Per BRP the 2009 and 2010 models in this manual are the same, so they did not release a separate 2010 manual.

This manual is fully searchable, just hold down the control key and the F key to search on any word.

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INTRODUCTION

GENERAL

This Shop Manual covers the following BRP made 2009 REV-XR (1200 4-TEC) models:

MODEL	ENGINE TYPE	CHASSIS	MODEL NUMBER
GTX LE	1203	REV-XR	EP9A, EP9B
GTX SE	1203	REV-XR	ER9A, ER9B
GSX Limited	1203	REV-XR	DK9A, DK9B
MXZ Renegade	1203	REV-XR	MN9A, MN9B
MXZ Renegade X	1203	REV-XR	MM9A, MM9B, MM9C
MXZ TNT	1203	REV-XR	ML9A
MXZ X	1203	REV-XR	MK9A, MBK9B, MBK9C

The information and component/system descriptions contained in this manual are correct at time of publication. 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, it may have some differences between the manufactured product and the description or specifications in this document.

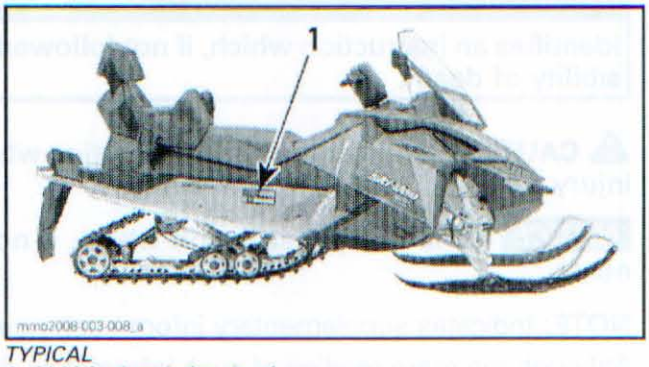
BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

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

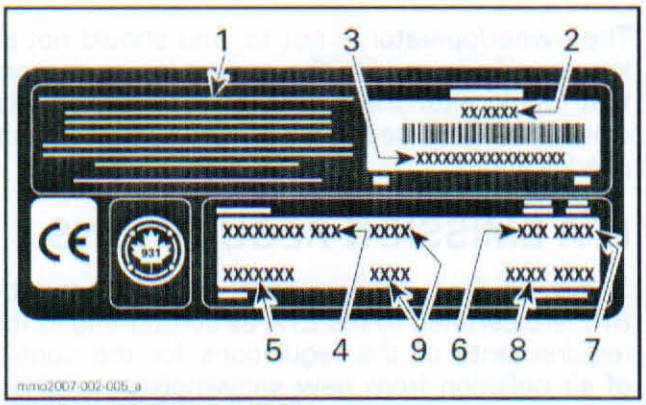
When ordering parts always refer to the specific model *PARTS CATALOG*.

HOW TO IDENTIFY YOUR VEHICLE

VEHICLE IDENTIFICATION NUMBER LOCATION

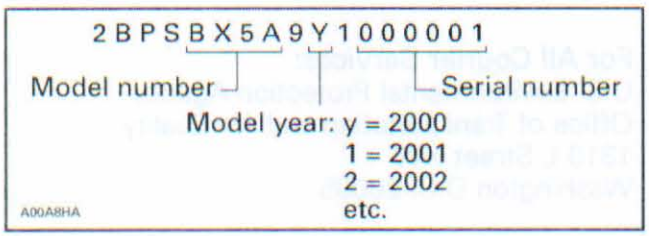


TYPICAL
1. Vehicle description decal

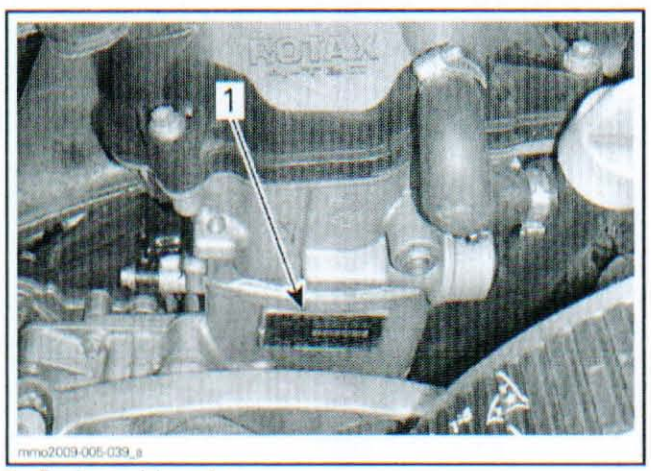


VEHICLE DESCRIPTION DECAL
1. *Manufacturer name*
2. *Manufacturing date*
3. *Vehicle identification number (V.I.N.)*
4. *Model name*
5. *Option package*
6. *Engine type*
7. *Model year*
8. *Color codes*
9. *Vehicle weight/engine power (European models)*

VEHICLE IDENTIFICATION NUMBER (V.I.N.) MEANING



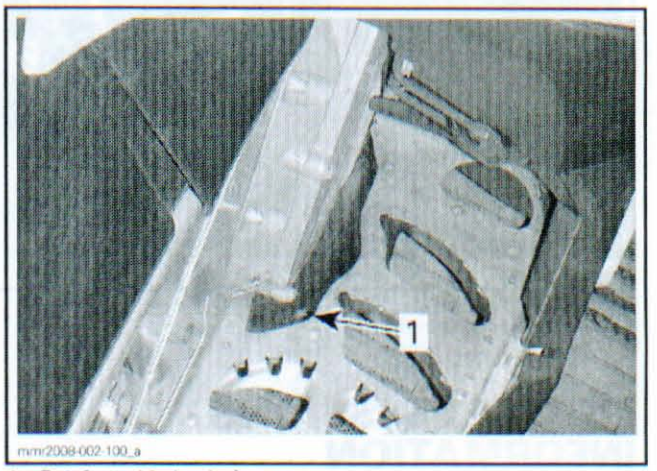
ENGINE SERIAL NUMBER LOCATION



1. *Engine serial number*

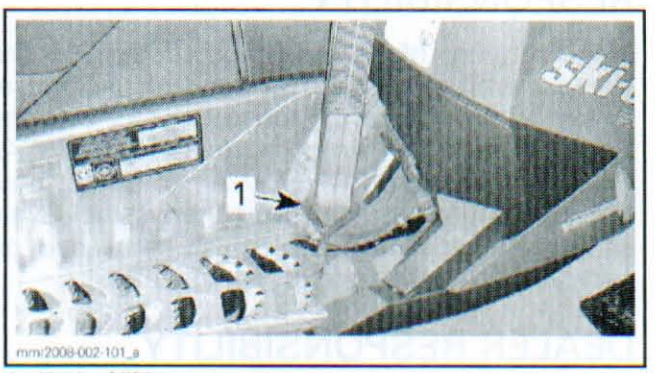
SNOWMOBILE LIFTING

To lift a REV-XR securely, it is important to use the reinforced footrest holes.



1. *Reinforced holes in footrest*

Install lifting tool hooks in holes as shown.



1. *Hook of lifting tool*

⚠ WARNING

Do not use footrest openings, operator's footrests (GTX models) or steering column to lift the snowmobile. These parts are not designed to support the snowmobile weight. Frame or steering system could be seriously damaged and serious injury or death could happen.

GTX MODEL SHOWN
1. *Reinforced holes in footrest*
2. *LH operator's footrest*

ENGINE EMISSIONS INFORMATION

MANUFACTURER'S RESPONSIBILITY

Manufacturers of engines must determine the exhaust emission levels for each engine horsepower family and certify these engines with the United States of America *ENVIRONMENTAL PROTECTION AGENCY (EPA)*. An emissions control information label, showing emission levels and engine specifications, must be placed on each vehicle at the time of manufacture.

DEALER RESPONSIBILITY

When performing service on snowmobiles that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

Exceptions include manufacturer's prescribed changes, such as altitude adjustments for example.

OWNER RESPONSIBILITY

The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.

The owner/operator is not to, and should not allow anyone to modify the engine in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

EPA EMISSION REGULATIONS

Some Ski-Doo snowmobiles manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new snowmobiles 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 snowmobiles products. For more detailed information on this subject, you may contact the following locations:

For All Courier Services:
U.S. Environmental Protection Agency
Office of Transportation and Air Quality
1310 L Street NW
Washington D.C. 20005

Regular US Postal Mail:
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

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

E-Mail: otaqpublicweb@epa.gov

TIGHTENING TORQUE

Tighten fasteners to torque mentioned in exploded views or text. When they are not specified, refer to following table.

⚠ WARNING

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

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

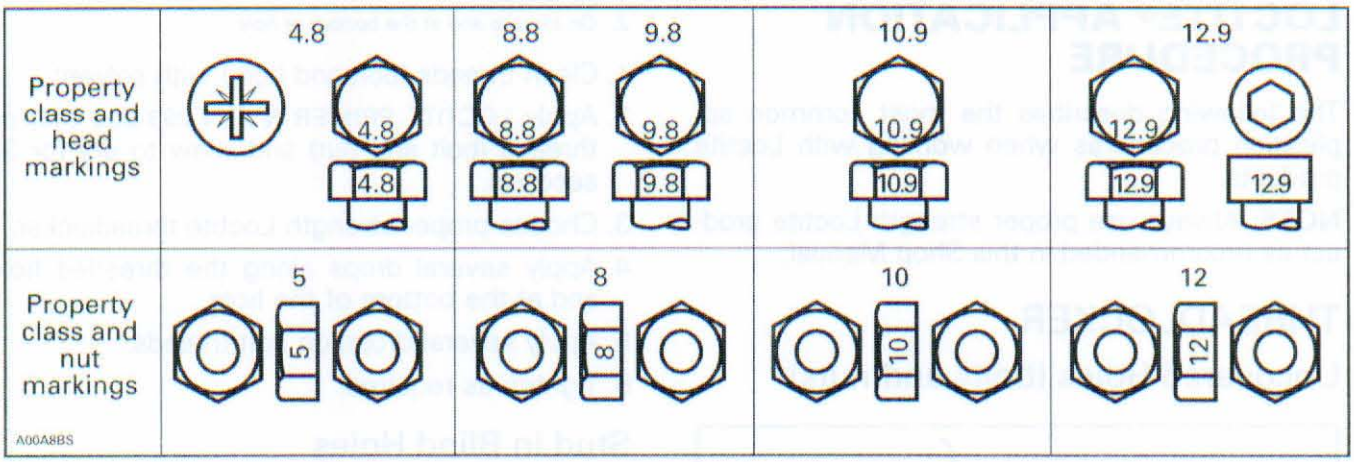
1. Manually screw all screws, bolts and/or nuts.
2. Apply the half of the recommended torque value.

NOTICE **Be sure to use proper tightening torque for the proper strength grade.**

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

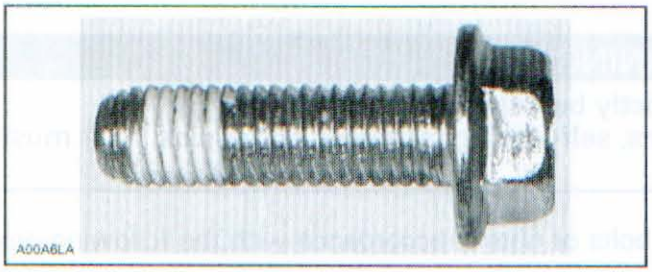
3. Torque at the recommended torque value.

NOTE: Always torque screws, bolts or nuts in a crisscross sequence.



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

SELF-LOCKING FASTENERS PROCEDURE



TYPICAL — SELF-LOCKING FASTENER

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

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

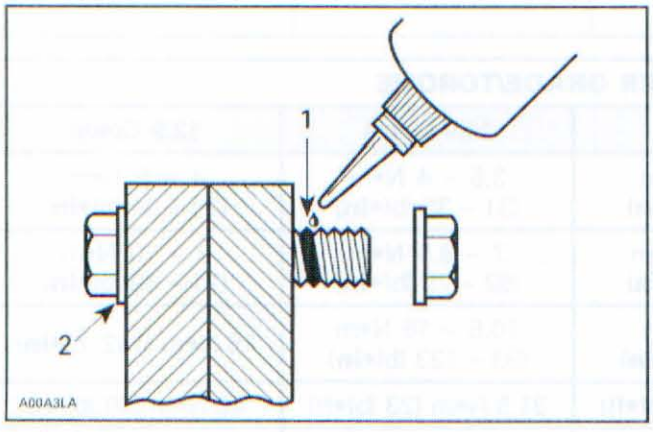
LOCTITE® APPLICATION PROCEDURE

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

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

THREADLOCKER

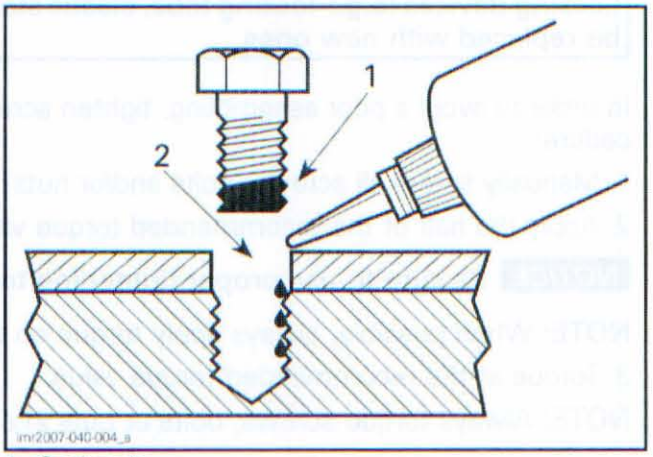
Uncovered Holes (bolts and nuts)



1. *Apply here*
2. *Do not apply*

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

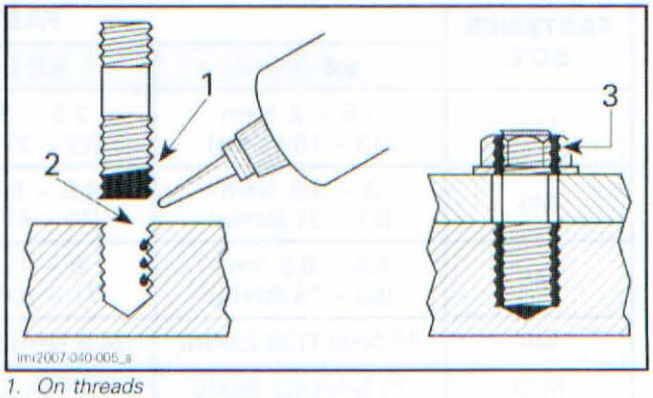
Blind Holes



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

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

Stud in Blind Holes



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

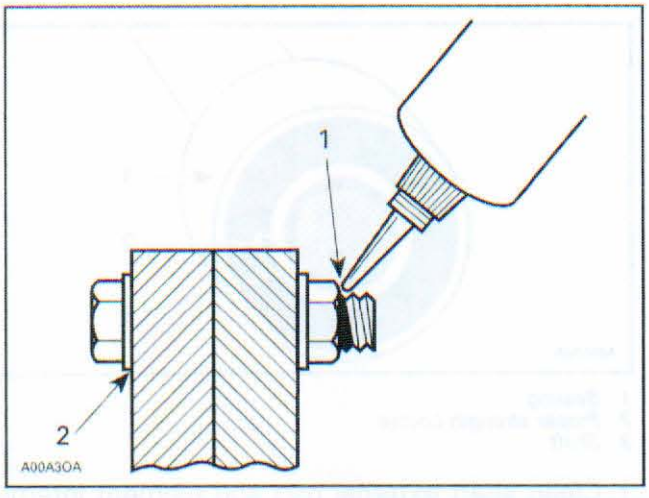
1. Clean threads (stud and hole) with solvent.
2. Apply LOCTITE PRIMER N (P/N 293 800 041) on threads and allow to dry.

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, etc.
7. Apply drops of proper strength Loctite on uncovered threads.
8. Tighten nuts as required.

Pre-Assembled Parts

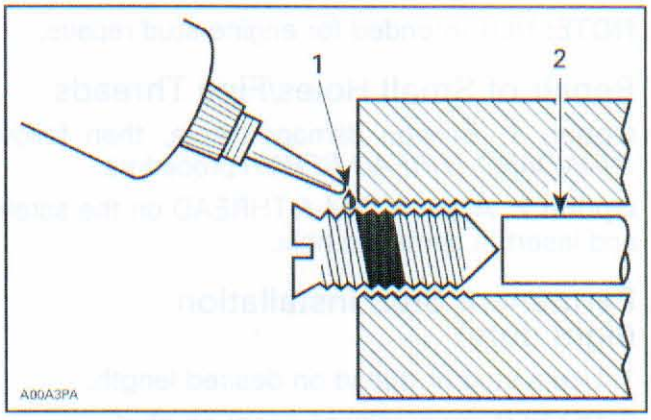


1. Apply here
2. Do not apply

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

NOTE: For preventive maintenance on existing equipment, retighten nuts and apply proper strength Loctite on bolt/nut contact surfaces.

Adjusting Screw

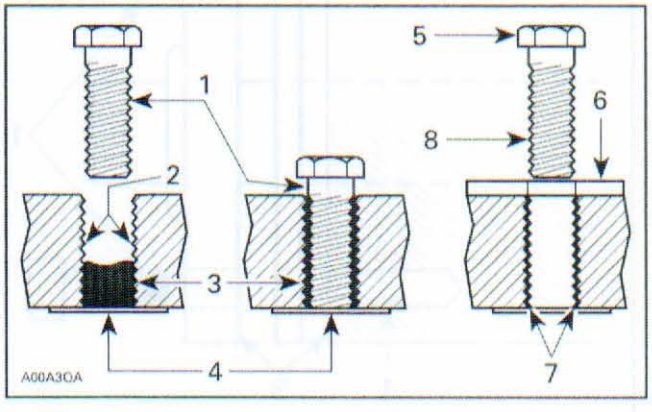


1. Apply here
2. Plunger

1. Adjust screw to proper setting.
2. Apply drops of proper strength Loctite threadlocker on screw/body contact surfaces.
3. Avoid touching metal with tip of flask.

NOTE: If it is difficult to readjust, heat screw with a soldering iron (232°C (450°F)).

STRIPPED THREAD REPAIR



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

Standard Thread Repair

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

If a plate is used to align bolt:

1. Apply release agent on mating surfaces.
2. Put waxed paper or similar film on the surfaces.

3. Twist bolt when inserting it to improve thread conformation.

NOTE: NOT intended for engine stud repairs.

Repair of Small Holes/Fine Threads

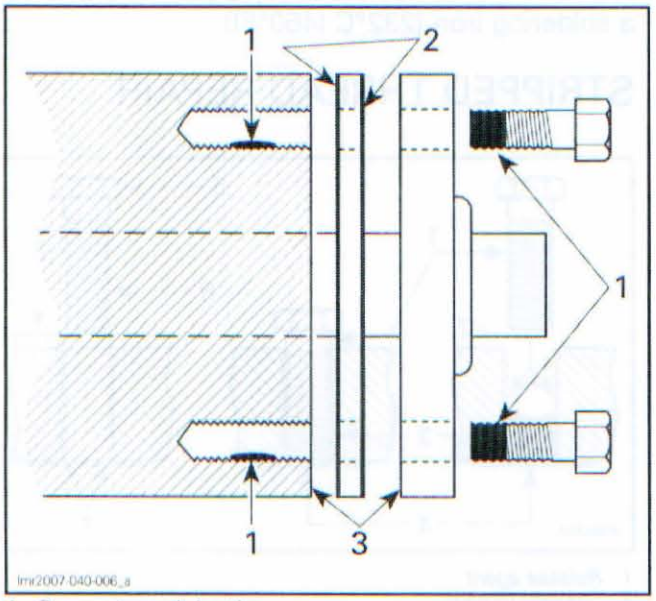
Option 1: Enlarge damaged hole, then follow *STANDARD THREAD REPAIR* procedure.

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

Permanent Stud Installation (light duty)

1. Use a stud or thread on desired length.
2. DO NOT apply release agent on stud.
3. Do a STANDARD THREAD REPAIR.
4. Allow to cure for 30 minutes.
5. Assemble.

GASKET COMPOUND



1. Proper strength Loctite
2. Loctite Primer N (P/N 293 800 041) and Gasket Eliminator 518 (P/N 293 800 038) on both sides of gasket
3. Loctite Primer N only

1. Remove old gasket and other contaminants with LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500). Use a mechanical mean if necessary.

NOTE: Avoid grinding.

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

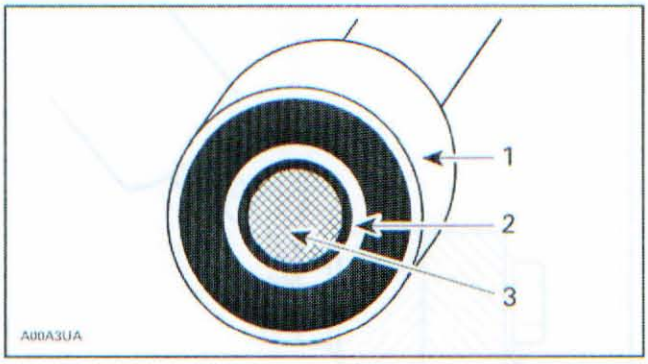
NOTE: If the cover is bolted to blind holes (above), apply proper strength Loctite in the hole and on threads. Tighten.

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

6. Tighten as usual.

MOUNTING ON SHAFT

Mounting with a Press



1. Bearing
2. Proper strength Loctite
3. Shaft

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

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

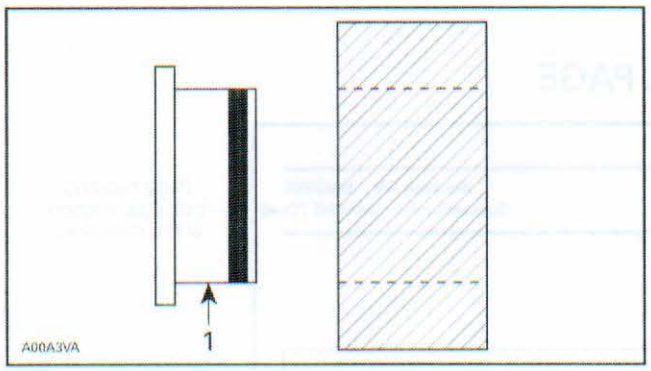
3. DO NOT use antiseize Loctite or any similar product.
4. No curing period is required.

Mounting in Tandem

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

CASE-IN COMPONENTS

Metallic Gaskets



1. Proper strength Loctite

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

NOTE: Any Loctite product can be used here. A low strength liquid is recommended as normal strength and gap are required.

4. Install according to standard procedure.
5. Wipe off surplus.
6. Allow it to cure for 30 minutes.

NOTE: Normally used on worn-out housings to prevent leaking or sliding.

It is generally not necessary to remove gasket compound applied on outer gasket diameter.

MANUAL INFORMATION

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

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

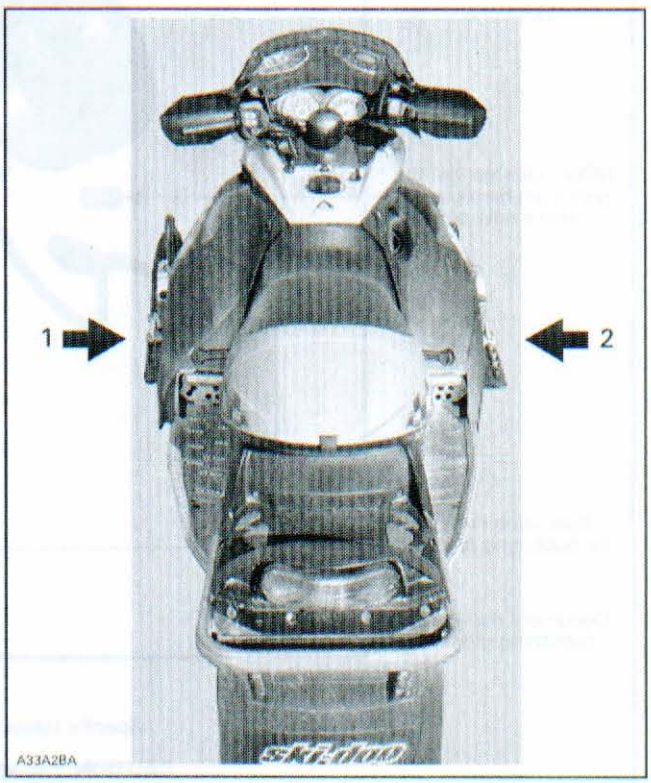
Illustrations and photos show the typical construction of the different assemblies and, in all cases, may not reproduce the full detail or exact shape of the parts shown. However, they represent parts which have the same or a similar function.

NOTICE Most components of those vehicles are built with parts dimensioned in the metric system. Most fasteners are metric and must not be replaced by customary fasteners or vice-versa. Mismatched or incorrect fasteners could cause damage to the vehicle or possible personal injury.

As many of the procedures in this manual are interrelated, we suggest, that before undertaking any task, you read and thoroughly understand the entire section or subsection in which the procedure is contained.

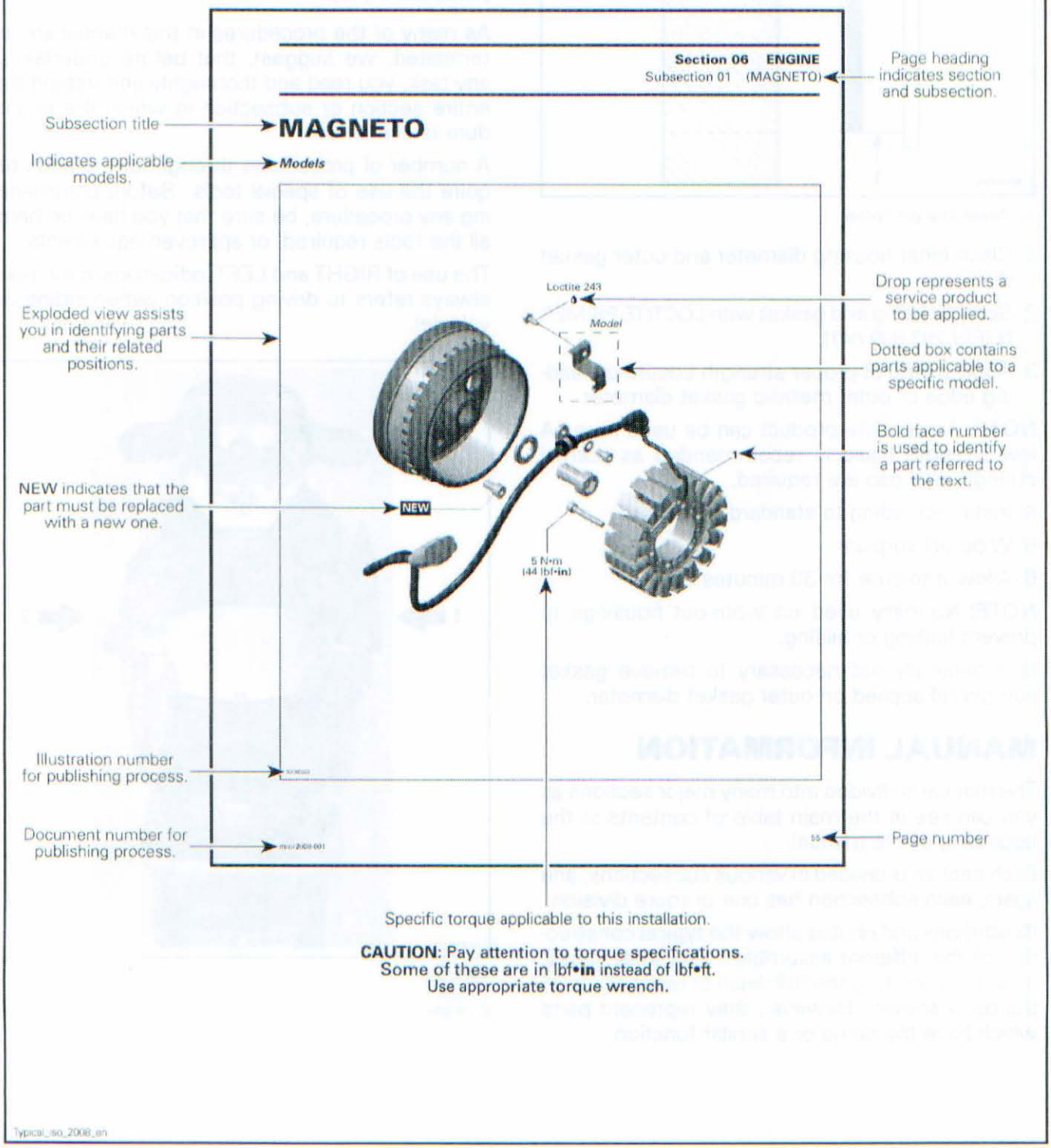
A number of procedures throughout the book require the use of special tools. Before commencing any procedure, be sure that you have on hand all the tools required, or approved equivalents.

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



TYPICAL
1. Left
2. Right

TYPICAL PAGE



TYPICAL PAGE

Section 03 ENGINE
Subsection 09 (MAGNETO SYSTEM)

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

GENERAL

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

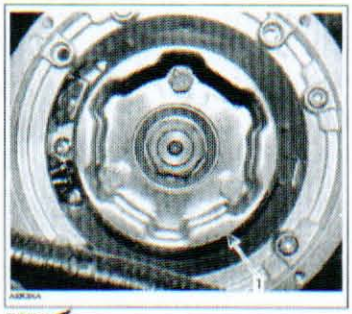
During assembly/installation, use the torque values and service products as in the exploded views.

Reference to a specific section or subsection.

Clean threads before applying a threadlocker. Refer to the *SELF-LOCKING FASTENERS* and *LOCTITE 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.



TYPICAL

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

Call-outs pertaining to above illustration.

PROCEDURES

Indicates component procedures apply to.

MAGNETO FLYWHEEL

Magneto Flywheel Cleaning

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

CAUTION: Clean magneto flywheel using only a clean cloth.

Indicates specific procedure to be carried out.

Magneto Flywheel Removal

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

Remove acoustic panel.

Remove rewind starter.

Remove starting pulley no. 2.

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

TYPICAL

Illustration always follows text to which it applies.

Models

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

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

mmr2009-021 57

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

typical_txt_2008_en

SERVICE TOOLS INDEX

ADAPTER HOSE
(P/N 529 035 652)

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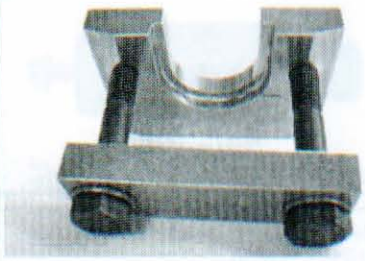
BALL JOINT EXTRACTOR
(P/N 529 035 827)



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BALL JOINT INSTALLER
(P/N 529 035 975)

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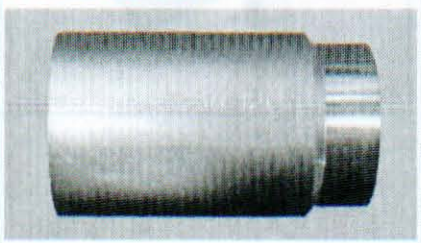
BALL JOINT REMOVER SUPPORT
(P/N 529 036 121)



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BEARING PULLER/PUSHER
(P/N 529 036 111)

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BEARING PULLER/PUSHER
(P/N 529 036 112)

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CALIPER PULLER
(P/N 529 036 145)

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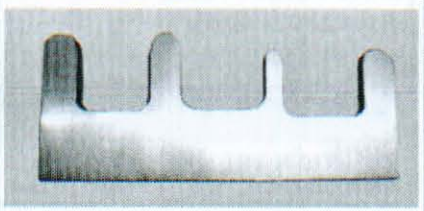
CAMSHAFT LOCKING TOOL
(P/N 529 036 149)



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CENTER BOLT
(P/N 529 036 154)

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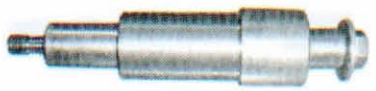
CHAINCASE GEAR RETAINING TOOL
(P/N 529 036 152)



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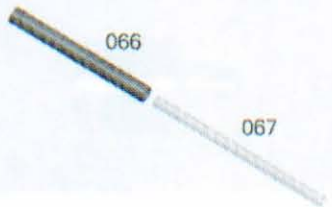
COUNTERSHAFT BEARING
INSTALLER
(P/N 529 036 066)



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COUNTERSHAFT BEARING
REMOVER
(P/N 529 036 065)

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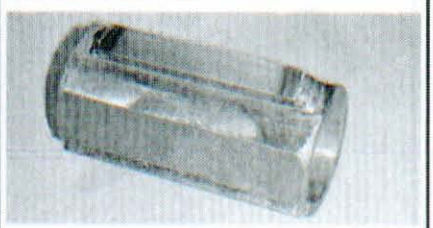
COUNTERSHAFT RETAINING TOOL
(P/N 529 036 165)



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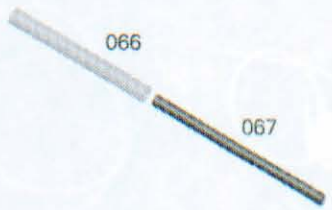
COUNTERSHAFT SUPPORT
(P/N 529 036 067)



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SERVICE TOOLS INDEX

CRANKSHAFT LOCKING BOLT
(P/N 529 036 148)

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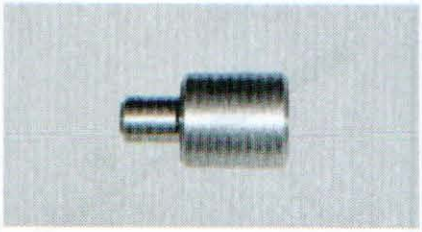
CRANKSHAFT PROTECTOR (MAG SIDE)
(P/N 529 036 160)



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CRIMPING PLIER FOR HEAVY GAGE WIRE
(P/N 529 035 730)

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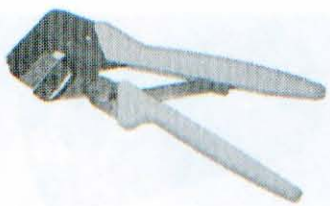
CRIMPING TOOL
(P/N 529 035 909)



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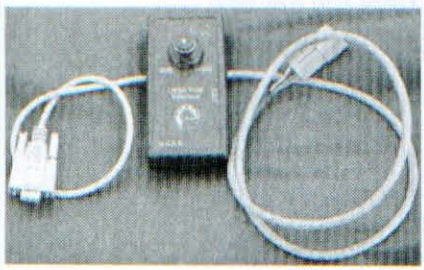
D.E.S.S. POST INTERFACE
(P/N 529 036 019)



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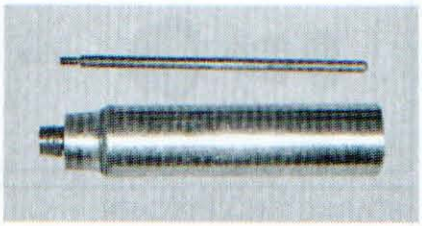
DIAL INDICATOR ADAPTER
(P/N 529 036 159)



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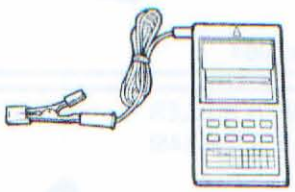
DIGITAL INDUCTION TACHOMETER
(P/N 529 014 500)



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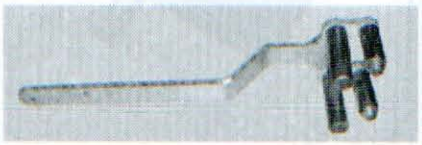
DRIVE PULLEY HOLDER
(P/N 529 035 674)



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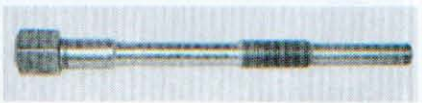
DRIVE PULLEY PULLER
(P/N 529 022 400)



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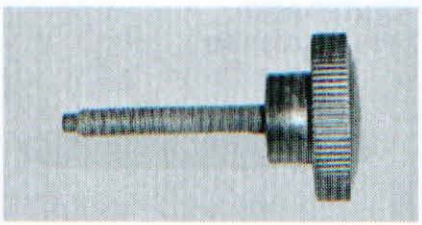
DRIVEN PULLEY OPENING TOOL
(P/N 529 017 200)



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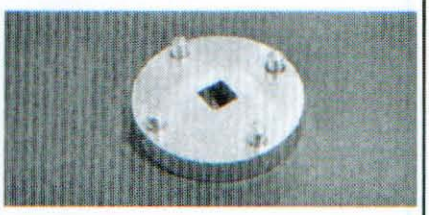
DRIVEN PULLEY OPENING TOOL
(P/N 529 036 127)



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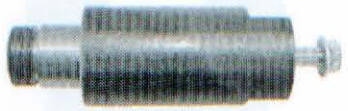
DRIVEN PULLEY SPRING COMPRESSOR
(P/N 529 036 064)



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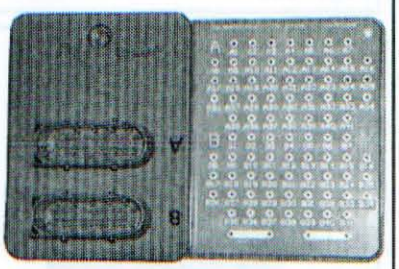
ECM ADAPTER TOOL (2 CONNECTORS)
(P/N 420 277 010)



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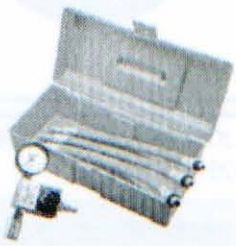
ENGINE LEAK DOWN TEST KIT
(P/N 529 035 661)



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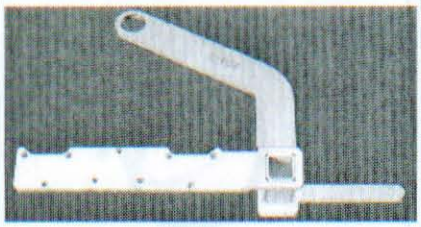
ENGINE LIFTING TOOL
(P/N 529 036 151)



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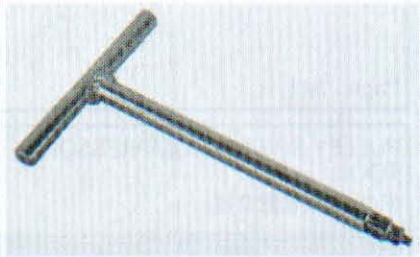
FLOATING PISTON PULLER
(P/N 529 035 901)



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FLOATING PISTON PULLER
(P/N 529 035 907)

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FLUKE 115 DIGITAL MULTIMETER
(P/N 529 035 868)

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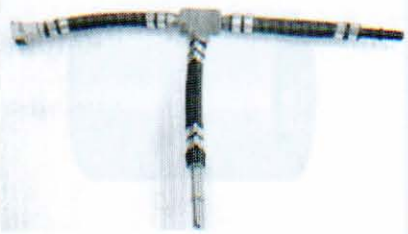
FUEL HOSE ADAPTER
(P/N 529 036 023)



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

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FUEL PUMP NUT TOOL
(P/N 529 036 118)

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FUEL TANK NUT WRENCH
(P/N 529 035 891)

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GAS FILL TOOL KIT
(P/N 503 190 102)

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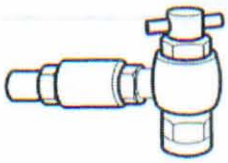
GAS SHOCK VALVE TOOL (TIRE VALVE TYPE)
(P/N 529 035 570)



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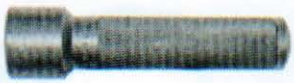
HANDLE
(P/N 420 877 650)



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HEATED GRIP INSTALLER
(P/N 529 035 897)

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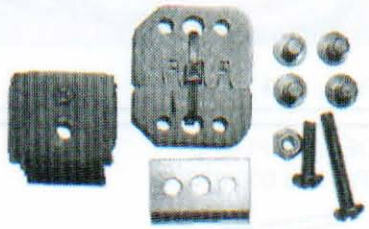
KOSTAL DIE
(P/N 529 035 906)



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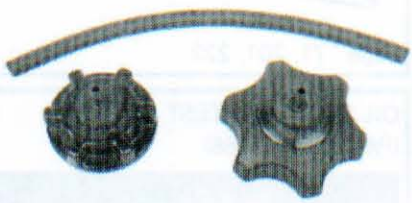
LEAK TEST KIT (FUEL/OIL)
(P/N 529 033 100)



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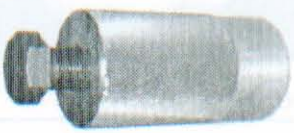
MAGNETO PULLER
(P/N 529 035 748)



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SERVICE TOOLS INDEX

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

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

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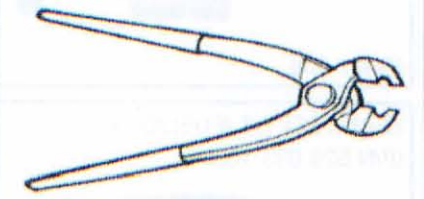
OETIKER PLIERS
(P/N 295 000 070)



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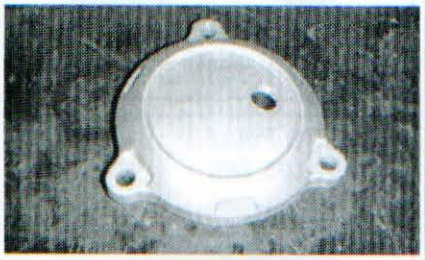
OIL PRESSURE TEST CAP
(P/N 529 036 158)



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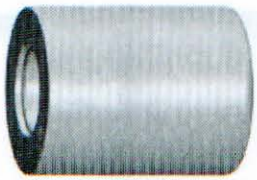
OIL SEAL INSTALLER
(P/N 529 036 155)



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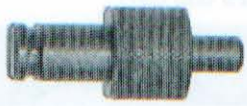
OIL SEAL PUSHER
(P/N 529 035 757)



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PISTON CIRCLIP INSTALLER
(P/N 529 036 153)

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PISTON RING COMPRESSOR
(P/N 529 036 156)

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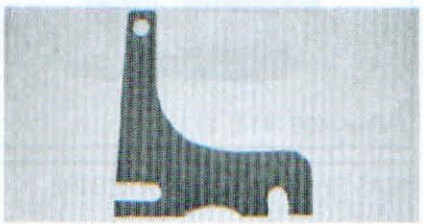
PRELOAD TESTER
(P/N 529 036 164)



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PRESSURE GAUGE
(P/N 529 035 709)

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PROTECTIVE CAP
(P/N 529 036 150)

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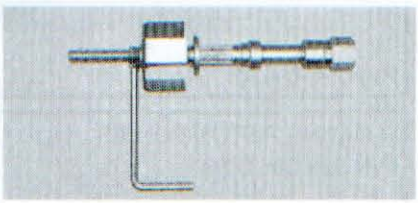
PULLEY SPRING COMPRESSOR TOOL
(P/N 529 036 012)



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QRS HUB TORQUING TOOL
(P/N 529 036 147)

Page: 323, 330

SHOCK RETAINER TOOL
(P/N 529 035 769)

Page: 408

SHOCK WRENCH
(P/N 529 035 727)

Page: 408

SLIDER SHOE FORK
(P/N 529 005 500)

Page: 308, 314

SLIDING HALF BUSHING REMOVER/INSTALLER
(P/N 529 035 931)

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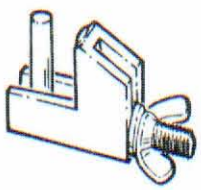
SMALL BUSHING PULLER/LARGE INSTALLER
(P/N 529 031 200)

Page: 311

SMALL HOSE PINCHER
(P/N 295 000 076)



Page: 201, 217

SPRING INSTALLER/REMOVER
(P/N 529 035 983)

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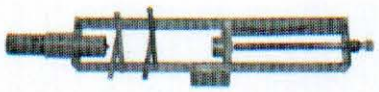
SPRING REMOVER
(P/N 529 036 007)



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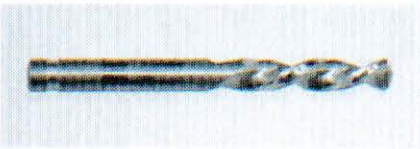
SUPERTITANIUM DRILL BIT 3/16"
(P/N 529 031 800)



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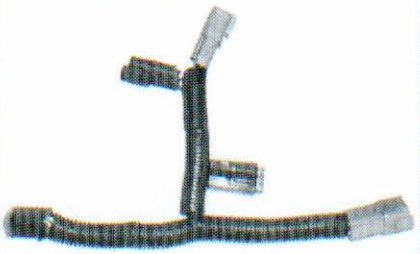
T-HARNESS
(P/N 529 035 869)



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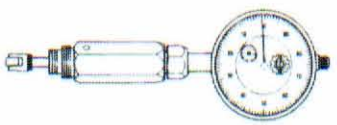
TDC DIAL INDICATOR
(P/N 414 104 700)



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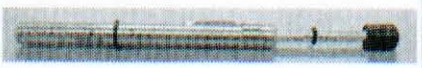
TENSIOMETER
(P/N 414 348 200)



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TEST CAP
(P/N 529 035 991)

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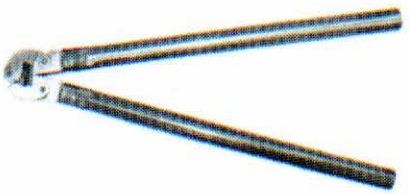
TRACK CLEAT INSTALLER
(P/N 529 036 044)



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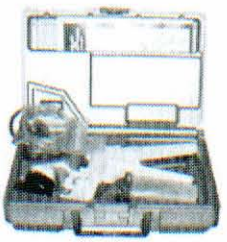
VACUUM PRESSURE PUMP
(P/N 529 021 800)



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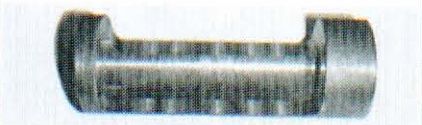
VALVE SPRING COMPRESSOR CUP
(P/N 529 036 161)



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VALVE SPRING COMPRESSOR
(P/N 529 035 724)

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WATER PUMP CERAMIC SEAL INSTALLER
(P/N 529 035 766)

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MAINTENANCE CHART

A: ADJUST
C: CLEAN
I: INSPECT
L: LUBRICATION
R: REPLACE
*: To be performed by an authorized SKI-DOO dealer

PART/TASK	*10-hour or 500 km (310 mi)	Weekly or every 250 km (150 mi)	Monthly or every 800 km (500 mi)	Every year or 3 200 km (2,000 mi)	Every 2 years or 6 000 km (3,700 mi)	*Storage	*Preseason
ENGINE							
Engine motor mounts	I			I		I	
Engine seals							I
Exhaust system							I
Exhaust manifold nuts (1)	I						I
Cooling system	I						I
Coolant (2) (3)	I			I			
Engine oil (4) and filter	R	(5)					
Valves adjustment	(6)						
ENGINE MANAGEMENT SYSTEM							
EMS fault codes	I					I	
FUEL SYSTEM							
Fuel stabilizer						(7)	
Fuel filter					R		
Fuel lines, fuel rail and connections	I						I
Throttle body							I, C
Throttle cable	I						I
Air silencer prefilter (8)							I
Fuel injection system (visual inspection)				I			I
DRIVE SYSTEM							
Drive belt (9)	I	I					I
Drive pulley (10)	I		I	C		I	C
Driven pulley (11)	I		I	C		I	C
Brake fluid	I	I			R		I
Brake hose, pads and disk	I	I					I
Drive chain	A		A			A	
Chaincase oil						R	
Track (12)	A (13)						

(1) Retighten to specified torque.
(2) Check coolant level before each ride.
(3) Have coolant density checked at preseason preparation. Have coolant changed every 5 years.
(4) Check oil level every 500 km (300 mi).
(5) Have oil and filter changed every 5 000 km (3,000 mi), 80 hours or at storage whichever comes firts.
(6) Have valve lash inspected and adjusted every 20 000 km (12,500 mi).

(7) Add to fuel at storage.
(8) Check condition before each ride.

(9) Adjust drive belt height and check the tension at every belt removal.
(10) Tightening torque of drive pulley must be checked at the 10-hour inspection and every year or 3 200 km (2,000 mi) thereafter.
(11) Driven pulley preload should be checked at the 10-hour inspection and every year or 3 200 km (2,000 mi) thereafter.
(12) Check track condition before each ride.
(13) Adjust track tension and alignment as required.

A: ADJUST
C: CLEAN
I: INSPECT
L: LUBRICATION
R: REPLACE
*: To be performed by an authorized SKI-DOO dealer

PART/TASK	*10-hour or 500 km (310 mi)	Weekly or every 250 km (150 mi)	Monthly or every 800 km (500 mi)	Every year or 3 200 km (2,000 mi)	Every 2 years or 6 000 km (3,700 mi)	*Storage	*Preseason	LEGEND
STEERING								
Steering mechanism (14)	I		I, L			I, L		(14) Lubricate whenever the vehicle is used in wet conditions (wet snow, rain, puddles).
Skis and runners	I	I				I		
SUSPENSION								
Front suspension (14)	I		I			I		(14) Lubricate whenever the vehicle is used in wet conditions (wet snow, rain, puddles).
Rear suspension (14)	I		I, L			I, L		
Rear suspension stopper strap				I		I		
ELECTRICAL SYSTEM								
Spark plugs	(15)							(15) Spark plugs must be inspected or replaced every 3 years or 10 000 km (6,200 mi).
Battery	I		I			I	I	
Wiring harnesses and cables	I		I			I		
Lighting system (HI/LO beam, brake light, etc.)	I	I				I		
Engine stop switch and tether cord cap (D.E.S.S.)	I	I				I		
CHASSIS/BODY								
Headlights beam aiming				A			A	—
Engine compartment	C		C			C		
Vehicle cleaning and protection	C		C			C		

STORAGE PROCEDURE

SERVICE PRODUCTS

Description	Part Number	Page
BRP FUEL STABILIZER	413 408 600	9
BRP PLASTIC & VINYL CLEANER	413 711 200	10
SCRATCH REMOVER KIT	861 774 800	10
SUSPENSION GREASE	293 550 033	10
XP-S LUBE	293 600 016	10
XP-S SYNTHETIC GREASE	293 550 010	10

GENERAL

Proper snowmobile storage is a necessity during the summer months or when a vehicle is not being used for certain period of time.

If vehicle is not used for 3 consecutive months, proceed as follows:

- Add fuel stabilizer in fuel tank to prevent fuel deterioration. Refer to *FUEL SYSTEM* further in this section.
- Refer to storage column from *MAINTENANCE CHART* jointly with the present procedures in order to cover each and every aspect of the snowmobile storage. Any worn, broken or damaged parts must be replaced.

⚠ WARNING

Unless otherwise specified, engine should be turned off for storage procedure.

To facilitate the inspection and ensure adequate lubrication of components, it is recommended to clean the entire vehicle.

PROCEDURES

ENGINE MANAGEMENT SYSTEM

Fault Codes

1. Using B.U.D.S., verify fault codes state. Refer to *ENGINE MANAGEMENT SYSTEM* section.

FUEL SYSTEM

Fuel System Protection

With the new fuel additives, it is critical to use the BRP FUEL STABILIZER (P/N 413 408 600) or an equivalent to prevent fuel deterioration, gum formation 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 components protection against varnish deposits.**

1. Pour fuel stabilizer in fuel tank.
2. Fill up fuel tank completely.
3. Ensure there is no water inside fuel tank.

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

Do not drain fuel system.

ENGINE

Engine Motor Mounts

Check if engine supports are cracked or damaged.

Check if rubber mounts are brittle, cracked or damaged.

Engine Oil and Filter Replacement

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

ELECTRICAL SYSTEM

Battery (if so equipped)

1. Remove battery, clean its tray and surrounding area with water and baking soda.
2. Inspect, clean and charge battery as explained in *CHARGING SYSTEM* subsection.

Wiring Harnesses, Cables and Connectors

Inspect for wear, deterioration or damage, replace defective parts if necessary.

DRIVE SYSTEM AND BRAKE

Brake Lever

Remove the brake lever pivot and apply XP-S SYNTHETIC GREASE (P/N 293 550 010) on it. Reinstall pivot and tighten its nut to 6 N•m (53 lbf•**in**).

Drive and Driven Pulleys

1. Remove drive belt.
2. Inspect and clean pulleys.
3. Spray XP-S LUBE (P/N 293 600 016) on sheaves to protect them from rust.
4. Do not reinstall drive belt.

Track

NOTE: Do not release track tension.

1. Visually inspect track for:
   - Cuts and abnormal wear
   - Broken rods
   - Broken or missing track cleats.

If track is damaged or rods are broken, replace track, refer to *TRACK* subsection.

For damaged or missing cleats, refer to *TRACK* subsection for procedure.

Chaincase

Chaincase Oil Replacement

Replace chaincase oil, refer to *CHAINCASE* subsection.

Drive Chain Adjustment

Check drive chain tension and adjust if necessary, refer to *CHAINCASE* subsection.

CHASSIS

Front Suspension

Inspect the front suspension arms for wear or damages, replace if necessary. Refer to *FRONT SUSPENSION* subsection.

Rear Suspension

1. Inspect rear suspension components for wear, deterioration or damage, replace defective parts if necessary.
2. Inspect strap for wear or cracks.
3. Check bolt and nut securing strap for tightness. If loose, inspect strap holes for deformation. Replace strap if necessary.
4. Lubricate rear arm at grease fittings using SUSPENSION GREASE (P/N 293 550 033).

Steering Mechanism

Inspect all components for tightness.

Skis and Runners

Inspect skis and runners for wear, deterioration or damage, replace if necessary.

VEHICLE

Vehicle Cleaning

Keep engine compartment clean of grass, twigs, cloth, etc. These are combustible under certain conditions.

To clean the vehicle, do not use high pressure washers (like the ones found in car washes) as it may damage certain parts of the vehicle.

To clean the vehicle, proceed as follows:

1. Rinse the vehicle thoroughly with water to remove loose dirt.
2. Using a soft clean cloth, wash the vehicle with water mixed with a mild detergent, such as soap specially formulated for motorcycles or automobiles.
3. While washing the vehicle, check for grease or oil. If necessary, use BRP PLASTIC & VINYL CLEANER (P/N 413 711 200) or a mild automotive degreaser. Follow thoroughly the manufacturer's instructions.

NOTICE **Do not use heavy duty cleaner on decals or vinyl.**

4. Dry the vehicle with a chamois or a soft towel.

⚠ WARNING

Do not apply a vinyl or plastic protector on the seat as the surface will become slippery and the operator or the passenger may slip off the vehicle.

Windshield Polishing

Windshield can be polished using SCRATCH REMOVER KIT (P/N 861 774 800) or a plastic cleaner specially formulated for these special surfaces.

NOTICE **Do not clean the windshield with alkaline or acid cleaner, gasoline or solvent to avoid windshield damage.**

Vehicle Waxing

Apply only nonabrasive wax safe for clear coats paints on glossy finishes.

Avoid applying wax on mat surfaces.

Vehicle Protection

1. Block air intake and muffler with clean rags.
2. Touch up all metal spots where paint has been scratched off.
3. Cover the vehicle with a permeable material. Avoid using plastic or similar non-breathing, coated materials that restrict air flow and allow heat and moisture to accumulate.
4. Store vehicle in a dry unheated area, away from sunlight, with a small amount of daily temperature variation.
5. Lift rear of vehicle until track is clear of the ground. Install on a snowmobile mechanical stand.

PRESEASON PREPARATION

SERVICE PRODUCTS

Description	Part Number	Page
PULLEY FLANGE CLEANER	413 711 809	13–14
XP-S SYNTHETIC GREASE	293 550 010	14

GENERAL

Proper vehicle preparation is necessary after the summer months or when a vehicle has not been used for more than three months.

Refer to preseason preparation column from *MAINTENANCE CHART* jointly with the present procedures in order to cover each and every aspect of the snowmobile preseason preparation.

Any worn, broken or damaged parts found should be replaced.

⚠ WARNING

Unless otherwise specified, engine should be turned off for preparation procedure.

PROCEDURES

ENGINE

Exhaust Manifold

Check exhaust manifold nuts for looseness. Retorque if necessary.

Check exhaust manifold for cracks or damages.

Exhaust pipe

Check exhaust pipe for cracks or damages.

Verify exhaust pipe shields for damages.

Muffler

Remove rags that were installed during storage preparation.

Cooling System

Inspect cooling system for leaks, refer to *COOLING SYSTEM* subsection.

Check coolant level in coolant reservoir.

Check coolant density.

PTO Cover Oil Seal

Make sure there is no oil coming out from PTO cover oil seal, if so replace seal. Refer to *CYLINDER BLOCK* subsection.

Air Intake Silencer Filter

Ensure that air intake silencer filter is properly installed and in good condition.

Rinse filter with fresh water to clean or replace if damaged.

FUEL SYSTEM

Inspect fuel system for leaks. Refer to *FUEL TANK AND FUEL PUMP* subsection.

Throttle Body

Using the PULLEY FLANGE CLEANER (P/N 413 711 809), clean the throttle plate and throttle body bores.

NOTE: To ease cleaning, remove throttle body from intake manifold and air intake silencer without disconnecting throttle cable and coolant hoses.

Throttle Lever

Make sure that throttle lever operates freely, adjust and lubricate throttle cable as required, refer to *FUEL SYSTEM* section.

ELECTRICAL SYSTEM

Battery

Install a fully charged battery.

Lighting System

Check lights operation.

Check headlights aligment. Adjust beam aiming if necessary.

Engine Stop Switch

Check engine stop switch operation.

Accessories

Check the operation of all accessories.

DRIVE SYSTEM AND BRAKE

Drive and Driven Pulley

Clean drive and driven pulleys sheaves with PULLEY FLANGE CLEANER (P/N 413 711 809).

Check tightening torque of drive pulley. Refer to *DRIVE PULLEY* subsection.

Check driven pulley preload. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

Drive Belt

Inspect belt for cracks, fraying or abnormal wear. Replace if necessary.

Make sure to install the proper belt with arrow printed on belt pointing front of vehicle.

Drive Axle End Bearing (Brake Side)

Remove the disc brake protector cover and make a visual inspection of the bearing seal to ensure it is not damaged. Refer to *DRIVE AXLE* subsection.

Brake

Brake Lever

Remove the brake lever pivot and apply XP-S SYNTHETIC GREASE (P/N 293 550 010) on it. Reinstall pivot and tighten its nut to 6 N•m (53 lbf•**in**).

Brake Fluid

Check brake fluid in reservoir for proper level. Add fluid (DOT 4) as required.

NOTICE **Use only DOT 4 brake fluid from a sealed container. An opened container may be contaminated or may have absorbed moisture from the air.**

Brake Hose, Pads and Disk

Inspect brake hose for wear, deterioration or damage.

Inspect brake pads for proper thickness. Refer to *BRAKE* subsection.

Remove any rust built-up on braking surfaces. Clean brake disk braking surfaces with PULLEY FLANGE CLEANER (P/N 413 711 809).

Track

Verify track tension and alignment, refer to *TRACK* subsection.

NOTE: Track tension and alignment are interrelated. Do not adjust one without checking the other. Track tension procedure must be carried out prior to track alignment.

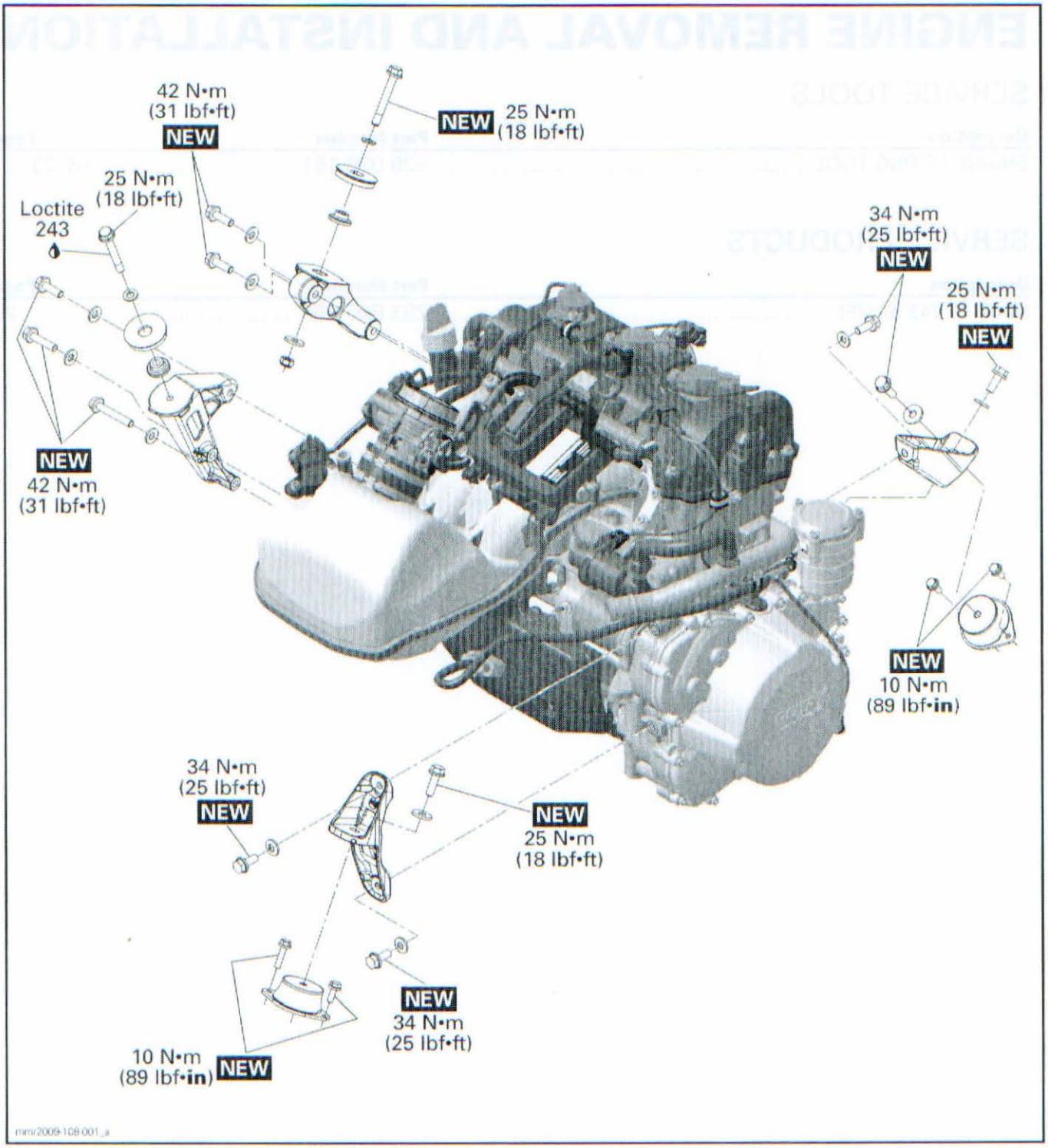
ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING TOOL	529 036 151	18, 23, 27

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	26


42 N•m
(31 lbf•ft)
NEW
NEW 25 N•m
(18 lbf•ft)
25 N•m
(18 lbf•ft)
Loctite
243
34 N•m
(25 lbf•ft)
NEW
25 N•m
(18 lbf•ft)
NEW
NEW
42 N•m
(31 lbf•ft)
NEW
10 N•m
(89 lbf•in)
34 N•m
(25 lbf•ft)
NEW
NEW
25 N•m
(18 lbf•ft)
NEW
34 N•m
(25 lbf•ft)
10 N•m
(89 lbf•in) NEW
mmr2009-108-001_a

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

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

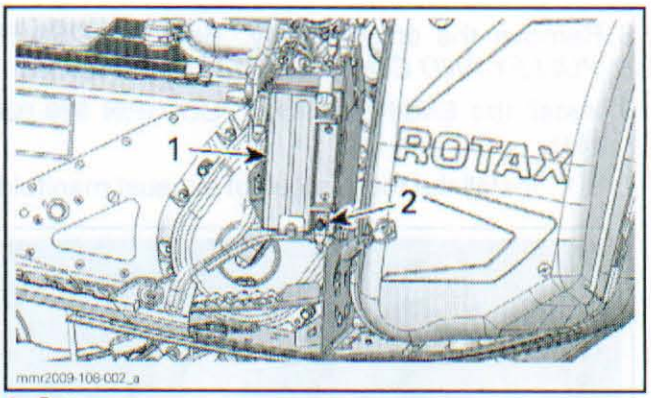
NOTICE **Locking ties removed during a procedure must be replaced and installed at the same location.**

PROCEDURES

ENGINE

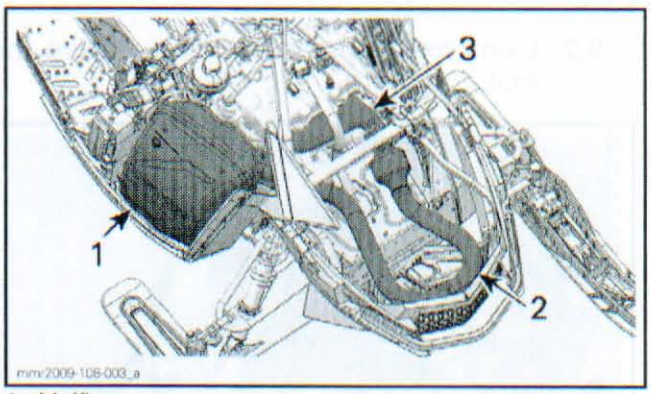
Engine Removal

1. Place vehicle at workstation that will have access to an engine-lifting hoist.
2. Refer to *BODY* subsection and remove the following:
   - LH and RH side panels
   - Hood
   - Front bottom pan cover
   - Console
   - Gauge support
   - Seat(s).
3. Remove the fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
4. Remove the negative (–) cable from battery.



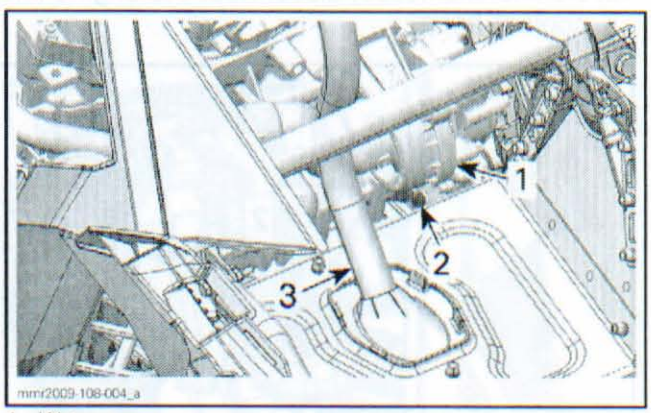
1. *Battery*
2. *Negative cable*

5. Remove muffler, exhaust pipe and exhaust manifold. Refer to *EXHAUST SYSTEM* subsection.



1. *Muffler*
2. *Exhaust pipe*
3. *Exhaust manifold*

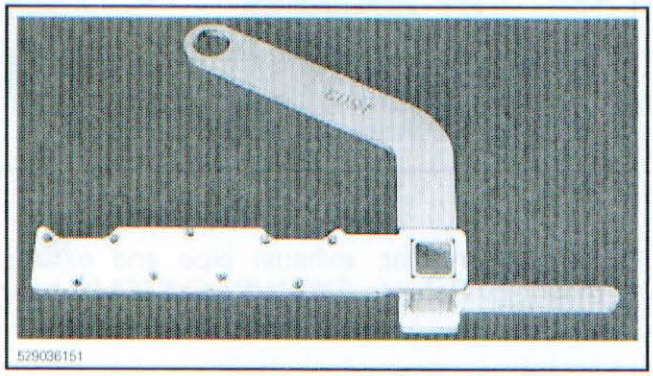
6. Remove the cooling drain screw located on water pump to drain the cooling system. Refer to *COOLING SYSTEM* subsection for complete procedure.



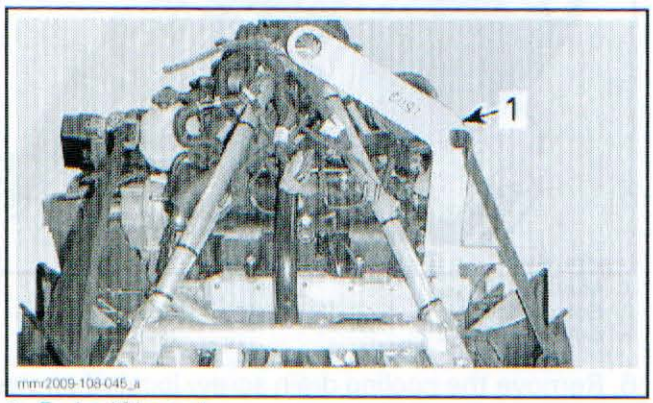
1. *Water pump*
2. *Drain screw*
3. *Steering column*

7. Remove the drive pulley. Refer to *DRIVE PULLEY* subsection.

8. Remove the driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
9. Install the ENGINE LIFTING TOOL (P/N 529 036 151).
   9.1 Install the tool instead of exhaust manifold.

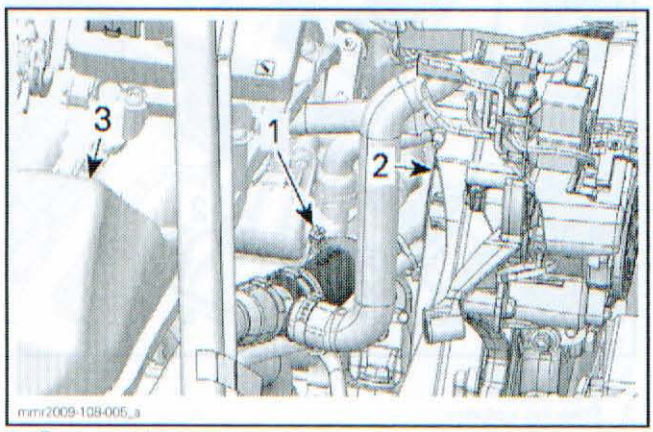


   9.2 Using exhaust manifold nuts, secure the tool.



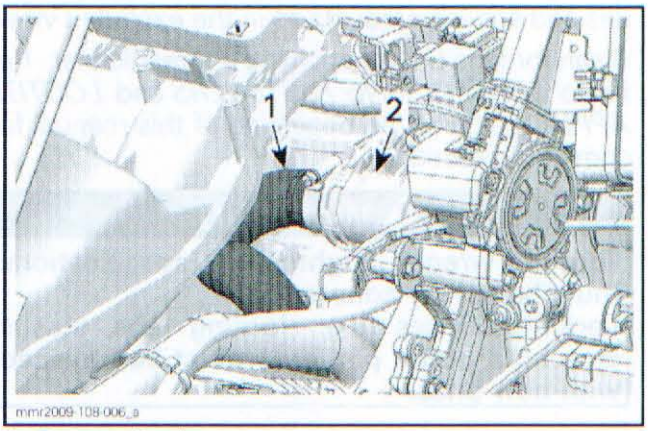
1. Engine lifting tool

   9.3 Install a hoist.
10. Behind chaincase, disconnect the engine inlet coolant hose.



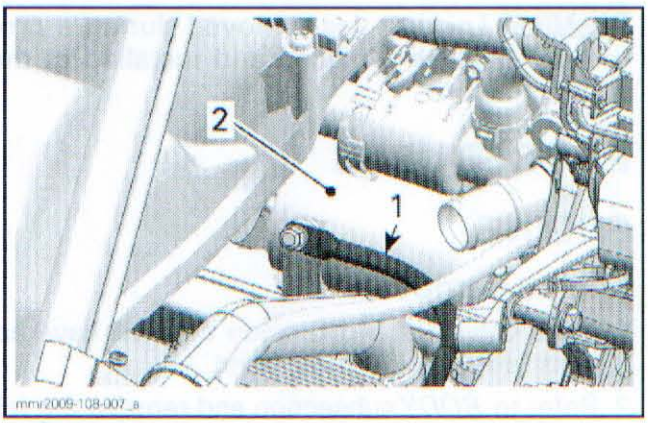
1. Remove this clamp
2. Chaincase
3. Intake manifold

11. Disconnect the engine coolant outlet hose from thermostat.



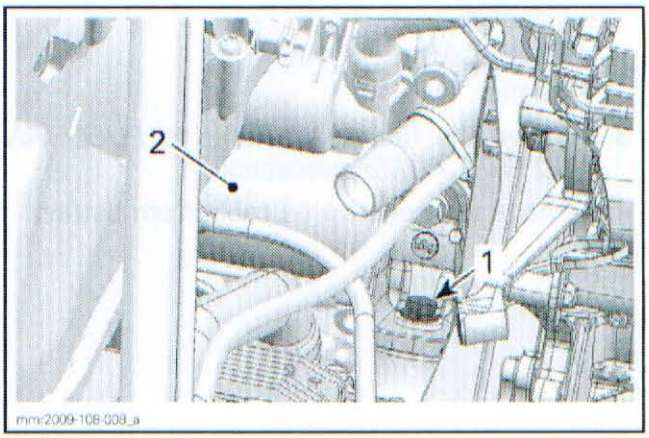
1. Remove this clamp
2. Thermostat

12. Remove starter cable from starter.



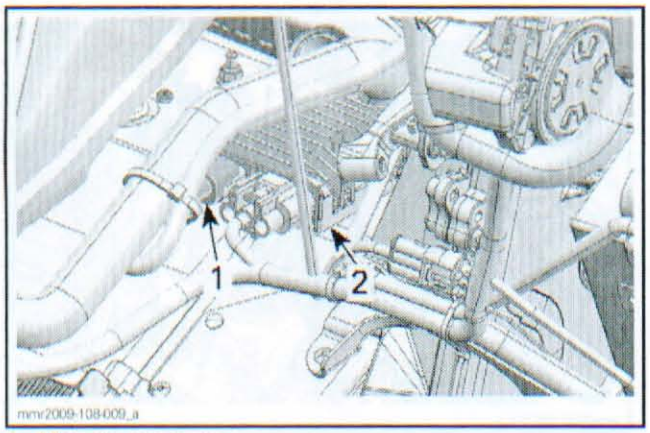
1. Starter cable
2. Starter

13. Remove the RH rear engine rubber mount screw.



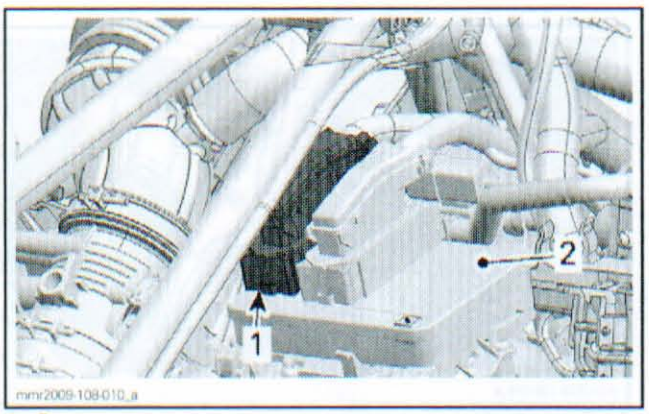
1. Engine rubber mount screw
2. Starter

14. Unplug the magneto connector from the voltage regulator.



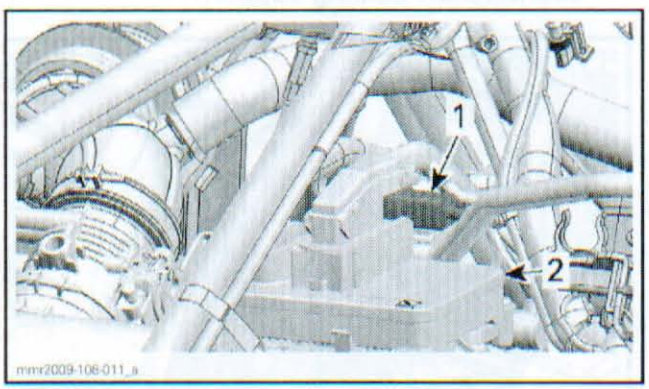
1. Magneto connector
2. Voltage regulator

15. Unplug the connector B from the ECM.



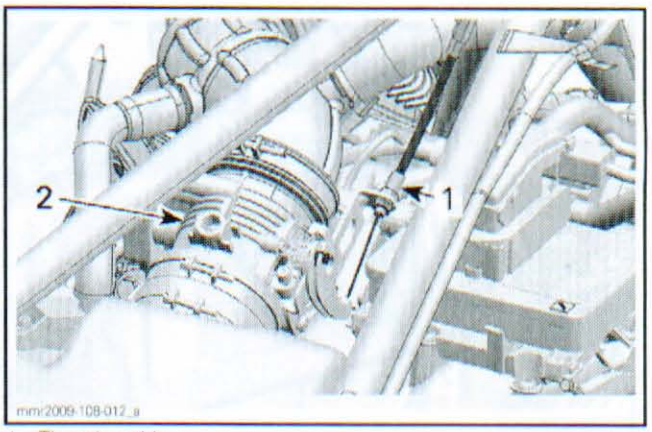
1. B connector
2. ECM

16. Unplug the engine connector.



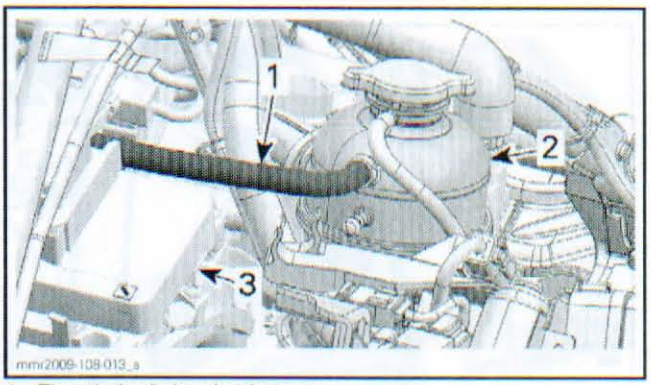
1. Engine connector
2. ECM

17. Cut locking ties securing the harness of ECM connector B to ECM support.
18. Detach the throttle cable from the throttle body.



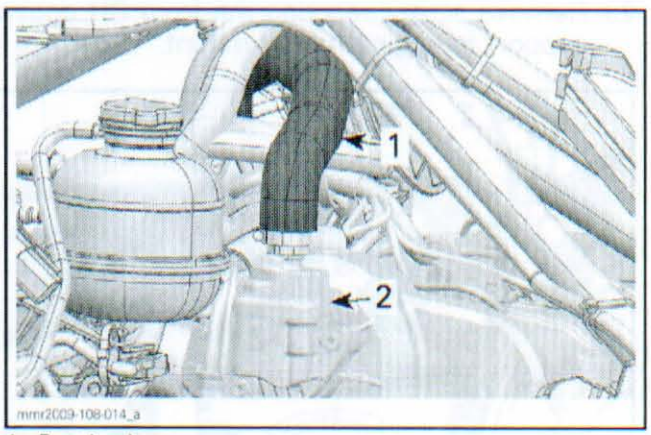
1. Throttle cable
2. Throttle body

19. Disconnect the throttle body heating hose from the coolant reservoir.



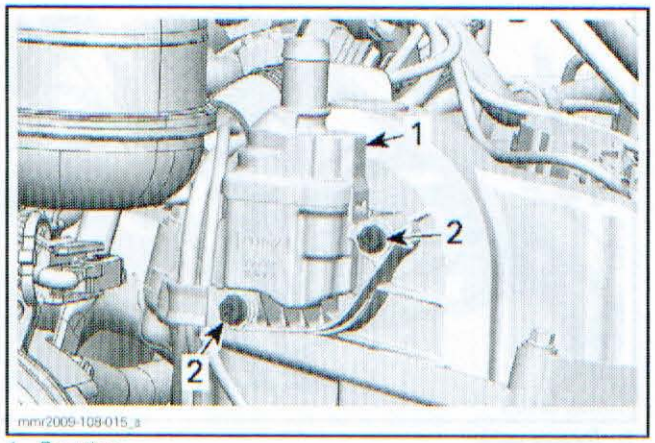
1. Throttle body heating hose
2. Coolant reservoir
3. ECM

20. Disconnect hose from breather.



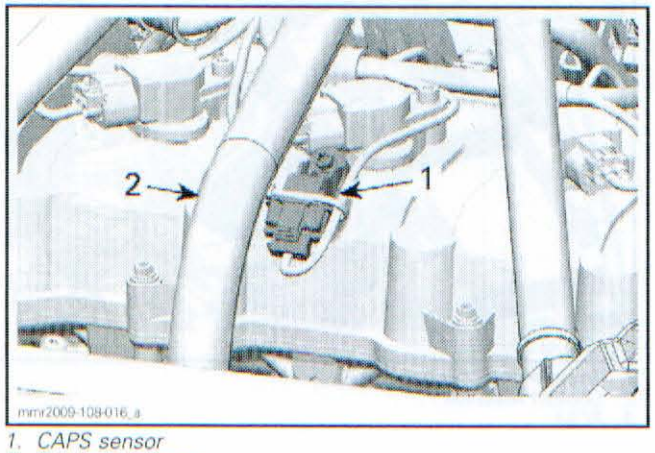
1. Breather hose
2. Breather

21. Remove breather from engine.



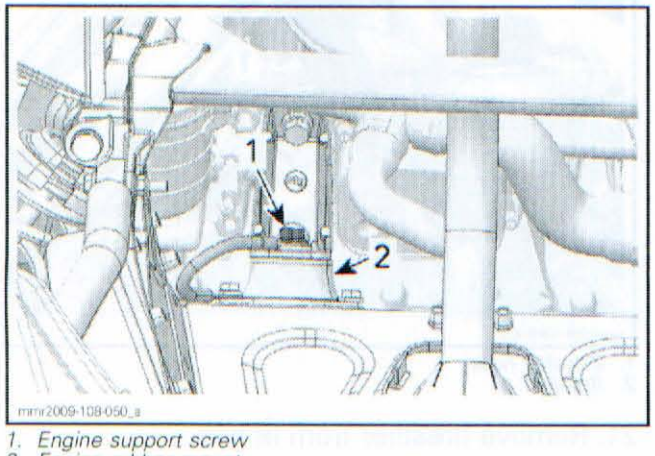
1. *Breather*
2. *Remove these screws*

22. Remove screw securing the camshaft position sensor (CAPS) then move the sensor aside.



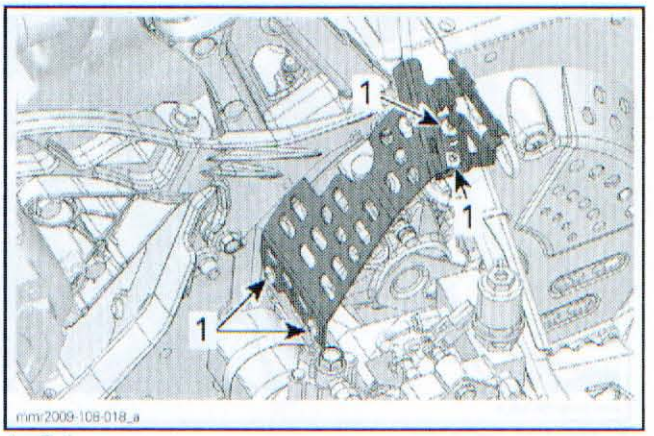
1. *CAPS sensor*
2. *Steering column*

23. Remove screw securing the front RH engine support to engine rubber mount.



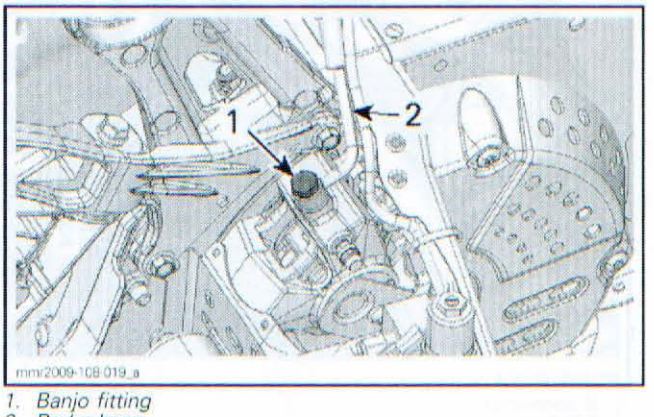
1. *Engine support screw*
2. *Engine rubber mount*

24. Remove the caliper protector.



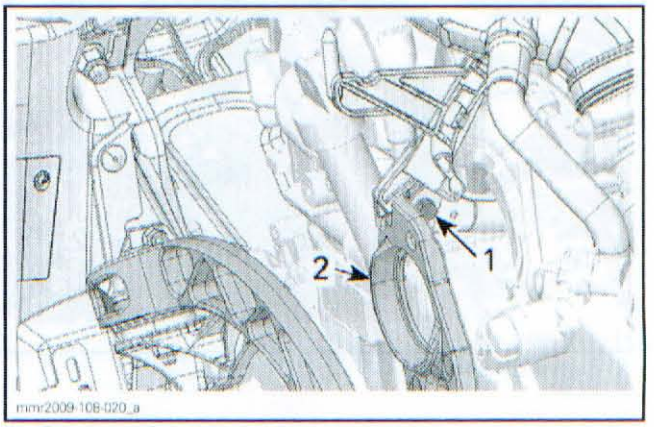
1. *Caliper protector screws*

25. Remove the Banjo fitting then move the brake hose aside. Discard sealing washers.



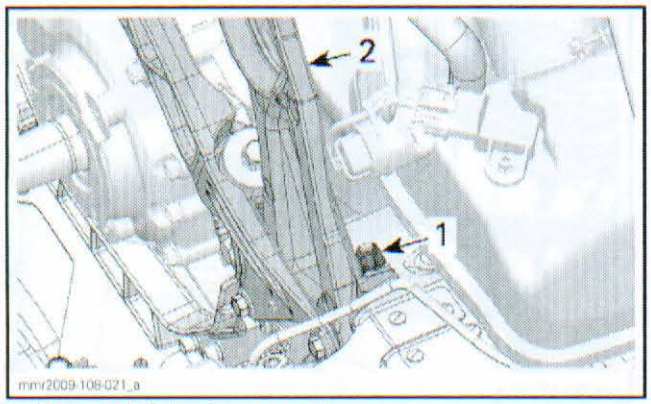
1. *Banjo fitting*
2. *Brake hose*

26. Remove the screw securing the top of the countershaft bearing support.



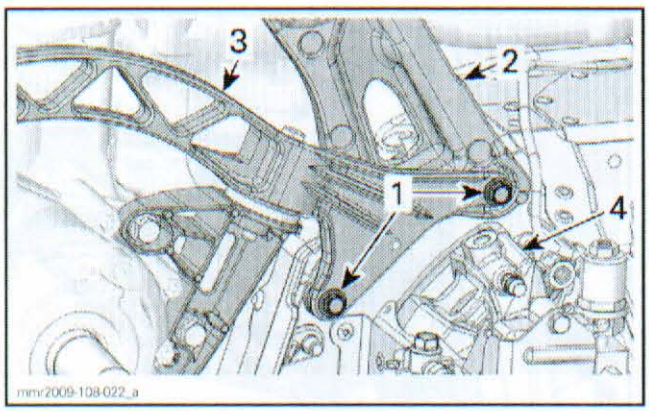
1. *Countershaft bearing support upper screw*
2. *Countershaft bearing support*

27. Loosen nut retaining the bottom of countershaft bearing support to frame.



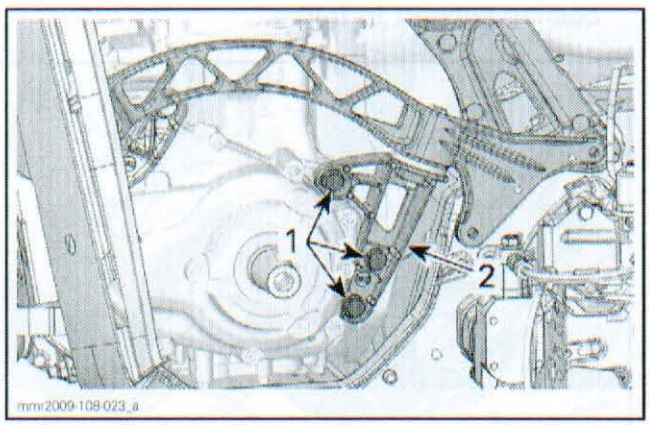
1. *Countershaft bearing support lower nut*
2. *Countershaft bearing support*

28. Remove both screws retaining the brace and the countershaft bearing support to frame.



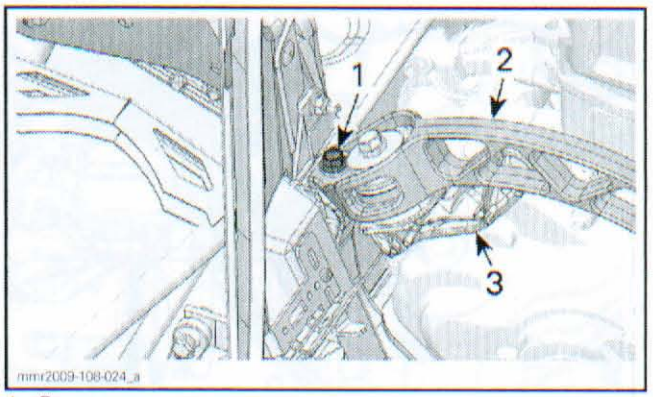
1. *Remove these screws*
2. *Countershaft bearing support*
3. *Brace*

29. Remove screws and washers securing the rear engine support to engine.



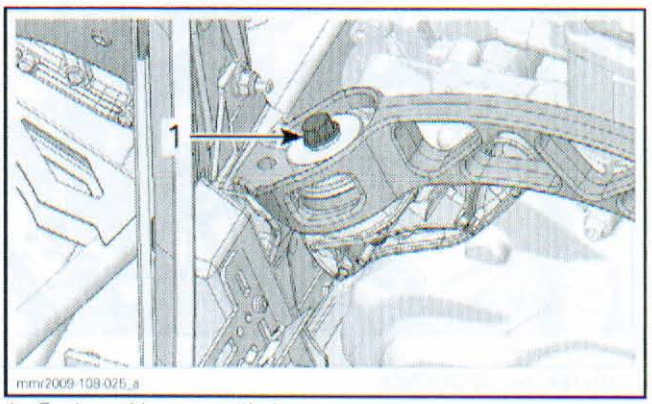
1. *Rear engine support screws*
2. *Rear engine support*

30. Remove screw and washer retaining brace to frame (front engine side).



1. *Brace screw*
2. *Brace*
3. *Front engine support*

31. Unscrew the engine front rubber mount.



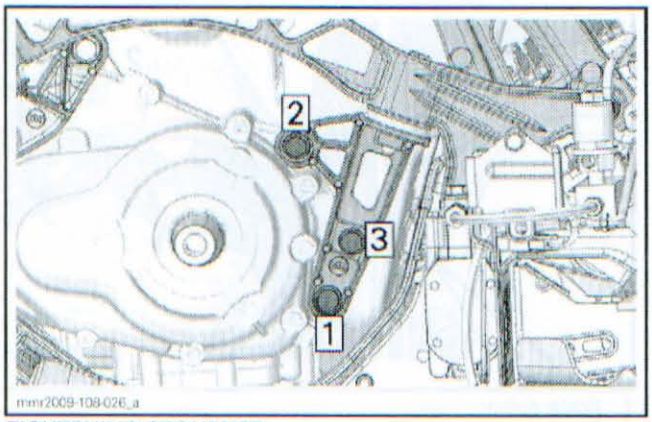
1. *Engine rubber mount bolt*

32. Remove the brace with countershaft bearing support and rear engine support.
33. Lift engine and slide it out of vehicle.

Engine Installation

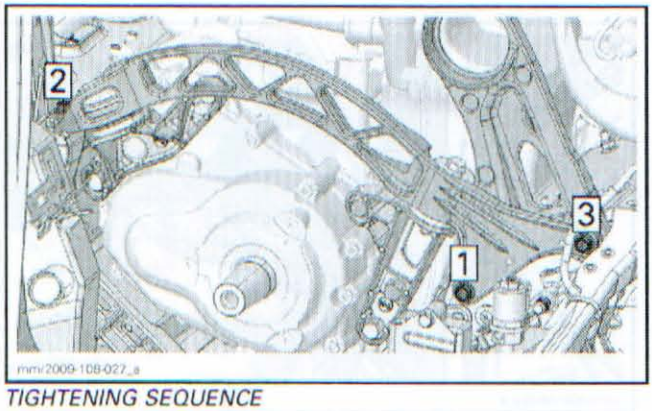
To install the engine, reverse the removal procedure. However, pay attention to the following.

1. Install **NEW** self-locking screws where required, refer to exploded view at the beginning of this section.
2. Install all retaining fasteners (bolt, screw and nut) before beginning the tightening sequence.
3. Tighten fasteners in this order:
   3.1 LH rear engine support screws.



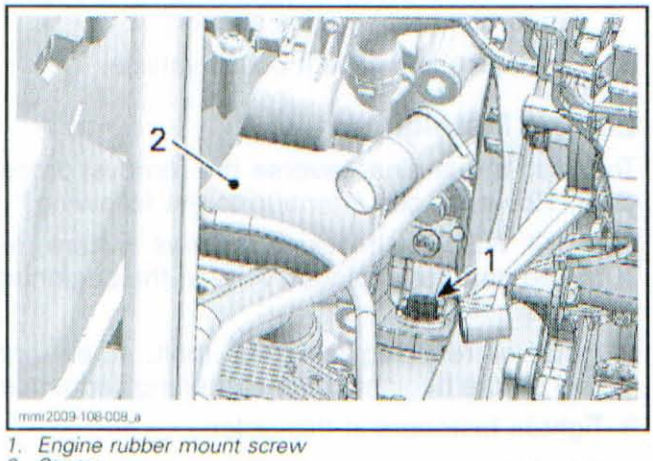
TIGHTENING SEQUENCE

3.2 Brace retaining screws.



TIGHTENING SEQUENCE

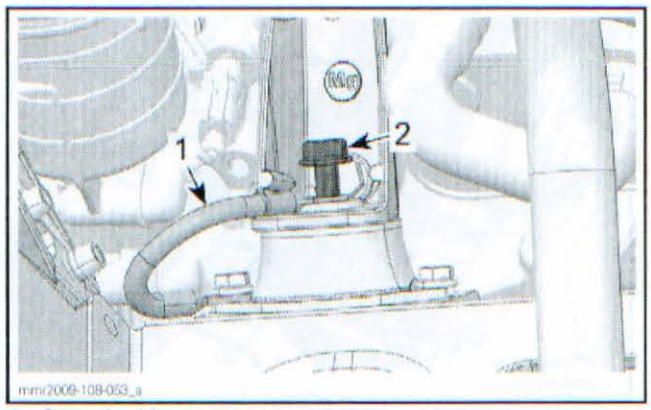
3.3 RH rear engine rubber mount screw.



