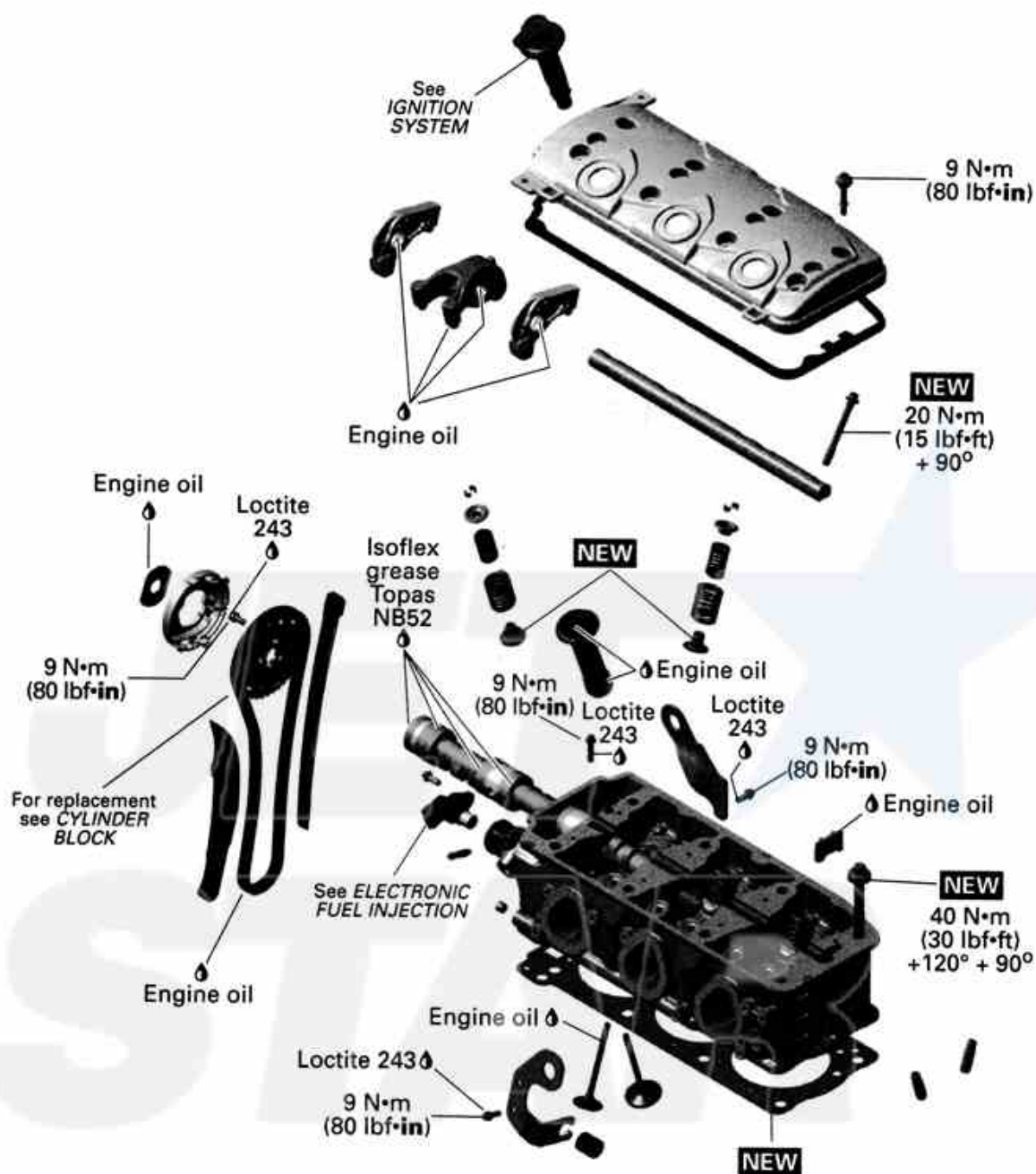
Description	Part Number	Page
SNAP-ON VALVE STEM SEAL PLIERS.....	YA8230	166

SERVICE PRODUCTS

Description	Part Number	Page
ISOFLEX GREASE TOPAS NB 52.....	293 550 021	162
LOCTITE 243 (BLUE).....	293 800 060	161, 164
MOLYKOTE G-N.....	420 297 433	170

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



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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 place the vehicle on level surface.

Always disconnect the negative wire from the battery before working on the engine.

Even if the removal of many parts is not necessary to reach another part, it is recommended to remove these parts in order to check them.

When disassembling parts that are duplicated in the engine, (e.g.: valves, bushings), it is strongly recommended to note their position (cylinder 1, 2 or 3) and to keep them as a "group". If you find a defective component, it would be much easier to find the cause of the failure within the group of parts (e.g.: you found a worn valve guide. A bent spring could be the cause and it would be easy to know which one among the springs is the cause to replace it if you grouped them at disassembly). Besides, since used parts have matched together during the engine operation, they will keep their matched fit when you reassemble them together within their "group".

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.

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

Be careful to burns when working on a hot engine.

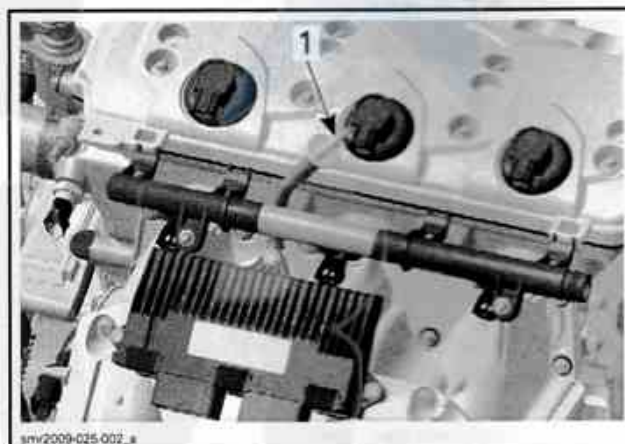
Preparation

1. Remove any required parts to give access to engine.
2. Remove the tether cord.
3. Remove jet pump (refer to *JET PUMP* subsection).
4. Remove coolant pressure cap.

⚠ WARNING

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

5. Remove oil dipstick.



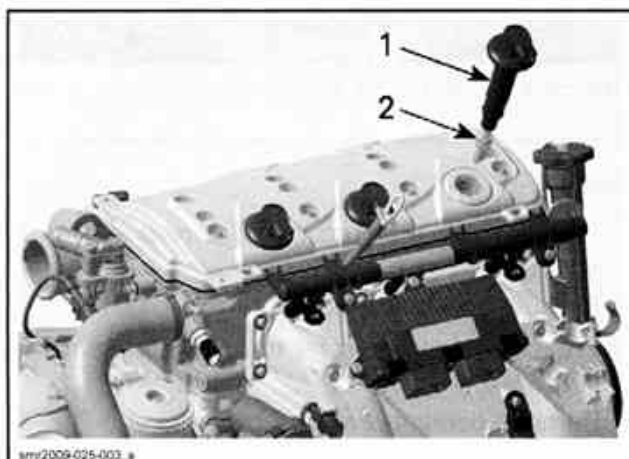
1. Oil dipstick

6. Unplug and remove ignition coils.
7. Remove spark plugs.

NOTE: Ignition coil may be used as an extractor.

Section 02 ENGINE

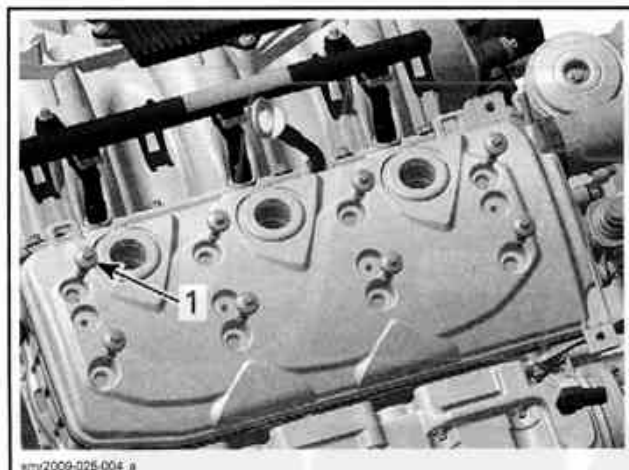
Subsection 12 (CYLINDER HEAD)



- 1. Ignition coil
- 2. Spark plug

8. Remove cylinder head cover cowl.

9. Unscrew and remove cylinder head cover.



- 1. Cylinder head cover screw (8)

10. Install the DRIVE SHAFT ADAPTER (P/N 529 035 985) on drive shaft end.

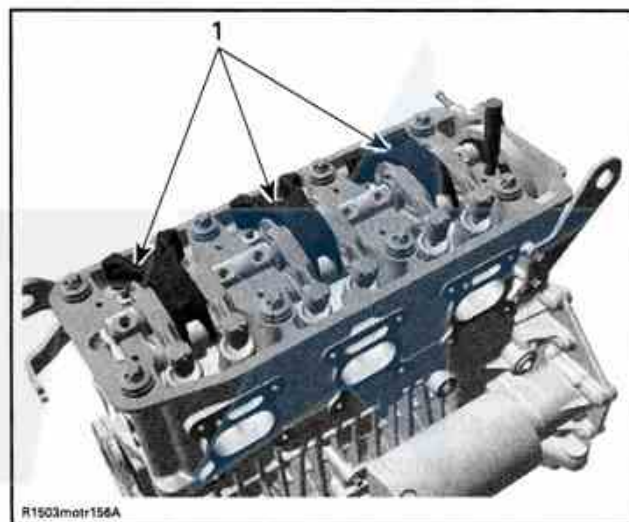


11. To rotate engine crankshaft, use an appropriate wrench lever with drive shaft adapter.

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

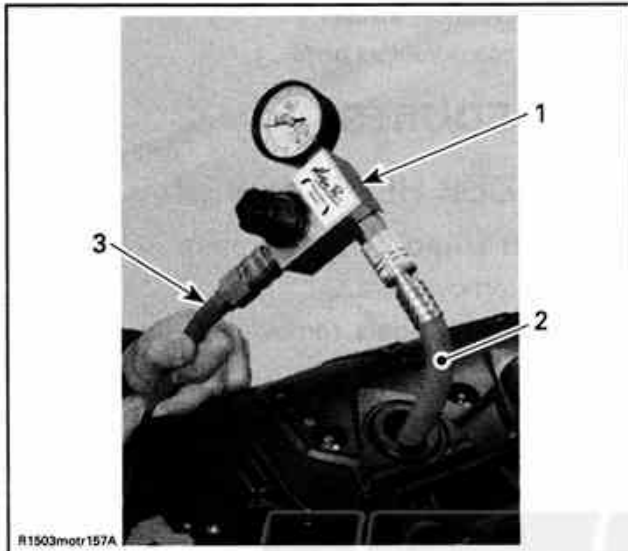
2. Secure the drive shaft adapter with a wrench lever against hull to prevent further crankshaft rotation.
3. Install gauge adapter from the ENGINE LEAK DOWN TEST KIT (P/N 529 035 661) into spark plug hole.
4. Connect to adequate air supply.

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

5. Set needle of measuring gauge to zero.
6. Supply combustion chamber with air.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



TYPICAL

1. Leak down tester gauge
2. Gauge adapter
3. Air supply hose

7. 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 down in some cases
41% and higher	Poor condition, diagnose and repair engine

- B. 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 **ENGINE MANAGEMENT** section.

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).

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)

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

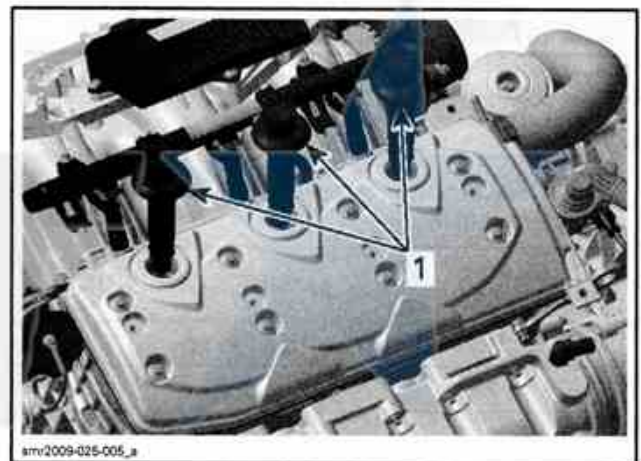
Cylinder Head Cover Access

Open or remove seat.

On iS and aS models, remove the rear ventilation cover.