1. *Engine rubber mount screw*
2. *Starter*

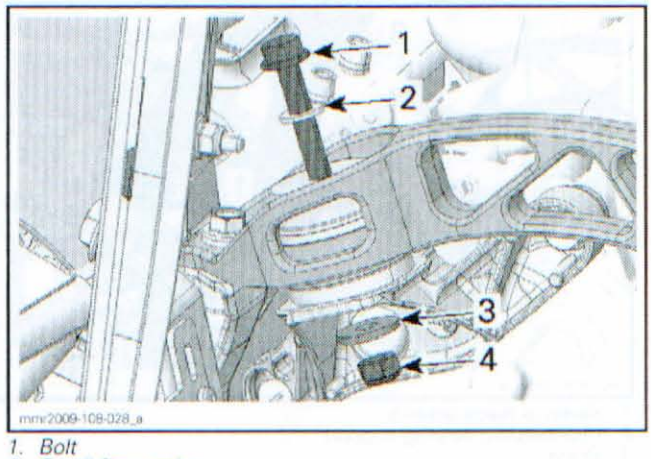
3.4 RH front engine support screw.

NOTE: Do not forget the ground cable.



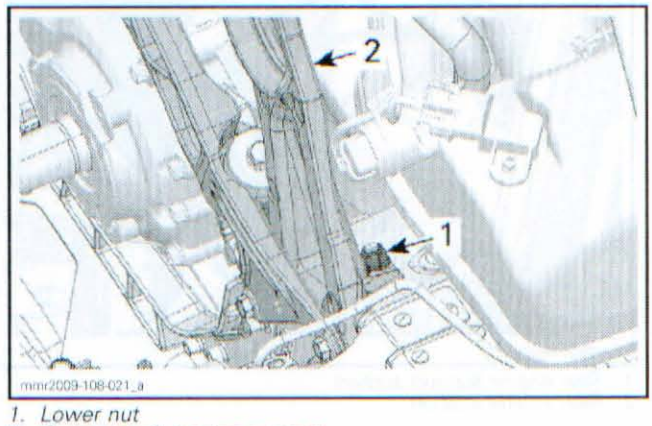
1. *Ground cable*
2. *Engine support screw*

3.5 LH front engine rubber mount bolt. Note position if parts.



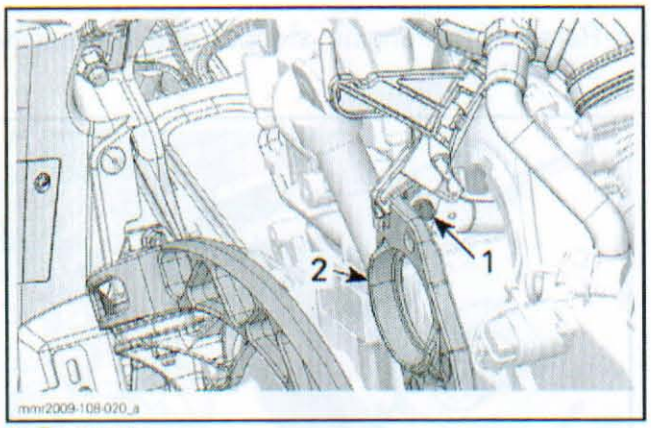
1. *Bolt*
2. *Small flat washer*
3. *Large flat washer with Teflon*
4. *Nut*

4. Tighten lower nut retaining the countershaft bearing support to frame.



1. *Lower nut*
2. *Countershaft bearing support*

5. Install the upper screw securing the countershaft bearing support.



1. *Top screw*
2. *Countershaft bearing support*

6. Install all other removed parts.

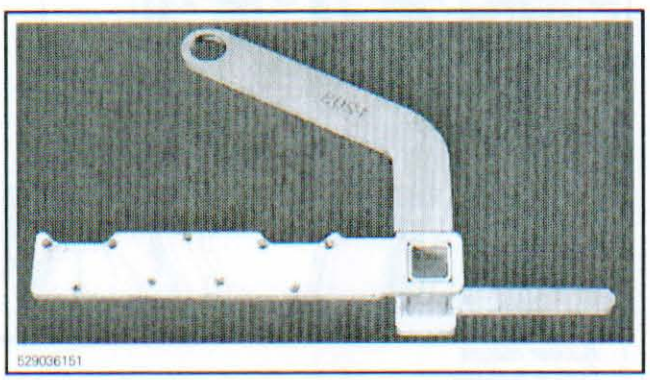
ENGINE SUPPORTS

Engine Support Inspection

Check if engine supports are cracked, bent or damaged. Replace if necessary.

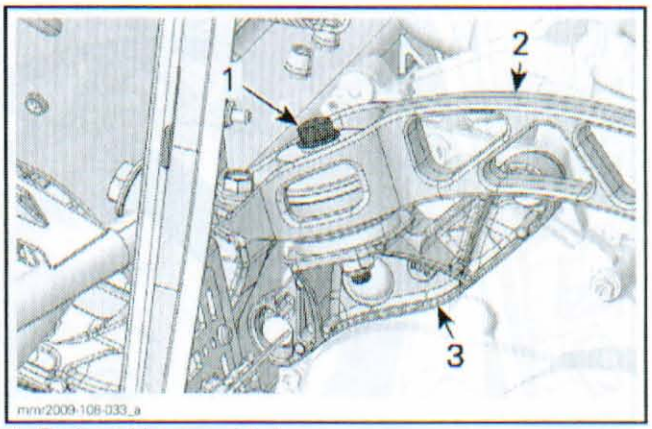
Engine Support Removal

NOTE: Remove the exhaust manifold and install the ENGINE LIFTING TOOL (P/N 529 036 151) before beginning the engine support removal procedure.



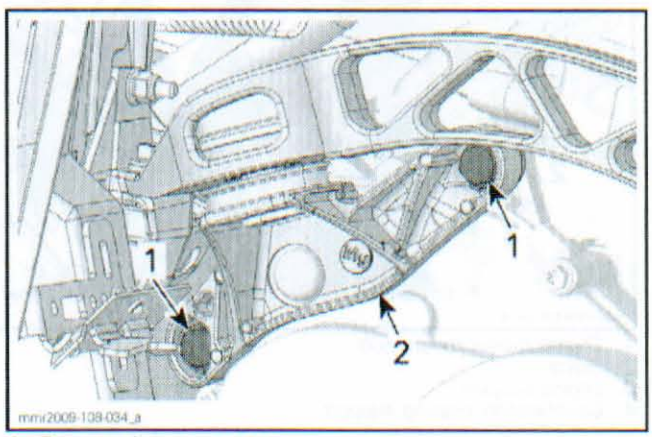
PTO Side Front Engine Support

1. Remove drive and driven pulleys. Refer to *DRIVE SYSTEM AND BRAKE* section.
2. Remove and discard bolt securing the engine rubber mount to front engine support.



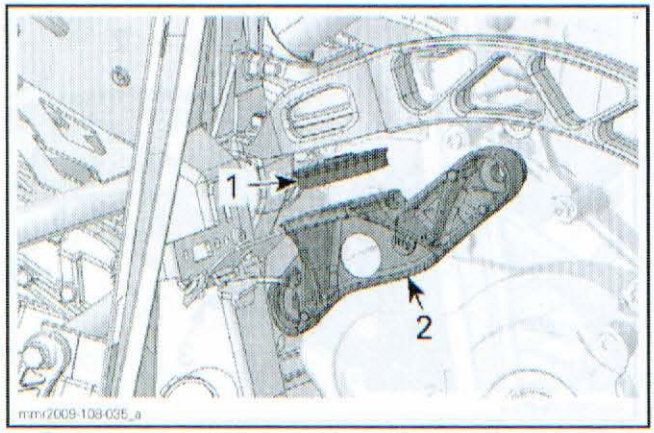
1. *Engine rubber mount bolt*
2. *Brace*
3. *Engine support*

3. Remove screws and washers securing the front engine support to engine. To reach the front screw, use the following tools:
   - A 1/4" drive ratchet
   - A long extension adaptor
   - An universal joint
   - A short 13 mm socket.



1. *Front engine support screws*
2. *Engine support*

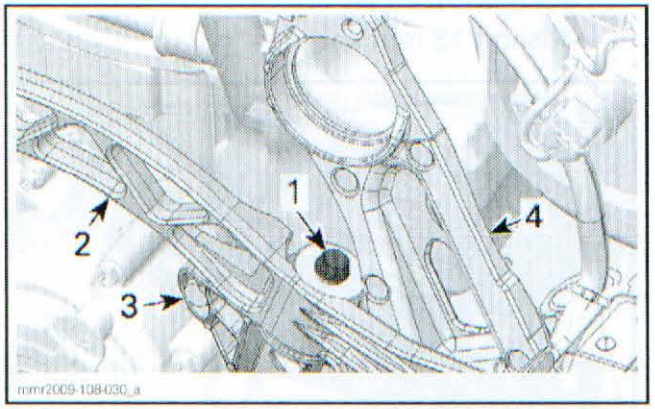
4. Discard engine support screws.
5. Remove the engine stopper and the engine support.



1. *Engine stopper*
2. *Front engine support*

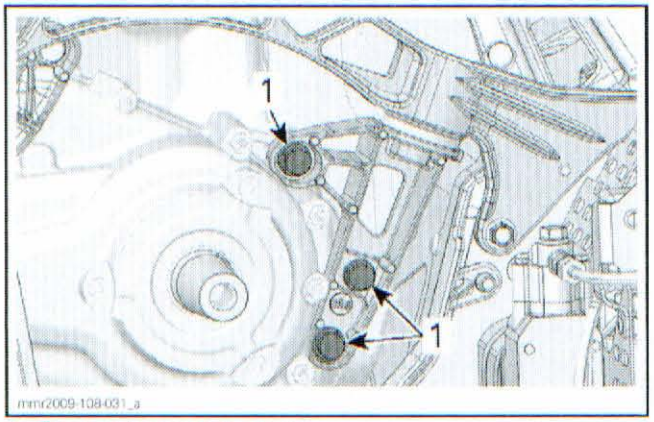
PTO Side Rear Engine Support

1. Remove drive and driven pulleys. Refer to *DRIVE SYSTEM AND BRAKE* section.
2. Loosen bolt securing the rear engine rubber mount to rear engine support.



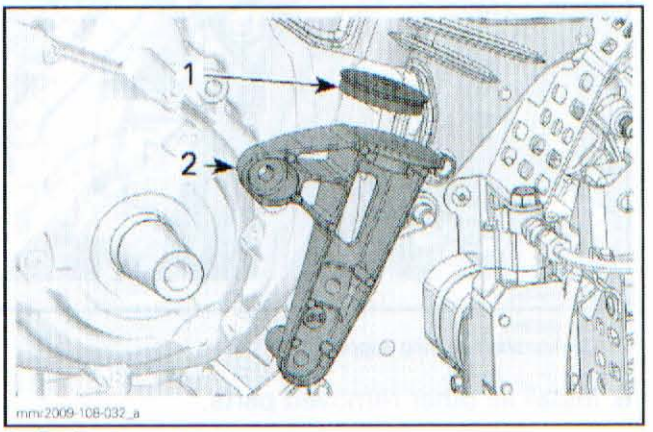
1. *Engine rubber mount bolt*
2. *Brace*
3. *Engine support*
4. *Countershaft bearing support*

3. Remove screws and washers securing the rear engine support to engine. Discard engine support screws.



1. *Rear engine support screws*

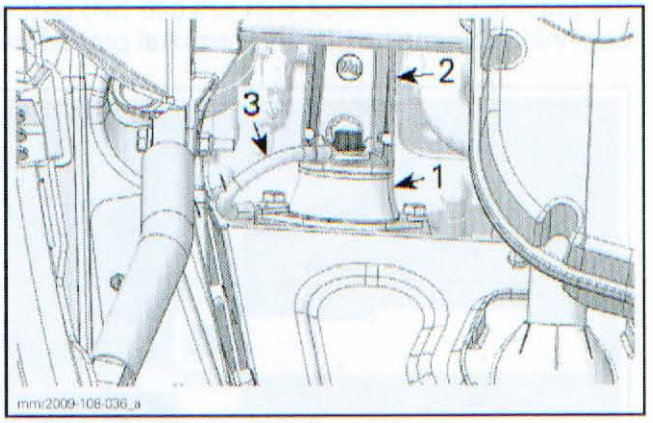
4. Remove the engine stopper and the engine support.



1. *Engine stopper*
2. *Rear engine support*

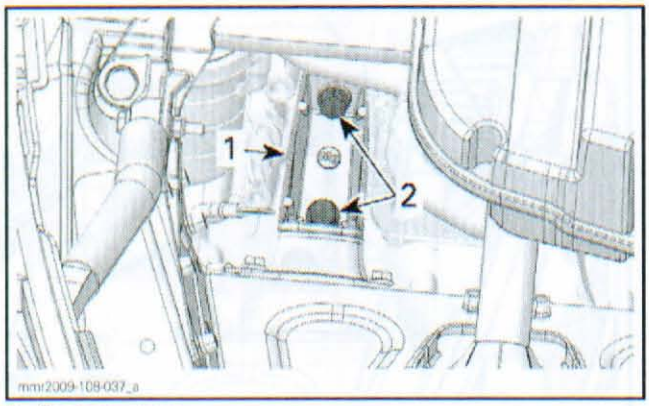
MAG Side Front Engine Support

1. Remove exhaust pipe to make room. Refer to *EXHAUST SYSTEM* subsection.
2. Remove and discard screw securing the ground cable and the front engine support to engine rubber mount.



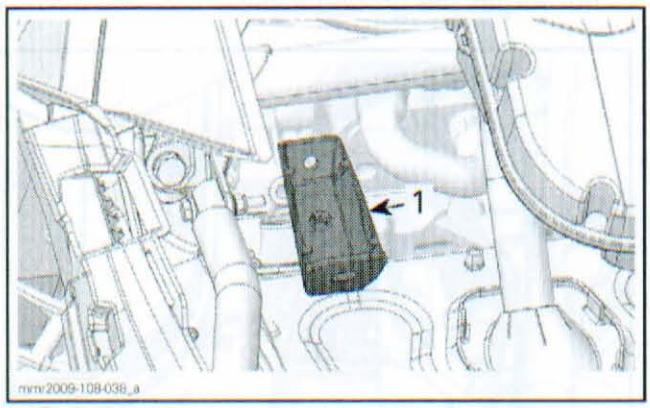
1. *Rubber mount*
2. *Engine support*
3. *Ground cable*

3. Remove and discard both screws retaining the engine support to engine.



1. *Engine support*
2. *Engine support screws*

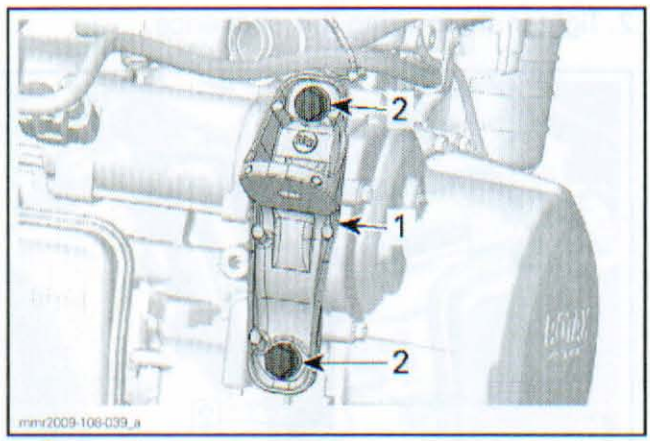
4. Remove engine support.



1. *Engine support*

MAG Side Rear Engine Support

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL* in this subsection.
2. Remove and discard both engine support screws.

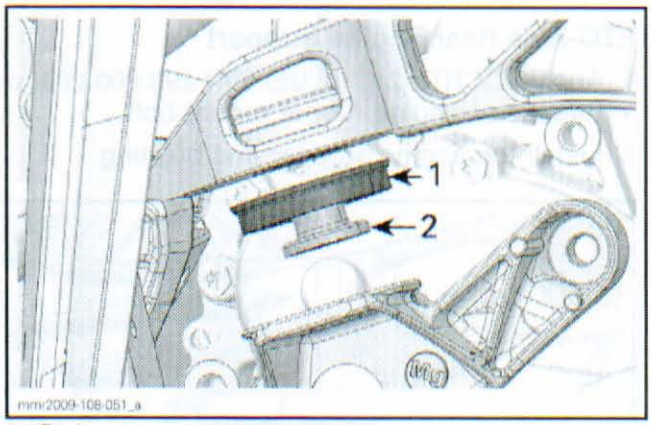


1. *Engine support*
2. *Engine support screws*

Engine Support Installation

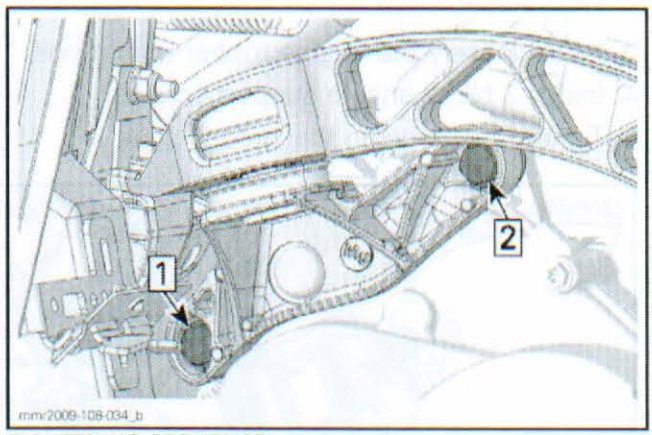
PTO Side Front Engine Support

1. Install the engine stopper and bushing.



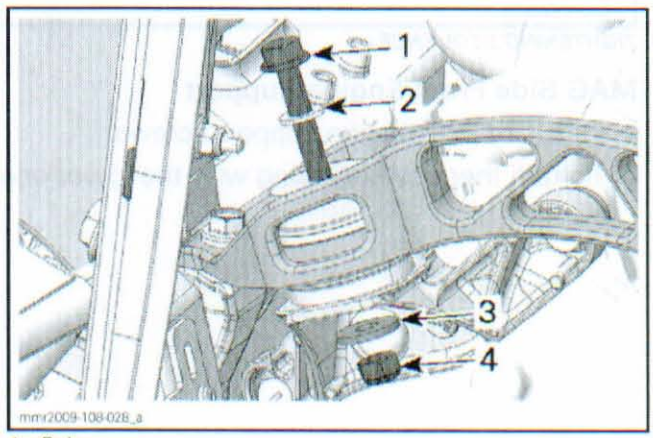
1. *Engine stopper*
2. *Engine stopper bushing*

2. Install loosely 2 **NEW** engine support screws and a **NEW** engine rubber mount bolt.
3. Tighten the lower engine support screw then the upper one.



TIGHTENING SEQUENCE

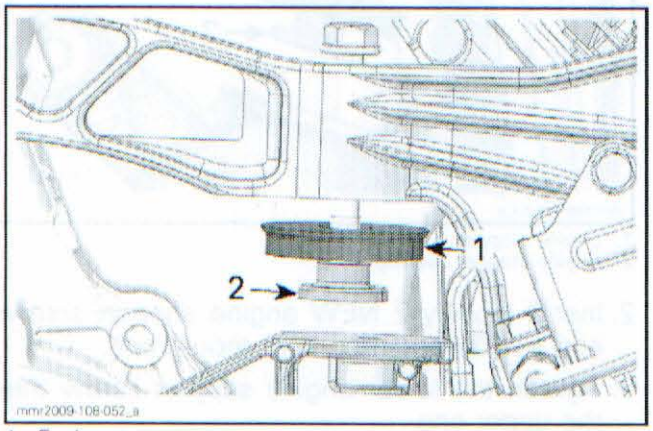
4. Make sure bolt and washer are installed in proper order then tighten the engine rubber mount bolt.



1. *Bolt*
2. *Small flat washer*
3. *Large flat washer*
4. *Nut*

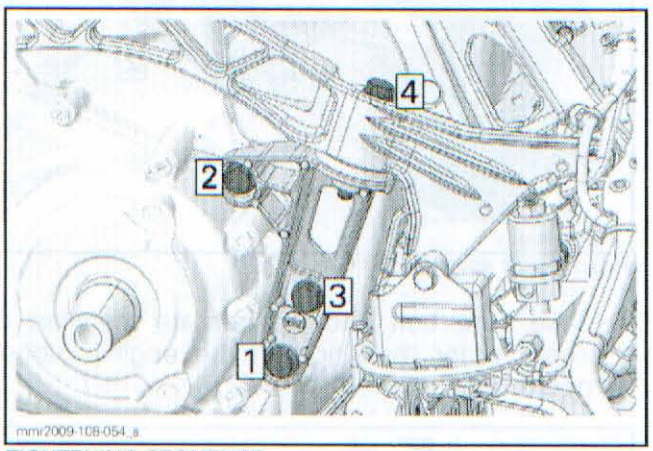
PTO Side Rear Engine Support

1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of engine rubber mount bolt.
2. Install the engine stopper and bushing.



1. *Engine stopper*
2. *Engine stopper bushing*

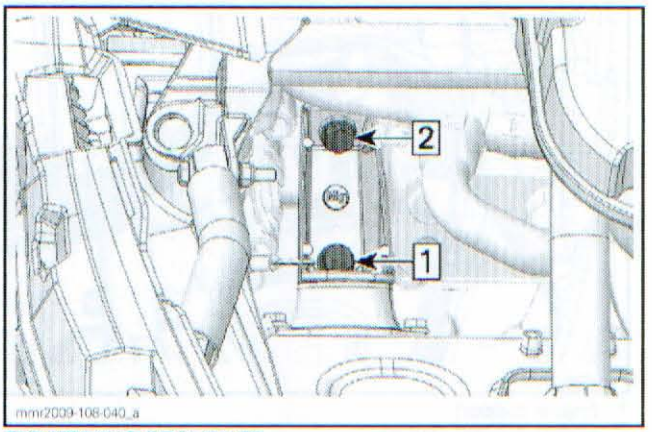
3. Install loosely the engine rubber mount bolt.
4. Install 3 **NEW** engine support screws.
5. Tighten fasteners in this order.



TIGHTENING SEQUENCE

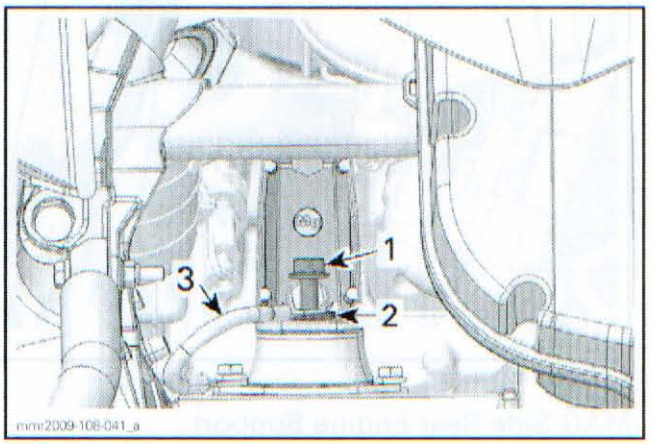
MAG Side Front Engine Support

1. Install 2 **NEW** engine support screws.
2. Tighten them by beginning with the lower one.



TIGHTENING SEQUENCE

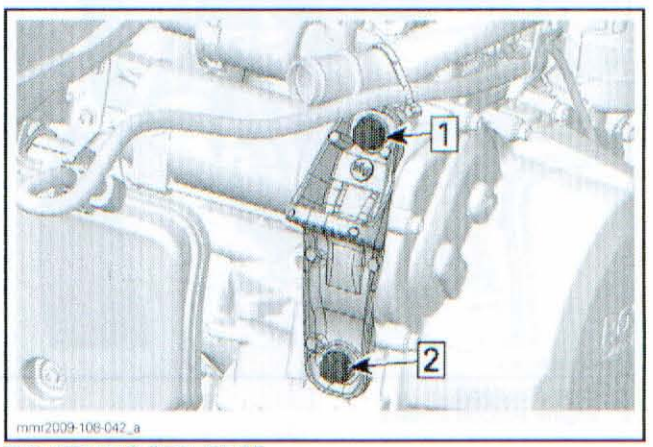
3. Install a **NEW** engine rubber mount screw. Do not forget the ground cable.



1. *Engine rubber mount screw*
2. *Washer*
3. *Ground cable*

MAG Side Rear Engine Support

1. Install 2 **NEW** engine support screws.
2. Tighten them using this sequence.



TIGHTENING SEQUENCE

3. Install the engine into vehicle. Refer to *ENGINE INSTALLATION* in this subsection.

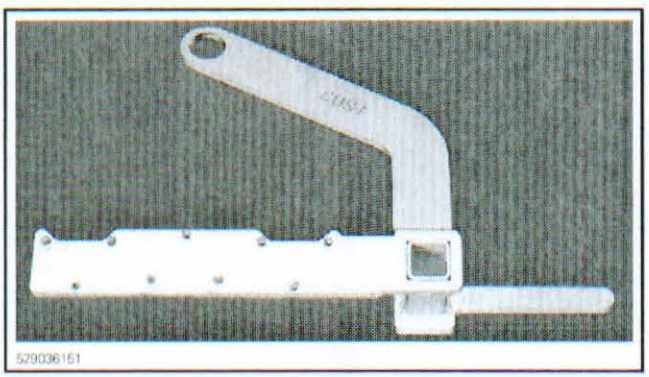
ENGINE RUBBER MOUNT

Engine Rubber Mount Inspection

Check rubber mounts. Replace them if brittle, cracked or damaged.

Engine Rubber Mount Removal

NOTE: Remove the exhaust manifold and install the ENGINE LIFTING TOOL (P/N 529 036 151) before beginning the engine rubber mount removal procedure.

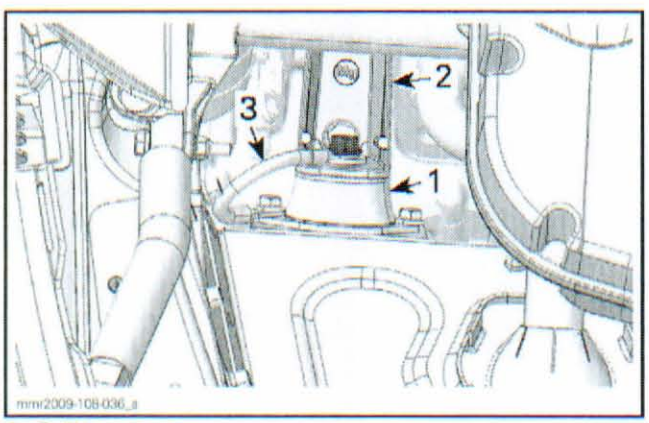


PTO Side Engine Rubber Mounts

The engine rubber mounts located on the brace are not available separately. Replace the brace when an engine rubber mount must be replaced. Refer to *PTO SIDE BRACE* in *FRAME* subsection.

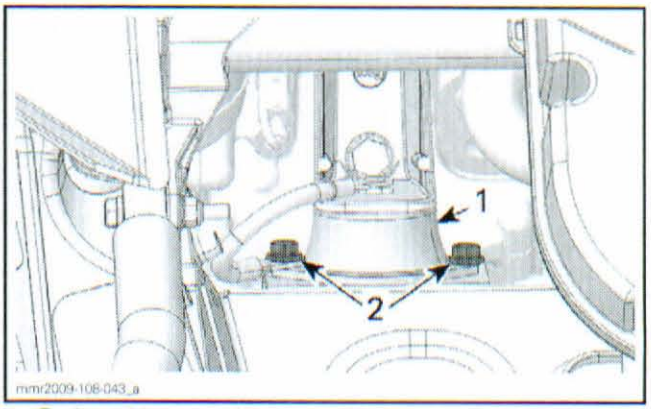
MAG Side Front Engine Rubber Mount

1. Remove the exhaust pipe. Refer to *EXHAUST SYSTEM* subsection.
2. Remove and discard screw securing the ground cable and the front engine support to engine rubber mount.



1. *Rubber mount*
2. *Engine support*
3. *Ground cable*

3. Remove screws securing the engine rubber mount to frame.

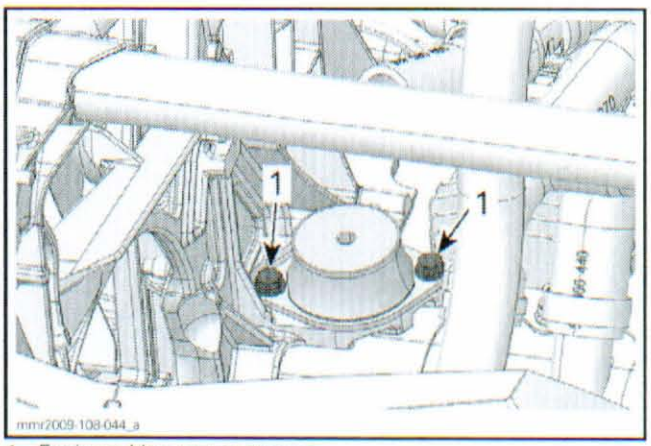


1. *Engine rubber mount*
2. *Retaining screws*

4. Remove the engine rubber mount.

MAG Side Rear Engine Rubber Mount

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL* in this subsection.
2. Remove and discard both engine rubber mount screws.



1. *Engine rubber mount screws*

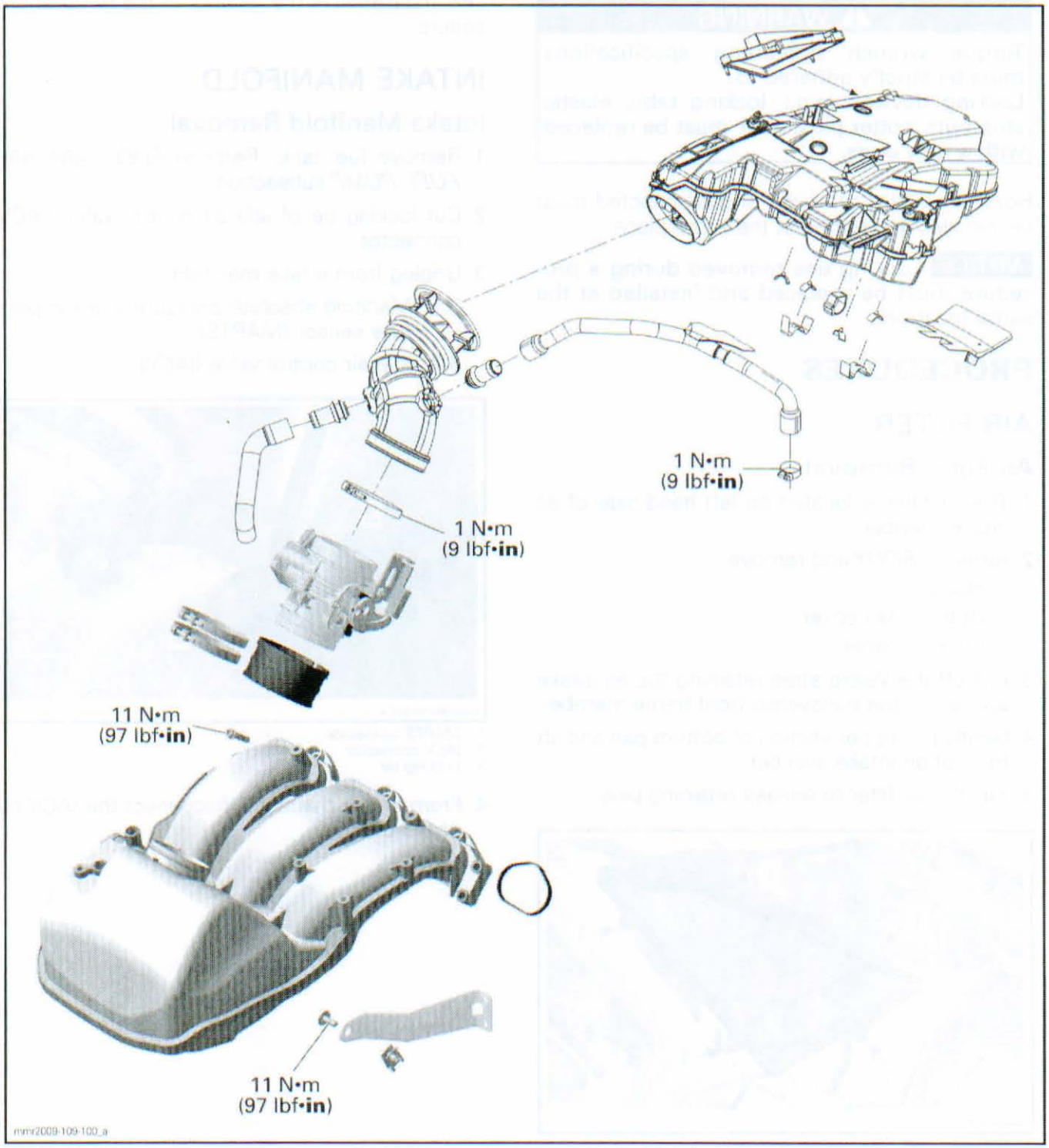
Engine Rubber Mount Installation

The installation is the reverse of the removal procedure.

AIR INTAKE SYSTEM

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON FLEXIBLE PICK-UP TOOL	dptc24	33



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

Hoses or cables removed or disconnected must be installed and routed at the same place.

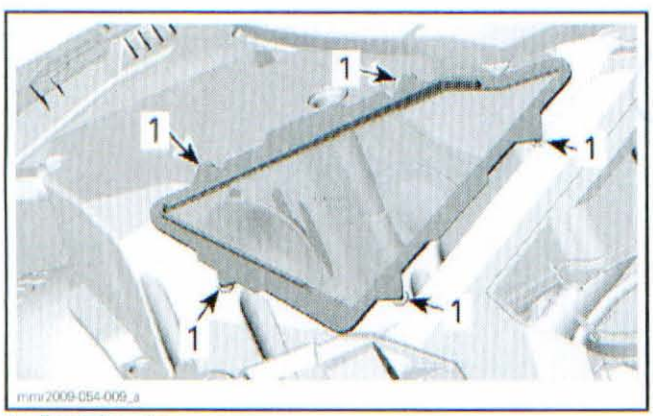
NOTICE Locking ties removed during a procedure must be replaced and installed at the same location.

PROCEDURES

AIR FILTER

Air Filter Removal

1. The air filter is located on left hand side of air intake silencer.
2. Refer to *BODY* and remove:
   - Hood
   - Bottom pan cover
   - LH side panel.
3. Pull off the Velcro strap retaining the air intake silencer to the transversal front frame member.
4. Gently pull upper section of bottom pan and lift front of air intake silencer.
5. Pull the air filter to release retaining pins.



1. Retaining pins

Air Filter Cleaning

Clean with fresh water and mild soap.

Replace air filter as required.

NOTE: If the filter is very dirty, clean the interior of air intake silencer at the same time.

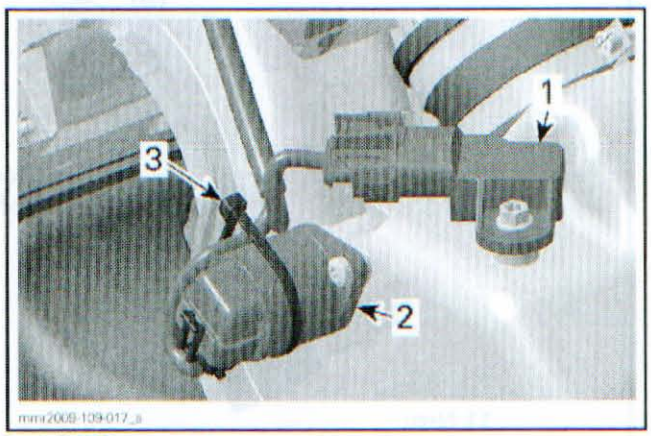
Air Filter Installation

The installation is the reverse of the removal procedure.

INTAKE MANIFOLD

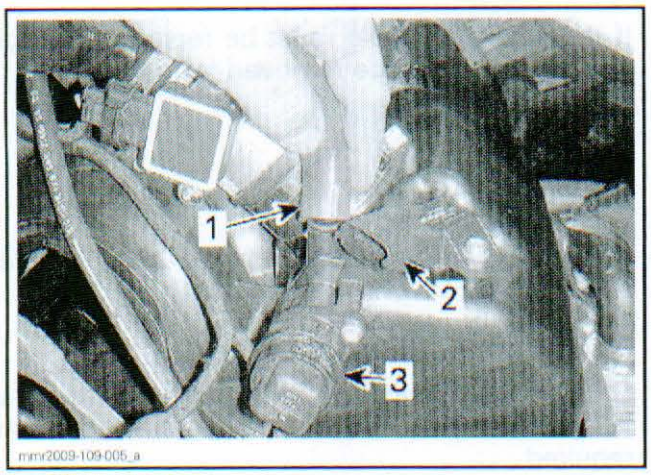
Intake Manifold Removal

1. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Cut locking tie of idle air control valve (IACV) connector.
3. Unplug from intake manifold:
   - 3.1 Manifold absolute pressure and temperature sensor (MAPTS)
   - 3.2 Idle air control valve (IACV).



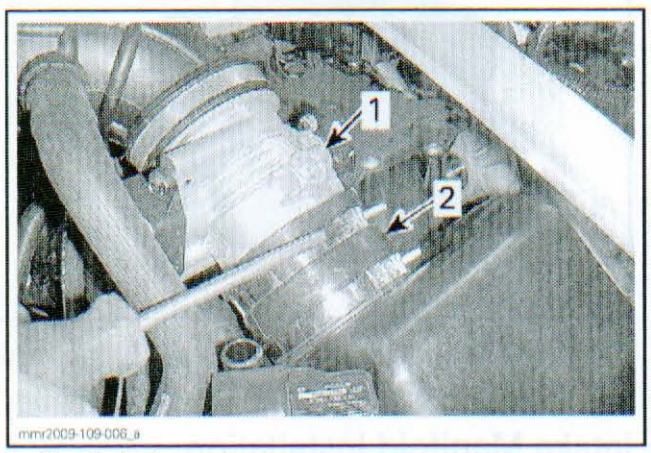
1. MAPTS connector
2. IACV connector
3. Locking tie

4. From intake manifold, disconnect the IACV bypass hose.



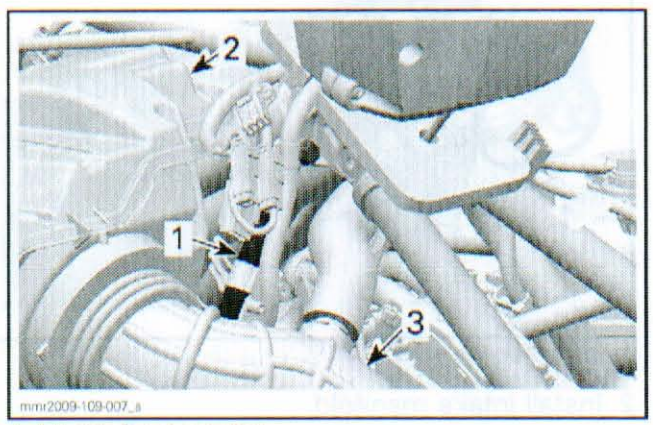
1. *IACV bypass hose*
2. *MAPTS*
3. *IACV*

5. Loosen clamp securing the throttle body to intake adapter.



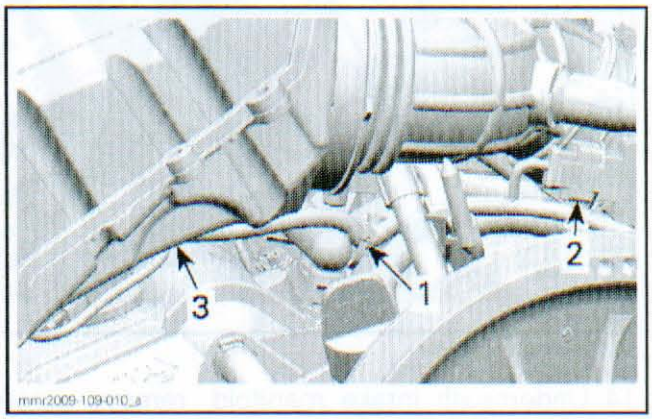
1. *Throttle body*
2. *Intake adapter*

6. Remove the throttle body from intake adapter and move throttle body aside.
7. Remove bolt securing the top of the LH side frame member.



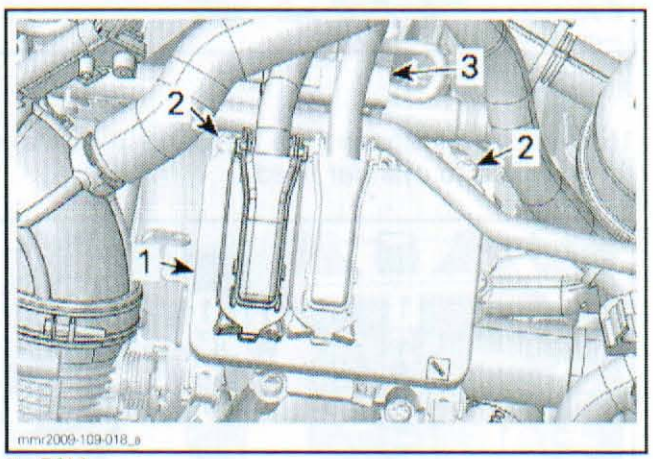
1. *LH side frame member*
2. *Air intake silencer*
3. *Intake hose*

8. Cut the locking tie securing the TPS harness to the fuel rail.



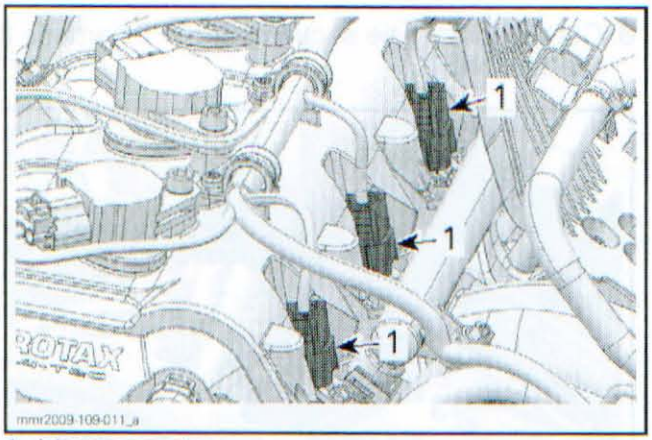
1. *Cut this locking tie*
2. *TPS connector*
3. *Air intake silencer*

9. From ECM support, cut locking ties securing:
   - Throttle body heater hose
   - Wiring harnesses.
10. Remove the ECM from its support without disconnecting connectors.
    10.1 Remove ECM retaining screws.
    10.2 Move ECM aside.
11. Unplug the engine connector.



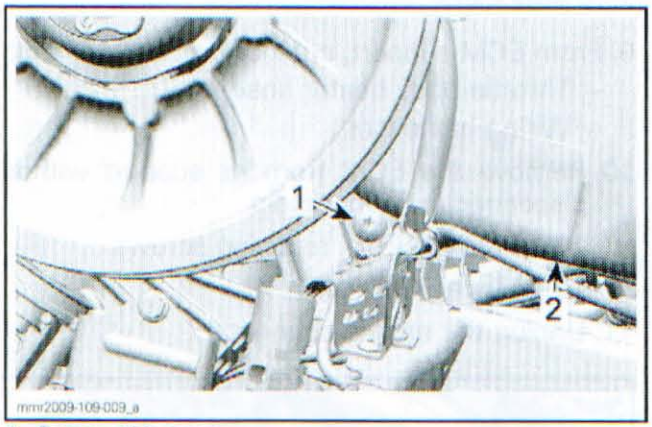
1. *ECM*
2. *ECM retaining screws*
3. *Engine connector*

12. Remove the engine connector housing from the ECM support.
13. Unplug the three injectors.



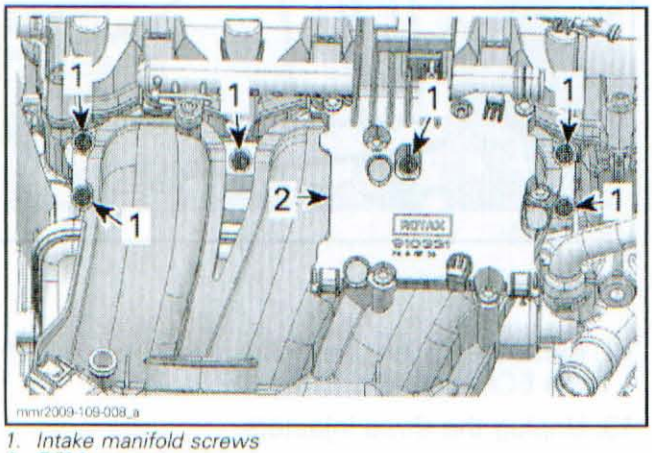
1. Injector connectors

14. Underneath intake manifold, remove screw retaining it to its bracket.



1. Remove this screw
2. Intake manifold

15. Remove all screws (6) securing the intake manifold to cylinder head.



1. Intake manifold screws
2. ECM support

16. Move the intake manifold upward and rearward to pass over the transversal bar.
17. Remove the intake manifold from the vehicle.

If the intake manifold must be replaced, the following parts must be removed from it:
- Intake adapter
- MAPTS
- IACV
- ECM support
- Fuel rail with injectors (refer to *ELECTRONIC FUEL INJECTION* subsection).

Intake Manifold Inspection

Check intake manifold for cracks, warping at flanges or any other visible damages. Replace as required.

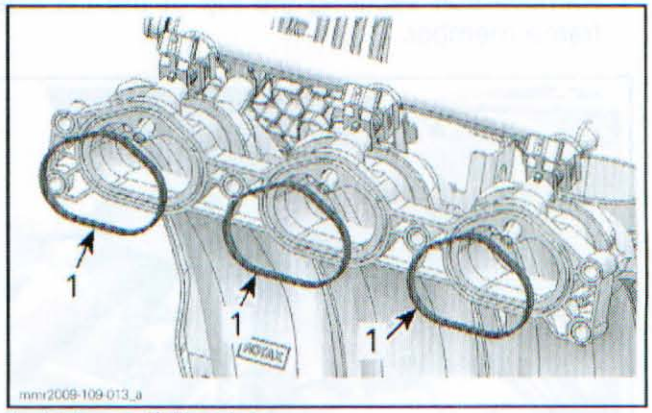
Check if intake adapter is cracked, brittle or otherwise damaged.

Check if intake manifold gaskets are brittle, hard or damages. Replace as required.

Intake Manifold Installation

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

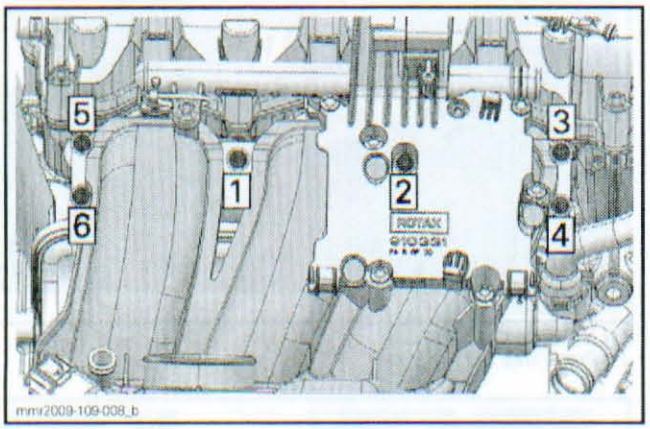
1. Ensure that all gaskets are properly installed.



1. Intake manifold gaskets

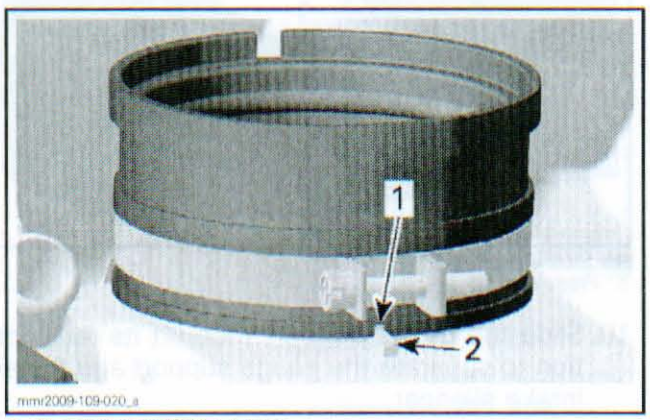
2. Install intake manifold.

3. Using a pick-up tool such as the SNAP-ON FLEXIBLE PICK-UP TOOL (P/N DPTC24), position intake manifold screws in their holes. Turn all screws 3-4 turns.
4. Install and tighten the retaining screw under intake manifold.
5. Tighten intake manifold screws using the following sequence.



mmr2009-109-008_b

6. When installing intake adapter onto intake manifold, make sure to index intake manifold tab with intake adapter notch.



mmr2009-109-020_a

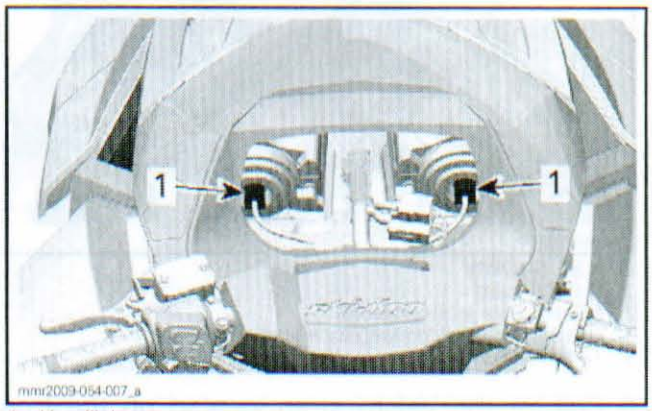
1. Notch in manifold adapter
2. Intake manifold tab

7. Install all other removed parts.

AIR INTAKE SILENCER

Air Intake Silencer Removal

1. Refer to *BODY* subsection and remove the following parts:
   - Both side panels
   - Hood
   - Bottom pan cover
   - Windshield
   - Console.
2. Remove the multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
3. Unplug headlight connectors.



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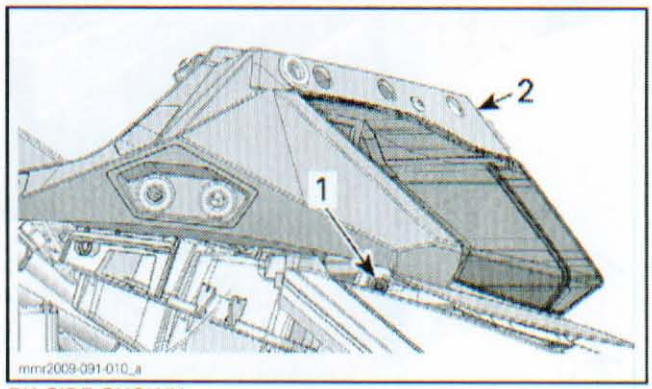
1. Headlight connectors

4. Remove screws securing the gauge support.



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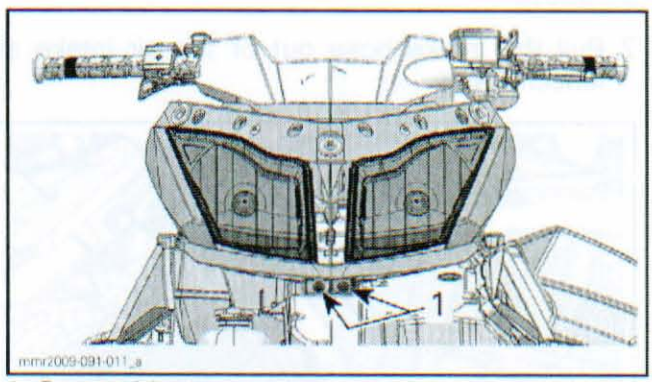
RH SIDE SHOWN
1. Retaining screw (one each side)
2. Gauge support



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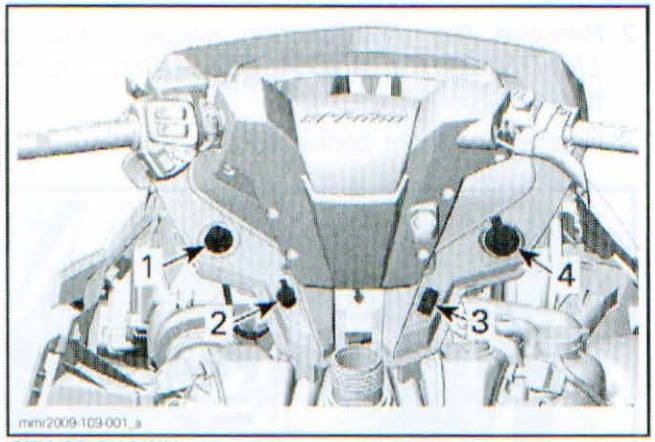
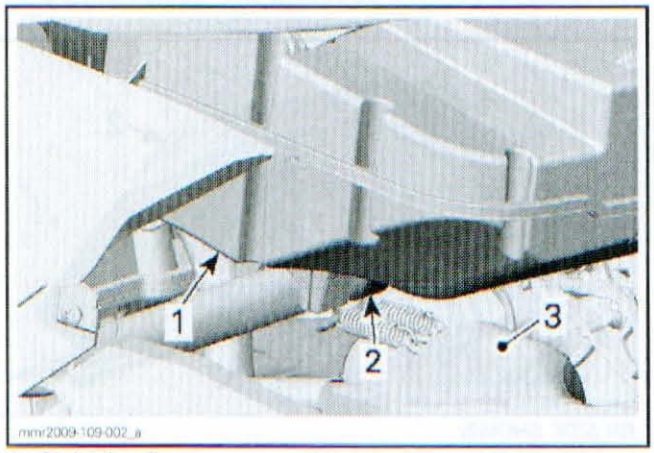
1. Front retaining screws

5. Unplug all switches, connectors or accessories from gauge support.



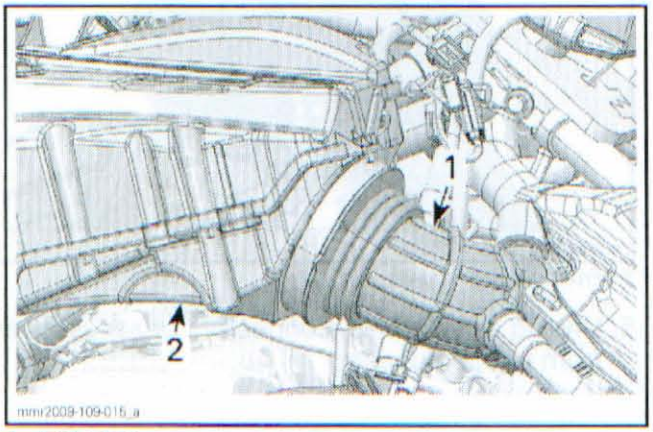
GTX SE SHOWN
1. *D.E.S.S. post*
2. *Electric visor jack connector*
3. *Heated seat switch (operator's seat)*
4. *12-volt power outlet*

6. Pull off the Velcro strap located on the front lower portion of the air intake silencer.



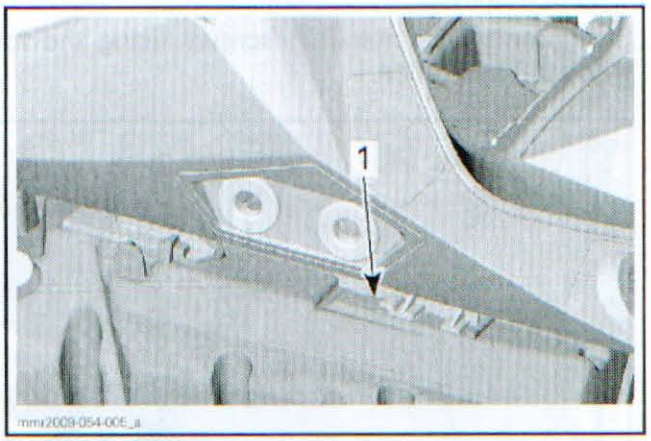
1. *Air intake silencer*
2. *Velcro Strap*
3. *Tuned pipe*

7. Pull the intake hose out of the air intake silencer.

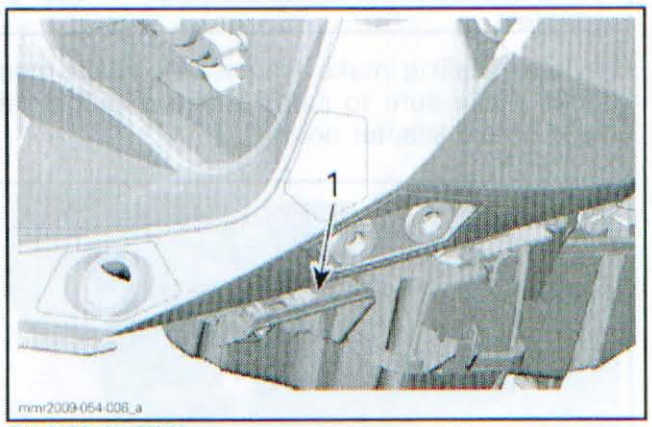


1. *Intake hose*
2. *Air intake silencer*

8. Remove the air intake silencer and the gauge support from the vehicle.
9. On LH and RH sides of gauge support, press and hold the tabs securing gauge support to air intake silencer.



LH SIDE SHOWN
1. *Press this tab*



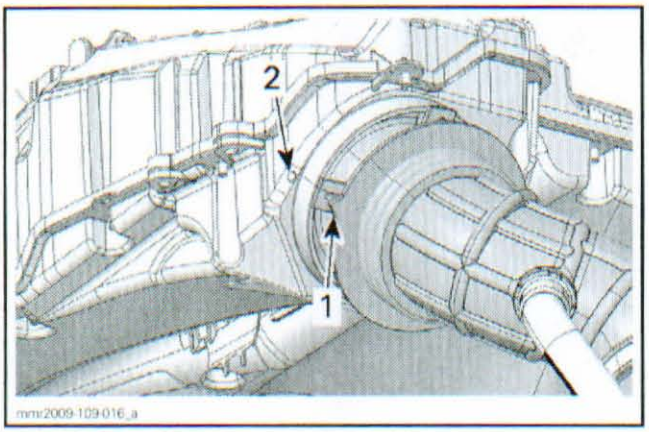
RH SIDE SHOWN
1. *Press this tab*

10. Slide the gauge support then lift its rear portion to separate the gauge support and the air intake silencer.

Air Intake Silencer Installation

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

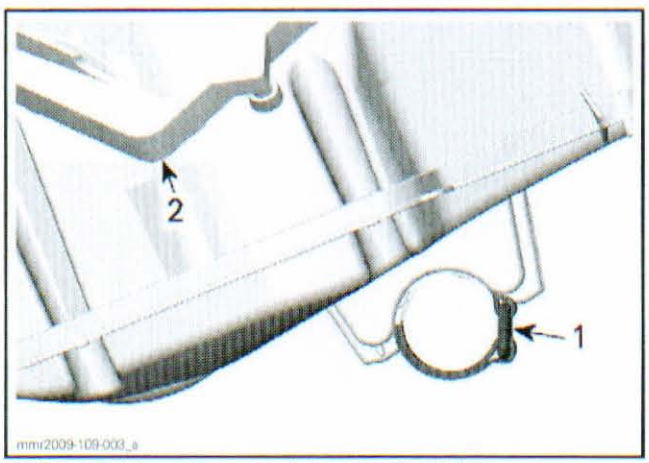
Insert intake hose into air intake silencer. Align the intake hose tip and air intake silencer arrow.



1. *Intake hose tip*
2. *Air intake silencer arrow*

NOTE: The intake hose is fully inserted when the last rib has a good 360° contact with the air intake silencer flange.

Make sure to route Velcro strap correctly.



1. *Ring of Velcro strap toward the rear of vehicle*
2. *Air filter*

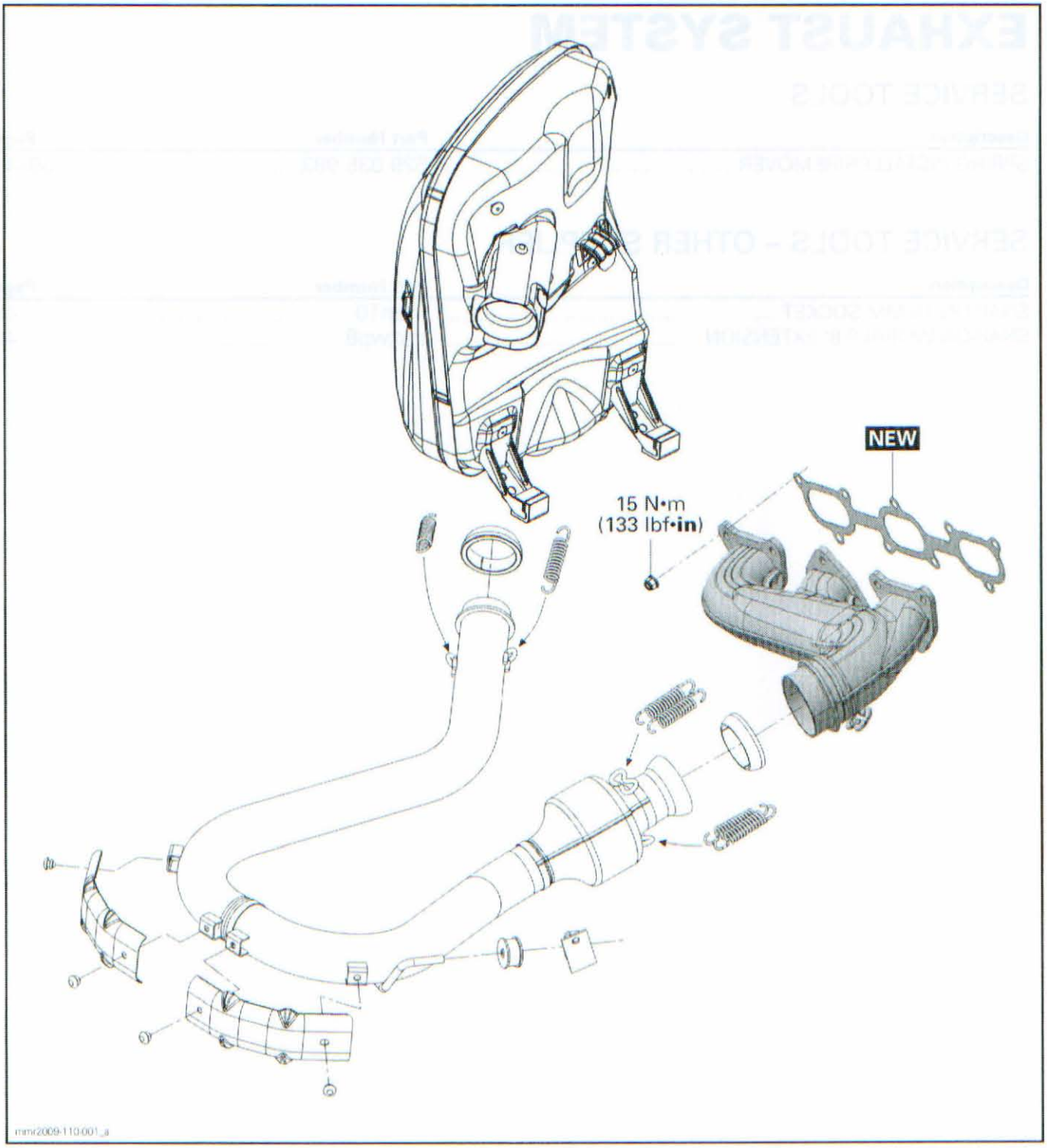
EXHAUST SYSTEM

SERVICE TOOLS

Description	Part Number	Page
SPRING INSTALLER/REMOVER	529 035 983	39–41

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON 10 MM SOCKET	tmm10	40
SNAP-ON WOBBLE 8" EXTENSION	tmxwp8	40


NEW
15 N•m
(133 lbf•in)
mmr2009-110-001_a

GENERAL

⚠ WARNING

To avoid potential burns, never touch exhaust system components immediately after the engine has been running because these components are very hot. Let engine and exhaust system cool down before performing any servicing.

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

⚠ WARNING

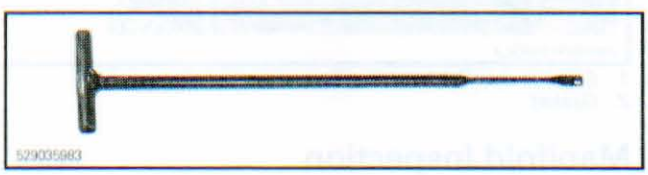
Torque wrench tightening specifications must be strictly adhered to.
Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced with new ones.

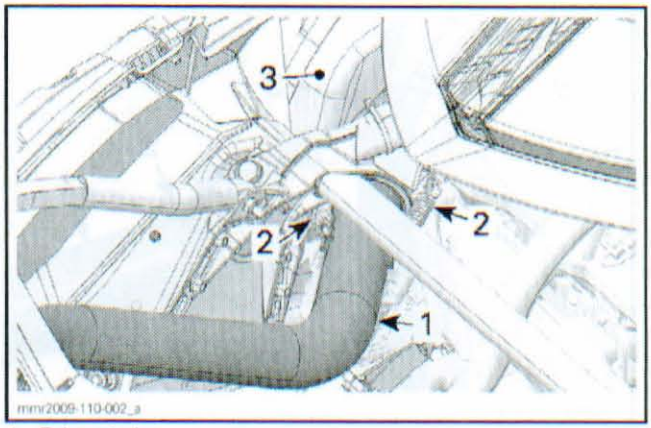
PROCEDURES

EXHAUST PIPE

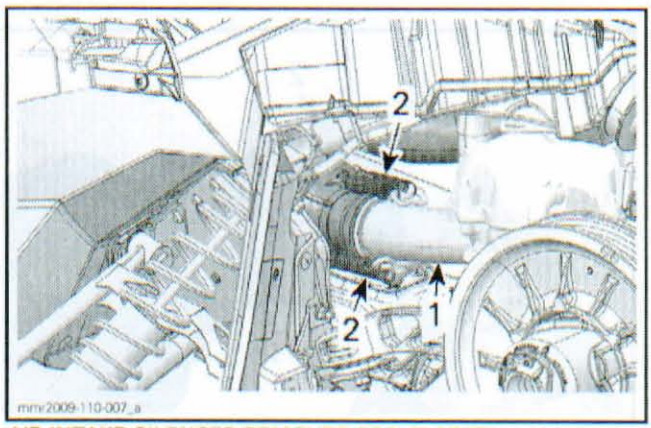
Exhaust Pipe Removal

1. Refer to *BODY* subsection and remove:
   - Both side panels
   - Hood
   - Bottom pan cover.
2. Remove the belt guard. Refer to *DRIVE BELT* subsection.
3. Using the SPRING INSTALLER/REMOVER (P/N 529 035 983), remove exhaust springs securing exhaust pipe to muffler and exhaust manifold.



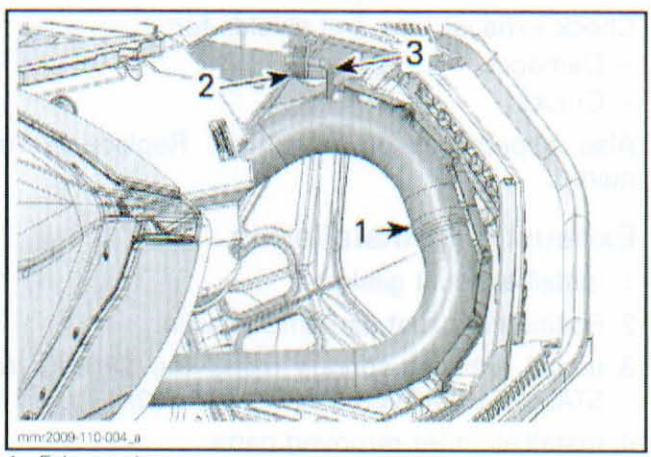


1. *Exhaust pipe*
2. *Exhaust springs*
3. *Muffler*



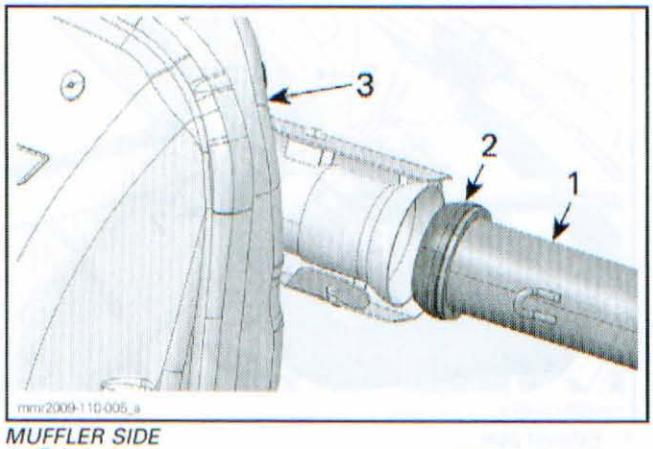
AIR INTAKE SILENCER REMOVED FOR CLARITY
1. *Exhaust manifold*
2. *Exhaust springs (4)*

4. Move the exhaust pipe forward to free its retaining rod from the rubber damper.

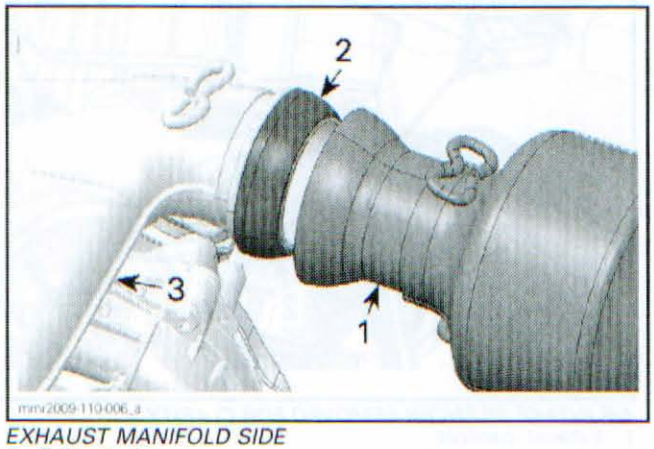


1. *Exhaust pipe*
2. *Rubber damper*
3. *Retaining rod*

5. Remove exhaust pipe from the vehicle.
6. Remove both exhaust gaskets.



MUFFLER SIDE
1. *Exhaust pipe*
2. *Exhaust gasket*
3. *Muffler*



EXHAUST MANIFOLD SIDE
1. *Exhaust pipe*
2. *Exhaust gasket*
3. *Exhaust manifold*

Exhaust Pipe Inspection

Check exhaust pipe and shields for:
- Damages
- Cracks.

Also inspect gaskets condition. Replace as required.

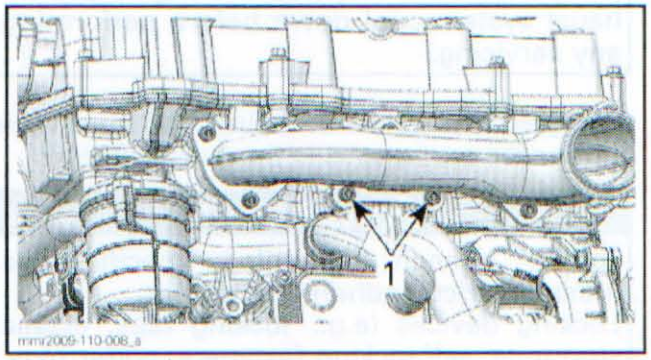
Exhaust Pipe Installation

1. Install exhaust gaskets.
2. Position exhaust pipe into vehicle.
3. Install exhaust springs using the SPRING INSTALLER/REMOVER (P/N 529 035 983).
4. Install all other removed parts.

EXHAUST MANIFOLD

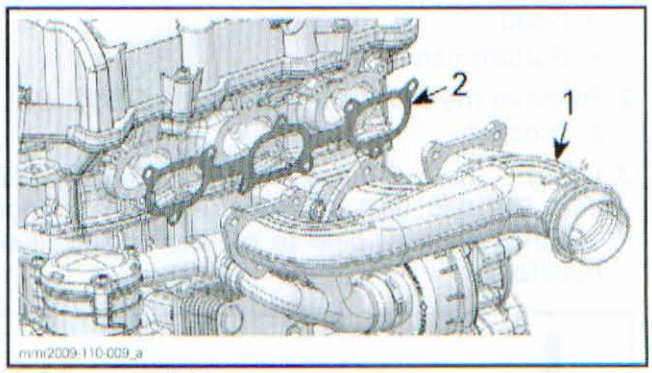
Exhaust Manifold Removal

1. Remove *EXHAUST PIPE*, see procedure in this subsection.
2. Remove manifold nuts using a 10 mm thin wall socket (1/4 drive) such as the SNAP-ON 10 MM SOCKET (P/N TMM10) with a wobble extension such as the SNAP-ON WOBBLE 8" EXTENSION (P/N TMXWP8).
   2.1 First, loosen both lower central nuts.



1. *Lower central nuts*

   2.2 Loosen the 7 other nuts.
   2.3 Lift up the front portion of the exhaust manifold and remove lower nuts.
   2.4 Remove the remaining nuts.
3. Remove the exhaust manifold.
4. Remove and discard the exhaust manifold gasket.



1. *Exhaust manifold*
2. *Gasket*

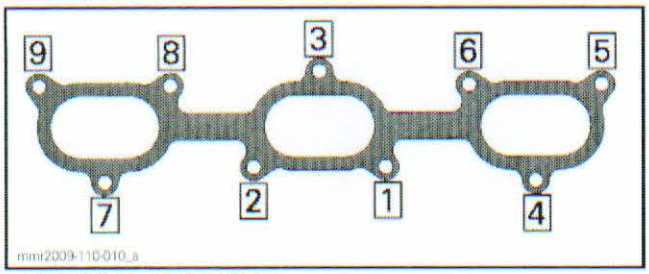
Manifold Inspection

Check if the manifold is cracked or damaged. Replace if necessary.

Manifold Installation

1. Install the exhaust manifold with a **NEW** gasket.
2. Position exhaust manifold on cylinder head.
3. Lift up the front portion of the exhaust manifold and install both lower central nuts.
4. Install all other nuts.

5. Tighten nuts to 15 N•m (133 lbf•**in**) using this pattern.



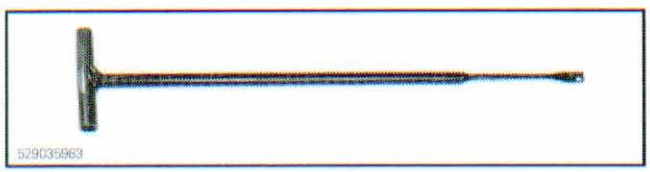
TIGHTENING SEQUENCE

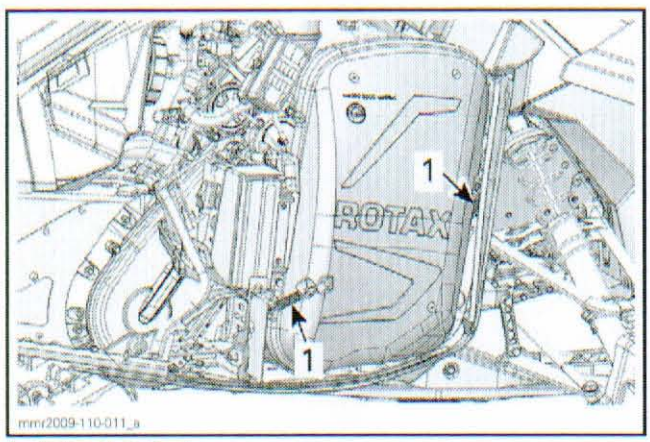
6. Install exhaust pipe.

MUFFLER

Muffler Removal

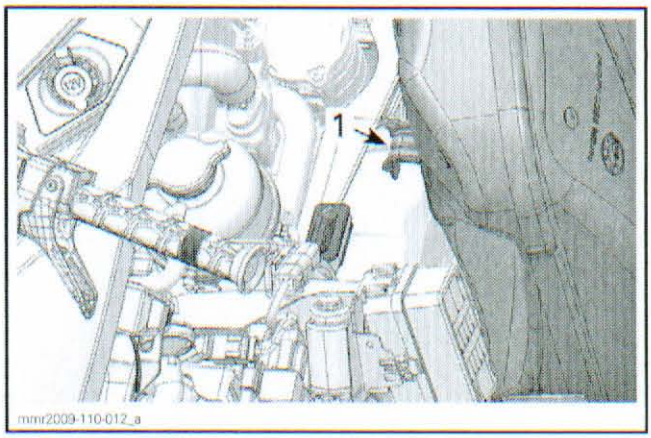
1. Remove the RH side panel.
2. Remove *EXHAUST PIPE*, see procedure in this subsection.
3. Using the SPRING INSTALLER/REMOVER (P/N 529 035 983), remove exhaust springs securing the muffler.





1. Exhaust springs

4. Lift up muffler to free the retaining hook.



1. Retaining hook

5. Remove the muffler.

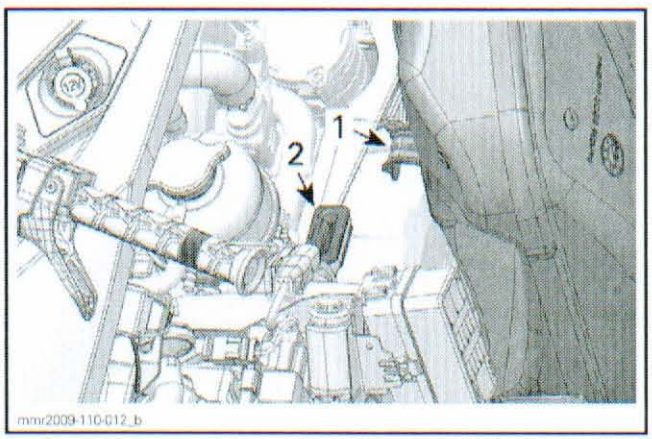
Muffler Inspection

Check the muffler for cracks or other damages.

Muffler Installation

For installation, reverse the removal procedure.

NOTE: Make sure retaining hook is inserted into the grommet.



1. Retaining hook
2. Grommet

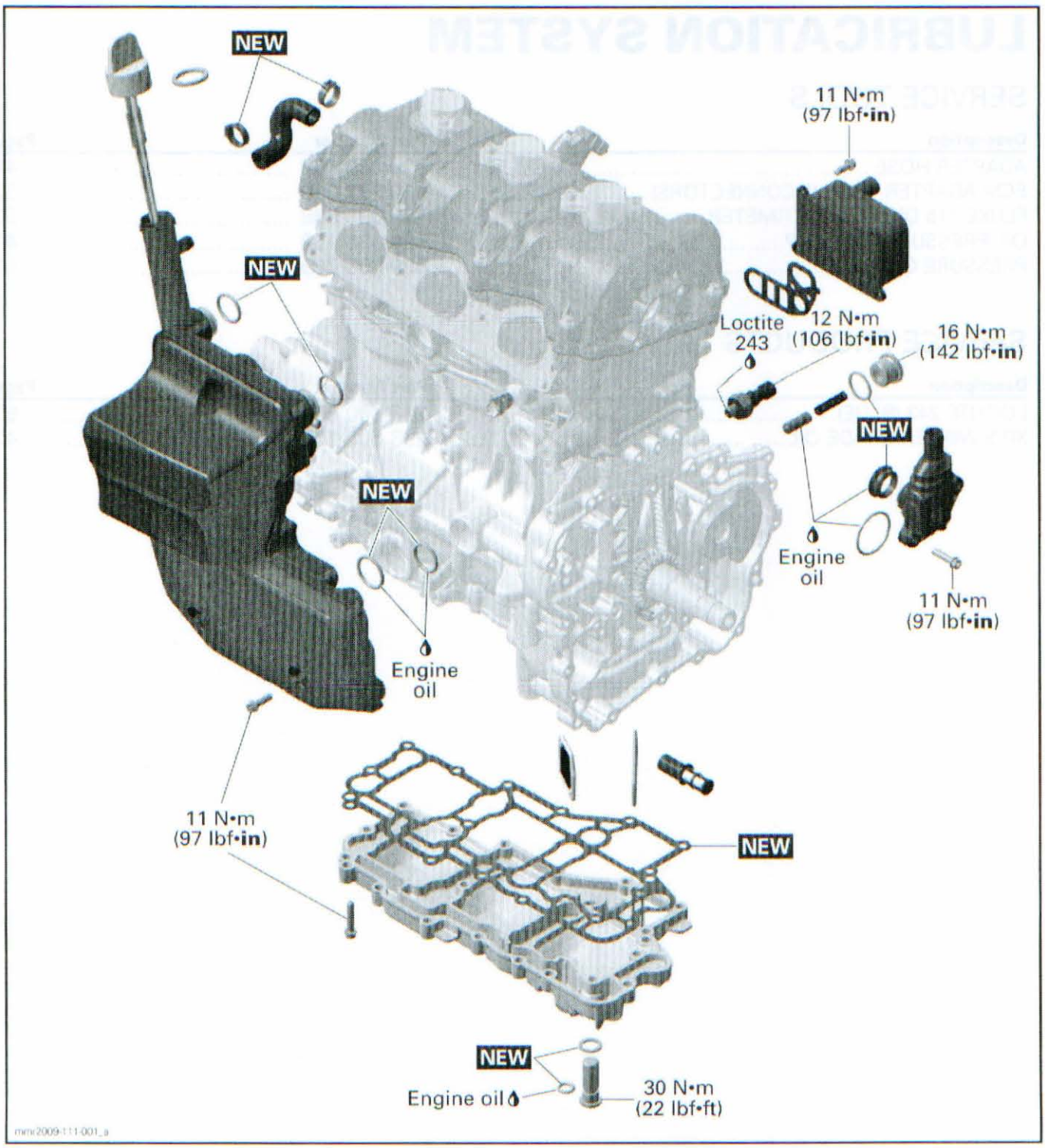
LUBRICATION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE	529 035 652	49
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	52
FLUKE 115 DIGITAL MULTIMETER	529 035 868	52
OIL PRESSURE TEST CAP	529 036 158	49
PRESSURE GAUGE	529 035 709	50

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	53
XP-S WINTER GRADE OIL	293 600 112	47


NEW
NEW
NEW
11 N•m
(97 lbf•in)
Loctite
243
12 N•m
(106 lbf•in)
16 N•m
(142 lbf•in)
NEW
Engine
oil
11 N•m
(97 lbf•in)
Engine
oil
11 N•m
(97 lbf•in)
NEW
NEW
Engine oil
30 N•m
(22 lbf•ft)
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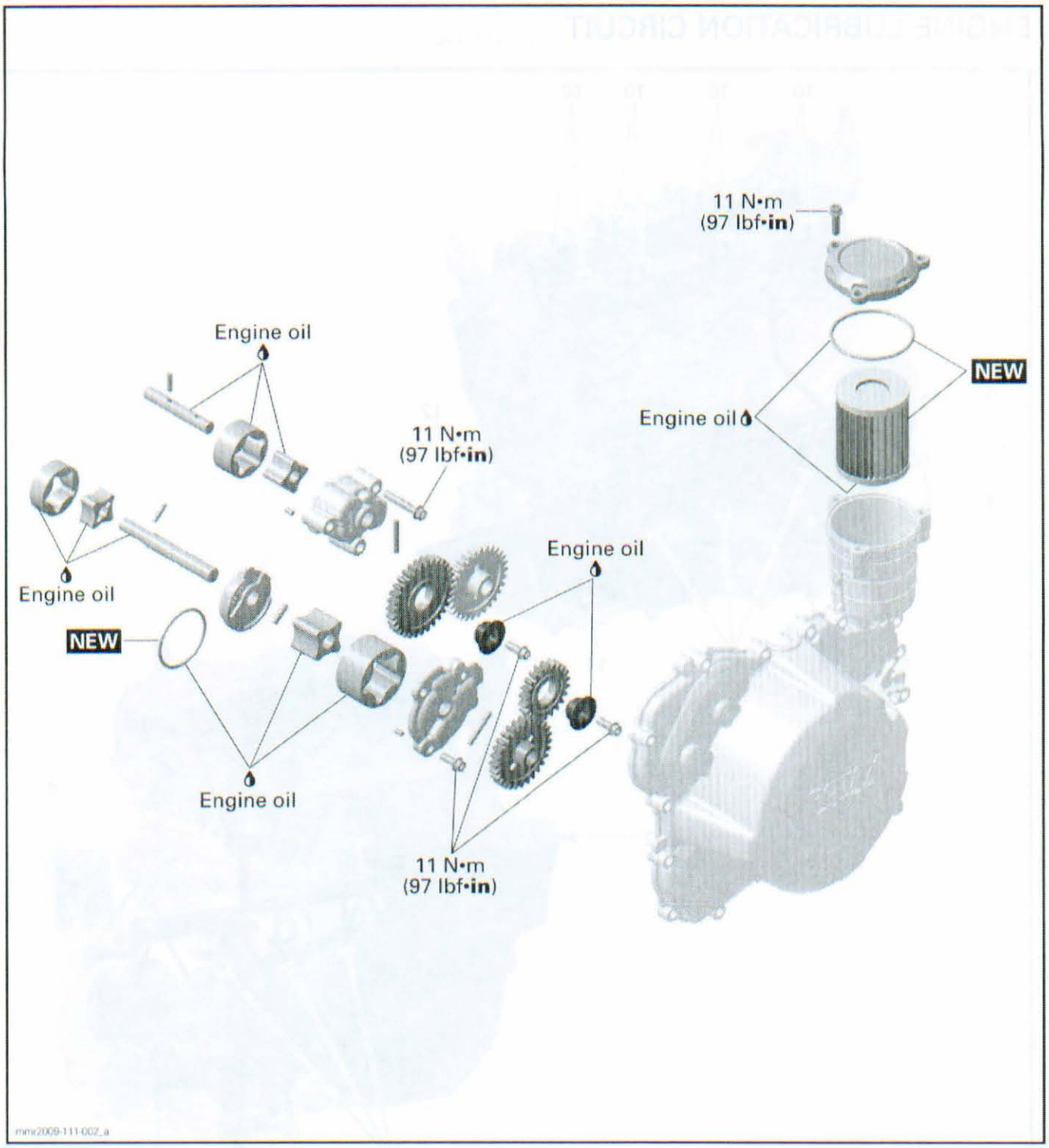
11 N•m
(97 lbf•in)
NEW
Engine oil
Engine oil
11 N•m
(97 lbf•in)
Engine oil
Engine oil
NEW
Engine oil
11 N•m
(97 lbf•in)
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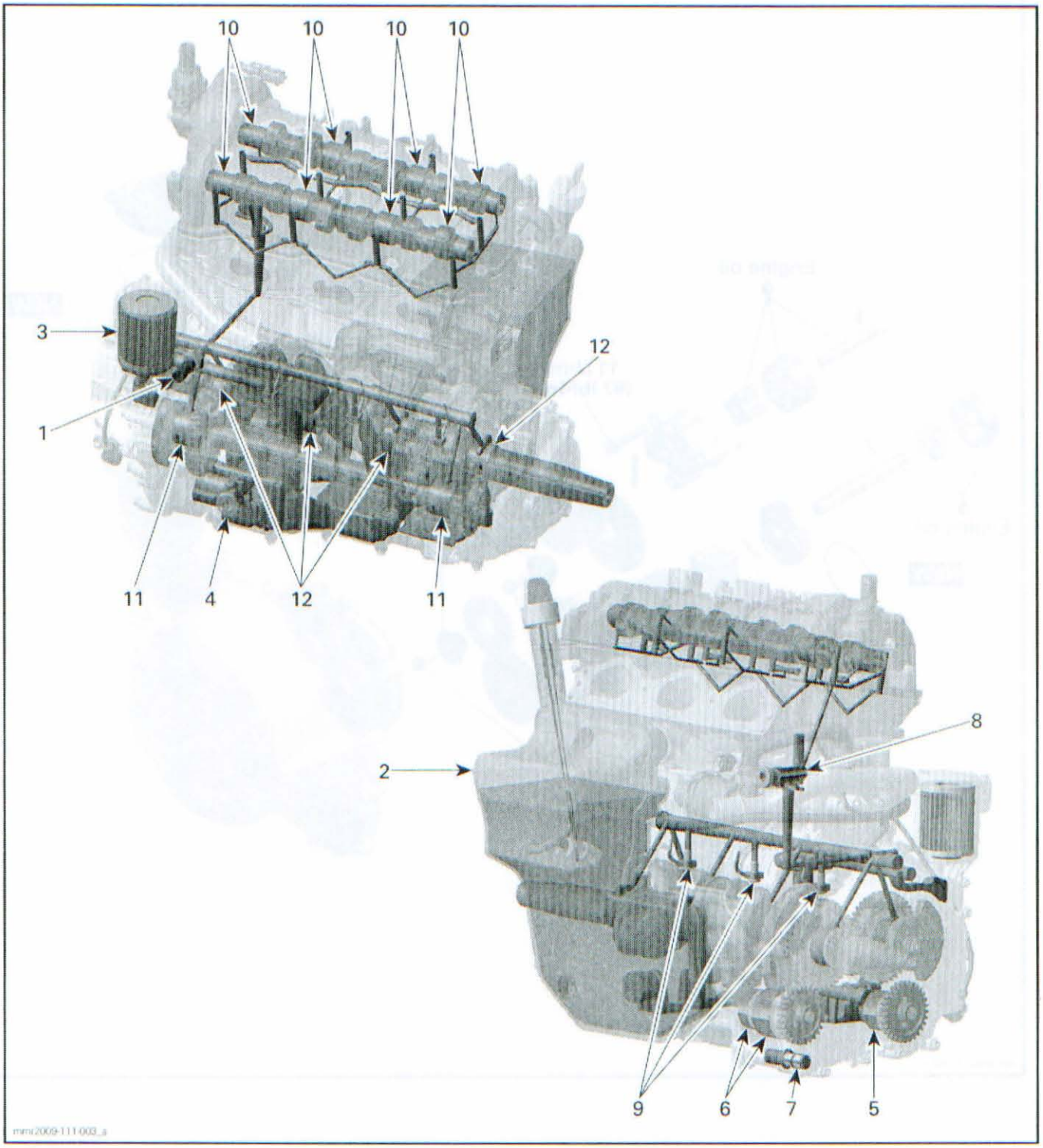
ENGINE LUBRICATION CIRCUIT



1. *Oil pressure switch*
2. *Oil tank*
3. *Oil filter*
4. *Oil pressure regulator*
5. *Oil pressure pump*
6. *Oil suction pumps*
7. *Oil strainer*
8. *Hydraulic chain tensioner*
9. *Oil spray nozzles*
10. *Camshaft plain bearings*
11. *Balancer shaft plain bearings*
12. *Crankshaft plain bearings*

GENERAL

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

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

⚠ WARNING

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

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

SYSTEM DESCRIPTION

The primary purpose of the lubrication system is to provide lubrication between moving metal parts in the engine. The friction caused by these parts when they move together creates high levels of heat that cause damage unless a lubricant is introduced to the mechanism. The oil is pressurized and distributed throughout the engine starting at the pump sent through galleries to the plain bearings (crankshaft, balancer shaft and camshafts) and other internal components. All components move on a thin film of oil.

This engine uses dry sump lubrication. The oil from the cylinder block, PTO cover and magneto cover is pumped by two scavenge pumps into an oil tank, located on the back side of the engine.

An oil filter and 3 oil strainers are used to filter dirt and debris from the oil circuit.

Two oil strainers are located between oil sump cover and cylinder block. The other oil strainer is located inside the cylinder block, on the engine magneto side.

Oil Pressure

Oil pressure allows to deliver engine oil to all internal moving parts of engine. Oil pressure is essential so that oil can reach remote components to allow at the engine a long life. A pressure pump is used to perform this.

The oil pressure is monitored by the ECM when engine reaches 2500 RPM. If a low oil pressure is detected, a fault code is registered in the ECM and the limp home mode is activated to avoid damaging the engine. The engine speed is limited to 4500 RPM.

MAINTENANCE

ENGINE OIL

Recommended Oil

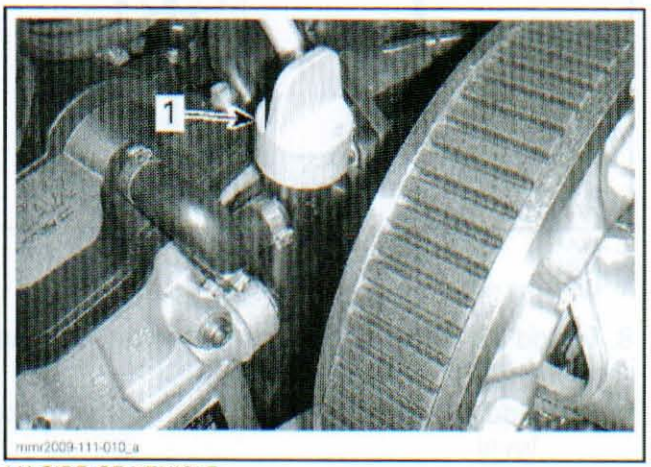
Use the XP-S WINTER GRADE OIL (P/N 293 600 112).

If this oil is not available, use a SAE 0W40 oil that meets or exceeds the requirement for API service classification SM, SL or SJ. Always check API service label certification on the oil container, it must contain at least one of the above standards.

NOTICE **This is the only recommended viscosity to ensure proper cold start and optimum engine protection at high RPM and high temperature.**

Engine Oil Level Verification

NOTICE **Operating the engine with an improper level may severely damage engine. Follow this procedure to obtain a precise reading of the engine oil level.**

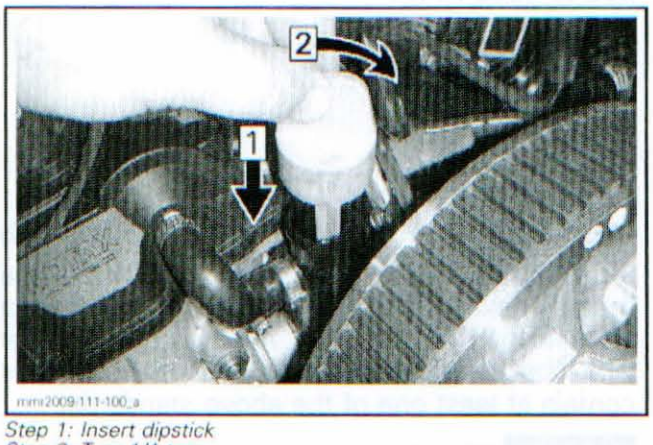


LH SIDE OF VEHICLE
1. Oil tank dipstick

With the engine at **normal operating temperature**, place vehicle on a level surface and proceed as follows to check oil level:

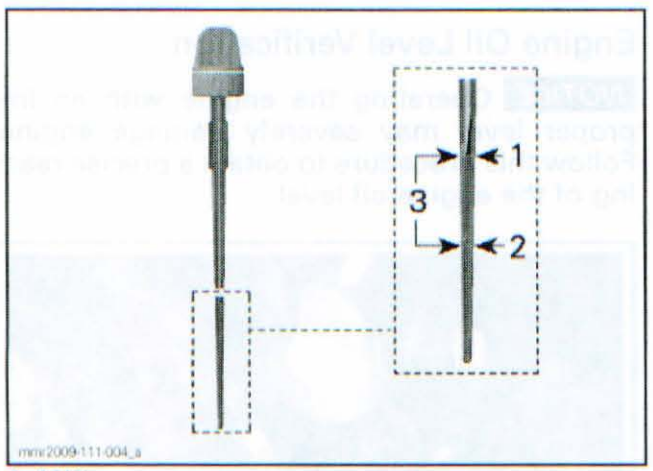
1. Start engine and let it idle for at least 30 seconds.
2. Stop engine.
3. Open the LH side panel.
4. Remove the drive belt guard. refer to *DRIVE BELT* subsection.
5. Unscrew and remove dipstick and wipe clean.