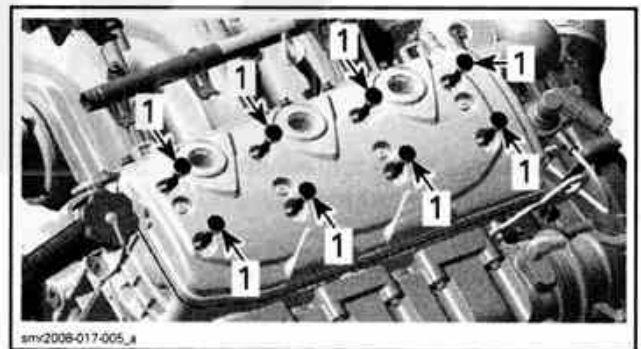
Cylinder Head Cover Removal

1. Unplug and remove ignition coils.



1. Ignition coils

2. Remove screws securing the cylinder head cover.

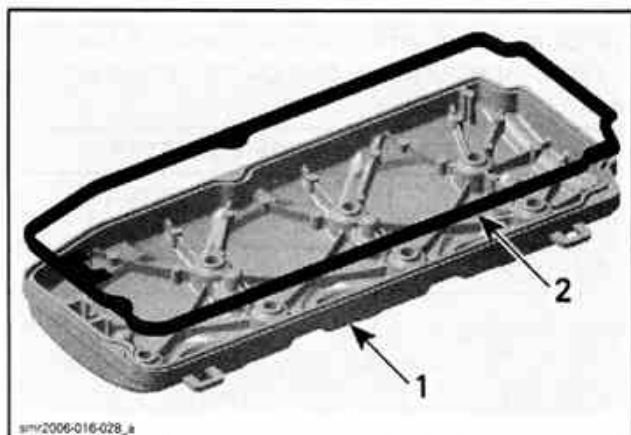


1. Cylinder head cover screws

3. Remove the cylinder head cover and its gasket.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



1. Cylinder head cover
2. Gasket

Cylinder Head Cover Inspection

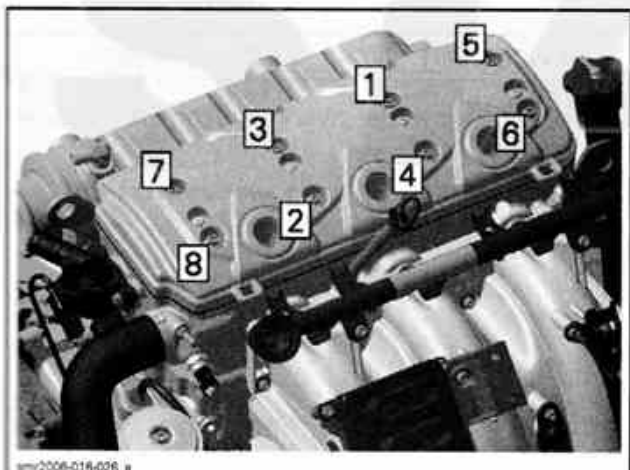
Check if the gasket on the cylinder head cover and the rubber bushing on the cylinder head cover screws are brittle, cracked or hard. If so, replace the gasket or the cylinder head cover screw accordingly.

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 the cylinder head cover screws according to following sequence.



TYPICAL

Torque screws to 9 N•m (80 lbf•in).

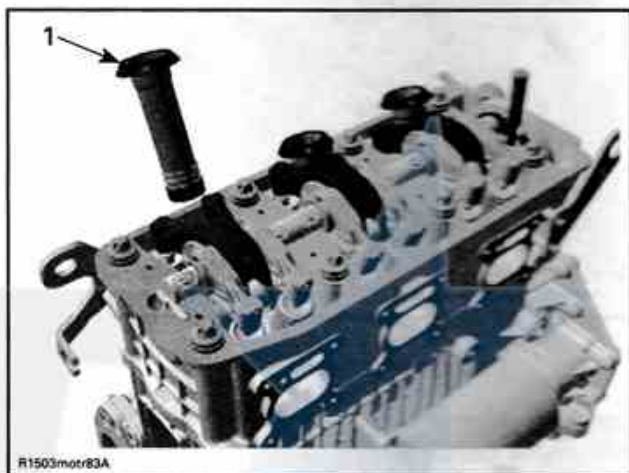
Install all other removed parts. Refer to proper subsection for procedure.

SPARK PLUG TUBES

Spark Plug Tube Removal

Remove the *CYLINDER HEAD COVER*, see procedure in this subsection.

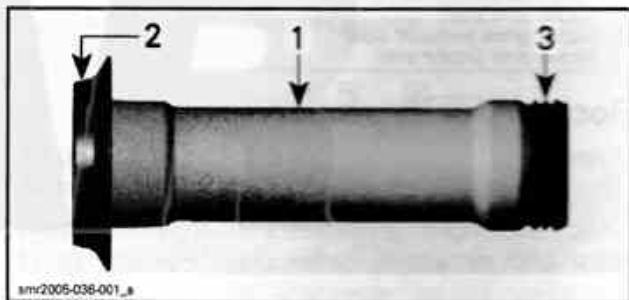
Pull spark plug tubes to remove them.



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.

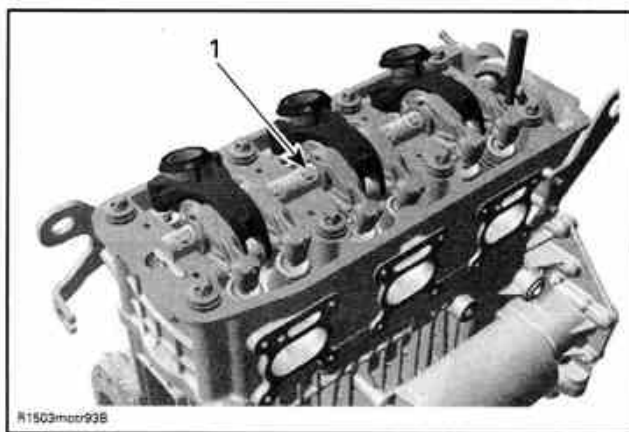
ROCKER ARMS

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.

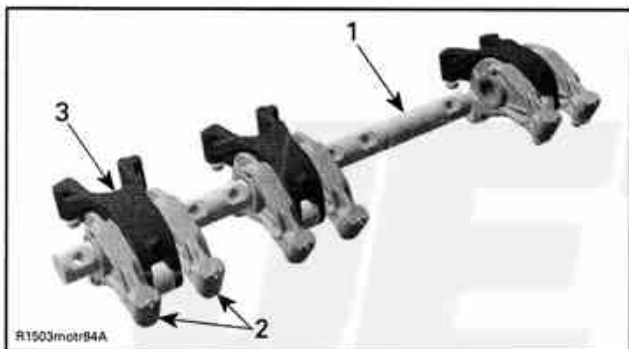
Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



1. Rocker arm shaft screw

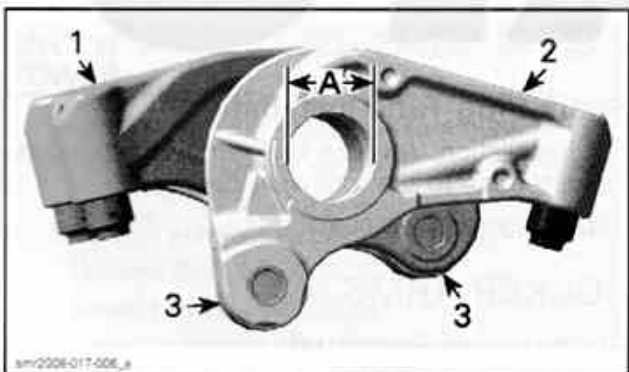
4. Remove rocker arm shaft with rocker arms.



- 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.

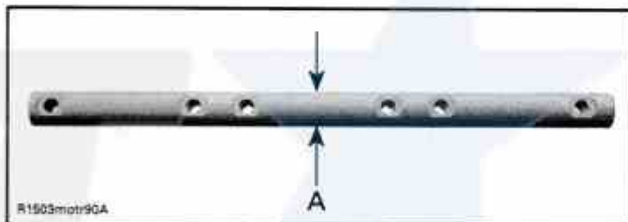
ROCKER ARM INSIDE DIAMETER	
NEW	20.007 mm - 20.020 mm (.7877 in - .7882 in)
SERVICE LIMIT	20.050 mm (.7894 in)

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

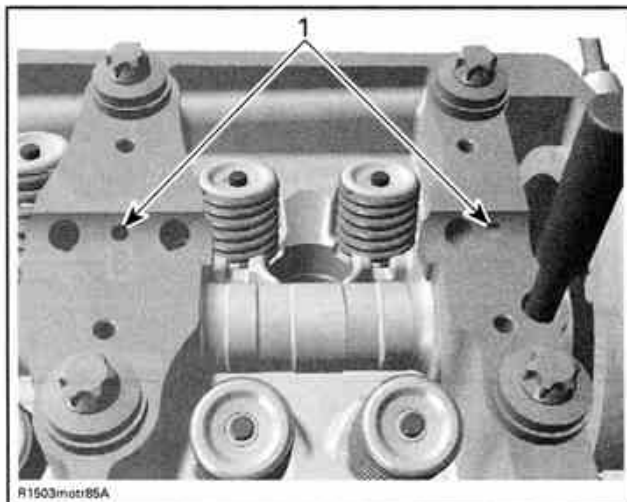
ROCKER ARM SHAFT DIAMETER	
NEW	19.980 mm - 19.993 mm (.7866 in - .7871 in)
SERVICE LIMIT	19.970 mm (.7862 in)

Any area worn excessively will require parts replacement.

Verify and clean oil orifices to ensure a good rocker arm shaft lubrication.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



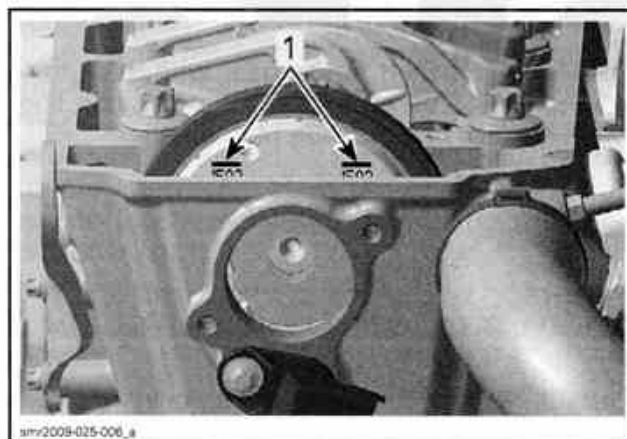
1. Oil orifices from the camshaft to the rocker arm shaft, then to the rocker arms and finally to the valve adjustment

Rocker Arm Installation

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

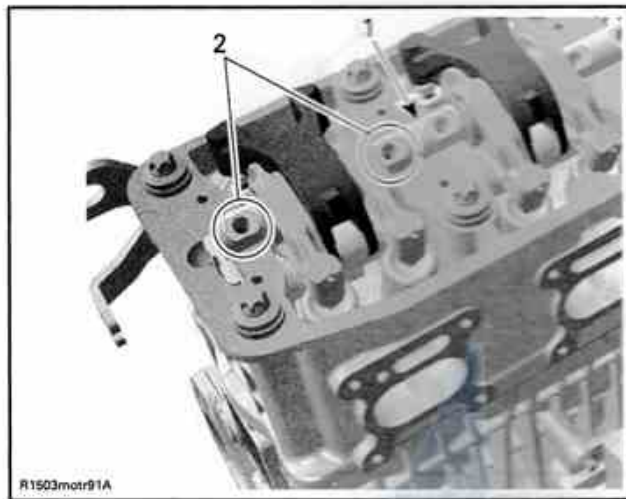
NOTE: The rocker arm shaft can only be installed in one specific position. Therefore the camshaft has to be positioned with its locking pin when the piston of cylinder 3 is on Ignition TDC.

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.

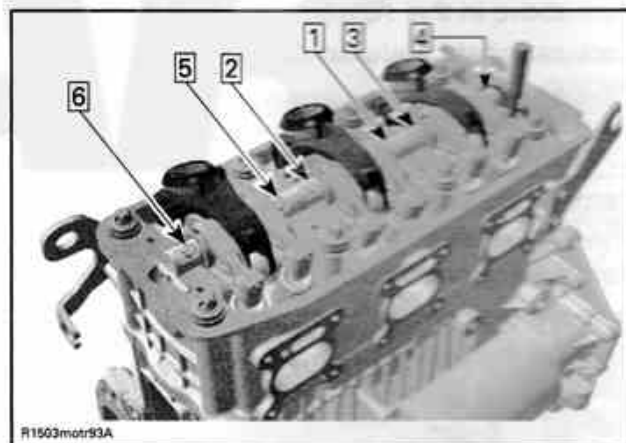


1. Rocker arm shaft
2. Rocker arm shaft notches

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.

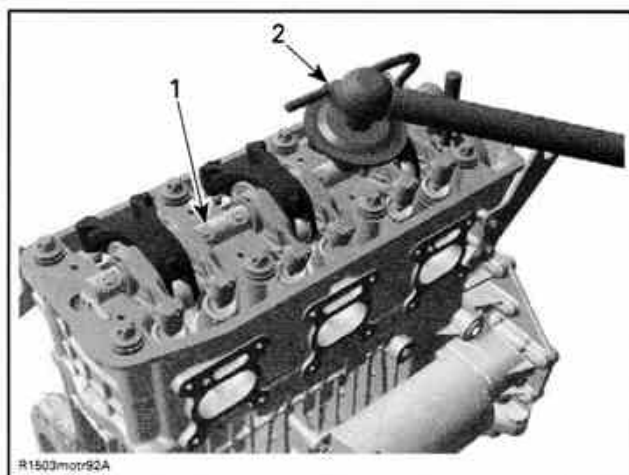
6. Torque screws at first to 10 N•m (89 lbf•in) according to following sequence.



7. Retorque screws to 20 N•m (15 lbf•ft).
8. Finish tightening screws turning an additional 90° rotation with a torque angle gauge.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



1. Rocker arm shaft screw
2. Torque angle gauge

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.

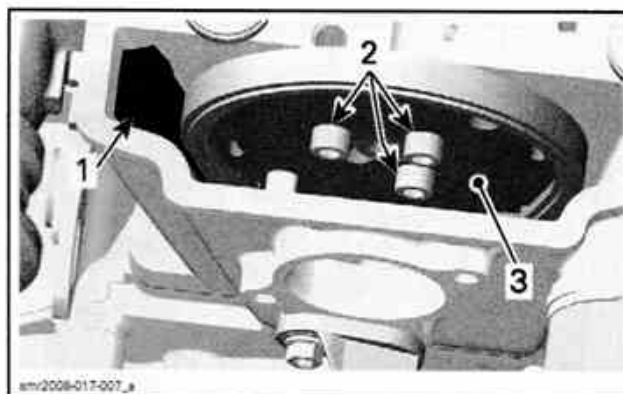
Remove the oil separator cover. Refer to *LUBRICATION SYSTEM* subsection.

Remove the chain tensioner. Refer to *CYLINDER BLOCK* subsection.

Remove the chain guide.

Remove the camshaft timing gear screws.

Remove the camshaft timing gear.



1. Chain guide
2. 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).

For crankshaft timing gear replacement, refer to *CYLINDER BLOCK* subsection.

Camshaft Timing Gear Installation

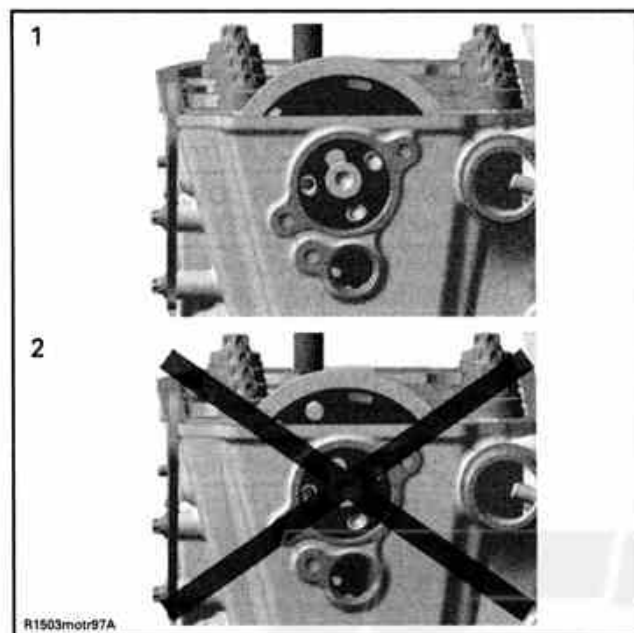
For installation, reverse the removal procedure. Pay attention to the following details.

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.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



1. Good (with 1503 aligned)
2. Never

Install timing chain. Refer to *CYLINDER BLOCK* subsection.

Ensure chain guides are properly installed.

Loosely install gear chain screws.

Install chain tensioner.

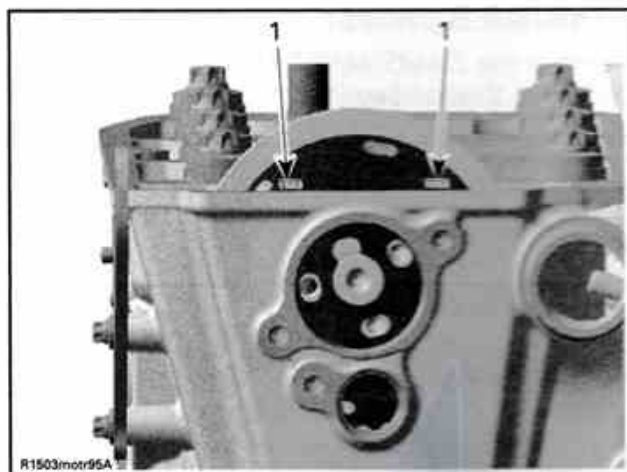
NOTE: There can be 2 different positions to install the timing gear on the camshaft. Basically both positions are working well, since the camshaft and crankshaft are locked in their proper position. Due to some tolerances, there could be one position which fits better than the other one. To check this, perform the following test.

Check if 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 timing gear screws and apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads.

Tighten timing gear screws to 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 locking tools when finished.

Install all other removed parts.

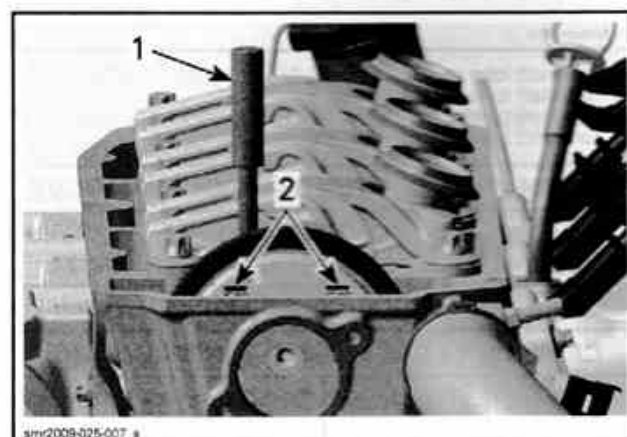
CAMSHAFT

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 using the CAMSHAFT LOCKING TOOL (P/N 529 035 839).



4. 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

Section 02 ENGINE

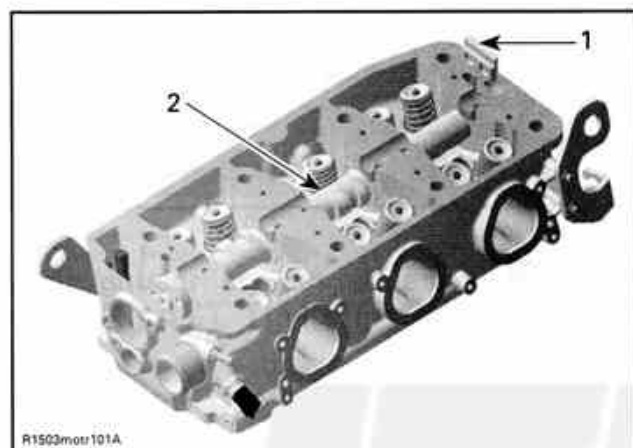
Subsection 12 (CYLINDER HEAD)

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.



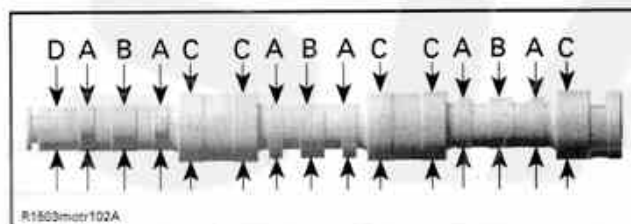
1. Camshaft lock
2. Camshaft

Camshaft Inspection

Check each lobe and bearing journal of camshaft for scoring, scuffing, cracks or 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)

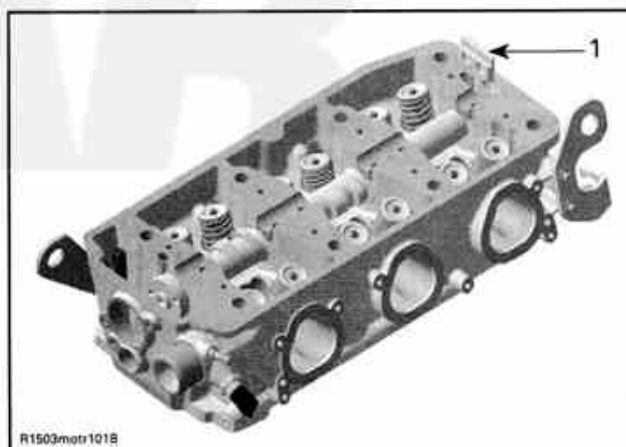
Replace parts that are not within specifications.

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.

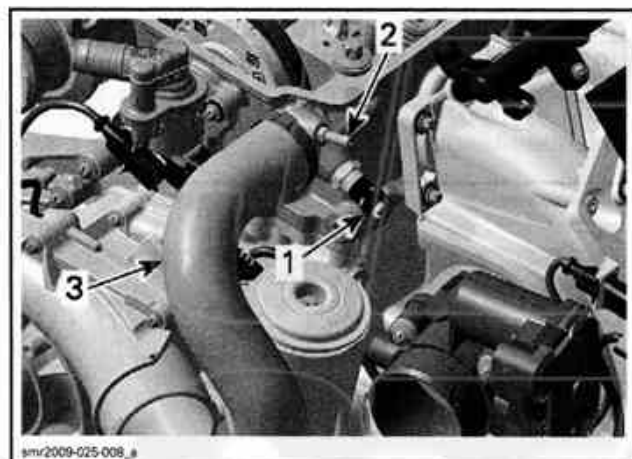
Remove blow-by valve from cylinder head. Refer to *LUBRICATION SYSTEM* subsection.

Unplug the camshaft position sensors (CAPS).

Unplug the coolant temperature sensor (CTS).

Disconnect bleeding hose.

Disconnect the cylinder head outlet hose.

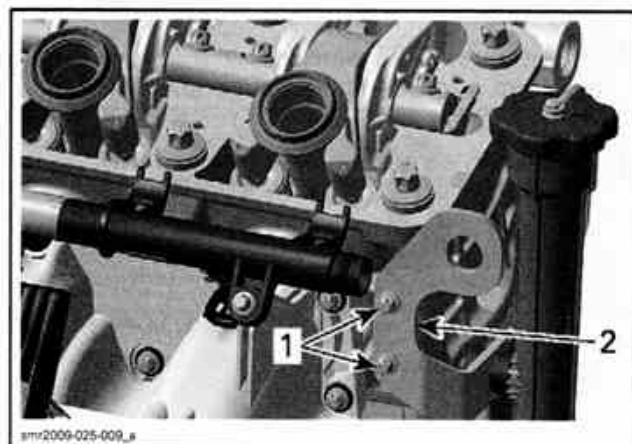


- 1. Coolant temperature sensor (CTS)
- 2. Bleeding nipple
- 3. Cylinder head outlet hose

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

Remove the exhaust manifold. Refer to *EXHAUST SYSTEM* subsection.

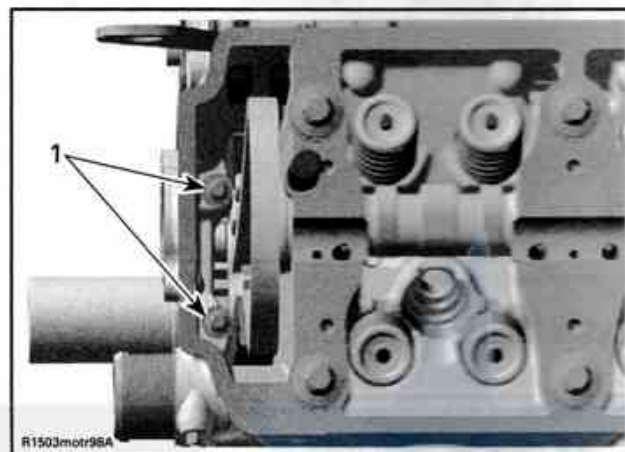
Unscrew the oil filler tube support from cylinder head.