6. Completely insert dipstick in the filler tube and tighten it by a 1/4 turn.



Step 1: Insert dipstick
Step 2: Turn 1/4 turn

7. Remove dipstick again and check oil level. It should be near or equal to the upper mark.



1. *MAX.*
2. *MIN.*
3. *Operating range*

8. To add oil, remove the dipstick. Place a funnel into the filler tube to avoid spillage.
   - 8.1 Add a small amount of oil and recheck oil level.
   - 8.2 Repeat the operation until oil level reaches the dipstick's upper mark. Do not overfill.

NOTE: The oil quantity between MIN. and MAX. mark is approximately 500 ml (17 U.S. oz).

9. Reinstall dipstick and properly tighten it by a 1/4 turn.
10. Wipe off any oil spillage.
11. Install drive belt guard.
12. Close the LH side panel.

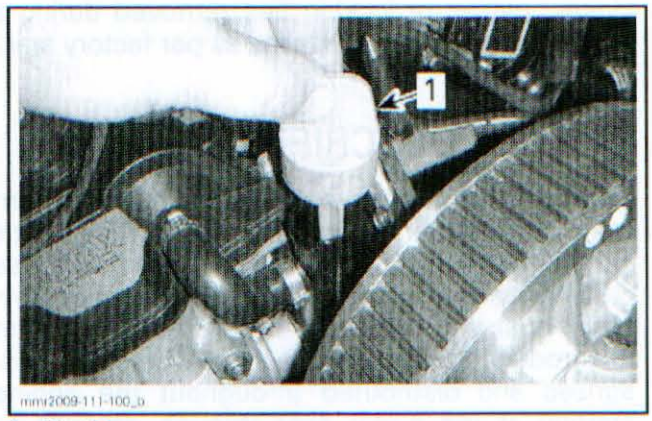
Engine Oil Replacement

⚠ WARNING

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

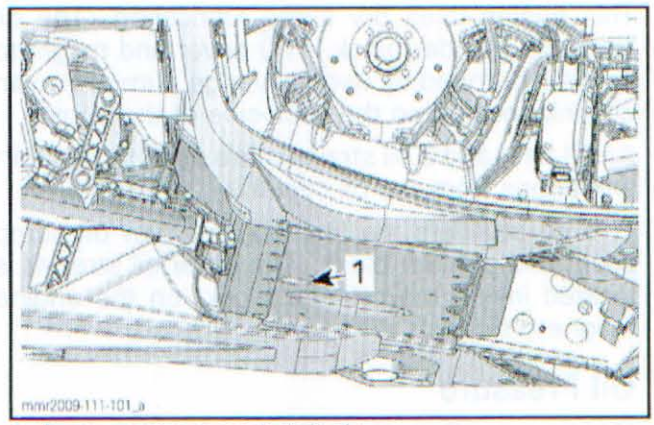
NOTICE **Engine oil and oil filter must be replaced at the same time.**

1. Place vehicle on a level surface.
2. Remove the LH side panel.
3. Remove the drive belt guard. Refer to *DRIVE BELT* subsection.
4. Remove dipstick.



1. *Dipstick*

5. From underneath of vehicle, clean drain plug area.



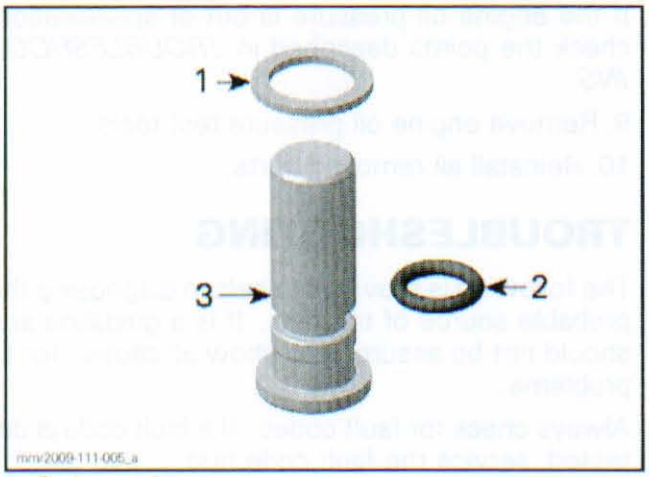
1. *Frame opening to reach drain plug*

6. Place a drain pan under frame opening.
7. Remove engine oil drain plug and discard sealing washer.
8. Allow oil to drain completely.

NOTE: Oil condition gives information about the engine condition. See *TROUBLESHOOTING* in this subsection.

9. Install **NEW** sealing washer and O-ring on oil drain plug.

NOTICE **Never use a sealing washer a second time. Always replace with a new one.**



1. Sealing washer
2. O-ring
3. Oil drain plug

10. Install and tighten oil drain plug.
11. Replace *OIL FILTER*, see procedure in this subsection.
12. Refill oil tank at the proper level with the recommended oil.

NOTE: Engine oil capacity with filter at oil change is approximately 3.5 L (3.7 qt (U.S. liq.)).

13. Reinstall dipstick in oil tank.
14. Start engine and let it idle for a few minutes.
15. Ensure there are no leaks.
16. Stop engine and check oil level. Refill as necessary.
17. Dispose oil and filter as per your local environmental regulations.

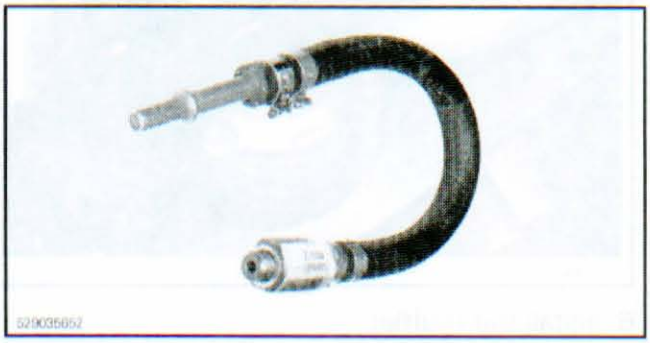
INSPECTION

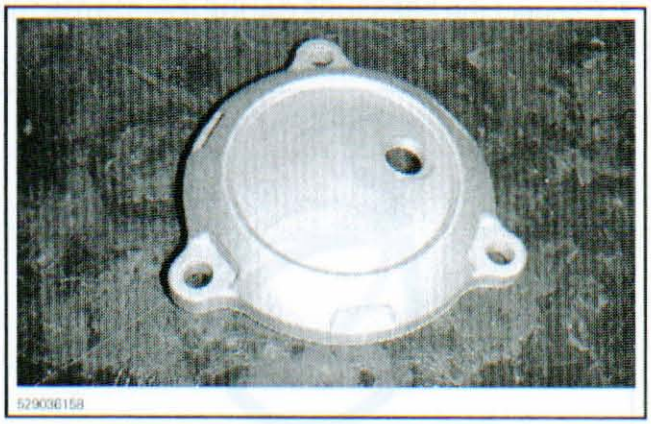
ENGINE OIL PRESSURE

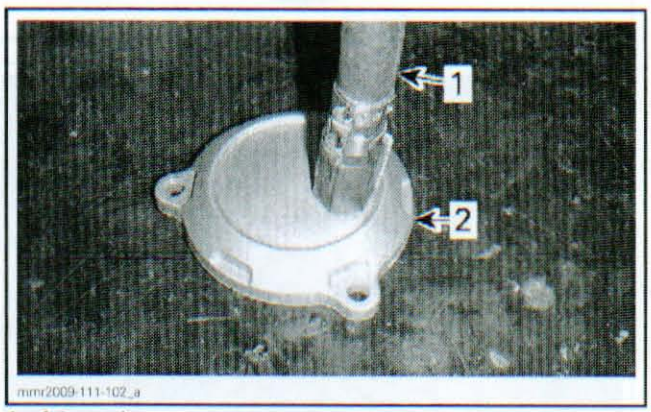
1. Remove the RH side panel.
2. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.
3. Replace *OIL FILTER*, see procedure in this subsection.

NOTICE **To avoid possible erroneous reading during the oil pressure test, it is important to replace the oil filter by a new one. The result of the oil pressure test will be false if the oil filter is clogged.**

4. Completely tighten the ADAPTER HOSE (P/N 529 035 652) on the OIL PRESSURE TEST CAP (P/N 529 036 158).

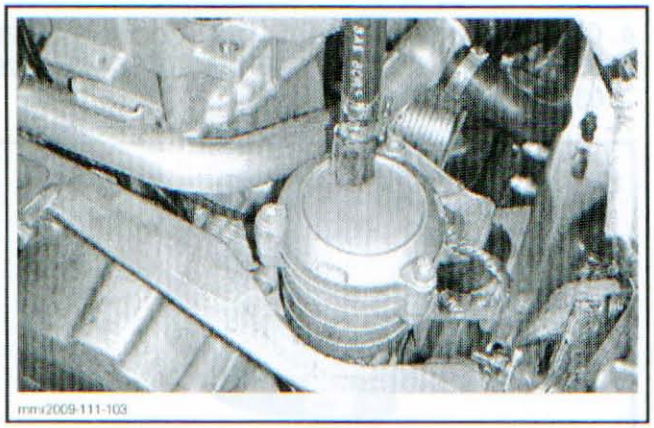




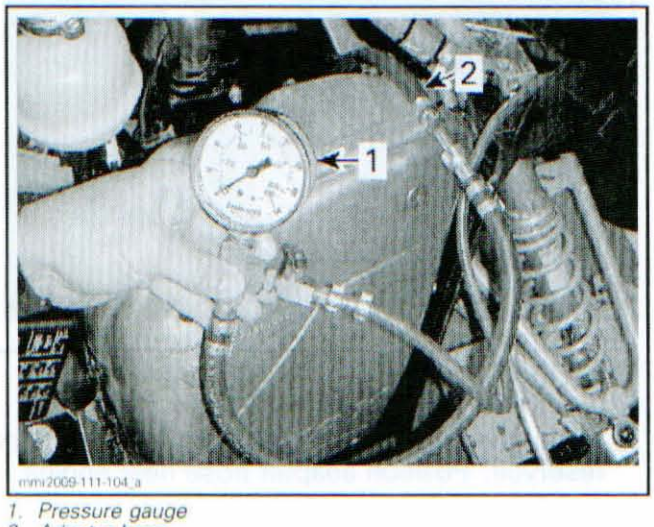


1. Adapter hose
2. Oil pressure test cap

5. Install the oil pressure test cap on the oil filter reservoir. Position adapter hose near engine.



6. Install the muffler.
7. Connect the PRESSURE GAUGE (P/N 529 035 709) to adapter hose.



1. *Pressure gauge*
2. *Adapter hose*

8. Start engine and check the oil pressure.

The engine oil pressure should be within the following specification with the recommended oil at the proper level and with engine at normal operating temperature (minimum oil temperature of 80°C (176°F)).

OIL PRESSURE	AT IDLE	7700 RPM
Minimum	100 kPa (15 PSI)	400 kPa (58 PSI)

If the engine oil pressure is out of specification, check the points described in *TROUBLESHOOTING*.

9. Remove engine oil pressure test tools.
10. Reinstall all removed parts.

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first.

LOW OR NO ENGINE OIL PRESSURE

1. **Oil level is 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. **Use of a bad grade oil**
   - *Replace engine oil with BRP recommended oil.*
3. **Oil pressure switch is defective.**
   - *Check and replace if necessary.*
4. **Oil filter is clogged.**
   - *Replace engine oil and oil filter at the same time.*
5. **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 out of specification.*
6. **Oil pump(s) worn or damaged.**
   - *Check if oil pump drive gears are damaged. Replace if necessary.*
   - *Check oil pump rotors and its bore for wear limits. Replace if out of specification.*
7. **Engine oil strainers are clogged.**
   - *Remove and clean engine oil strainers.*
8. **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)

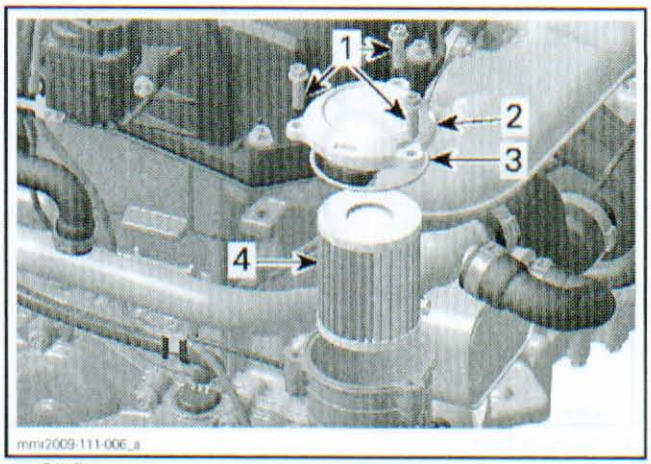
1. Oil seal and rotary seal on water pump shaft leaking.
   - *Replace oil seal and water pump shaft assembly. Change engine oil.*
2. Cylinder head gasket leaking.
   - *Replace cylinder head gasket. Change engine oil.*
3. Cylinder head screws not properly tightened.
   - *Retighten screws with recommended torque. Change engine oil.*
4. Oil cooler gasket leaking.
   - *Replace gasket. Change engine oil.*

PROCEDURES

OIL FILTER

Oil Filter Removal

1. Remove the RH side panel.
2. Remove muffler, refer to *EXHAUST SYSTEM* subsection.
3. Clean oil filter area.
4. Remove:
   - Oil filter cover screws
   - Oil filter cover with O-ring
   - Oil filter.



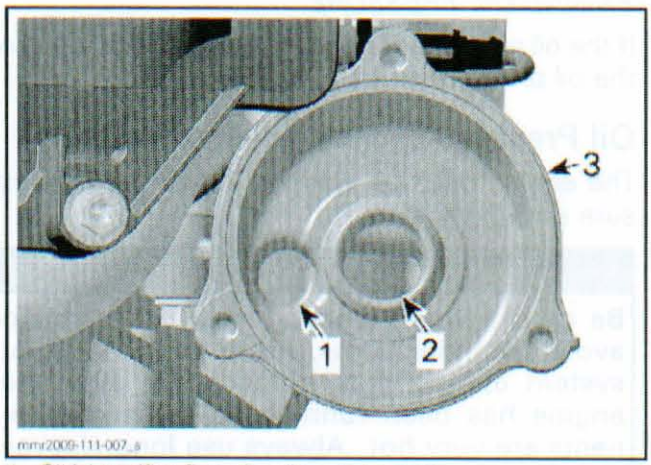
1. Oil filter cover screws
2. Oil filter cover
3. O-ring
4. Oil filter

5. Dispose filter as per your local environmental regulations.

Oil Filter Installation

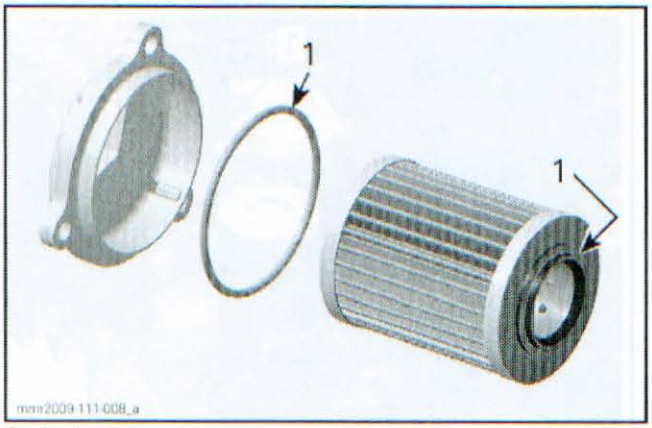
The installation is the reverse of the removal procedure. Pay attention to the following details.

1. Check the oil filter inlet and outlet orifices inside oil filter receptacle (integrated part of magneto cover) for dirt and contaminations.



1. Oil inlet orifice from the oil pressure pump
2. Oil outlet orifice to the engine lubrication system
3. Oil filter receptacle

2. Install a **NEW** O-ring on oil filter cover.
3. Apply engine oil on filter and on filter cover O-ring.



1. Apply oil here

4. Install the oil filter cover.
5. Tighten oil filter cover screws.

OIL PRESSURE SWITCH (OPS)

Oil Pressure Switch Activation

The oil pressure switch activates if engine oil pressure falls between 20 kPa and 40 kPa (2.9 PSI and 5.8 PSI).

Oil Pressure Switch Inspection

First, ensure oil pressure is adequate. Refer to *ENGINE OIL PRESSURE*.

If the oil pressure is good, check the resistance of the oil pressure switch.

Oil Pressure Switch Resistance Test

The engine must be warm to check the oil pressure switch properly.

⚠ WARNING

Be careful when working near hot part. To avoid potential burns, never touch exhaust system components immediately after the engine has been running as these components are very hot. Always use long sleeves and gloves.

1. Remove hood. Refer to *BODY* subsection.
2. Unplug the connector from the oil pressure switch.
3. Using the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868), check the oil pressure switch resistance.

4. Read result and compare to table.

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

If resistance is out of specification, replace the oil pressure switch.

If the resistance is correct, go to step 5.

5. Start engine.
6. Read result and compare to table.

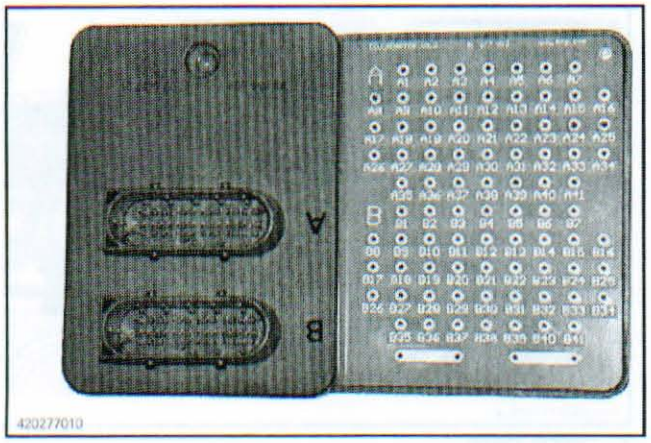
RESISTANCE (Ω)		
ENGINE RUNNING		
OPS pin	Engine ground	Infinitely high (OL)

If resistance is out of specification, replace the oil pressure switch.

If the resistance is correct, check the oil pressure switch circuit continuity.

Oil Pressure Switch Circuit Continuity Test

1. Remove the air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove hose between breather and throttle body adapter.
3. Unplug the connector A from the ECM.
4. Using the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010), check continuity of circuit A6.



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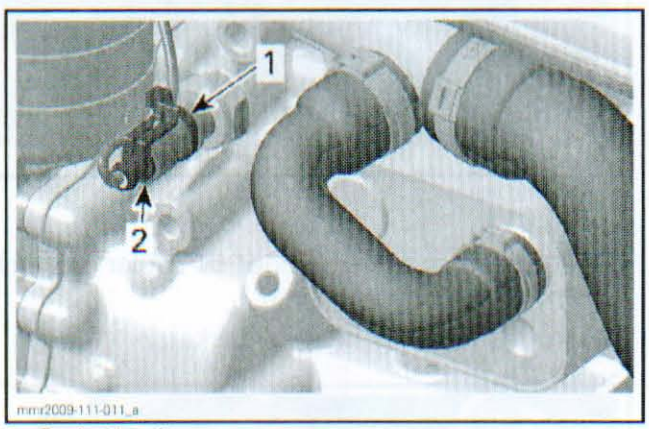
If the continuity is good and all other tests, try a new ECM.

If the continuity is bad, repair or replace defective wire or connectors.

Oil Pressure Switch Removal

1. Remove the front engine support on MAG side. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Cut locking tie and unplug the OPS switch connector.



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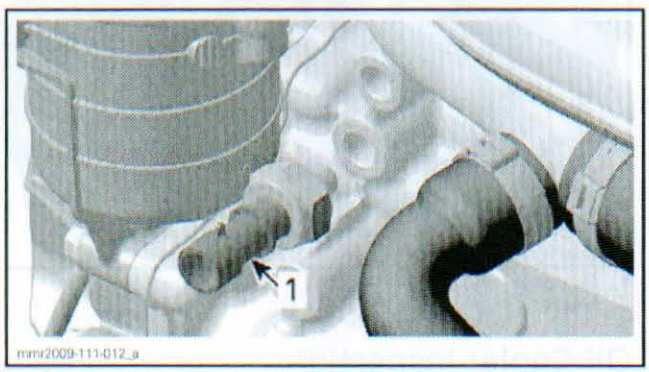
1. Cut locking tie
2. OPS switch connector

3. Unscrew and remove the OPS switch.



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1. Oil pressure switch

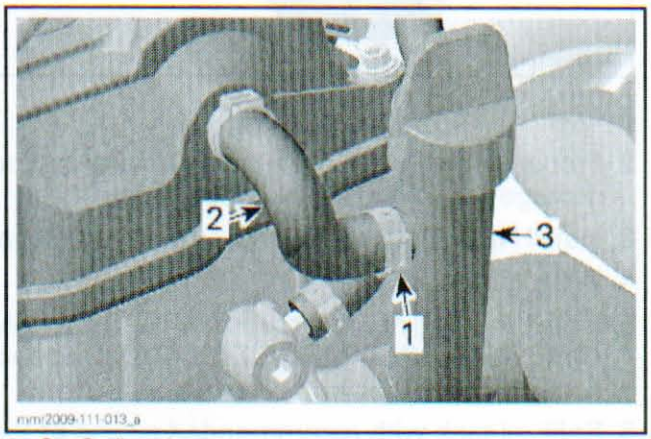
Oil Pressure Switch Installation

1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of oil pressure switch.
2. Torque oil pressure switch to 12 N•m (106 lbf•**in**).
3. Install engine support and all other removed parts.

OIL TANK

Oil Tank Removal

1. Remove the engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Drain engine oil. Refer to *ENGINE OIL REPLACEMENT* in this subsection.
3. Cut and discard the Oetiker clamp securing the oil tank vent hose to filler tube.
4. Remove oil tank vent hose.



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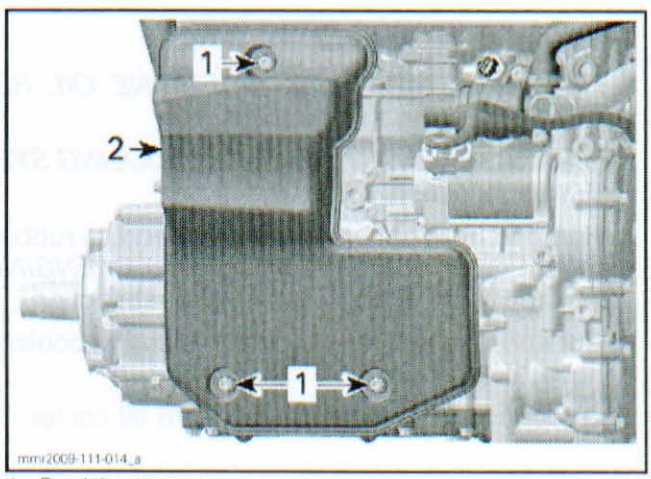
1. Cut Oetiker clamp
2. Oil tank vent hose
3. Filler tube

5. Unscrew oil tank retaining screws.



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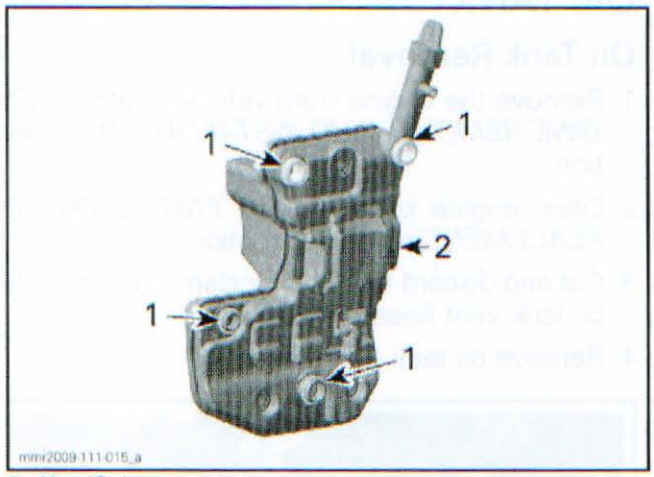
1. Retaining screws
2. Oil tank

6. Place a drain pan underneath oil tank.
7. Remove oil tank from the engine.

Oil Tank Installation

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

1. Install **NEW** oil tank O-rings.



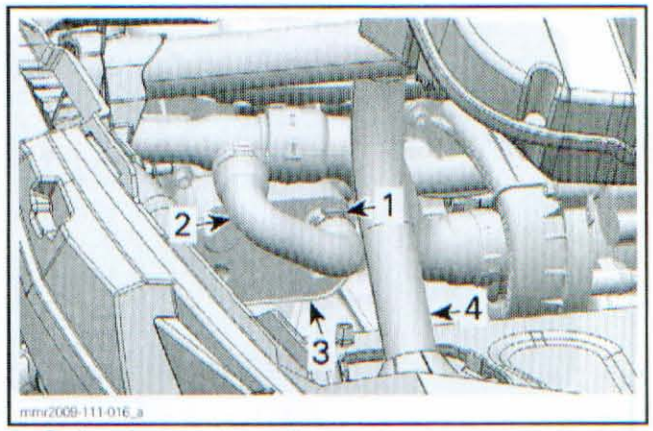
1. New O-rings
2. Oil tank

2. Properly fit oil tank to engine, ensure not to damage the O-rings during installation.
3. Install **NEW** Oetiker clamp to oil tank vent hose.
4. Wipe off any oil spillage.
5. Install the engine in the vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
6. Refill oil tank with recommended oil and at the proper level. Refer to *ENGINE OIL REPLACEMENT* at the beginning of this subsection.

OIL COOLER

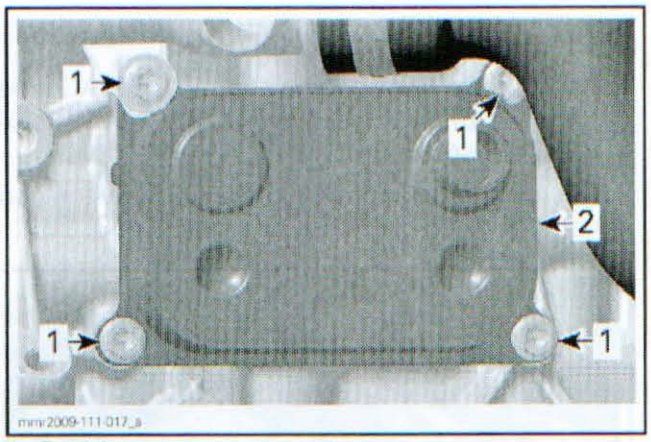
Oil Cooler Removal

1. Drain engine oil. Refer to *ENGINE OIL REPLACEMENT* in this subsection.
2. Drain cooling system. Refer to *COOLING SYSTEM* subsection.
3. Remove the front engine support and its rubber mount on engine MAG side. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
4. Cut and discard Oetiker clamp securing coolant hose to oil cooler.
5. Disconnect the coolant hose from oil cooler.



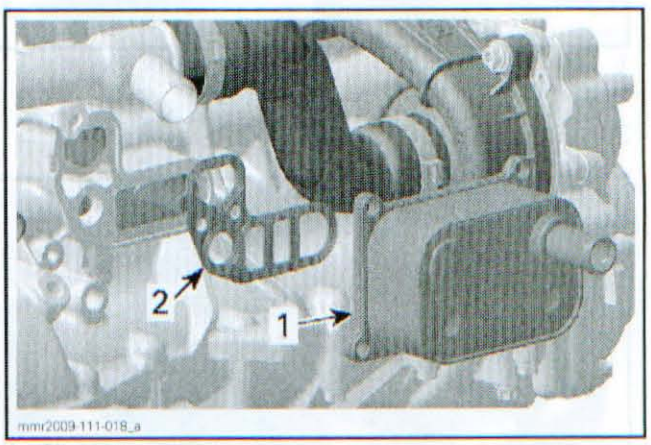
1. Oetiker clamp
2. Coolant hose
3. Oil cooler
4. Steering column

6. Remove oil cooler retaining screws.



1. Retaining screws
2. Oil cooler

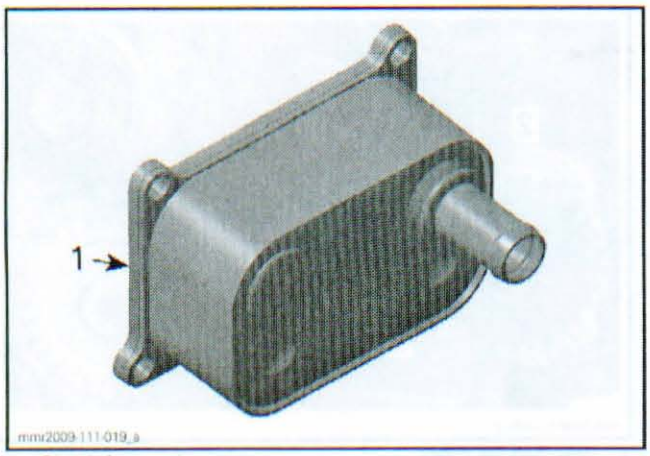
7. Place rags or towels under oil cooler to catch remaining oil and coolant.
8. Remove oil cooler and its gasket.



1. Oil cooler
2. Gasket

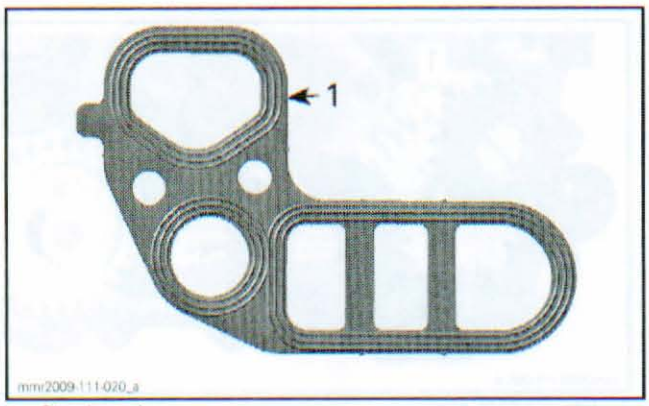
Oil Cooler Inspection

Check oil cooler for cracks and other damage.



1. Check for cracks

Check if gasket is brittle, hard or otherwise damaged.



1. Check gasket

Replace parts as necessary.

Oil Cooler Installation

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

Install a **NEW** Oetiker clamp on coolant hose.

Wipe off any oil and coolant spillage.

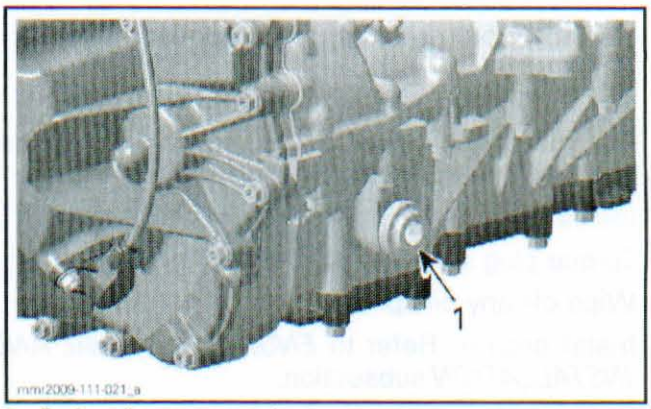
Install the engine support. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Refill oil tank with recommended oil and at the proper level. Refer to *ENGINE OIL REPLACEMENT* in this subsection.

Refill and bleed cooling system. Refer to *COOLING SYSTEM* subsection.

ENGINE OIL PRESSURE REGULATOR

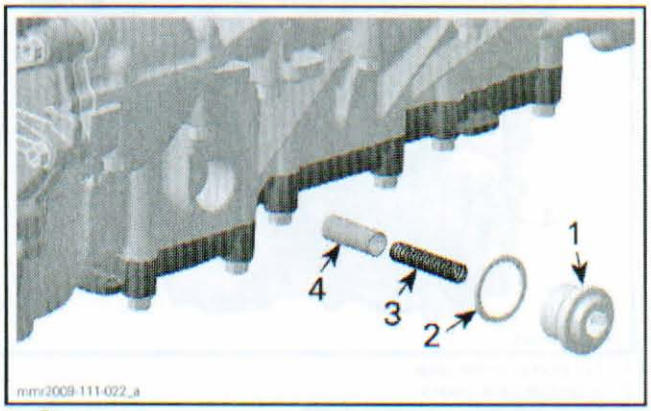
The engine oil pressure regulator is located inside the cylinder block on the front side of the engine.



1. Engine oil pressure regulator

Oil Pressure Regulator Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Drain engine oil. Refer to *ENGINE OIL REPLACEMENT* in this subsection.
3. Remove plug screw and sealing washer. Discard sealing washer.
4. Pull out oil pressure regulator.



1. Plug screw
2. Sealing washer
3. Regulator spring
4. Regulator piston

Oil Pressure Regulator Inspection

Clean bore and thread in the cylinder block from metal shavings and other contaminations.

Inspect oil pressure regulator piston and its bore in cylinder block for scoring or other damages.

Check if piston moves easily in its bore.

Check compression spring for free length.

SPRING FREE LENGTH	
New nominal	46 mm (1.811 in)
Service limit	45 mm (1.772 in)

Visually check compression spring for squareness.

Replace worn or damaged components.

Oil Pressure Regulator Installation

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

Install a **NEW** sealing washer on plug screw.

Torque plug screw to 45 N•m (33 lbf•ft).

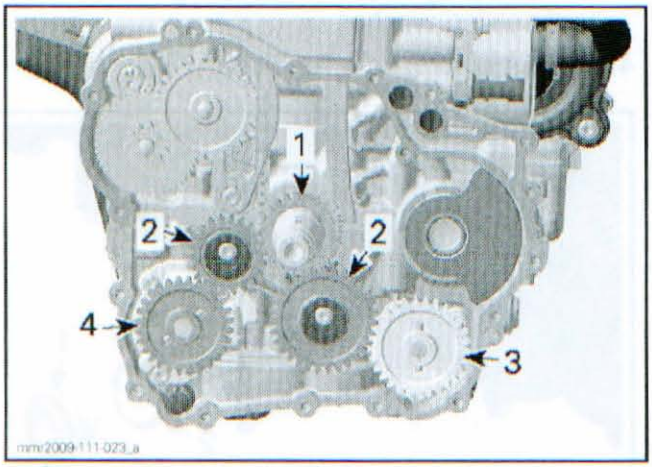
Wipe off any oil spillage.

Install engine. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Refill oil tank with recommended oil and at the proper level. Refer to *ENGINE OIL REPLACEMENT* at the beginning of this subsection.

OIL PUMP GEARS

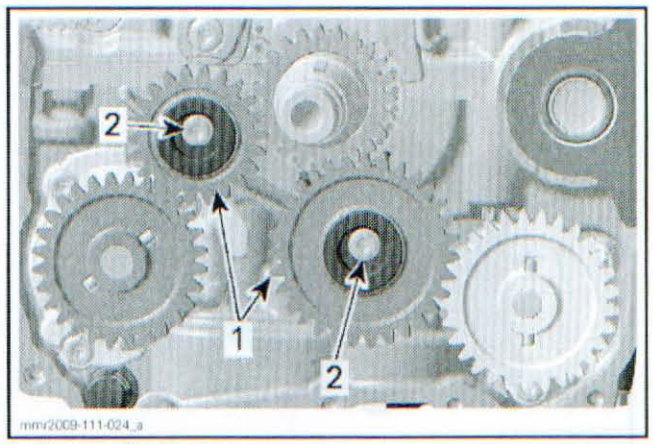
The oil pump gears are located on the MAG side, behind the magneto cover.



1. *Oil pump drive gear*
2. *Intermediate gears*
3. *Oil pump gear - pressure pump*
4. *Oil pump gear - suction pumps*

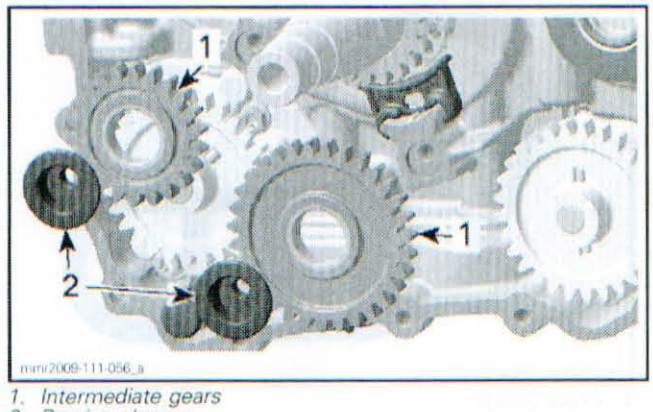
Oil Pump Gear Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Refer to *MAGNETO SYSTEM* subsection to remove:
   - Magneto cover
   - Rotor
   - Sprag clutch gear.
3. Unscrew oil pump intermediate gear screws.



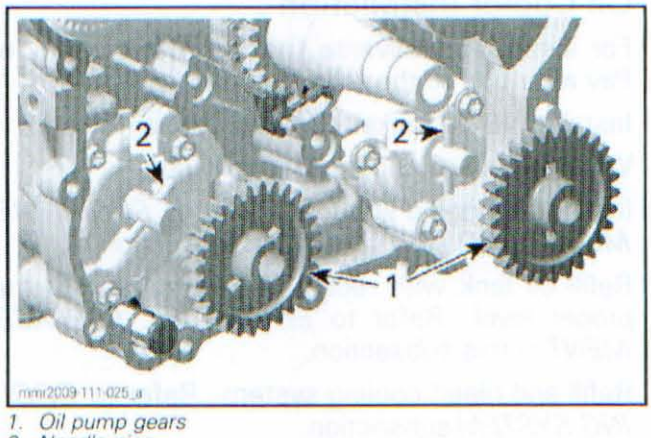
1. *Intermediate gears*
2. *Retaining screws*

4. Remove bearing sleeves and oil pump intermediate gears.



1. *Intermediate gears*
2. *Bearing sleeves*

5. Remove oil pump gears and needle pins.



1. *Oil pump gears*
2. *Needle pins*

Oil Pump Gear Inspection

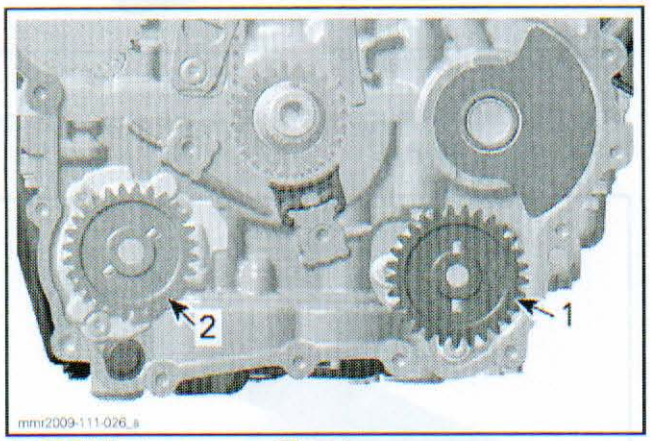
Inspect gears for wear, cracks or other damage.

Replace if damaged.

Oil Pump Gear Installation

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

1. Ensure not to mix up the oil pump gears, see next illustration.
   1.1 Install the BROWN oil pump gear (29 teeth) on oil pressure pump.
   1.2 Install the BLACK oil pump gear (28 teeth) on oil suction pump.

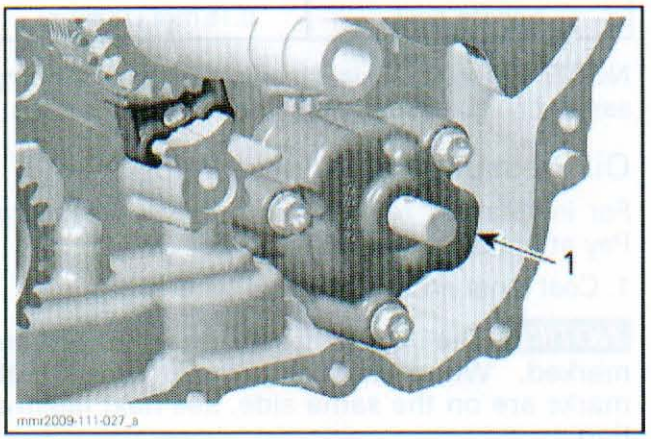


1. BROWN oil pump gear - 29 teeth
2. BLACK oil pump gear - 28 teeth

2. Apply engine oil on bearing sleeves of intermediate gear during installation.
3. Install all other removed parts.

OIL PRESSURE PUMP

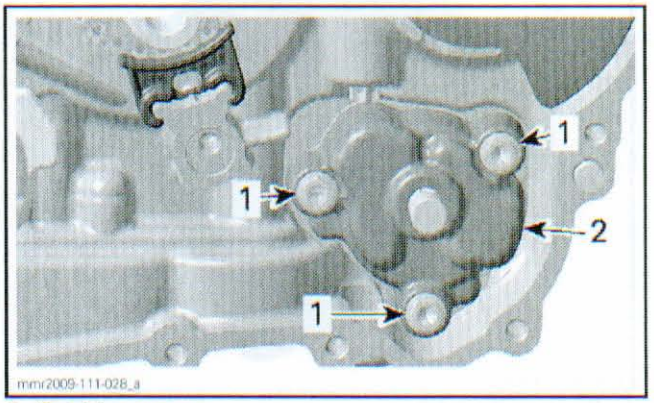
The oil pressure pump is located in the cylinder block, behind the magneto cover.



1. Oil pressure pump

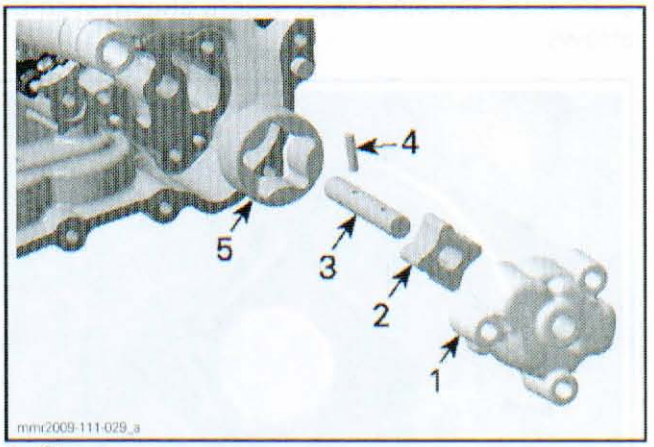
Oil Pressure Pump Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove *OIL PUMP GEARS*, see procedure in this subsection.
3. Unscrew oil pump cover.



1. Retaining screws
2. Oil pump cover

4. Remove the following parts.



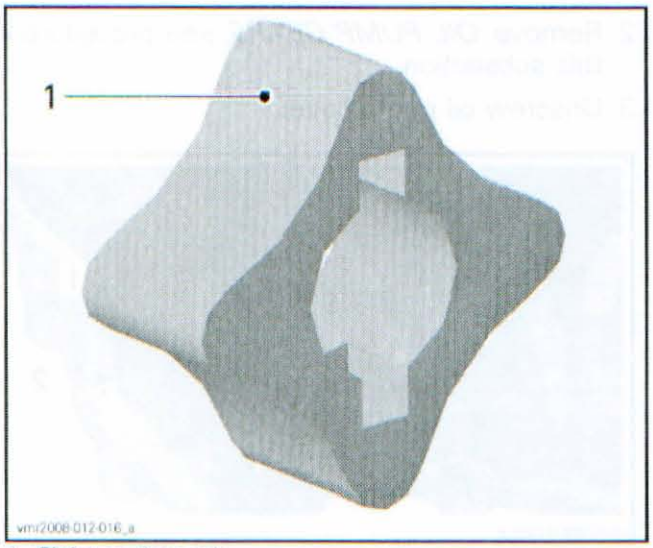
1. Oil pump cover
2. Inner rotor
3. Oil pump shaft
4. Needle pin
5. Outer rotor

Oil Pressure Pump Inspection

Inspect oil pump and oil pump cover bore for marks, scratches or other damages. If so, replace damaged parts.

Check oil pump cover for damages and for surface straightness with a straight edge.

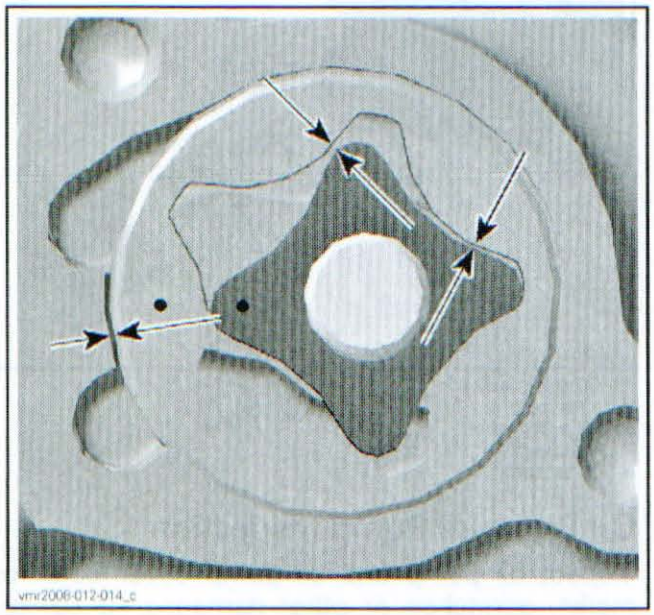
Check inner rotor for corrosion pin holes or other damages. If so, replace inner and outer rotor at the same time.



1. Pitting on the teeth

Radial Clearance

Using a feeler gauge, measure the clearance of outer rotor and inner rotor where shown with the arrows.

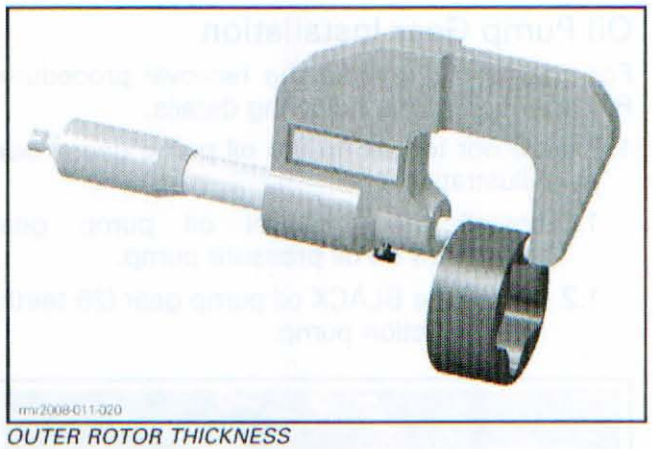


OIL PUMP RADIAL CLEARANCE	
Service limit	0.25 mm (.0098 in)

NOTE: If clearance of inner and outer rotors exceeds the tolerance, replace oil pump.

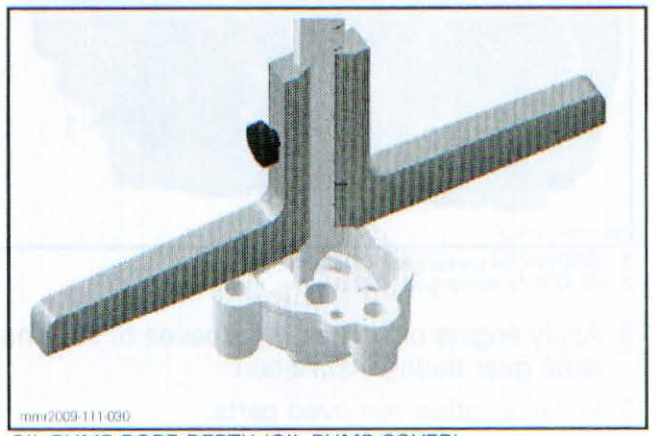
Axial Clearance

Measure outer rotor thickness with a micrometer.



OUTER ROTOR THICKNESS

Using a depth gauge, measure the depth of oil pump cover bore.



OIL PUMP BORE DEPTH (OIL PUMP COVER)

Substract bore depth from rotor thickness to obtain axial clearance.

OIL PUMP AXIAL CLEARANCE	
Service limit	0.15 mm (.0059 in)

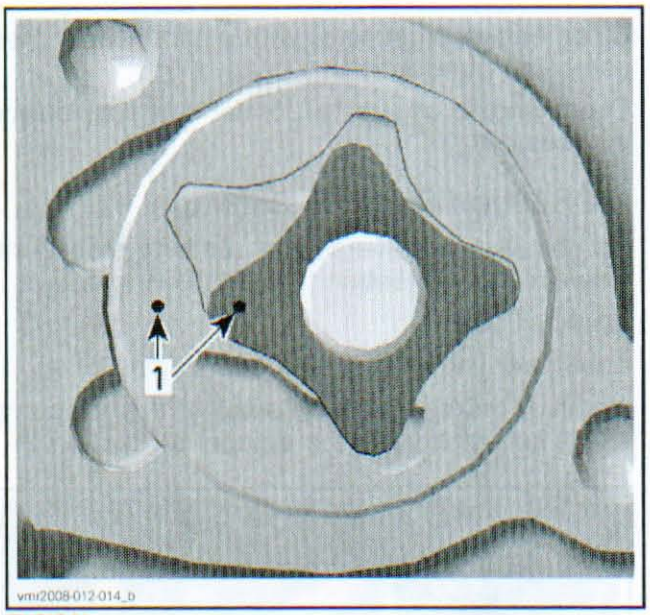
NOTE: When the axial clearance of the oil pump assembly increases, the oil pressure decreases.

Oil Pressure Pump Installation

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

1. Coat inner and outer rotors with engine oil.

NOTICE The outer and inner rotor are marked. When installing, make sure both marks are on the same side, see next illustration.



TYPICAL
1. Marks on inner and outer rotor

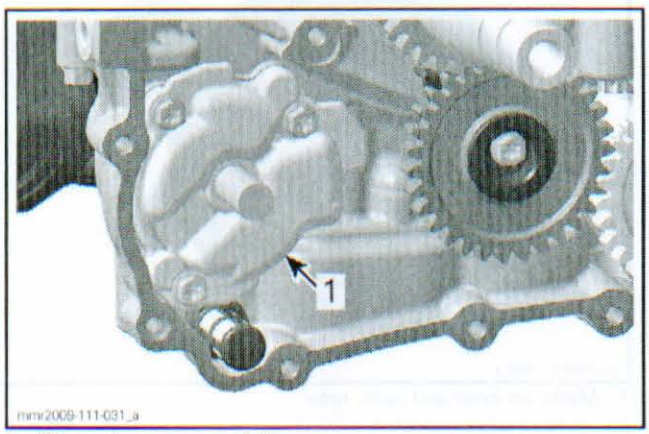
After installation of the remaining parts, check for smooth operation of the oil pump assembly.

After engine is completely reassembled, start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE* in this subsection).

OIL SUCTION PUMPS

The engine is equipped with two oil suction pumps. Both pumps are integrated into one oil suction pump module.

The oil suction pump module is located in the cylinder block, behind the magneto cover.



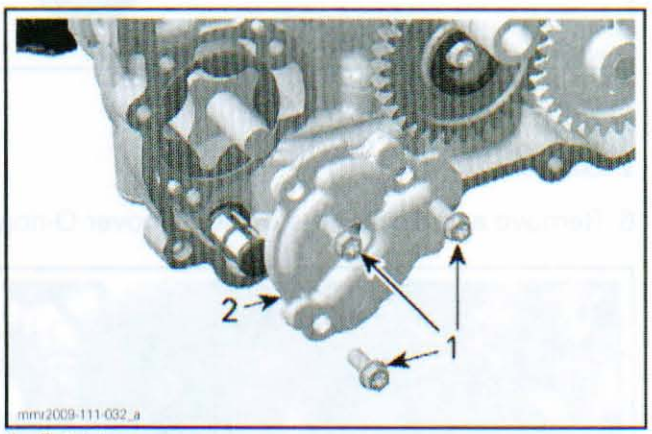
1. Oil suction pump module

The 26 mm (1.024 in) large oil suction pump sucks oil from the crankshaft and PTO chamber, back to the oil reservoir.

The 14 mm (.551 in) small oil suction pump sucks oil from the magneto chamber, back to the oil reservoir.

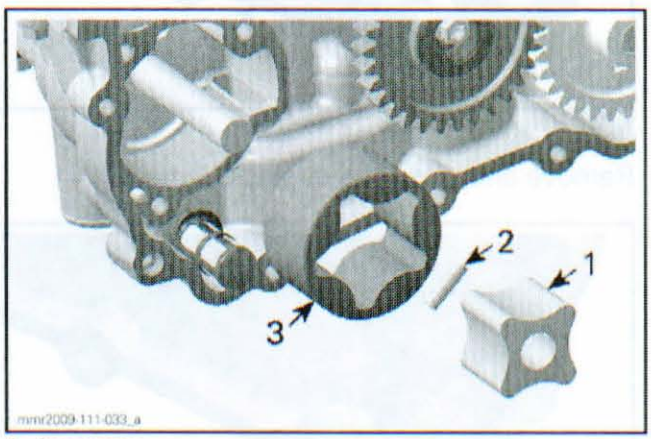
Oil Suction Pump Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove *OIL PUMP GEARS*, see procedure in this subsection.
3. Unscrew and remove oil pump cover.



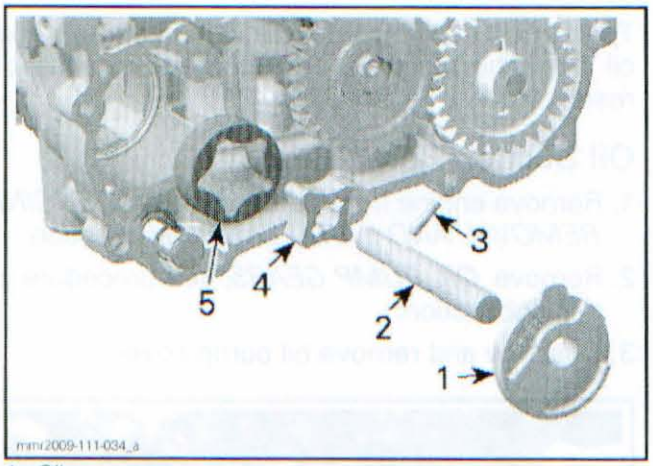
1. Retaining screws
2. Oil pump cover

4. Remove the following parts of the large oil suction pump:



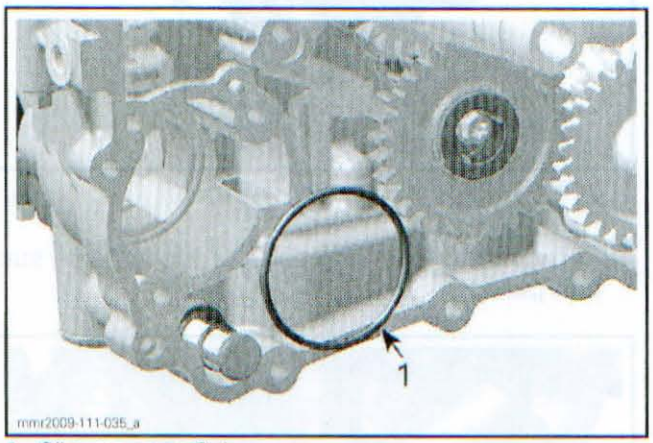
1. Inner rotor
2. Needle pin
3. Outer rotor

5. Remove the following parts of the small oil suction pump:



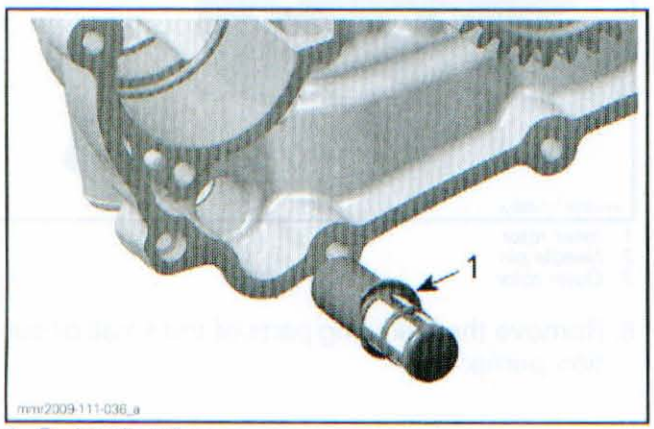
1. *Oil pump cover*
2. *Oil pump shaft*
3. *Needle pin*
4. *Inner rotor*
5. *Outer rotor*

6. Remove and discard the oil pump cover O-ring.



1. *Oil pump cover O-ring*

Remove and clean the engine oil strainer.



1. *Engine oil strainer*

Oil Suction Pump Inspection

The inspection of both oil suction pumps is the same as for the oil pressure pump. Refer to *OIL PRESSURE PUMP* in this subsection.

Clean engine oil strainer with a part cleaner then use an air gun to dry it.

Check engine oil strainer for damage and replace if necessary.

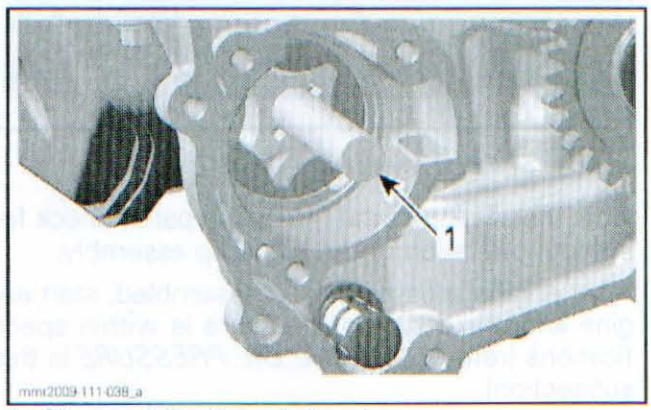
Oil Suction Pump Installation

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

Install oil strainer.

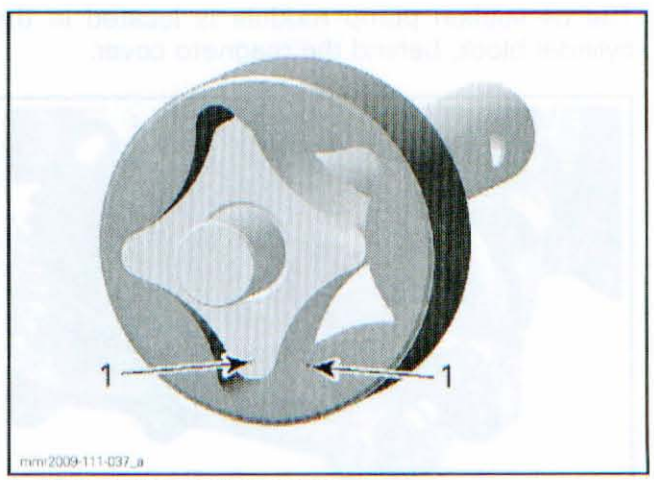
Coat inner and outer rotors with engine oil.

Install oil pump shaft with small oil suction pump rotors into its bore in the cylinder block.



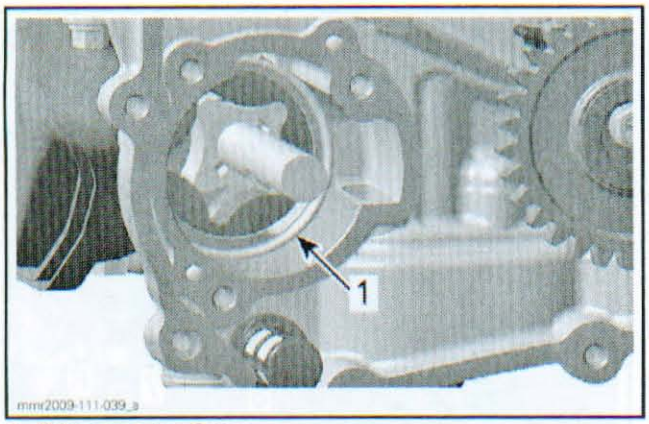
1. *Oil pump shaft with small oil suction pump*

NOTICE The outer and inner rotor are marked. When installing, make sure both marks are on the same side and are pointed toward the inside of cylinder block.



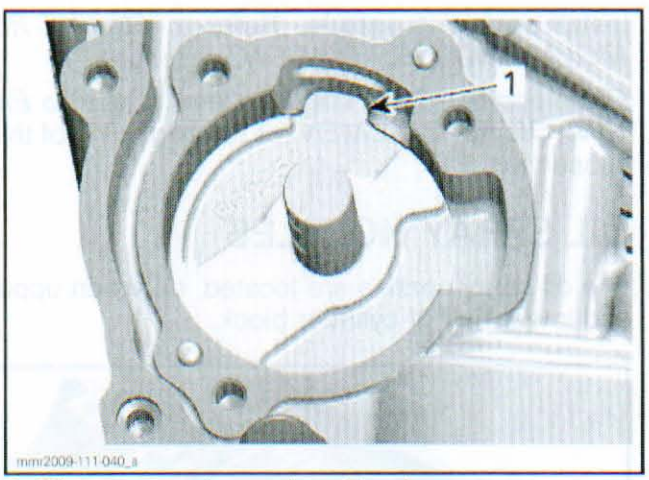
1. *Marks on inner and outer rotor*

Install a **NEW** oil pump cover O-ring.



1. Oil pump cover O-ring

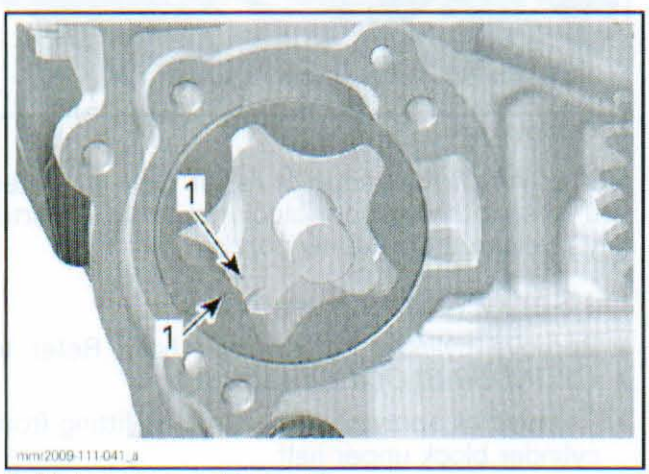
Install oil pump cover. Align the oil pump cover tab with the cylinder block recess. Ensure that cover fits properly in cylinder block.



1. Oil pump cover tab properly positioned

Install needle pin, inner and outer rotor of large oil suction pump.

NOTE: The outer and inner rotor are marked. When installing, make sure both marks are on the same side.



1. Marks on inner and outer rotor

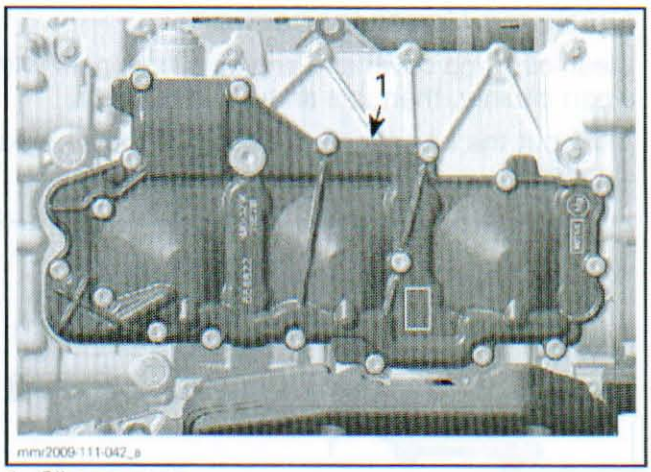
Before installation of the oil pump cover, make sure engine oil strainer is in place.

After installation of the remaining parts, check for smooth operation of the oil pump assembly.

After engine is completely reassembled, start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE* in this subsection).

OIL SUMP COVER

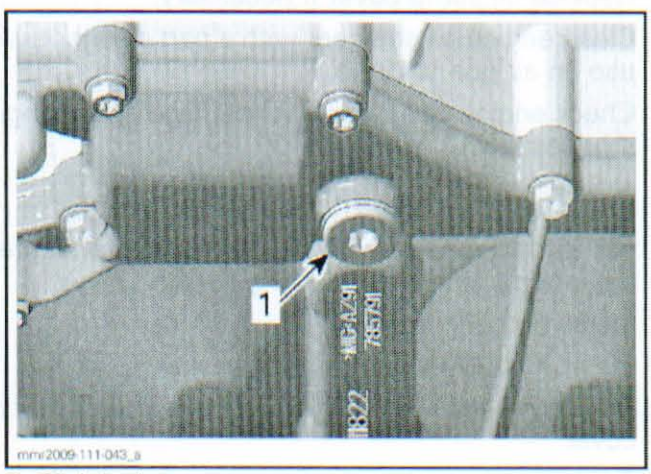
The oil sump cover is located on the bottom side of the engine.



1. Oil sump cover

Oil Sump Cover Removal

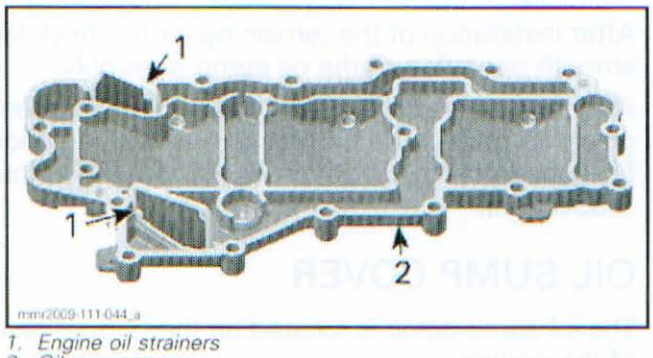
1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Place a drain pan under oil sump cover.
3. Remove oil drain plug. Discard sealing washer.



1. Oil drain plug

4. Unscrew oil sump cover retaining screws.
5. Remove oil sump cover. Discard gasket.

6. Remove and clean engine oil strainers.

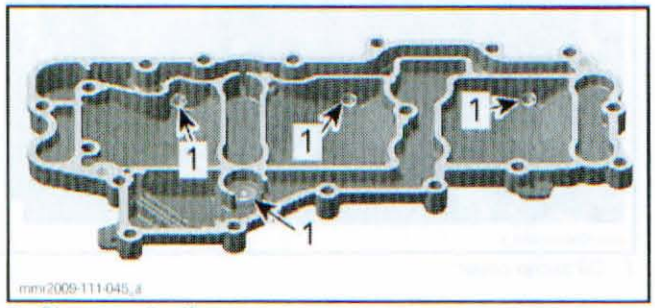


1. *Engine oil strainers*
2. *Oil sump cover*

Oil Sump Cover Inspection

Clean oil sump cover and engine oil strainers with a part cleaner, then use an air gun to dry it.

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



1. *Blow out oil orifices*

Check oil sump cover for cracks or other damages.

Check oil sump cover for flatness with straight edge.

Replace oil sump cover if necessary.

Clean engine oil strainers with a part cleaner then use an air gun to dry it.

Check engine oil strainers for damage and change if necessary.

Oil Sump Cover Installation

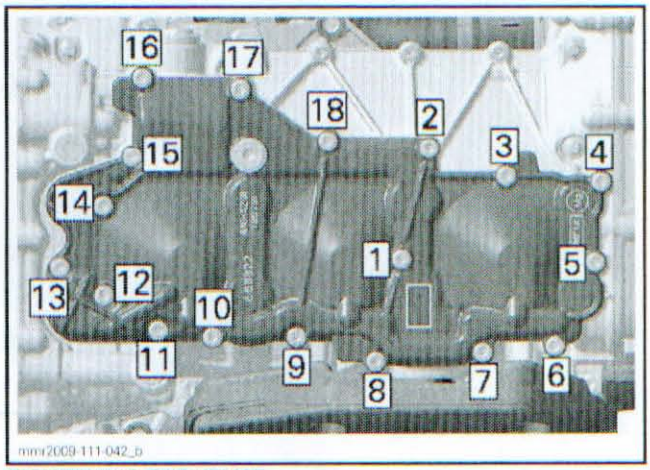
For installation, reverse the removal procedure. Pay attention to the following details.

Install both oil strainers.

Install a **NEW** oil sump cover gasket.

Properly reinstall engine oil strainers into oil sump cover.

Tighten the oil sump cover screws in accordance with the following pattern.



TIGHTENING SEQUENCE

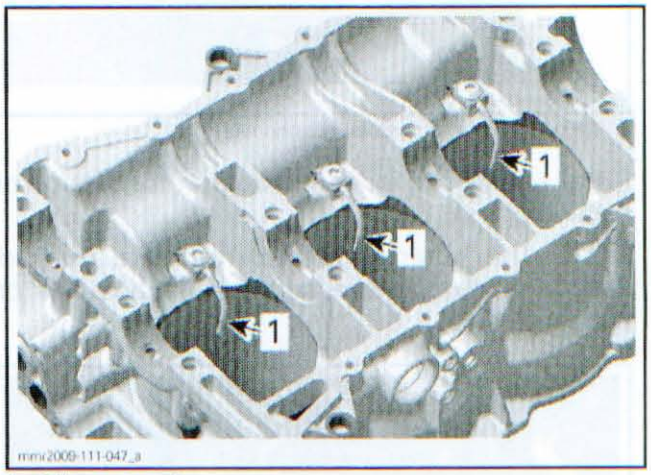
Reinstall oil drain plug using a **NEW** sealing washer.

Install engine in vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Fill up engine oil and check oil level. Refer to *ENGINE OIL REPLACEMENT* at the beginning of this subsection.

OIL SPRAY NOZZLES

The oil spray nozzles are located, between upper and lower half of cylinder block.

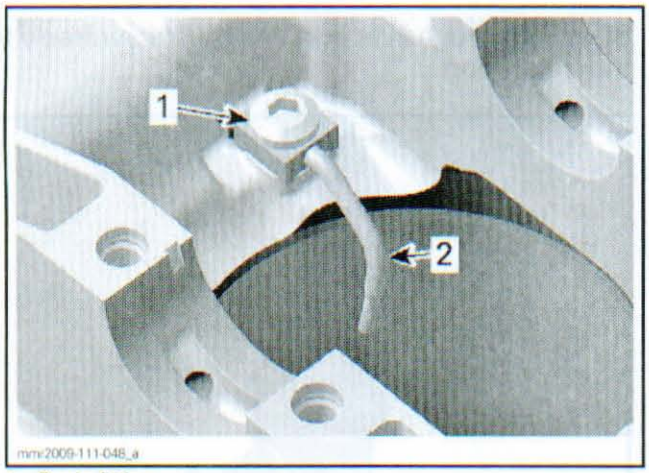


1. *Oil spray nozzles*

NOTE: When the scope of repair work obligates you to split the cylinder block, take this opportunity to clean the oil spray nozzles.

Oil Spray Nozzle Removal

1. Remove cylinder block lower half. Refer to *CYLINDER BLOCK* subsection.
2. Remove oil spray nozzle and Banjo fitting from cylinder block upper half.

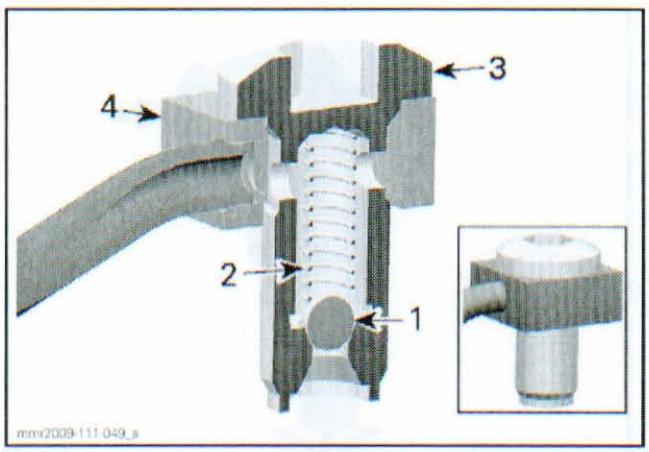


1. *Banjo fitting*
2. *Oil spray nozzle*

Oil Spray Nozzle Cleaning and Inspection

Clean oil spray nozzle and Banjo fitting from dirt and debris. Use a part cleaner, then an air gun and dry the parts.

Check if ball inside Banjo fitting moves freely.

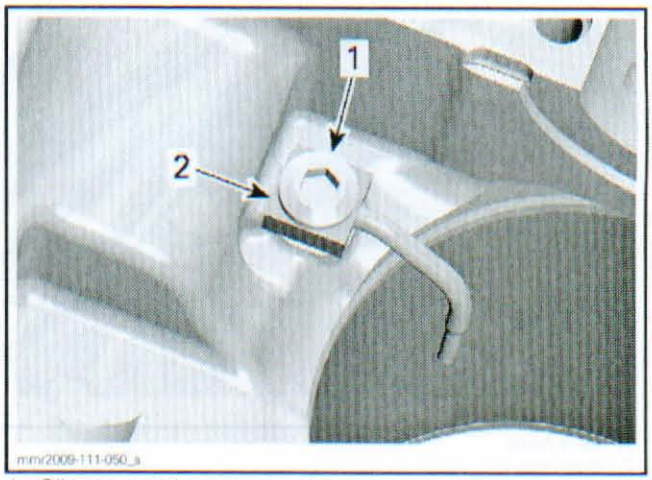


1. *Ball*
2. *Spring*
3. *Banjo fitting*
4. *Oil spray nozzle*

NOTE: If the oil spray nozzle is damaged or bent during work in the cylinder block, it must be replaced immediately.

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.**

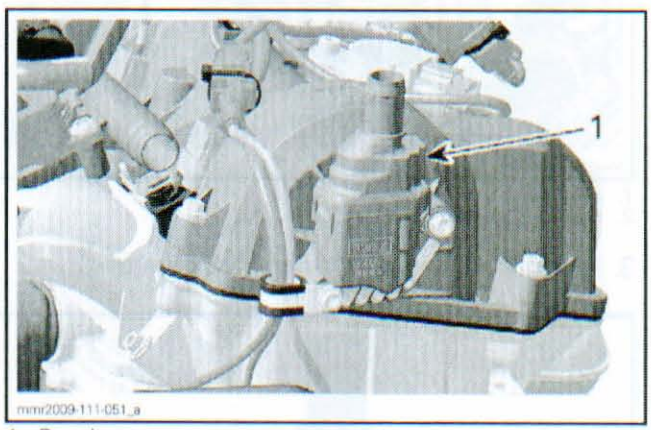


1. *Oil spray nozzle*
2. *Contact surface*

BREATHER

The engine is equipped with a breather which blocks engine oil and allows vapors to return in the intake system.

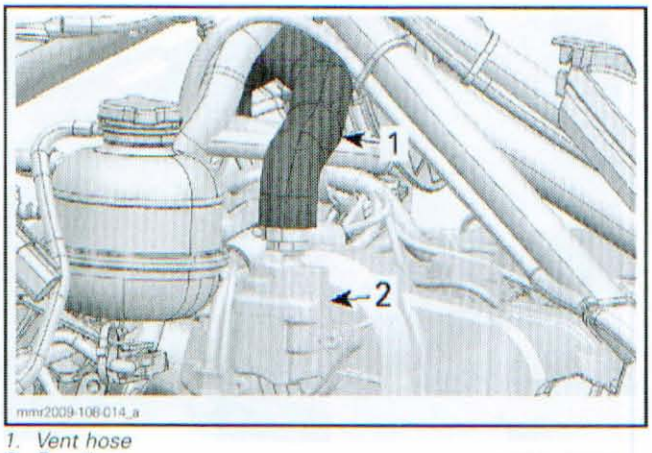
The breather is a mechanical device that does not require electrical supply for its operation.



1. *Breather*

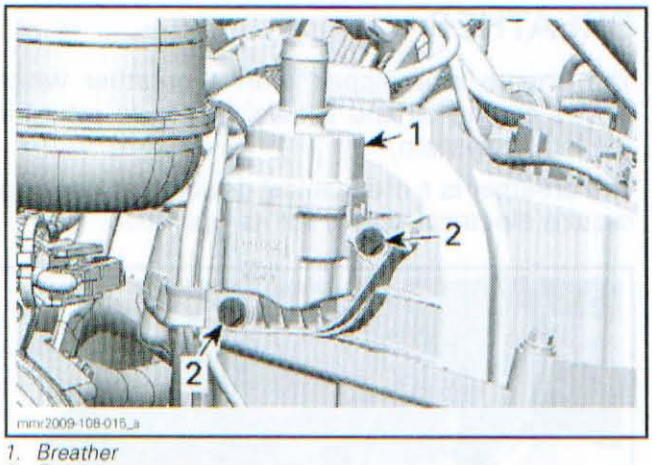
Breather Removal

1. Remove vent hose from breather.



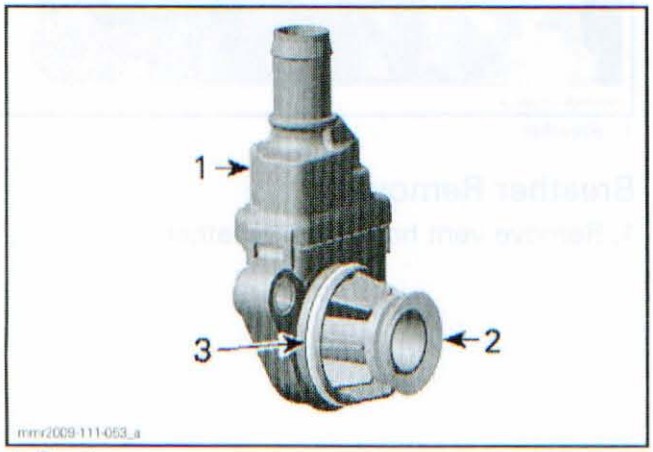
1. Vent hose
2. Breather

2. Unscrew and remove breather.



1. Breather
2. Retaining screws

3. Remove O-ring and V-ring from breather.



1. Breather
2. V-ring
3. O-ring

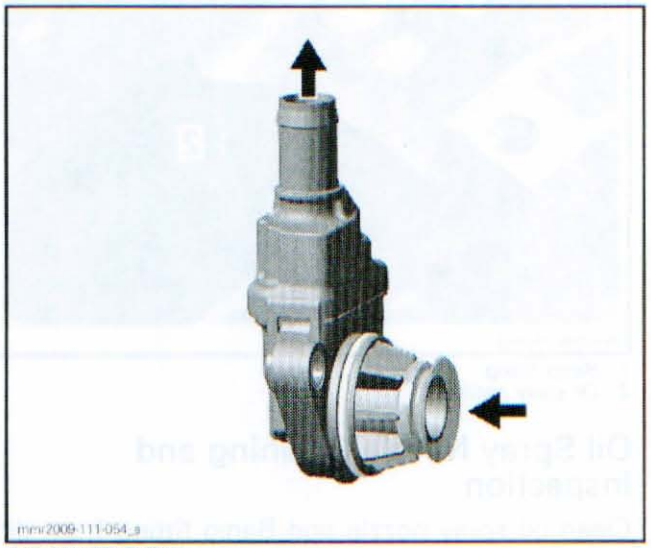
NOTE: Breather can not be disassembled.

Breather Inspection

Check breather for cracks or other damage.

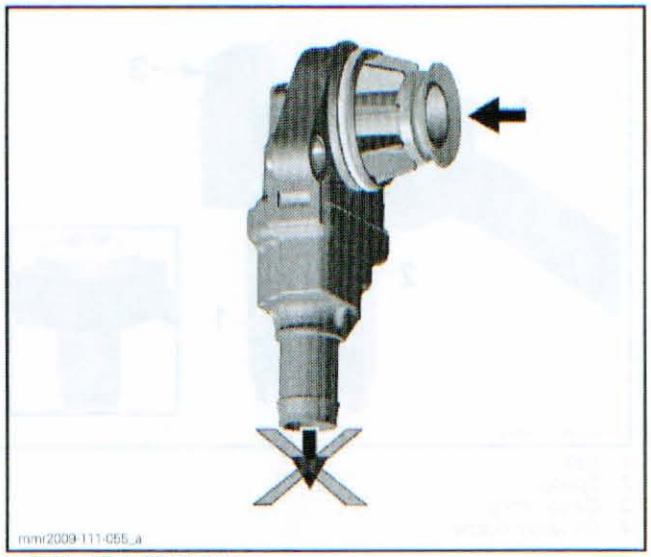
Clean all contact surfaces of breather.

Blow air through inlet port. Air must flow freely to the outlet port.



AIR MUST FLOW

Turn breather upside down and blow air again. Air must NOT flow out.



AIR MUST NOT FLOW

If test fails, replace the breather.

Breather Installation

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

Install breather with a **NEW** O-ring and a **NEW** V-ring.

COOLING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
HANDLE	420 877 650	77
OETIKER PLIERS	295 000 070	71
OIL SEAL PUSHER	529 035 757	77
TEST CAP	529 035 991	70
VACUUM PRESSURE PUMP	529 021 800	70
WATER PUMP CERAMIC SEAL INSTALLER	529 035 766	77

SERVICE PRODUCTS

Description	Part Number	Page
BRP PREMIXED COOLANT	219 700 362	68
DOW CORNING 111	413 707 000	74
LOCTITE 380 (BLACK MAX)	413 408 300	81
SUPER LUBE GREASE	293 550 030	77

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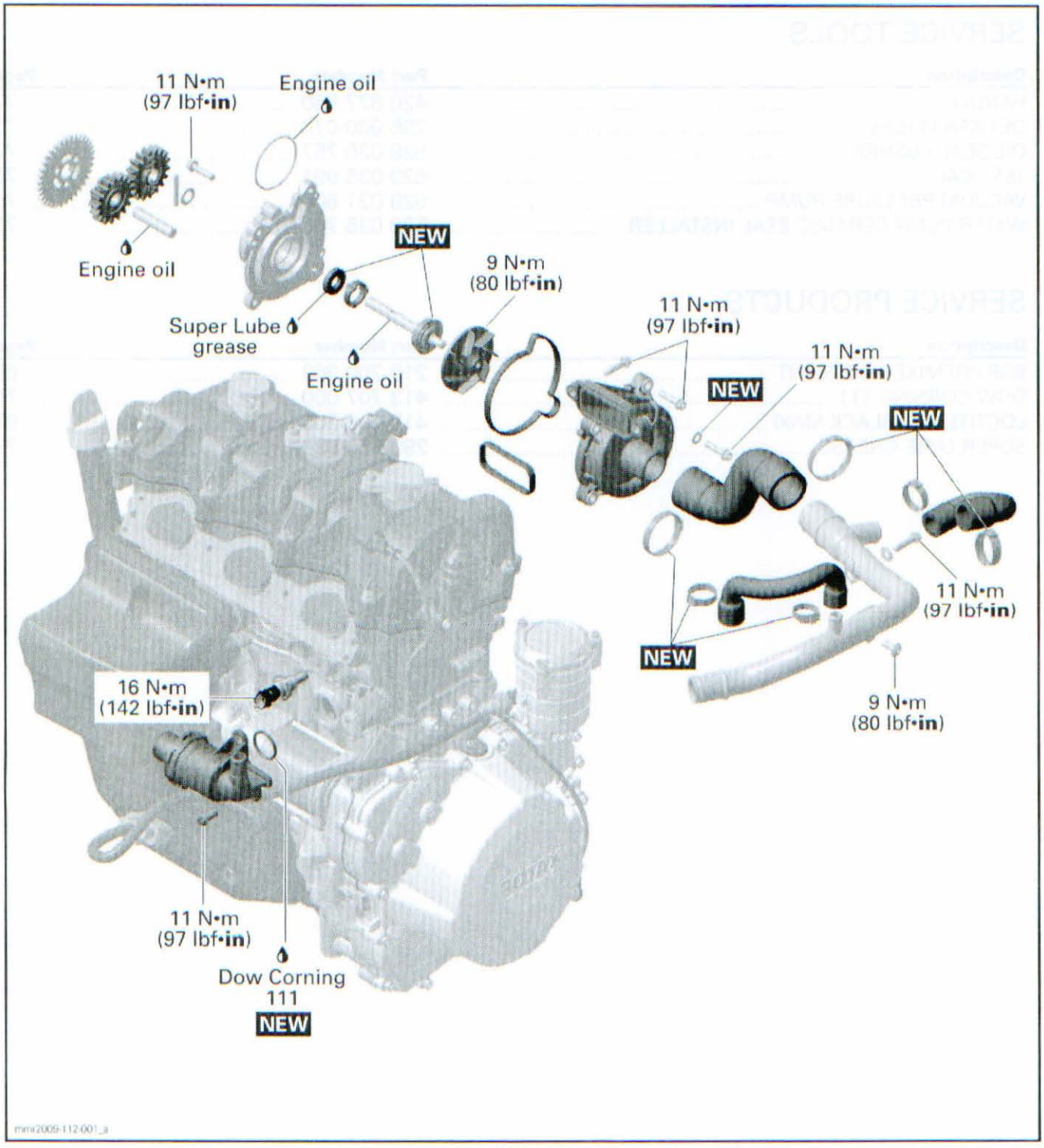
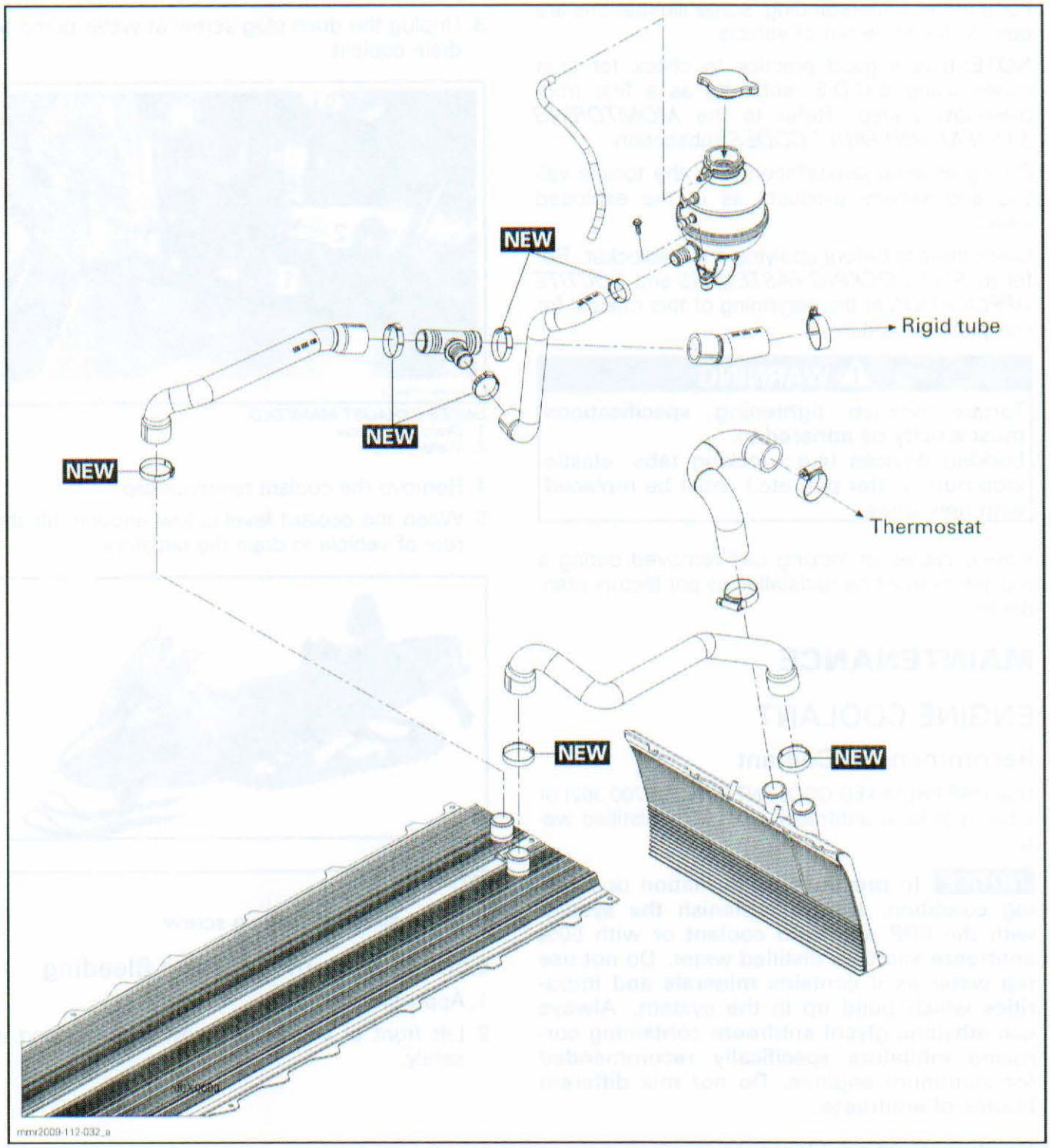
ENGINE COMPONENTS



VEHICLE COMPONENTS



GENERAL

For a better understanding, some illustrations are take with engine out of vehicle.

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

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

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

⚠ WARNING

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

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

MAINTENANCE

ENGINE COOLANT

Recommended Coolant

Use BRP PREMIXED COOLANT (P/N 219 700 362) or a blend of 50% antifreeze with 50% distilled water.

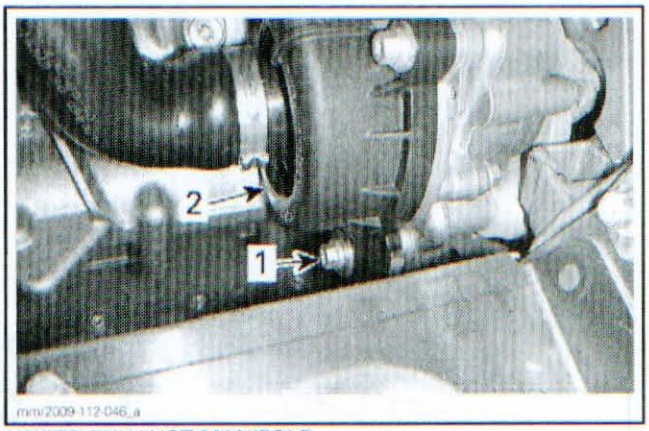
NOTICE **To prevent rust formation or freezing condition, always replenish the system with the BRP premixed coolant or with 50% antifreeze and 50% distilled water. Do not use tap water as it contains minerals and impurities which build up in the system. Always use ethylene glycol antifreeze containing corrosion inhibitors specifically recommended for aluminum engines. Do not mix different brands of antifreeze.**

Cooling System Draining

⚠ WARNING

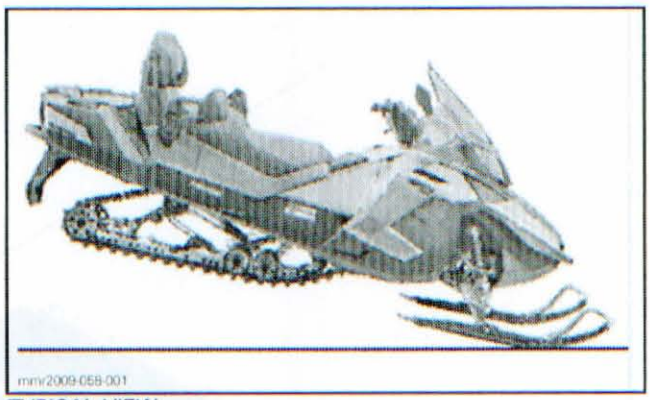
Never drain or refill the cooling system when engine is hot.

1. Remove hood. Refer to *BODY* subsection.
2. Place a large drain pan under the vehicle bottom pan.
3. Unplug the drain plug screw at water pump to drain coolant.



UNDER EXHAUST MANIFOLD
1. Drain plug screw
2. Water pump

4. Remove the coolant reservoir cap.
5. When the coolant level is low enough, lift the rear of vehicle to drain the radiators.



TYPICAL VIEW

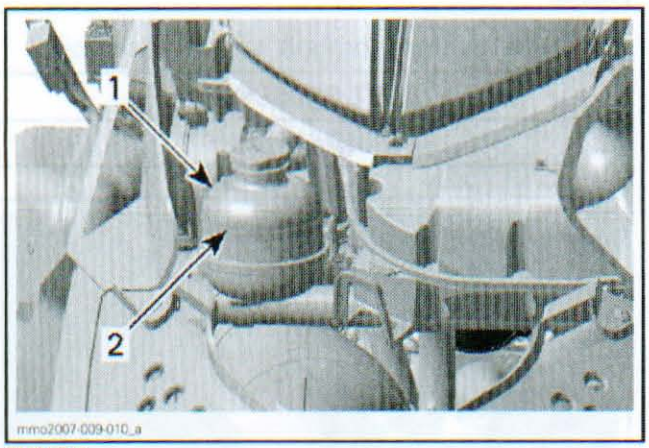
6. Reinstall the drain plug screw.