- 1. Retaining screws
- 2. Oil filler tube support

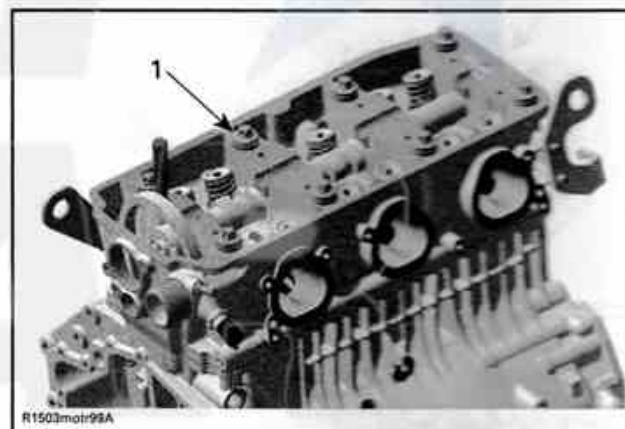
Remove the *CAMSHAFT TIMING GEAR*, see procedure in this subsection.

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 gasket.

Cylinder Head Cleaning

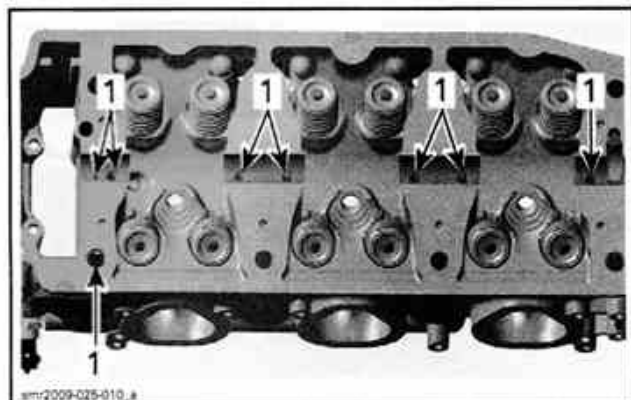
Remove carbon deposits from combustion chamber, exhaust port and piston top.

Clean cylinder head, especially cylinder head screw surface from oil spillage.

Blow out the oil orifices and check if they are not clogged.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)

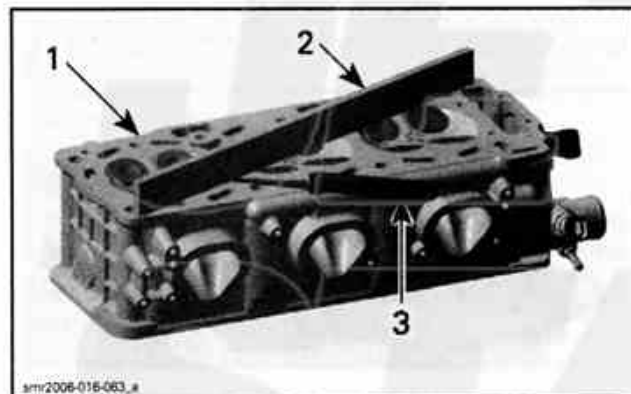


1. Oil orifices

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.

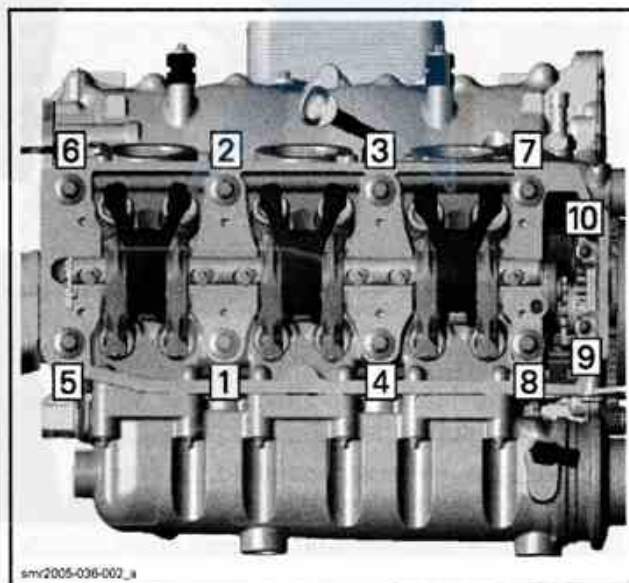
Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of M6 screws.

Install M6 screws and manually tighten them.

Install **NEW** M11 screws and tighten them manually.

NOTICE This assembly uses stretch screws. As the M11 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 screws as described below.



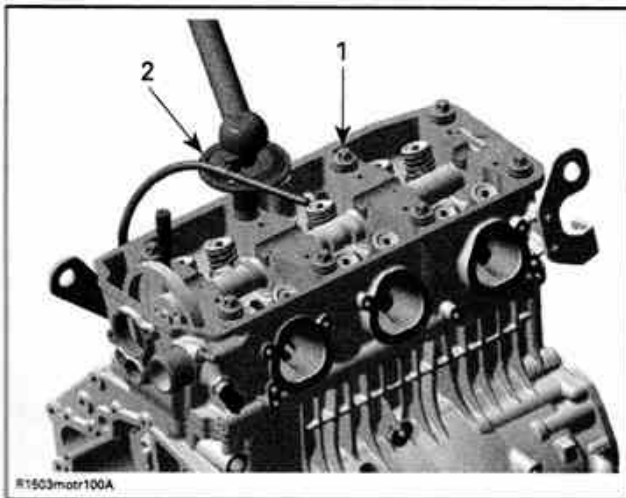
1. First torque M11 screws to 40 N•m (30 lbf•ft).

2. Then tighten M11 screws turning a 120° rotation with a torque angle gauge and finish tightening with an additional 90° rotation.

3. Torque M6 screws to 9 N•m (80 lbf•in).

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



1. M11 cylinder screws
2. Angle torque wrench

Remove all locking tools.
Install all removed parts.

VALVE SPRINGS

Valve Spring Removal

Remove rocker arm shaft. Refer to *ROCKER ARM* procedure in this subsection.

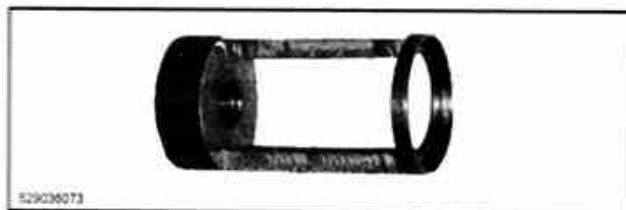
Remove *CYLINDER HEAD*, see procedure in this subsection.

Compress valve springs, using the VALVE SPRING COMPRESSOR (P/N 529 035 724) and the VALVE SPRING COMPRESSOR CUP (P/N 529 036 073).



529035724

VALVE SPRING COMPRESSOR

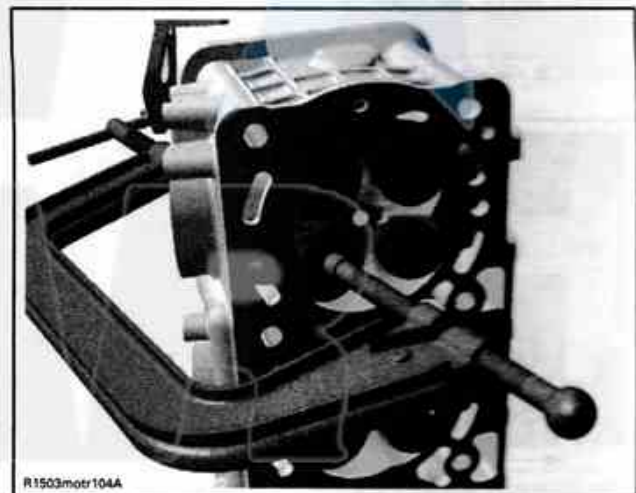


529036073

VALVE SPRING COMPRESSOR CUP



1. Valve spring compressor clamp
2. Valve spring compressor cup



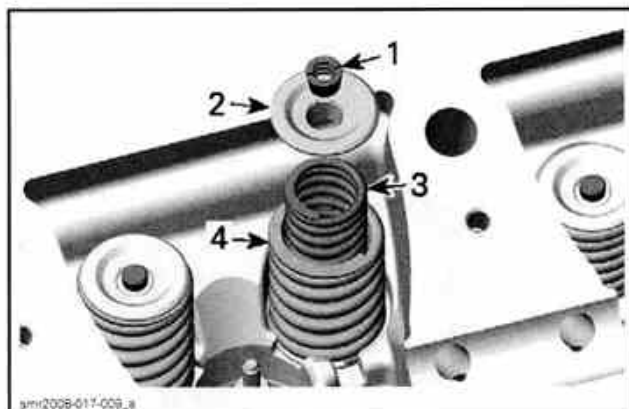
LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve cotteners.

Withdraw valve spring compressor, valve spring retainer and valve springs.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



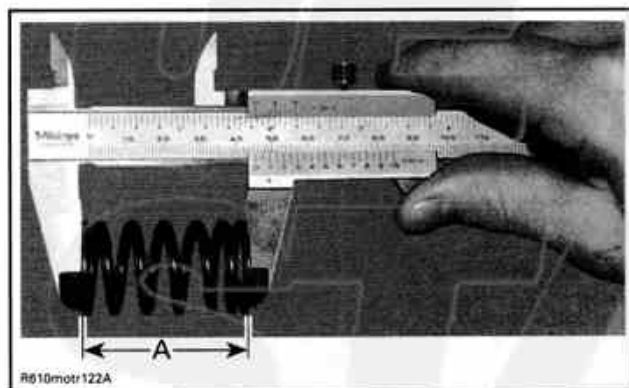
1. Valve cotter
2. Valve spring retainer
3. Inner valve spring
4. Outer valve spring

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

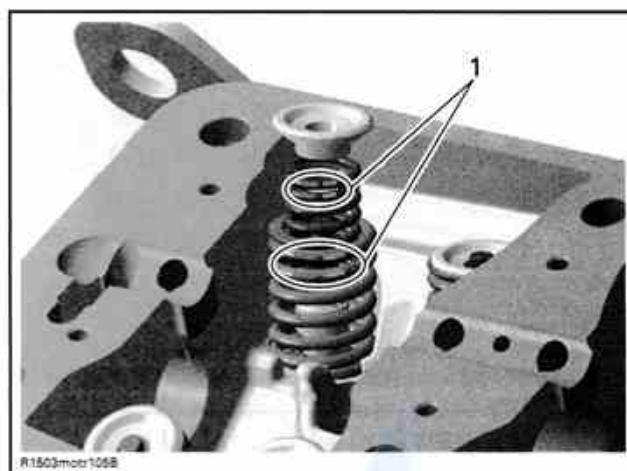
OUTER VALVE SPRING FREE LENGTH	
NEW NOMINAL	45.45 mm (1.789 in)
SERVICE LIMIT	43.00 mm (1.693 in)
INNER VALVE SPRING FREE LENGTH	
NEW NOMINAL	41.02 mm (1.615 in)
SERVICE LIMIT	38.8 mm (1.528 in)

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 cotteners must be properly engaged in valve stem grooves.



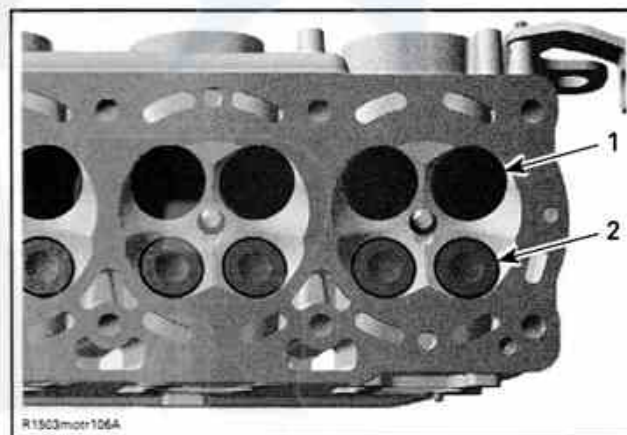
1. Position of the valve spring

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 such as the SNAP-ON VALVE STEM SEAL PLIERS (P/N YA8230).

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)



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

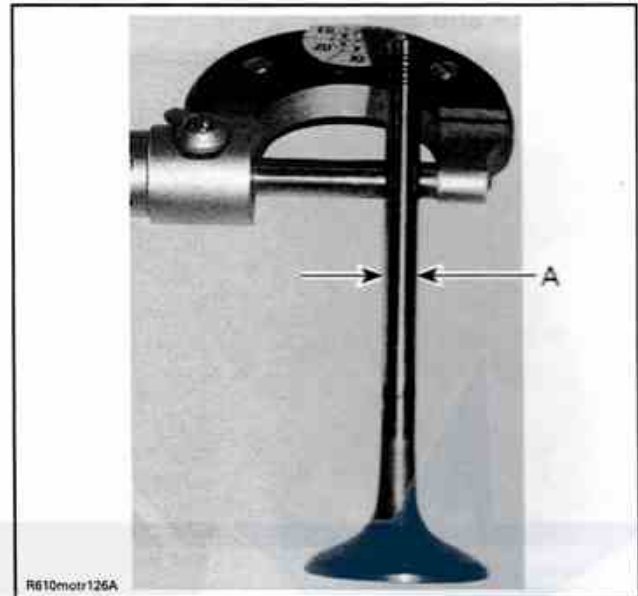
Inspect valve surface, check for abnormal stem wear and bending. If so, replace by a new one.

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	

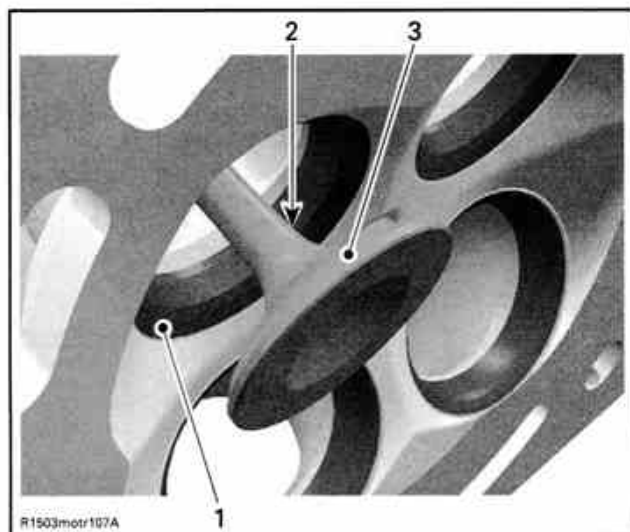
Replace valve guide if it is out of specification or has other damages such as wear or friction surface. Refer to valve guide replacement below.

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	

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)

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.

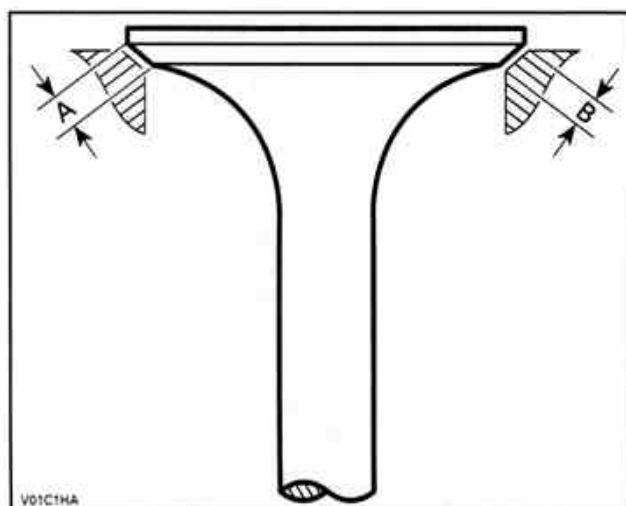
Measure valve face contact width.

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.

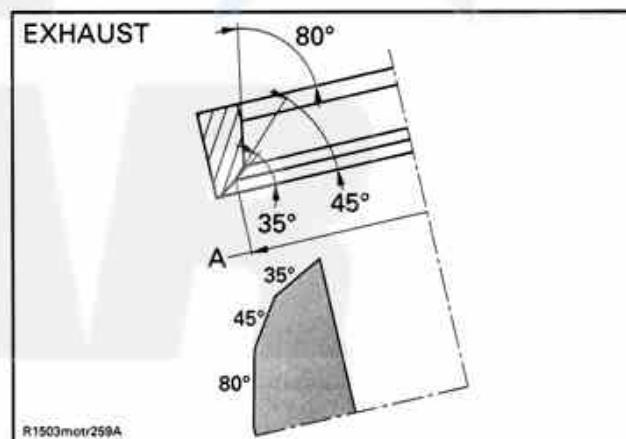


- A. Valve face contact width
B. Valve seat contact width

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.

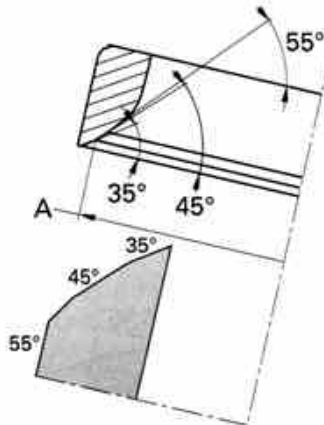


- A. Valve seat outer diameter EXHAUST

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)

INTAKE



A. Valve seat outer diameter INTAKE

VALVE SEAT OUTER DIAMETER

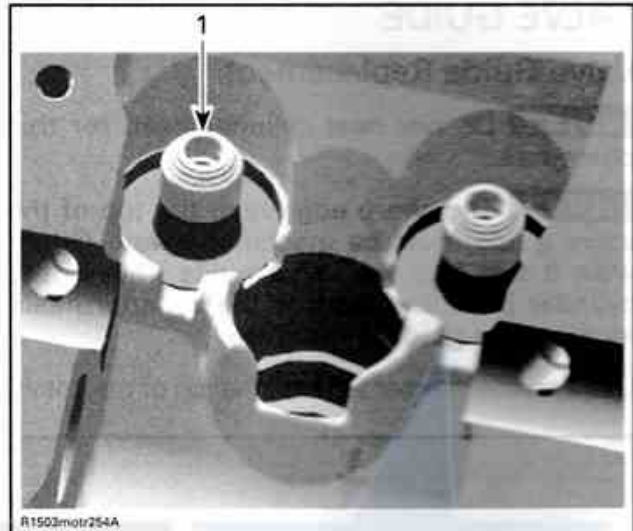
INTAKE	37.35 mm (1.4705 in)
EXHAUST	30.3 mm (1.1929 in)

- Using a 55° stone for the intake and an 80° stone for the exhaust valve, reduce the valve seat contact width to the appropriate value mentioned above.
- Finally, coat the valve seating surface with a fine paste of valve grinding compound using a manual valve grinding mandrel. Lightly grind the valves until a smooth, even, uniform sealing surface of the appropriate inside and outside diameter is obtained on both the valve and the seat. Use only a hand held valve grinding mandrel with a suction cup, rotating the valve back and forth through about 45°, and then advancing the valve 45° before repeating this operation.

Valve Installation

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

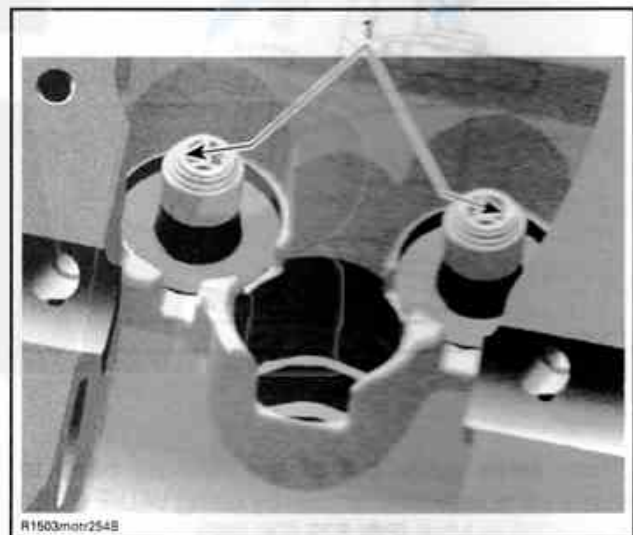
Install **NEW** valve stem seal.



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.

Section 02 ENGINE

Subsection 12 (CYLINDER HEAD)

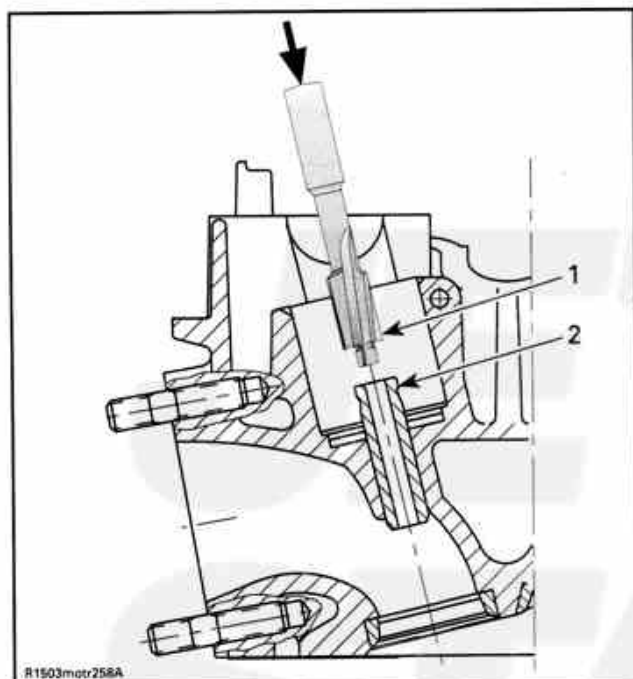
VALVE GUIDE

Valve Guide Replacement

NOTICE Do not heat cylinder head for this procedure.

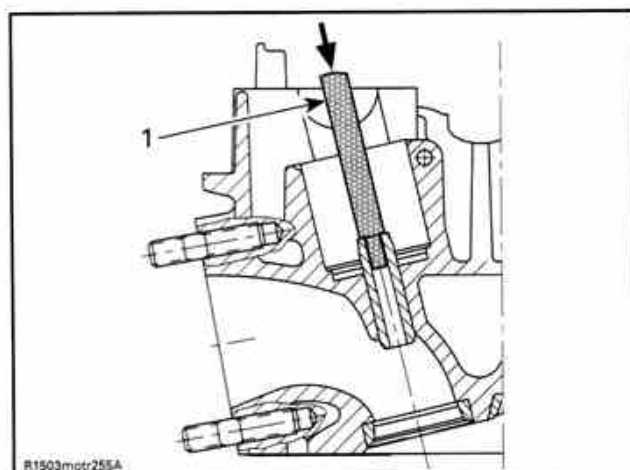
NOTICE The sharp edge near the top of the valve guide must be machined away. Otherwise it will foul the valve guide hole in the cylinder head and destroy the cylinder head, as the valve guide is removed.

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

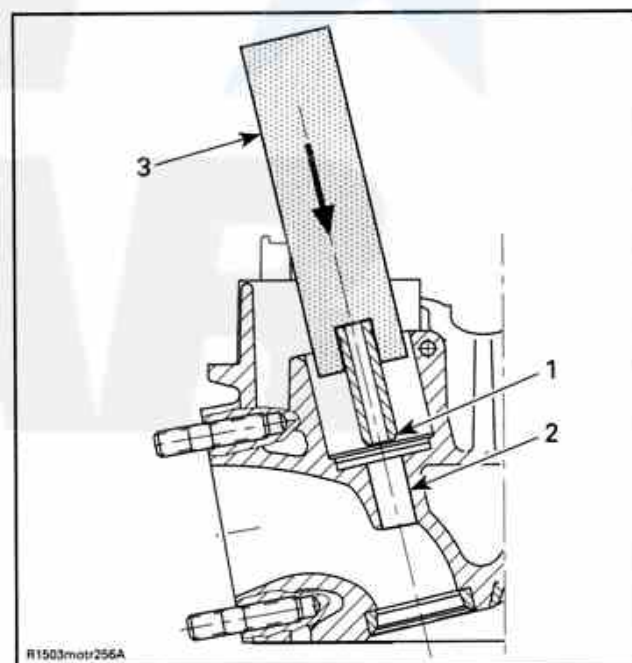


TYPICAL
1. Punch

Check valve guide bore for abraded material. The inlet and exhaust valve guides have the same length and are interchangeable.

NOTE: If valve guide has caused scoring during extraction, replace the cylinder head.

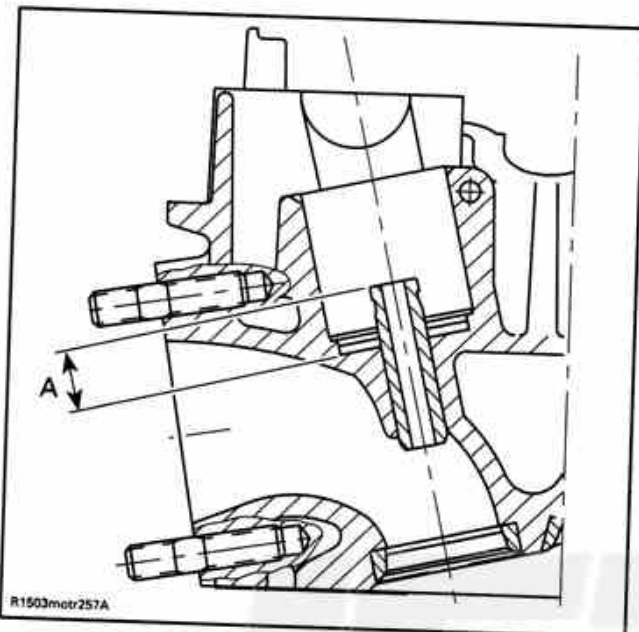
Grease the bore in cylinder head and the leading end of valve guide with MOLYKOTE G-N (P/N 420 297 433).