Cooling System Refill and Bleeding

1. Apply braking brake.
2. Lift front of vehicle as shown and support it safely.

TYPICAL VIEW
A. At least 60 cm (24 in)

3. Refill coolant reservoir up to COLD LEVEL line.

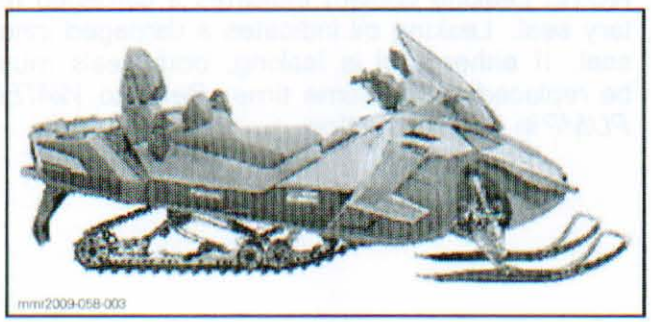


TYPICAL
1. Coolant reservoir
2. COLD LEVEL line

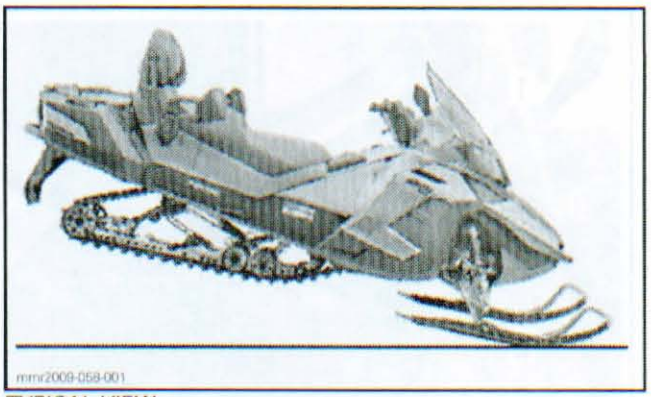
4. Start engine.
5. Refill up to line while engine is idling until rear radiators are warm to the touch (about 4 to 5 minutes).

NOTE: Make sure to maintain proper coolant level in reservoir to avoid air entering in the system.

6. Install pressure cap.
7. Lower vehicle back on the ground.



8. Lift rear of vehicle and support it safely.

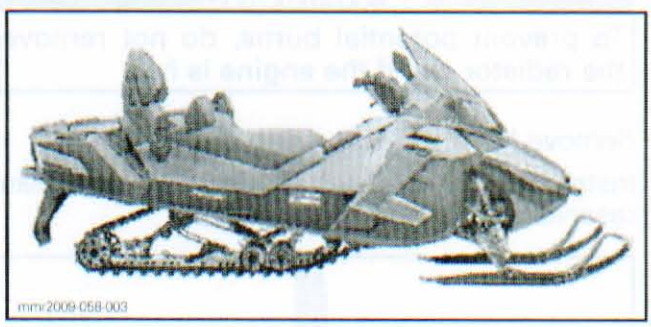


TYPICAL VIEW

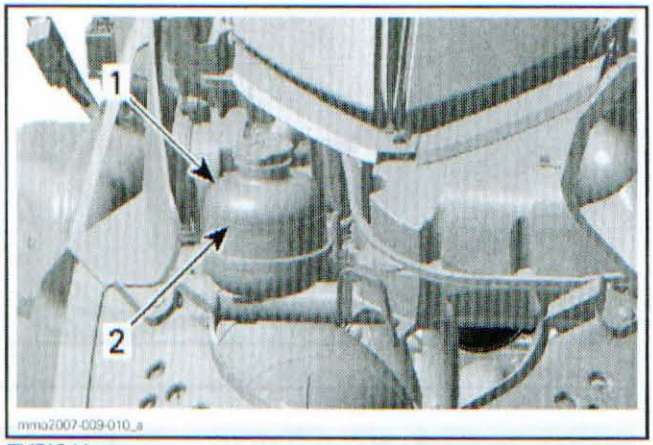
⚠ WARNING

Before revving engine, ensure that the track is free of particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Always lift the snowmobile on a wide-base stand with a rear deflector panel. Ensure no one is standing in close proximity to the snowmobile, especially at the rear of the track. Centrifugal force could cause debris, damaged or loose studs, pieces of torn track, or an entire track to be violently thrown backwards out of the frame with tremendous force, possibly resulting in the loss of a leg or other serious injury.

9. Remove parking brake.
10. Activate throttle lever 3 - 4 times to bring engine speed to 7000 RPM.
11. Apply the brake.
12. Lower vehicle back on ground.
13. Stop engine.



14. Add coolant up to 15 mm (1/2 in) above the COLD LEVEL line.



TYPICAL
1. *Coolant reservoir*
2. *Coolant 15 mm (1/2 in) above COLD LEVEL line*

15. When engine has completely cooled down, recheck coolant level in coolant reservoir and refill up to line if needed.
16. Check coolant freezing point.

COOLANT RECOMMENDED FREEZING POINT
-37°C (-35°F)

17. Adjust mixture as necessary.
18. Reinstall removed parts.
19. Run vehicle a few minutes then recheck coolant level.

INSPECTION

COOLING SYSTEM LEAK TEST

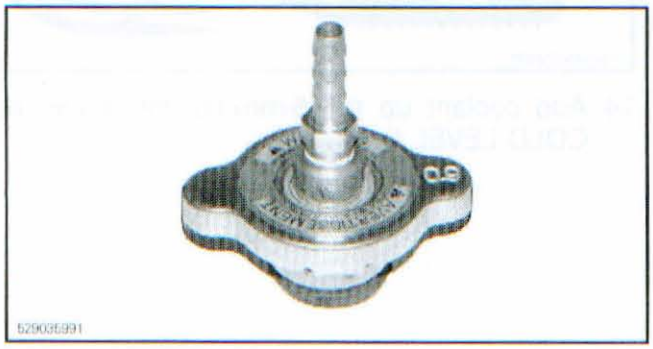
NOTE: This test confirms if there is a leak in the cooling system, including the engine.

⚠ WARNING

To prevent potential burns, do not remove the radiator cap if the engine is hot.

Remove hood.

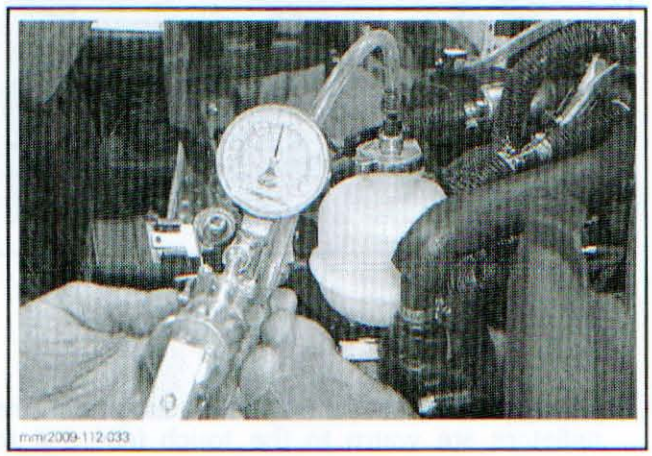
Install the TEST CAP (P/N 529 035 991) on coolant reservoir.



Connect the VACUUM PRESSURE PUMP (P/N 529 021 800) to the test cap nipple.

Pressurize system through coolant reservoir.

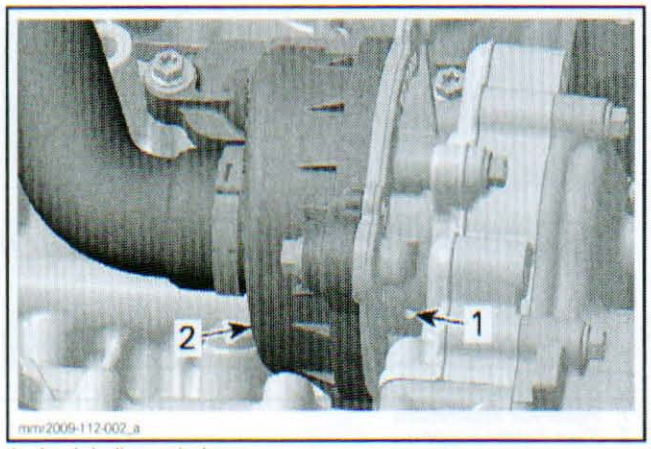
TEST PRESSURE
100 kPa (15 PSI)



If pressure drops, check all hoses and engine for coolant leaks. Spray a soap/water solution and look for air bubbles.

Check the leak indicator hole if there is oil or coolant leaking.

NOTE: Leaking coolant indicates a damaged rotary seal. Leaking oil indicates a damaged inner seal. If either seal is leaking, both seals must be replaced at the same time. Refer to *WATER PUMP* in this subsection.



1. Leak indicator hole
2. Water pump

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first.

ENGINE OVERHEATING

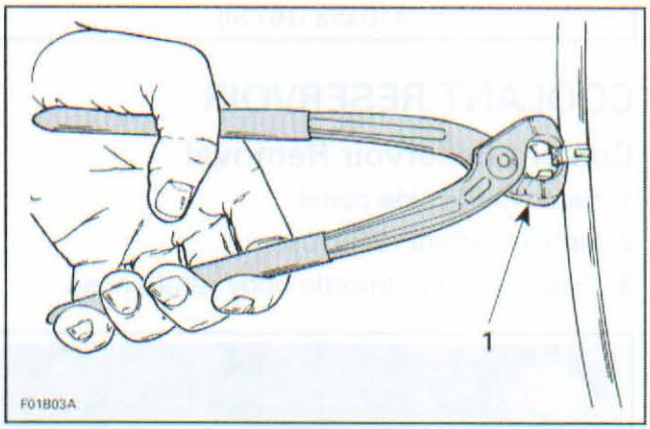
1. Low coolant level.
   - *Refill and check for leaks (coolant leaking out of leak indicator hole, hoses or clamps missing or defective, or cylinder head gaskets leaks). Repair or replace.*
2. Air in cooling system.
   - *Refill and bleed cooling system.*
3. Defective thermostat (does not open when engine is warm up).
   - *Replace thermostat.*
4. Defective water pump.
   - *Inspect and replace defective components.*
5. Water temperature sensor defective.
   - *Check and replace.*
6. Dirty radiators.
   - *Clean radiator fins. Replace radiator(s) as required.*
7. Wrong coolant concentration.
   - *Check and adjust coolant concentration according to BRP's recommendations or replace coolant.*
8. Defective coolant reservoir cap.
   - *Replace cap.*

PROCEDURES

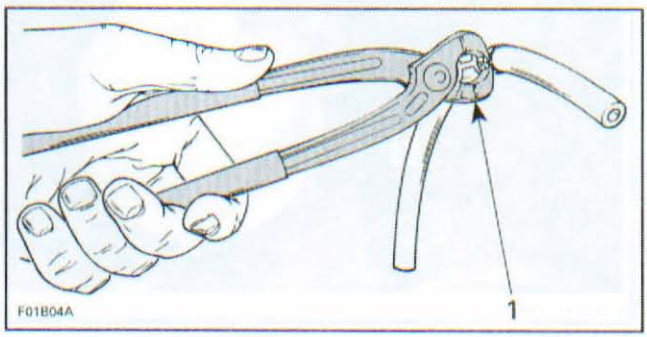
OETIKER CLAMPS

Oetiker Clamp Replacement

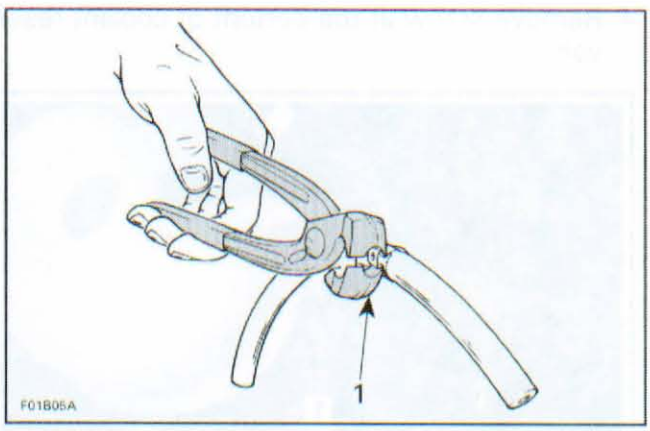
To secure or cut Oetiker clamps, use OETIKER PLIERS (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



1. Securing clamp in limited access

COOLANT RESERVOIR CAP

Coolant Reservoir Cap Test

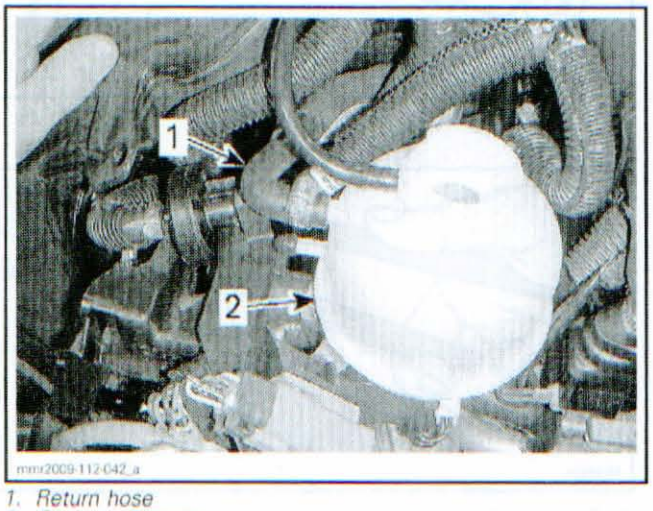
Using a pressure cap tester, check the efficiency of coolant reservoir cap. If the efficiency is weak, replace the cap.

CAP OPENING PRESSURE
110 kPa (16 PSI)

COOLANT RESERVOIR

Coolant Reservoir Removal

1. Remove RH side panel.
2. Siphon coolant reservoir.
3. Disconnect the throttle body return hose.



1. Return hose
2. Coolant reservoir

4. Remove screw at the bottom of coolant reservoir.

1. Retaining screw

5. Move the coolant reservoir toward the engine to free the reservoir attachment from the fuse holder support.

1. Reservoir attachment
2. Fuse holder support

6. Cut the Oetiker clamp securing the lower coolant hose to coolant reservoir.

1. Cut this Oetiker clamp

Coolant Reservoir Inspection

Check if the reservoir is cracked or melted. Replace if necessary.

Coolant Reservoir Installation

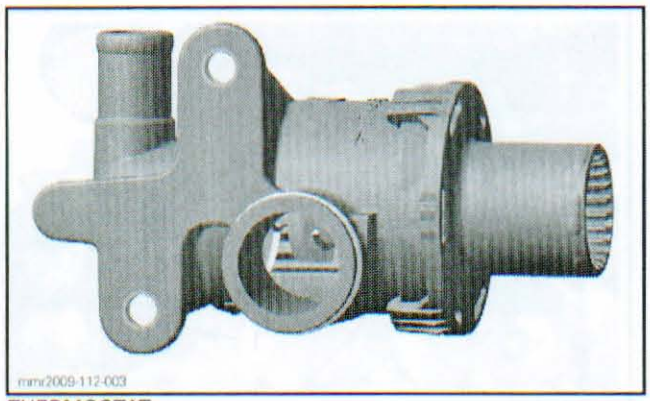
For installation, reverse the removal procedure.

Refill cooling system as described in this subsection.

THERMOSTAT

The thermostat is a dual action type.

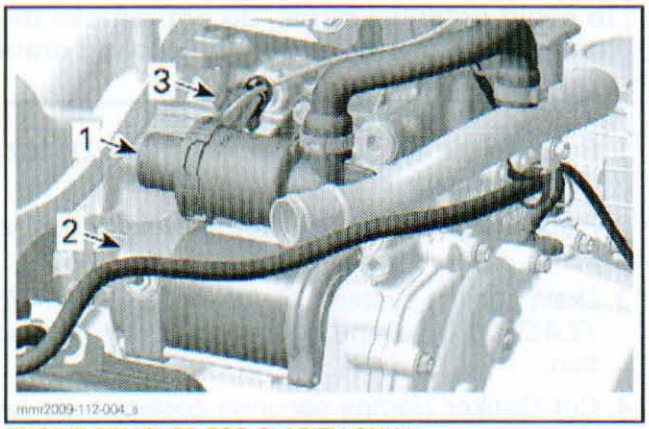
NOTE: Thermostat is integrated in a housing and is replaced as a complete unit.



THERMOSTAT

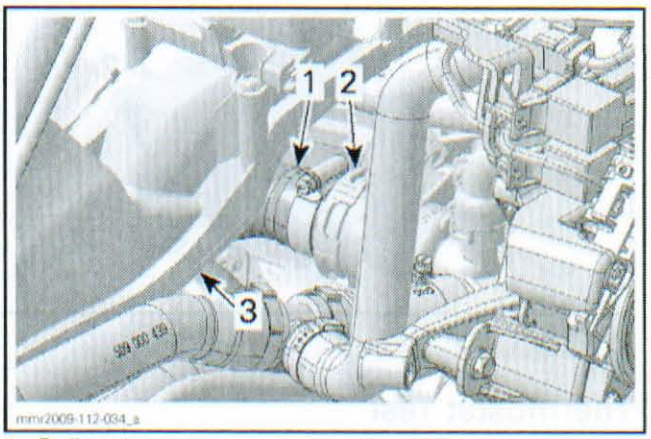
Thermostat Removal

The thermostat is located on the rear side of engine above the electric starter.



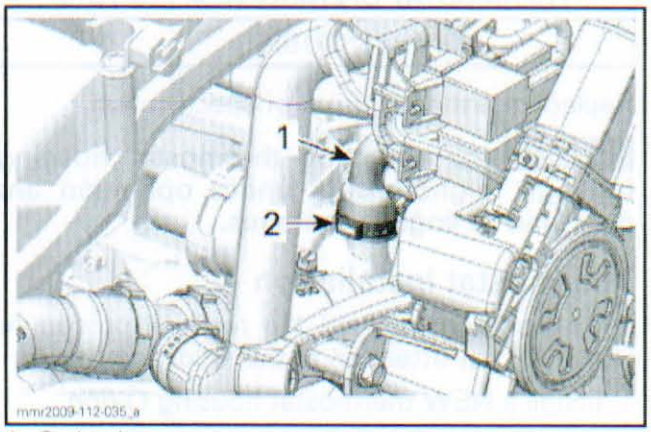
ENGINE REMOVED FOR CLARITY ONLY
1. *Thermostat*
2. *Electric starter*
3. *Coolant temperature sensor (CTS)*

1. Drain coolant system. Refer to *COOLING SYSTEM DRAINING* at the beginning of this subsection.
2. Move fuel tank rearward. Refer to *FUEL TANK AND FUEL PUMP* subsection.
3. Remove the driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
4. Remove the clamp securing radiator hose to thermostat.



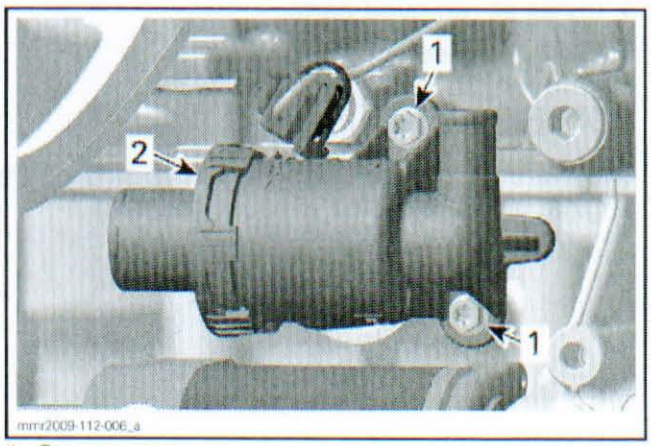
1. *Radiator hose*
2. *Thermostat*
3. *Intake manifold*

5. Cut Oetiker clamp retaining the coolant hose on the top of thermostat.



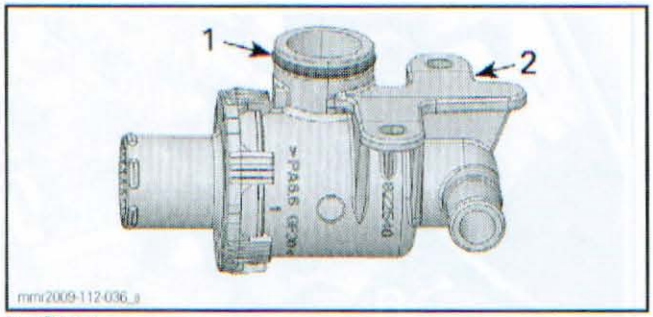
1. *Coolant hose*
2. *Oetiker clamp*

6. Remove retaining screws from the thermostat.



1. *Remove screws*
2. *Thermostat*

7. Pull out thermostat. Catch spilled coolant.
8. Remove the O-ring from the thermostat.



1. *O-ring*
2. *Thermostat housing*

Thermostat Test

1. To check the operation of the thermostat , soak it in water and heat the water.
2. Check thermostat opening temperature using a thermometer.

THERMOSTAT OPENING TEMPERATURE
75°C (167°F)

Replace thermostat if out of specification.

NOTICE **Do not open thermostat housing. Leakage might occurs under operation and may lead to engine damages.**

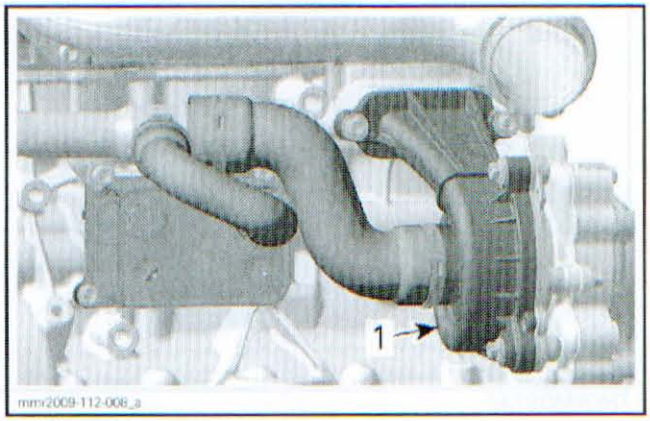
Thermostat Installation

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

1. Install a **NEW** thermostat housing O-ring.
2. Apply DOW CORNING 111 (P/N 413 707 000) on O-ring before installing the thermostat.
3. Install a **NEW** Oetiker clamp.
4. Install all removed parts.
5. Refill and bleed coolant circuit.

WATER PUMP

The water pump is located on front side of the engine, underneath the exhaust manifold.



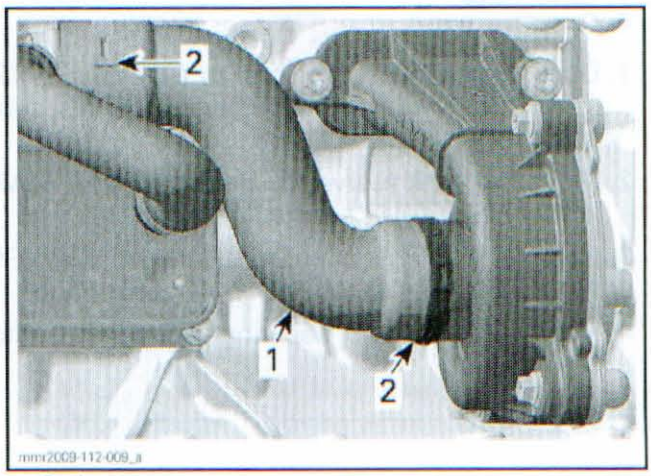
1. *Water pump*

Water Pump Removal

⚠ WARNING

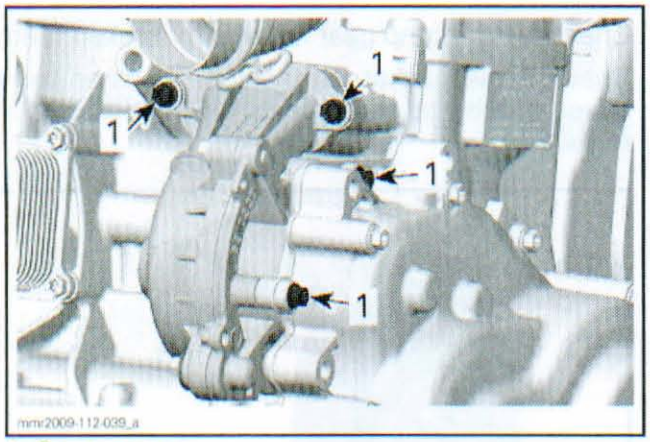
To avoid potential burns, do not remove the coolant tank cap or loosen the cooling drain plug if the engine is hot.

1. Remove the exhaust pipe. Refer to *EXHAUST SYSTEM* subsection.
2. Place a large drain pan under the vehicle bottom pan.
3. Drain cooling system. Refer to *COOLANT REPLACEMENT* at the beginning of this subsection.
4. Cut Oetiker clamps securing coolant hose between the rigid tube and water pump.



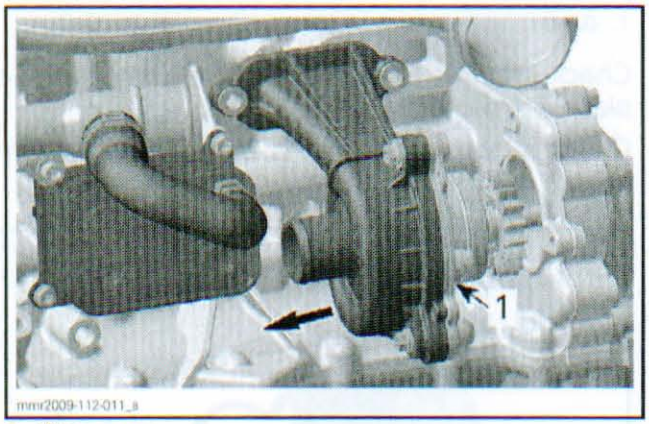
1. *Coolant hose*
2. *Oetiker clamps*

5. Remove the coolant hose to make room.
6. Remove screws retaining water pump module.



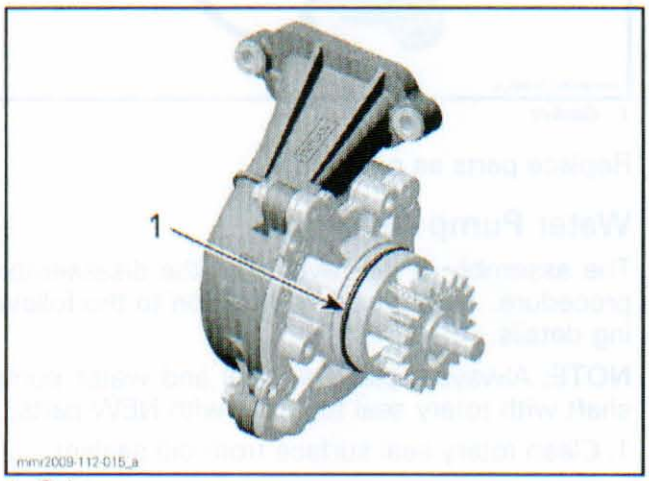
1. Remove screws

7. Pull water pump from engine and remove it from vehicle.



1. Water pump

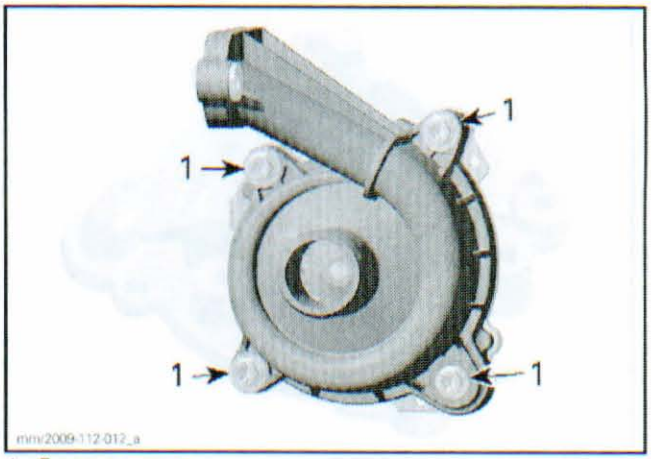
8. Remove and discard the O-ring on water pump module.



1. O-ring

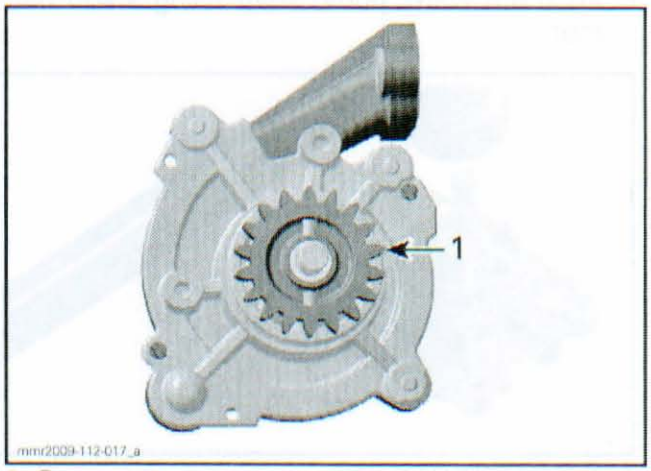
Water Pump Disassembly

1. Remove screws retaining water pump housing.



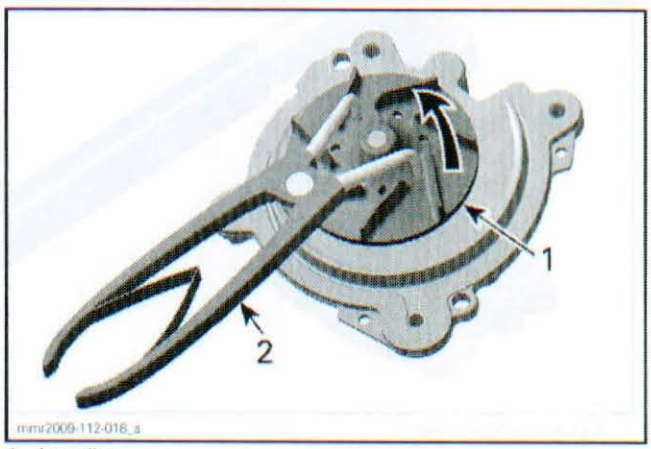
1. Remove screws

2. Remove water pump gear.



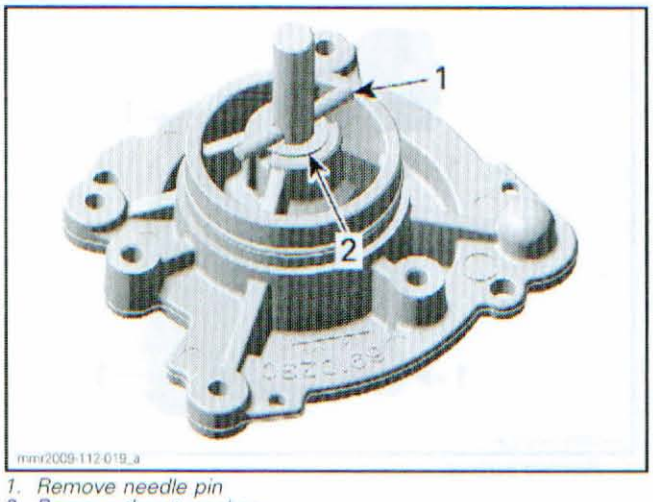
1. Remove water pump gear

3. Fix water pump shaft into a vise with aluminium jaws.
4. Unscrew the impeller counterclockwise using appropriate pliers.



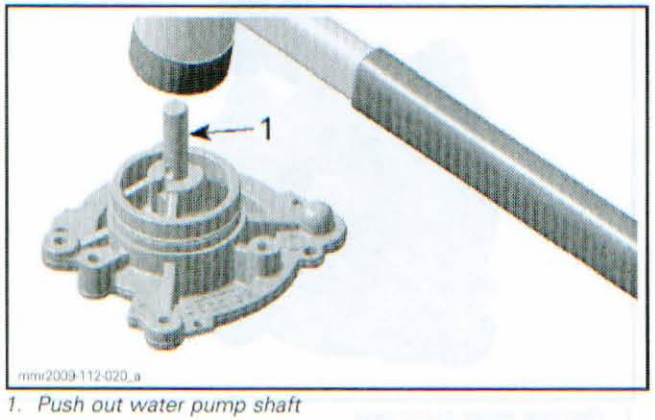
1. Impeller
2. Pliers

5. Remove needle pin and trust washer.



1. *Remove needle pin*
2. *Remove thrust washer*

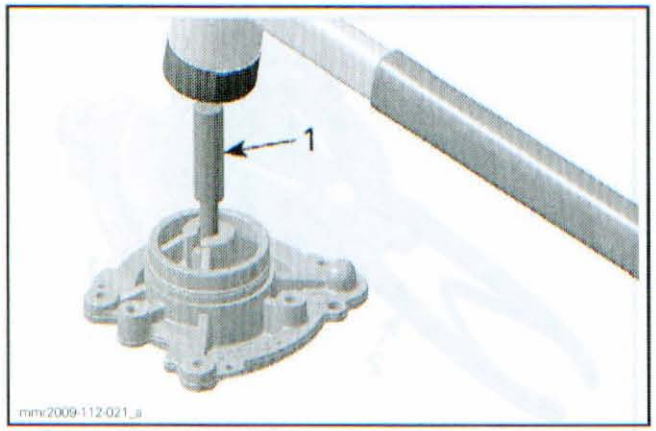
6. Push out water pump shaft using a soft hammer.



1. *Push out water pump shaft*

7. Extract oil seal and remaining parts of rotary seal with a pusher.

NOTE: Be careful not to damage the surface of the rotary seal bore in water pump housing.



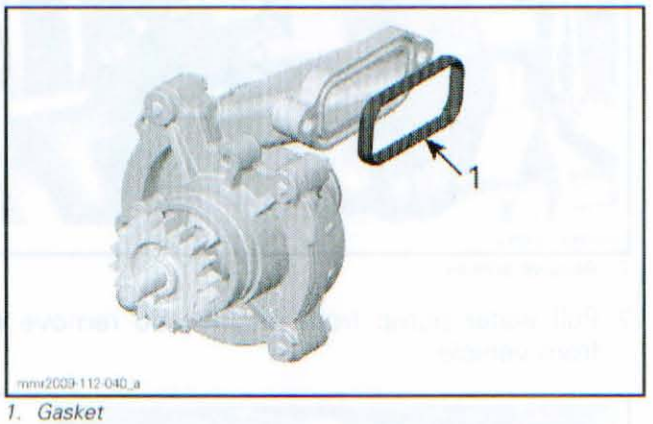
1. *Extract with pusher*

Water Pump Inspection

Check water pump housing for cracks or other visible damage.

Check water pump gear for wear or broken teeth.

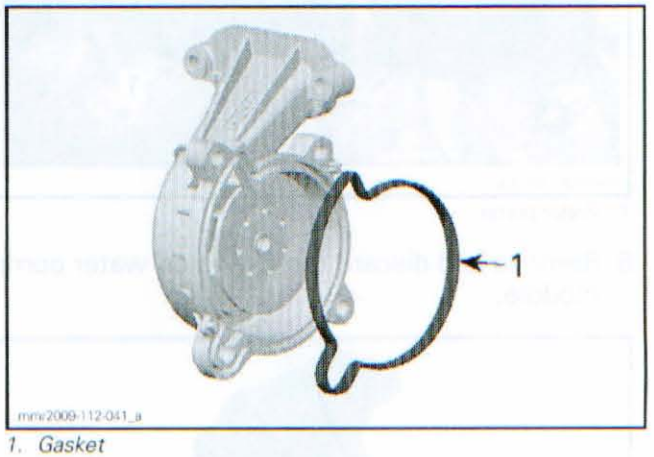
Check if the gasket on the top of water pump housing is brittle, hard or damaged. Replace as required.



1. *Gasket*

Check impeller for cracks or other damage. Replace it if damaged.

Check if housing gasket is brittle, hard or damaged.



1. *Gasket*

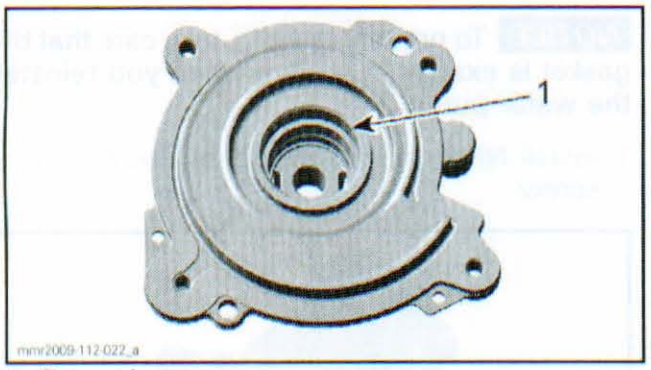
Replace parts as necessary.

Water Pump Assembly

The assembly is the reverse of the disassembly procedure. However, pay attention to the following details.

NOTE: Always replace oil seal and water pump shaft with rotary seal together with NEW parts.

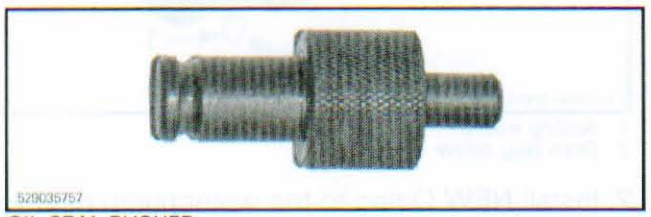
1. Clean rotary seal surface from old sealant.



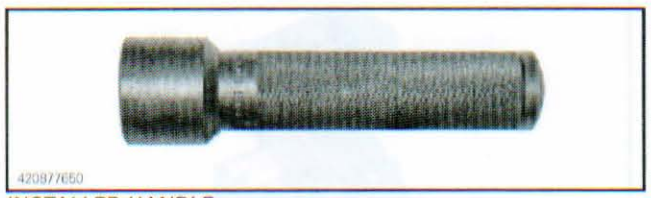
1. Clean surface

NOTE: Never use oil in the press fit area of the oil seal and rotary seal.

2. Use the OIL SEAL PUSHER (P/N 529 035 757) and the HANDLE (P/N 420 877 650) to install the oil seal.



OIL SEAL PUSHER

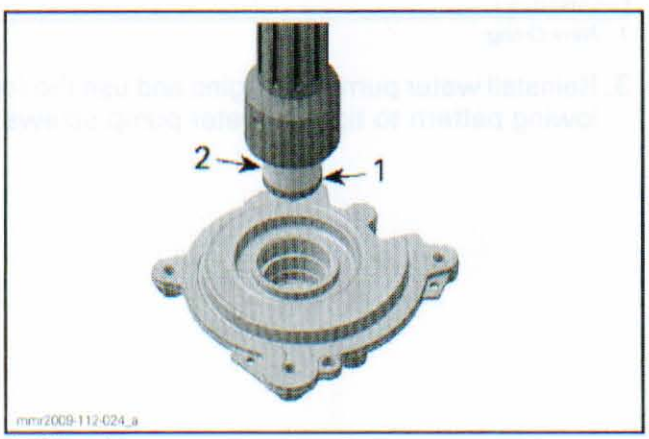


INSTALLER HANDLE

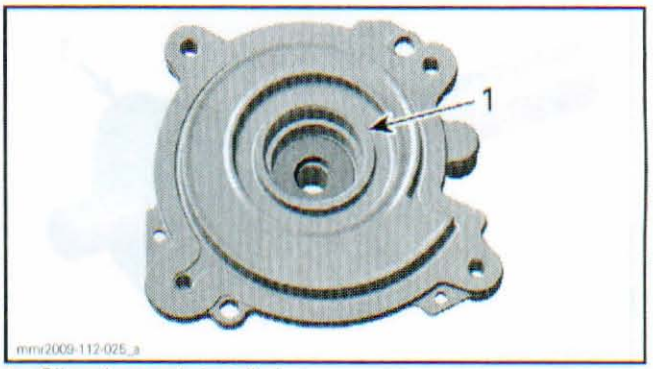
3. Apply SUPER LUBE GREASE (P/N 293 550 030) on sealing lip of the oil seal.

NOTE: When installing the oil seal on the pusher, make sure sealing lip faces outside.

4. Push **NEW** oil seal in place.

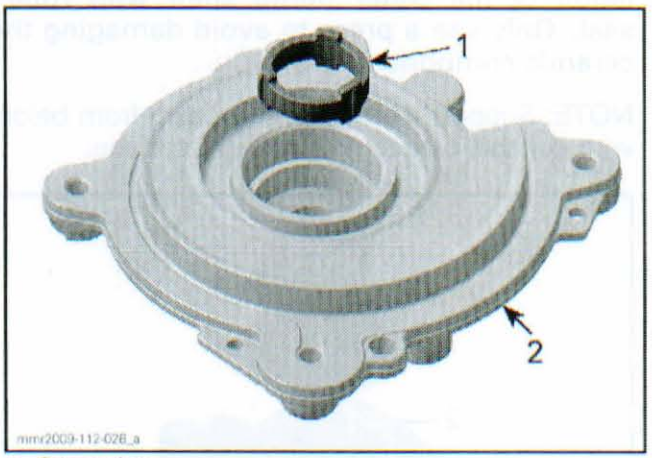


1. Oil seal
2. Oil seal pusher



1. Oil seal properly installed

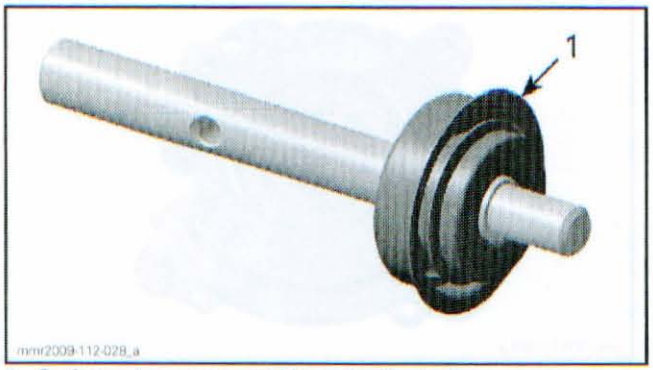
5. Install spacer ring into water pump housing.



1. Spacer ring
2. Water pump housing

6. Slide **NEW** water pump shaft with rotary seal into water pump housing.

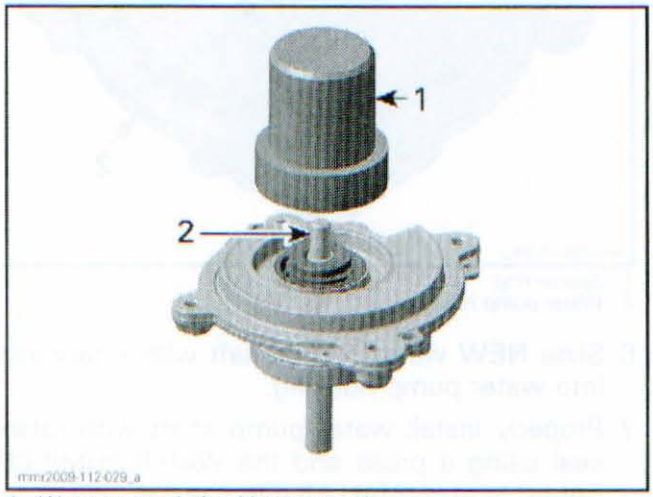
7. Properly install water pump shaft with rotary seal using a press and the WATER PUMP CERAMIC SEAL INSTALLER (P/N 529 035 766).



1. Surface where rotary seal is pushed by tool

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

NOTE: Support water pump housing from below with suitable sleeve with straight surface.



1. Water pump shaft with rotary seal
2. Rotary seal installer

NOTE: After installation, water pump shaft with rotary seal must rotate freely.

8. Properly reinstall remaining components, refer to procedures above.
9. Install the impeller.

NOTICE Be careful not to damage impeller wings during its installation.

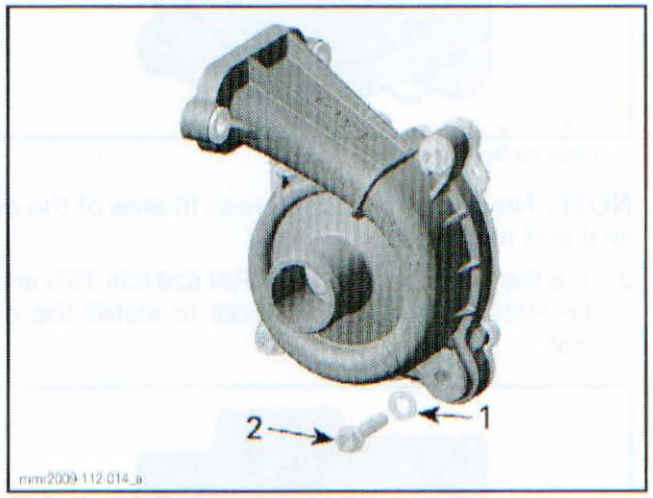
10. Tighten screws of water pump housing in a crisscrossed sequence.

Water Pump Installation

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

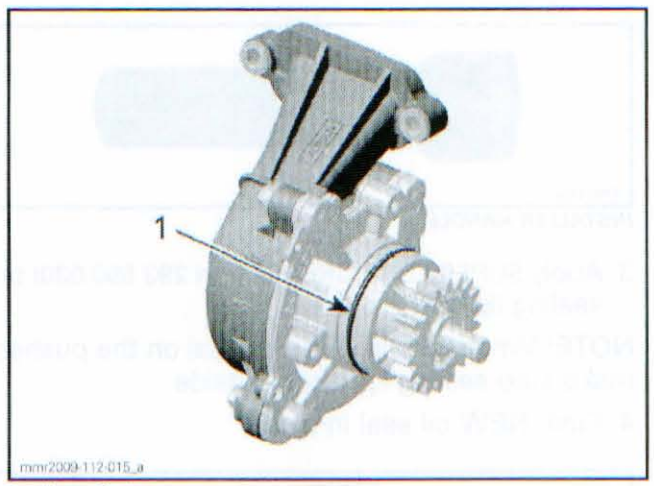
NOTICE To prevent leaking, take care that the gasket is exactly in groove when you reinstall the water pump.

1. Install **NEW** sealing washer to the drain plug screw.



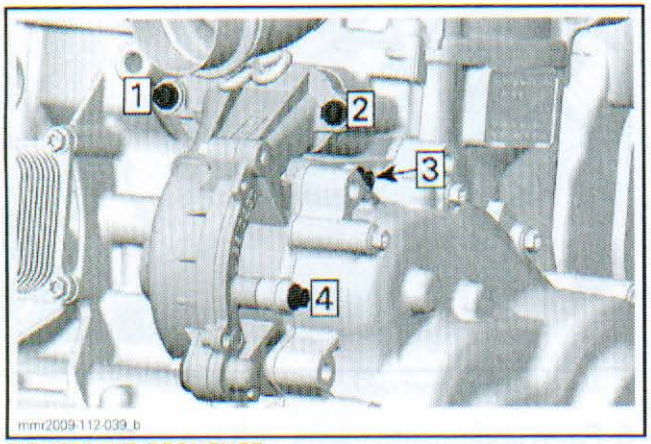
1. Sealing washer
2. Drain plug screw

2. Install **NEW** O-ring to the water pump module.



1. New O-ring

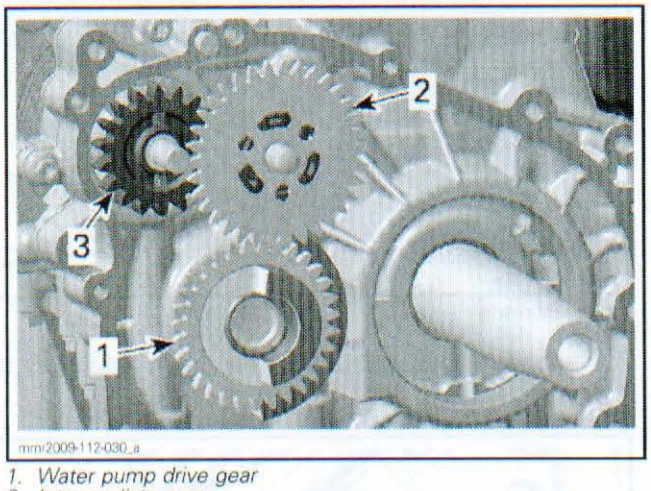
3. Reinstall water pump on engine and use the following pattern to tighten water pump screws.



TIGHTENING SEQUENCE

WATER PUMP DRIVE GEARS

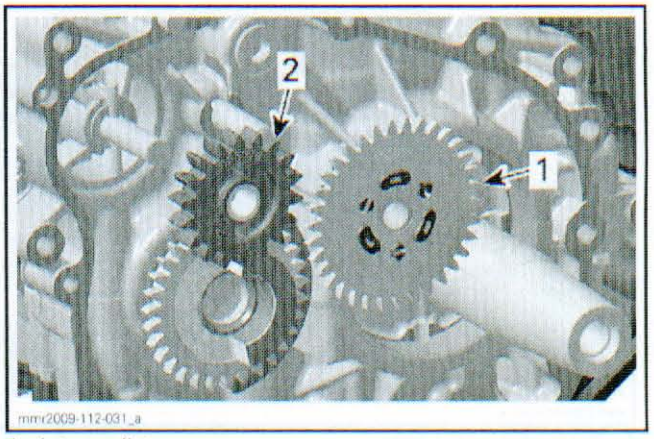
The water pump drive gears are located on the engine PTO side, behind the PTO cover.



1. *Water pump drive gear*
2. *Intermediate gear*
3. *Water pump gear*

Water Pump Drive Gear Removal

1. Remove PTO cover, Refer to *CYLINDER BLOCK* subsection.
2. Remove intermediate gear and water pump gear.



1. *Intermediate gear*
2. *Water pump gear*

NOTE: Water pump drive gear can not be removed from balancer shaft.

Water Pump Drive Gear Inspection

Inspect gears for wear or other damage.

Replace gear(s) if necessary.

Water Pump Drive Gear Installation

The installation is the reverse of the removal procedure.

FRONT RADIATOR

Front Radiator Cleaning and Inspection

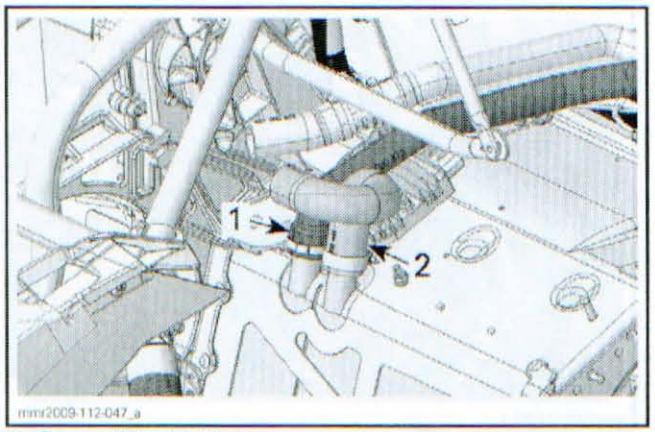
Remove all debris between radiator fins. A clean radiator is more efficient than a dirty one.

Check if the radiator fins are damaged. Replace the front radiator if necessary.

NOTE: A radiator with many broken fins does not work properly.

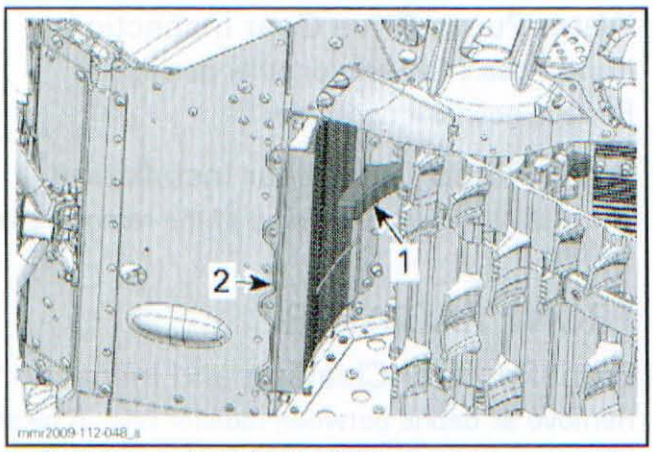
Front Radiator Removal

1. Remove the engine from the vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Lift and secure rear of vehicle.
3. Remove both hoses from radiator tubes.

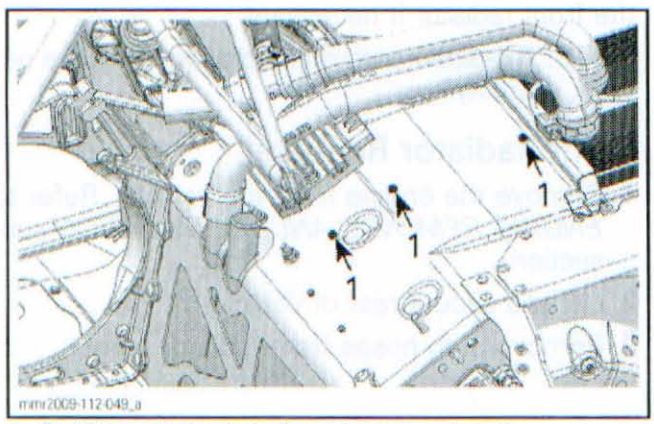


1. *Rear radiator inlet hose*
2. *Engine outlet hose*

4. From engine compartment, grind the 3 rivets retaining the radiator protector.

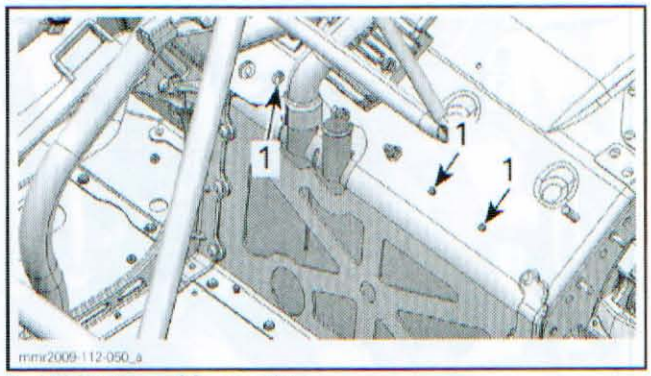


1. *Radiator protector (in front of track)*
2. *Front radiator*



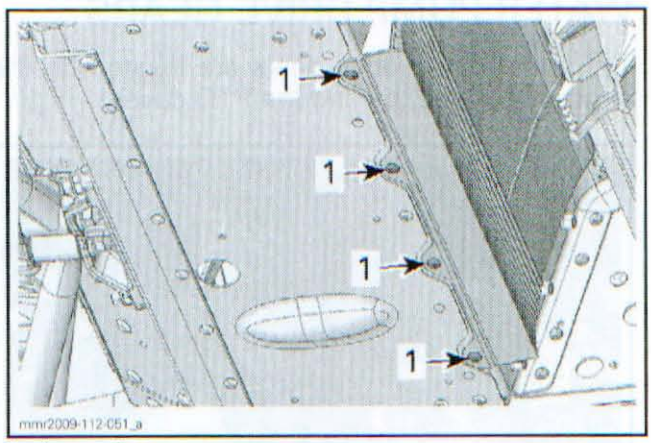
1. *Radiator protector rivets (in engine compartment)*

5. Remove the upper rivets retaining the front radiator to the frame.



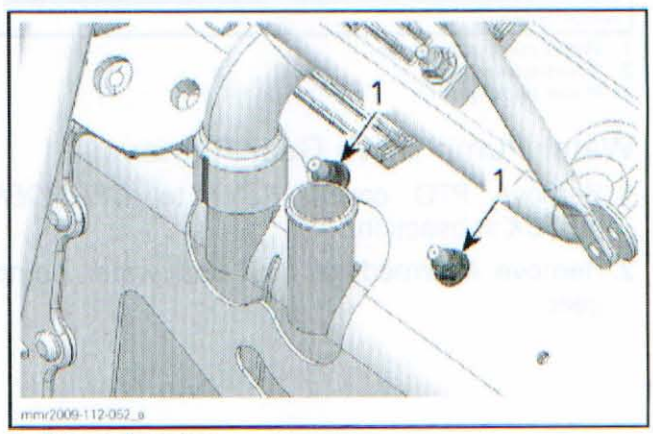
1. *Upper rivets of front radiator*

6. From underneath frame, drill the lower rivets of front radiator or grind them with a grinding disk.



1. *Lower rivets*

7. Remove nuts securing the front radiator to frame.



1. *Front radiator nuts*

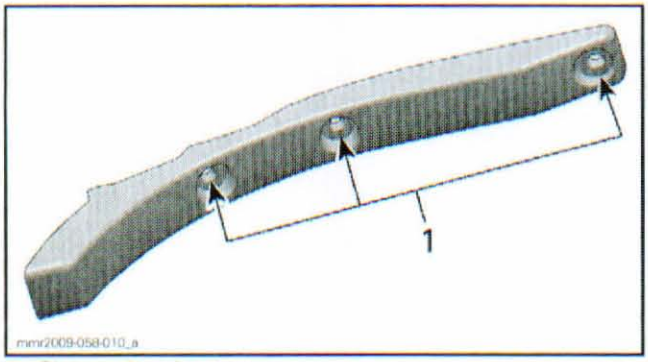
8. Remove front radiator from vehicle.

Front Radiator Installation

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

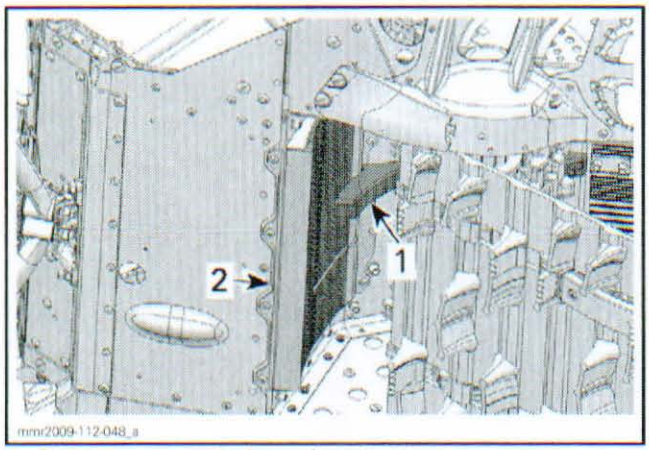
1. Lift and secure rear of vehicle.
2. Install the front radiator in frame.

3. Install nuts to secure radiator. Do not torque yet.
4. Install all rivets.
5. Tighten nuts to 5 N•m (44 lbf•**in**).
6. Install the radiator protector. To avoid removing the track, proceed as follow:
   6.1 Using LOCTITE 380 (BLACK MAX) (P/N 413 408 300), glue 3 washers (P/N 517 124 300) in protector bores.



1. Glue washers here

   6.2 From underneath frame, position protector.



1. Radiator protector (in front of track)
2. Front radiator

   6.3 From engine compartment, secure protector with the rivets. Ensure to insert the rivet ends in washers.
7. Reinstall remaining removed parts.
8. Refill cooling system as described in this subsection.

REAR RADIATOR

Rear Radiator Cleaning and Inspection

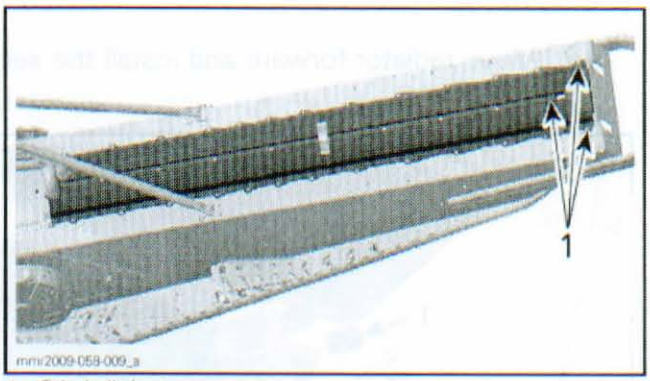
Remove all debris between radiator fins. A clean radiator is more efficient than a dirty one.

Check if the radiator fins are damaged. Replace the rear radiator if necessary.

NOTE: A radiator with many broken fins does not work properly.

Rear Radiator Removal

1. Drain cooling system, see *COOLING SYSTEM DRAINING* in this subsection.
2. Remove rear suspension. Refer to the *REAR SUSPENSION* subsection.
3. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
4. Remove luggage rack as necessary according to vehicle.
5. Remove snow guard.
6. Remove rear bumper
7. Remove polystyrene board and tape securing the wiring harness in the middle of rear radiator and move harness aside.
8. Using a grinding disk, grind all rivet rows retaining rear radiator to frame. Work from top of frame.



1. Grind all rivet rows

NOTE: When pushing the grinded rivets out, support the frame around the rivet with a socket on the opposite side to avoid warpage.

9. Unplug coolant hoses from rear radiator then remove radiator from vehicle.

Rear Radiator Installation

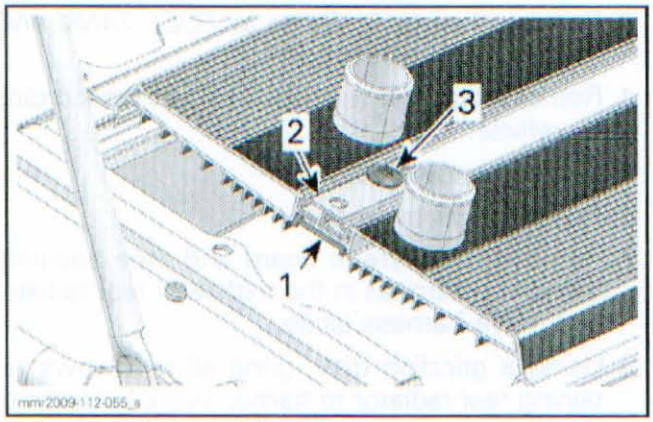
The installation is the reverse of the removal procedure. However, pay attention to the following.

1. Slide radiator into frame.
2. Near radiator tube, replace both HUCK rivets by the following parts.

NEW FASTENERS	
TORX screw M6 x 25 (2x)	(P/N 250 000 284)
Hexagonal flanged elastic stop nut M6 (2x)	(P/N 233 261 414)

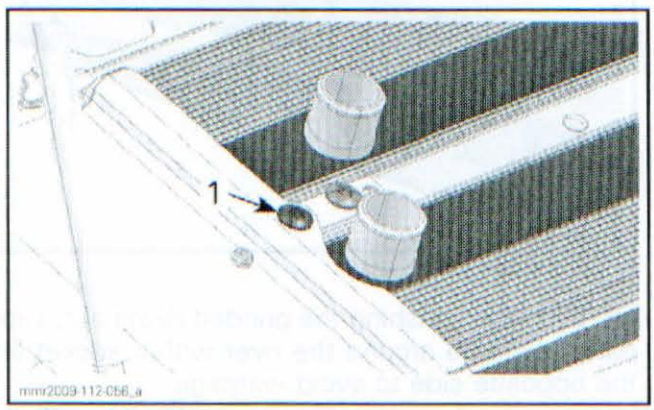
3. Install both reinforcement plates using new fasteners.

   3.1 First install the rear screw. Place it head on the top. Do not torque yet.



1. Lower reinforcement plate
2. Upper reinforcement plate
3. Screw M6 x 25

   3.2 Move radiator forward and install the second screw.



1. Screw M6 x 25

   3.3 Tighten bolts to 10 N•m (89 lbf•**in**).

4. Secure radiator to frame using new rivets (head on top).
5. If traction enhancing products (studs) are used on vehicle, install the appropriate radiator protector. Refer to *TRACK* to choose the proper protectors kit.
6. Refill cooling system as described in this subsection.
7. Install all removed parts.

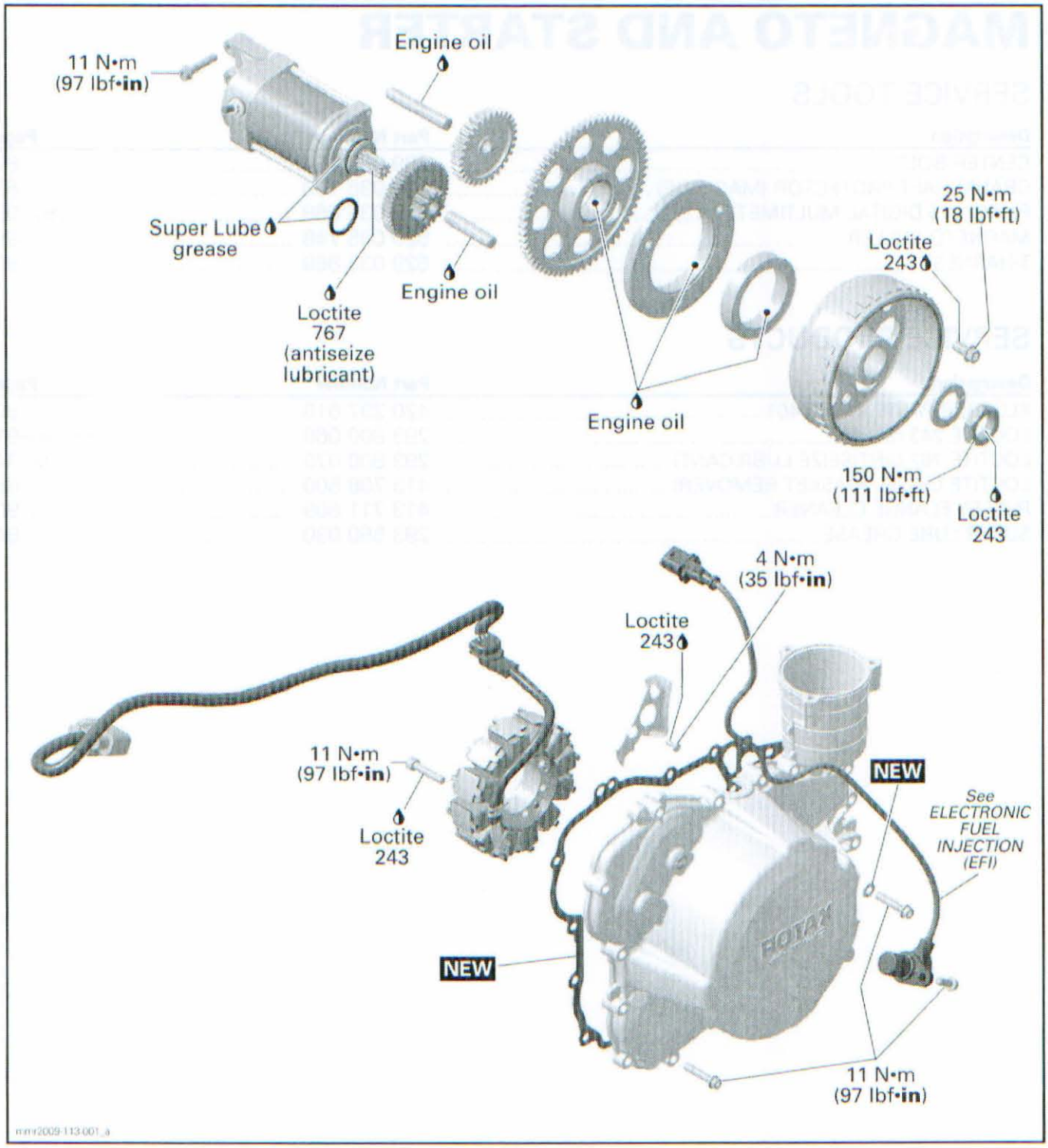
MAGNETO AND STARTER

SERVICE TOOLS

Description	Part Number	Page
CENTER BOLT	529 036 154	86
CRANKSHAFT PROTECTOR (MAG SIDE)	529 036 160	89
FLUKE 115 DIGITAL MULTIMETER	529 035 868	87, 93
MAGNETO PULLER	529 035 748	89
T-HARNESS	529 035 869	93

SERVICE PRODUCTS

Description	Part Number	Page
KLÜEBER PASTE 46 MR 401	420 297 616	86
LOCTITE 243 (BLUE)	293 800 060	88, 90–91
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	92, 94
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	86
PULLEY FLANGE CLEANER	413 711 809	90
SUPER LUBE GREASE	293 550 030	94


11 N•m
(97 lbf•in)
Engine oil
Super Lube grease
Loctite 767 (antiseize lubricant)
Engine oil
25 N•m
(18 lbf•ft)
Loctite 243
Engine oil
150 N•m
(111 lbf•ft)
Loctite 243
4 N•m
(35 lbf•in)
Loctite 243
11 N•m
(97 lbf•in)
Loctite 243
NEW
See ELECTRONIC FUEL INJECTION (EFI)
NEW
11 N•m
(97 lbf•in)
mmr2009-113-001_a

GENERAL

⚠ WARNING

Always disconnect BLACK (-) cable first and reconnect last.

The engine removal is necessary to work on the magneto system.

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 strictly be adhered to.
Locking devices (ex: locking tabs, elastic stop nuts, self-locking fasteners, cotter pin, etc.) must be replaced with new ones.

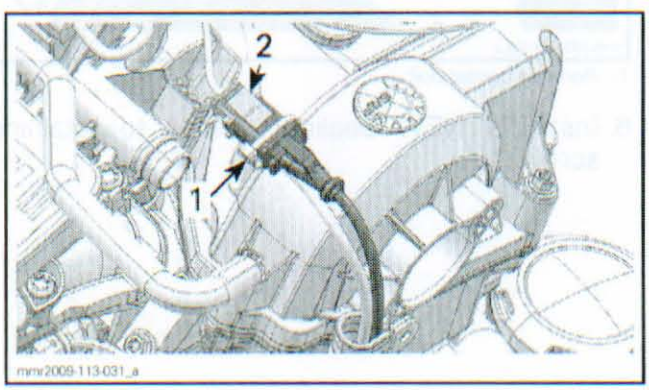
Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

PROCEDURES

MAGNETO COVER

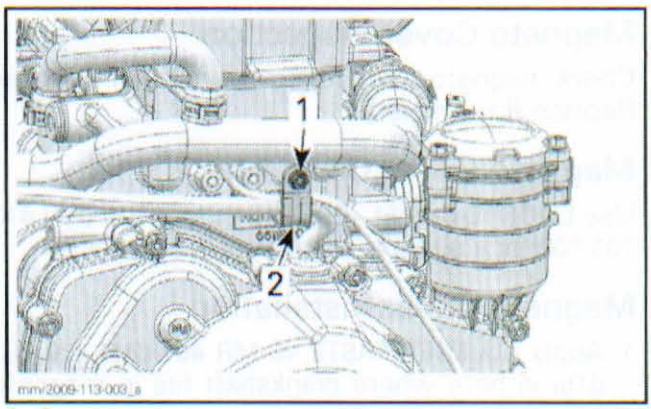
Magneto Cover Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Drain engine oil. Refer to *LUBRICATION SYSTEM* subsection.
3. Cut locking tie and disconnect crankshaft position sensor (CPS) connector.



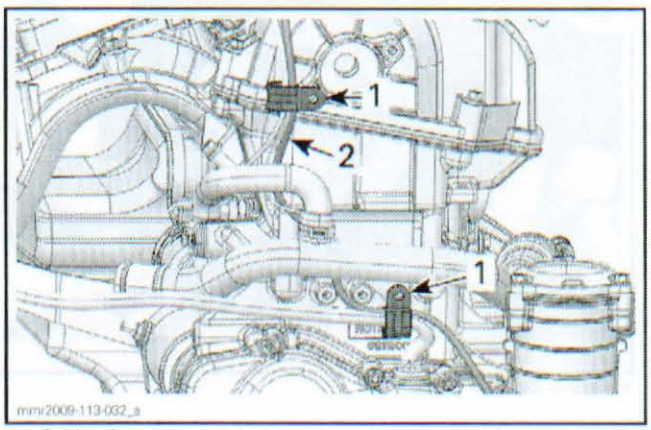
1. Locking tie
2. CPS sensor connector

4. Remove retaining screw and cable clamp.



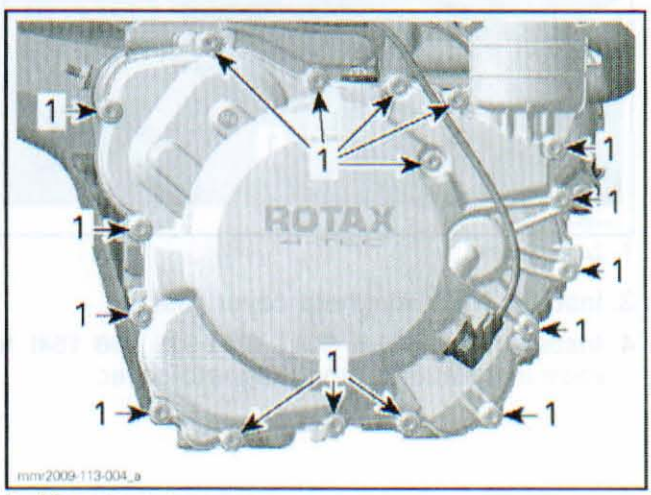
1. Remove screw
2. Cable clamp

5. Remove CPS sensor wire from both cable clamps.



1. Cable clamps
2. CPS sensor wire

6. Place an oil pan under magneto area to catch remaining oil.
7. Remove magneto cover retaining screws and discard sealing washer.



1. Magneto cover screws

8. Pull off magneto cover.
9. Discard magneto cover gasket.

Magneto Cover Inspection

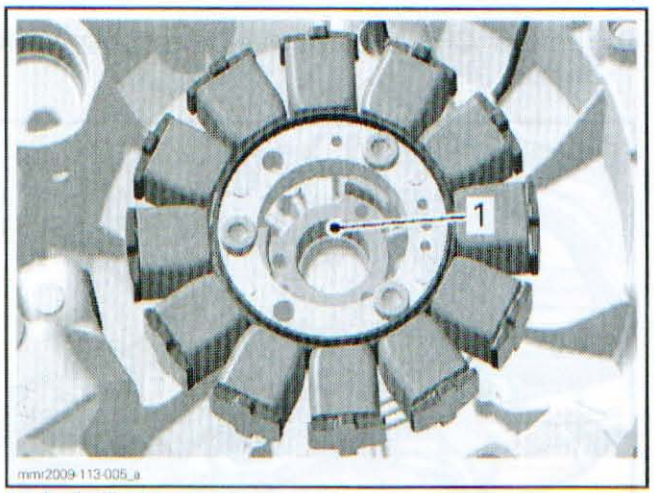
Check magneto cover for cracks or other damage. Replace if necessary.

Magneto Cover Cleaning

Use LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) or a suitable equivalent for cleaning.

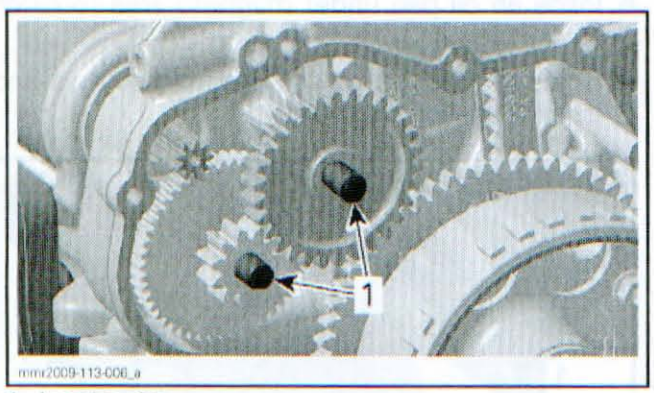
Magneto Cover Installation

1. Apply KLÜEBER PASTE 46 MR 401 (P/N 420 297 616) in bore where crankshaft fits in magneto cover.



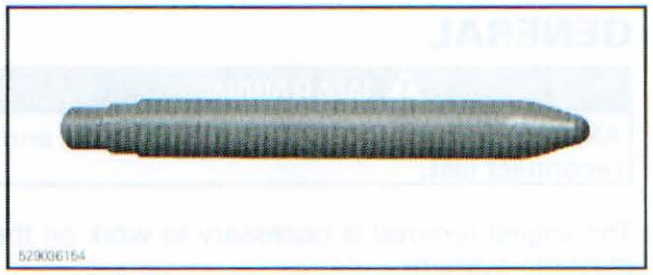
1. Apply Klueber paste

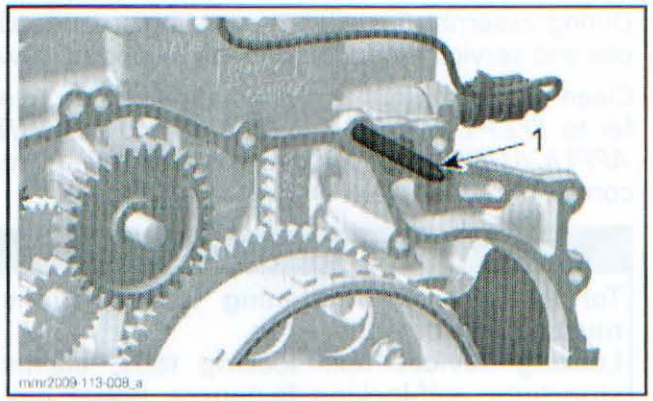
2. Ensure location pins for starter drive gears are in place.



1. Location pins

3. Install a **NEW** magneto cover gasket.
4. Install the CENTER BOLT (P/N 529 036 154) to ease installation of the magneto cover.

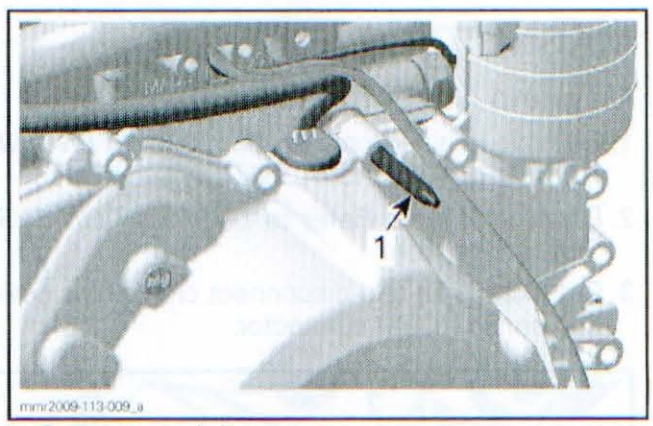




1. Center bolt

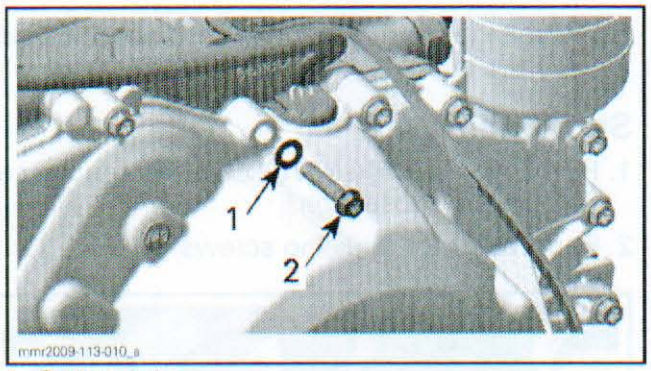
5. Carefully install magneto cover, then remove center bolt.

⚠ CAUTION Magneto force between magneto flywheel and stator is very high. Avoid contusion of your fingers



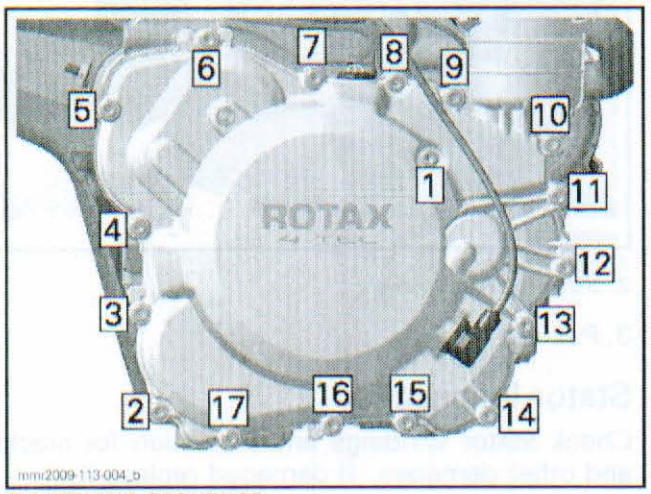
1. Remove center bolt

6. Install a **NEW** sealing washer to retaining screw.



1. *Sealing washer*
2. *Retaining screw*

7. Tighten magneto cover screws as per the following sequence.

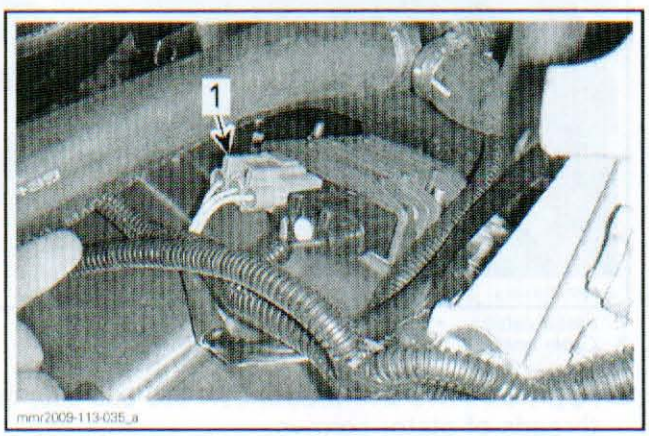


TIGHTENING SEQUENCE

STATOR

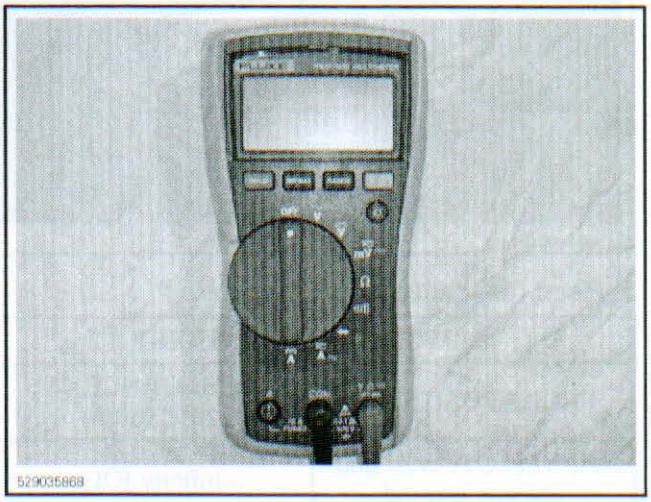
Stator Continuity Test

1. Disconnect battery.
2. Move fuel tank back. Refer to *FUEL TANK AND FUEL PUMP* subsection.
3. Disconnect the magneto connector from voltage regulator.

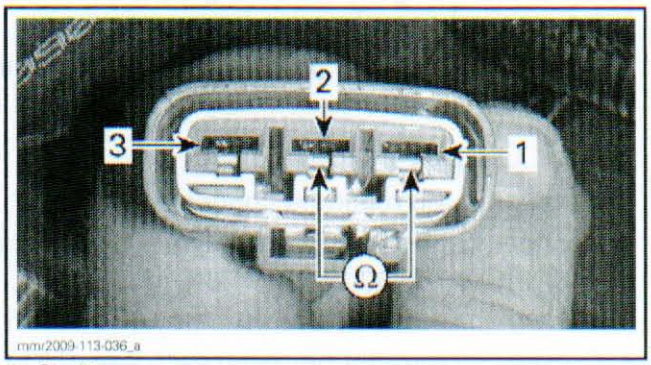


1. *Magneto connector*

4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.



5. Connect multimeter probes between each pair of YELLOW wires.



1. *Pin #1*
2. *Pin #2*
3. *Pin #3*

6. Read resistance as per following table.

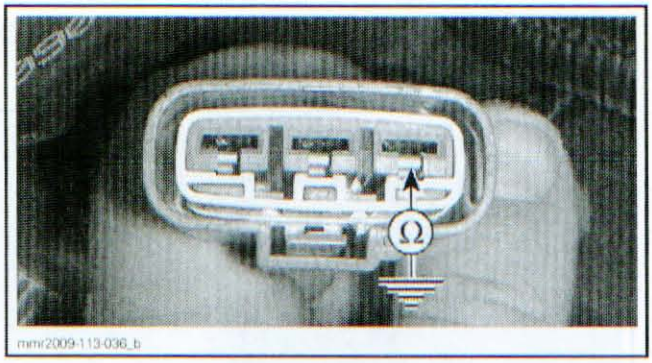
STATOR CONTINUITY TEST	
YELLOW WIRES (EACH PAIR)	RESISTANCE @ 20°C (68°F)
Pins 1 and 2	0.1 - 1 Ω
Pins 1 and 3	
Pins 2 and 3	

If any resistance reading is not as specified, the stator or the wiring (including connector) is shorted to ground and needs to be repaired or replaced.

If resistance is good, perform the stator insulation test.

Stator Insulation Test

1. Connect multimeter between any YELLOW wire and chassis ground.



2. Read resistance.

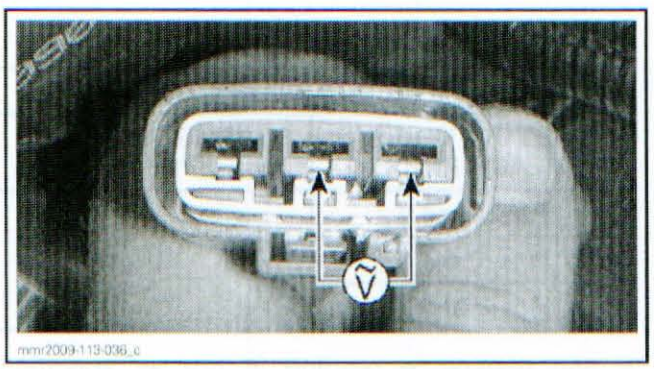
STATOR INSULATION TEST	
PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and chassis ground	Infinity (OL)

If any resistance reading is not as specified, the stator or the wiring is shorted to ground and needs to be repaired or replaced.

If the insulation test is good, perform the output voltage test.

Stator Output Voltage Test

1. Reconnect the magneto connector.
2. Connect battery and start engine. Let engine reach its operating temperature.
3. Set multimeter to Vac scale.
4. Connect multimeter between each pair of YELLOW wires.



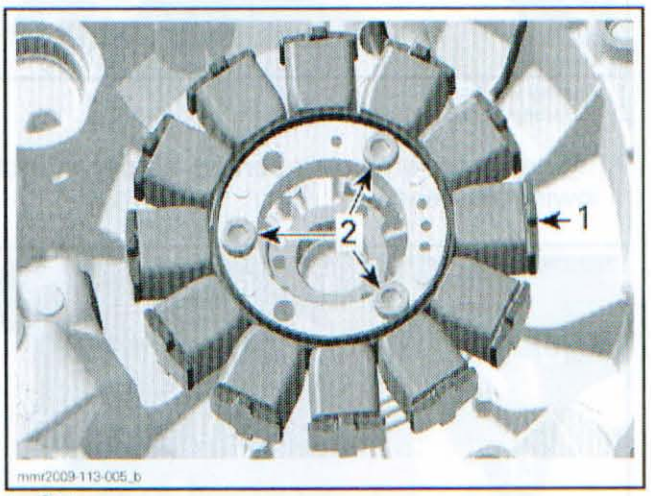
5. Read voltage.

STATOR OUTPUT VOLTAGE TEST		
TEST ENGINE SPEED	TERMINAL	VOLTAGE
Idle speed	1 and 2	± 25 Vac
	1 and 3	
	2 and 3	

If any voltage reading is lower than specification, replace the stator.

Stator Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Remove stator retaining screws.



1. Stator
2. Stator retaining screws

3. Pull out stator.

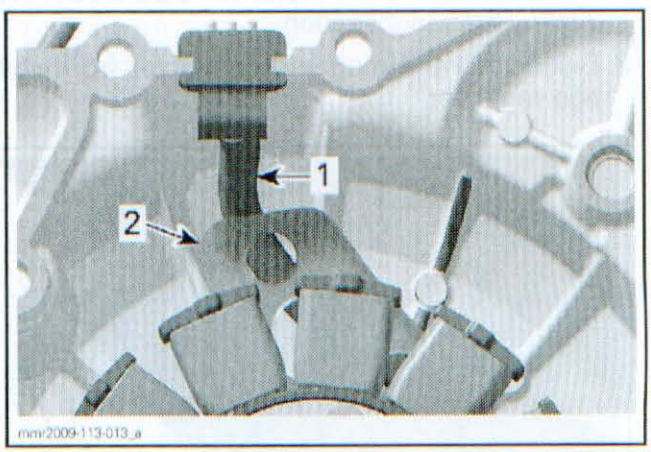
Stator Inspection

Check stator windings and insulation for cracks and other damages. If damaged replace it.

Check if stator wires are brittle, hard or otherwise damaged.

Stator Installation

1. Ensure that the stator cable is underneath the cable holder during installing of the stator.



1. Stator cable
2. Cable holder

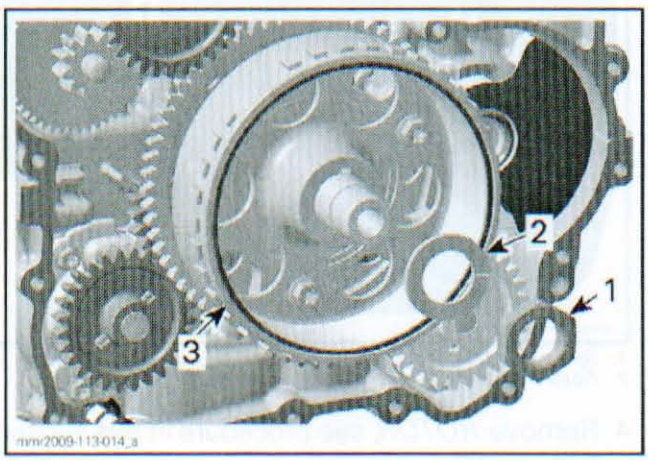
2. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of stator screws.

3. Install screws and tighten them to 11 N•m (97 lbf•**in**).
4. Reinstall *MAGNETO COVER*, see procedure in this subsection.

ROTOR

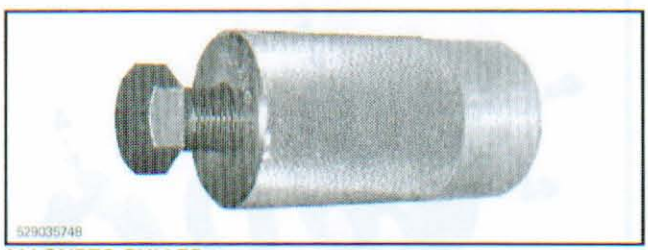
Rotor Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *CYLINDER BLOCK* subsection.
3. Remove rotor retaining nut and lock washer.

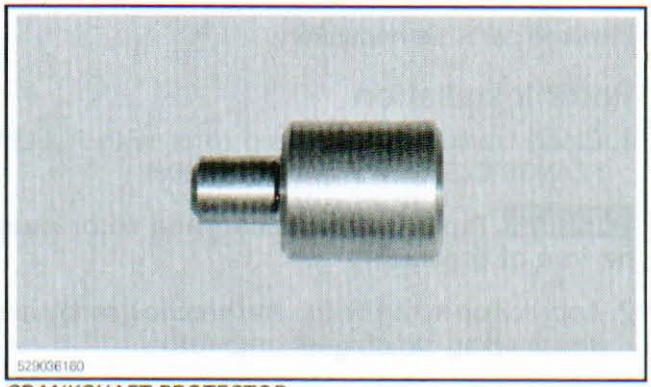


1. Retaining nut
2. Lock washer
3. Rotor

4. Install the MAGNETO PULLER (P/N 529 035 748) and the CRANKSHAFT PROTECTOR (MAG SIDE) (P/N 529 036 160) then remove rotor.



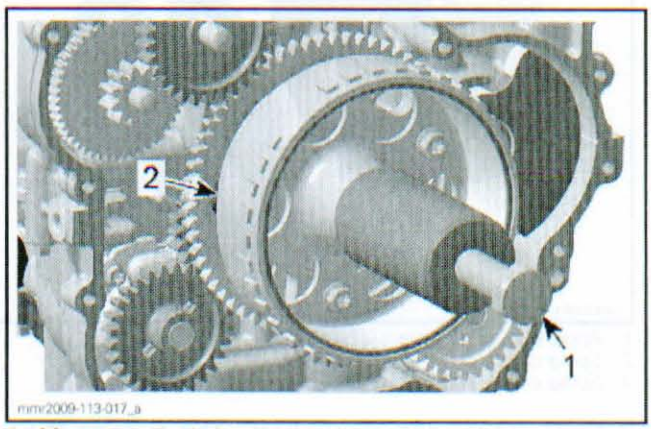
MAGNETO PULLER



CRANKSHAFT PROTECTOR

NOTE: Use grease to fit protector on crankshaft end prior to screw in the magneto puller.

5. Screw in magneto puller bolt to remove rotor.



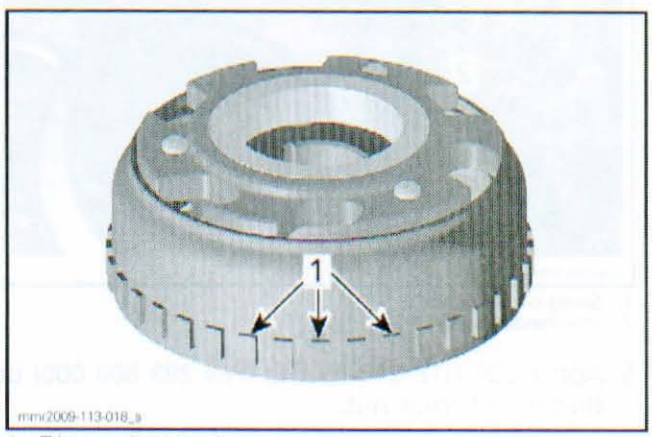
1. Magneto puller bolt
2. Rotor

Rotor Inspection

Check inner side of rotor for scratches or other damage.

Check woodruff key and keyway for wear or damages.

Check trigger wheel teeth for wear or other damages.



1. Trigger wheel teeth

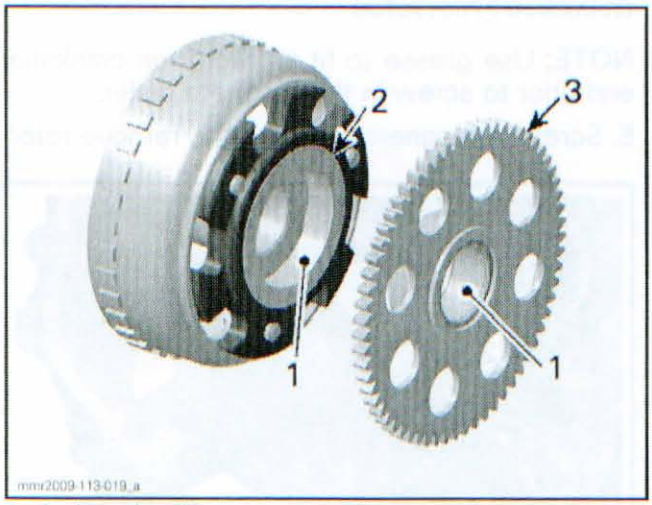
Replace parts as necessary.