TYPICAL
1. Valve guide leading end
2. Cylinder head bore
3. Jig

With the VALVE GUIDE PUSHER (6 MM) (P/N 529 036 087), press the valve guide into the **COLD** cylinder head as shown.

Section 02 ENGINE
Subsection 12 (CYLINDER HEAD)



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	184, 188, 190, 195
HANDLE	420 877 650	193
PISTON CIRCLIP INSTALLER.....	529 035 765	181
STARTER DRIVE SEAL PUSHER.....	420 876 502	193

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON PISTON RING COMPRESSOR PLIERS	RC980	181

SERVICE PRODUCTS

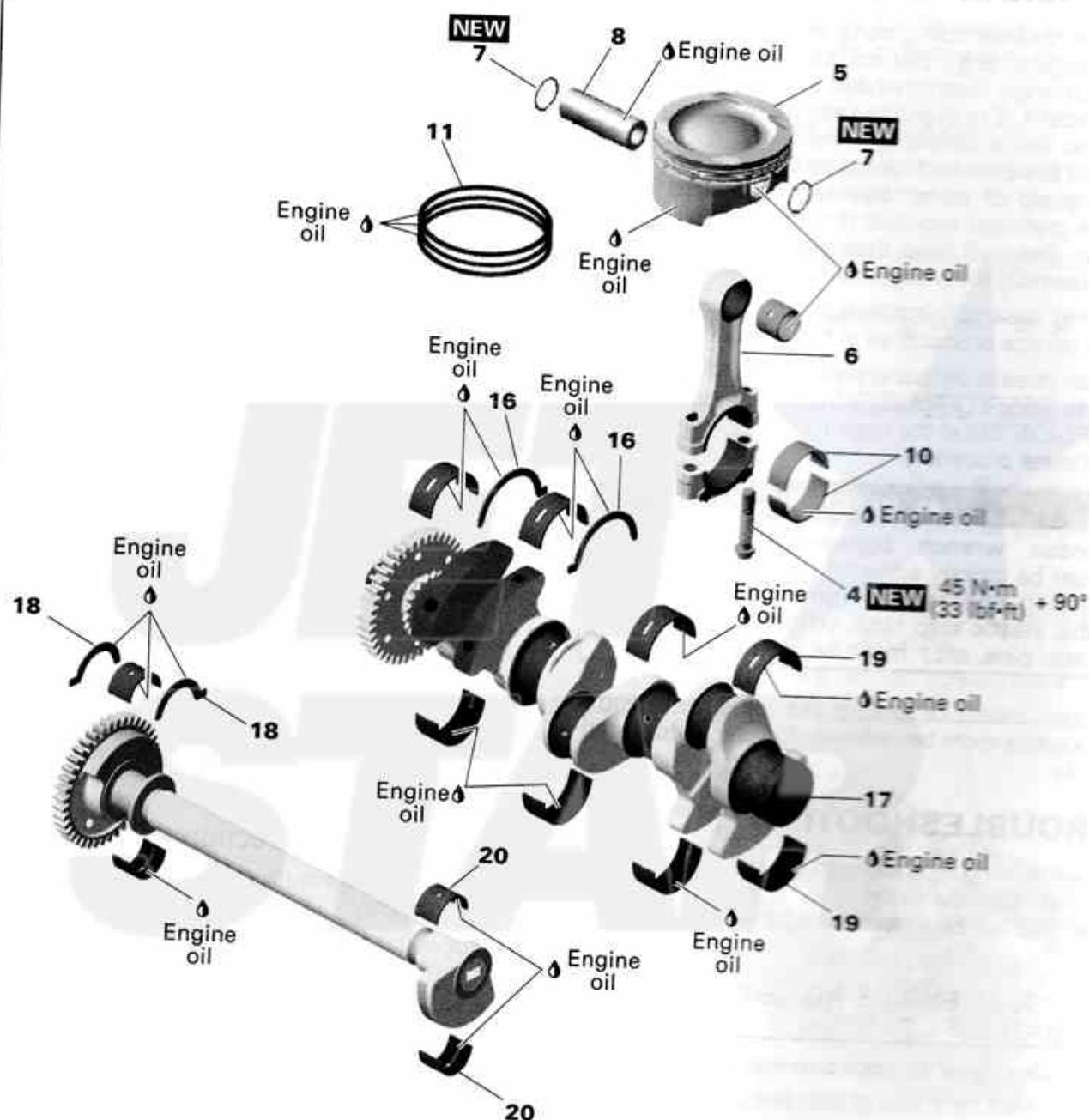
Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	194
LOCTITE 5910	293 800 081	193
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	193

Subsection 13 (CYLINDER BLOCK)



Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)



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Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)

GENERAL

When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position (cylinder 1, 2 or 3) and to keep them as a "group". If you find a defective component, it would be much easier to find the cause of the failure within the group of parts. Besides, since used parts have matched together during the engine operation, they will keep their matched fit when you reassemble them together within their "group".

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.

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.

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 scraper 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.

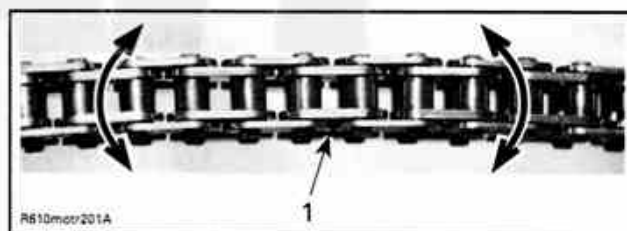
PROCEDURES

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)

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)

- 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.

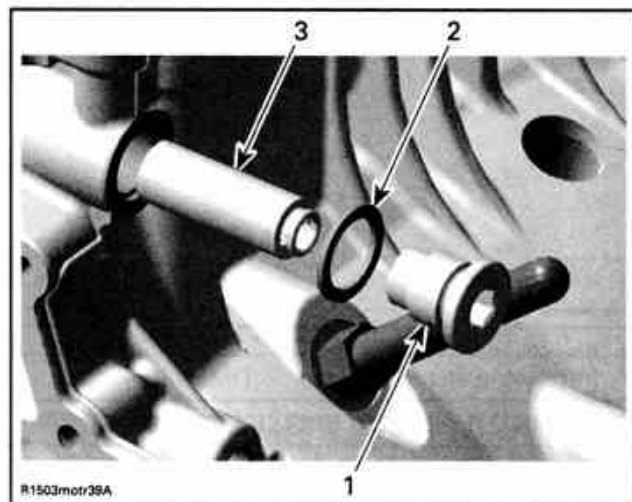
CHAIN TENSIONER

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).

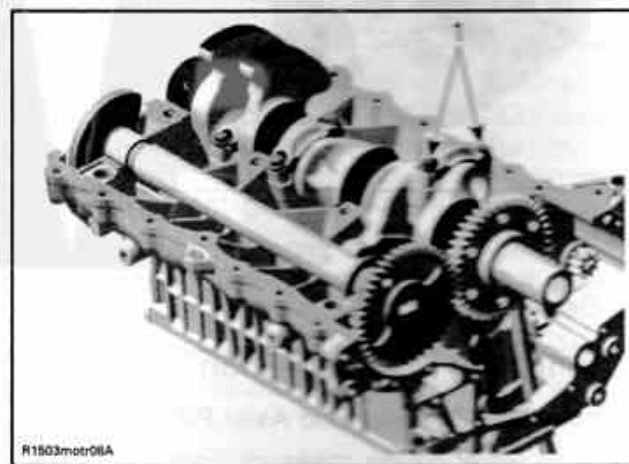
PISTONS AND CONNECTING RODS

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.



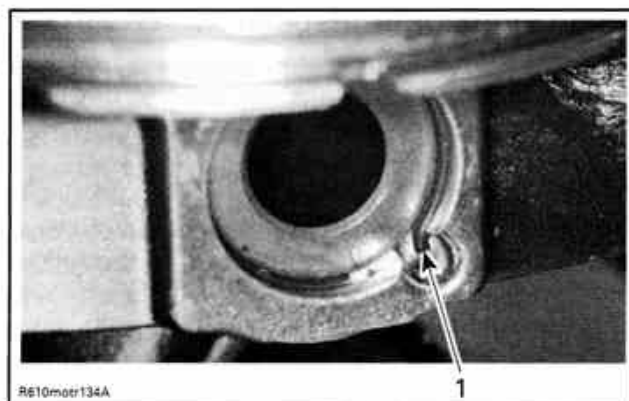
1. Connecting rod screws

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.

Section 02 ENGINE

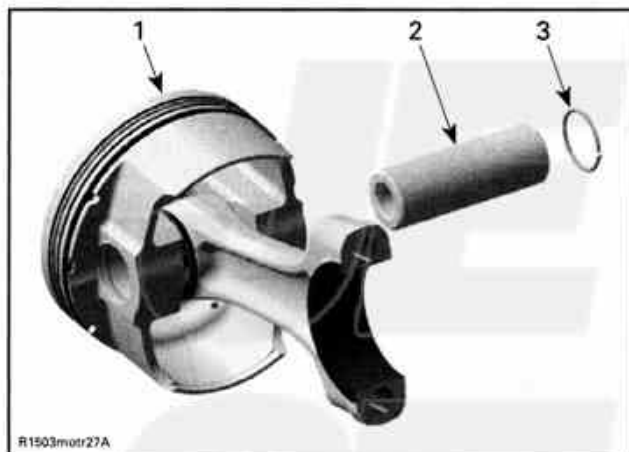
Subsection 13 (CYLINDER BLOCK)



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.



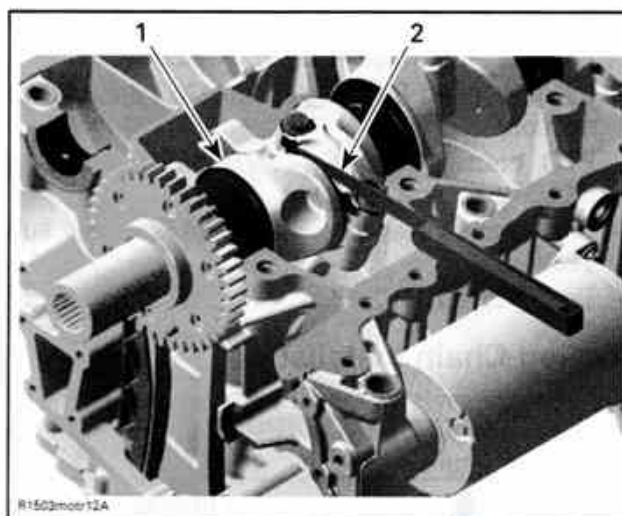
1. Piston
2. Piston pin
3. Circlip

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.



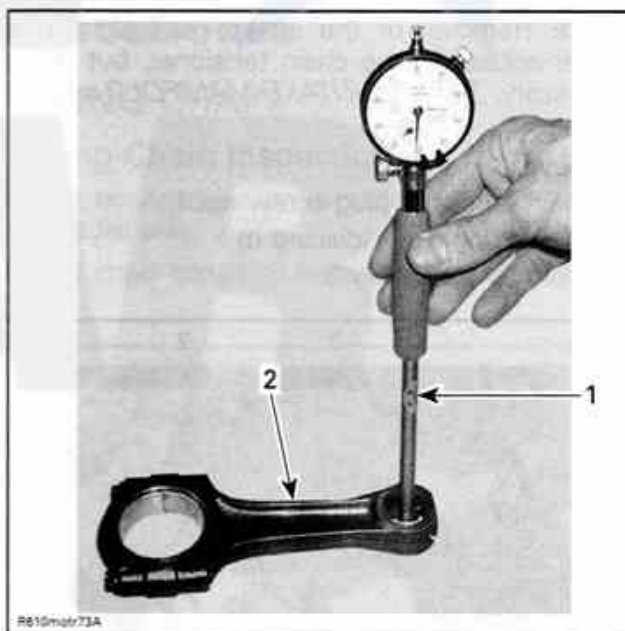
1. Crankshaft
2. Feeler gauge

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)

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)

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)

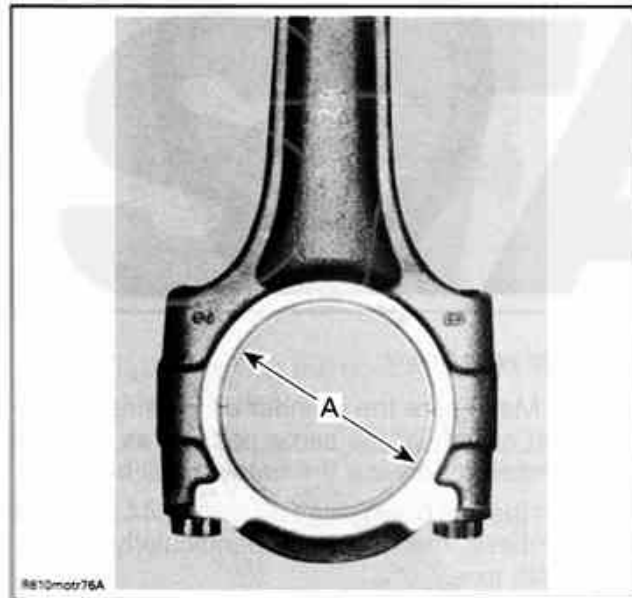
Connecting Rod Big End Radial Play

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)

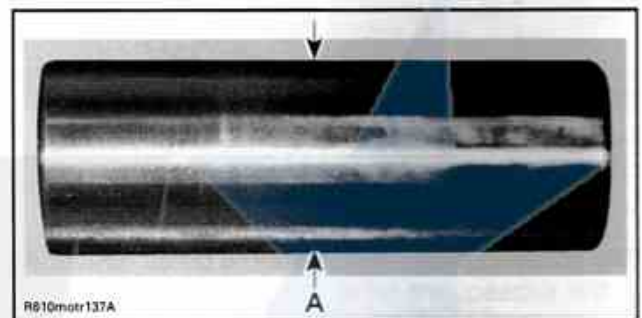
Use **NEW** bearings, when connecting rod big end diameter is out of specification.