Rotor Installation

1. Clean crankshaft taper and rotor with PULLEY FLANGE CLEANER (P/N 413 711 809).

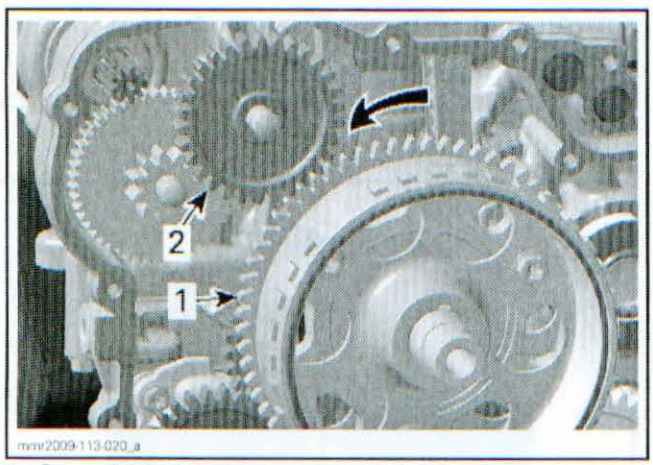
NOTICE **Taper on crankshaft and rotor must be free of grease.**

2. Apply oil on sprag clutch and needle bearing and install sprag clutch gear onto rotor.



1. Apply engine oil here
2. Sprag clutch
3. Sprag clutch gear

3. Slide rotor onto crankshaft. The woodruff key and groove must be aligned.
4. Rotate sprag clutch gear counterclockwise to align intermediate gear teeth with sprag clutch gear.



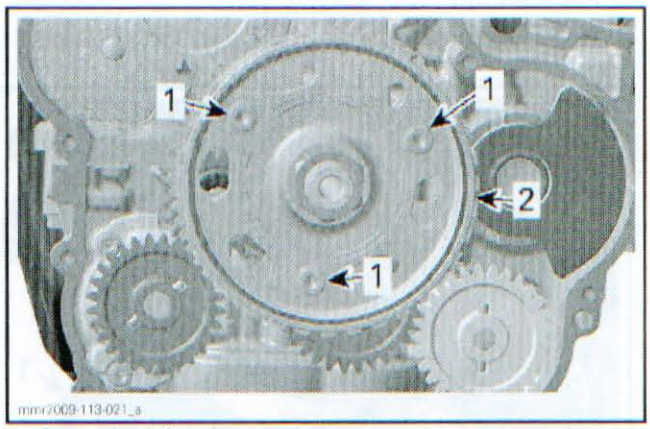
1. Sprag clutch gear
2. Intermediate gear

5. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of rotor nut.
6. Install washer and nut.
7. Tighten nut to 150 N•m (111 lbf•ft).

SPRAG CLUTCH

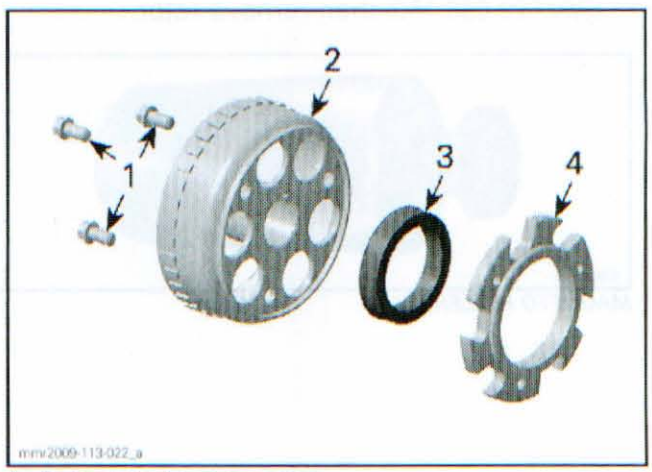
Sprag Clutch Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *CYLINDER BLOCK* subsection.
3. Loosen and remove sprag clutch housing screws.



1. Sprag clutch housing screws
2. Rotor

4. Remove *ROTOR*, see procedure in this subsection.
5. Remove sprag clutch housing.
6. Remove sprag clutch from sprag clutch housing.



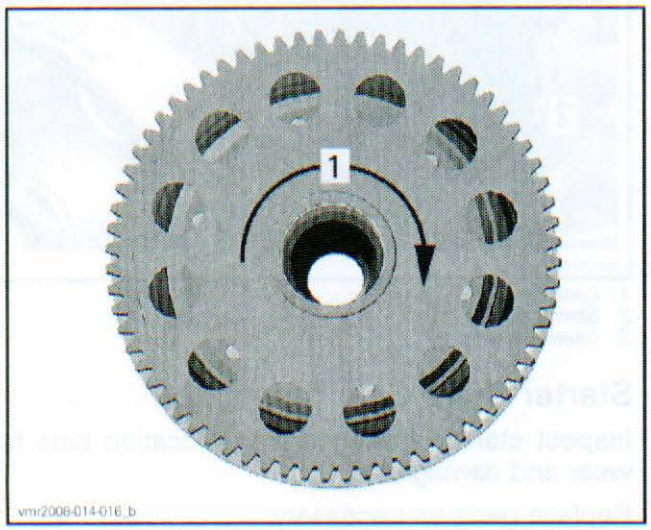
1. Sprag clutch housing screws
2. Rotor
3. Sprag clutch
4. Sprag clutch housing

Sprag Clutch Inspection

Inspect sprag clutch and sprag clutch housing for wear and damage.

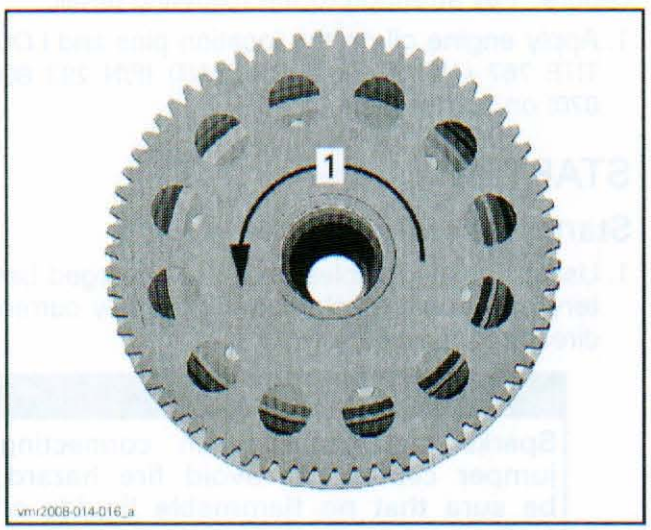
Check the collar of the sprag clutch gear, refer to *SPRAG CLUTCH GEAR*.

Rotate sprag clutch gear clockwise. Gear must rotate freely.



1. Free

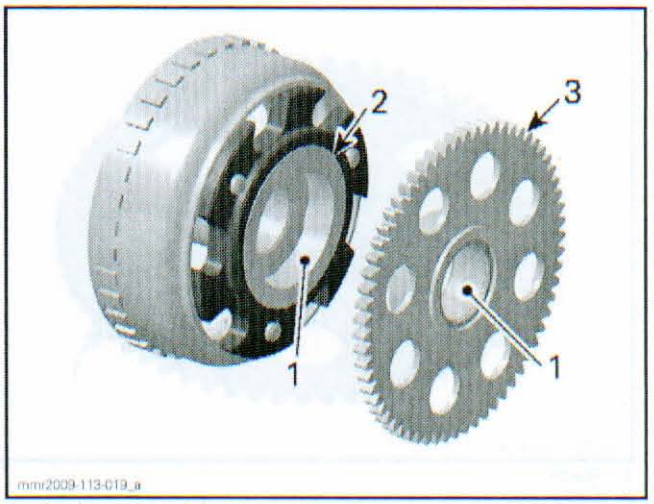
Rotate sprag clutch gear counterclockwise. Gear must lock.



1. Lock

Sprag Clutch Installation

1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of sprag clutch housing screws.
2. Loosely install screws.
3. Apply engine oil on sprag clutch and sprag clutch gear needle bearing.



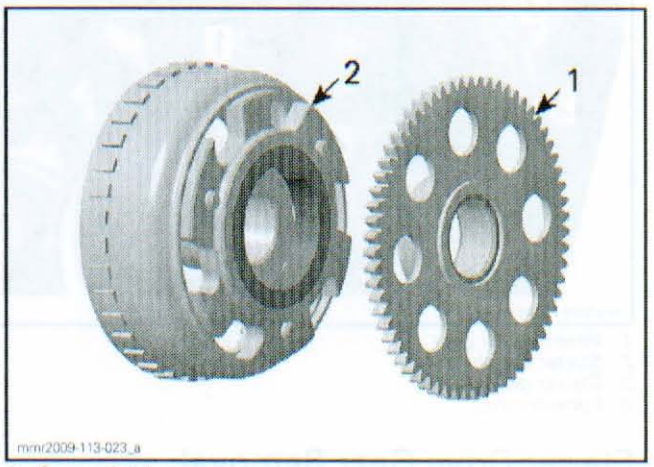
1. Apply engine oil here
2. Sprag clutch
3. Sprag clutch gear

4. Install *ROTOR*, see procedure in this subsection.
5. Tighten sprag clutch housing screws to 25 N•m (18 lbf•ft).
6. Install all other removed parts.

SPRAG CLUTCH GEAR

Sprag Clutch Gear Removal

1. Remove rotor and sprag clutch gear together. Refer to *ROTOR* in this subsection.
2. Pull sprag clutch gear from the rotor.

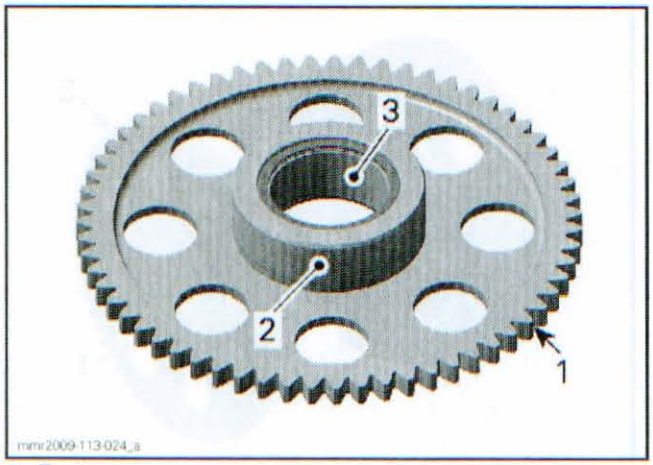


1. Sprag clutch gear
2. Rotor

Sprag Clutch Gear Inspection

Inspect gear, especially teeth and sprag clutch collar for wear and other damage.

Check needle bearing for wear and pittings.



1. *Teeth*
2. *Collar*
3. *Needle bearing*

Replace sprag clutch gear if necessary.

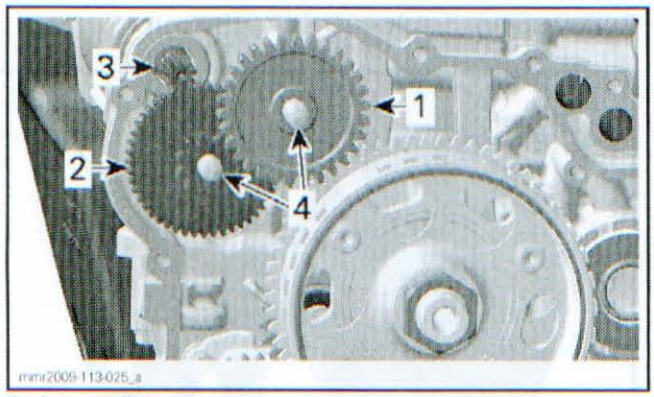
Sprag Clutch Gear Installation

The installation is the reverse of the removal procedure. Pay attention to the following detail.

NOTE: Apply engine oil on needle bearing and collar of sprag clutch gear.

STARTER DRIVE GEARS

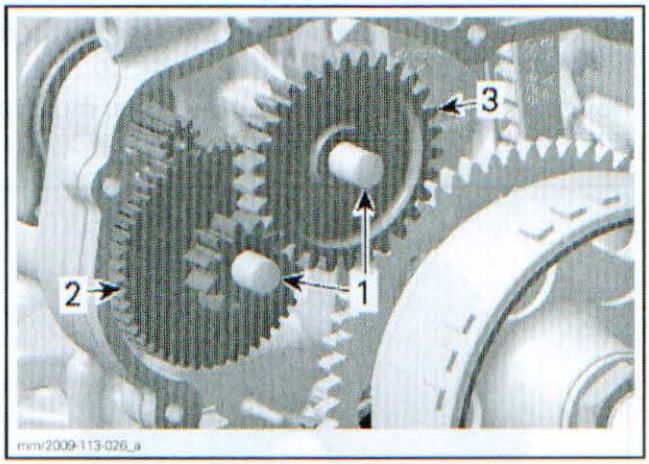
The starter drive gears are located on the engine MAG side behind the magneto cover.



1. *Intermediate gear*
2. *Starter double gear*
3. *Starter gear*
4. *Location pins*

Starter Drive Gear Removal

1. Remove *MAGNETO COVER*, see procedure in this subsection.
2. Remove location pins, starter double gear and intermediate gear.



1. *Location pins*
2. *Starter double gear*
3. *Intermediate gear*

Starter Drive Gear Inspection

Inspect starter drive gears and location pins for wear and damage.

Replace parts as necessary.

Starter Drive Gear Installation

The installation is the reverse of the removal procedure. Pay attention to the following detail.

1. Apply engine oil on the location pins and LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on starter gear.

STARTER

Starter Operation Test

1. Using boosting cables and a full charged battery or a power pack, carefully supply current directly to the starter.

⚠ WARNING

Sparks can occur when connecting jumper cables. To avoid fire hazard, be sure that no flammable liquids or fuel vapors are in the test area.

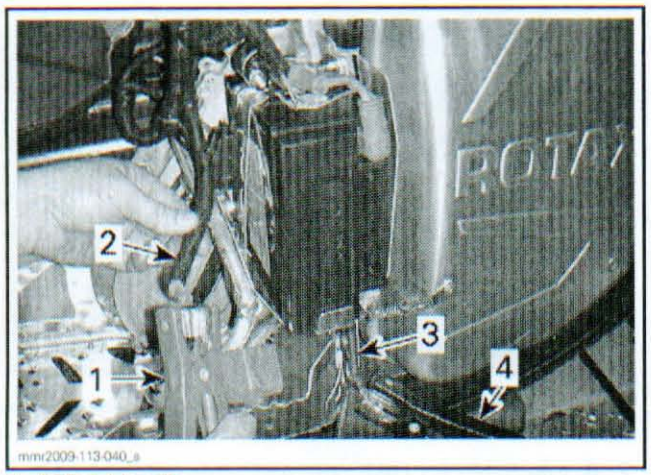
1.1 To prevent engine running, remove injector fuses (F3, F4 and F5 in fuse holder).

1.2 Disconnect ground cable from the battery.

1.3 Disconnect starter cable from starting solenoid.

1.4 Connect the BLACK (-) cable first.

1.5 Then connect the remaining jump cable to the starter cable.



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1. *RED (+) handle*
2. *Starter cable*
3. *Ground cable*
4. *BLACK (-) handle*

If starter now turns ensure the cable and connections from battery to starter solenoid are in good condition.

- If they test good, the starter solenoid can be suspected. Refer to *STARTING SYSTEM* subsection.
- If starter solenoid test good, perform the *STARTER VOLTAGE DROP TEST (AT BATTERY)*. A problem with the starter armature is possible.

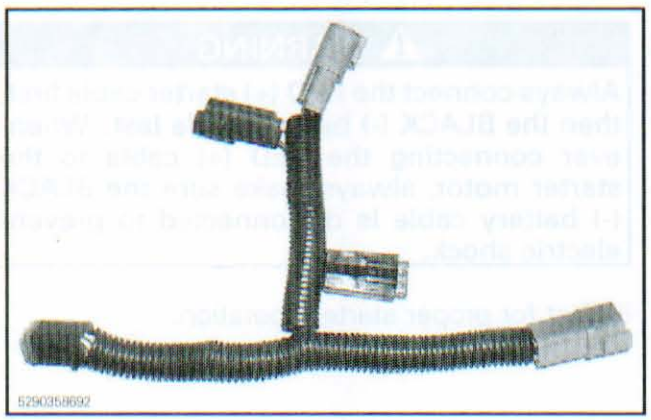
If starter does not turn, check the starter cable and connections.

- If good, check for mechanical problems in the starter.

Starter Voltage Drop Test (At Battery)

NOTE: This test will confirm if starter draws too much current. Battery must be fully charged and in good condition.

1. To prevent engine running, remove injector fuses (F3, F4 and F5 in fuse holder).
2. Connect the T-HARNESS (P/N 529 035 869) to diagnostic connector.



5290358692

3. Install probes of the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) on battery posts.

529035868

4. Crank engine by installing a fused jumper wire between the negative post of battery and the ORANGE/BLACK wire on starter solenoid.

mmr2009-113-041_a

1. *Fused jumper wire*

5. Check battery voltage as the starter is cranking.

NOTE: Battery voltage will drop approximately 2 Vdc and fluctuate with starter cranking load.

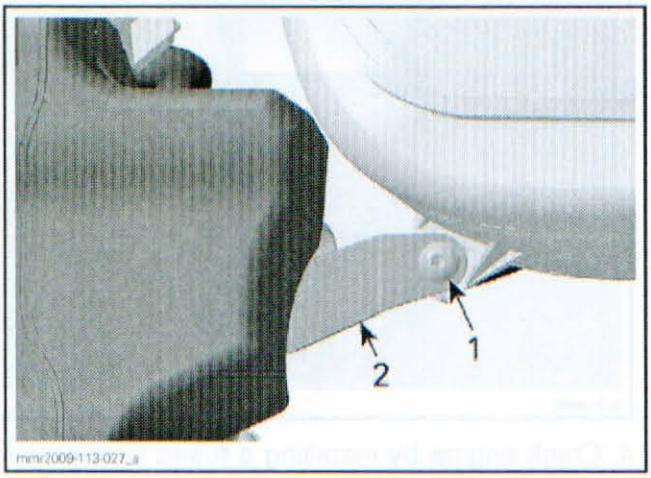
If the result is close to battery voltage, the starter is in good condition.

If the result is below battery voltage (- 2 Vdc and more), the starter may be defective.

Starter Removal

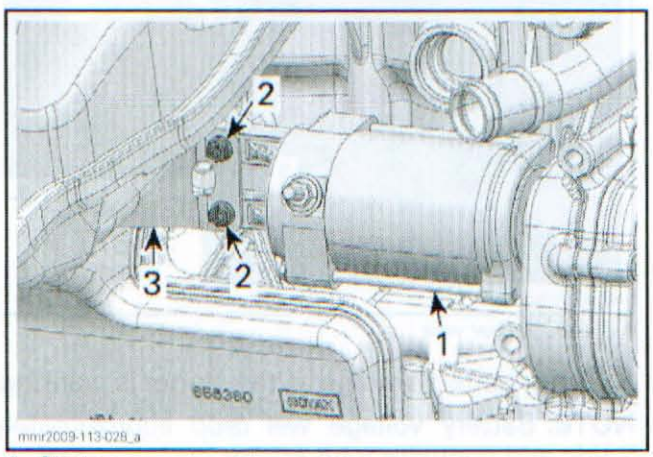
1. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Disconnect battery cables. Refer to *CHARGING SYSTEM* subsection.
3. Remove driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

4. Remove the thermostat. Refer to *COOLING SYSTEM* subsection.
5. Remove retaining screw from intake manifold support.



1. *Remove screw*
2. *Intake manifold support*

6. Remove the starter cable from starter.
7. Remove starter retaining screws and intake manifold support.



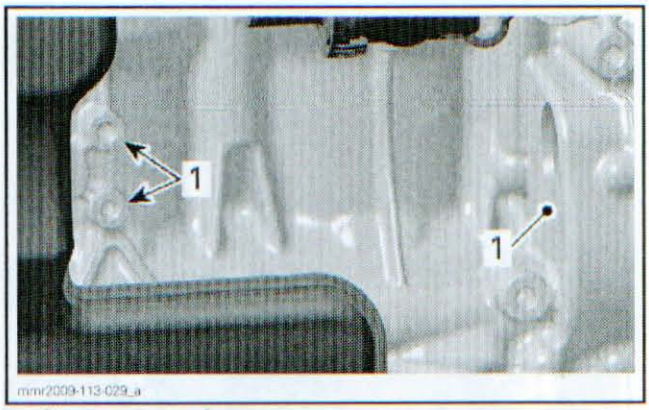
1. *Starter*
2. *Starter retaining screws*
3. *Intake manifold support*

8. Pull electric starter out from cylinder block.
9. Remove starter from vehicle.

Starter Installation

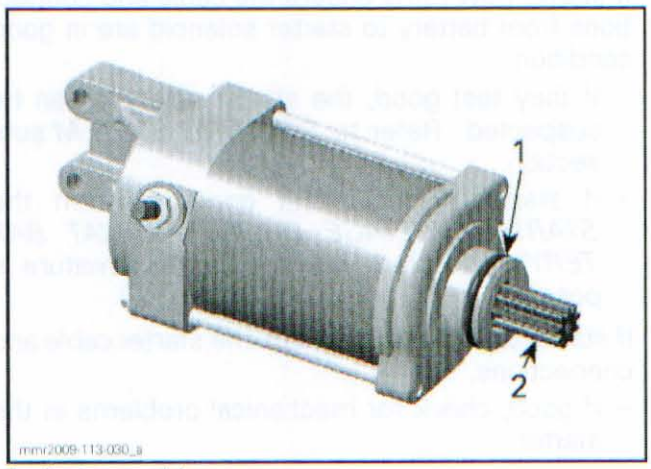
1. Ensure starter and engine mating surfaces are free of debris.

NOTICE **Serious problems may arise if the starter is not properly aligned.**



1. *Clean mating surfaces*

2. Apply SUPER LUBE GREASE (P/N 293 550 030) on the starter O-ring and LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on starter gear before installation.



1. *Apply super lube grease*
2. *Apply antiseize lubricant*

3. Install starter screws with the air intake manifold support.
4. Tighten screws to 11 N•m (97 lbf•**in**).
5. Connect the starter cable to the starter and torque nut to 7 N•m (62 lbf•**in**).
6. Install all other removed parts.
7. Reconnect battery cables.

⚠ WARNING

Always connect the RED (+) starter cable first, then the BLACK (-) battery cable last. Whenever connecting the RED (+) cable to the starter motor, always make sure the BLACK (-) battery cable is disconnected to prevent electric shock.

8. Test for proper starter operation.

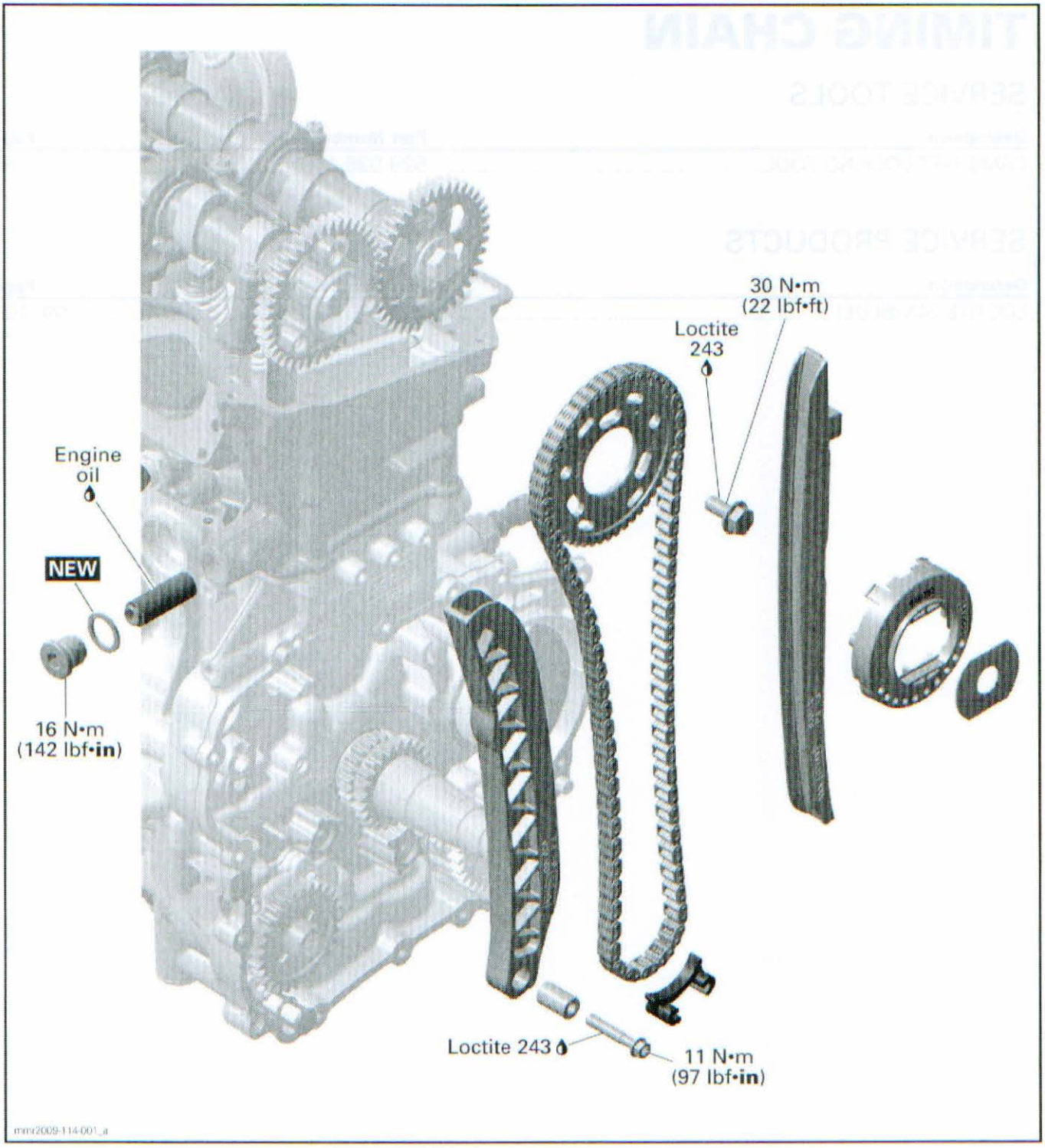
TIMING CHAIN

SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT LOCKING TOOL	529 036 149	98

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	99, 101


30 N•m
(22 lbf•ft)
Loctite
243
Engine
oil
NEW
16 N•m
(142 lbf•in)
Loctite 243
11 N•m
(97 lbf•in)
mmr2009-114-001_a

GENERAL

The engine removal is necessary to work on the following components:

- Timing chain
- Timing chain guide (tensioner side).

Always disconnect BLACK (-) cable from the battery, then RED (+) cable before working on the engine.

⚠ WARNING

Always disconnect BLACK (-) cable first and reconnect last.

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

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

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were break-in together during the engine operation, they will keep their matched fit when parts are reassemble together within their "group".

TROUBLESHOOTING

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

Always check for fault codes. If a fault code is detected, service the fault code first.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Faulty chain tensioner.**
   - *Replace chain tensioner.*
2. **Chain guide(s) worn out.**
   - *Replace chain guide(s).*
3. **Stretched timing chain or worn out sprockets.**
   - *Replace timing chain and sprockets.*
4. **Timing chain gear screws got loose.**
   - *Retighten screws with recommended torque.*
5. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

ENGINE LACKS ACCELERATION OR POWER

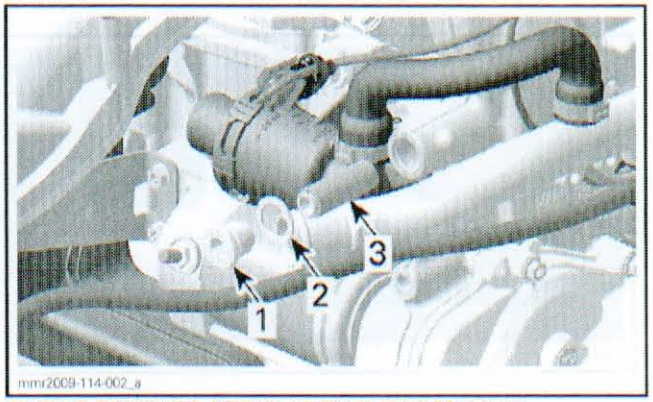
1. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

PROCEDURES

TIMING CHAIN TENSIONER

Timing Chain Tensioner Removal

1. Lock crankshaft, refer to procedure in *CYLINDER BLOCK* subsection.
2. Remove the driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
3. Move fuel tank back to access at the timing chain tensioner plug. Refer to *FUEL TANK AND FUEL PUMP* subsection
4. Remove plug screw and discard the sealing washer.
5. Pull out chain tensioner.



ENGINE REMOVED FOR CLARITY PURPOSE ONLY
1. *Plug screw*
2. *Sealing washer*
3. *Chain tensioner*

Timing Chain Tensioner Inspection

Check chain tensioner for free movement in bore and for scoring.

Compress chain tensioner and check if it works properly.

Timing Chain Tensioner Installation

1. Apply engine oil on chain tensioner.
2. Insert chain tensioner into housing, the plunger pointing outside of engine.

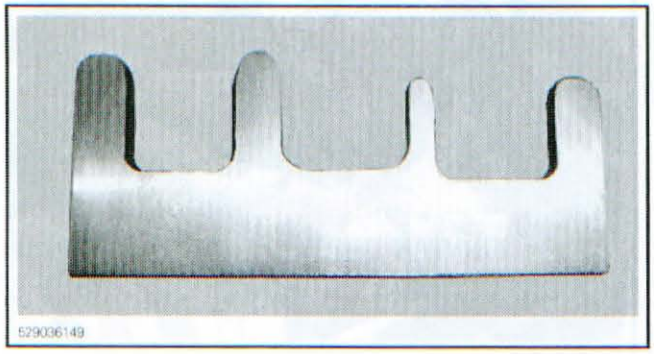
1. Chain tensioner
2. Plunger

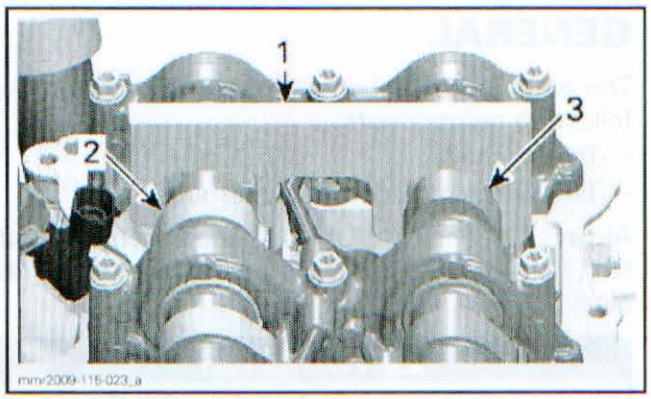
3. Install plug screw with a **NEW** sealing washer.
4. Tighten plug screw to 16 N•m (142 lbf•**in**).
5. Install all other removed parts.

TIMING CHAIN GEAR

Timing Chain Gear Removal

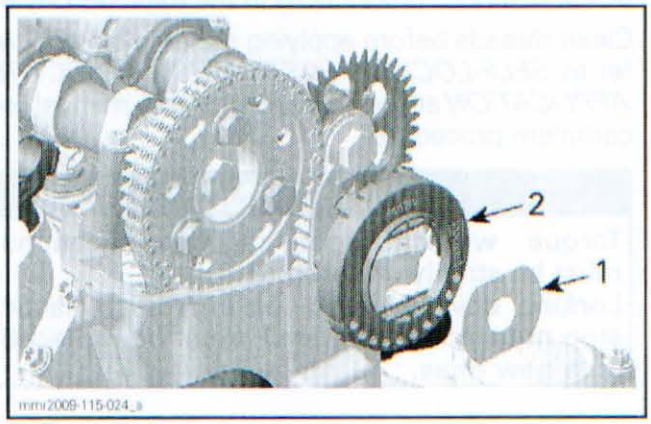
1. Remove *VALVE COVER*, see procedure in *CYLINDER HEAD* subsection.
2. Lock crankshaft, refer to procedure in *CYLINDER BLOCK* subsection.
3. Lock camshaft using the CAMSHAFT LOCKING TOOL (P/N 529 036 149).





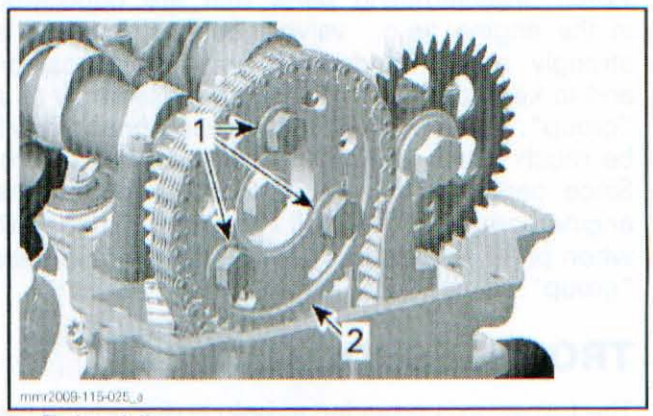
1. Camshaft locking tool
2. Intake camshaft
3. Exhaust camshaft

4. Remove thrust washer and breather cover.



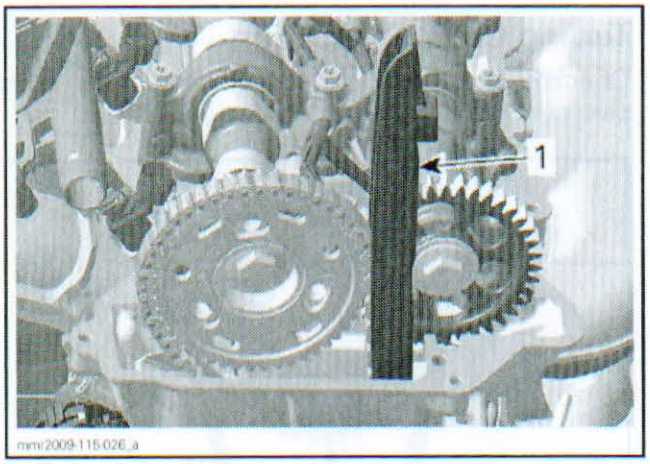
1. Thrust washer
2. Breather cover

5. Unscrew and remove timing chain gear screws.



1. Timing chain gear screws
2. Timing chain gear

6. Remove *TIMING CHAIN TENSIONER*, see procedure in this subsection.
7. Remove timing chain guide.



1. Timing chain guide

8. Remove timing chain gear.

NOTE: Secure timing chain with a retaining wire.

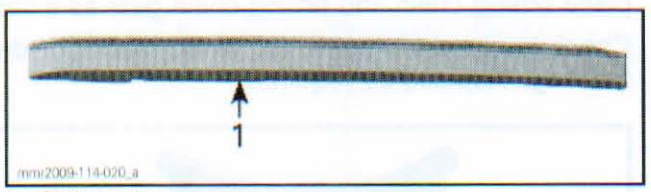
Timing Chain Gear Inspection

Check timing chain gear for wear or deterioration. If the gear is worn or damaged, replace timing chain gear and timing chain as a set.

NOTE: For crankshaft timing gear inspection, refer to *CYLINDER BLOCK* subsection.

Check chain guide for wear, cracks or deforming. Replace as required.

Replace chain guide if grooves depth (caused by timing chain) exceed 1.2 mm (.0472 in).



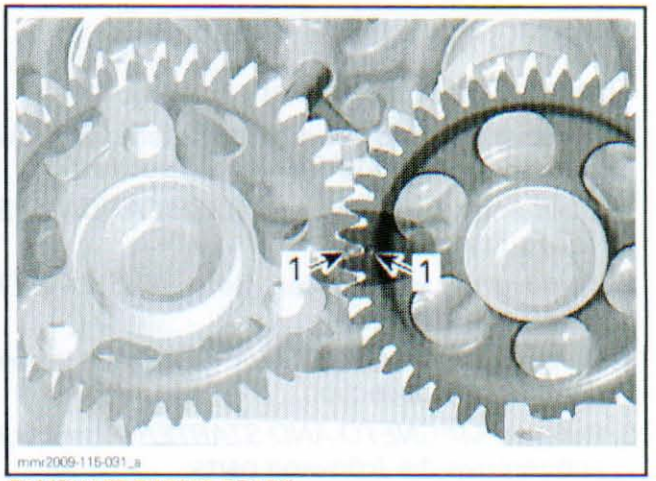
1. Chain guide

Timing Chain Gear Installation

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

NOTICE Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure.

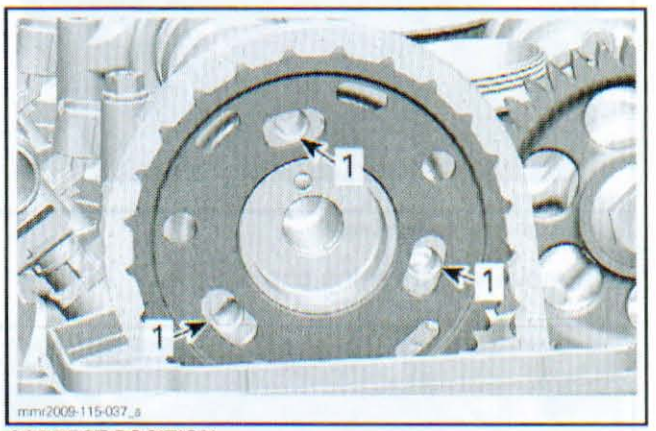
1. Check that marks on camshaft timing gears are still aligned.



CAMSHAFT TIMING GEARS
1. Marks must be aligned

2. Install timing chain over timing gear. The timing gear mark "IN" must be pointing outside (must be visible from the MAG side).
3. Install timing chain gear over camshaft timing gear on intake side.

NOTE: Timing chain gear fits only in one position. The threaded holes for retaining screws must be in the center of slots.



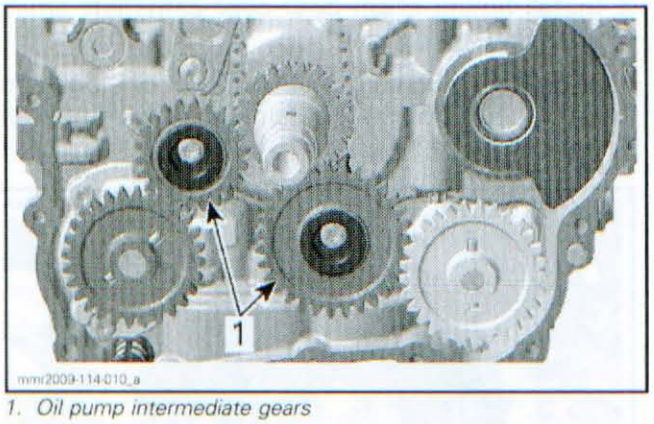
CORRECT POSITION
1. Threaded holes are in center of slots

4. Install timing chain guide.
5. Install *TIMING CHAIN TENSIONER*, see procedure in this subsection.
6. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of timing chain gear screws.
7. Tighten screws to 30 N•m (22 lbf•ft).
8. Remove camshaft locking tool and crankshaft locking tool.
9. Install remaining parts.

TIMING CHAIN

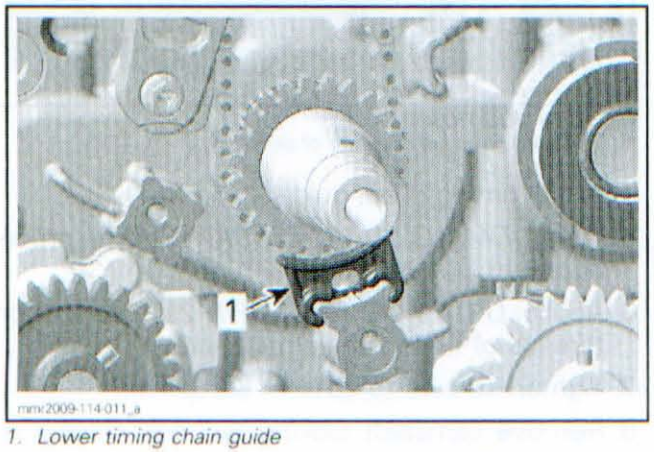
Timing Chain Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Drain engine oil. Refer to *LUBRICATION SYSTEM* subsection.
3. Remove the valve cover. Refer to *CYLINDER HEAD* subsection.
4. Remove the *TIMING CHAIN GEAR*, see procedure in this subsection.
5. Refer to *MAGNETO AND STARTER* subsection and remove the following parts:
   - Magneto cover
   - Rotor
   - Starter drive gears.
6. Remove oil pump intermediate gears.



1. Oil pump intermediate gears

7. Remove lower timing chain guide.



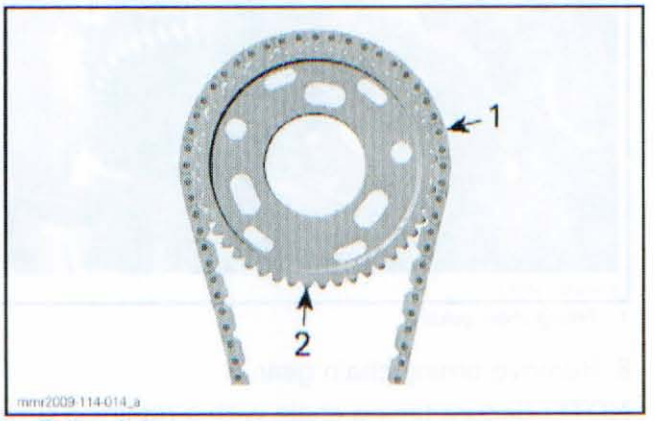
1. Lower timing chain guide

8. Remove timing chain.

NOTE: Mark the operating direction of the timing chain before removal.

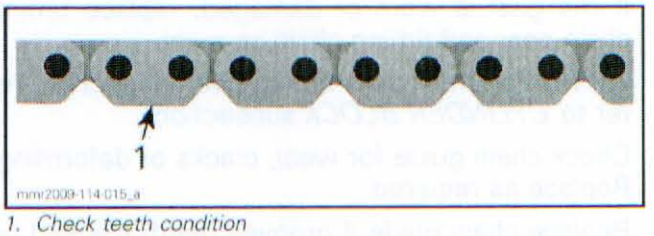
Timing Chain Inspection

Check timing chain on timing chain gear for excessive radial play.



1. Timing chain
2. Timing chain gear

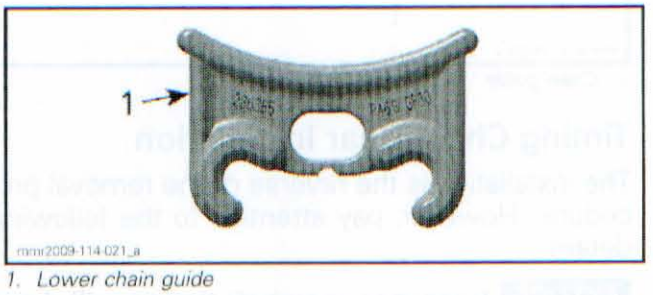
Check timing chain for wear and teeth condition.



1. Check teeth condition

If timing chain is excessively worn or damaged, replace timing chain and timing chain gear as a set.

Check lower chain guide for wear, cracks or deforming. Replace as required.



1. Lower chain guide

Replace lower chain guide if grooves depth (caused by timing chain) exceed 1.2 mm (.0472 in).

NOTE: Check also the chain guide (tensioner side).

Timing Chain Installation

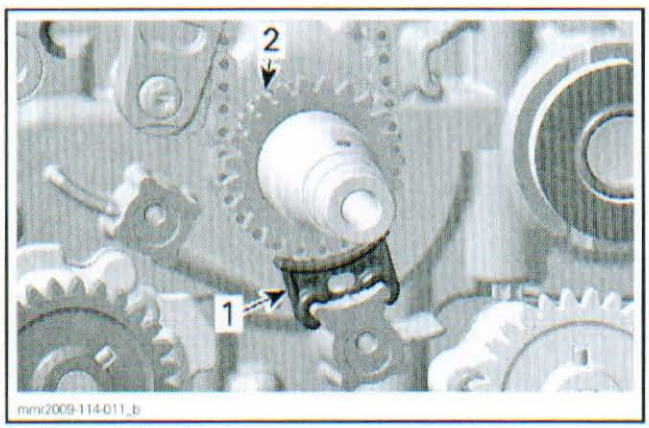
The installation is the reverse of the removal procedure. However, pay attention to the following details.

NOTICE Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure.

1. Install timing chain.

NOTE: If the same timing chain is reinstalled, make sure to reinstall it in the same operating direction as marked during removal procedure.

2. Reinstall lower chain guide to fit timing chain correctly on crankshaft timing gear.



1. Lower chain guide
2. Crankshaft timing gear

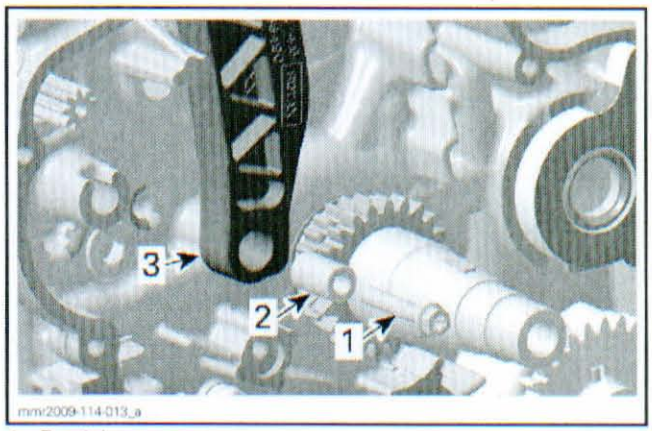
3. Continue with *TIMING CHAIN GEAR INSTALLATION* (see procedure in this subsection), to achieve proper camshaft timing.
4. Install all other removed parts.

CHAIN GUIDE (TENSIONER SIDE)

Chain Guide Removal (Tensioner Side)

NOTE: Removal of chain guide is not recommended if there is no need for replacement.

1. Remove the *TIMING CHAIN GEAR*, see procedure in this subsection.
2. Remove the camshaft timing gear on intake side. Refer to *CYLINDER HEAD* subsection.
3. Remove:
   - Retaining screw
   - Distance sleeve
   - Chain guide (tensioner side).

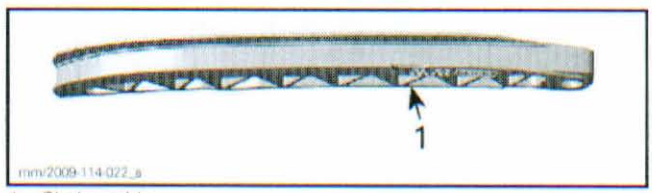


1. Retaining screw
2. Distance sleeve
3. Chain guide

Chain Guide Inspection (Tensioner Side)

Check chain guide for wear, cracks or deforming. Replace as required.

Replace chain guide if grooves depth (caused by timing chain) exceed 1.2 mm (.0472 in).



1. Chain guide

Chain Guide Installation (Tensioner Side)

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

NOTICE Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure.

1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on retaining screw of chain guide.
2. Tighten retaining screw to 11 N•m (97 lbf•**in**).
3. Properly reinstall intake camshaft timing gear on camshaft. Refer to *CYLINDER HEAD* subsection.

CYLINDER HEAD

SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT LOCKING TOOL	529 036 149	117
ENGINE LEAK DOWN TEST KIT	529 035 661	108
VALVE SPRING COMPRESSOR CUP	529 036 161	124
VALVE SPRING COMPRESSOR	529 035 724	124

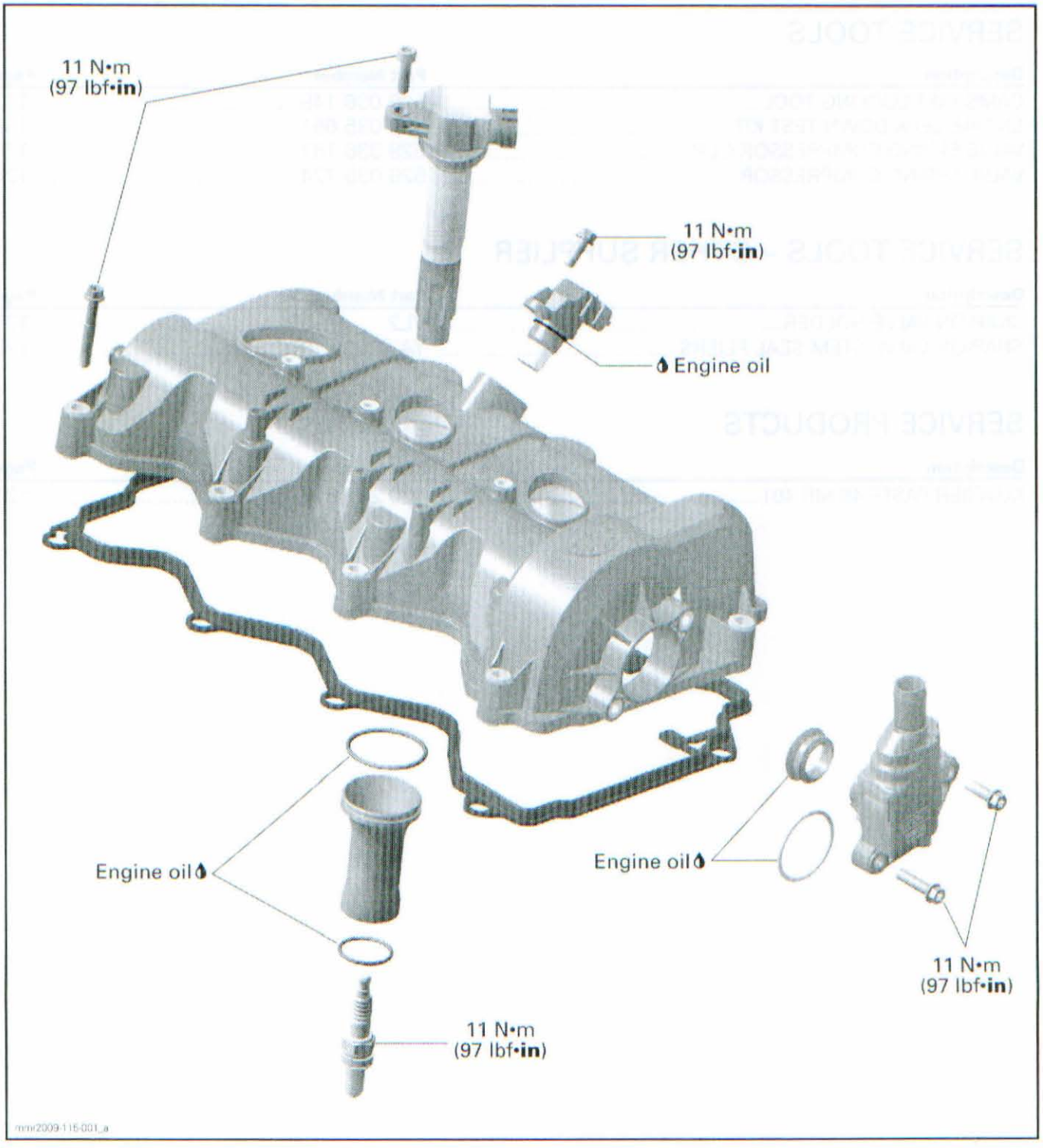
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON VALVE HOLDER	VL2	127
SNAP-ON VALVE STEM SEAL PLIERS	YA 8230	126

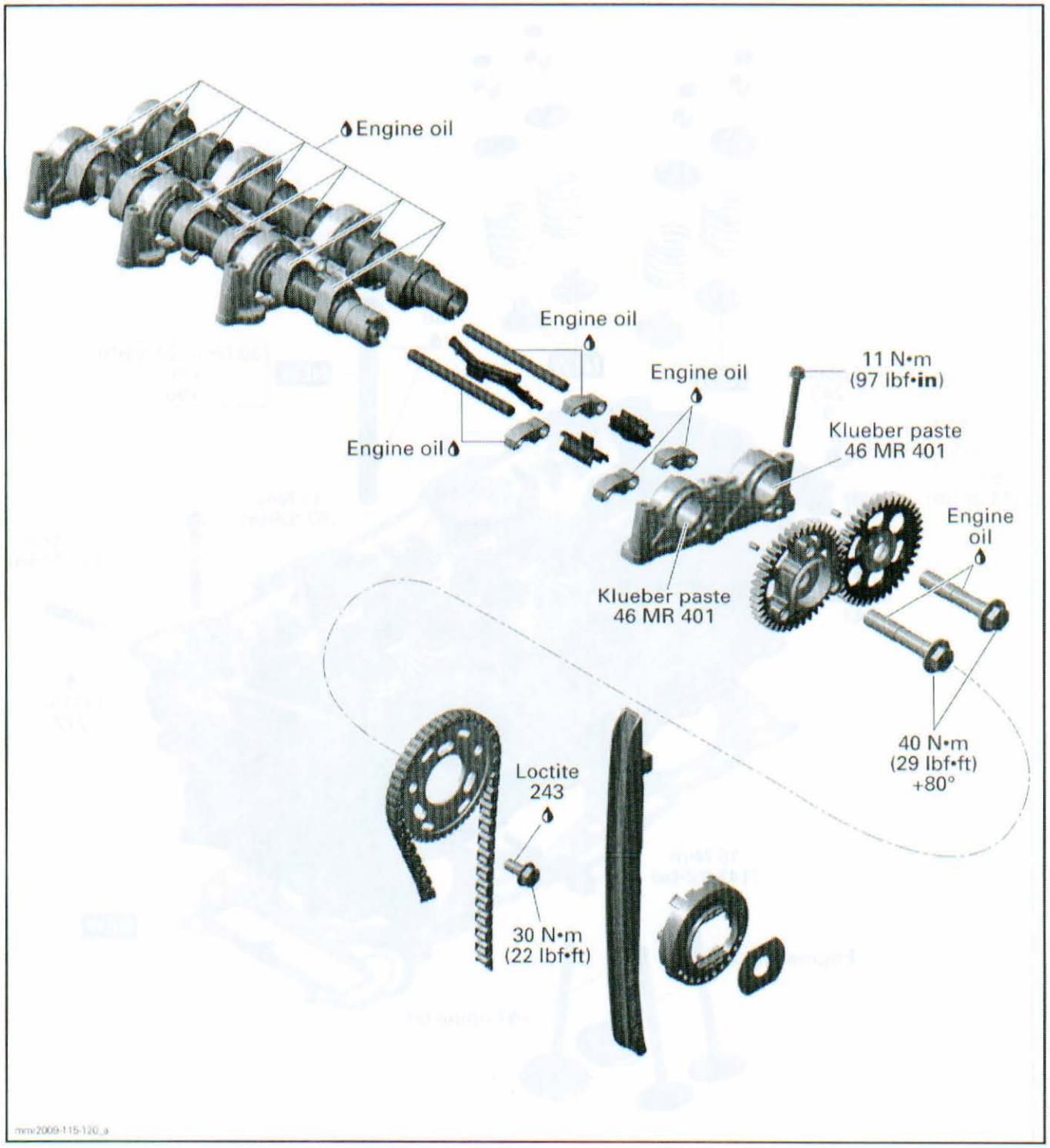
SERVICE PRODUCTS

Description	Part Number	Page
KLÜEBER PASTE 46 MR 401	420 297 616	121

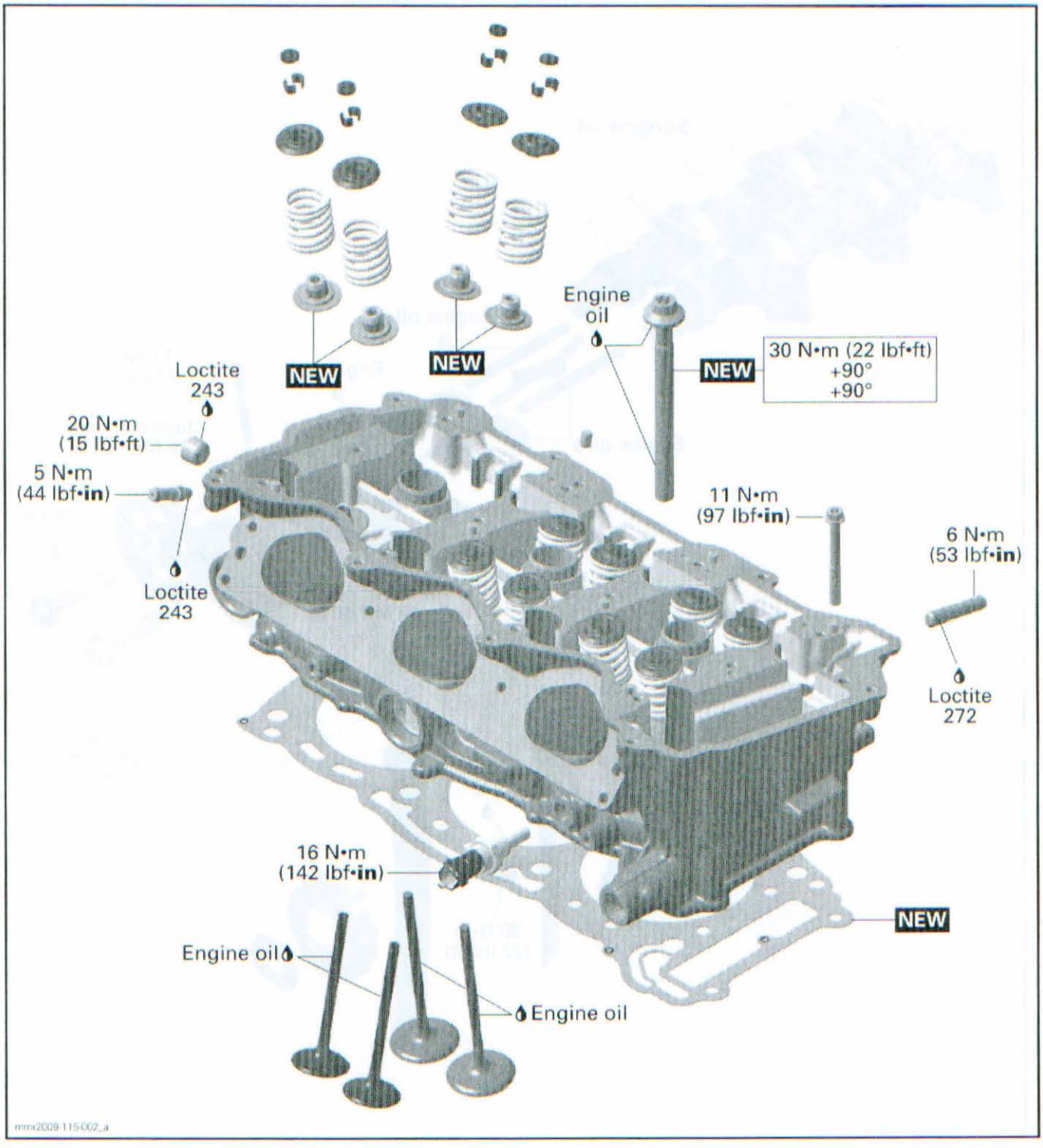
VALVE COVER


11 N•m
(97 lbf•in)
11 N•m
(97 lbf•in)
Engine oil
Engine oil
Engine oil
11 N•m
(97 lbf•in)
11 N•m
(97 lbf•in)
mmr2009-115-001_a

CAMSHAFTS


Engine oil
Engine oil
Engine oil
Engine oil
11 N•m
(97 lbf•in)
Klueber paste
46 MR 401
Engine
oil
Klueber paste
46 MR 401
40 N•m
(29 lbf•ft)
+80°
Loctite
243
30 N•m
(22 lbf•ft)

CYLINDER HEAD



GENERAL

NOTE: For a better understanding, some illustrations are taken with engine out of vehicle.

Always disconnect BLACK (-) cable from the battery, then RED (+) cable before working on the engine.

⚠ WARNING

Always disconnect BLACK (-) cable first and reconnect last.

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

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

⚠ WARNING

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

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

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were break-in together during the engine operation, they will keep their matched fit when parts are reassemble together within their "group".

ADJUSTMENT

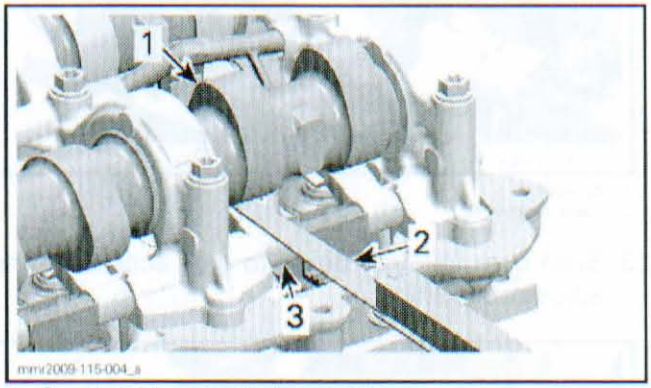
VALVE CLEARANCE

Check and adjust the valve clearance only on a cold engine, at room temperature.

When the valve clearance has to be measured or adjusted, the piston must be at TDC of compression stroke.

Valve Clearance Inspection

1. Remove the *VALVE COVER*, see procedure in this subsection.
2. Remove spark plugs.
3. Using the drive pulley, turn engine counterclockwise until camshaft lobes are opposite to cam followers.
4. Use a feeler gauge and check the valve clearance between camshaft and cam follower.



1. Camshaft lobe opposite to cam follower
2. Feeler gauge
3. Cam follower

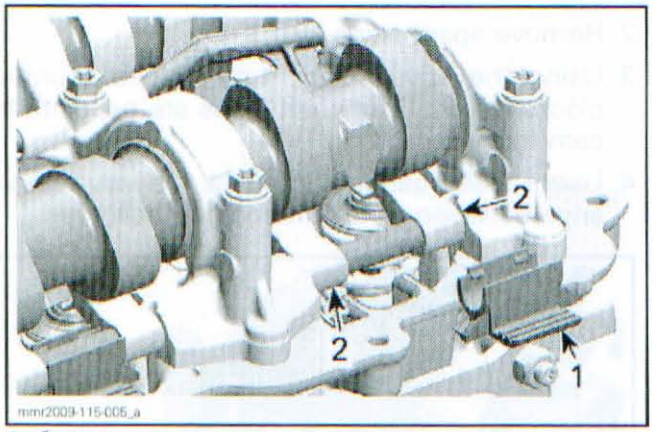
5. Repeat steps 3 and 4 for all intake and exhaust valves.
6. Adjust the valve clearance if out of specification, see *VALVE CLEARANCE ADJUSTMENT*.

VALVE CLEARANCE	
EXHAUST	0.30 mm to 0.40 mm (.0118 in to .0157 in)
INTAKE	0.10 mm to 0.20 mm (.0039 in to .0079 in)

Valve Clearance Adjustment

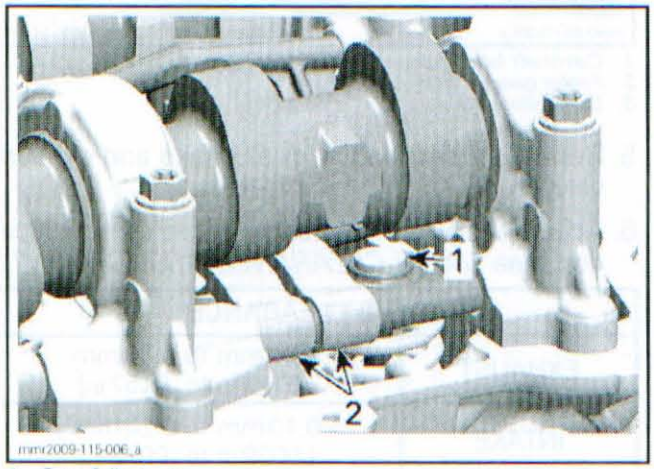
If the valve clearance is out of specification, adjust valve clearance by replacing the adjustment shim of the respective valve. Proceed as follows.

1. Turn drive pulley counterclockwise and position appropriate camshaft lobe opposite to cam follower.
2. Remove cam follower spacer.



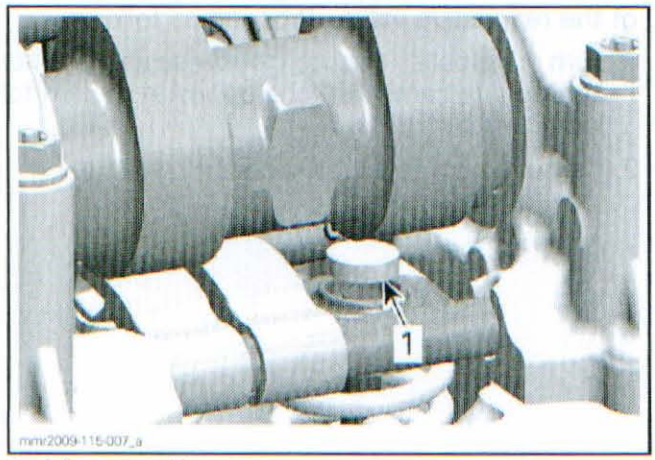
1. Spacer
2. Cam followers

3. Slide cam follower aside to gain access to the adjustment shim.



1. Cam followers
2. Adjustment shim

4. Remove adjustment shim and check its thickness with a micrometer.



1. Adjustment shim

5. Choose the proper adjustment shim thickness to reach the specified valve clearance.

6. After reassembly of parts, measure the valve clearance again.

If valve clearance is still out of specification, repeat all steps until the specified clearance is obtained.

INSPECTION

CYLINDER LEAK TEST

General

Before performing the cylinder leak test, verify the following:

- Clamp tightness
- Hoses condition.

NOTE: For best accuracy, the leak test should be done with the engine at normal operating temperature.

⚠ WARNING

Prevent burning yourself due to handling on the hot engine.

NOTE: The following steps are the same for each cylinder.

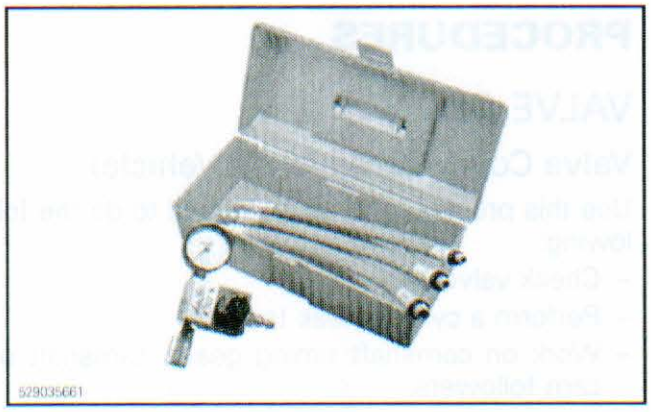
Preparation

1. Remove the *VALVE COVER*, see procedure in this subsection.
2. Remove spark plugs.
3. Using the drive pulley, turn the engine counterclockwise to bring piston to TDC of compression stoke. Use a dial gauge or a suitable tool to position the piston to TDC.

NOTE: The piston must be set precisely to TDC of compression stroke. If this is not ensured the engine will continue to rotate when pressure builds up.

Leak Test

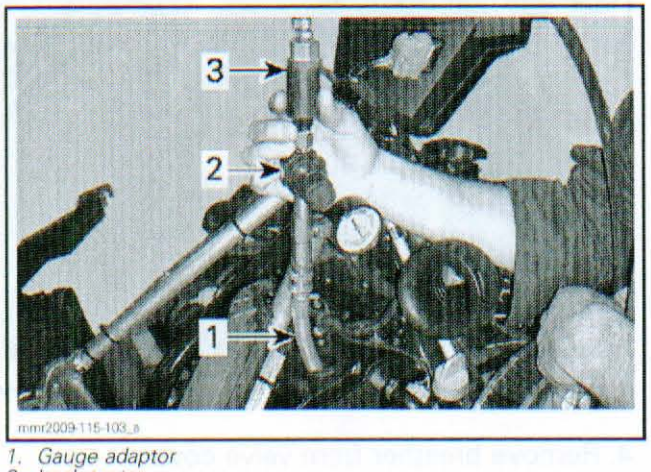
1. Install a gauge adaptor of the ENGINE LEAK DOWN TEST KIT (P/N 529 035 661) into spark plug hole.



2. Connect the leak down tester to an adequate air supply.
3. Set needle of measuring gauge to zero.

NOTE: All testers have specific instructions on gauge operation and required pressure. Refer to manufacturer's instructions.

4. Supply combustion chamber with air pressure.



1. Gauge adaptor
2. Leak tester
3. Air supply hose

5. Gently tap on each valve spring retainer to remove carbon deposits from valves.
6. Note the amount or percentage of leakage (depending on tester).

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

Diagnosis

Listen for air leaks.

- Air escaping on intake port or throttle body means leaking intake valve(s).
- Air escaping on exhaust port means leaking exhaust valve(s).
- Air bubbles out of coolant tank means leaking cylinder head gasket.
- Air or coolant escaping from cylinder head means damaged gasket or loosened screws.
- Air escaping into crankcase area means excessively worn cylinder or broken piston rings.
- Air or oil escaping from crankcase means damaged gasket or loosened screws.

Repair Tips

Blue exhaust gas means damaged or worn piston rings or valve stem seals.

White exhaust gas means damaged cylinder head gasket.

Coolant tank cap opening without overheat means damaged cylinder head gasket.

Assembly

Reverse the preparation procedure.

TROUBLESHOOTING

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

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

NOTE: When diagnosing an engine problem, always perform the cylinder leak test. This will help pinpoint a problem. Refer to *CYLINDER LEAK TEST* in this subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Improper valve clearance adjustment.**
   - *Adjust valve clearance.*
2. **Cam followers or cam follower shaft worn out.**
   - *Check and replace damaged parts.*
3. **Cam follower spacers got loose.**
   - *Check if cam follower spacers are in place.*

4. Camshaft(s) or camshaft holder(s) worn out.
   - *Check and replace damaged parts.*
5. Faulty chain tensioner.
   - *Replace chain tensioner. Refer to TIMING CHAIN subsection.*
6. Chain guide(s) worn out.
   - *Replace chain guide(s). Refer to TIMING CHAIN subsection.*
7. Stretched timing chain or worn out sprockets.
   - *Replace timing chain and sprockets. Refer to TIMING CHAIN subsection.*
8. Timing chain gear screws got loose.
   - *Retighten screws with recommended torque.*
9. Incorrect camshaft timing.
   - *Replace damaged components and readjust camshaft timing.*

OIL LEAKAGE FROM CYLINDER HEAD

1. Valve cover gasket is leaking.
   - *Replace valve cover gasket and retighten valve cover with recommended torque.*
   - *Check valve cover for cracks or other damage.*
2. Spark plug tube O-rings are leaking.
   - *Replace spark plug tube O-rings.*
   - *Clean spark plug area from oil spillage.*
3. Breather is leaking.
   - *Replace breather O-ring.*
4. Cylinder head gasket is leaking.
   - *Check cylinder head for damage.*
   - *Replace cylinder head gasket and retighten screws with recommended torquing procedure.*

ENGINE SUDDENLY TURNS OFF OR LACKS ACCELERATION OR POWER

1. Valve clearance too tight.
   - *Adjust valve clearance.*
2. Incorrect camshaft timing.
   - *Replace damaged components and readjust camshaft timing.*
3. Intake or exhaust valves are leaking.
   - *Perform a CYLINDER LEAK TEST. Repair or replace damaged components.*
4. Broken valve spring(s).
   - *Replace defective parts.*

PROCEDURES

VALVE COVER

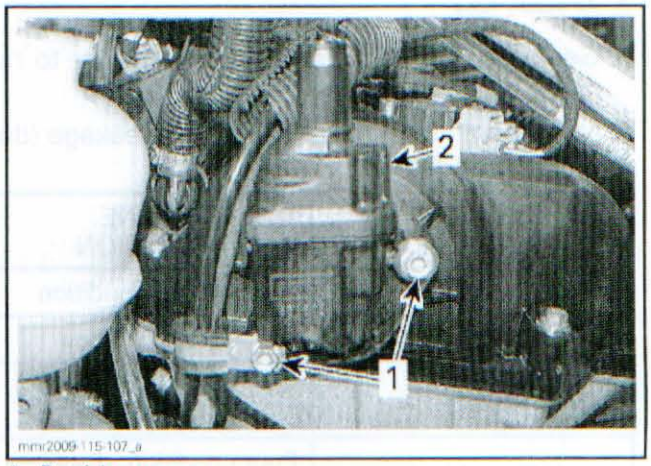
Valve Cover Removal (In Vehicle)

Use this procedure when you need to do the following:
- Check valve clearance.
- Perform a cylinder leak test.
- Work on camshaft timing gears, camshaft or cam followers.

1. Remove the air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove the muffler and the exhaust manifold. Refer to *EXHAUST SYSTEM* subsection.
3. Disconnect breather hose from valve cover and air intake adapter.

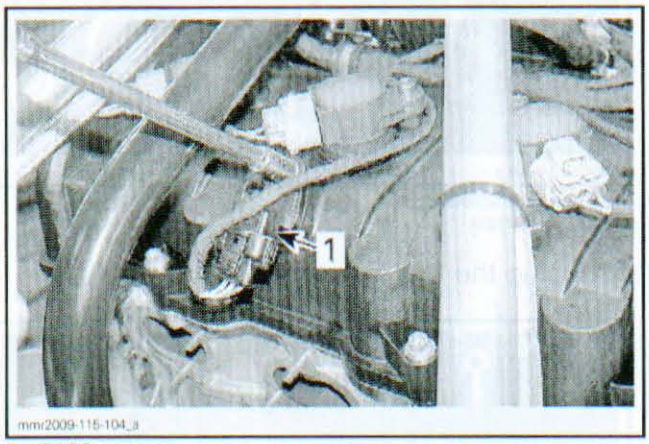
1. Breather hose

4. Remove breather from valve cover.



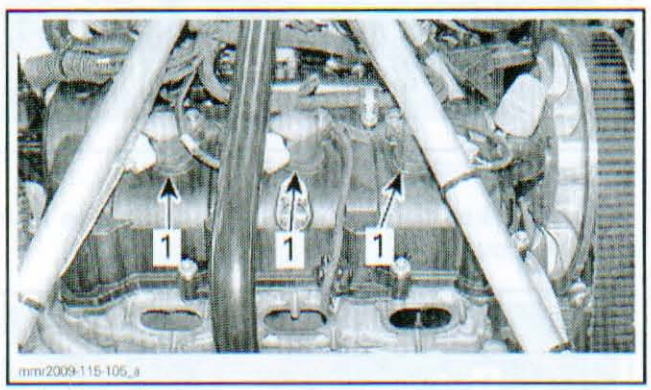
1. Retaining screws
2. Breather

5. Cut locking tie retaining the CAPS sensor connector to sensor.
6. Unplug and remove the CAPS sensor from the valve cover.



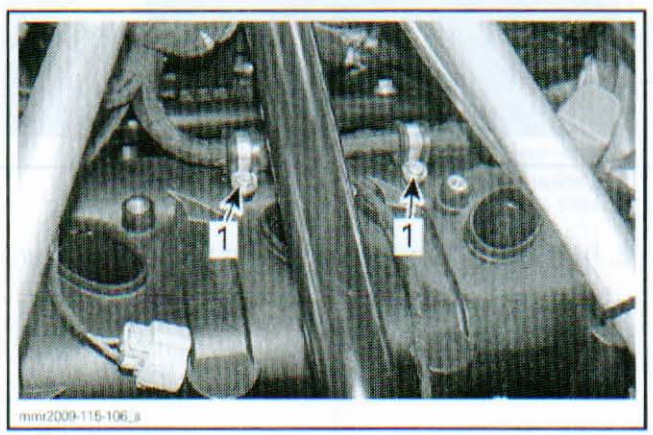
1. CAPS sensor

7. Unplug and remove ignitions coils.



1. Ignition coils

8. Remove screws securing the harness to valve cover.

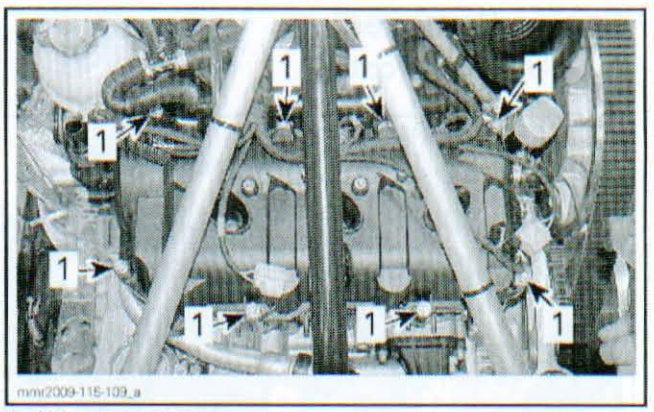


1. Retaining screws

9. Unplug all fuel injectors.
10. Disconnect vent tube from the valve cover.

1. Cut this Oetiker clamp
2. Vent tube

11. Remove screws (8) retaining valve cover.

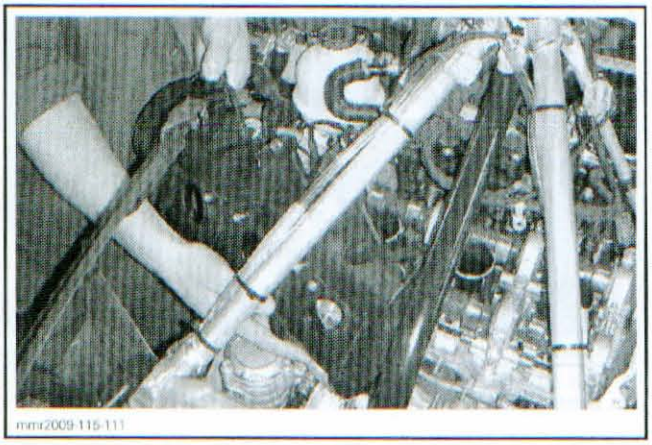


1. Valve cover screws

12. Pull up the cover.
13. Tilt the front of the valve cover toward the exhaust manifold.

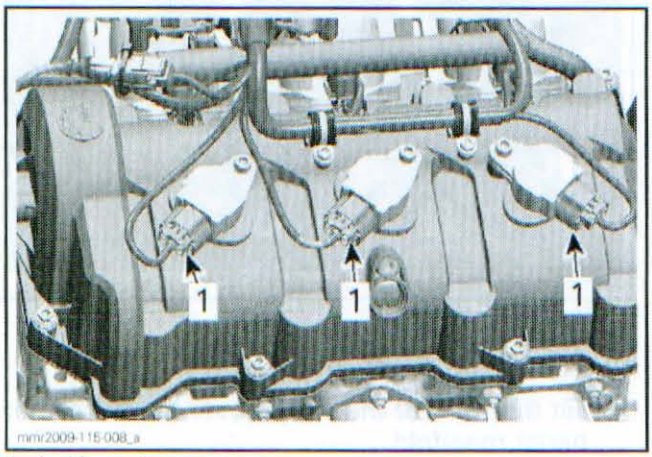
1. Valve cover

14. Move the valve cover toward the RH side of the vehicle.



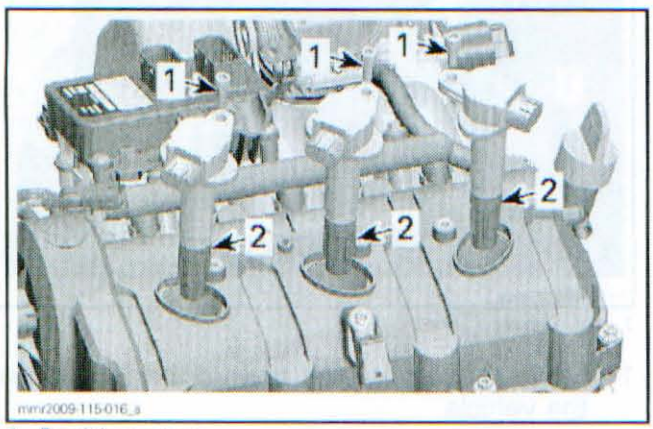
Valve Cover Removal (Engine Removed)

1. Unplug ignition coils.



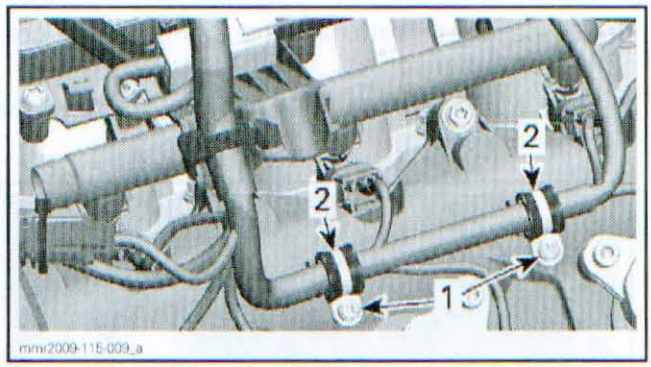
1. Ignition coil connectors

2. Remove ignition coils.



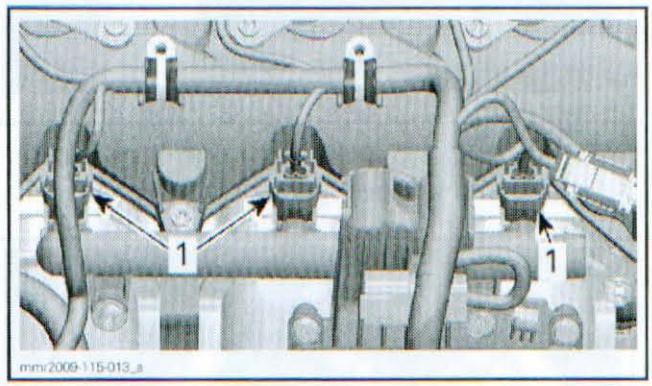
1. Retaining screws
2. Ignition coils

3. Remove screws securing the harness to the valve cover.



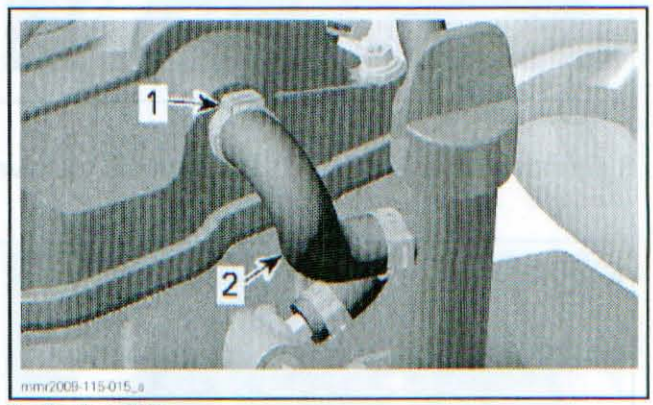
1. Retaining screws
2. Cable clamps

4. Unplug the fuel injector connectors.



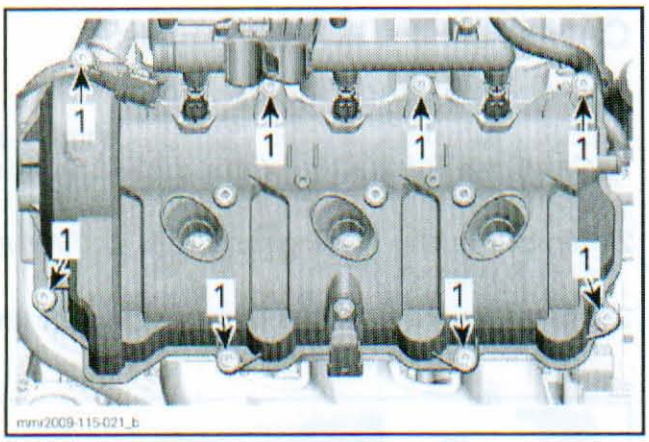
1. Injector connectors

5. Cut Oetiker clamp and remove vent tube from valve cover.



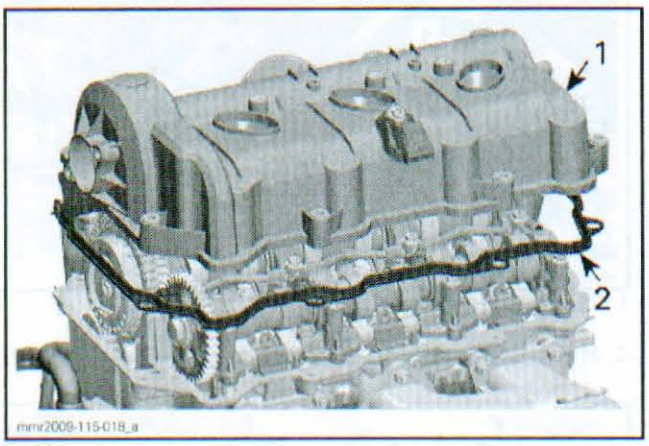
1. Oetiker clamp
2. Vent tube

6. Remove screws (8) retaining the valve cover.



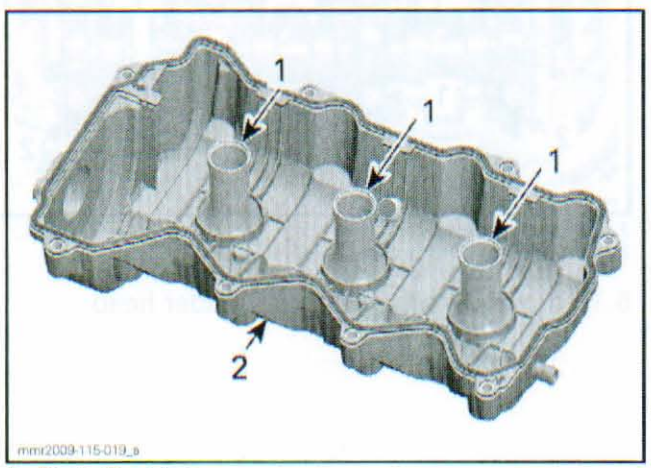
1. Valve cover screws

7. Remove valve cover and its gasket.



1. Valve cover
2. Gasket

8. Remove spark plug tubes from valve cover.



1. Spark plug tubes
2. Valve cover

Valve Cover Inspection

Check the valve cover for cracks or other damages.

Check if the valve cover gasket is brittle, hard or otherwise damaged.

Replace defective parts.

Spark Plug Tube Inspection

Check spark plug tubes for cracks or other damages.

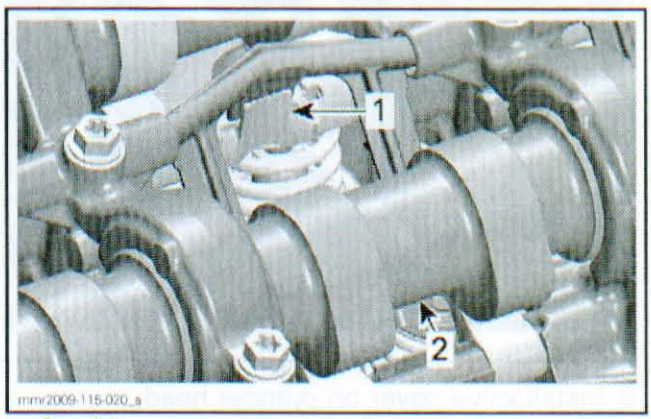
Check if O-rings are brittle, hard or otherwise damaged.

Replace defective parts.

Valve Cover Installation

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

1. Apply engine oil on spark plug tube O-rings before installation.
2. Ensure that cam follower spacers (for the intake camshaft) are in place during installation of spark plug tubes.

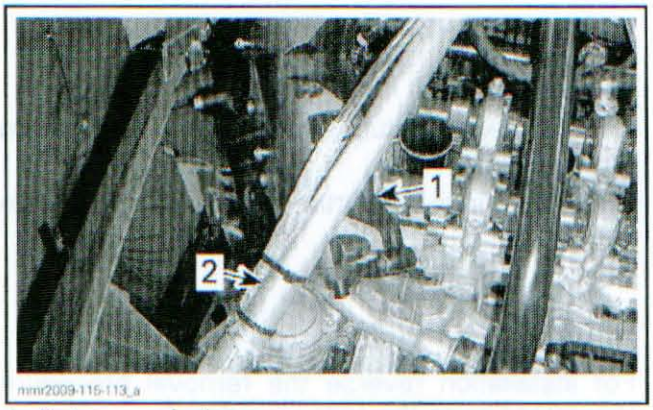


1. Cam follower spacer properly in place
2. Exhaust camshaft

3. Properly fit gasket into the groove of valve cover.

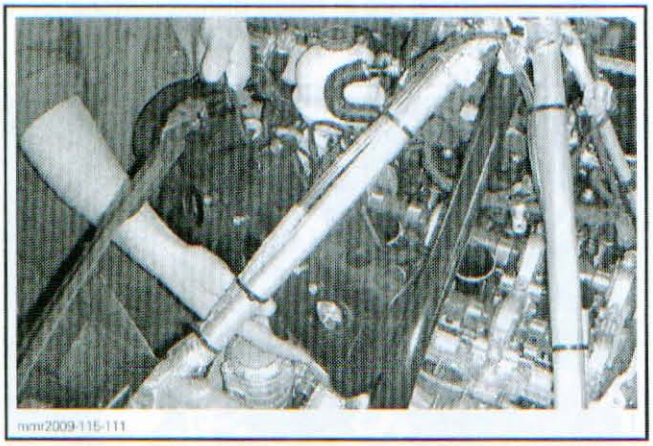
If the engine is not in the vehicle, go to step 8. If the engine is installed in the vehicle, continue with next step.

4. Insert valve cover by the RH side. Align the first recess with the front frame member.

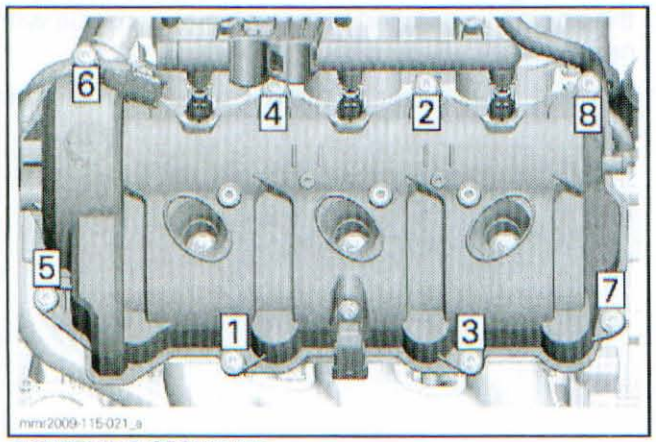


1. First recess of valve cover
2. Front frame member

5. Slide the valve cover inside engine compartment.



6. Install valve cover on cylinder head.
7. Push down the valve cover to insert spark plug tubes.
8. Install valve cover screws according to the following sequence.

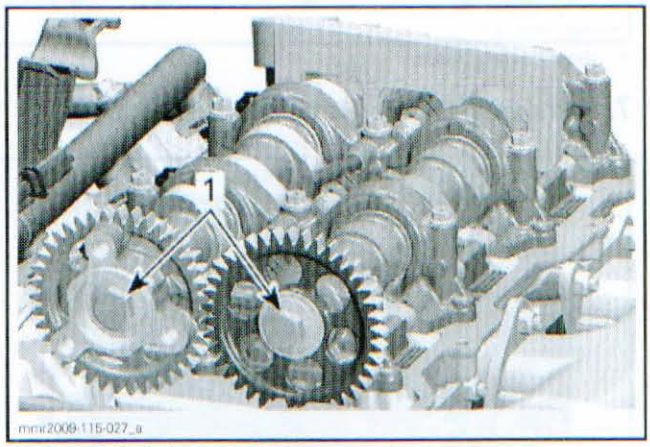


TIGHTENING SEQUENCE

CAMSHAFT TIMING GEARS

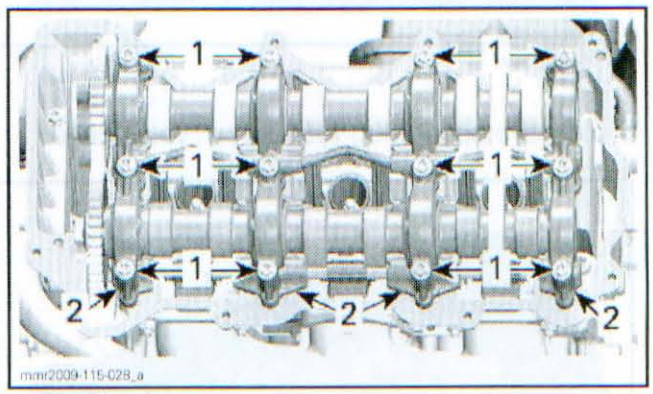
Camshaft timing Gear Removal

1. Lock camshaft, refer to procedure in *CAMSHAFT LOCKING PROCEDURE* in this subsection.
2. Remove timing chain gear. Refer to *TIMING CHAIN* subsection.
3. Using a breaker bar and a 16 mm socket, loosen camshaft timing gears screws.



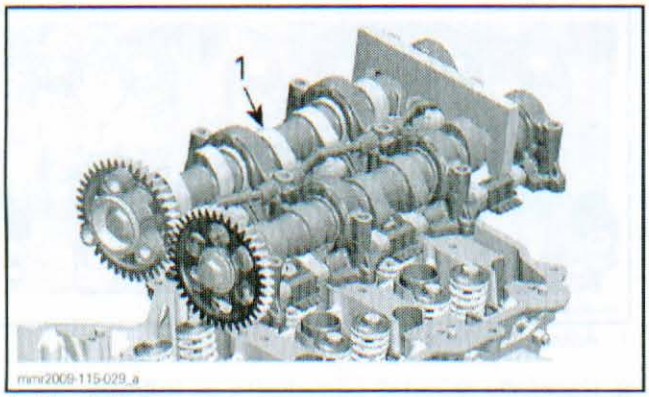
1. Camshaft timing gears screws

4. Remove retaining screws of camshaft holders.



1. Retaining screws
2. Camshaft holders

5. Remove camshafts from cylinder head.



1. Camshafts

6. Remove camshaft timing gears from camshafts.

Camshaft Timing Gear Inspection

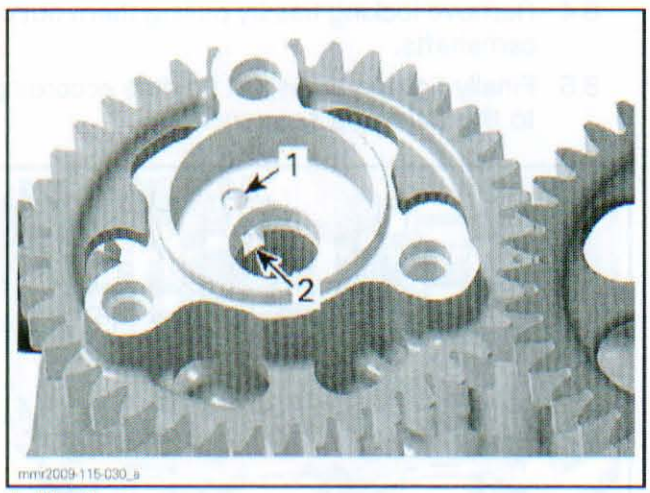
Check camshaft timing gears for wear or deterioration.

Replace both camshaft timing gears as a set, if damaged.

Camshaft Timing Gear Installation

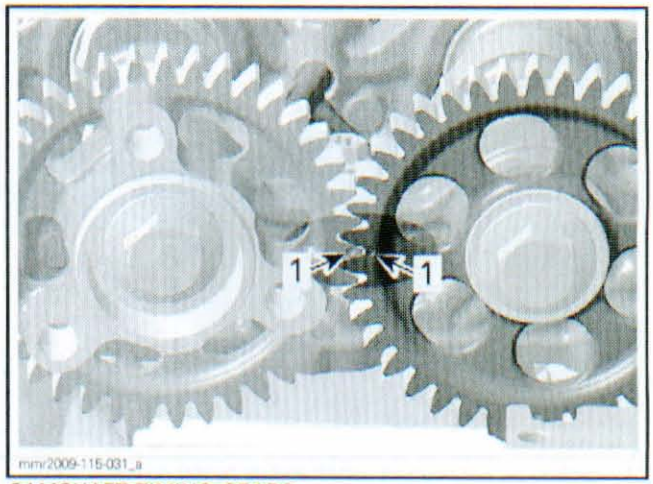
The installation is the reverse of the removal procedure. However, pay attention to the following.

1. Properly reinstall camshaft timing gears on camshafts as follows:
   1.1 Ensure that needle pin of camshaft timing gear fits into groove in camshaft.



1. Needle pin
2. Groove

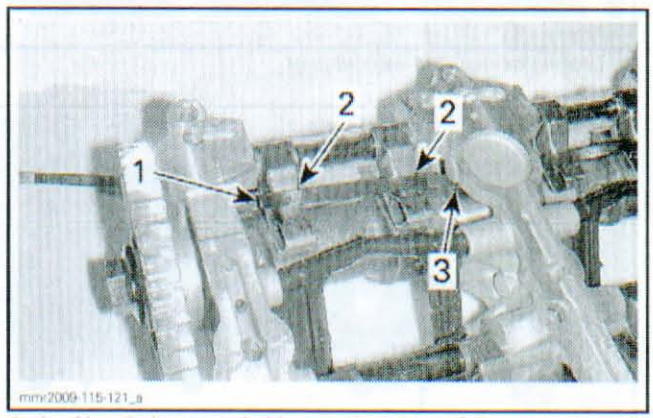
2. Marks on camshaft timing gears must be aligned during installation.



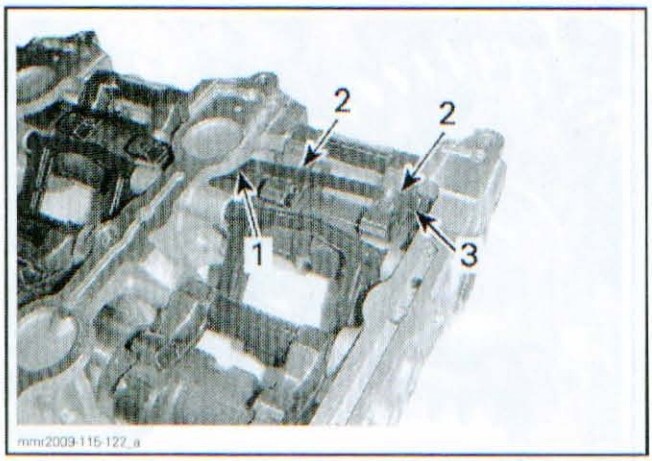
CAMSHAFT TIMING GEARS
1. Marks must be aligned

3. If camshaft locking tool has been removed, reinstall it on camshafts.
4. Apply engine oil on threads of camshaft timing gear screws and install them. Do not torque yet.
5. Turn the camshafts upside down.
6. Using a long locking tie attach cam followers.

NOTE: The locking tie will retain cam followers during the installation of the camshafts. Use the same procedure for both camshafts.

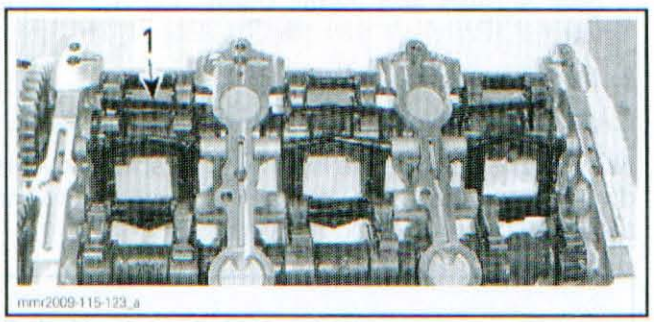


1. Locking tie between holder no. 1 and cam follower
2. Locking tie over cam followers
3. Locking tie between camshaft and its holder no. 2

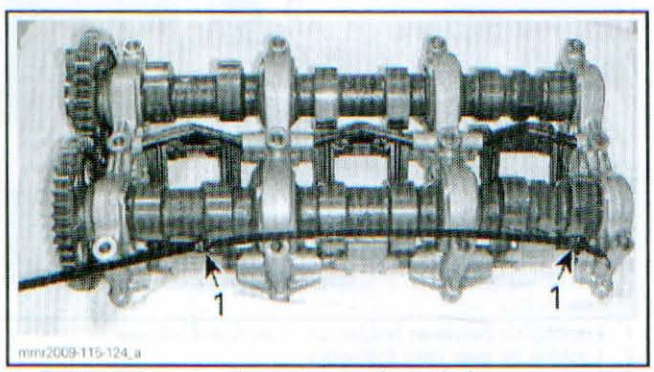


1. *Locking tie between camshaft and its holder no. 3*
2. *Locking tie over cam followers*
3. *Locking tie between cam follower and holder no. 4*

NOTE: If two locking ties must be used to attach one side, make sure both attachment ends are on the top side of camshafts.

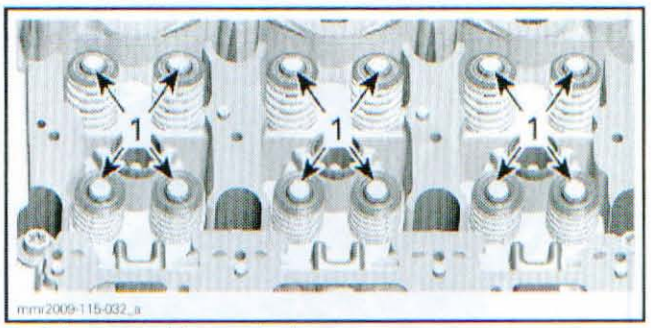


1. *Locking tie installed without joint*



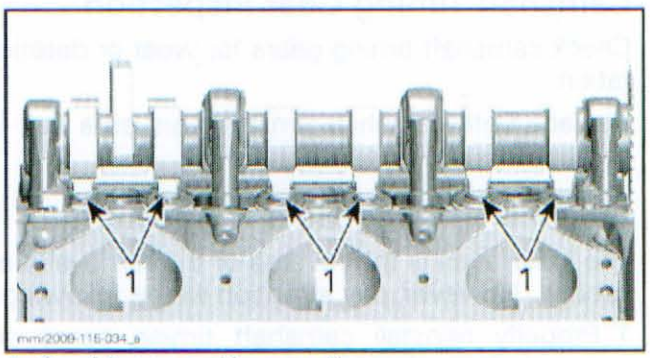
1. *Both attachment ends on the top of camshafts*

7. Ensure all valve adjustment shims are in place, prior to install camshafts.



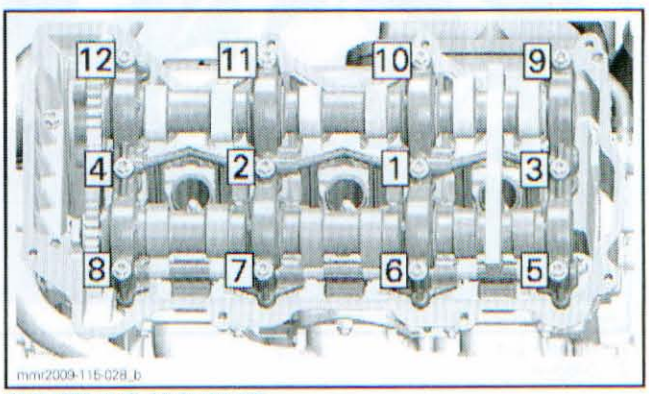
1. *Adjustment shims are in place*

8. Carefully reinstall camshafts as follows.
   - 8.1 Move camshafts to their final position.
   - 8.2 Check if all shims and all cam followers are in place.



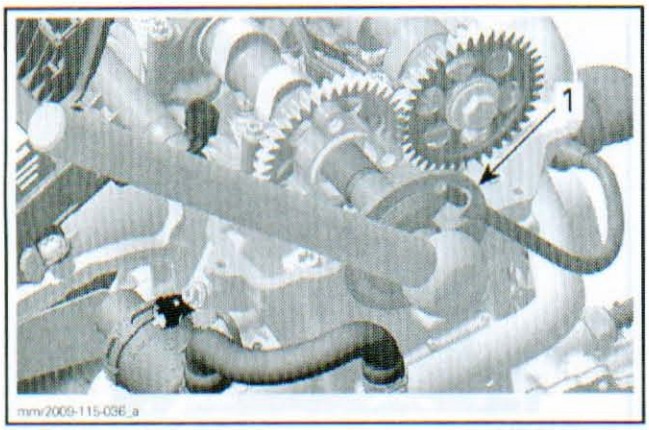
1. *Cam followers position over shims*

   - 8.3 Install loosely all screws securing camshaft holders.
   - 8.4 Remove locking ties by pulling them out of camshafts.
   - 8.5 Finally tighten camshaft holders according to the following sequence.



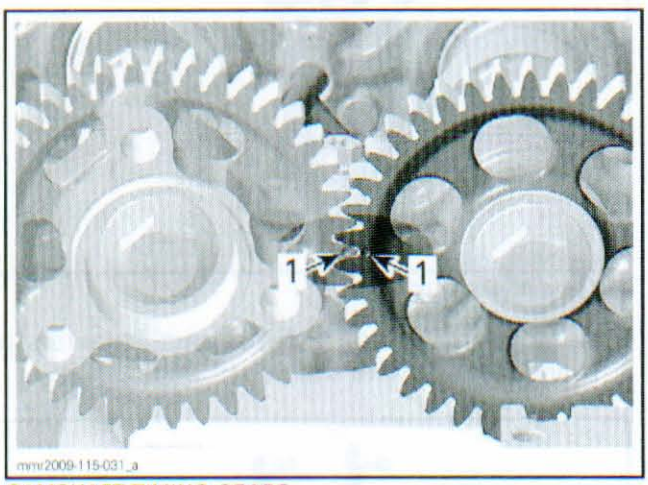
TIGHTENING SEQUENCE

9. Tighten camshaft timing gears screws to 40 N•m (30 lbf•ft).
   - 9.1 Finish tightening screws turning an additional 80° rotation with a torque angle gauge.



1. Torque angle gauge

NOTE: Make sure that crankshaft and camshaft are still locked. In this condition, marks on camshaft timing gears must be aligned.



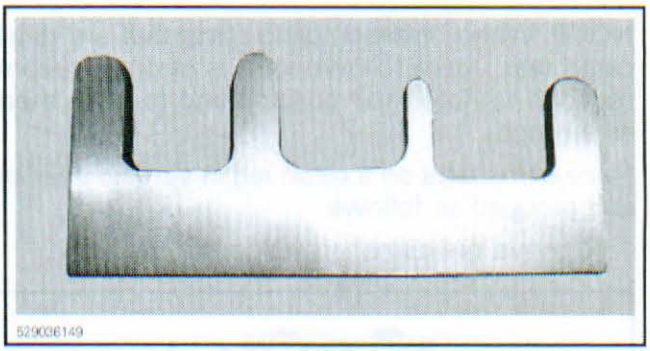
CAMSHAFT TIMING GEARS
1. Marks must be aligned

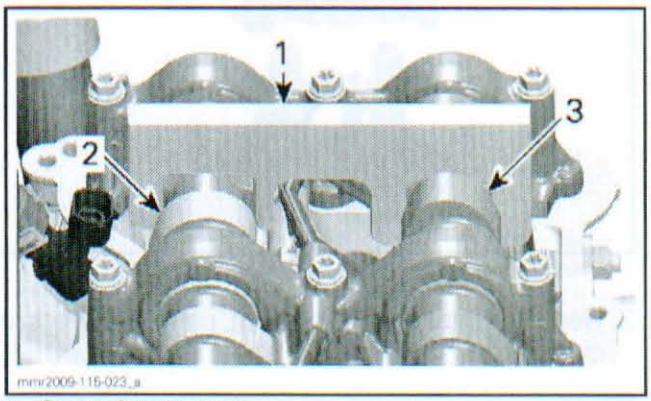
10. Properly install timing chain gear. Refer to *TIMING CHAIN* subsection.
11. Remove camshaft locking tool and crankshaft locking tool.
12. Check valve clearance. Refer to *VALVE CLEARANCE* in this subsection.
13. Install remaining parts.

CAMSHAFTS

Camshaft Locking Procedure

1. Remove *VALVE 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 529 036 149).



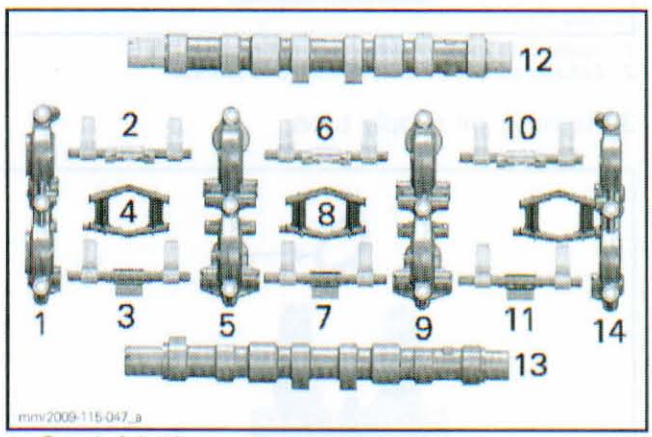


1. Camshaft locking tool
2. Intake camshaft
3. Exhaust camshaft

Camshaft Removal

Refer to *CAMSHAFT TIMING GEAR* in this subsection to remove camshafts.

Camshaft Disassembly

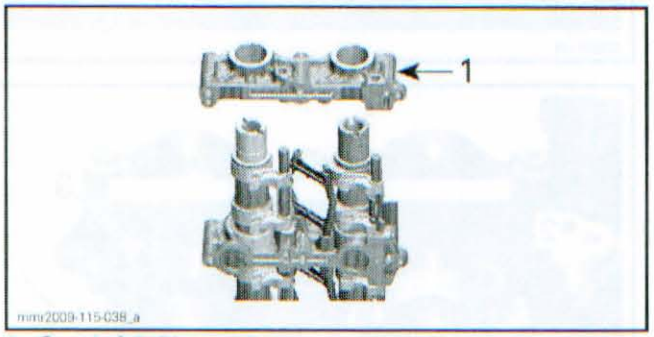


1. Camshaft holder no. 1
2. Intake cam followers with shaft and spacer, cylinder 3
3. Exhaust cam followers with shaft and spacer, cylinder 3
4. Oil supply tube, cylinder 3
5. Camshaft holder no. 2
6. Intake cam followers with shaft and spacer, cylinder 2
7. Exhaust cam followers with shaft and spacer, cylinder 2
8. Oil supply tube, cylinder 2
9. Camshaft holder no. 3
10. Intake cam followers with shaft and spacer, cylinder 1
11. Exhaust cam followers with shaft and spacer, cylinder 1
12. Intake camshaft
13. Exhaust camshaft
14. Camshaft holder no. 4

NOTE: When disassembling parts that are duplicated (e.g.: cam followers), it is strongly recommended to note their position and to keep them as a group.

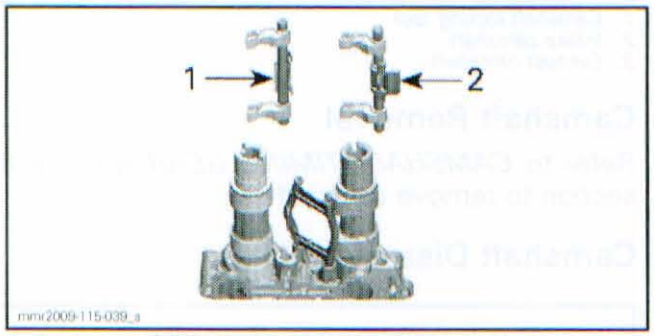
Place camshafts on a clean rag in vertical position and proceed as follows.

1. Remove the camshaft holder no. 1.



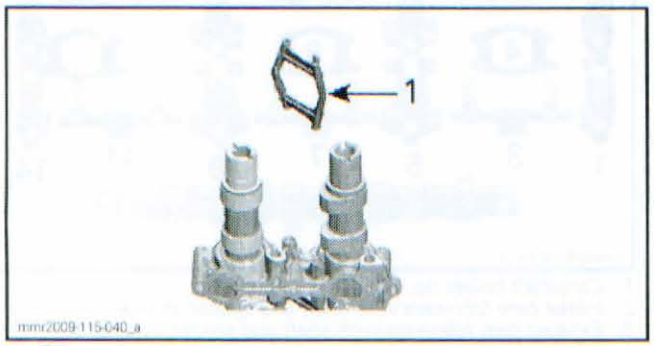
1. Camshaft holder no. 1

2. Remove intake and exhaust cam followers of cylinder no. 3 with their shaft and spacer.



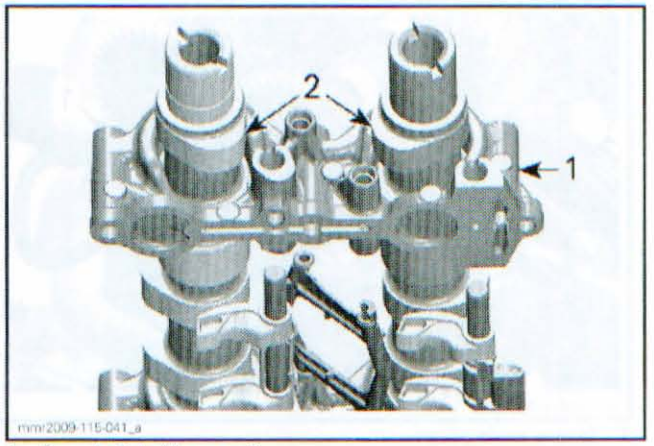
1. Intake cam follower with shaft and spacer
2. Exhaust cam follower with shaft and spacer

3. Remove oil supply tube.

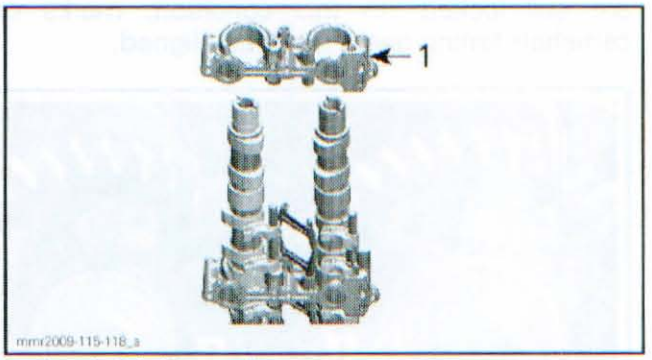


1. Oil supply tube

4. Turn camshafts to clear lobes from camshaft holder no. 2. Remove holder.

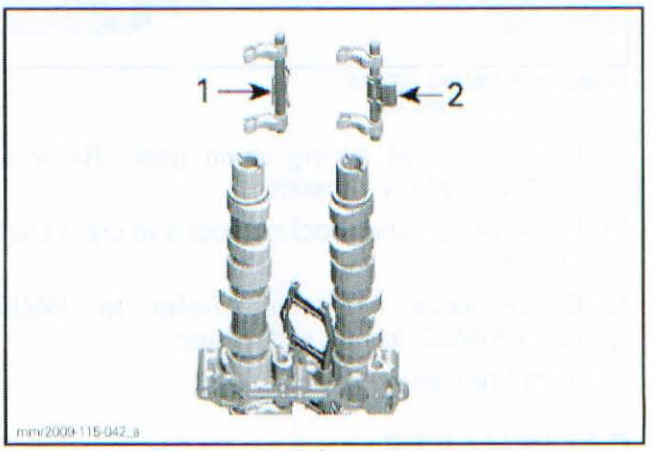


1. Camshaft holder no. 2
2. Camshaft lobes



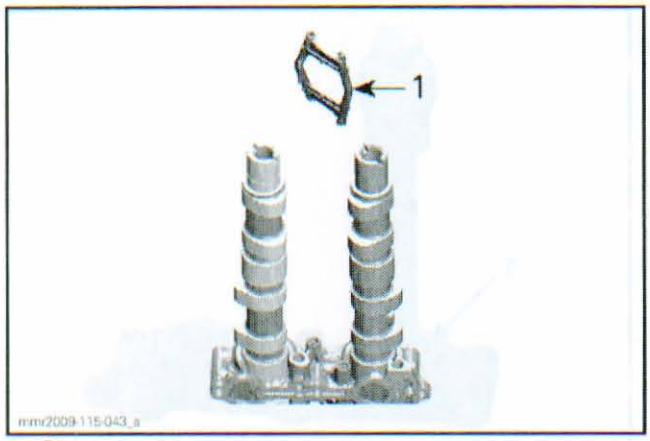
1. Camshaft holder no. 2

5. Remove intake and exhaust cam followers of cylinder no. 2 with their shaft and spacer.



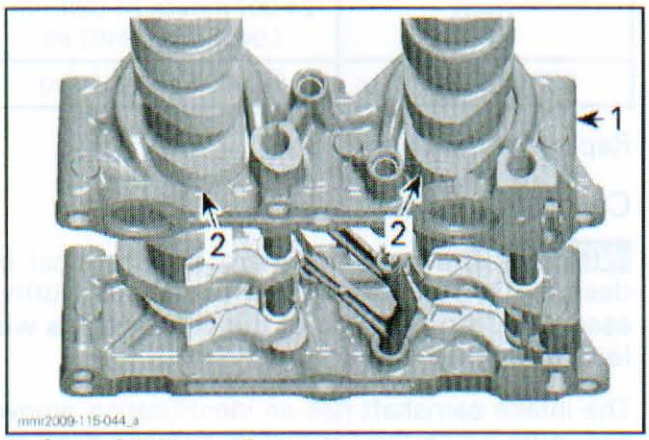
1. Intake cam follower with shaft and spacer
2. Exhaust cam follower with shaft and spacer

6. Remove oil supply tube.

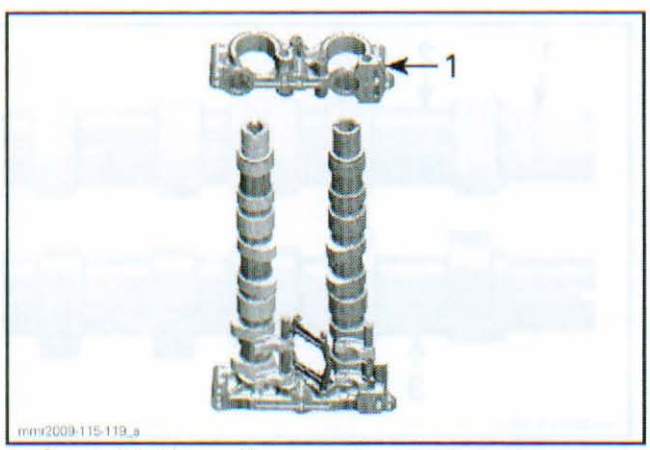


1. *Oil supply tube*

7. Turn camshafts to clear lobes from camshaft holder no. 3. Remove holder.

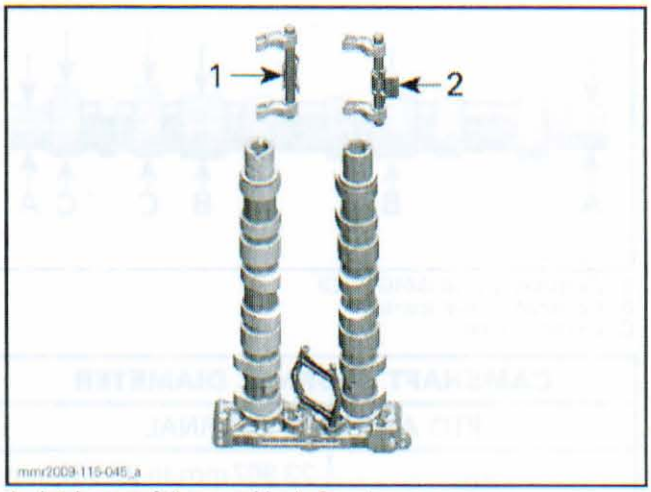


1. *Camshaft holder no. 3*
2. *Camshaft lobes*



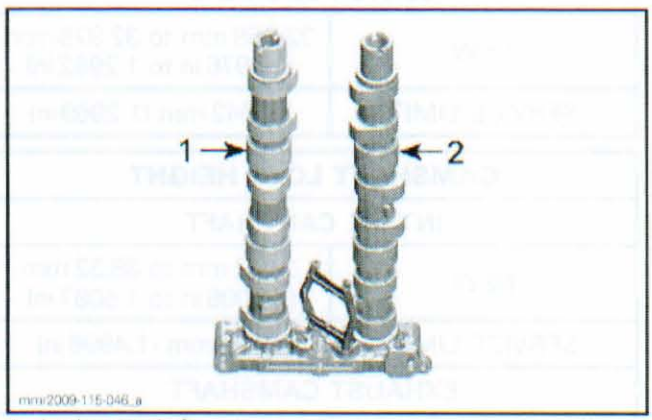
1. *Camshaft holder no. 3*

8. Remove intake and exhaust cam followers of cylinder no. 1 with their shaft and spacer.



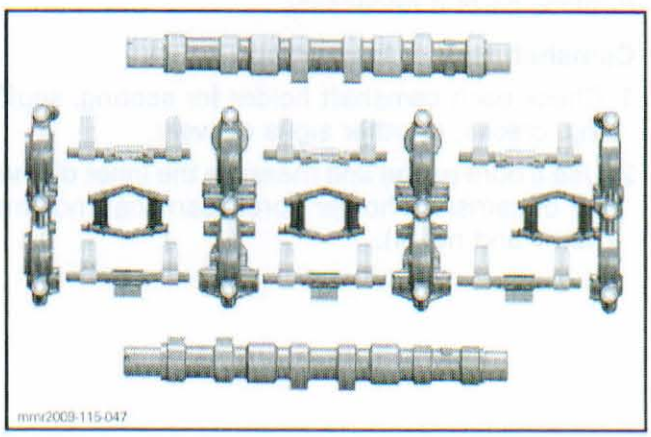
1. *Intake cam follower with shaft and spacer*
2. *Exhaust cam follower with shaft and spacer*

9. Remove intake and exhaust camshafts.



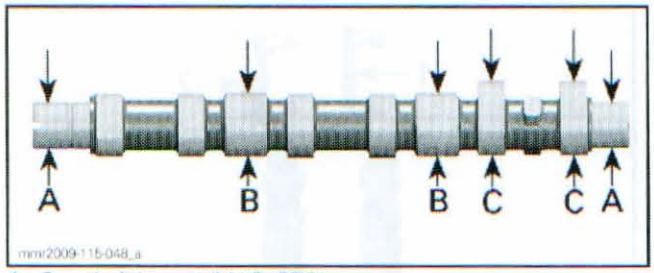
1. *Intake camshaft*
2. *Exhaust camshaft*

NOTE: Place all components in their original assembly order on a clean rag, to ease reassembly.



Camshaft Inspection

1. Check each lobe and bearing journal for scoring, scuffing, cracks, or other signs of wear.
2. Measure camshaft bearing journal diameter and lobe height, using a micrometer.



A. Camshaft journal (MAG, PTO)
B. Camshaft journal (center)
C. Camshaft lobe

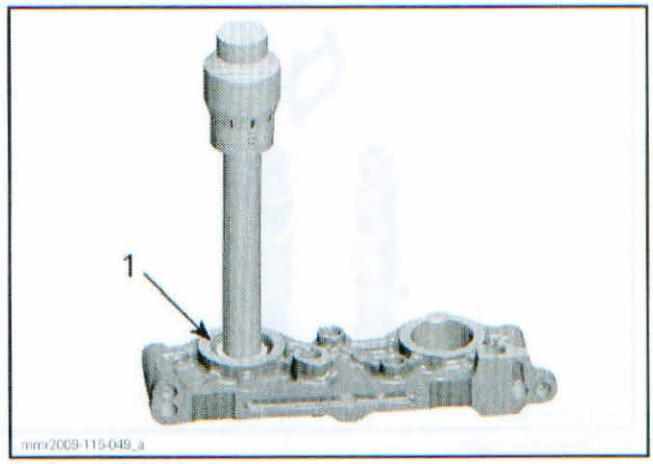
CAMSHAFT JOURNAL DIAMETER	
PTO AND MAG JOURNAL	
NEW	23.967 mm to 23.980 mm (.9436 in to .9441 in)
SERVICE LIMIT	23.950 mm (.9429 in)
CENTER JOURNAL	
NEW	32.959 mm to 32.975 mm (1.2976 in to 1.2982 in)
SERVICE LIMIT	32.942 mm (1.2969 in)

CAMSHAFT LOBE HEIGHT	
INTAKE CAMSHAFT	
NEW	38.12 mm to 38.32 mm (1.5008 in to 1.5087 in)
SERVICE LIMIT	38.09 mm (1.4996 in)
EXHAUST CAMSHAFT	
NEW	37.86 mm to 38.06 mm (1.4906 in to 1.4984 in)
SERVICE LIMIT	37.83 mm (1.4894 in)

Replace parts if necessary.

Camshaft Holder Inspection

1. Check each camshaft holder for scoring, scuffing, cracks, or other signs of wear.
2. Use a bore gauge and measure the inner diameter of camshaft holder bores (camshaft holders no. 1 and no. 4).



1. Camshaft holder bore

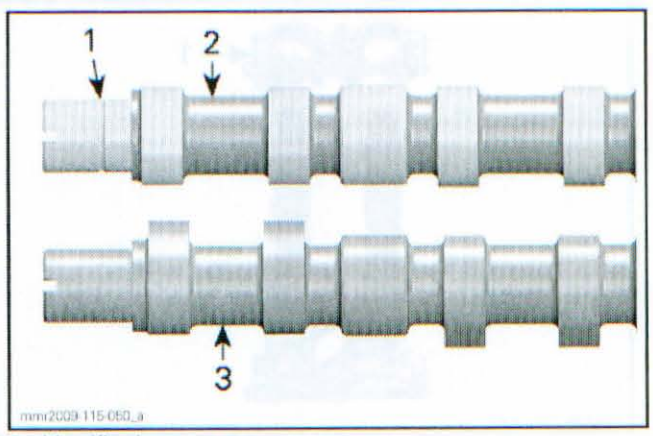
INNER BORE DIAMETER (CAMSHAFT HOLDER)	
NEW	24.007 mm to 24.020 mm (.9452 in to .9457 in)
SERVICE LIMIT	24.070 mm (.9476 in)

Replace parts if necessary.

Camshaft Assembly

NOTICE **The camshafts are not identical in design. Do not mix-up the camshafts during assembly. Any mix-up of the components will lead to engine damage.**

The intake camshaft has an identification groove and must be on the LH side during camshaft assembly.



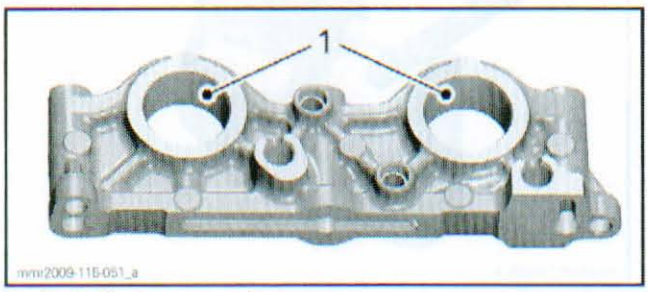
1. Identification groove
2. Intake camshaft
3. Exhaust camshaft

The assembly is the reverse of the disassembly procedure. However, pay attention to the following.

NOTICE During assembly, make sure to fit the components exactly in their original position on their respective cylinder. Any inversion of the components may cause damage to the engine.

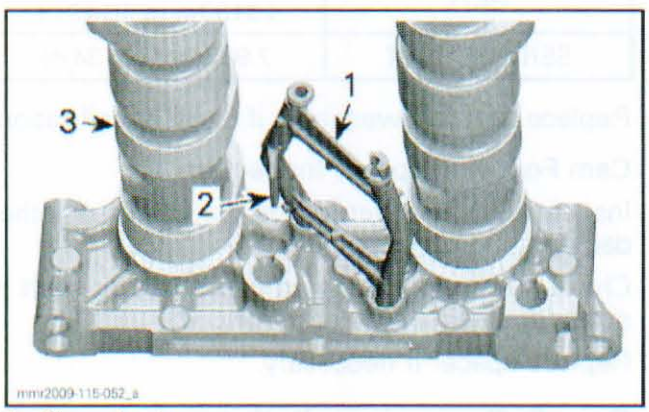
1. Apply KLÜEBER PASTE 46 MR 401 (P/N 420 297 616) on camshaft holder bores during assembly.

NOTICE Do not use other lubricant. Camshaft seizure can happen if another lubricant is used.



1. Apply Klueber grease here

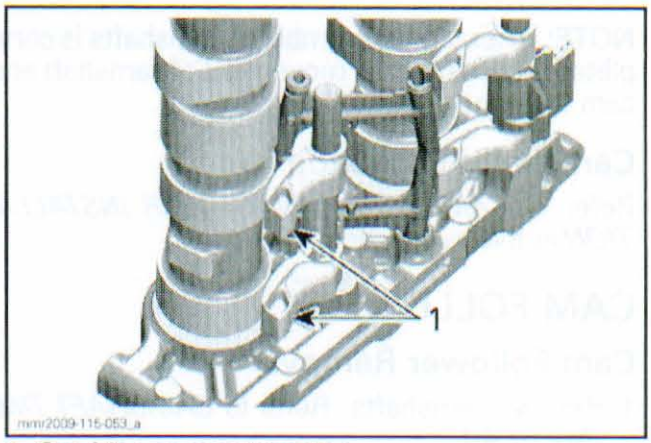
2. Ensure that the flat spot of oil supply tube tab faces to intake camshaft.



1. Oil supply tube
2. Flat side of tab
3. Intake camshaft

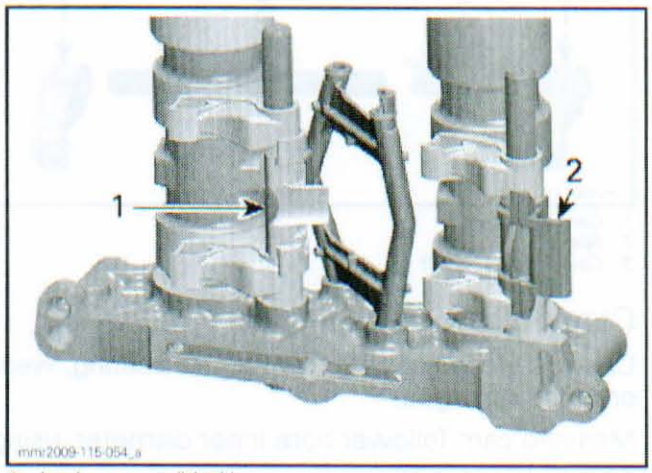
3. Properly reinstall cam follower with its shaft and spacer into camshaft holders as follows.

   3.1 Fit the cam followers as next illustration.



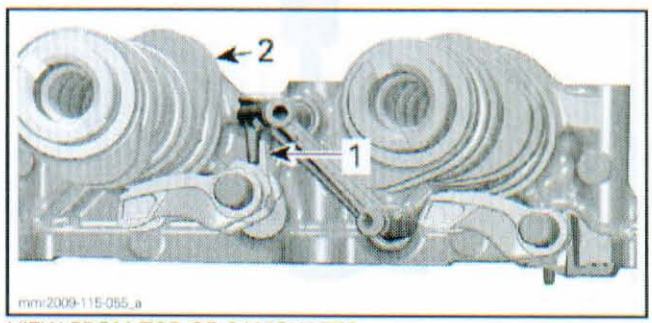
1. Cam followers properly installed

NOTE: Do not mix-up cam follower spacers of intake and exhaust camshaft. Intake spacers are black and exhaust spacers are white colored.



1. Intake spacer (black)
2. Exhaust spacer (white)

   3.2 Ensure that the flat spot of intake spacer (black) contacts the flat spot of oil tube, see next illustration.



VIEW FROM TOP OF CAMSHAFTS
1. Exhaust spacer properly installed
2. Intake camshaft

4. Properly fit camshaft holders onto oil supply tubes during assembly.

NOTE: After the reassembly of camshafts is completed, check for easy movement of camshaft and cam followers.

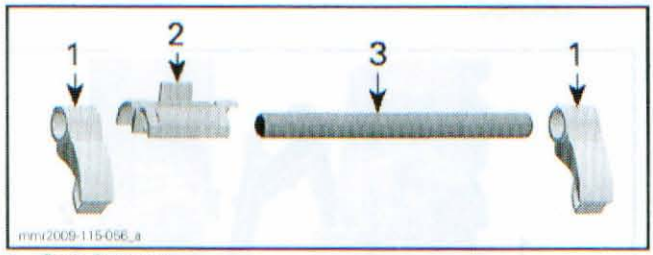
Camshaft Installation

Refer to *CAMSHAFT TIMING GEAR INSTALLATION* in this subsection.

CAM FOLLOWERS

Cam Follower Removal

1. Remove camshafts. Refer to *CAMSHAFT TIMING GEAR.*
2. Disassemble camshafts. Refer to *CAMSHAFT.*
3. Remove cam followers and spacer from cam follower shaft.



1. *Cam followers*
2. *Spacer*
3. *Cam follower shaft*

Cam Follower Inspection

Check surfaces of cam follower for scoring, wear or other damages.

Measure cam follower bore inner diameter, using a small bore gauge.

1. *Cam follower bore*

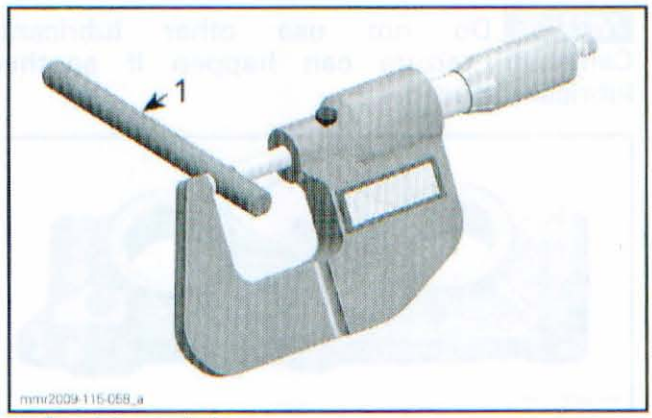
CAM FOLLOWER BORE INNER DIAMETER	
NEW	8.013 mm to 8.049 mm (.3155 in to .3169 in)
SERVICE LIMIT	8.060 mm (.3173 in)

Replace cam follower, if out of specification.

Cam Follower Shaft Inspection

Check cam follower shaft for scoring, wear or other damages.

Measure cam follower shaft diameter, using a micrometer.



1. *Cam follower shaft*

CAM FOLLOWER SHAFT DIAMETER	
NEW	7.972 mm to 7.980 mm (.3139 in to .3142 in)
SERVICE LIMIT	7.960 mm (.3134 in)

Replace cam follower shaft, if out of specification.

Cam Follower Spacer Inspection

Inspect cam follower spacer for cracks or other damage.

Check if clamping force on cam follower shaft is still adequate.

Replace spacer if necessary.

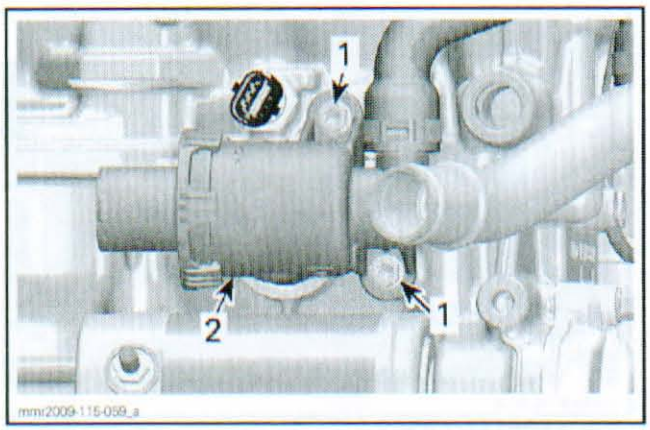
Cam Follower Installation

Refer to *CAMSHAFT* assembly steps in this section.

CYLINDER HEAD

Cylinder Head Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove the intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
3. Remove oil tank from engine. Refer to *LUBRICATION SYSTEM* subsection.
4. Remove screws securing the thermostat to engine. Move thermostat aside.

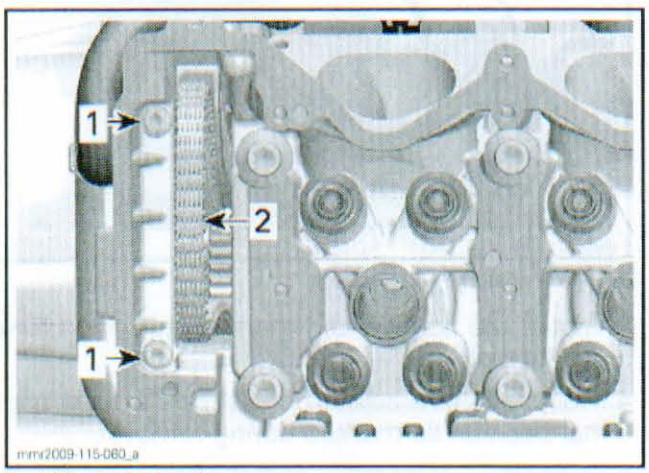


1. Retaining screws
2. Thermostat

5. Remove the *CAMSHAFT TIMING GEARS*, see procedure in this subsection.
6. Remove valve adjustment shims from spring retainers.

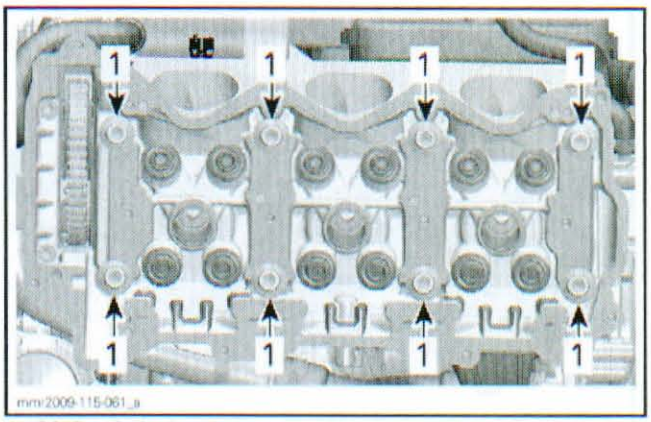
NOTE: Identify the position of each valve adjustment shim very carefully, so it can be reinstalled in its original place.

7. Remove M6 cylinder head screws.



1. M6 cylinder head screws
2. Timing chain

8. Remove and discard M10 cylinder head screws.

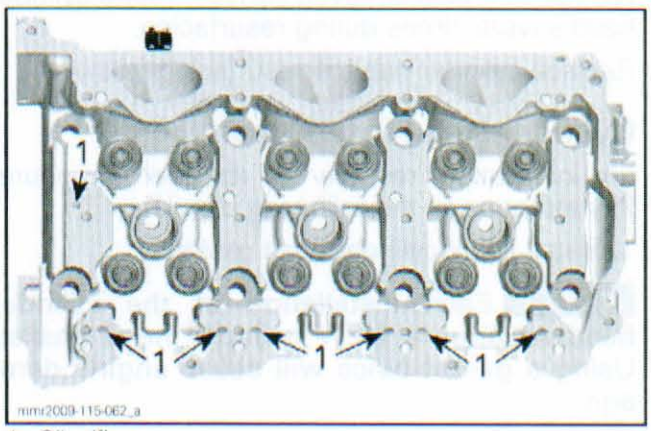


1. M10 cylinder head screws

9. Pull up cylinder head.
10. Remove and discard cylinder head gasket.

Cylinder Head Cleaning

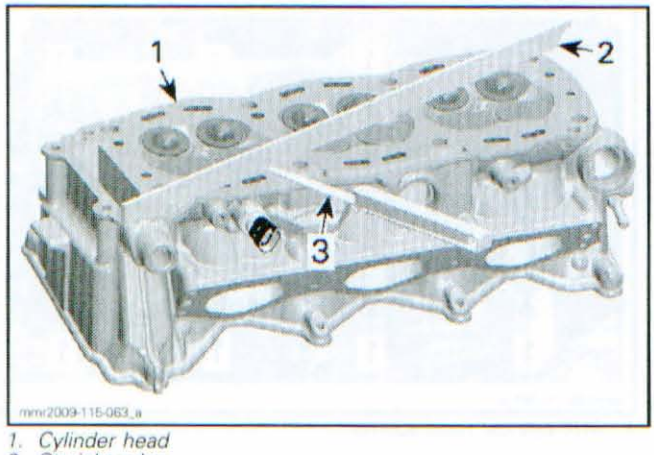
1. Remove carbon deposits from combustion chamber, exhaust port and piston top.
2. Clean cylinder head, especially cylinder head screw surface from oil spillage.
3. Blow out the oil orifices and check if they are not clogged.



1. Oil orifices

Cylinder Head Inspection

1. Check for cracks between valve seats or other damages, if so, replace cylinder head.
2. Check cylinder head mating surface for flatness using a straight edge.



1. *Cylinder head*
2. *Straight edge*
3. *Feeler gauge*

Check cylinder head warpage.

CYLINDER HEAD WARPAGE	
Maximum	0.10 mm (.0039 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.

1. Install **NEW** cylinder head gasket.

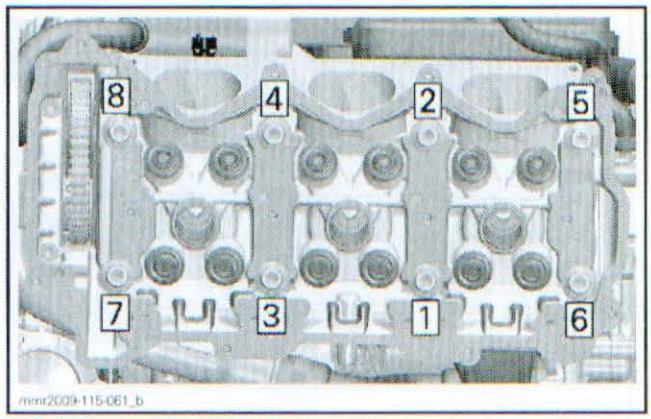
NOTICE Each installation of the cylinder head requires a NEW cylinder head gasket. Using a gasket twice will cause engine damage.

2. Install **NEW** M10 cylinder head screws, proceed as follows.

NOTICE For this assembly, stretch screws are used. 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.

2.1 Apply engine oil on screw threads and under screw head.

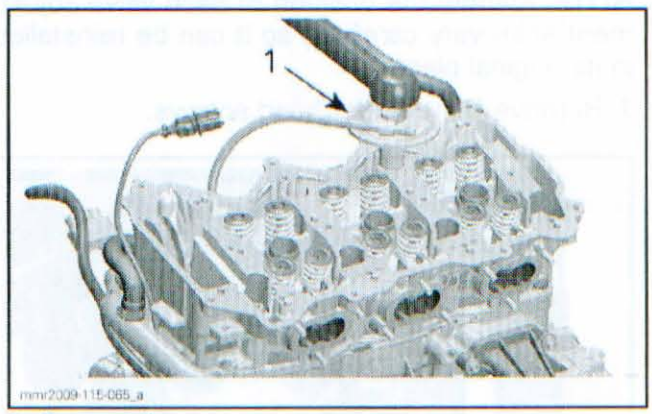
2.2 First torque M10 screws to 30 N•m (22 lbf•ft) using the following sequence.



TIGHTENING SEQUENCE

2.3 Using the same sequence, tighten M10 screws by turning a 90° rotation with a torque angle gauge.

2.4 Finally tighten M10 screws by another 90° turn using an angle torque wrench.



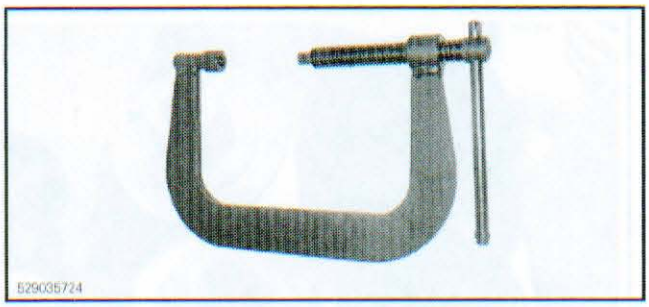
1. *Torque angle gauge*

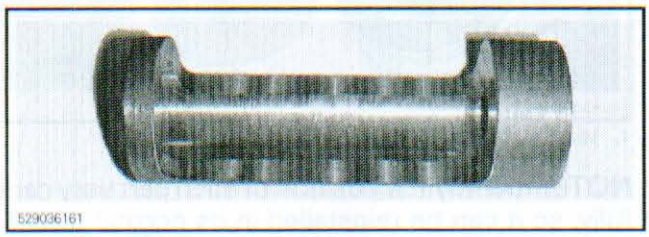
3. Install M6 screws and them torque to 11 N•m (97 lbf•**in**).
4. Reinstall valve adjustment shims in their original position as marked during removal.
5. Properly reinstall camshafts, refer to *CAMSHAFT TIMING GEAR INSTALLATION.*

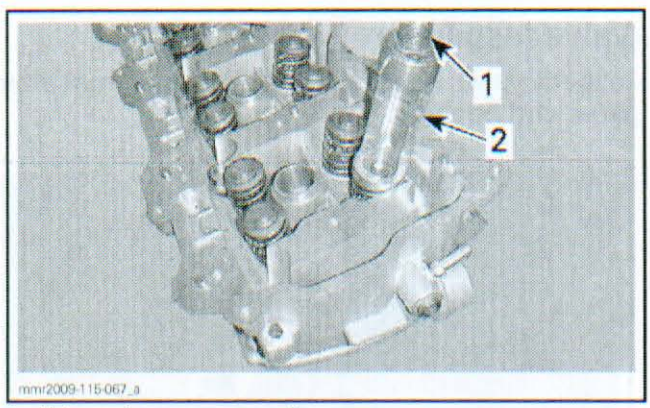
VALVE SPRINGS

Valve Spring Removal

1. Remove *CYLINDER HEAD*, see procedure in this subsection.
2. Compress valve spring, using the VALVE SPRING COMPRESSOR (P/N 529 035 724) and the VALVE SPRING COMPRESSOR CUP (P/N 529 036 161).

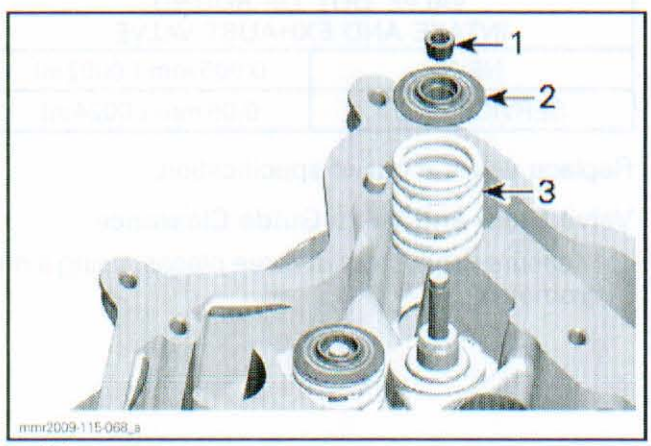






1. Valve spring compressor clamp
2. Valve spring compressor cup

3. Remove valve cotters.
4. Withdraw valve spring compressor tools.
5. Remove valve spring retainer and valve spring.

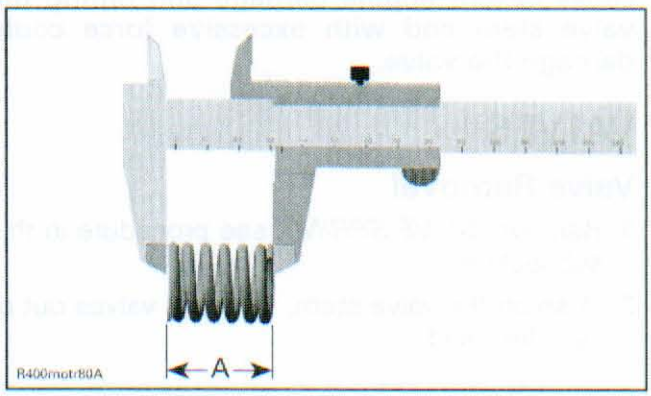


1. Valve cotters
2. Valve spring retainer
3. Valve spring

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Spring Inspection

1. Check valve spring for rust, corrosion or other visible damages.
2. Check valve spring free length and straightness.



A. Spring free length

VALVE SPRING FREE LENGTH	
NEW	36.7 mm (1.4449 in)
SERVICE LIMIT	35.5 mm (1.3976 in)

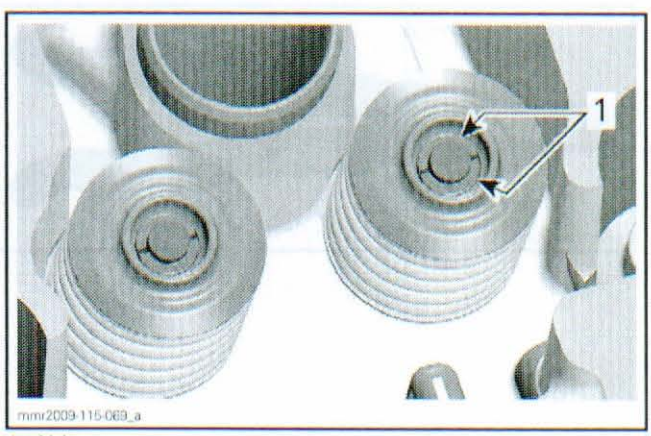
Replace valve spring, if out of specification.

Valve Spring Installation

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

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

1. Apply some grease on valve cotters, so that they remain in place while releasing the valve spring.
2. Make sure valve cotters are properly engaged into valve stem groove.



1. Valve cotters

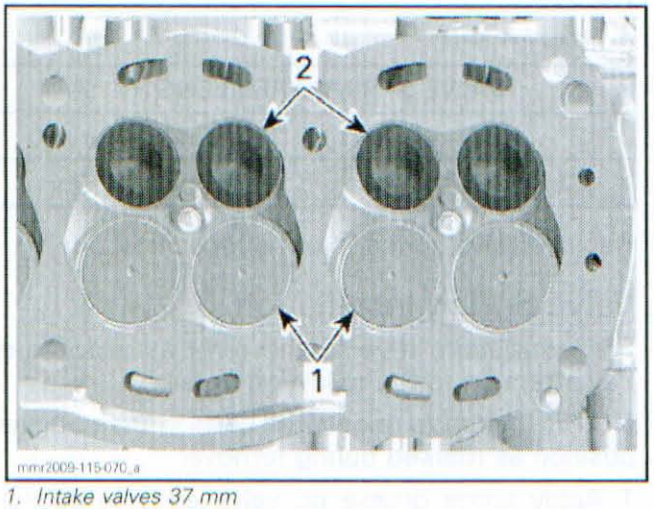
3. After spring is installed, ensure it is properly locked by lightly tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE **Improperly locked valve spring will cause severe engine damage and hitting the valve stem end with excessive force could damage the valve.**

VALVES

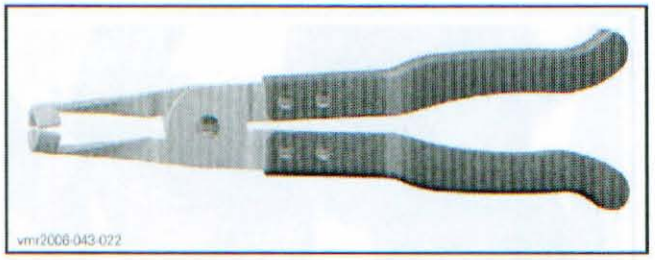
Valve Removal

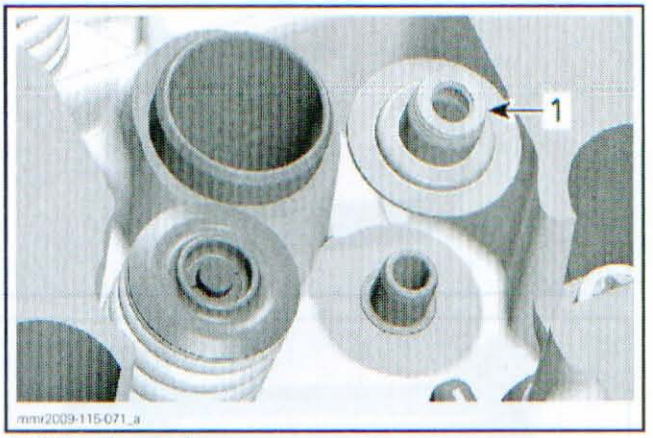
1. Remove *VALVE SPRING*, see procedure in this subsection.
2. Push on the valve stem, then pull valves out of cylinder head.



1. Intake valves 37 mm
2. Exhaust valves 31 mm

3. Remove and discard valve stem seal with special pliers such as the SNAP-ON VALVE STEM SEAL PLIERS (P/N YA 8230).



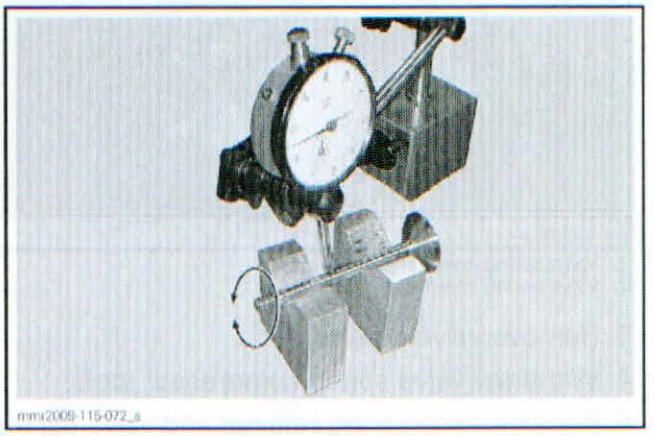


1. Valve stem seal

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Inspection

Inspect valve surface, check for abnormal stem wear and bending.

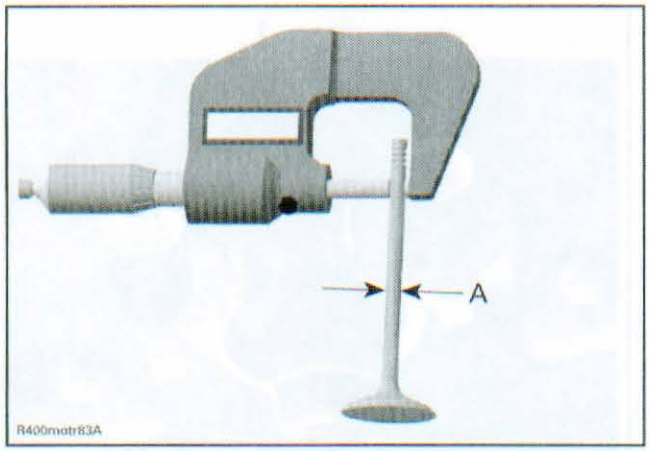


VALVE OUT OF ROUND INTAKE AND EXHAUST VALVE	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

Replace valve, if out of specification.

Valve Stem and Valve Guide Clearance

1. Measure valve stem at three places, using a micrometer.



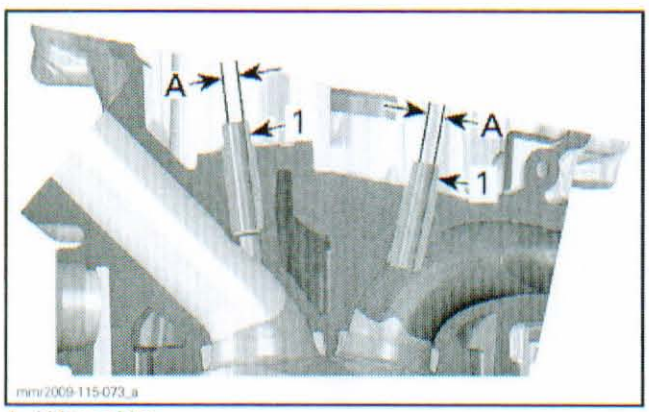
A. Valves stem diameter

VALVE STEM DIAMETER	
INTAKE VALVE	
NEW	5.471 mm to 5.486 mm (.2154 in to .216 in)
SERVICE LIMIT	5.450 mm (.2146 in)
EXHAUST VALVE	
NEW	5.461 mm to 5.476 mm (.215 in to .2156 in)
SERVICE LIMIT	5.440 mm (.2142 in)

Replace valve, if valve stem is out of specification or has other damages such as wear or friction surface.

2. Measure valve guide inner diameter, using a small bore gauge.

NOTE: Clean valve guide from carbon deposits before measuring.

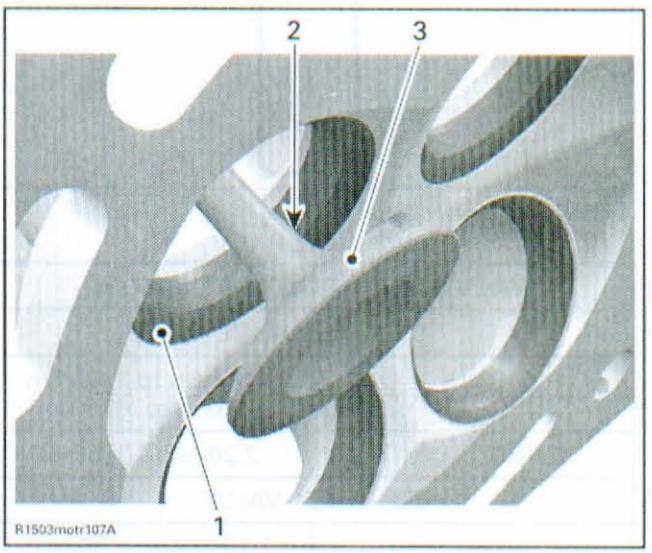


1. Valve guides
A. Valve guide inner diameter

VALVE GUIDE INNER DIAMETER	
NEW	5.505 mm to 5.518 mm (.2167 in to .2172 in)
SERVICE LIMIT	5.568 mm (.2192 in)

Replace cylinder head, if valve guide is out of specification.

Valve Face and Seat

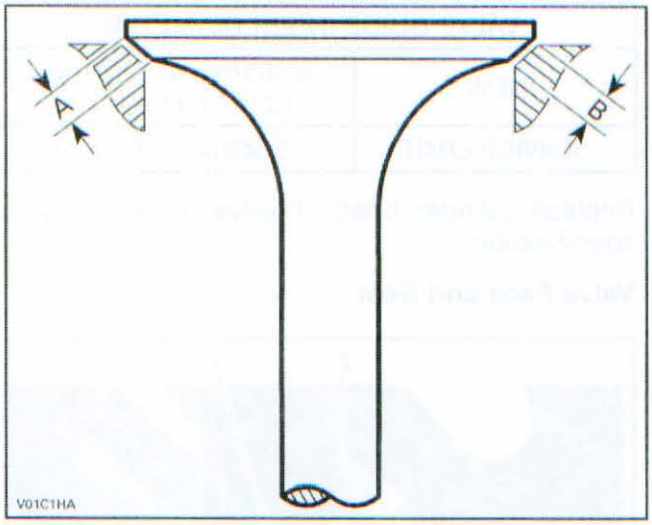


TYPICAL
1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

1. Check valve face and seat for burning, pitting and other signs of damage.
2. Check if valve seats properly in cylinder head. Proceed as follows.
   2.1 Apply some lapping compound on valve face and work valve on its seat with a lapping tool such as the SNAP-ON VALVE HOLDER (P/N VL2).

   NOTE: The location of contact area should be in center of valve face.

   2.2 Repeat procedure until valve seat and valve face fit together.
3. Measure valve seat contact width, using a caliper.



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

VALVE SEAT CONTACT WIDTH	
INTAKE VALVE	
NEW	1.60 mm to 1.80 mm (.063 in to .0709 in)
SERVICE LIMIT	2.20 mm (.0866 in)
EXHAUST VALVE	
NEW	1.40 mm to 1.80 mm (.0551 in to .0709 in)
SERVICE LIMIT	2.40 mm (.0945 in)

Replace parts if out of specification.

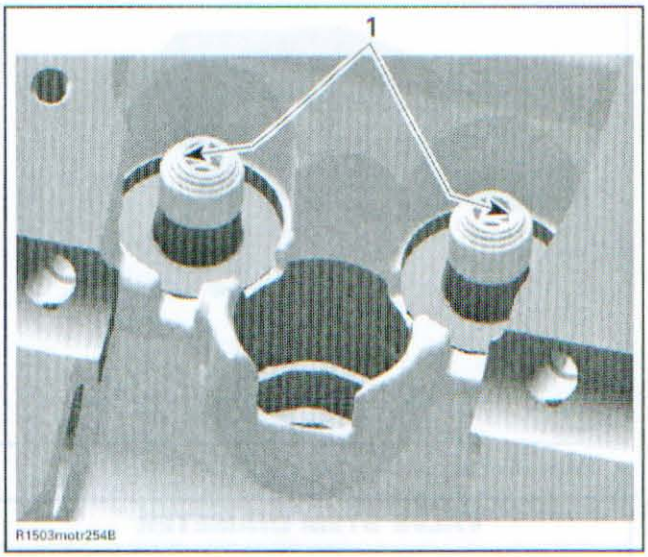
Valve Installation

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

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

1. Install a NEW valve stem seal whenever valve is removed.
2. Apply engine oil on valve stem and carefully slide through cylinder head and valve stem seal.

NOTICE **Be careful when valve stem is passed through sealing lip of valve stem seal.**



TYPICAL
1. Sealing lips of valve stem seal

3. Install *VALVE SPRING*. See procedure in this subsection.
4. Install all other removed parts.

CYLINDER BLOCK

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT	529 036 148	141, 144
DIAL INDICATOR ADAPTER	529 036 159	141
OIL SEAL INSTALLER	529 036 155	133
PISTON CIRCLIP INSTALLER	529 036 153	148
PISTON RING COMPRESSOR	529 036 156	149
TDC DIAL INDICATOR	414 104 700	141

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	133–134, 140
LOCTITE 5910	293 800 081	139
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	135
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	137
SUPER LUBE GREASE	293 550 030	133

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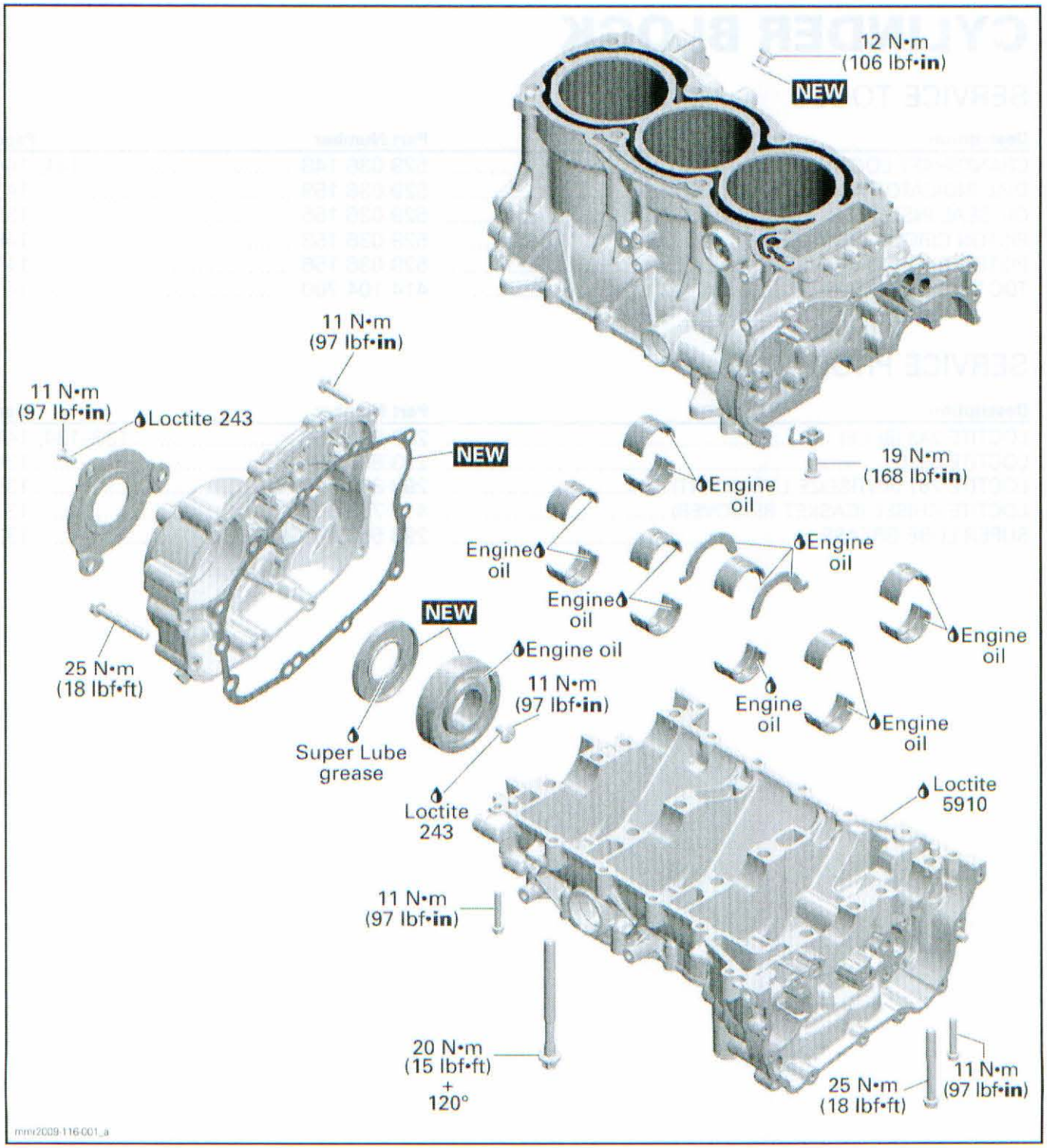
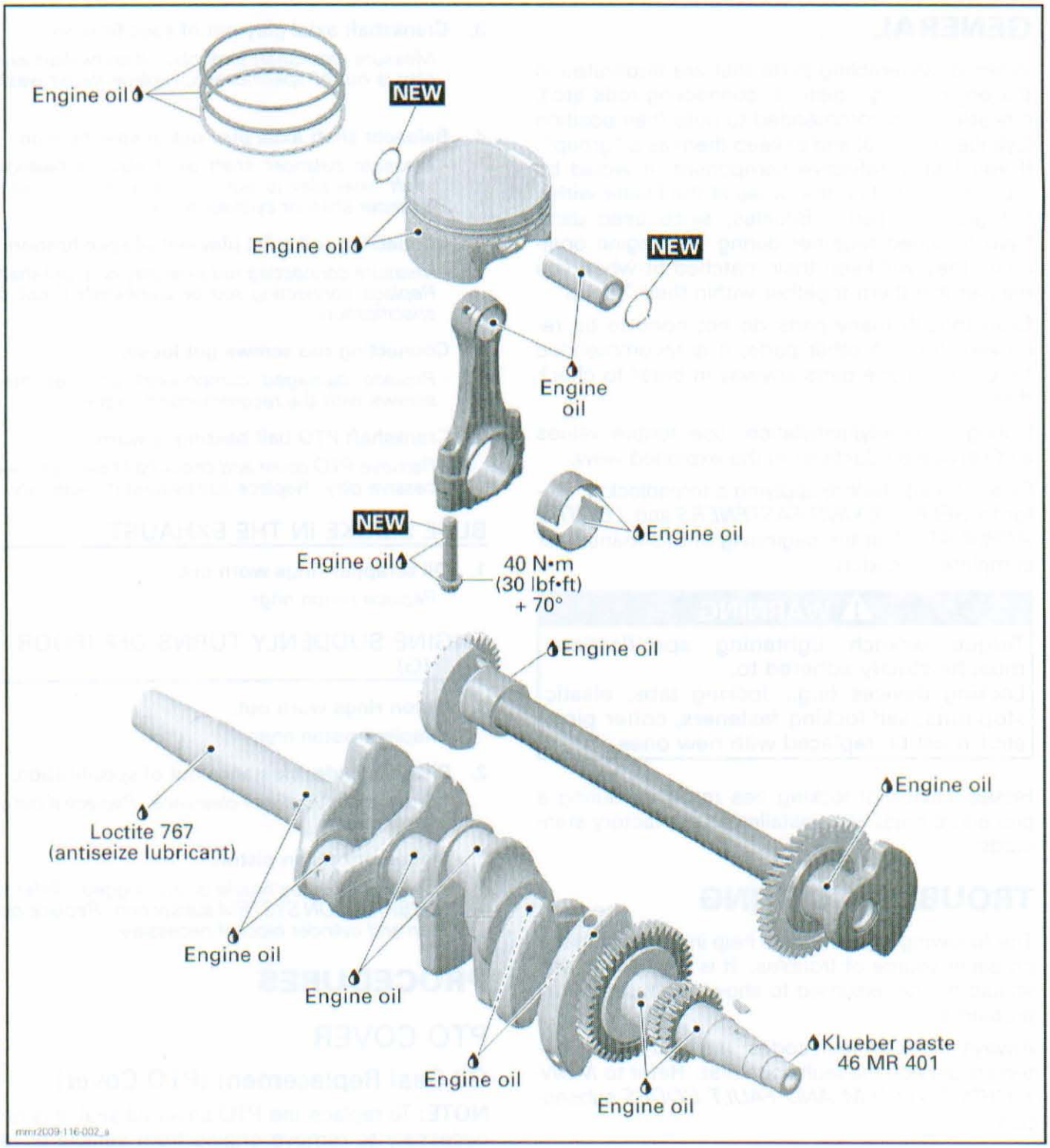

12 N•m
(106 lbf•in)
NEW
11 N•m
(97 lbf•in)
11 N•m
(97 lbf•in)
Loctite 243
NEW
19 N•m
(168 lbf•in)
Engine oil
Engine oil
Engine oil
Engine oil
Engine oil
NEW
Engine oil
25 N•m
(18 lbf•ft)
11 N•m
(97 lbf•in)
Engine oil
Engine oil
Super Lube grease
Loctite 243
Loctite 5910
11 N•m
(97 lbf•in)
20 N•m
(15 lbf•ft)
+
120°
25 N•m
(18 lbf•ft)
11 N•m
(97 lbf•in)
mmr2009-116-001_a


Engine oil
NEW
Engine oil
NEW
Engine oil
NEW
Engine oil
Engine oil
40 N•m
(30 lbf•ft)
+ 70°
Engine oil
Engine oil
Loctite 767
(antiseize lubricant)
Engine oil
Engine oil
Engine oil
Engine oil
Klueber paste
46 MR 401
mmr2009-116-002_a

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".

Even though many parts do not need to be removed to reach other parts, it is recommended to remove these parts anyway in order to check them.

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.

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 should not be assumed to show all causes for all problems.

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

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. Heavy wear on plain bearings.
   - *Check radial play of plain bearings. Replace 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 axial play out of specification.
   - *Measure crankshaft axial play. If crankshaft axial play is out of specification, replace thrust washers.*
4. Balancer shaft axial play out of specification.
   - *Measure balancer shaft axial play. If balancer shaft axial play is out of specification, replace balancer shaft or cylinder block.*
5. Connecting rod axial play out of specification.
   - *Measure connecting rod axial play on crankshaft. Replace connecting rod or crankshaft if out of specification.*
6. Connecting rod screws got loose.
   - *Replace damaged components and retighten screws with the recommended torque.*
7. Crankshaft PTO ball bearing is worn.
   - *Remove PTO cover and check ball bearing for excessive play. Replace ball bearing if necessary.*

BLUE SMOKE IN THE EXHAUST

1. Oil scrapper rings worn out.
   - *Replace piston rings.*

ENGINE SUDDENLY TURNS OFF (POOR IDLING)

1. Piston rings worn out.
   - *Replace piston rings.*
2. Piston/cylinder clearance out of specification.
   - *Check piston/cylinder 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

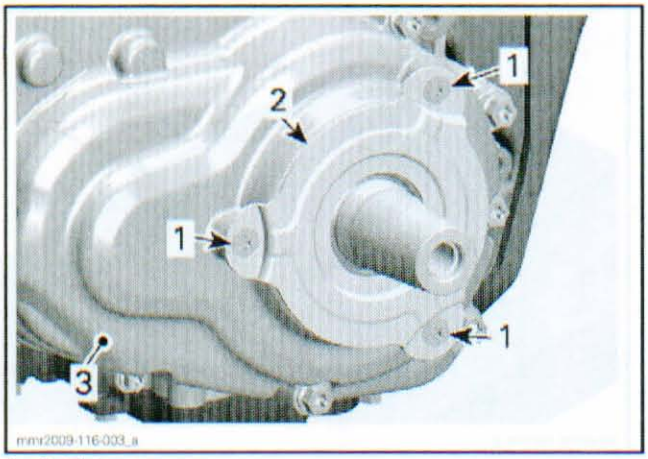
PTO COVER

Oil Seal Replacement (PTO Cover)

NOTE: To replace the PTO cover oil seal, it is not necessary to remove engine from vehicle or remove PTO cover from the engine.

Oil Seal Removal

1. Remove drive pulley. Refer to *DRIVE PULLEY* subsection.
2. Unscrew and remove oil seal retainer.



1. *Retaining screws*
2. *Oil seal retainer*
3. *PTO cover*

3. Remove PTO oil seal with a small flat screwdriver.

NOTICE **Avoid scoring surfaces with tool.**

Oil Seal Installation

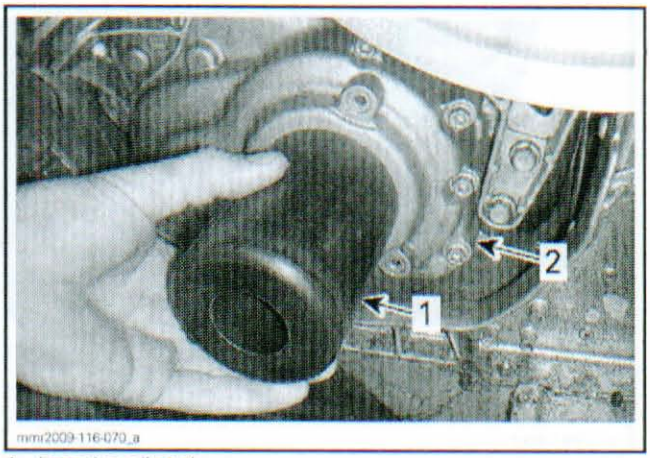
NOTE: Check the oil seal running surface of crankshaft for grooves, before installation of NEW oil seal.

1. Lubricate sealing lip of oil seal with SUPER LUBE GREASE (P/N 293 550 030).

NOTICE **Oil seal must be installed with sealing lip toward the engine.**

2. Push the NEW oil seal in place by using the OIL SEAL INSTALLER (P/N 529 036 155).

INSERTION OIL SEAL PTO COVER

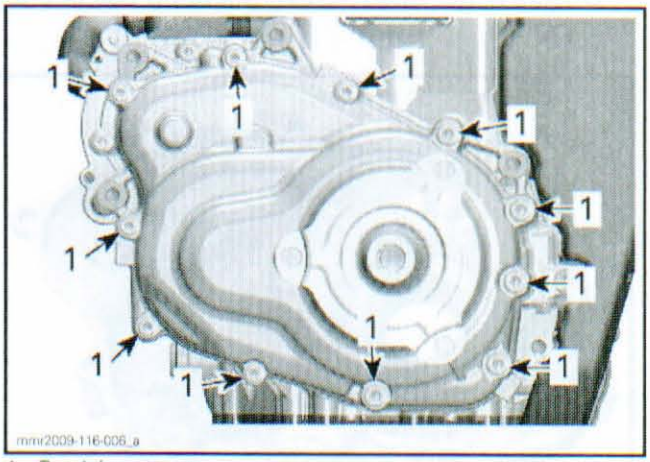


1. *Insertion oil seal*
2. *PTO cover*

3. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on oil seal retainer screws and torque them to 11 N•m (97 lbf•**in**).

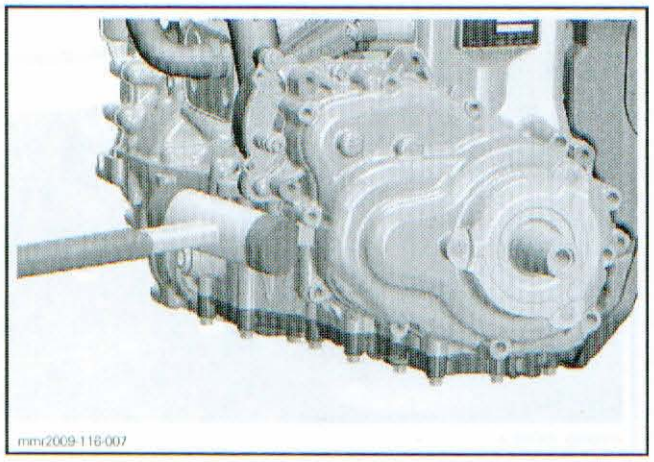
PTO Cover Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Drain engine oil, refer to *LUBRICATION SYSTEM* subsection.
3. Unscrew and remove PTO cover screws.



1. *Retaining screws*

4. Remove PTO cover by using a soft hammer.



PTO Cover Inspection

Check the PTO cover for cracks or other damages.

Check the sealing surface for flatness using a straight edge.

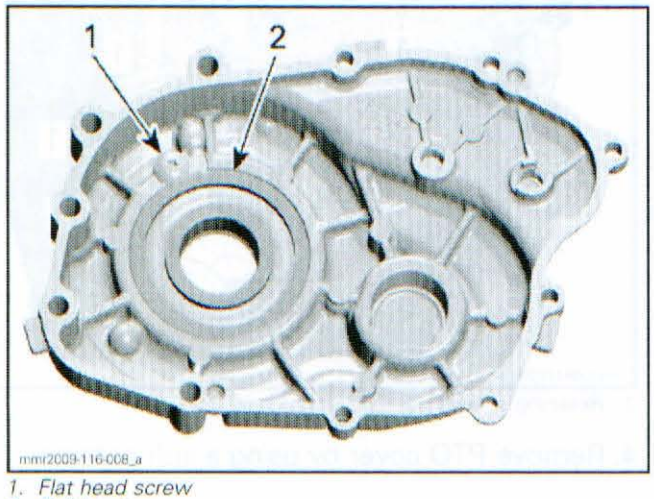
Inspect ball bearing for excessive play and smooth operation.

Replace damaged parts.

Bearing Replacement (PTO Cover)

Bearing Removal

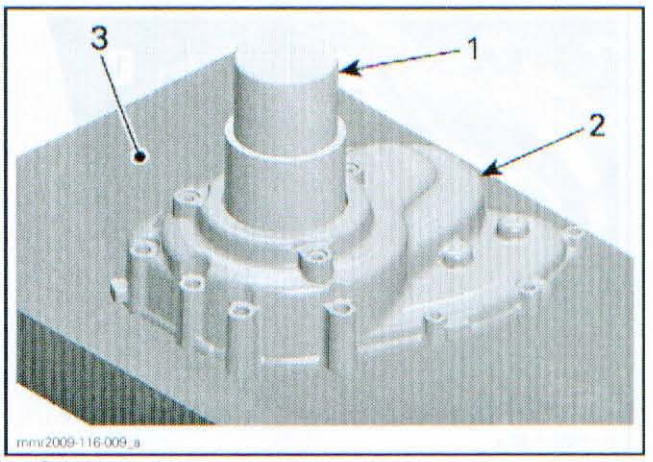
1. Unscrew flat head screw, securing ball bearing in place.



1. Flat head screw
2. Ball bearing

2. Remove oil seal retainer and oil seal, see *OIL SEAL REPLACEMENT (PTO COVER)* in this subsection.
3. Push-out the ball bearing from the outside towards the inside by using a suitable pusher and a press.

NOTE: The PTO cover has to be supported on a suitable straight surface, in order to prevent damage of the sealing surface.



1. Suitable pusher
2. PTO cover
3. Straight support

4. Discard the ball bearing.

Bearing Installation

NOTICE Never reinstall a ball bearing that has been removed. Unless otherwise instructed, never use a hammer to install ball bearings. Use a press only.

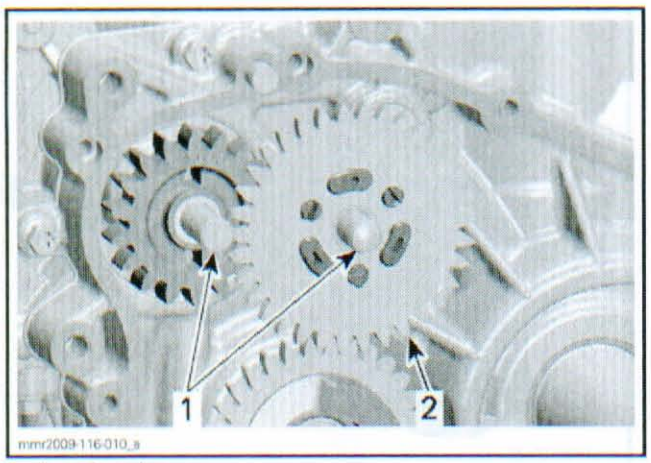
1. Support the PTO cover with a suitable support underneath the bearing seat.
2. Carefully press-in the **NEW** ball bearing from the inside towards the outside by using a suitable steel tube with an outer diameter of 76 mm (2.992 in).

NOTICE Never push on the inner race of the bearing, during installation.

3. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on flat head screw securing ball bearing and torque screw to 11 N•m (97 lbf•**in**).
4. Reinstall a **NEW** oil seal, refer to *OIL SEAL REPLACEMENT (PTO COVER)* in this subsection.

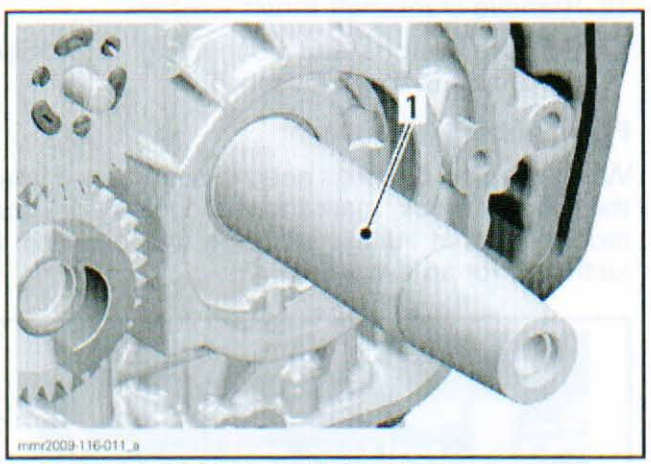
PTO Cover Installation

1. Install **NEW** PTO cover gasket.
2. Ensure that location pins and water pump intermediate gear are in place, before installing the PTO cover.



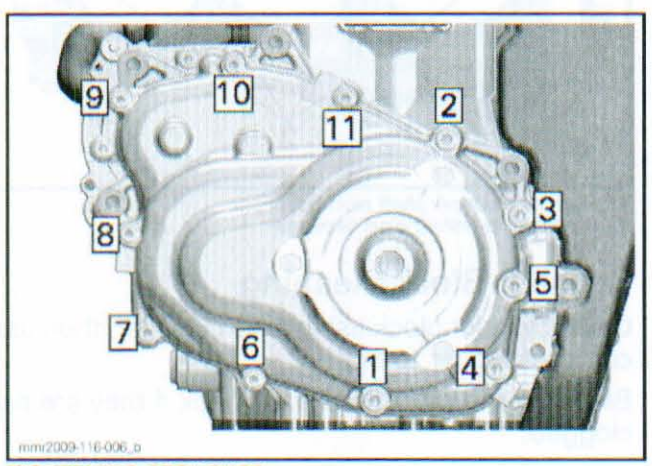
1. *Location pins*
2. *Water pump intermediate gear*

3. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on crankshaft where bearing fits before installing the PTO cover.



1. *Apply Loctite 767 (antiseize lubricant) here*

4. Tighten PTO cover screws according to the following sequence.

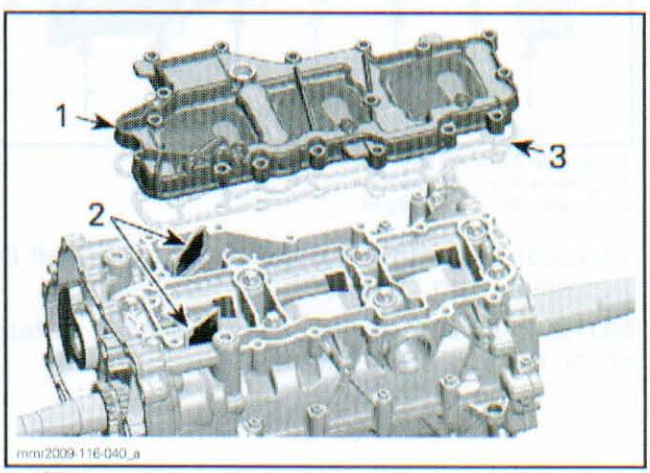


TIGHTENING SEQUENCE

CYLINDER BLOCK

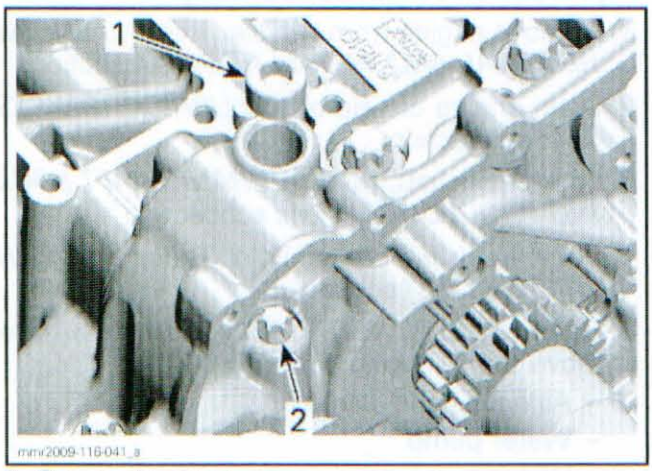
Cylinder Block Disassembly

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Drain engine oil. Refer to *LUBRICATION SYSTEM* subsection.
3. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in this subsection.
4. Remove air intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
5. Refer to *COOLING SYSTEM* subsection to remove the following parts:
   - All hoses and clamps
   - Water pump
   - Water pump drive gears.
6. Refer to *LUBRICATION SYSTEM* subsection to remove the following parts:
   - Oil tank
   - Oil cooler
   - Oil pressure regulator
   - Oil pump gears and oil pumps.
7. Refer to *MAGNETO AND STARTER* subsection to remove the following parts:
   - Magneto cover
   - Rotor
   - Starter drive gears
   - Electric starter.
8. Remove timing chain and timing chain guides, refer to *TIMING CHAIN* subsection.
9. Remove cylinder head. Refer to *CYLINDER HEAD* subsection.
10. Remove oil sump cover and oil strainers. Refer to *LUBRICATION SYSTEM* subsection.



1. *Oil sump cover*
2. *Engine oil strainers*
3. *Gasket*

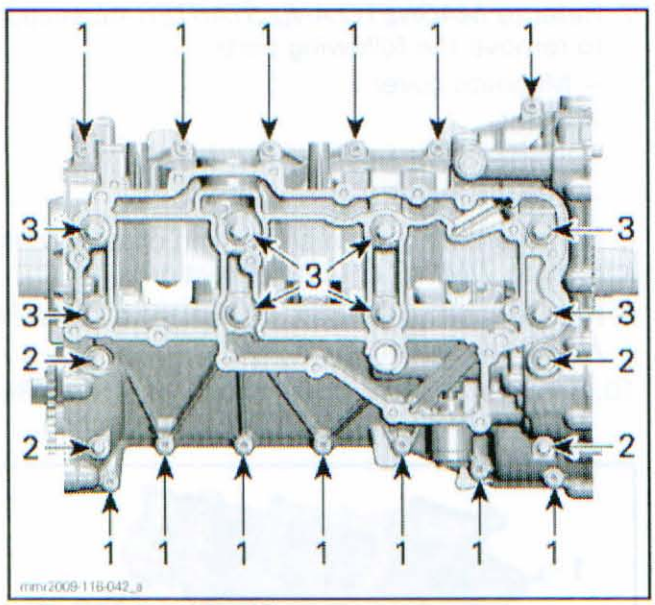
11. Remove plug screw to get access to M8 cylinder block screw.



1. *Remove plug screw*
2. *M8 cylinder block screw*

NOTE: Before splitting the cylinder block, measure crankshaft and balancer shaft axial play. Refer to *CRANKSHAFT* and *BALANCER SHAFT* in this subsection.

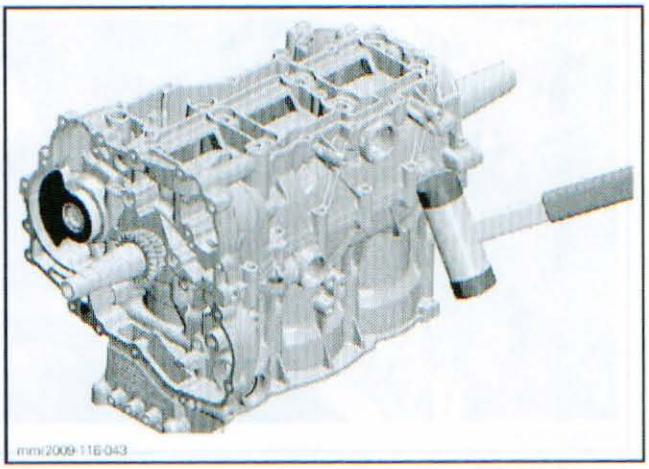
12. Remove cylinder block screws.