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.

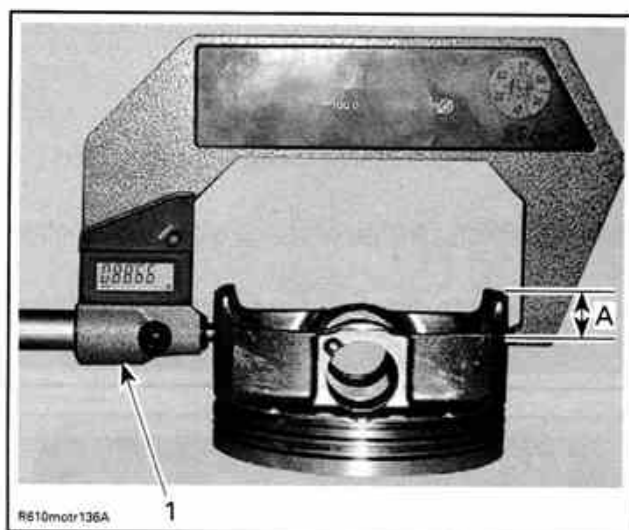
Piston Inspection

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.

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)



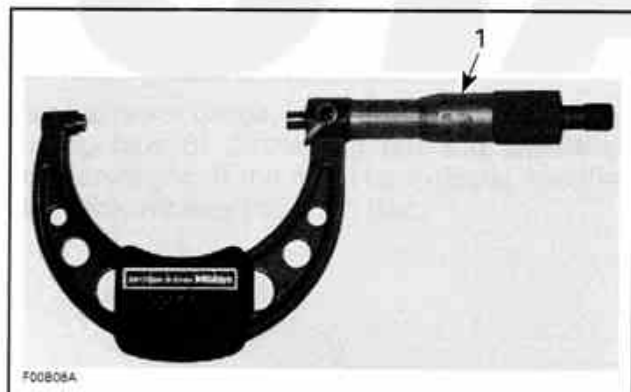
1. Measuring perpendicularly (90°) to piston pin axis
A. 18 mm (.709 in)

The measured dimension should be as described in the subsequent table. If not, replace piston.

PISTON MEASUREMENT	
130 AND 155 ENGINES	
NEW NOMINAL	99.951 mm - 99.969 mm (3.935 in - 3.936 in)
SERVICE LIMIT	99.90 mm (3.933 in)
215 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

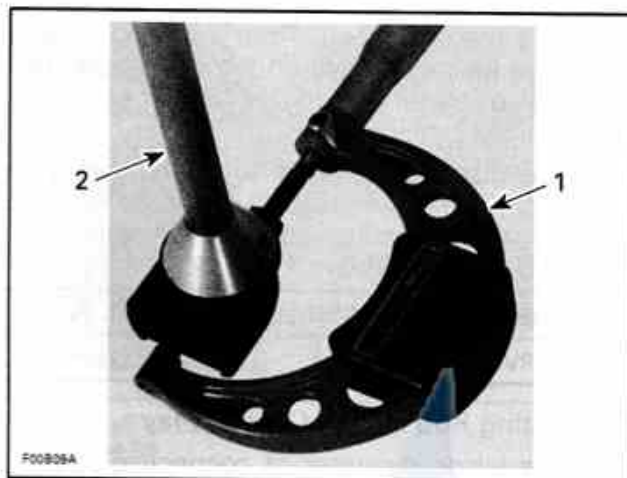
Adjust and lock a micrometer to the piston dimension.



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.

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)

PISTON/CYLINDER CLEARANCE	
130 AND 155 ENGINES	
NEW NOMINAL	0.024 mm - 0.056 mm (.001 in - .002 in)
SERVICE LIMIT	0.100 mm (.004 in)
215 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.

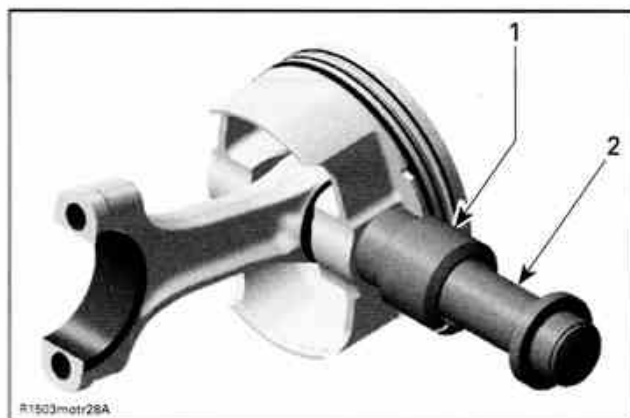
Insert piston pin into piston and connecting rod.

Use the PISTON CIRCLIP INSTALLER (P/N 529 035 765) to assemble the piston circlip.



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



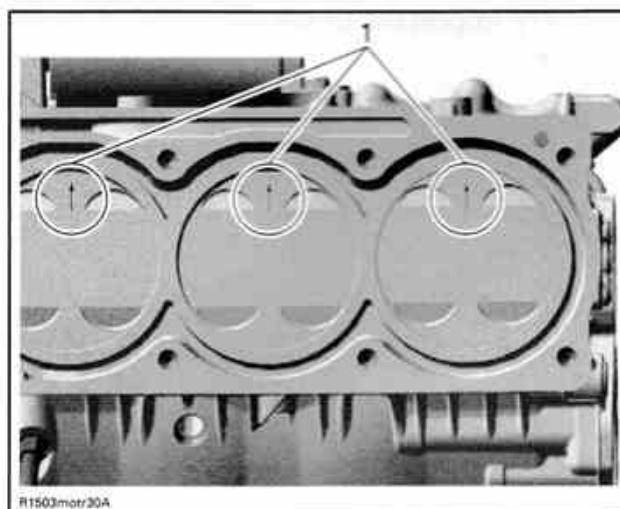
CORRECT POSITION OF THE PISTON CIRCLIP

Piston and Connecting Rod Installation

1. Using a piston ring compressor such as the SNAP-ON PISTON RING COMPRESSOR PLIERS (P/N RC980), slide piston into cylinder.



NOTICE Install piston with punched arrow toward exhaust side.

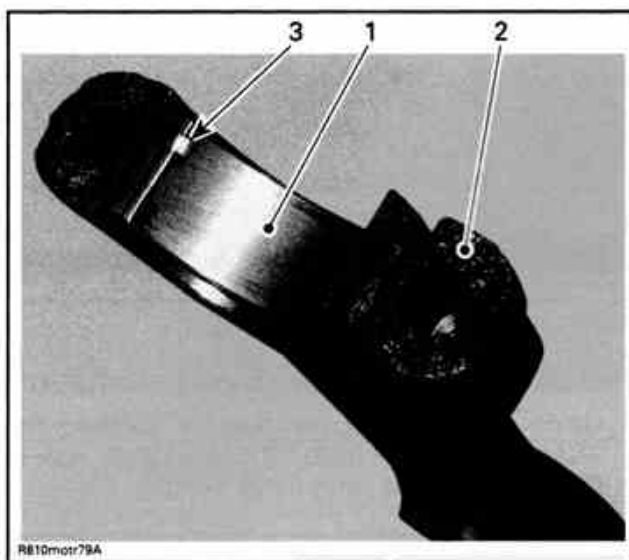


1. Arrows toward exhaust side

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)

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

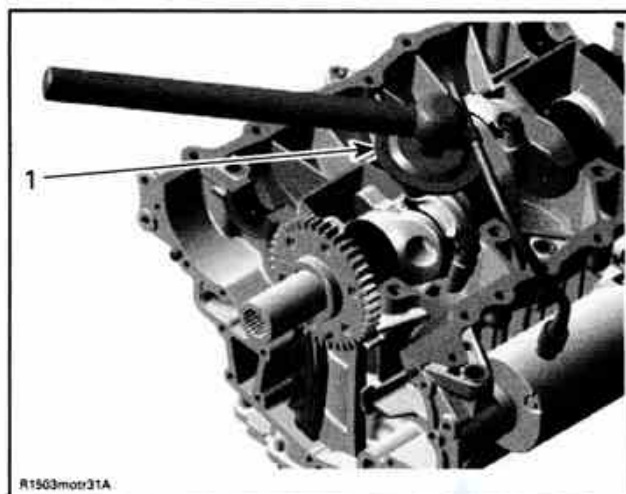
3. Torque **NEW** connecting rod screws as per following procedure:

- 3.1 Install screws and torque to 45 N•m (33 lbf•ft).

NOTE: Do not apply any threadlocker product on threads of connecting rod screws.

- 3.2 Finish tightening the screws with an additional 90° turn using an angle torque wrench.

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

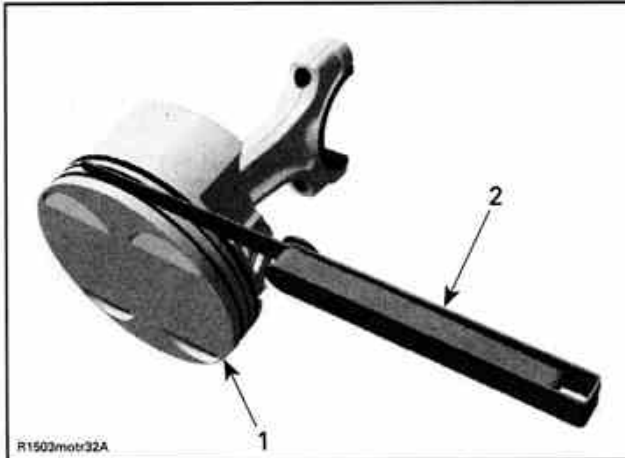
Ring/Piston Groove Clearance

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)

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)



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.

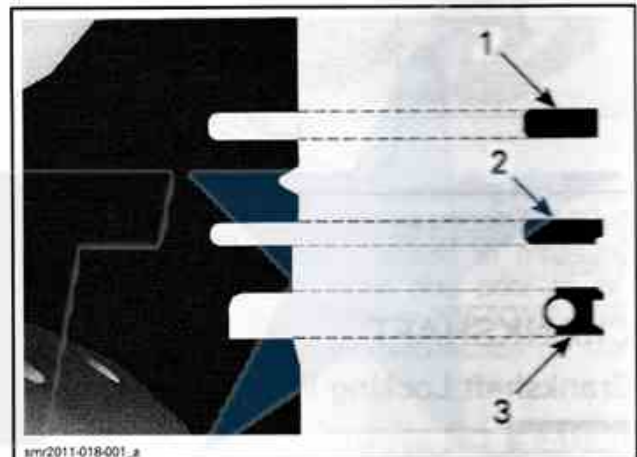
Using a feeler gauge, check ring end gap. Replace ring if gap exceeds above described specified tolerance.

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.

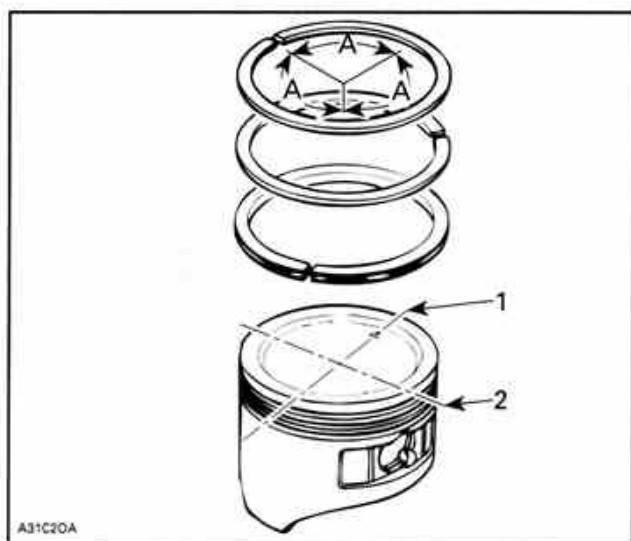
NOTE: Use a ring expander to prevent breakage during installation. The oil ring must be installed by hand.