1. *Screws M6 x 30 (qty 13)*
2. *Screws M8 x 70 (qty 4)*
3. *Screws M9 x 113 (qty 8)*

13. Carefully remove cylinder block lower half by using a soft hammer.

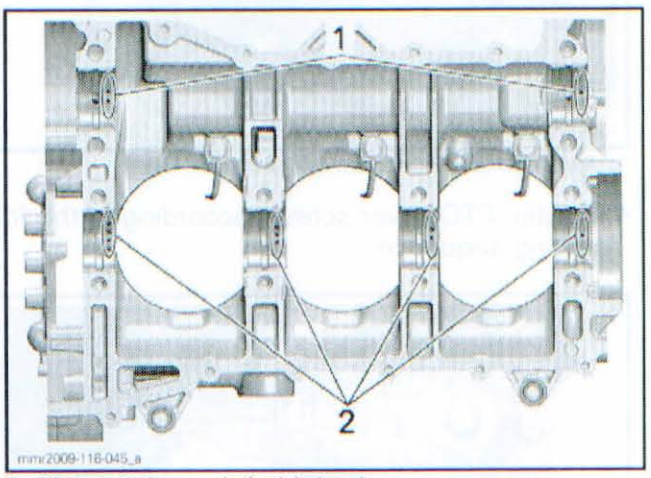
NOTE: Ensure not to damage the sealing surface of the cylinder block halves.



14. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS*.
15. Remove balancer shaft and crankshaft. See procedure in this subsection.
16. Remove crankshaft thrust washers.
17. Remove pistons and connecting rods. See procedure in this subsection.

Plain Bearing Removal

When the plain bearings need to be removed from the cylinder block, mark them to identify the correct position at installation. See the following illustration for an example.

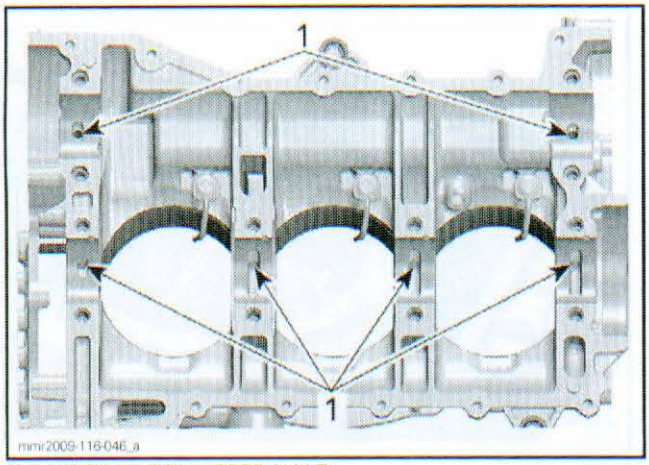


1. *Mark on balancer shaft plain bearings*
2. *Mark on crankshaft plain bearings*

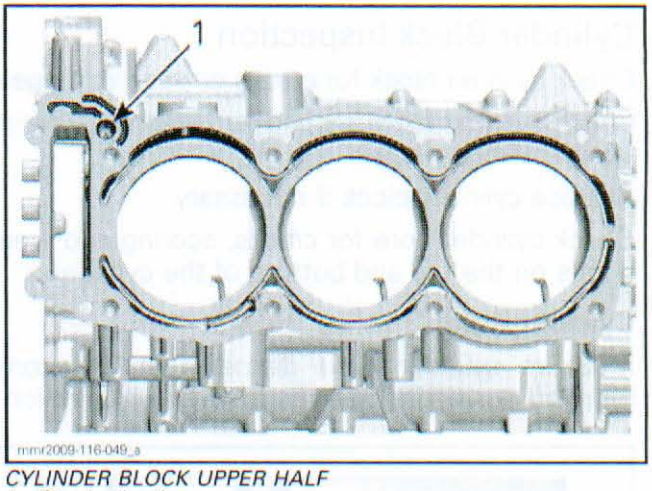
Cylinder Block Cleaning

Clean cylinder block using a part cleaner, then use compressed air to dry it.

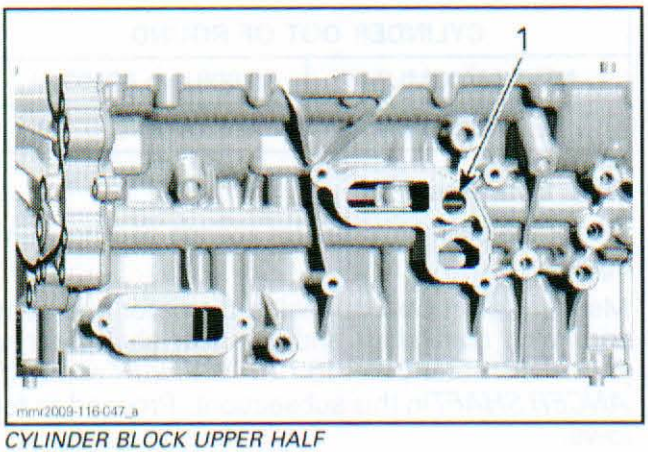
Blow out the oil orifices and check if they are not clogged.



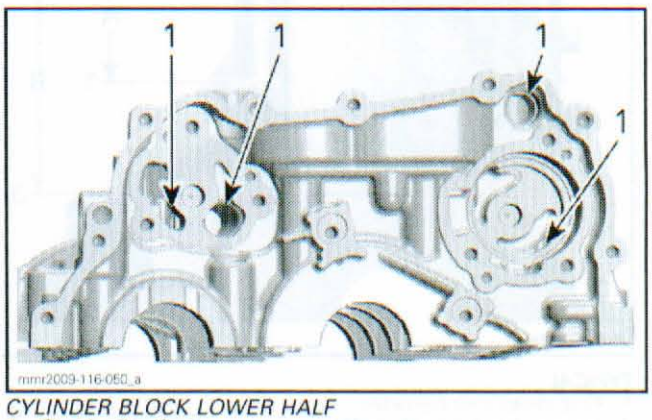
CYLINDER BLOCK UPPER HALF
1. Check oil orifices



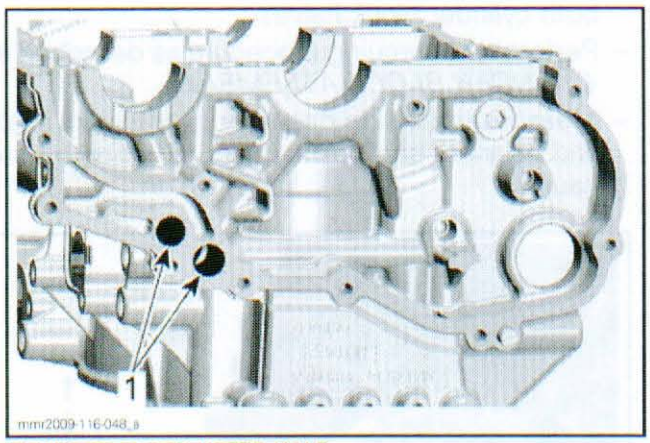
CYLINDER BLOCK UPPER HALF
1. Check oil orifice



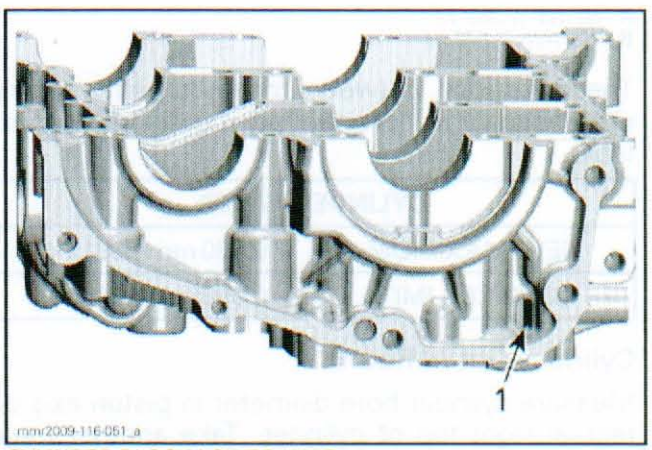
CYLINDER BLOCK UPPER HALF
1. Check oil orifice



CYLINDER BLOCK LOWER HALF
1. Check oil orifices



CYLINDER BLOCK UPPER HALF
1. Check oil orifices



CYLINDER BLOCK LOWER HALF
1. Check oil orifices

Clean all metal components in a solvent.

Clean cylinder block mating surfaces with LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

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

Cylinder Block Inspection

Check cylinder block for cracks or other damages.

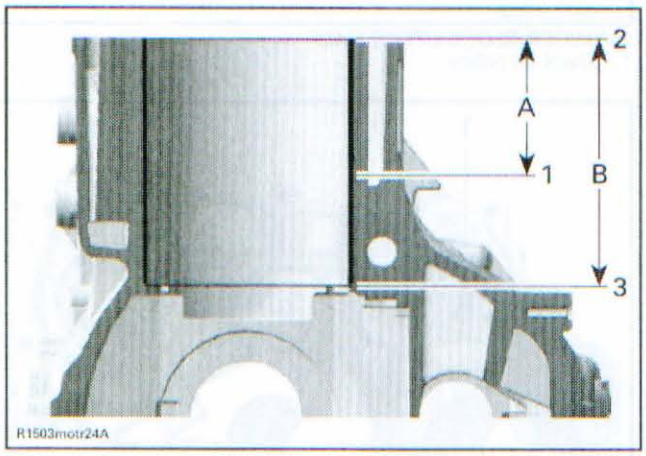
Check cylinder block mating surfaces for flatness using a straight edge.

Replace cylinder block if necessary.

Check cylinder bore for cracks, scoring and wear ridges on the top and bottom of the cylinder.

Cylinder Taper

Measure cylinder bore diameter at 3 recommended positions. See the following illustration.



TYPICAL
1. *First measuring diameter*
2. *Second measuring diameter*
3. *Third measuring diameter*

A. 60 mm (2.362 in)
B. 101 mm (3.976 in)

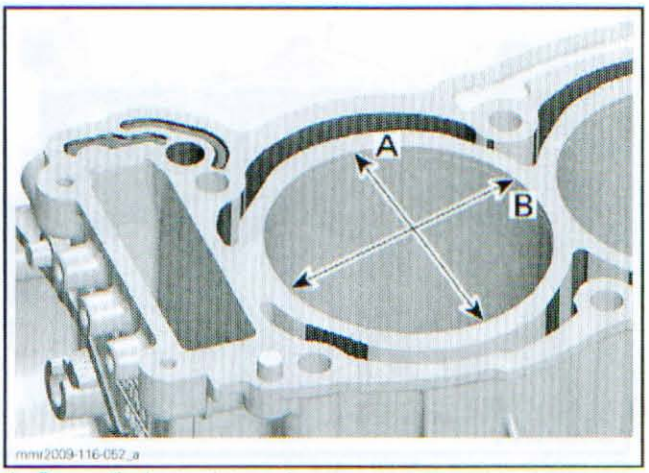
The difference between measurements should not exceed the service limit mentioned in next table.

CYLINDER TAPER	
NEW MAXIMUM	0.030 mm (.0012 in)
SERVICE LIMIT	0.090 mm (.0035 in)

Cylinder Out of Round

Measure cylinder bore diameter in piston axis direction from top of cylinder. Take another measurement 90° from first one and compare.

NOTE: Take the same measuring points as described in *CYLINDER TAPER*.



A. Perpendicular to piston axis
B. Parallel to piston axis

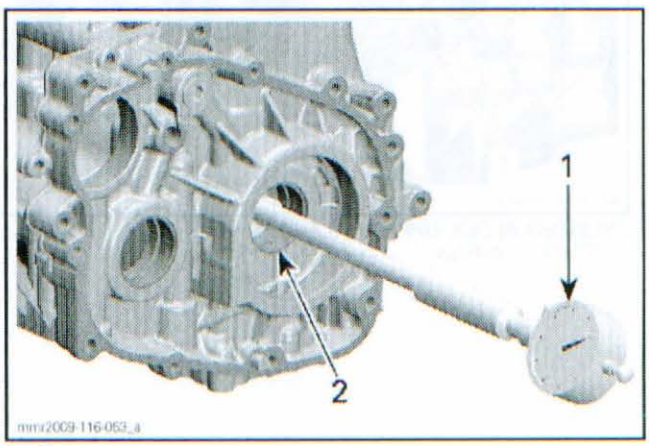
CYLINDER OUT OF ROUND	
NEW MAXIMUM	0.008 mm (.0003 in)
SERVICE LIMIT	0.050 mm (.002 in)

Plain Bearings

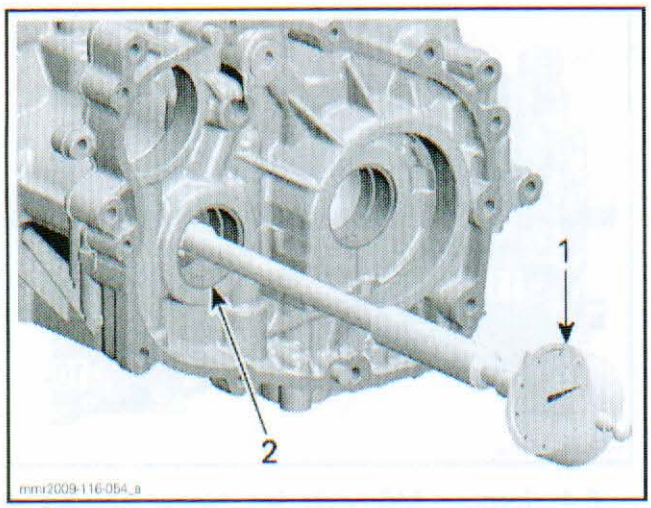
Check the plain bearings for scoring or other damages.

Measure plain bearing inside diameter and compare with crankshaft and balancer shaft bearing journal diameter (refer to *CRANKSHAFT* and *BALANCER SHAFT* in this subsection). Proceed as follows.

- Use the **OLD** plain bearings and put together both cylinder block halves.
- Perform the torquing procedure as described in *CYLINDER BLOCK ASSEMBLY*.
- Measure the inside diameter of the crankshaft and balancer shaft plain bearings, using a bore gauge.



1. *Bore gauge*
2. *Crankshaft plain bearing*



1. Bore gauge
2. Balancer shaft plain bearing

CRANKSHAFT/BALANCER SHAFT PLAIN BEARING INSIDE DIAMETER	
SERVICE LIMIT	36.100 mm (1.4213 in)

Replace bearings if they are out of specifications.

Oil Spray Nozzles

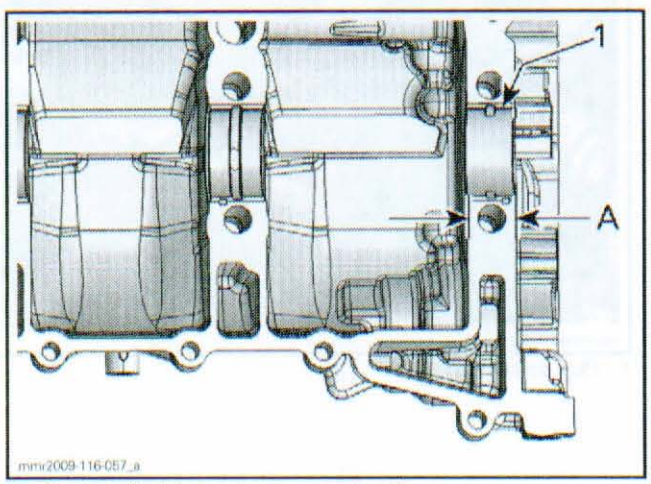
Clean the oil spray nozzles. Refer to *LUBRICATION SYSTEM* subsection.

Cylinder Block Assembly

For assembly, reverse the disassembly procedure. Pay attention to the following details.

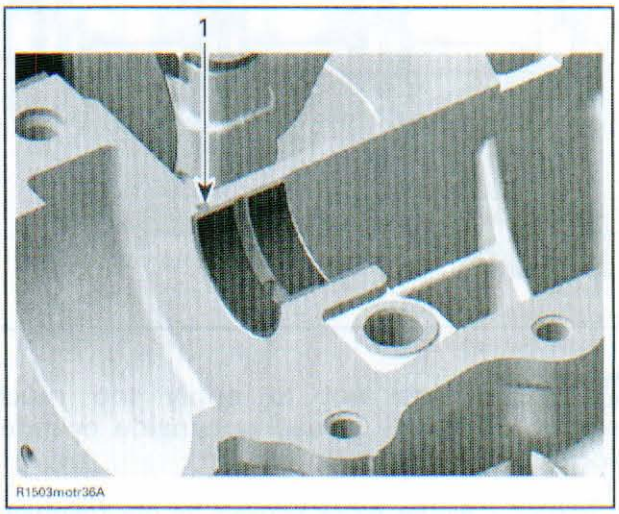
1. Correctly reinstall plain bearings as follows.
   1.1 Use **NEW** bearings if diameters are out of specification. Refer to *PLAIN BEARING INSPECTION* in this subsection.

   NOTE: The "narrow" plain bearing halves (20 mm (.787 in) wide) must be placed in crankshaft bearing seat, on magneto side.



1. Crankshaft plain bearing - magneto side
A. 20 mm (.787 in)

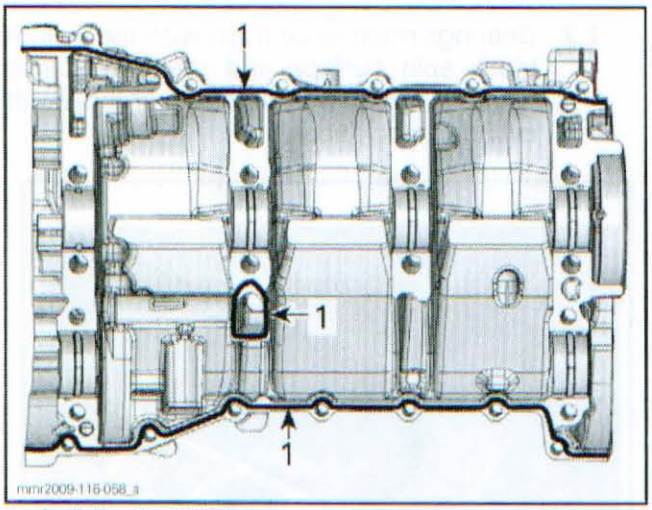
   1.2 Bearings must to be flush with the cylinder block split surface and their protrusions have to fit in the notched areas in the cylinder block seat.



TYPICAL
1. Bearing protrusion in cylinder block notch

2. Install pistons, refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Apply engine oil on all plain bearings.
4. Install the following components:
   - Crankshaft and thrust washers (refer to *CRANKSHAFT*)
   - Connecting rod caps (refer to *PISTONS AND CONNECTING RODS*)
   - Balancer shaft (refer to *BALANCER SHAFT*).
5. Apply LOCTITE 5910 (P/N 293 800 081) on mating surface of cylinder block lower half as shown on next illustration.

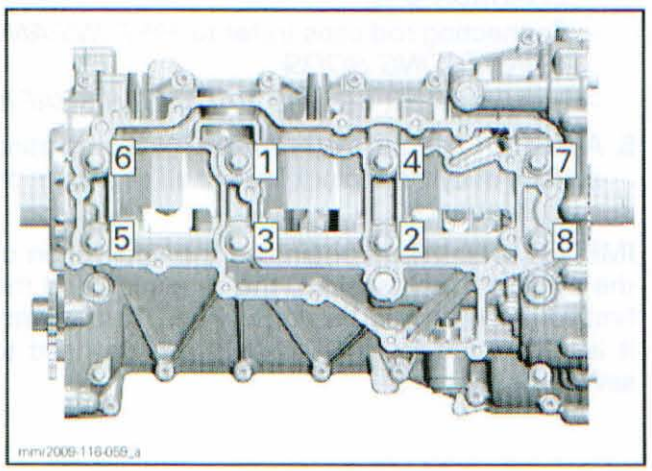
IMPORTANT: When beginning the application of the cylinder block sealant, the assembly and the first torquing should be done within 10 minutes. It is suggested to have all you need on hand to save time.



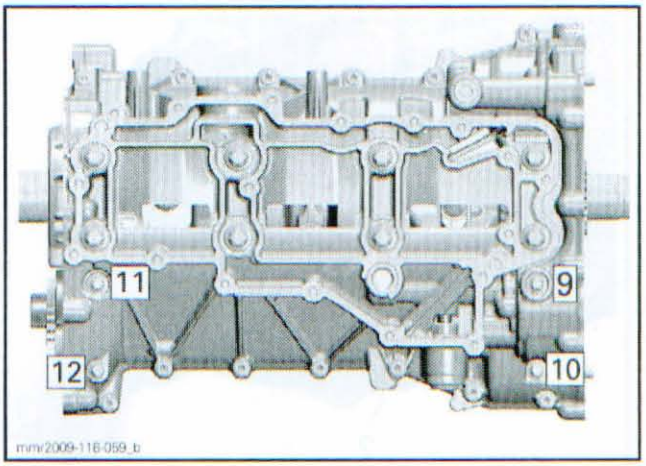
1. Apply Loctite 5910 here

NOTICE **Ensure not to apply too much sealant, as it will spread out inside cylinder block.**

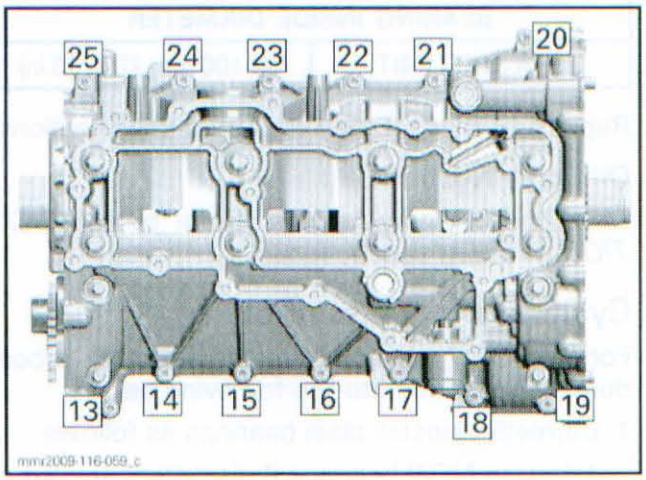
6. Tighten cylinder block screws as per following procedure.
   - 6.1 Torque M9 cylinder block screws to 20 N•m (15 lbf•ft) following the sequence 1 to 8.
   - 6.2 Using the same sequence, torque an additional 120° turn, using an torque angle gauge.



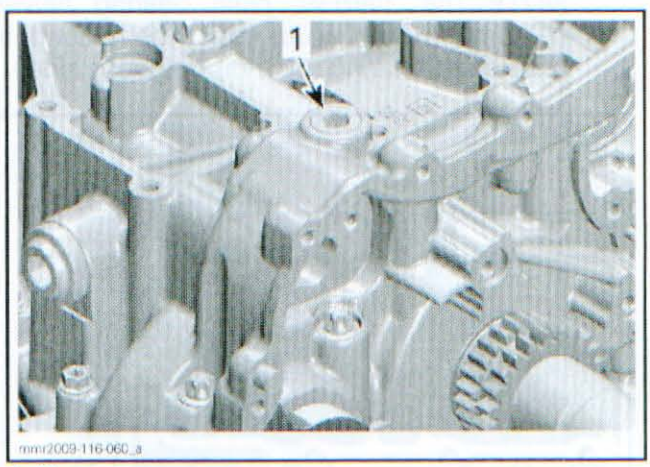
- 6.3 Torque M8 cylinder block screws to 25 N•m (18 lbf•ft) following the sequence 9 to 12.



- 6.4 Torque M6 cylinder block screws to 11 N•m (97 lbf•**in**) following the sequence 13 to 25.



7. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on plug screw and torque to 16 N•m (142 lbf•**in**).



1. Plug screw

NOTE: Before continuing the assembly process, the axial clearance of balancer shaft and crankshaft has to be checked. Refer to *CRANKSHAFT* and *BALANCER SHAFT* in this subsection for the procedure.

8. Reassemble engine in accordance with the proper assembly procedures.

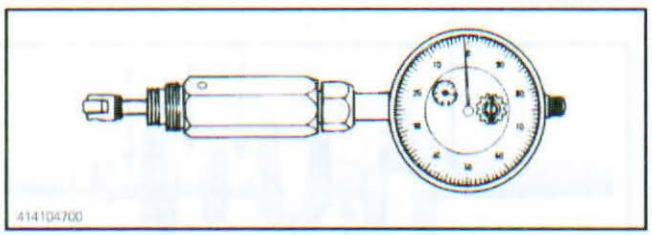
CRANKSHAFT

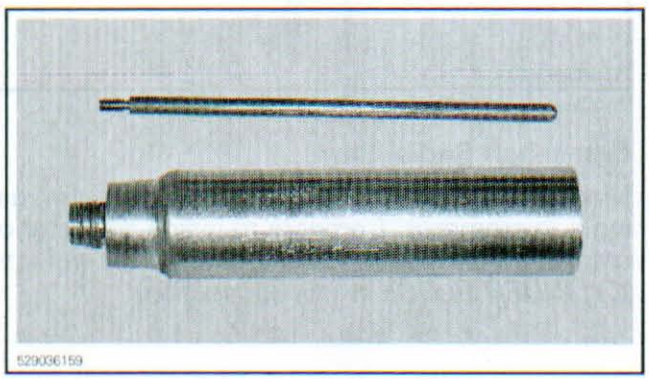
Crankshaft Locking Procedure

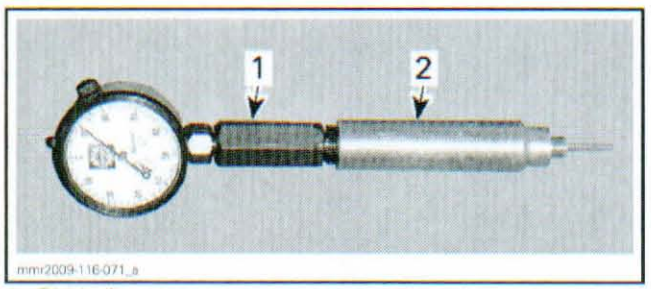
NOTICE **The crankshaft must be locked at TDC for removal and installation work on crankshaft, balancer shaft and camshaft.**

NOTE: When the crankshaft is locked, the piston of cylinder no. 2 is at overlapping TDC. Crankshaft can be not locked at cylinder no. 1 and no. 3 TDC.

1. Remove the valve cover. Refer to *CYLINDER HEAD* subsection.
2. Remove spark plugs.
3. Remove the tip at the end of the TDC DIAL INDICATOR (P/N 414 104 700) and install the DIAL INDICATOR ADAPTER (P/N 529 036 159).

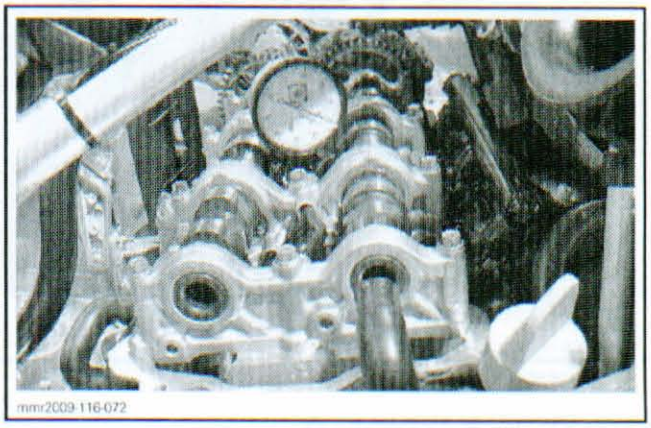




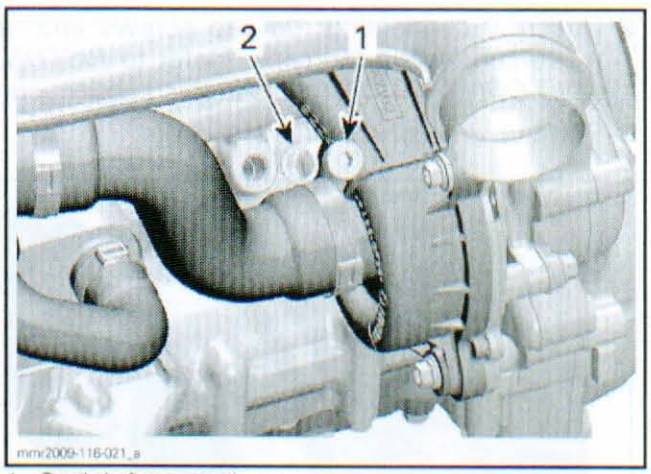


1. *Dial indicator*
2. *Dial indicator adaptor*

4. Install the dial indicator in spark plug hole of cylinder no. 2.

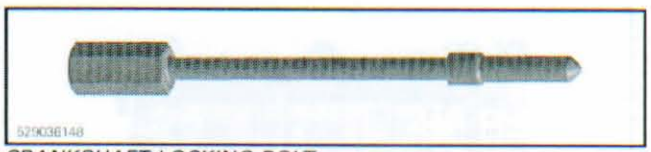


5. Remove crankshaft access plug screw and gasket ring.

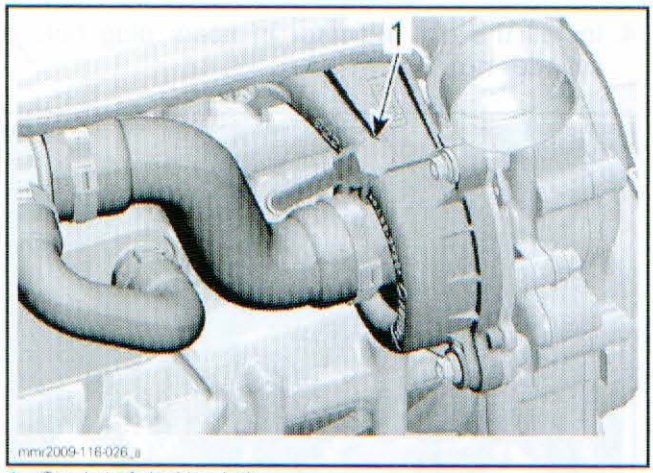


1. *Crankshaft access plug screw*
2. *Gasket ring*

6. Turn engine counterclockwise to bring piston of cylinder no. 2 to overlapping TDC.
7. Use a small screwdriver to check if the groove in the crankshaft is aligned with the hole.
8. Lock crankshaft by using the CRANKSHAFT LOCKING BOLT (P/N 529 036 148).



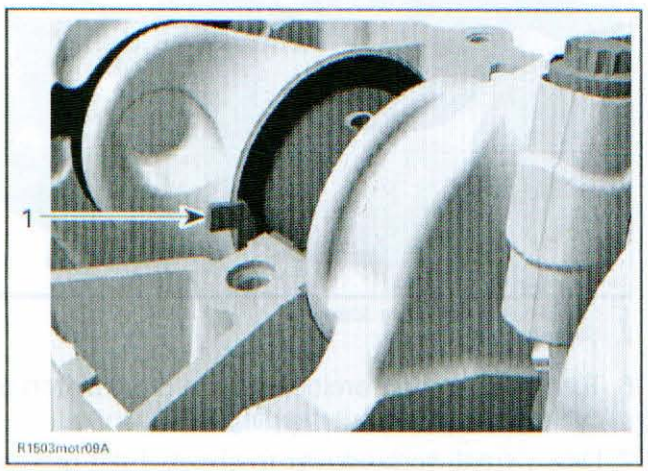
CRANKSHAFT LOCKING BOLT



1. Crankshaft locking bolt

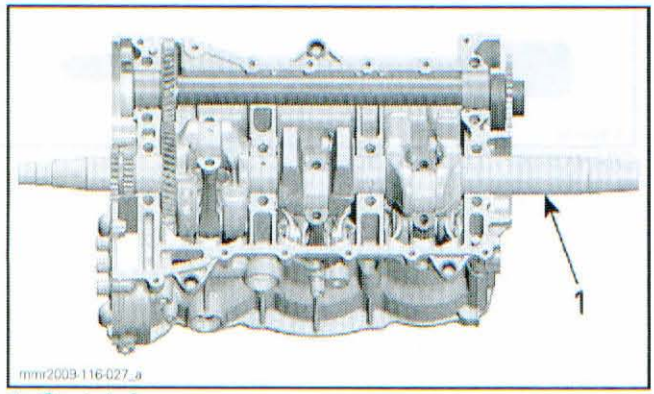
Crankshaft Removal

1. Disassemble *CYLINDER BLOCK*, see procedure in this subsection.
2. Unscrew connecting rod cap screws and remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Remove crankshaft thrust washers.



TYPICAL
1. Thrust washer

4. Remove crankshaft from cylinder block.

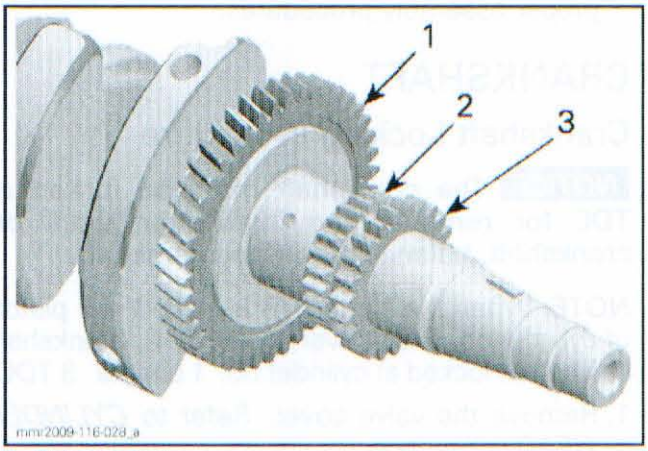


1. Crankshaft

Crankshaft Inspection

Check each bearing journal of crankshaft for scoring, scuffing, cracks or other signs of wear.

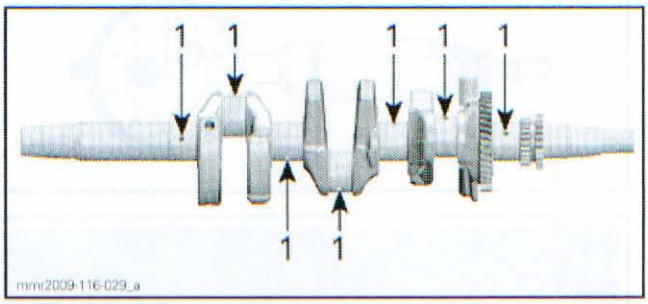
Check if crankshaft gears are worn or otherwise damaged.



1. Balancer gear
2. Crankshaft timing gear
3. Oil pump drive gear

Replace crankshaft if damaged.

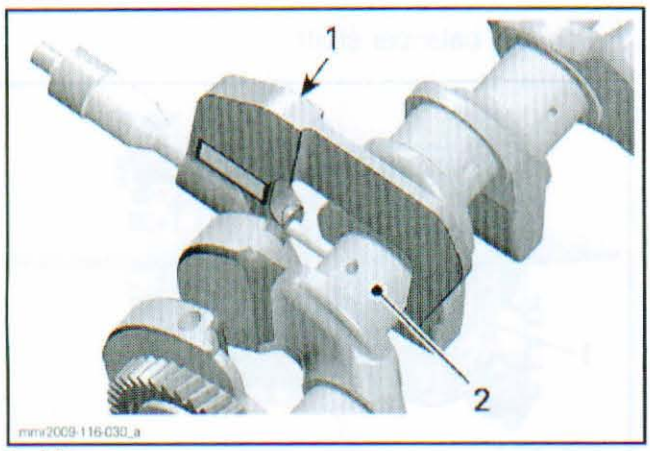
Blow out the oil orifices and check if they are not clogged.



1. Check oil orifices

Crankshaft Radial Play

Measure crankshaft bearing journal diameter, using a micrometer. Compare to inside diameter of crankshaft plain bearings in cylinder block (refer to *CYLINDER BLOCK* in this subsection).



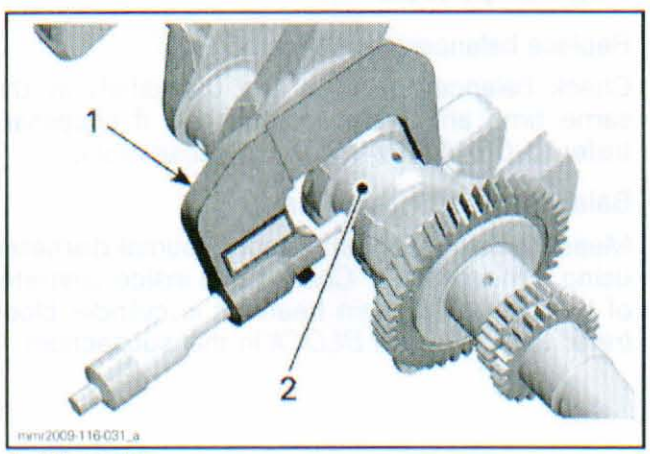
1. *Micrometer*
2. *Crankshaft area for plain bearing*

CRANKSHAFT BEARING JOURNAL DIAMETER	
NEW	35.984 mm to 36.000 mm (1.4167 in to 1.4173 in)
SERVICE LIMIT	35.970 mm (1.4161 in)

CRANKSHAFT RADIAL PLAY	
SERVICE LIMIT	0.10 mm (.0039 in)

Crankshaft Pin Diameter

Measure crankshaft pin diameter, using a micrometer. Compare to inside diameter of connecting rod plain bearings (refer to *CONNECTING ROD INSPECTION* in this subsection).



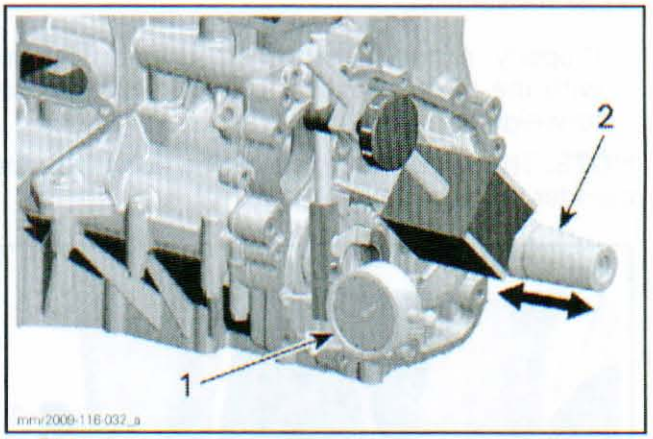
1. *Micrometer*
2. *Crankshaft pin area for plain bearing*

CRANKSHAFT PIN DIAMETER	
NEW	37.984 mm to 38.000 mm (1.4954 in to 1.4961 in)
SERVICE LIMIT	37.970 mm (1.4949 in)

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.08 mm (.0031 in)

Crankshaft Axial Play

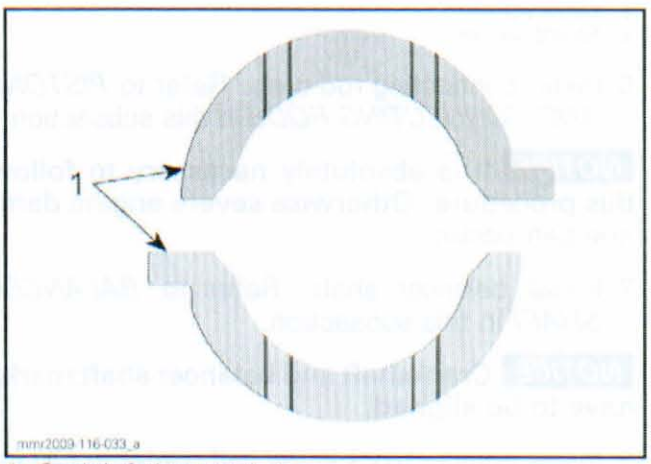
With the crankshaft in cylinder-block, measure the crankshaft axial play, using a dial indicator.



1. *Dial indicator*
2. *Crankshaft*

CRANKSHAFT AXIAL PLAY	
NEW	0.080 mm to 0.313 mm (.0031 in to .0123 in)
SERVICE LIMIT	0.350 mm (.0138 in)

If play is out of specification, replace the crankshaft thrust washers and repeat measurement.



1. *Crankshaft thrust washers*

Crankshaft Installation

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

1. Install pistons and connecting rods in the cylinder block.
2. Turn cylinder block upside down.

NOTICE **Be careful that connecting rods do not hit the cylinder block.**

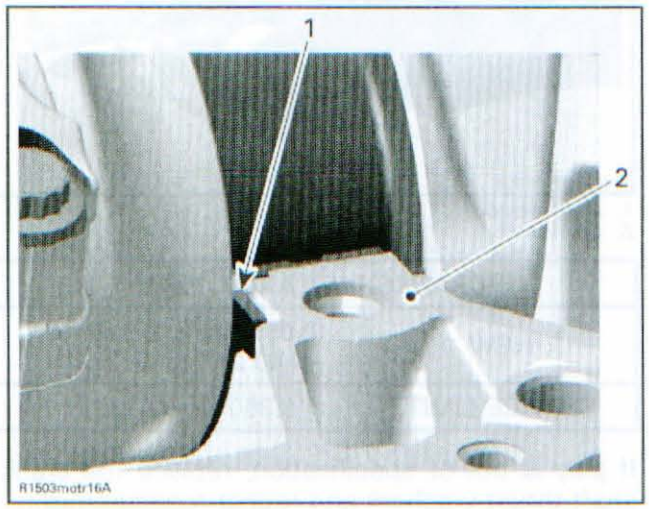
3. Apply engine oil on all plain bearings.

4. Install crankshaft.

NOTICE **If the oil spray nozzle is damaged, it must be replaced. Refer to *LUBRICATION SYSTEM* subsection.**

5. Properly reinstall crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Thrust washers have to be flush with the cylinder block sealing surface.



TYPICAL
1. *Thrust washer*
2. *Sealing surface*

6. Install connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTICE **It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.**

7. Install balancer shaft. Refer to *BALANCER SHAFT* in this subsection.

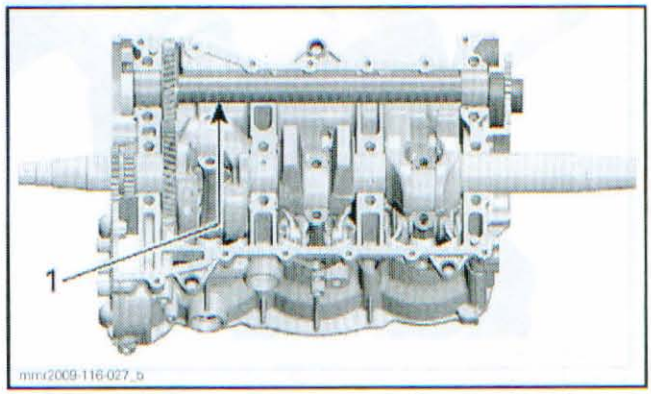
NOTICE **Crankshaft and balancer shaft marks have to be aligned.**

8. Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.
9. Install the CRANKSHAFT LOCKING BOLT (P/N 529 036 148) to position crankshaft at TDC, before further assembly of the engine. See *CRANKSHAFT LOCKING PROCEDURE* in this subsection.

BALANCER SHAFT

Balancer Shaft Removal

1. Disassemble *CYLINDER BLOCK*, see procedure in this subsection.
2. Remove balancer shaft.

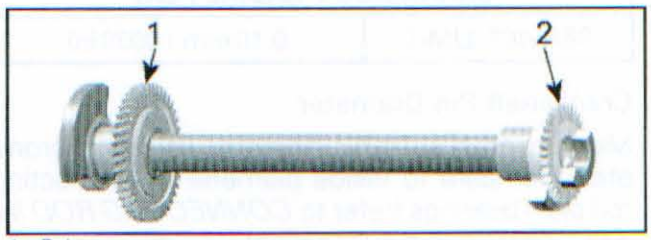


1. *Balancer shaft*

Balancer Shaft Inspection

Check each bearing journal of balancer shaft for scoring, scuffing, cracks or other signs of wear.

Check if balancer shaft gears are worn or otherwise damaged.



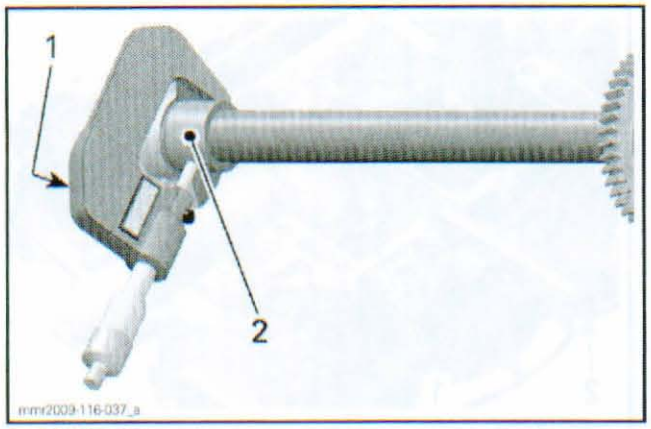
1. *Balancer gear*
2. *Water pump drive gear*

Replace balancer shaft if damaged.

Check balancer gear on the crankshaft at the same time and replace crankshaft if necessary (refer to *CRANKSHAFT* in this subsection).

Balancer Shaft Radial Play

Measure balancer shaft bearing journal diameter, using a micrometer. Compare to inside diameter of balancer shaft plain bearings in cylinder block (refer to *CYLINDER BLOCK* in this subsection).



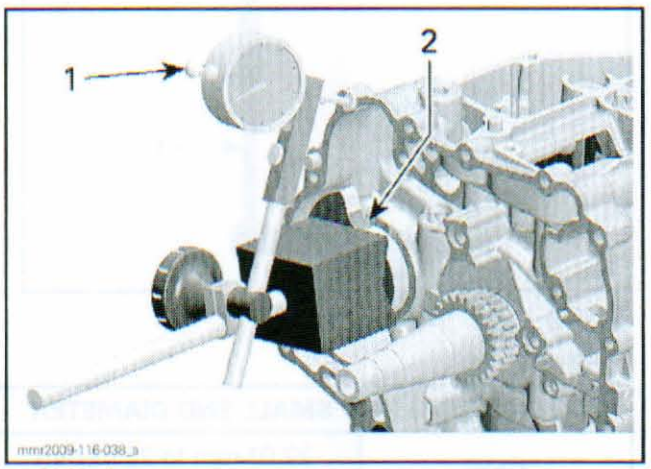
1. *Micrometer*
2. *Balancer shaft area for plain bearing*

BALANCER SHAFT BEARING JOURNAL DIAMETER	
NEW	35.984 mm to 36.000 mm (1.4167 in to 1.4173 in)
SERVICE LIMIT	35.970 mm (1.4161 in)

BALANCER SHAFT RADIAL PLAY	
SERVICE LIMIT	0.10 mm (.0039 in)

Balancer Shaft Axial Play

With the balancer shaft in cylinder-block, measure the balance shaft axial play, using a dial indicator.



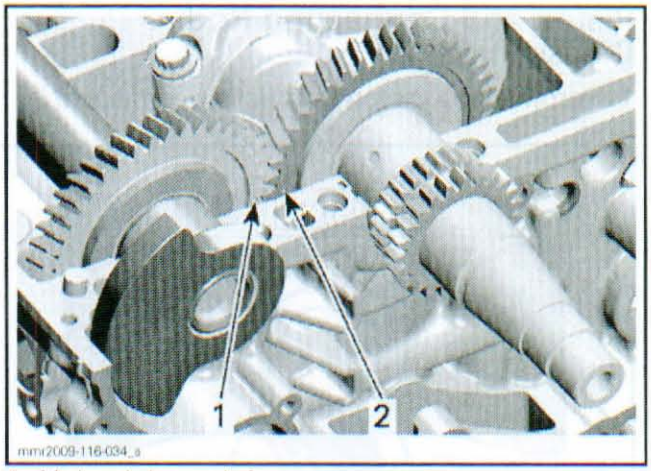
1. *Dial indicator*
2. *Balancer shaft*

BALANCER SHAFT AXIAL PLAY	
NEW	0.10 mm to 0.23 mm (.0039 in to .0091 in)
SERVICE LIMIT	0.35 mm (.0138 in)

Balancer Shaft Installation

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

NOTICE Balancer shaft and crankshaft marks have to be aligned.



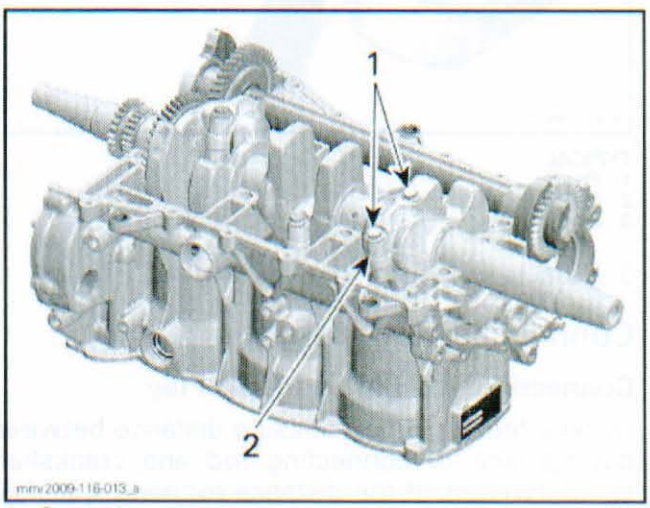
1. *Mark on balancer shaft*
2. *Mark on crankshaft*

PISTONS AND CONNECTING RODS

Piston and Connecting Rod Removal

1. Disassemble *CYLINDER BLOCK* as per procedure in this subsection.
2. Unscrew connecting rod screws and remove connecting rod cap.

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 *CONNECTING ROD INSPECTION*.



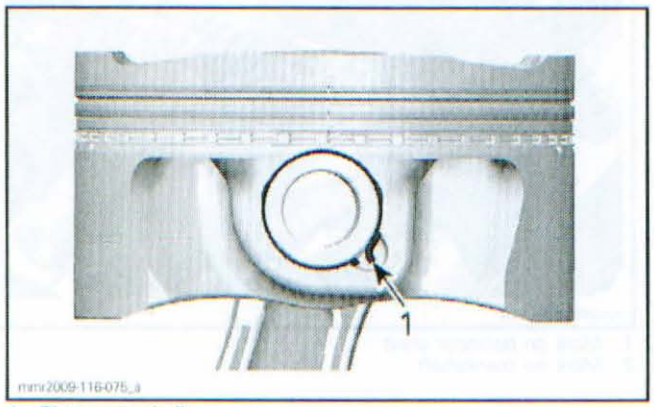
1. *Connecting rod screws*
2. *Connecting rod cap*

3. Remove *CRANKSHAFT* and *BALANCER SHAFT* as per procedure in this subsection.

4. Turn cylinder block and push piston with connecting rod out of the cylinder.

Piston and Connecting Rod Disassembly

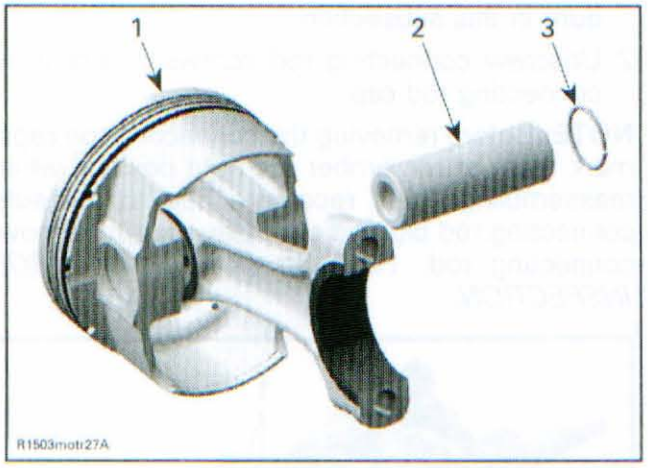
1. Remove one piston pin circlip and discard it.



1. Piston pin circlip

NOTE: The removal of both piston pin circlips is not necessary to remove piston pin.

2. Push piston pin out of piston.



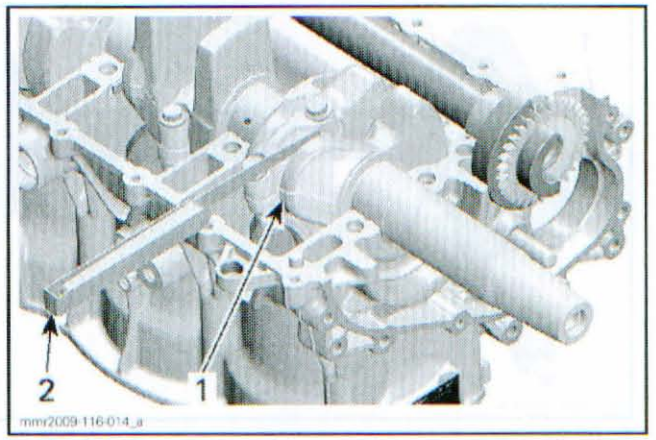
TYPICAL
1. Piston
2. Piston pin
3. Circlip

3. 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.

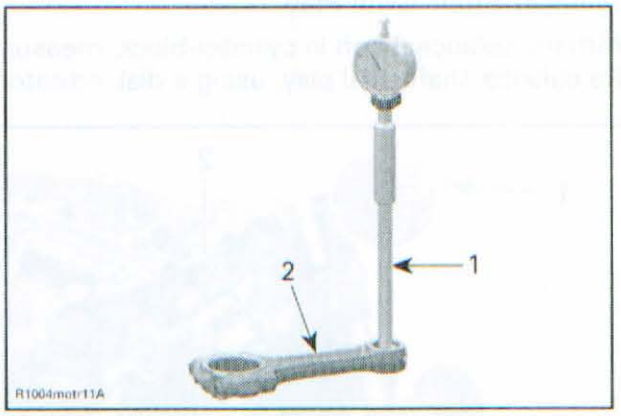


1. Crankshaft
2. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY	
NEW	0.100 mm to 0.352 mm (.004 in to .014 in)
SERVICE LIMIT	0.400 mm (.016 in)

Connecting Rod Small End Radial Play

Measure connecting rod small end, using a bore gauge.



TYPICAL
1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER	
NEW	22.01 mm to 22.02 mm (.8665 in to .8669 in)
SERVICE LIMIT	22.04 mm (.8677 in)

If the connecting rod small end diameter is out of specification, replace the connecting rod.

Measure piston pin diameter (refer to *PISTON PIN INSPECTION*) and compare to inside diameter of connecting rod to obtain connecting rod small end radial play.

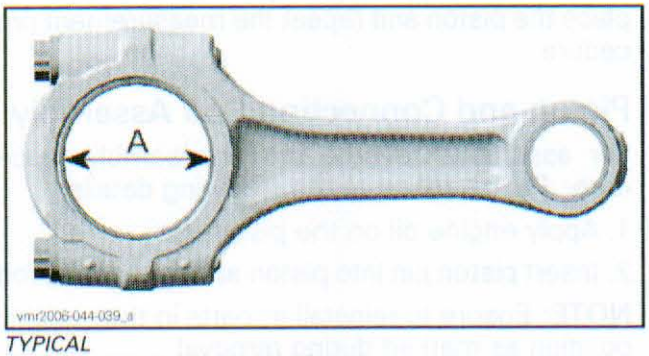
CONNECTING ROD SMALL END RADIAL PLAY	
SERVICE LIMIT	0.045 mm (.0018 in)

Connecting Rod Big End Radial Play

1. Measure inside diameter of connecting rod big end and compare to crankshaft pin diameter.
   1.1 Install the **OLD** plain bearings as they were mounted initially.
   1.2 Perform the torquing procedure as described in *PISTON AND CONNECTING ROD INSTALLATION* in this subsection.

   NOTE: To measure the connecting rod big end diameter, ALWAYS use the **OLD** connecting rod screws.

   1.3 Measure inside diameter.



TYPICAL
A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	38.060 mm (1.4984 in)

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.0031 in)

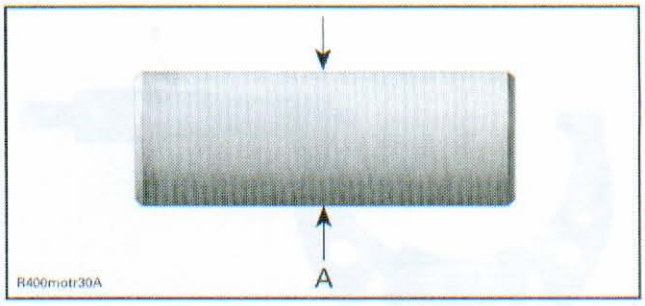
If connecting rod big end diameter is out of specification, install **NEW** plain bearings.

Piston Pin Inspection

Using synthetic abrasive woven, clean piston pin from deposits.

Inspect piston pin for scoring, cracking or other damages.

Measure piston pin diameter, using a micrometer. See the following illustration for the proper measurement position.



A. Measure piston pin diameter here

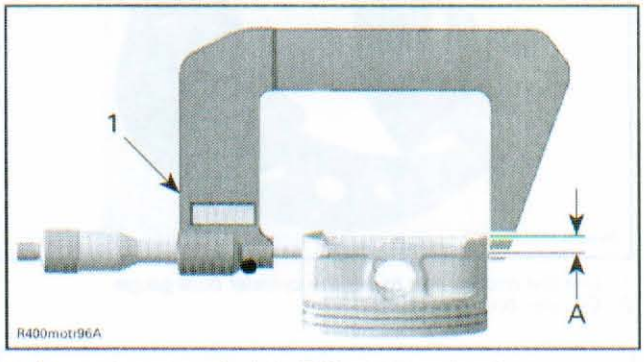
PISTON PIN DIAMETER	
NEW	21.991 mm to 21.996 mm (.8658 in to .866 in)
SERVICE LIMIT	21.985 mm (.8656 in)

Replace the piston pin, if it is out of specification.

Piston Inspection

Inspect piston for scoring, scuffing, cracking or other damages. Replace piston and piston rings if necessary.

Using a micrometer, measure piston at 8 mm (.315 in) perpendicularly (90°) to piston pin axis.



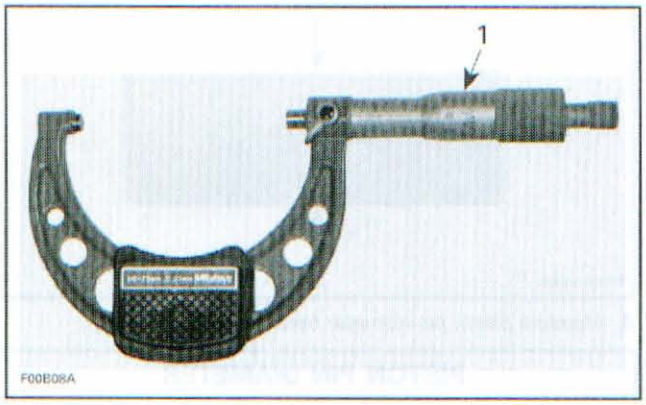
1. Measuring perpendicularly (90°) to piston pin axis
A. 8 mm (.315 in)

PISTON MEASUREMENT	
NEW NOMINAL	90.950 mm to 90.966 mm (3.5807 in to 3.5813 in)
SERVICE LIMIT	90.900 mm (3.5787 in)

Replace the piston, if it is out of specification.

Piston/Cylinder Clearance

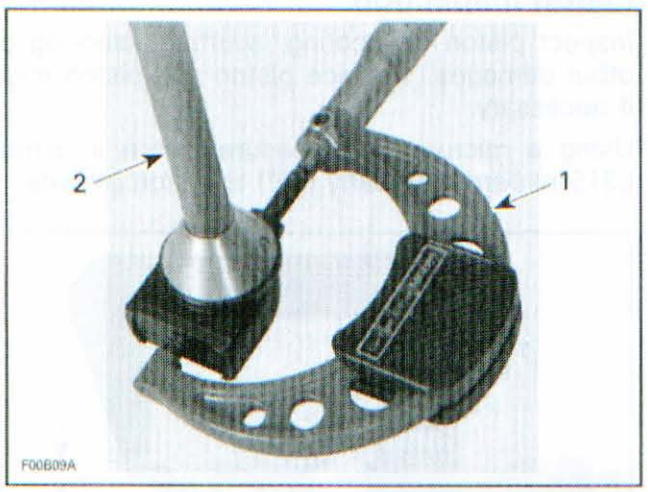
1. Adjust and lock a micrometer to the piston dimension.



1. Micrometer set to the piston dimension

NOTE: Make sure used piston is not worn.

2. 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. Cylinder 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.

3. Position the cylinder bore gauge 30 mm (1.181 in) below the cylinder head mating surface, measuring perpendicularly (90°) to piston pin axis.
4. Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder clearance.

PISTON/CYLINDER CLEARANCE	
NEW NOMINAL	0.027 mm to 0.057 mm (.0011 in to .0022 in)
SERVICE LIMIT	0.100 mm (.0039 in)

If clearance exceeds the specified tolerance, replace the piston and repeat the measurement procedure.

Piston and Connecting Rod Assembly

For assembly, reverse the disassembly procedure. Pay attention to the following details.

1. Apply engine oil on the piston pin.
2. Insert piston pin into piston and connecting rod.

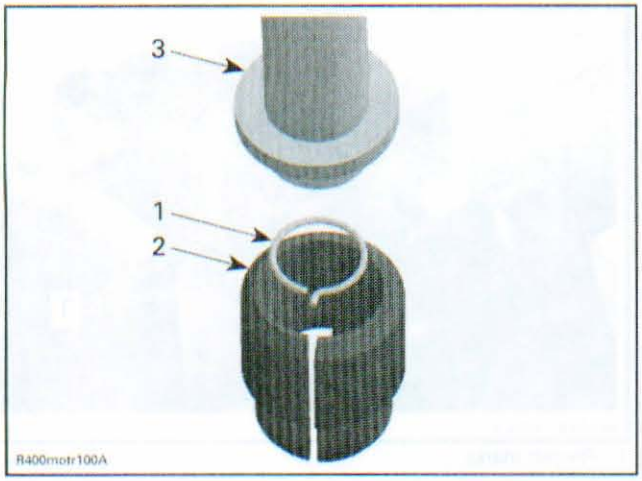
NOTE: Ensure to reinstall all parts in their original position as marked during removal.

3. Install **NEW** piston pin circlip(s) by using the PISTON CIRCLIP INSTALLER (P/N 529 036 153). Proceed as follows.

PISTON CIRCLIP INSTALLER 1203

NOTICE Always replace disassembled piston pin circlips by NEW ones.

3.1 Place circlip in sleeve as per following illustration.

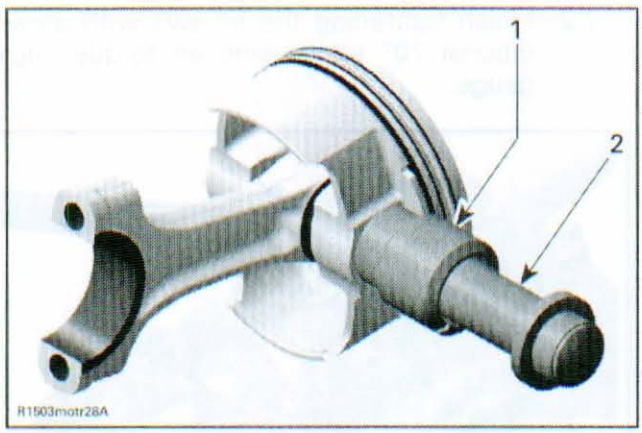


1. *Circlip*
2. *Sleeve*
3. *Piston circlip installer handle*

3.2 Push piston circlip installer handle until circlip reaches mid position in sleeve.

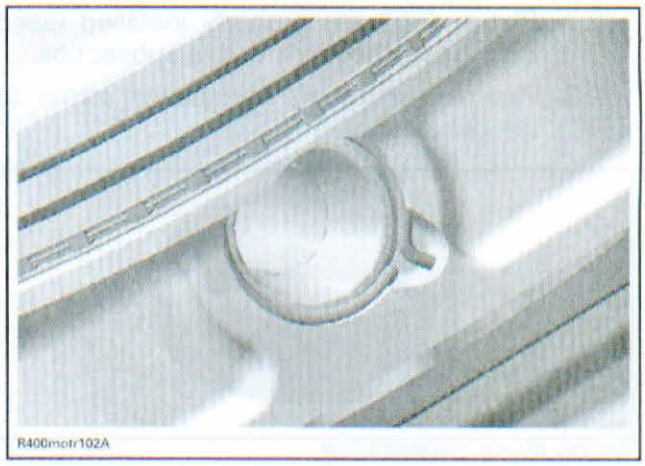
3.3 Insert the end of the handle into piston pin.

3.4 Hold piston and push handle to engage the circlip into piston groove.



TYPICAL
1. *Sleeve with piston circlip inside*
2. *Piston clip installer handle*

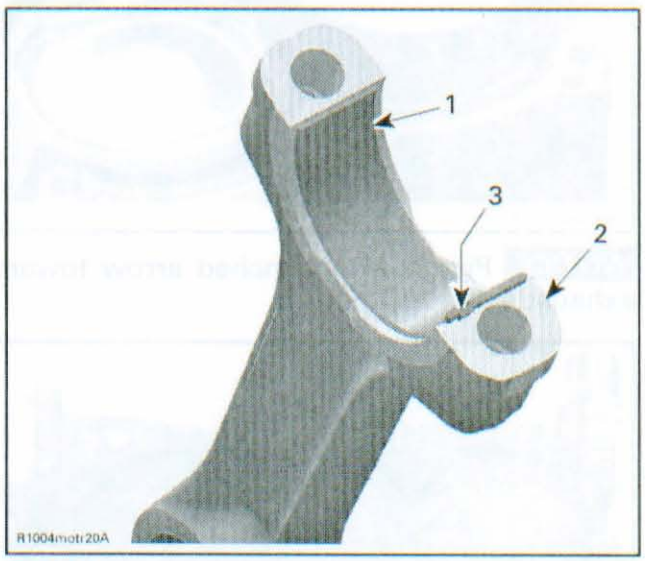
NOTE: Take care that the hook of the piston pin circlip is positioned properly.



CORRECT POSITION OF THE PISTON PIN CIRCLIP

NOTICE If piston pin circlip installation fails, repeat step 3 by using a NEW circlip.

4. Correctly install plain bearings and carefully clean split surface on both sides (cracked area).



TYPICAL
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*

Piston and Connecting Rod Installation

1. Use engine oil and lubricate:
   - Piston
   - Piston rings
   - Cylinder bore
   - Connecting rod bearings.
2. Slide piston into cylinder bore by using the PISTON RING COMPRESSOR (P/N 529 036 156). Pay attention to the following.

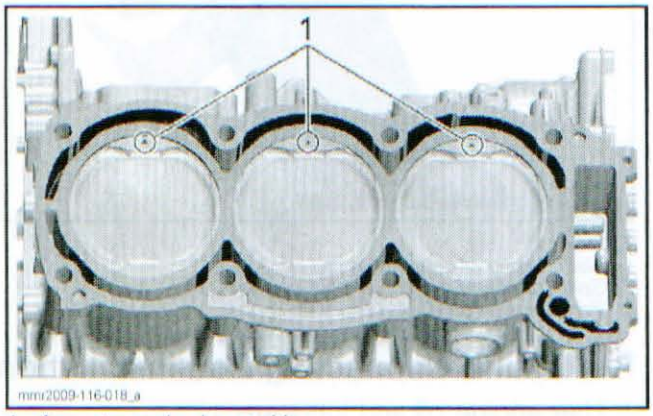
   2.1 If reused, install piston in its original bore.

2.2 Piston rings are properly installed (spacing). See procedure in this subsection.

2.3 Piston orientation. The punch arrow on the exhaust side.

PISTON RINGS COMPRESSOR

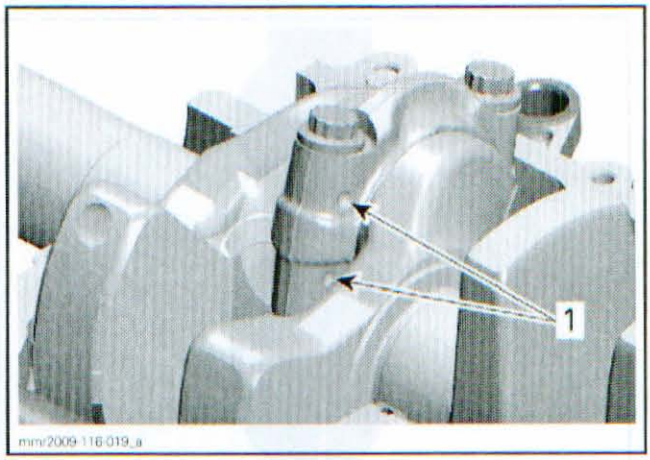
NOTICE Piston with punched arrow toward exhaust side.



1. Arrow toward exhaust side

3. Turn cylinder block upside down.
4. Install *CRANKSHAFT* as per procedure in this subsection.
5. Oil the crankshaft crank pin.
6. Install connecting rod caps.

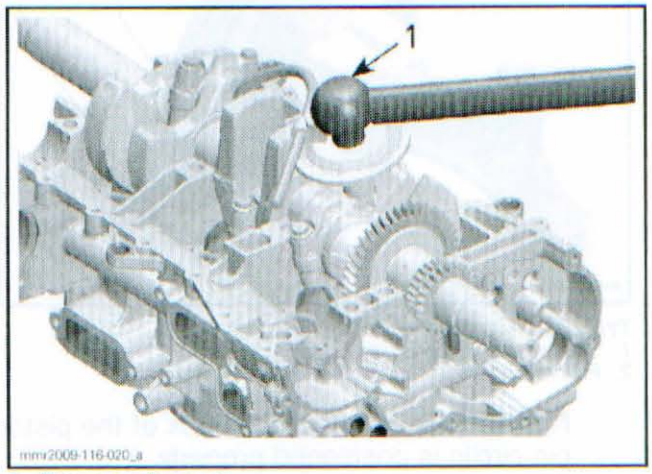
NOTE: Printed marks on connecting rod and cap must point together.



1. Printed marks

NOTICE Always use NEW connecting rod screws for the final assembly of the connecting rod. As the screws have been stretched from the previous assembly, it is very important to use NEW screws at assembly.

7. Apply oil on head of NEW connecting rod screws and torque as per following procedure.
   7.1 First, torque screws to 40 N•m (30 lbf•ft).
   7.2 Finish tightening the screws with an additional 70° turn, using an torque angle gauge.



1. Torque angle gauge

NOTICE Failure to strictly follow this procedure may cause screws to loosen and lead to severe engine damage.

8. Install *BALANCER SHAFT* as per procedure in this subsection.
9. Install all other removed parts.

PISTON RINGS

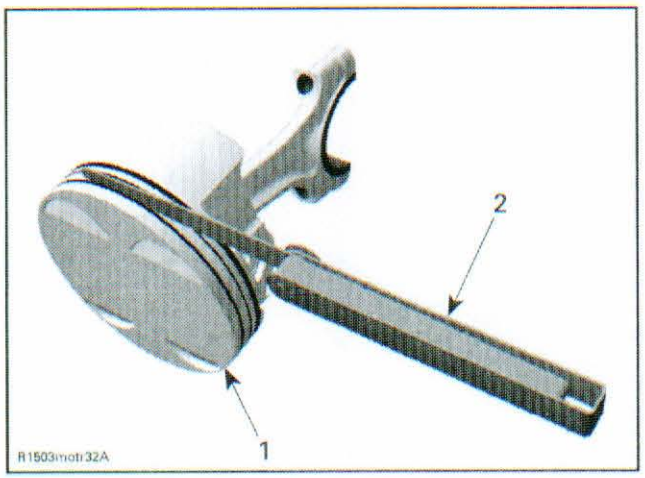
Piston Ring Removal

1. Remove piston, see procedure in this subsection.
2. Remove rings from piston.

Piston Ring Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance.



TYPICAL
1. Piston
2. Feeler gauge

RING/PISTON GROOVE CLEARANCE	
UPPER COMPRESSION RING	
NEW	0.030 mm to 0.070 mm (.0012 in to .0028 in)
SERVICE LIMIT	0.150 mm (.0059 in)
LOWER COMPRESSION RING	
NEW	0.020 mm to 0.060 mm (.0008 in to .0024 in)
SERVICE LIMIT	0.150 mm (.0059 in)
OIL SCRAPER RING	
NEW	0.010 mm to 0.180 mm (.0004 in to .0071 in)
SERVICE LIMIT	0.250 mm (.0098 in)

If the clearance is out of specification, the piston and rings should be replaced.

Ring End Gap

1. Place piston ring in the cylinder bore between 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 bore, use piston as a pusher.

2. Using a feeler gauge, check ring end gap.

RING END GAP	
UPPER COMPRESSION RING	
NEW	0.25 mm to 0.40 mm (.0098 in to .0157 in)
SERVICE LIMIT	0.60 mm (.0236 in)
LOWER COMPRESSION RING	
NEW	0.20 mm to 0.40 mm (.0079 in to .0157 in)
SERVICE LIMIT	0.70 mm (.0276 in)
OIL SCRAPER RING	
NEW	0.20 mm to 0.70 mm (.0079 in to .0276 in)
SERVICE LIMIT	1.00 mm (.0394 in)

If the ring end gap is out of specification, replace piston rings.

Piston Ring Installation

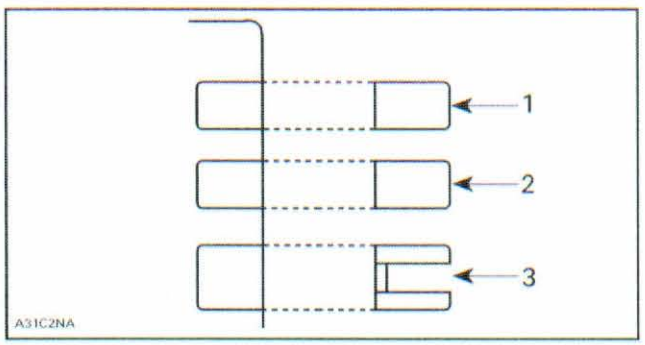
1. Install the piston rings in the following assembly order.

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

   1.1 Install oil scraper ring.

   1.2 Install the lower compression ring with the word "N and TOP" facing up.

   1.3 Install upper compression ring with the word "N and TOP" facing up.

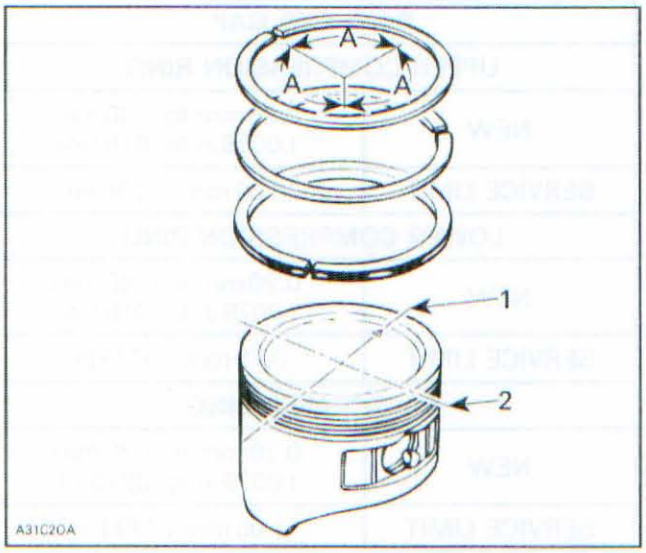


1. Upper compression ring
2. Lower compression ring
3. Oil scraper ring

NOTICE **Ensure that upper and lower compression rings are not interchanged.**

2. Check that rings rotate smoothly after installation.

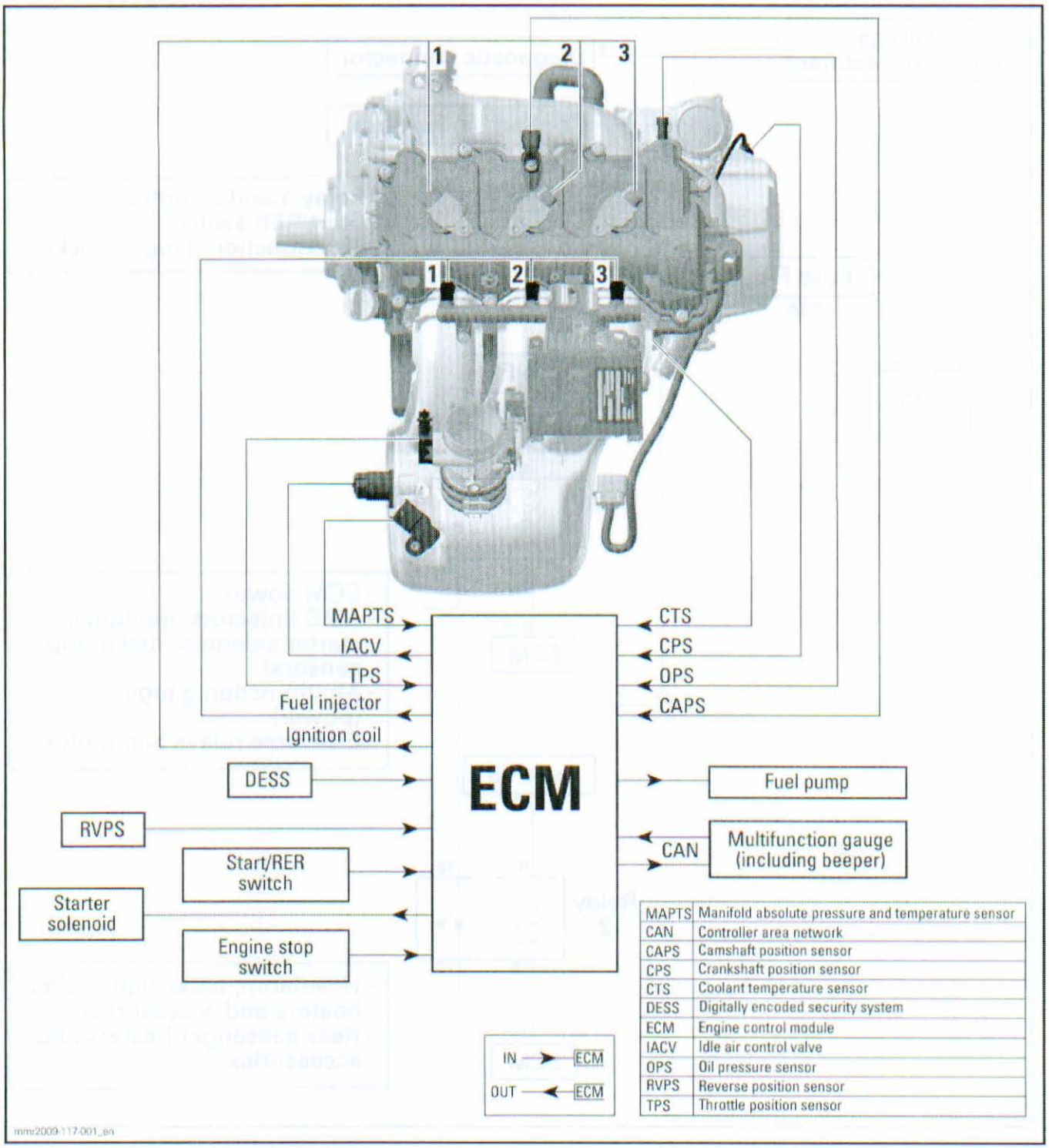
3. Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.



TYPICAL
1. *DO NOT align ring gap with piston trust side axis*
2. *DO NOT align ring gap with piston pin bore axis*

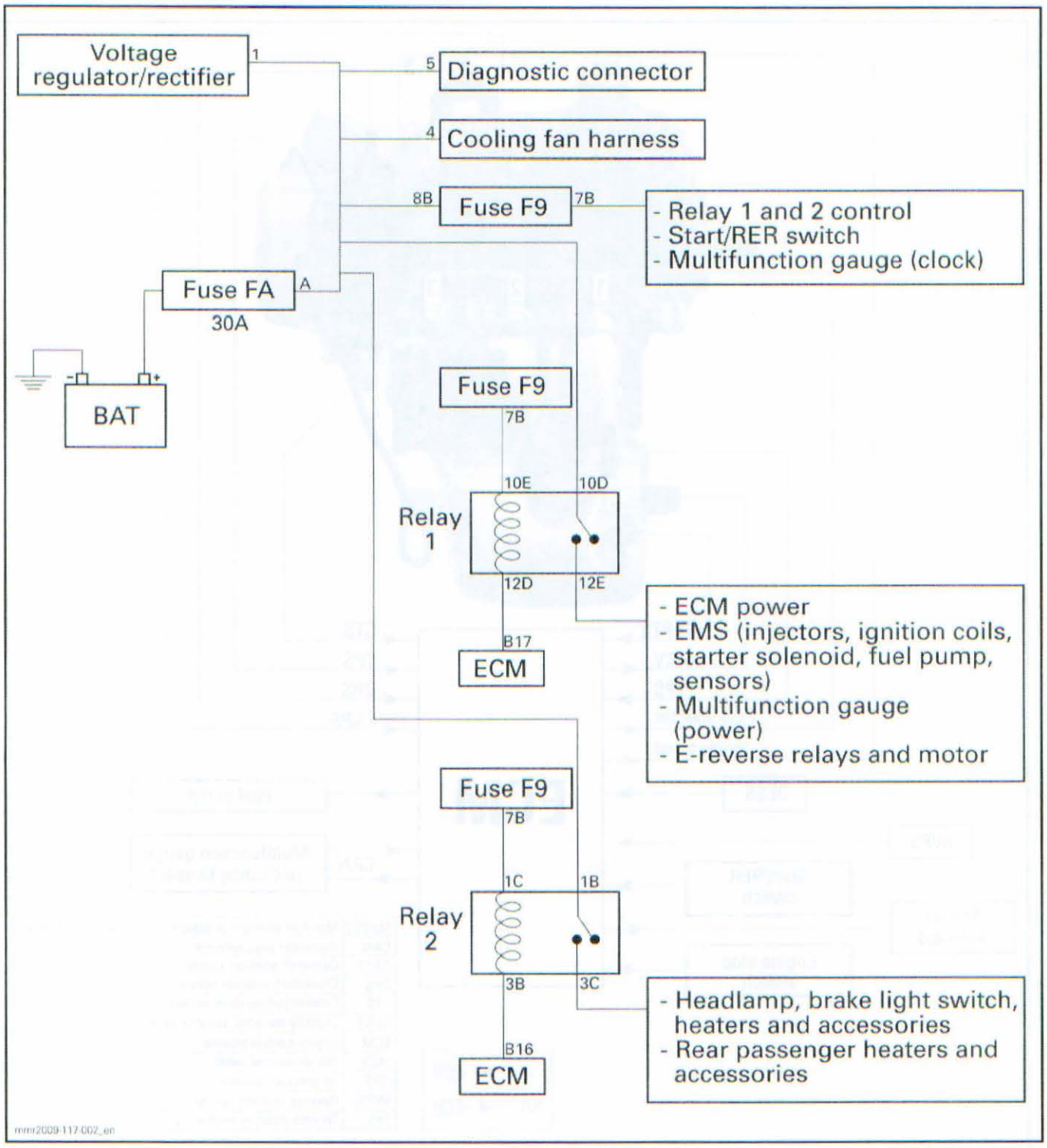
A. 120°

OVERVIEW



MAPTS	Manifold absolute pressure and temperature sensor
CAN	Controller area network
CAPS	Camshaft position sensor
CPS	Crankshaft position sensor
CTS	Coolant temperature sensor
DESS	Digitally encoded security system
ECM	Engine control module
IACV	Idle air control valve
OPS	Oil pressure sensor
RVPS	Reverse position sensor
TPS	Throttle position sensor

POWER DISTRIBUTION



GENERAL

SYSTEM DESCRIPTION

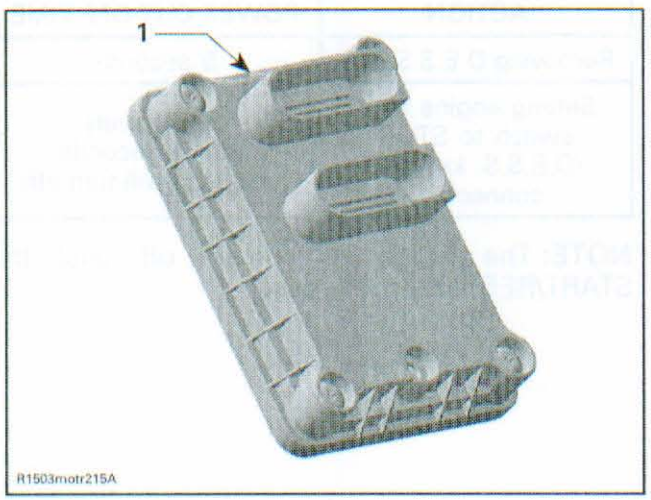
The engine management system (EMS) controls or interacts with the following systems:

- Electronic fuel injection (EFI)
- Digitally Encoded Security System (D.E.S.S.)
- Starting system
- Ignition system
- Electronic Reverse
- Lubrication system
- Electrical accessories.

The EMS also offers a monitoring system and diagnostic mode to help troubleshooting some problems. Refer to *MONITORING SYSTEM AND FAULT CODES* section for more details.

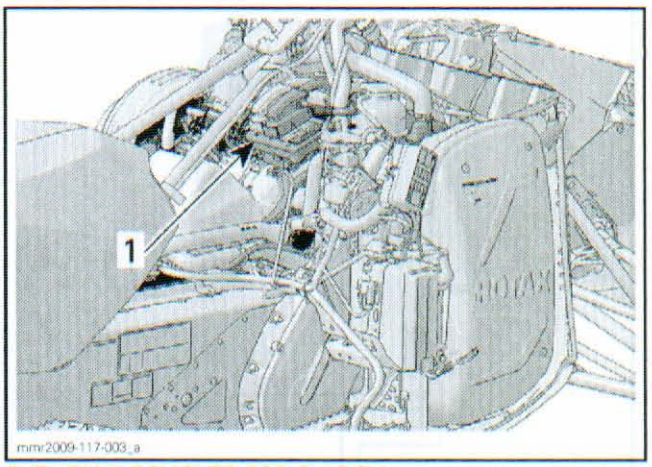
The power distribution is also controlled by the engine management system.

Engine Control Module (ECM)



1. TYPICAL ECM

The ECM is located below the front part of fuel tank.



FUEL TANK REMOVED FOR CLARITY
1. ECM

The ECM is the central point of the engine management system. It reads the inputs, makes computations, uses pre-determined parameters and sends the proper signals to the outputs for proper engine management.

The ECM features a permanent memory that will keep the fault codes, customer information and other engine information when the engine is stopped and when battery is removed.

Throttle Protection

If throttle is not completely closed during engine startup, engine will not start.

To revert to normal operation, release the throttle completely.

Engine Drowned Mode

This mode is intended to crank an engine that is fuel flooded. When this mode is active, fuel injectors and ignition coils are disabled.

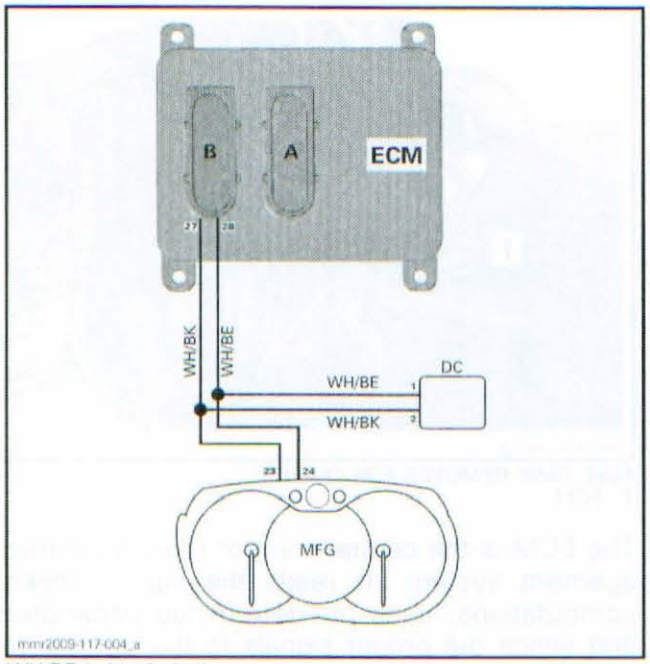
To activate the drowned mode:

1. Fully squeeze throttle lever and hold.
2. Press the START/RER button.
3. The mode is now on.

To exit this mode, release throttle and start engine normally.

Controller Area Network (CAN)

The CAN protocol is an ISO standard for serial data communication. The CAN bus links the ECM and the multifunction gauge. Two wires connect each component and they are in constant communication with each other. CAN lines consist of a pair of wires (WHITE/BEIGE and WHITE/BLACK).



WH/BE (white/beige)
WH/BK (white/black)
MFG (multifunction gauge)
ECM (electronic control module)
DC (diagnostic connector)

Fault codes are broadcasted to the CAN bus and can be displayed in B.U.D.S. or in the premium multifunction gauge.

Power Distribution

All the electrical system is powered by DC current supplied by a 12 V battery. The battery charge is maintained by the charging system.

Electrical system is protected by fuses located in the fuse box. Refer to *LIGHTS, INSTRUMENTS AND ACCESSORIES*.

The system uses 2 relays that control different electrical components.

Relay 1 Functions

When the START/RER button is briefly pressed or held, it wakes up the ECM that in turn, powers the relay 1. At this point, the fuel pump is activated for approximately 2 seconds to build up pressure in the fuel system. Also, engine-related sensors and injectors are continuously powered. **The ECM switches the ground to complete the electrical circuits it controls.**

If the engine stop switch is in the RUN position and the D.E.S.S. key is present while the START/RER button is held, the starter solenoid is activated and engine starts.

Relay 2 Functions

When engine reaches approximately 500 RPM, the ECM activates the relay 2. At this point, lights, heaters and accessories are powered.

Multifunction Gauge Current Supply

Multifunction gauge is powered for approximately 20 seconds when briefly pressing the START/RER button.

NOTE: The clock power line in gauge is permanently powered by the vehicle battery.

Automatic Power Cut-Off

The ECM features an automatic power cut-off that will completely turn off the ECM (after engine was running) and thus cutting all power to components. All the vehicle electrical loads will be turned off (except the clock in the multifunction gauge). This feature prevents the battery from discharging if the D.E.S.S. key is left on its post when the engine is not running.

The cut-off time is as follows.

ACTION	POWER CUT-OFF TIME
Removing D.E.S.S. key	5 seconds
Setting engine stop switch to STOP (D.E.S.S. key still connected)	30 seconds (after 5 seconds, headlamp will turn off)

NOTE: The ECM will remain off until the START/RER button is pressed.

COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE

SERVICE TOOLS

Description	Part Number	Page
D.E.S.S. POST INTERFACE	529 036 019	161
MPI-2 DIAGNOSTIC CABLE	710 000 851	161
MPI-2 INTERFACE CARD	529 036 018	159
T-HARNESS	529 035 869	158, 160

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
MALE-FEMALE EXTENSION SERIAL CABLE	DB9	161–162

GENERAL

Refer to *PROCEDURES* for instructions on the communication tools.

If communication problems occurs, refer to *TROUBLESHOOTING*.

TROUBLESHOOTING

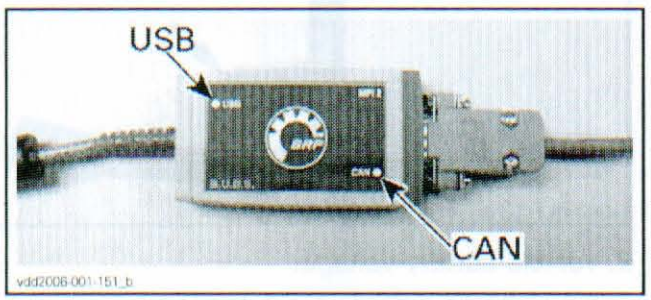
DIAGNOSTIC TIPS

IMPORTANT: Make sure all connections have been made **before starting B.U.D.S.** to allow proper operation.

MPI-2 Connection Troubleshooting

The MPI-2 includes 2 status lights to show the connection conditions: USB and CAN.
Both lights must be GREEN so that MPI-2 works properly. Otherwise, refer to the following charts.

Flashing GREEN lights indicate the communication is active.



Prerequisite for USB Communication:
- PC Computer turned on.
- MPI-2 connected to PC computer.

COMMUNICATION PROBLEM (USB)	
STATUS	WHAT TO DO
Light is OFF	– Check USB connection between MPI-2 and PC computer. – Check USB operation on PC computer (hardware or Windows drivers).

Prerequisite for CAN Communication:
1. MPI-2 connected to diagnostic connector.
2. D.E.S.S. key installed on its post.
3. B.U.D.S. started and logged.

COMMUNICATION PROBLEM (CAN)	
STATUS	WHAT TO DO
Light is OFF	– Check MPI protocol in B.U.D.S. – Check connection between MPI-2 and diagnostic cable connector. – Check connection between diagnostic cable connector and T-harness. – Check fuse, wiring and connectors, and diode of T-harness. – Check connection between T-harness and diagnostic connector. – Check that ECM is powered.
Light is RED	– Check CAN wires and connectors on vehicle.

Communication Problems with B.U.D.S.

B.U.D.S. Screen is Cycling

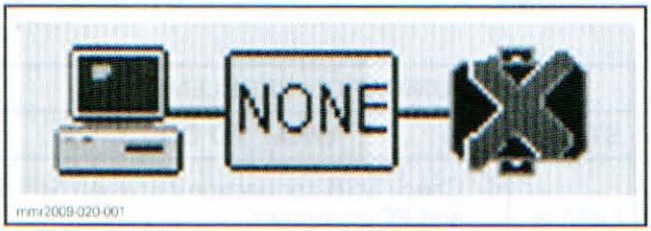
When T-harness is connected to the vehicle diagnostic connector and the following is observed:

- Fuel pump is continuously cycling ON and OFF.
- **Read Data** and **Write Data** buttons in B.U.D.S. are continously cycling black and grey.

Install D.E.S.S. key on its post to solve the problem.

Missing Module

If an "X" is shown in the status bar, it means that no "ECU" is communicating with the MPI. Check the following:

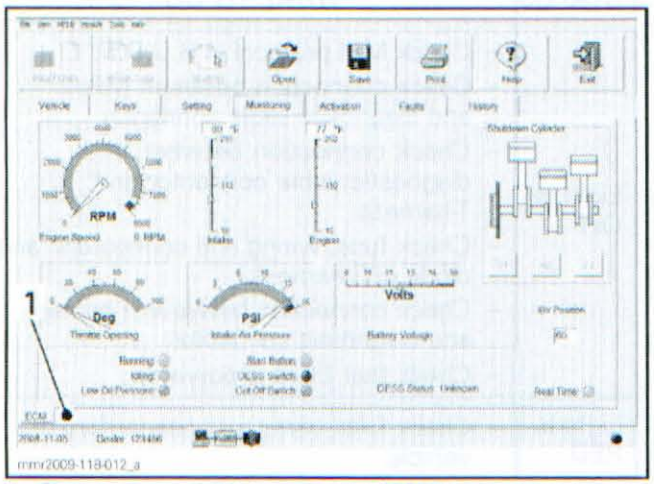


- Check MPI protocol in B.U.D.S.
- Check connections between the PC computer and the vehicle.