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.

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)



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

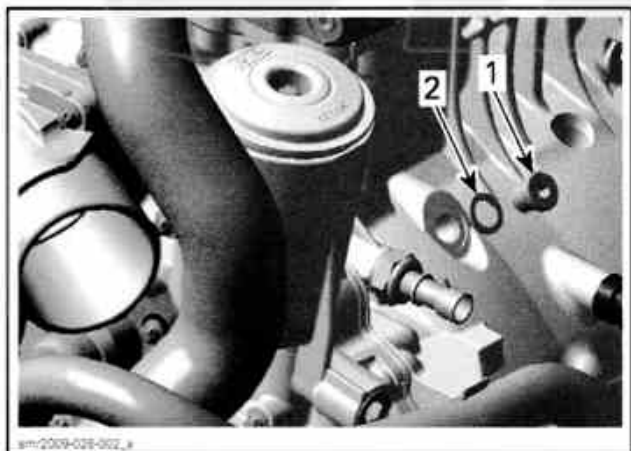
Crankshaft Locking Procedure

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.

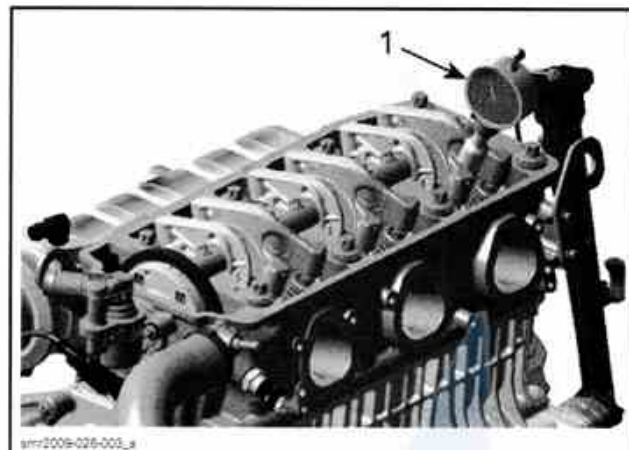


1. Crankshaft access plug screw
2. Gasket ring

Turn engine counterclockwise.

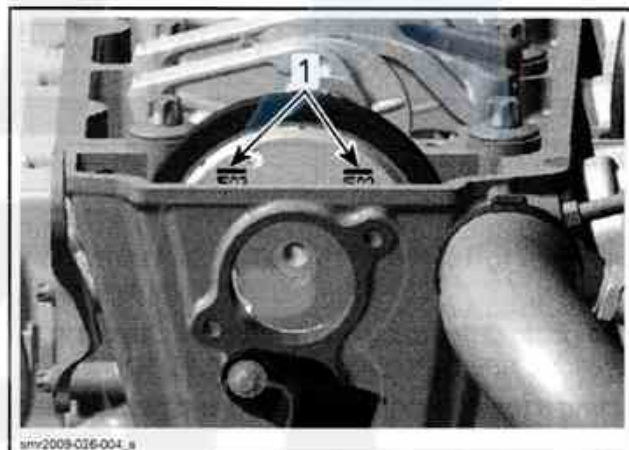
Bring piston of cylinder 3 to ignition TDC, using a dial gauge or another similarly suitable tool.

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 using the CRANKSHAFT LOCKING TOOL (P/N 529 035 821).



Crankshaft Removal

1. Drain engine oil (refer to *LUBRICATION SYSTEM* subsection).

Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)

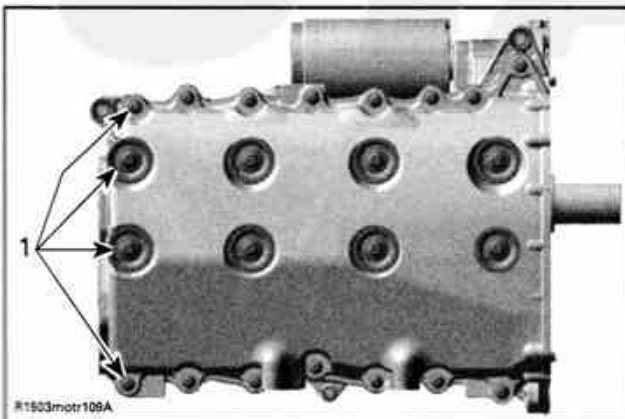
2. Remove engine from vehicle (refer to *ENGINE REMOVAL AND INSTALLATION* subsection).
3. Remove cylinder head (refer to *CYLINDER HEAD* subsection).
4. Remove PTO housing (refer to *PTO HOUSING AND MAGNETO* subsection).
5. Remove starter gear (refer to *PTO HOUSING AND MAGNETO* subsection).
6. Remove starter drive.
7. Remove oil suction pump (refer to *LUBRICATION SYSTEM* subsection).
8. Remove engine mounting brackets.
9. Remove oil reservoir plug screws no. 12 with O-ring no. 13.



ENGINE UPSIDE DOWN

1. Oil reservoir plug screw with O-ring

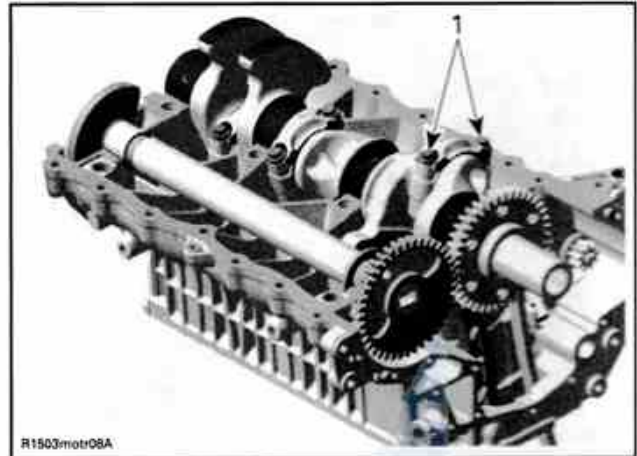
10. Remove cylinder block screws no. 14 and no. 15.



BOTTOM VIEW OF ENGINE

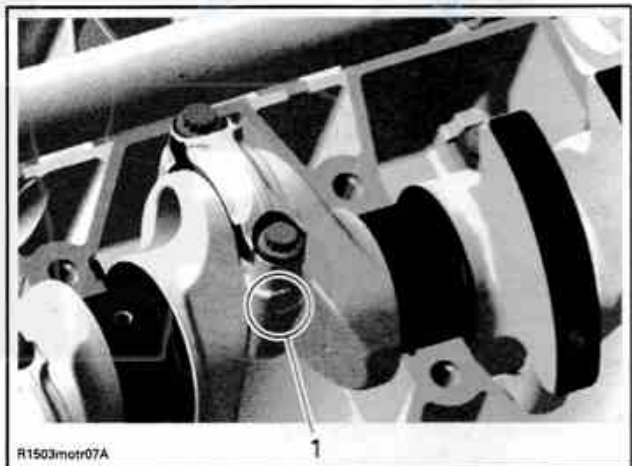
1. Screws

11. Remove cylinder block lower half.
12. 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.

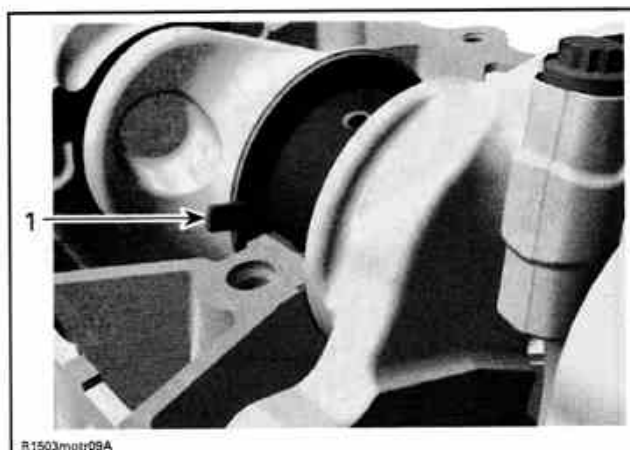


1. Mark on connecting rod

13. Remove thrust washers no. 16.

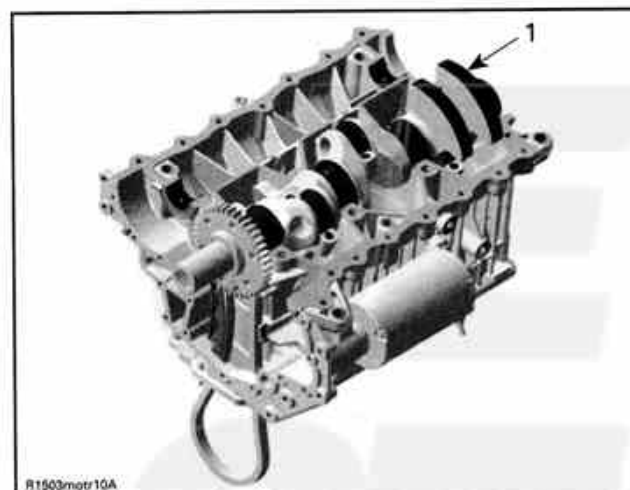
Section 02 ENGINE

Subsection 13 (CYLINDER BLOCK)



1. Thrust washer

14. Remove crankshaft no. 17.

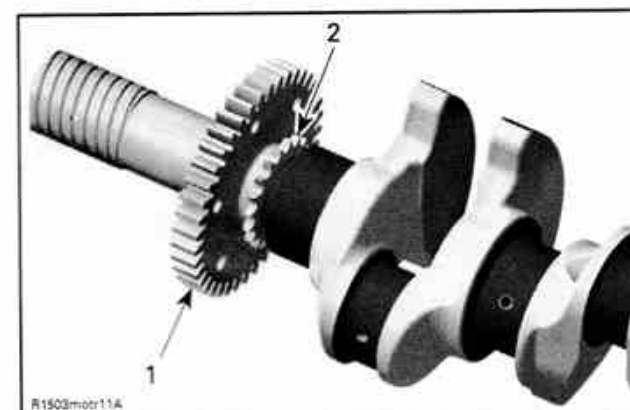


1. Crankshaft

Crankshaft Inspection

Crankshaft Gear Inspection

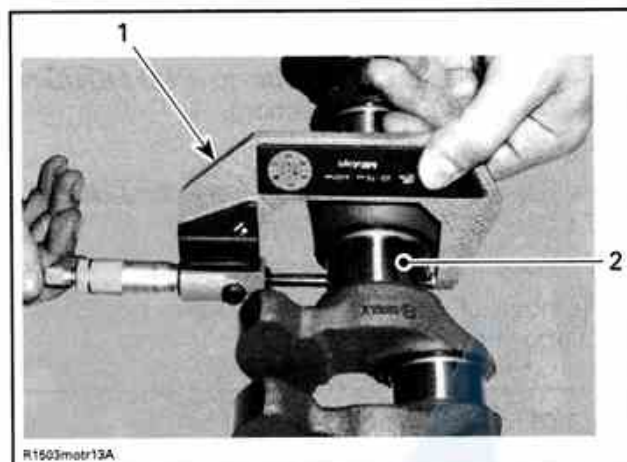
Replace crankshaft if the gears are worn or otherwise damaged.



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

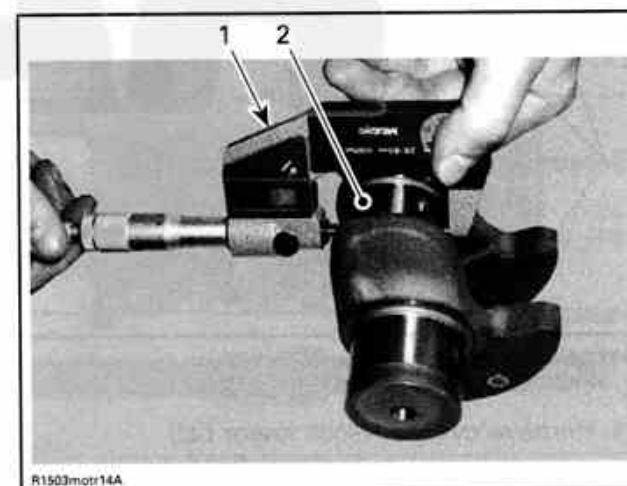
NEW	49.991 mm - 50.01 mm (1.9681 in - 1.9689 in)
SERVICE LIMIT	49.95 mm (1.9665 in)

CRANKSHAFT JOURNAL RADIAL CLEARANCE

SERVICE LIMIT	0.07 mm (.0028 in)
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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