If one or more "ECU" is (are) not communicating with the MPI a module may not be powered or is defective.

Check to find which module is missing in B.U.D.S.

The tab of the missing module will not be visible at the bottom of B.U.D.S. screen.

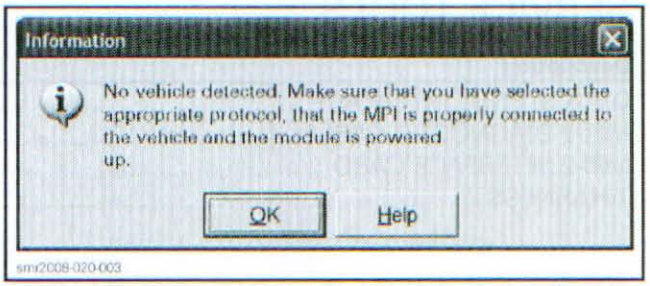


1. Cluster tab not visible meaning this "ECU" is not communicating

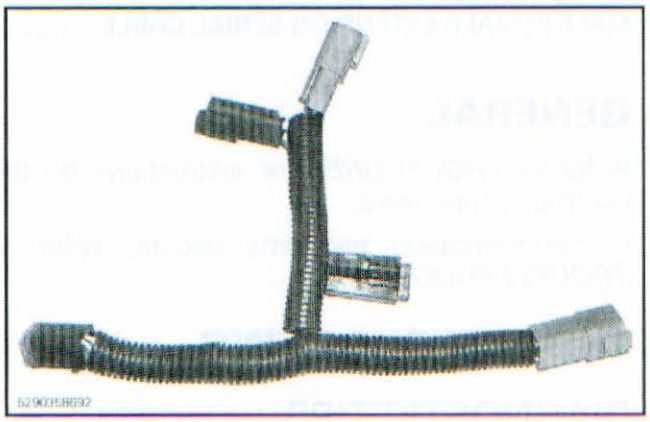
If the module is missing, check wiring and power supply to that module.

No Vehicle is Detected

If B.U.D.S. is trapped in a loop that continually display **No vehicle detected...**, exit B.U.D.S. then restart it.

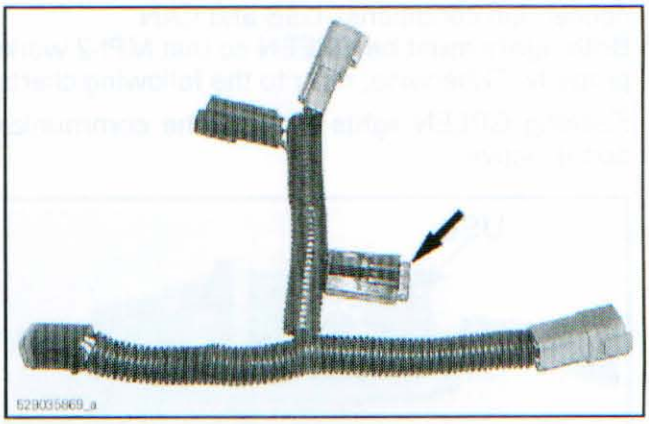


T-Harness Operation Test

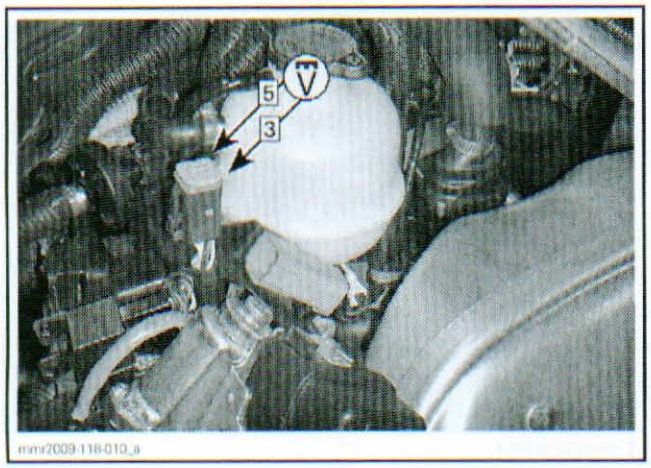


When the T-HARNESS (P/N 529 035 869) is connected to the vehicle diagnostic connector, ECM and multifunction gauge should turn on. Otherwise, check the following and repair or replace T-harness if any test failed.

1. T-harness fuse.



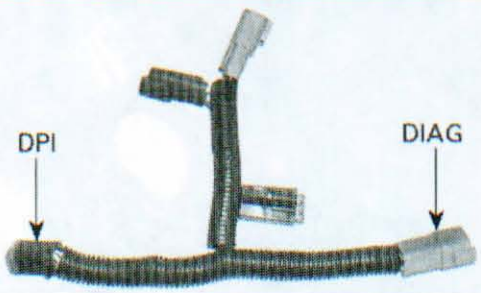
2. Vehicle battery voltage.
   2.1 Charge battery if it is too low.
3. Battery power between pins 5 and 3 of vehicle diagnostic connector.



3.1 If battery voltage is not read, check vehicle wiring harness.

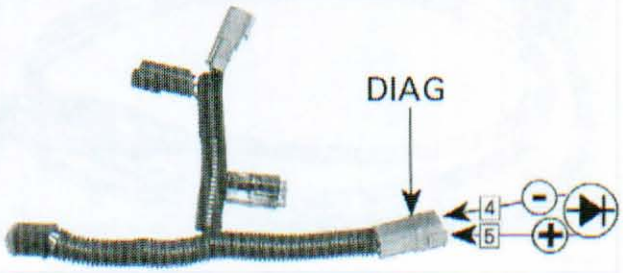
4. Wiring and connectors of the T-harness.

T-HARNESS CONTINUITY TEST			
"DPI" CONNECTOR	"DIAG" CONNECTOR	FUNCTION	TEST
1	1	CAN line	Continuity (close to 0 Ω)
2	2	CAN line	
3	3	Ground	
4	4	None	N.A.
5	5	Vehicle battery	Continuity (close to 0 Ω)
6	6	None	N.A.

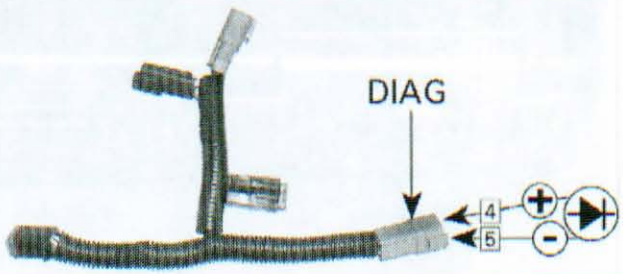


5. Diode in the T-harness.

T-HARNESS DIODE TEST		
"DIAG" CONNECTOR		
FROM	TO	TEST
5	4	Close to 0.5 V



4	5	Open



Notes:
Set multimeter to ⊣⊢

Probe diode paying attention to proper polarity. The + sign indicates the RED probe.

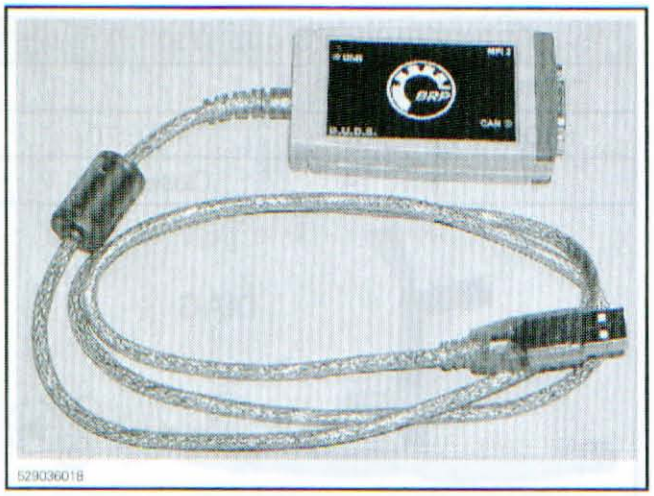
PROCEDURES

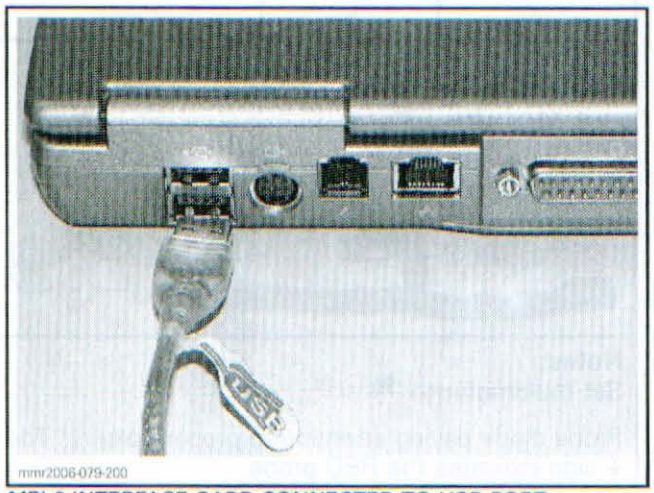
MULTI-PURPOSE INTERFACE-2 (MPI-2)

The MPI-2 (Multi-Purpose Interface-2) is used with B.U.D.S. software to communicate with the ECM (engine control module) and other modules such as the multifunction gauge.

MPI-2 Connections with Vehicle

Connect the MPI-2 INTERFACE CARD (P/N 529 036 018) to the USB port of a PC (personal computer).



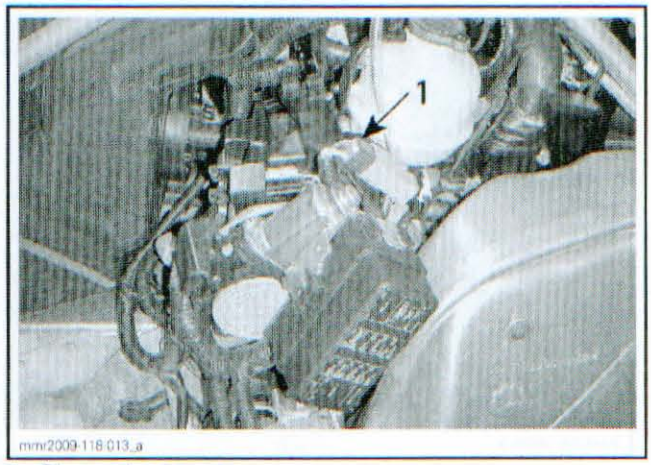


MPI-2 INTERFACE CARD CONNECTED TO USB PORT

⚠ WARNING

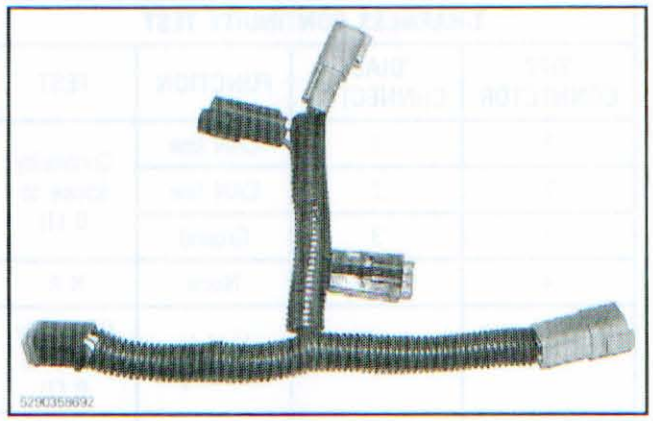
If the computer you are using is connected to the power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the computer.

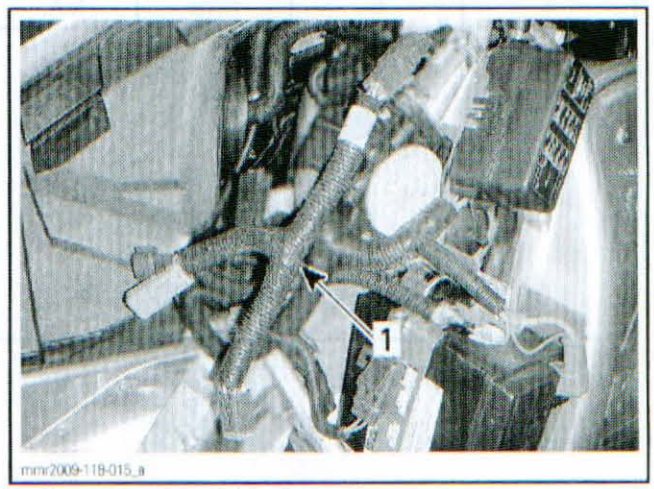
Remove the diagnostic connector from the protective cap on the right side of the vehicle.



1. Diagnostic connector

Connect the T-HARNESS (P/N 529 035 869) to vehicle diagnostic connector.



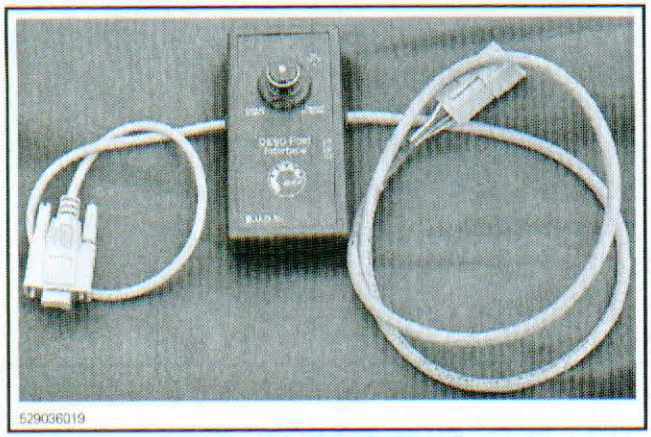


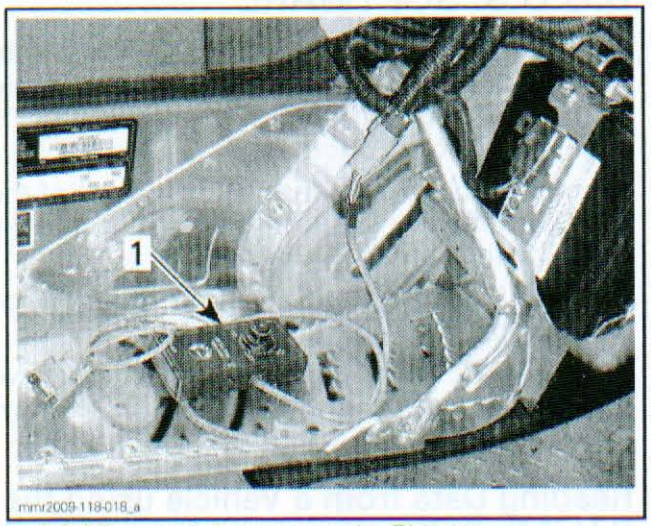
1. T-harness connected to diagnostic connector

NOTICE Connecting MPI-2 directly to diagnostic connector (without T-harness) may prevent proper communication. Always use the T-harness.

Connections to Program or Erase D.E.S.S. Key with B.U.D.S.

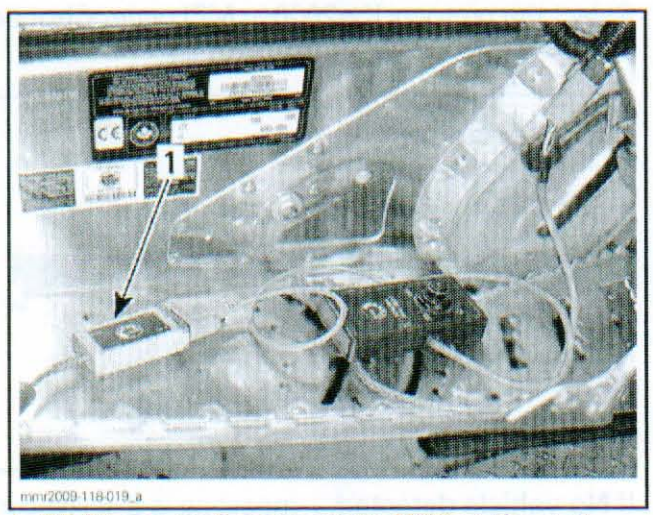
Connect the D.E.S.S. POST INTERFACE (P/N 529 036 019) to T-harness connector.





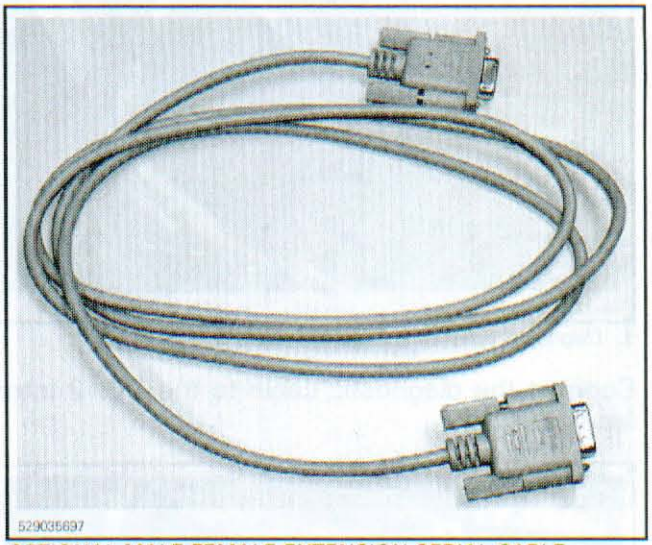
1. D.E.S.S. post interface connected to T-harness

Connect the D.E.S.S. post interface to the MPI-2 interface card.



1. D.E.S.S. post interface connected to MPI-2 interface card

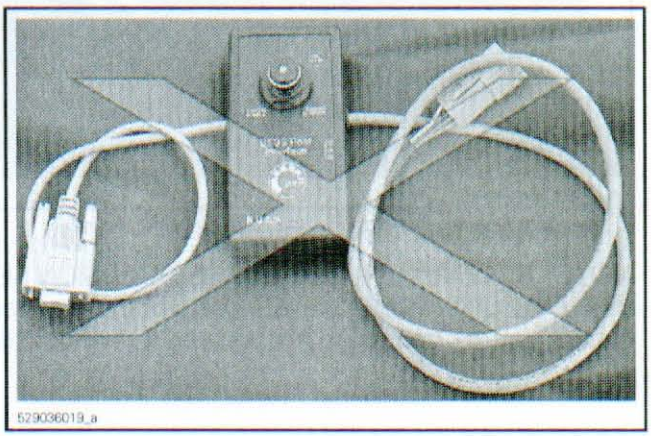
NOTE: An optional MALE-FEMALE EXTENSION SERIAL CABLE (P/N DB9) available at electronic retail outlets can be used. Do not exceed 7.6 m (25 ft).



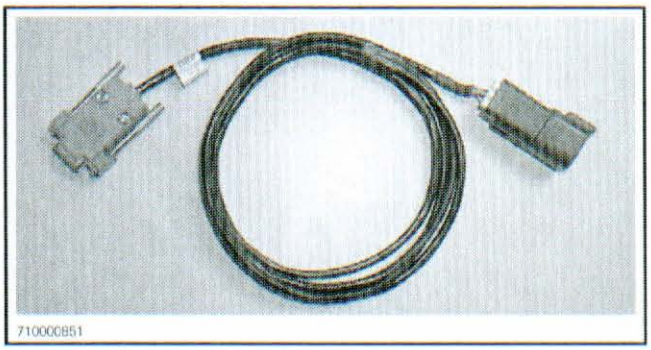
OPTIONAL MALE-FEMALE EXTENSION SERIAL CABLE

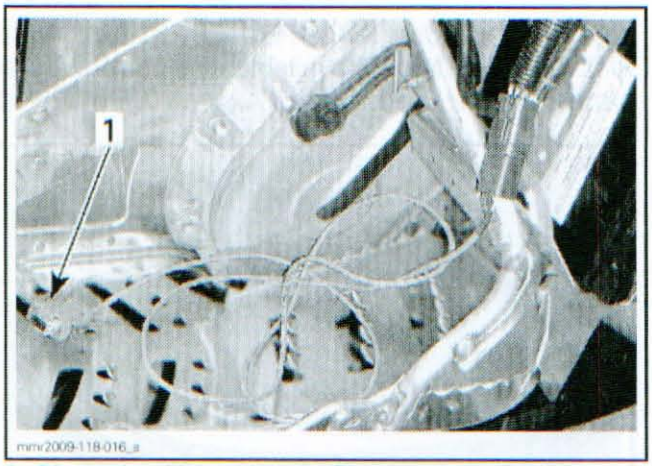
Connections for Data Entry or Troubleshooting with B.U.D.S.

NOTICE **Do not use the D.E.S.S. post interface for data entry or troubleshooting.**



Connect the MPI-2 DIAGNOSTIC CABLE (P/N 710 000 851) to T-harness connector.



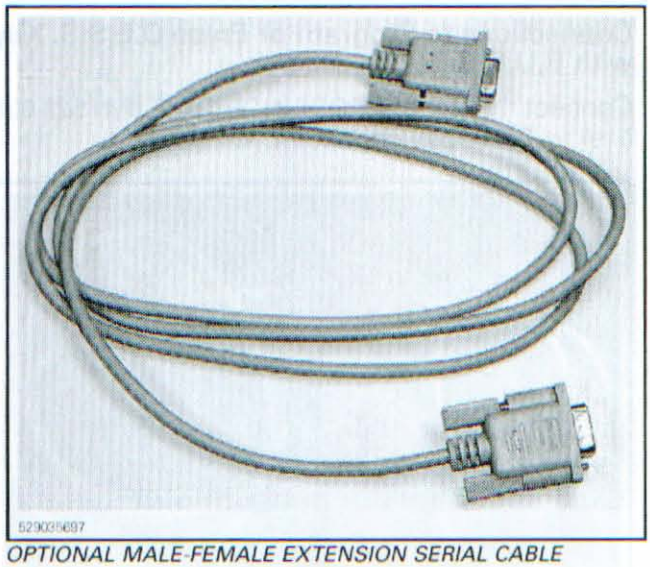


1. Diagnostic cable connected to T-harness

Connect the diagnostic cable to the MPI-2 interface card.

1. Diagnostic cable connected to the MPI-2 interface card

NOTE: An optional MALE-FEMALE EXTENSION SERIAL CABLE (P/N DB9) available at electronic retail outlets can be used. Do not exceed 7.6 m (25 ft).



OPTIONAL MALE-FEMALE EXTENSION SERIAL CABLE

B.U.D.S. SOFTWARE

B.U.D.S. (Bombardier Utility and Diagnostic Software) is designed to allow electrical component inspection, diagnostic options and adjustments such as the closed throttle.

For more information pertaining to the use of the B.U.D.S. software, use its help which contains detailed information on its functions.

Use the latest B.U.D.S. version available on BOSSWeb.

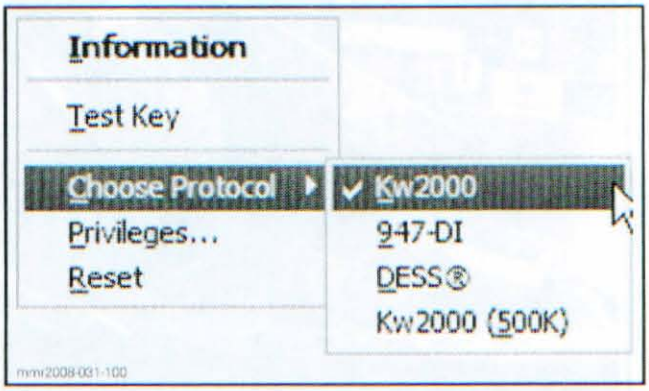
IMPORTANT: Make sure all connections have been made **before starting B.U.D.S.** to allow proper operation.

Reading Data from a Vehicle using the B.U.D.S. Software

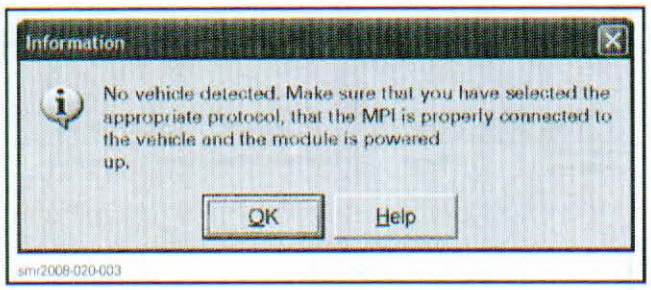
Install D.E.S.S. key on its post.

Start B.U.D.S. and logon.

Select the protocol **Kw2000** in **MPI** under **Choose protocol**.

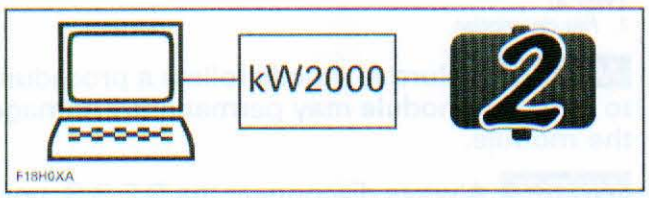


If **No vehicle detected...** message is displayed in B.U.D.S.:



Make sure both USB and CAN lights of MPI-2 are GREEN. Otherwise, refer to *TROUBLESHOOTING* in this section.

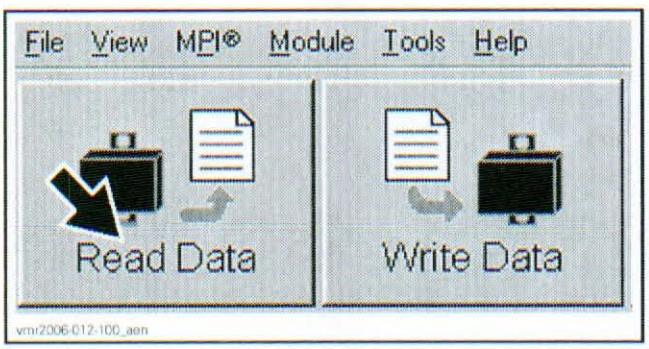
Make sure the status bar shows the kW2000 and the number 2 to its right. Otherwise, refer to *TROUBLESHOOTING* in this section.



CONNECTION SUCCESSFUL

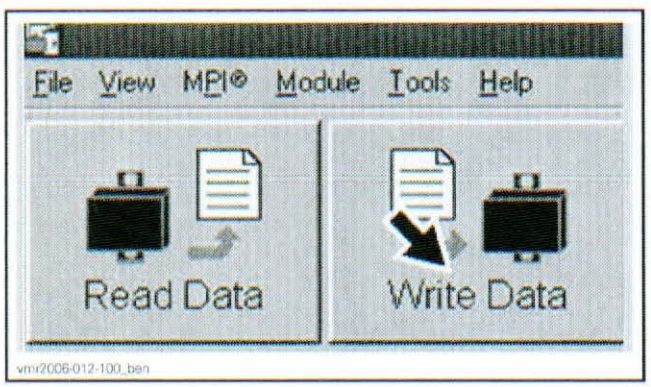
NOTE: Number 2 indicates that the ECM and the multifunction gauge are recognized by the MPI.

Read ECM by clicking the **Read Data** button.

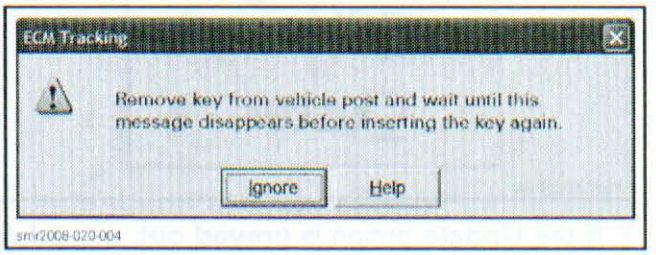


Writing Data Changes in ECM

When finished, save new data in ECM by clicking the **Write Data** button.



Anytime a change is brought in ECM through B.U.D.S., there will be an ECM Tracking box that will say **Remove key from vehicle....**



When this occurs, remove D.E.S.S. key and wait until the message disappears (it lasts approximately 20 seconds after key removal).

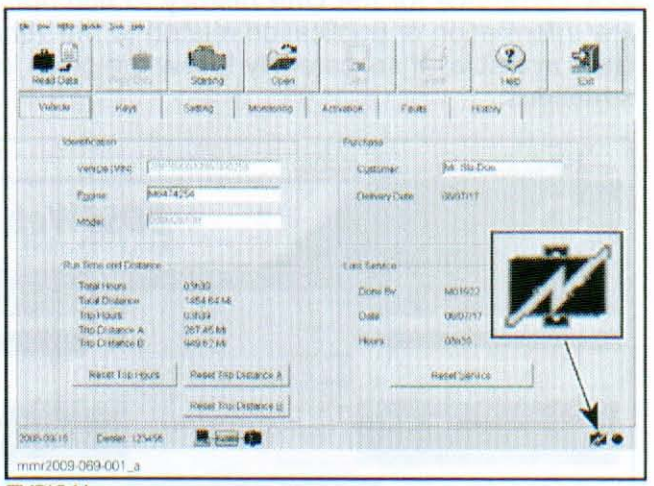
Disconnect MPI connections and reconnect the 6-pin connector in its protective cap.

NOTICE Failure to secure the diagnostic connector in its protective cap would allow corrosion and damage to the terminals.

NOTE: There is a 120 Ω resistor in protective cap to minimize the possibility of communication error.

Electronic Modules ("ECU") Update

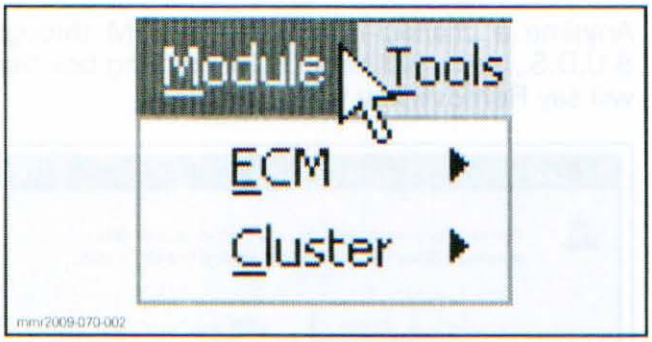
Whenever B.U.D.S. is started, check if there is an update icon in B.U.D.S. status bar.



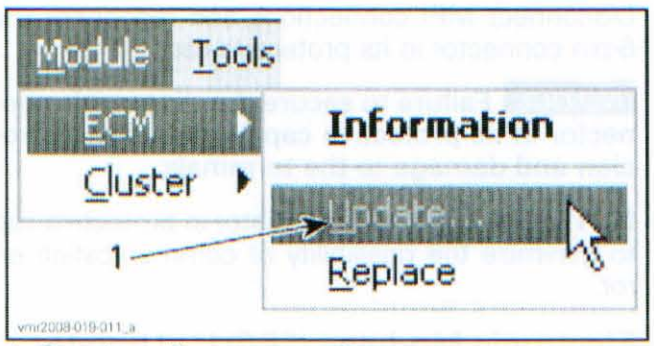
TYPICAL

The icon indicates that a file is available in B.U.D.S. to update any of the following electronic modules: ECM or multifunction gauge.

Use the **Module** menu and check all modules one at a time.

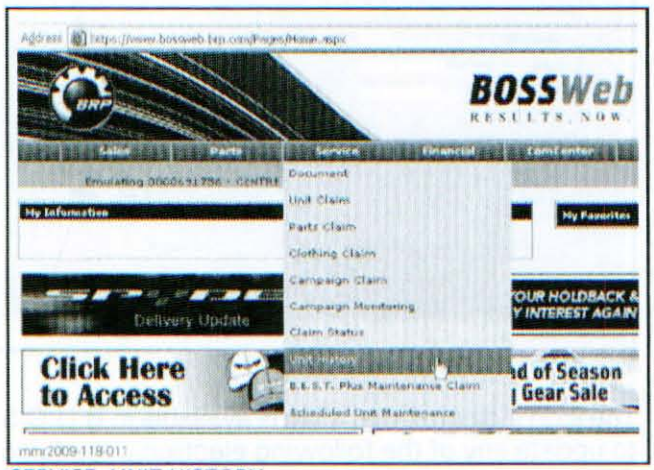


1. If the **Update** option is **greyed out**, no update file is available for this module.
2. If the **Update** option is **black**, an update file is available for this module.



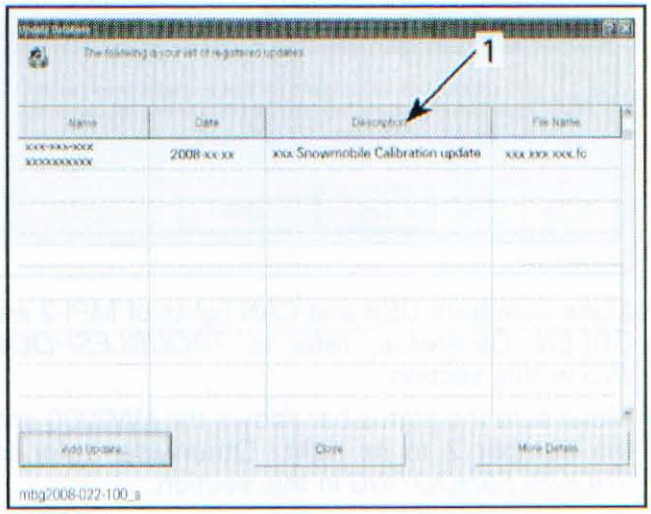
1. Greyed out: No update to perform
Black: Update file available

Before applying an update, log in BOSSWeb and look in **Service** for the **Unit history** to find out if any information or publication related to the vehicle is available. If so, carefully follow the given instructions.



SERVICE, UNIT HISTORY

NOTE: When selecting the update menu in B.U.D.S., a dialog box will appear and the update file description may give some clue to find the vehicle-related information in BOSSWeb.



TYPICAL
1. File description

NOTICE Failure to strictly follow a procedure to update a module may permanently damage the module.

NOTICE Always disconnect the D.E.S.S. post interface before updating any module.

MONITORING SYSTEM/FAULT CODES

GENERAL

MONITORING SYSTEM

The EMS features a monitoring system that self-diagnose its electronic components.

When a predefined condition (engine overheat for example) or a fault occurs, the ECM sends a signal to the multifunction gauge and/or audible signals to a beeper to inform you of this particular condition.

The ECM monitors the following functions and components.

COMPONENT
EMS (TPS, CPS, CAPS, MAPTS, OPS, CTS, RVPS, IACV, ignition coils and fuel injectors)
12 V low/high voltage and overload
D.E.S.S.
Relays (R1 and R2)
Electronic reverse relays
Engine oil pressure
Engine RPM
Coolant temperature
CAN
ECM
Starter solenoid
Fuel pump

Engine Overheat Protection

COOLANT TEMP.	ENGINE OPERATING CONDITION	EMS ACTION
Above 70°C (158°F)	Idling more than 5 minutes	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge.
Within 111°C (232°F) and 117°C (243°F)	Idling less than 5 minutes	Beeper is activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge.
Above 110°C (230°F)	Riding	
Above 118°C (244°F)	Idling more than 30 seconds	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge.
	Riding	Beeper is activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge. Check engine light is turned ON. Engine speed is limited to 5500 RPM. A fault code is set.

Limp Home Mode

The ECM may automatically set default parameters to ensure the safe operation of the vehicle if a component of the engine management system is not operating properly.

NOTE: Sensor failures will not lead automatically to a limp home mode. The check engine LED will turn on and in some cases the beeper.

The engine RPM may be limited if some critical components fail. In this case, releasing throttle and letting the engine returning to idle speed may allow normal operation to come back. If it does not work, try removing the D.E.S.S. key, wait until multifunction gauge turns off then reinstall D.E.S.S. key.

These performance-reduced modes allow the rider to go back home while minimizing the risk of a complete power loss due to engine failure.

EMS ACTION	CAUSE
Engine speed is limited to 4500 RPM	TPS (throttle position sensor) connector is disconnected or faulty. IACV (idle air control valve) connector is disconnected or faulty. Low engine oil pressure.
Engine speed is limited to 8500 RPM	Maximum engine RPM allowed.
Engine power is reduced	Transmission is set to reverse.

Pilot Lamps

Warning lights in multifunction gauge and/or a beeper provide signals as vehicle operation feedback or to indicate a problem.

Pilot lamp can flash alone or in combination with another lamp.

Beeper codes will be heard and messages will be displayed to catch your attention.

NOTE: Message display is not available on all gauges.

PILOT LAMP(S) ON	BEEPER	MESSAGE DISPLAY (1)	DESCRIPTION
	4 short beeps every 2 minutes	LOW OIL	Low engine oil pressure.
	3 short beeps	REV. FAIL	Gear change has not occurred after pressing START/RER button, try again.
	4 short beeps	ENGINE_TEMP	Engine is overheating.
	4 short beeps every 2 minutes	LOW BAT	Low or high battery voltage condition.
		HIGH BAT	
	4 short beeps	CHECK ENGINE	Engine fault.
	4 short beeps every 2 minutes	LIMP HOME	Engine RPM limited for engine protection when certain faults occur.
	Continuous short beeps	SHUTDOWN	Engine shutdown due to extented engine idling time.
—	—	COMMUNICATION	Communication problem between ECM and gauge. Stop engine, remove D.E.S.S. key and wait until multifunction gauge turns off. Restart engine.
	—	THROTTLE OPEN	Throttle applied while attempting an engine start (engine will not crank). Release throttle while starting.

(1) Premium multifunction gauge only.

FAULT CODES

A fault code is an indication that a glitch or malfunction is detected by the monitoring system of the vehicle.

When there is a problem, the EMS (engine management system) can provide fault codes to ease the troubleshooting.

The faults registered in the ECM (engine control module) are kept when the battery is disconnected.

Fault codes are broadcasted to the CAN bus and can be displayed in B.U.D.S. or in the premium multifunction gauge.

Many fault codes at the same time is likely to be caused by burnt fuse(s), a faulty relay or a problem with the vehicle wiring harness.

When using the service action suggested in the **Fault** section of B.U.D.S., a system circuit referred to as 3-DA-26 for instance, means connector "A" on the ECM and the pin 26.

IMPORTANT: After a problem has been solved, ensure to clear the fault(s) in the ECM using the B.U.D.S. software. This will properly reset their states.

How to Read Fault Codes Using B.U.D.S. Software

Refer to *COMMUNICATION TOOLS/B.U.D.S. SOFTWARE* section.

For more information pertaining to the faults code status and report, refer to B.U.D.S. online help or to the EMS fault code tables.

How to Read Fault Codes on the Premium Multifunction Gauge

Fault codes can also be displayed in the premium multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.

SPECIFIC FAULT CODES

The following gives additional information related to specific fault codes.

Fault Code P0339

This code could occur if the CPS picked up some electromagnetic interference from the magneto rotor.

The engine will not start or it may start and run but will hesitate when depressing throttle lever.

Test the CPS as described in *ELECTRONIC FUEL INJECTION*. If CPS tested good, try a new magneto rotor.

FAULT CODE TABLES

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0107	Air pressure sensor voltage too low.	Damaged circuit wires, damaged or disconnected sensor, sensor shorted to ground.	Make sure sensor's connector is fully inserted. Check for approximately 5 volts between MAPTS sensor pins 1 and 3. Check MAPTS sensor pin 1 circuit for resistivity to ground. Check for circuits continuity from ECM to MAPTS connector (refer to the shop manual for wiring diagram).
P0108	Air pressure sensor voltage too high.	Damaged circuit wires, damaged or disconnected sensor, sensor shorted to a supply.	Make sure sensor's connector is fully inserted. Check for approximately 5 volts between MAPTS sensor pins 1 and 3. Check MAPTS sensor pin 1 circuit for resistivity to ground. Check for circuits continuity from ECM to MAPTS connector (refer to the shop manual for wiring diagram).
P0111	Air temperature sensor functional problem.	Intermittent air temperature sensor reading or circuit wires shorted to ground.	Make sure sensor's connector is fully inserted. Check MAPTS sensor pin 1 circuit for resistivity to ground. Check for circuits continuity from ECM to MAPTS connector (refer to the shop manual for wiring diagram).
P0112	Air temperature sensor voltage too low.	Air temperature sensor or circuit wires shorted to ground.	Make sure sensor's connector is fully inserted. Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. Check MAPTS pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for circuits continuity from ECM to MAPTS connector (refer to the shop manual for wiring diagram). Check MAPTS sensor pin 1 circuit for resistivity to ground.
P0113	Air temperature sensor voltage too high.	Disconnected sensor or sensor's resistance too high.	Make sure sensor's connector is fully inserted. Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. Check MAPTS pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for circuits continuity from ECM to MAPTS connector (refer to the shop manual for wiring diagram). Check MAPTS sensor pin 1 circuit for resistivity to ground.
P0116	Engine temperature sensor functional problem.	Intermittent engine temperature sensor reading or circuit wires shorted to ground.	Make sure sensor's connector is fully inserted. Check CTS pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for continuity all circuits from ECM to CTS connector (refer to the shop manual for wiring diagram). Check CTS pin 1 circuits for resistivity to ground.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0117	Engine temperature sensor voltage too low.	Engine temperature sensor or circuit wires shorted to ground.	Make sure sensor's connector is fully inserted. Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. Check CTS pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for continuity all circuits from ECM to CTS connector (refer to the shop manual for wiring diagram). Check circuit of CTS pin 1 for resistivity to ground.
P0118	Engine temperature sensor voltage too high.	Disconnected sensor or sensor's resistance too high.	Make sure sensor's connector is fully inserted. Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. Check CTS pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Check for continuity all circuits from ECM to CTS connector (refer to the shop manual for wiring diagram). Check circuit of CTS pin 1 for resistivity to ground.
P0122	Throttle position sensor voltage too low.	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Make sure sensor's connector is fully inserted. Check for approximately 5 volts between TPS pins 1 and 2. Check for continuity all circuits from ECM to TPS connector (refer to the shop manual for wiring diagram). Refer to the shop manual for complete throttle position sensor testing procedure.
P0123	Throttle position sensor voltage too high.	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Make sure sensor's connector is fully inserted. Check for approximately 5 volts between TPS pins 1 and 2. Check for continuity all circuits from ECM to TPS connector (refer to the shop manual for wiring diagram). Refer to the shop manual for complete throttle position sensor testing procedure.
P0231	Fuel pump open circuit or shorted to ground.	Blown fuse, damaged or disconnected fuel pump, damaged circuit wires, damaged connectors or damaged ECM output pins.	Make sure fuel pump connector is fully inserted. Check fuse F2. Check for approximately 1 ohm between fuel pump connector pins. Check for approximately 12 volts between harness connector pin PE-2 and ground. Check for continuity from ECM to Fuel pump connector and fuse F2 to Fuel pump connector (refer to the shop manual for wiring diagram). Check if system circuit fuel pump pin 1 is shorted to 12 V.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0232	Fuel pump shorted to battery.	Damaged fuel pump, damaged circuit wires, damaged connectors or damaged ECM output pins.	Make sure fuel pump connector is fully inserted. Check fuse F2. Check for approximately 1 ohm between fuel pump connector pins. Check for approximately 12 volts between harness connector pin PE-2 and ground. Check for continuity from ECM to Fuel pump connector and fuse F2 to Fuel pump connector (refer to the shop manual for wiring diagram). Check if system circuit fuel pump pin 1 is shorted to 12 V.
P0261	Injector cylinder #1 (PTO) open circuit or shorted to ground.	Blown fuse, damaged or disconnected injector, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuses F3, F4 and F5. Check connections on injector. Check for approximately 14.5 ohms on injector. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to Injector connector and injector to fuse (refer to the shop manual for wiring diagram). Check if system circuit injector pin 2 is shorted to 12 V.
P0262	Injector cylinder #1 (PTO) shorted to battery.	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.	Check fuses F3, F4 and F5. Check connections on injector. Check for approximately 14.5 ohms on injector. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to injector connector and injector to fuse (refer to the shop manual for wiring diagram). Check if system circuit injector pin 2 is shorted to 12 V.
P0264	Injector cylinder #2 (CTR) open circuit or shorted to ground.	Blown fuse, damaged or disconnected injector, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuses F3, F4 and F5. Check connections on injector. Check for approximately 14.5 ohms on injector. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to injector connector and injector to fuse (refer to the shop manual for wiring diagram). Check if system circuit injector pin 2 is shorted to 12 V.
P0265	Injector cylinder #2 (CTR) shorted to battery.	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.	Check fuses F3, F4 and F5. Check connections on injector. Check for approximately 14.5 ohms on injector. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to injector connector and injector to fuse (refer to the shop manual for wiring diagram). Check if system circuit injector pin 2 is shorted to 12 V.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0267	Injector cylinder #3 (MAG) open circuit or shorted to ground.	Blown fuse, damaged or disconnected injector, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuses F3, F4 and F5. Check connections on injector. Check for approximately 14.5 ohms on injector. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to injector connector and injector to fuse (refer to the shop manual for wiring diagram). Check if system circuit injector pin 2 is shorted to 12 V.
P0268	Injector cylinder #3 (MAG) shorted to battery.	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.	Check fuses F3, F4 and F5. Check connections on injector. Check for approximately 14.5 ohms on injector. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to Injector connector and injector to Fuse (refer to the shop manual for wiring diagram). Check if system circuit Injector pin 2 is shorted to 12 V.
P0336	High engine RPM detected.	CPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Check for 775 to 950 ohms between CPS pins connector. Check for 2 volts AC between terminals DA-5 and DA-19 of ECM connector while cranking the engine.
P0339	Crankshaft signal fault.	CPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Check for 775 to 950 ohms between CPS pins connector. Check for 2 volts AC between terminals DA-5 and DA-19 of ECM connector while cranking the engine.
P0344	Cam sensor signal missing.	Blown fuse, damaged circuit wires or damaged sensor.	Check fuse F2. Check for 12 volts between sensor's connector pins 1 and 3. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to CAPS connector and fuse F2 to CAPS (refer to the shop manual for wiring diagram).
P0351	No ignition output cylinder #1 (PTO).	Blown fuse, damaged circuit wires, damaged connector, damaged or disconnected ignition coil.	Check fuses F3, F4 and F5. Check for approximately 12 volts on terminal 1 of ignition coil connector. Check connector HIC connecting the engine harness to the vehicle harness. Check for continuity from ECM to ignition coil terminal 3 (refer to the shop manual for wiring diagram). Refer to the shop manual for detailed ignition coil testing procedure.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0352	No ignition output cylinder #2 (CTR).	Blown fuse, damaged circuit wires, damaged connector, damaged or disconnected ignition coil.	Check fuses F3, F4 and F5. Check for approximately 12 volts on terminal 1 of ignition coil connector. Check connector HIC connecting the engine harness to the vehicle harness. Check for continuity from ECM to ignition coil terminal 3 (refer to the shop manual for wiring diagram). Refer to the shop manual for detailed ignition coil testing procedure.
P0353	No ignition output cylinder #3 (MAG).	Blown fuse, damaged circuit wires, damaged connector, damaged or disconnected ignition coil.	Check fuses F3, F4 and F5. Check for approximately 12 volts on terminal 1 of ignition coil connector. Check connector HIC connecting the engine harness to the vehicle harness. Check for continuity from ECM to ignition coil terminal 3 (refer to the shop manual for wiring diagram). Refer to the shop manual for detailed ignition coil testing procedure.
P0480	Fan relay shorted to battery.	Blown fuse, damage fan relay, disconnected fan relay harness, damaged circuit wires, damage or disconnected pins or damage ECM output pin.	Check fuse F11. Check for disconnected fan relay or disconnected fan harness connectors. Check for approximately 12 volts between fan relay terminal #30 or #85 and engine ground. Check for continuity to ground from FAN connector to engine ground. Check for continuity from ECM to fan harness connector (refer to the shop manual for wiring diagram).
P0480	Fan relay open circuit or shorted to ground.	Blown fuse, damage fan relay, disconnected fan relay harness, damaged circuit wires, damage or disconnected pins or damage ECM output pin.	Check fuse F11. Check for disconnected fan relay or disconnected fan harness connectors. Check for approximately 12 volts between fan relay terminal #30 or #85 and engine ground. Check for continuity to ground from FAN connector to engine ground. Check for continuity from ECM to fan harness connector (refer to the shop manual for wiring diagram).
P0505	IACV output stage cutoff memory difference.	Damaged actuator, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 50 ohms between pins A and D and also between pins B and C of the idle air control valve. Check for damaged circuit wires. Check for continuity from ECM to IACV connector (refer to the shop manual for wiring diagram). Check for damaged connector or damaged ECM output pins.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0505	IACV output stage fault.	Damaged actuator, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 50 ohms between pins A and D and also between pins B and C of the idle air control valve. Check for damaged circuit wires. Check for continuity from ECM to IACV connector (refer to the shop manual for wiring diagram). Check for damaged connector or damaged ECM output pins.
P0520	Oil pressure switch functional problem.	Oil pressure switch open circuit or disconnected.	Check oil pressure switch resistance. With engine stopped, the resistance should be less than 1 ohm. With engine running, the resistance should be infinitely high (0L). Check for continuity from ECM to oil pressure switch (refer to the shop manual for wiring diagram).
P0562	Battery voltage too low.	Battery failure, rectifier failure, damaged circuit wires or connection, damaged AC generator.	Check battery voltage for 11 to 13 volts with engine stopped. Check battery voltage for 13.5 to 14.5 volts with engine speed above 2500 RPM. Check connections on regulator. Check for loose or broken ring terminals on regulator. Check ground and positive connections near the starter solenoid.
P0563	Battery voltage too high.	Damaged regulator. An external battery charger may have been used.	Check battery voltage for 11 to 13 volts with engine stopped. Check battery voltage for 14.0 to 14.5 volts with engine idling. Check connections on regulator. Check for loose or broken ring terminals on regulator. Check ground and positive connections near the starter solenoid.
P0601	Internal ECM error or TPS learn unlikely.	Wrong throttle position during reset of closed throttle and idle actuator	Check cable adjustment. Check idle stop for wear. Make sure throttle plate is against throttle stop. Reset closed TPS. Refer to the shop manual for detailed reset closed throttle and idle actuator procedure.
P0601	Internal ECM error or TPS learn unlikely.	ECM internal error	Try updating the ECM. If the problem persists, try replacing the ECM.
P0602	ECM not coded.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.
P0604	ECM RAM fault.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.
P0605	ECM EEPROM fault.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.
P0605	ECM EEPROM fault.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0605	ECM EEPROM fault.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.
P0605	ECM EEPROM fault.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.
P0605	ECM EEPROM fault.	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, try replacing the ECM.
P0608	Sensor's power supply voltage too low.	Damaged circuit wires, shorted air pressure sensor or shorted TPS.	Check for continuity from ECM to MAPTS connector and ECM to TPS connector (refer to the shop manual for wiring diagram).
P0608	Sensor's power supply voltage too low.	Damaged circuit wires, shorted air pressure sensor or shorted TPS.	Check for continuity from ECM to MAPTS connector and ECM to TPS connector (refer to the shop manual for wiring diagram).
P0616	Starter solenoid open circuit or shorted to ground.	Blown fuse, damaged or disconnected starter solenoid, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse F2 and fuse 30 A. Disconnect the starter solenoid and check for approximately 7.3 ohms between the small starter solenoid terminals. Check for approximately 12 volts between starter solenoid RD wire and ground. Check for continuity from ECM to starter solenoid (refer to the shop manual for wiring diagram).
P0617	Starter solenoid shorted to battery.	Blown fuse, damaged or disconnected starter solenoid, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse F2 and fuse 30 A. Disconnect the starter solenoid and check for approximately 7.3 ohms between the small starter solenoid terminals. Check for approximately 12 volts between starter solenoid RD wire and ground. Check for continuity from ECM to starter solenoid (refer to the shop manual for wiring diagram).
P0736	E-Reverse plausibility error.	Blown fuse, wrong belt adjustment, DC motor damaged, reverse switch disconnected, relay damaged or disconnected, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse F8. Check for belt adjustment as per specification (refer to the shop manual). Make sure reverse position switch is connected. Make sure reverse harness and DC motor connector is fully inserted. Check connector HIC connecting the two harnesses together. Try resetting fault code faults and restart. Check for approximately 12 volt DC on relays pins 86 and 87. Check for ground on relays pin 87a. Check for continuity from ECM connectors A and B to electromechanical relays (refer to the shop manual for wiring diagram).

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0750	E-Reverse forward relay open circuit or shorted to ground.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F8. Make sure reverse harness and DC motor connector is fully inserted. Check for approximately 12 volt DC on relays pins 86 and 87. Check for ground on relays pin 87a. Check for approximately 100 ohms between coil relay pins 85 and 86. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to electromechanical relays pins (refer to the shop manual for wiring diagram).
P0753	E-Reverse relay shorted to battery.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F8. Make sure reverse harness and DC motor connector is fully inserted. Check for approximately 12 volt DC on relays pins 86 and 87. Check for ground on relays pin 87a. Check for approximately 100 ohms between coil relay pins 85 and 86. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to electromechanical relays pins (refer to the shop manual for wiring diagram).
P0755	E-Reverse relay open circuit or shorted to ground.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F8. Make sure reverse harness and DC motor connector is fully inserted. Check for approximately 12 volt DC on relays pins 86 and 87. Check for ground on relays pin 87a. Check for approximately 100 ohms between coil relay pins 85 and 86. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to electromechanical relays pins (refer to the shop manual for wiring diagram).
P0758	E-Reverse relay shorted to battery.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F8. Make sure reverse harness and DC motor connector is fully inserted. Check for approximately 12 volt DC on relays pins 86 and 87. Check for ground on relays pin 87a. Check for approximately 100 ohms between coil relay pins 85 and 86. Check connector HIC connecting the two harnesses together. Check for continuity from ECM to electromechanical relays pins (refer to the shop manual for wiring diagram).

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P1102	Throttle position sensor adaptation failure.	Wrong throttle body mechanical position during reset of closed throttle and idle actuator or no initialization after ECM replacement.	Check cable adjustment. Check idle stop for wear. Make sure throttle plate is against throttle stop. Reset closed throttle and idle actuator. Refer to the shop manual for detailed reset closed throttle and idle actuator procedure.
P1104	Throttle position sensor adaptation cancelled.	Wrong throttle body mechanical position during reset of closed throttle and idle actuator or no initialization after ECM replacement.	Check cable adjustment. Check idle stop for wear. Make sure throttle plate is against throttle stop. Reset closed TPS. Refer to the shop manual for detailed reset closed throttle and idle actuator procedure.
P1116	Engine temperature high.	Not enough cooling due to lack of snow going to the radiator. Idling for too long. Problem with cooling system. Coolant level too low.	Check cooling system, check coolant level.
P1148	Safety fuel cut off detected.	IACV not installed.	Make sure IACV connector is fully inserted in air intake silencer. Check for continuity from ECM to IACV connector (refer to the shop manual for wiring diagram). Remove D.E.S.S. and wait complete ECM shutdown.
P1520	Low oil pressure.	Low oil detected in engine.	Refer to shop manual for low oil service.
P1611	IACV output signal failed.	Damaged actuator, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 50 ohms between pins A and D and also between pins B and C of the idle air control valve. Check for damaged circuit wires. Check for continuity from ECM to IACV connector (refer to the shop manual for wiring diagram). Check for damaged connector or damaged ECM output pins.
P1655	D.E.S.S.® shorted to battery.	Damaged circuit wires or mixed up connections.	Check system circuits DB-26 for continuity to terminal 1 of D.E.S.S. post connector, DB-38 for continuity to terminal 3 of D.E.S.S. post connector and DB-39 for continuity to terminal 2 of D.E.S.S. post connector. Check system circuit DB-26 for continuity to circuit DB-39 when D.E.S.S. key is installed on D.E.S.S. post. Check system circuit DB-38 for continuity to the center contact of the D.E.S.S. post connector and circuit DB39 for continuity to the outer ring of the D.E.S.S. post. Check system circuits DB-26, DB-38 and DB-39 for short to 12 volts.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P1656	D.E.S.S. line shorted to ground.	Damaged circuit wires or mixed up connections.	Check system circuits DB-26 for continuity to terminal 1 of D.E.S.S. post connector, DB-38 for continuity to terminal 3 of D.E.S.S. post connector and DB-39 for continuity to terminal 2 of D.E.S.S. post connector. Check system circuit DB-26 for continuity to circuit DB-39 when D.E.S.S. key is installed on D.E.S.S. post. Check system circuit DB-38 for continuity to the center contact of the D.E.S.S. post connector and circuit DB39 for continuity to the outer ring of the D.E.S.S. post. Check system circuits DB-26, DB-38 and DB-39 for continuity to ground.
P1675	Relay 2 shorted to battery.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F9. Check for approximately 100 ohms between coil relay pins. Check for continuity from ECM to relay (refer to the shop manual for wiring diagram).
P1676	Relay 2 open circuit or shorted to ground.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F9. Check for approximately 100 ohms between coil relay pins. Check for continuity from ECM to relay (refer to the shop manual for wiring diagram).
P1677	Relay 3 shorted to battery.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F9. Check for approximately 100 ohms between coil relay pins. Check for continuity from ECM to relay (refer to the shop manual for wiring diagram).
P1678	Relay 3 open circuit or shorted to ground.	Blown fuse, damaged or disconnected relay, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F9. Check for approximately 100 ohms between coil relay pins. Check for continuity from ECM to relay (refer to the shop manual for wiring diagram).

DTC	DESCRIPTION	CAUSE	ACTION
P0340	Camshaft Position Sensor "A" Circuit Malfunction (Bank 1 or Single Sensor)	Damaged timing wheel or sensor Timing out of synchronization	Check for proper timing Check sensor and wiring Check for proper sensor gap Check for proper sensor voltage Check for proper sensor resistance Check for proper sensor signal Check for proper sensor ground Check for proper sensor power Check for proper sensor connector Check for proper sensor wiring Check for proper sensor grounding Check for proper sensor shielding Check for proper sensor routing Check for proper sensor mounting Check for proper sensor alignment Check for proper sensor clearance Check for proper sensor orientation Check for proper sensor installation Check for proper sensor calibration Check for proper sensor programming Check for proper sensor software Check for proper sensor firmware Check for proper sensor hardware Check for proper sensor connector Check for proper sensor wiring Check for proper sensor grounding Check for proper sensor shielding Check for proper sensor routing Check for proper sensor mounting Check for proper sensor alignment Check for proper sensor clearance Check for proper sensor orientation Check for proper sensor installation Check for proper sensor calibration Check for proper sensor programming Check for proper sensor software Check for proper sensor firmware Check for proper sensor hardware
P0341	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or Single Sensor)	Sensor fault, damaged or misconfigured relay, damaged or misconfigured power supply, damaged ECM output pin	Check fuse F3. Check for open or short to ground in the wire between the relay and the sensor. Check for open or short to ground in the wire between the ignition switch and the relay. Check for open or short to ground in the wire between the ignition switch and the sensor. Check for open or short to ground in the wire between the sensor and the ECM.
P0342	Camshaft Position Sensor "A" Circuit Low (Bank 1 or Single Sensor)	Sensor fuse, damaged or misconfigured relay, damaged or misconfigured power supply, damaged ECM output pin	Check fuse F3. Check for open or short to ground in the wire between the relay and the sensor. Check for open or short to ground in the wire between the ignition switch and the relay. Check for open or short to ground in the wire between the ignition switch and the sensor. Check for open or short to ground in the wire between the sensor and the ECM.
P0343	Camshaft Position Sensor "A" Circuit High (Bank 1 or Single Sensor)	Sensor fuse, damaged or misconfigured relay, damaged or misconfigured power supply, damaged ECM output pin	Check fuse F3. Check for open or short to ground in the wire between the relay and the sensor. Check for open or short to ground in the wire between the ignition switch and the relay. Check for open or short to ground in the wire between the ignition switch and the sensor. Check for open or short to ground in the wire between the sensor and the ECM.

ELECTRONIC FUEL INJECTION

SERVICE TOOLS

Description	Part Number	Page
DIGITAL INDUCTION TACHOMETER	529 014 500	181
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	184, 186–187, 198, 204, 209–211
FLUKE 115 DIGITAL MULTIMETER	529 035 868	187, 196–199, 201–202, 207, 211
FUEL HOSE DISCONNECT TOOL	529 036 037	193
OETIKER PLIERS	295 000 070	201
SMALL HOSE PINCHER	295 000 076	201

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBE	TP88	207

SERVICE PRODUCTS

Description	Part Number	Page
DEOXIT LUBRICANT	293 550 034	184
LOCTITE 243 (BLUE)	293 800 060	210

GENERAL

When removing or installing high pressure test equipment and disconnecting fuel line connections, follow these instructions:

- Release fuel pressure prior to removing a hose.
- Remove the main fuse to disable fuel pump.
- Cover the fuel line connection with an absorbent shop rag.
- Slowly disconnect the fuel hose to minimize spilling.
- Do not allow fuel to spill on hot parts and electrical connectors.
- Wipe up any fuel spillage in the engine compartment.

⚠ WARNING

Fuel is flammable and explosive under certain conditions. Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses and work in a well ventilated area. Fuel lines remain under pressure at all times.

⚠ WARNING

After working on the fuel system, pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

⚠ WARNING

After servicing a vehicle, always apply parking brake before starting engine.

SYSTEM DESCRIPTION

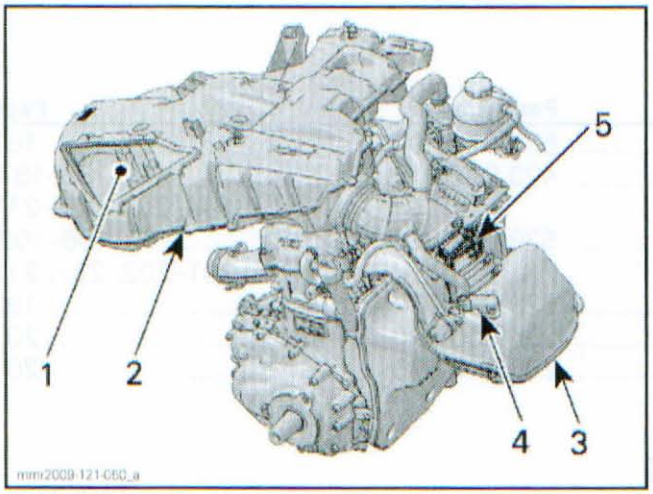
The ECM reads the input signals from different sensors which indicate engine operating conditions at micro-second intervals.

The ECM calculates the proper air/fuel ratio and activates the output to injectors.

Signals from sensors are used by the ECM to determine the injection parameters (fuel maps required for optimum air-fuel ratio).

The crankshaft position sensor (CPS), the throttle position sensor (TPS) are the primary sensors used to control the injection. Other sensors (like temperature sensors, etc.) are used as secondary input.

Air Induction



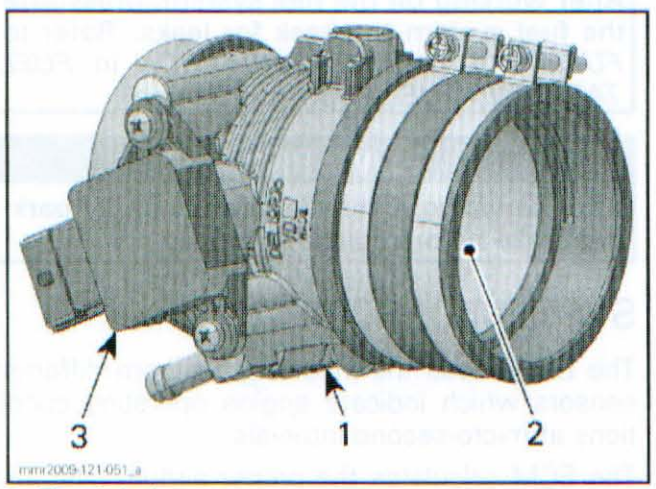
1. *Mesh filter*
2. *Air intake silencer*
3. *Intake manifold*
4. *Manifold absolute pressure and temperature sensor*
5. *Throttle body*

Air flows through a mesh filter in the air intake silencer mounted on top of engine. The mesh filter prevents snow from being drawn into the engine.

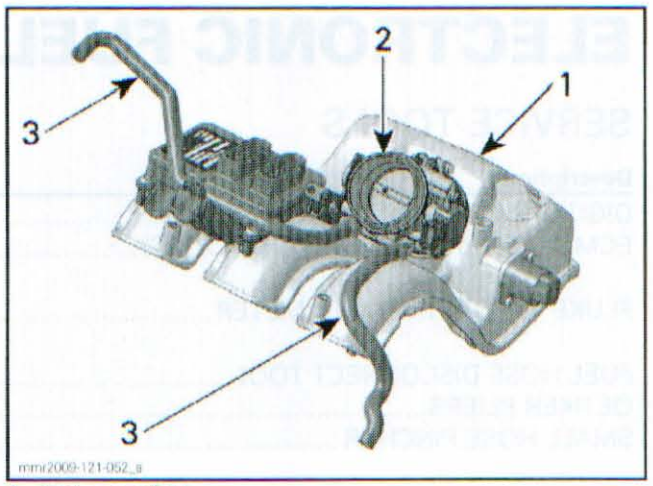
Air is then drawn through the throttle body.

Manifold absolute pressure and temperature are measured in the intake manifold.

Throttle Body



1. *Throttle body*
2. *Throttle plate*
3. *TPS (Throttle Position Sensor)*



1. *Intake manifold*
2. *Throttle body*
3. *Coolant-heated lines*

The heated single 52 mm throttle body is mounted on intake manifold.

The TPS (Throttle Position Sensor) is fitted on the throttle body. The TPS sends throttle angle position to the ECM.

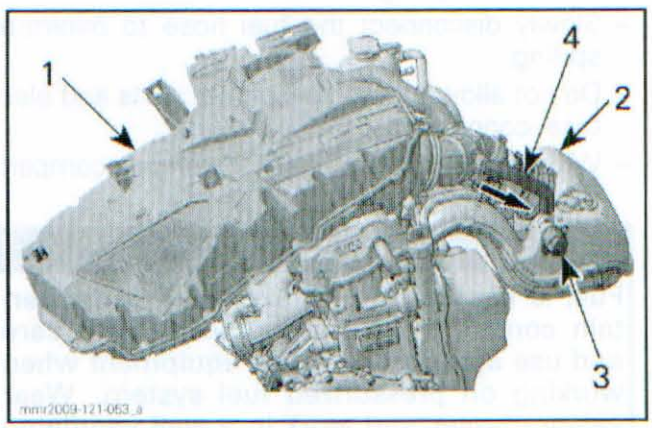
Engine coolant flows through throttle body to prevent potential freezing of throttle plate.

The air then continues through the intake manifold.

Idle Air Control Valve (IACV)

Since the throttle plate is closed when engine is idling, an idle air control valve (IACV) is used to allow air to bypass the throttle plate through a hose linking the intake air to the intake manifold.

Idle control is required to satisfy the varying conditions such as air temperature, altitude, engine load, etc.



1. *Air intake silencer*
2. *Intake manifold*
3. *IACV (Idle air control valve)*
4. *Bypass hose*

The amount of opening or closing of the IACV is controlled by the ECM. As the IACV opening is increased, more air is bypassed resulting in an increased idle speed.

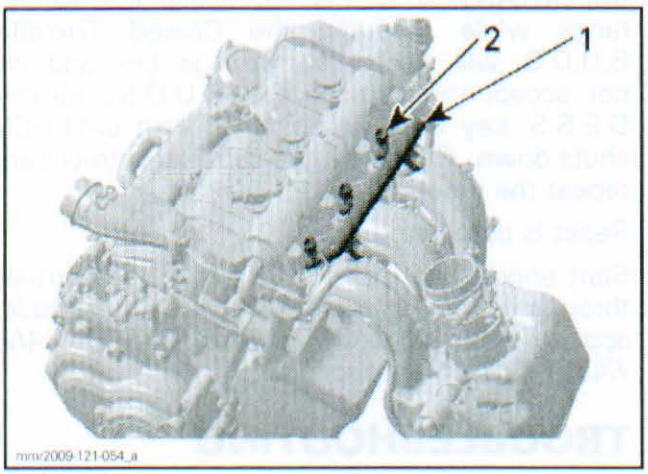
Intake Manifold

The intake manifold is mounted to the cylinder head inlet ports.

The air flows through the intake manifold to the intake valves to finally reach the combustion chamber.

The intake manifold also provides a support for the ECM.

Fuel Rail



1. *Fuel rail*
2. *Fuel injector*

The fuel rail is mounted on the intake manifold. It delivers fuel to the fuel injectors. The fuel rail is fed by the fuel pump with the properly regulated fuel pressure.

Fuel Injectors

Three fuel injectors are used to inject fuel into the intake ports of the cylinder head.

One injector is used per cylinder.

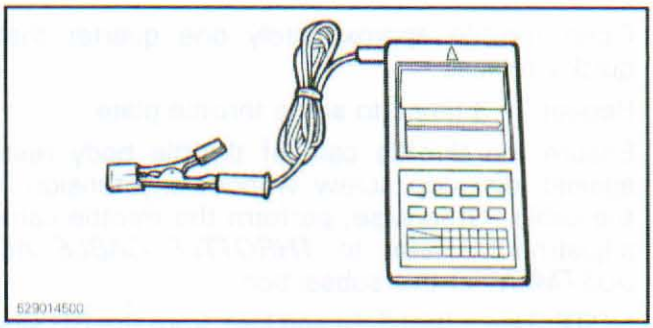
Fuel is injected in accordance with injection signals from the ECM.

ADJUSTMENT

IDLE SPEED

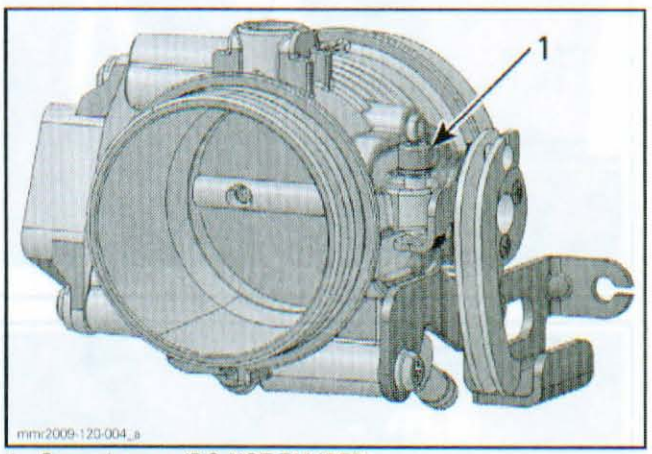
Idle speed is controlled by the EMS (Engine Management System) and is not adjustable.

If desired, the engine RPM can be verified with a DIGITAL INDUCTION TACHOMETER (P/N 529 014 500).



If idle speed is not as per specification (refer to *TECHNICAL SPECIFICATIONS*), perform the *CLOSED THROTTLE RESET (TPS)*.

NOTICE **Never attempt to adjust the capped idle stop screw. It is calibrated at the factory. If the screw adjustment is changed, the throttle body must be replaced.**



1. *Capped screw (DO NOT TAMPER)*

CLOSED THROTTLE RESET (TPS)

General Information

This operation performs a reset of the TPS (throttle position sensor) values in the ECM when the throttle is closed. This reset is very important as the setting of the TPS will determine the basic parameters for all fuel mapping and several ECM calculations for idle speed control of the engine.

Closed throttle reset must be done if:

- TPS is loosen, removed or replaced.
- Throttle body is replaced.
- ECM is replaced.

NOTICE **An improperly set TPS may lead to poor engine performance.**

Closed Throttle Reset Procedure (TPS)

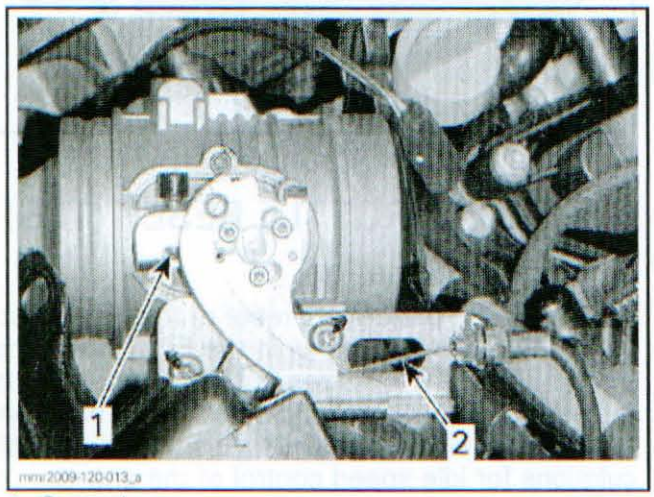
Connect the B.U.D.S. software to perform this adjustment. Refer to *MONITORING AND FAULT CODES* subsection.

Open throttle approximately one quarter then quickly release.

Repeat 2 - 3 times to settle throttle plate.

Ensure the throttle cam of throttle body rests against idle stop screw without any tension in the cable. Otherwise, perform the throttle cable adjustment. Refer to *THROTTLE CABLE ADJUSTMENT* in this subsection.

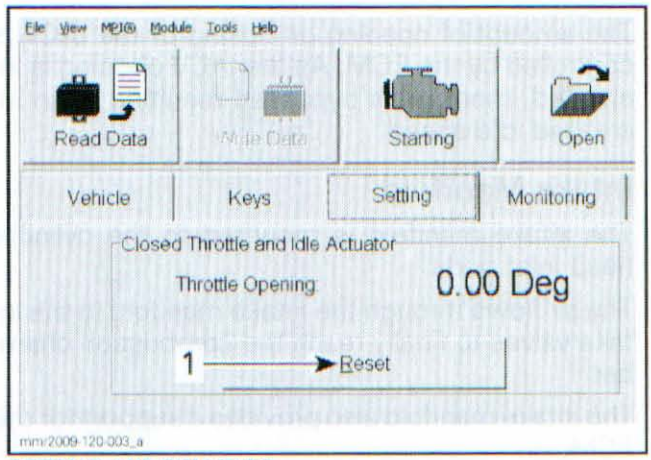
NOTE: Use a flashlight and look from the RH side to see the throttle cam and the idle stop screw.



1. *Contact here*
2. *Free-play here*

NOTICE **Do not alter the setting of the capped screw, otherwise throttle body must be replaced.**

In B.U.D.S., click on the **Reset** button.



SETTING AND ECM TABS
1. Click Reset

IMPORTANT: If TPS is not within the allowed range while resetting the **Closed Throttle**, B.U.D.S. will display a message box and will not accept the setting. Exit B.U.D.S., remove D.E.S.S. key from its post and wait until ECM shuts down. Check throttle cable adjustment and repeat the reset.

Reset is completed.

Start engine and make sure it operates normally through its full engine RPM range. If fault codes appear, refer to *MONITORING SYSTEM AND FAULT CODES* subsection.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Engine problems are not necessarily related to the injection system.

It is important to ensure the mechanical integrity of the engine is intact.

Poor Idling

If poor idling is experienced, check the following:
- Throttle cable adjustment or routing.
- IACV operation, cleanliness, leaking or clogged air passages.
- Throttle body cleanliness and idle stop screw.
- Engine leaks or other mechanical problem.

Electrical Related Problems

It is important to check the following in the electrical system:
- Battery voltage
- Ground connections
- Wiring connectors.

Ensure that all electronic components are original BRP recommended components.

Any modification on the wiring harness may lead to generate fault codes or bad operation.

⚠ WARNING

All electrical actuators (example: injectors, fuel pump and ignition coils) are powered as soon as the START/RER button is depressed.

Electrical Connections

Pay particular attention to ensure that pins are not out of their connectors or out of shape.

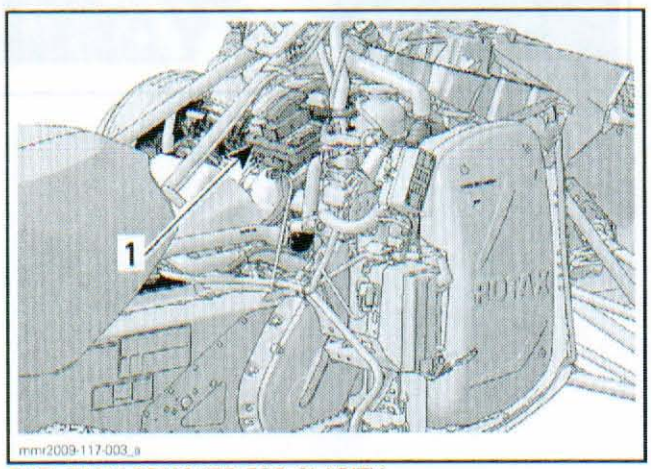
Make sure that connections are very tight and they make good contact, they are corrosion-free and show no signs of moisture. Particularly check ECM ground connections.

NOTE: Do not apply dielectric grease or other lubricant on the ECM connectors.

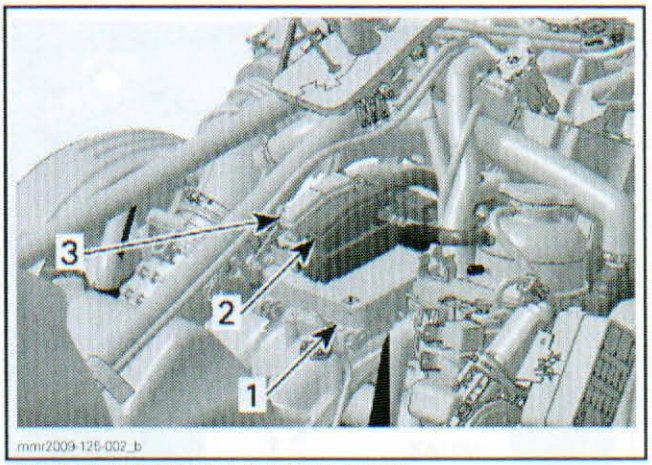
Check if wiring harness shows any signs of scoring.

PROCEDURES

ENGINE CONTROL MODULE (ECM)



FUEL TANK REMOVED FOR CLARITY
1. ECM



SOME PARTS REMOVED FOR CLARITY
1. ECM
2. A connector
3. B connector

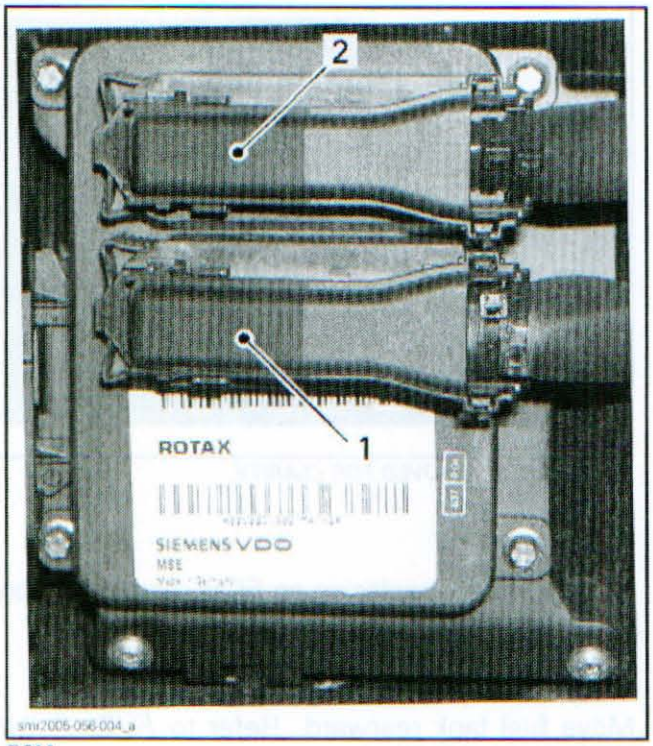
NOTE: Prior to replacing an ECM, ensure to conduct all testing procedures.

ECM Connector Access

Move fuel tank rearward. Refer to *FUEL PUMP AND FUEL TANK* subsection.

ECM Connector Identification

There are two Kostal connectors used and they are connected on the ECM. The engine harness female connector is connected on the module male connector A and the vehicle system control harness female connector is connected to the module male connector B. The ECM connectors have 41 pins.



ECM
1. *Connector A (engine harness)*
2. *Connector B (vehicle harness)*

NOTICE **Do not disconnect the ECM connectors needlessly. They are not designed to be disconnected/reconnected frequently.**

ECM Connector Cleaning

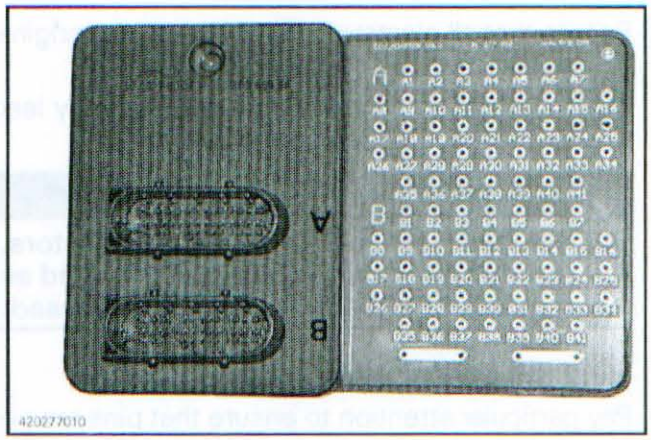
To clean oxidized ECM terminals, use a contact cleaner such as DEOXIT LUBRICANT (P/N 293 550 034).

NOTICE **Remove connector seal prior to applying the product. Otherwise, the seal will swell and will let water enter inside connector. Dry out connector with compressed air prior to reinstalling the seal.**

Do not apply any lubricant product to the pins of the connector on the ECM.

ECM Connector Probing

The most recommended and safest method to probe ECM connector terminals is to use the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010). This tool will prevent deforming or enlarging terminals which would lead to bad ECM terminal contact creating intermittent or permanent problems.

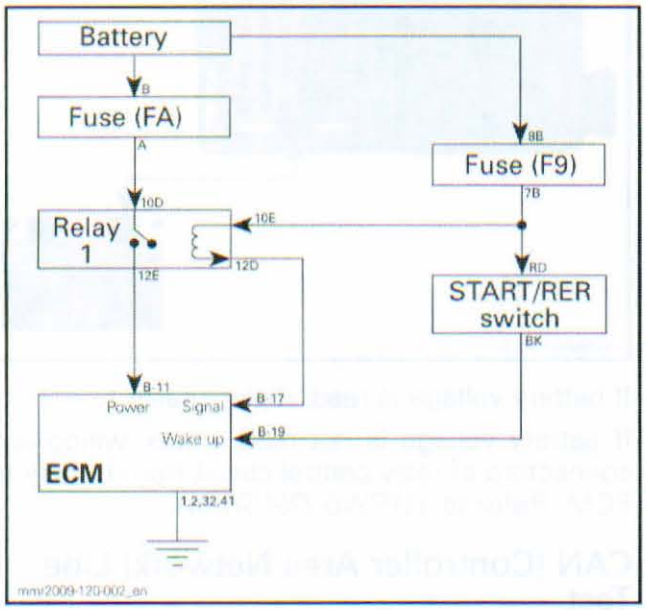


Disconnect the desired connector (A or B) from ECM and reconnect on the matching tool connector. Probe required terminals directly in the tool pins.

1. Probe copper ring

ECM Power Supply Troubleshooting

ECM Power Supply Diagram



ECM Power Supply Validation

Briefly press START/RER button.

This should wake up the ECM and continuously activate the relay 1.

QUICK INDICATION THAT ECM IS NOT POWERED (ASSUMING THE OBSERVED COMPONENT IS WORKING)
Multifunction gauge does not turn on.
Fuel pump does not turn on for approx. 2 seconds.
Engine cranking does not occur when pressing START/RER button.

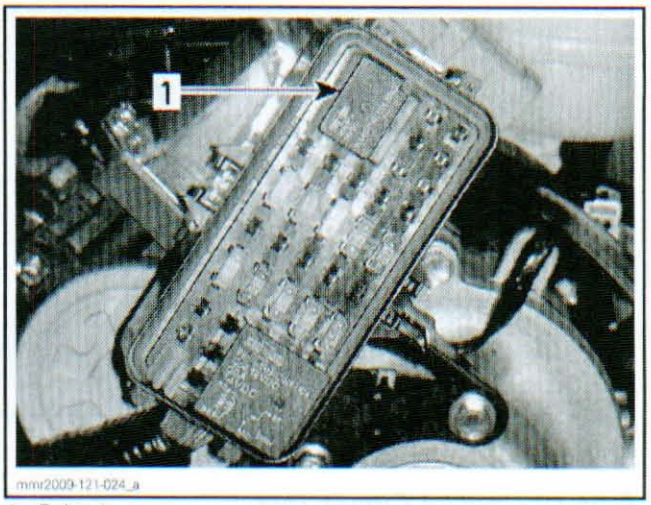
If ECM does not turn on, check the following:

- Fuse FA and F9.
- Battery voltage. Refer to *CHARGING SYSTEM*
- Relay 1.
- START/RER switch. Refer to *STARTING SYSTEM*.
- ECM power supply wires and ground wires.

Relay 1 Test

When relay 1 is not working, the EMS (engine management system) and the complete vehicle electrical system will not be powered.

Remove relay 1 from fuse box.

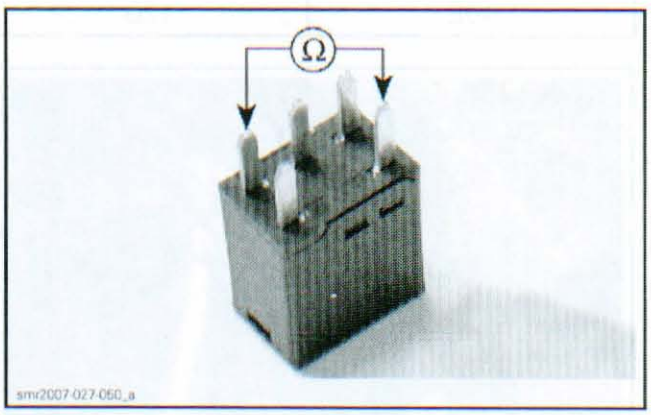


1. Relay 1

Use a multimeter and select the Ω position.

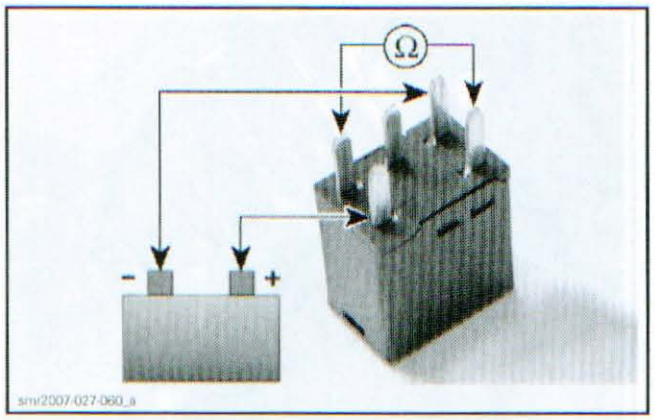
Probe relay as follows.

TERMINAL		RESISTANCE
30	87	Open circuit (OL)



Connect a battery to relay terminals as shown and probe relay again as follows.

TERMINAL		RESISTANCE
30	87	0.5 Ω max. (continuity)



If relay failed any test, replace it.

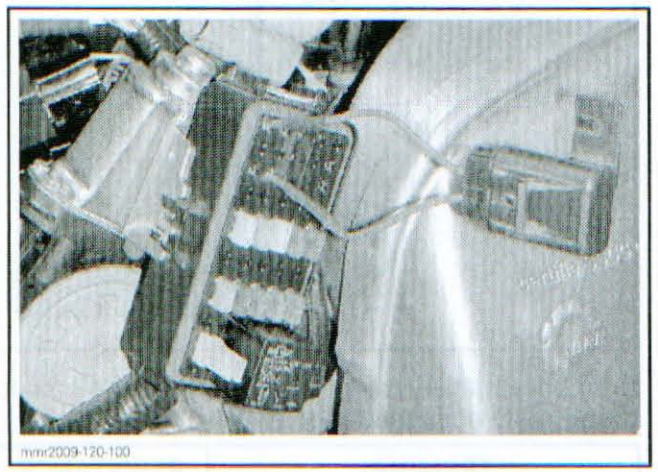
Relay 1 Control Circuit Test

Disconnect ECM connector B.

Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.

Temporarily install an appropriate fused jumper between terminals as per table.

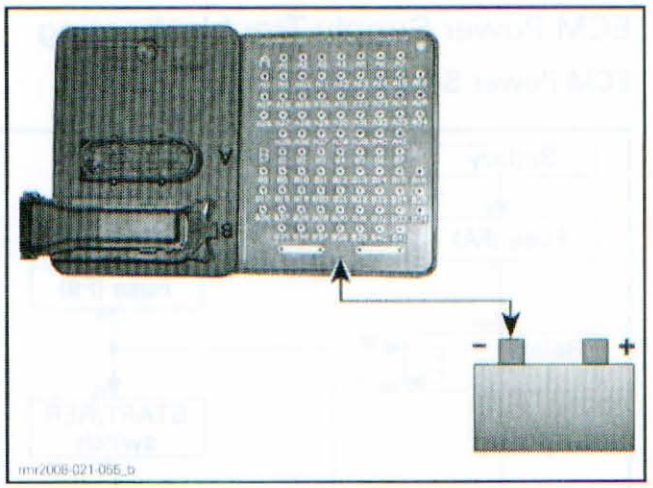
FUSE BOX TERMINAL COORDINATES	
10E	12D



Use a multimeter and select Vdc.

Read voltage as follows.

ECM CONNECTOR B		MEASUREMENT
B-17	Battery ground	Battery voltage

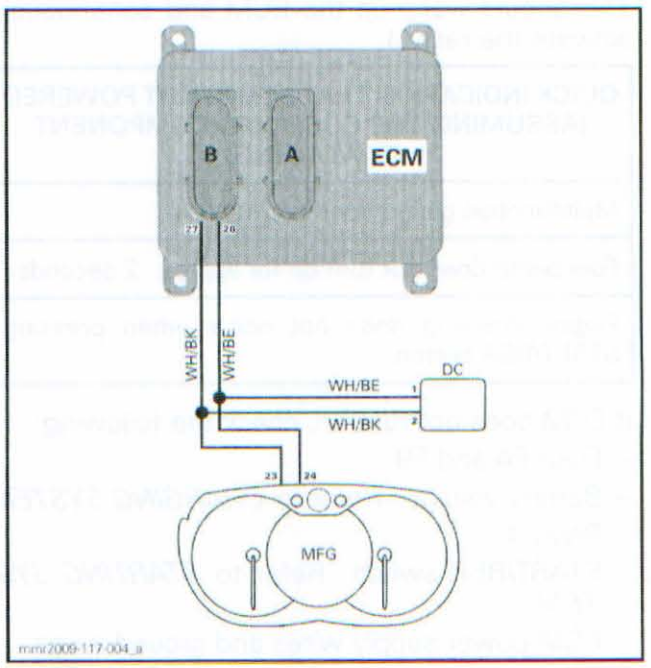


If battery voltage is read, replace relay 1.

If battery voltage is not read, check wiring and connectors of relay control circuit from battery to ECM. Refer to *WIRING DIAGRAM*.

CAN (Controller Area Network) Line Test

CAN lines link the ECM, multifunction gauge and vehicle diagnostic connector.



WH/BE (white/beige)
WH/BK (white/black)
MFG (multifunction gauge)
ECM (electronic control module)
DC (diagnostic connector)

Test wires continuity as follows.

Disconnect ECM connector B. Refer to *ECM* in this subsection.

Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.

Disconnect multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and select Ω.

Read wire resistance as follows.

ECM CONNECTOR	GAUGE CONNECTOR	MEASUREMENT
Pin B-27	Pin 23	Close to 0 Ω
Pin B-28	Pin 24	

If continuity is out of specification, repair or replace wiring harness between ECM and multifunction gauge.

If continuity is as per specification, carry out the following test.

Disconnect vehicle diagnostic connector from its protective cap.

Read wire resistance as follows.

DIAGNOSTIC CONNECTOR	GAUGE CONNECTOR	MEASUREMENT
Pin 2	Pin 23	Close to 0 Ω
Pin 1	Pin 24	

If continuity is out of specification, repair or replace wiring harness between diagnostic connector and multifunction gauge.

If continuity is as per specification, CAN lines are functional.

Reconnect connectors and reinstall removed parts.

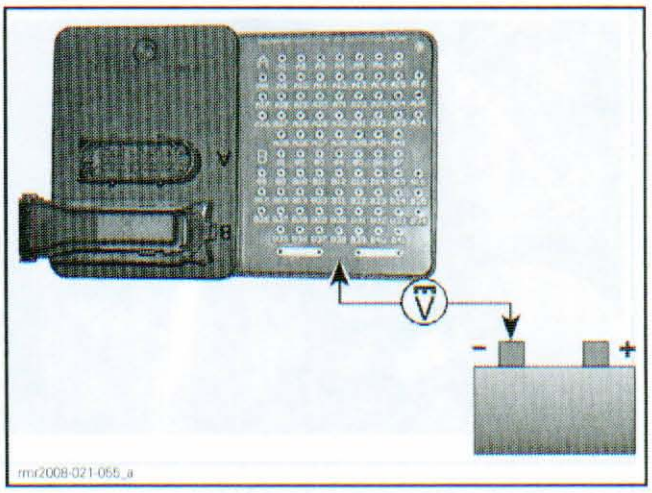
ECM Wake Up Circuit Test

Disconnect B connector from ECM.

Use a multimeter and select Vdc.

While pressing START/RER button, read voltage as follows.

ECM CONNECTOR	BATTERY	MEASUREMENT
B-19	Battery ground	Battery voltage



If voltage is out of specification, check START/RER switch (refer to *STARTING SYSTEM*). If switch tested good, check wiring and connectors from battery to ECM. Refer to *WIRING DIAGRAM*.

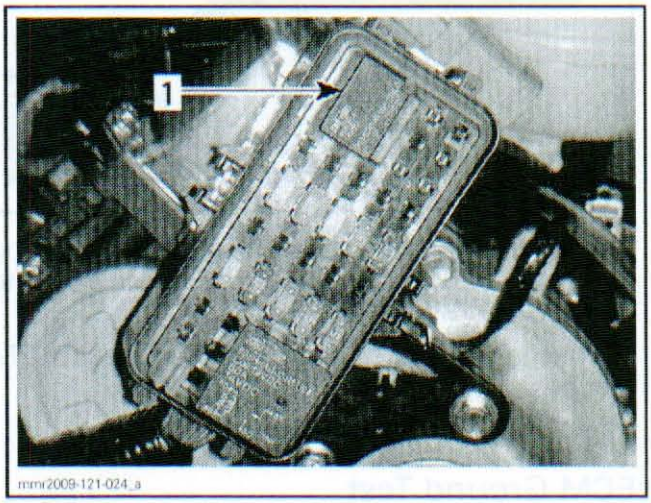
If voltage is as per specification, check the power circuit test.

ECM Power Circuit Test

Disconnect ECM connector B.

Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.

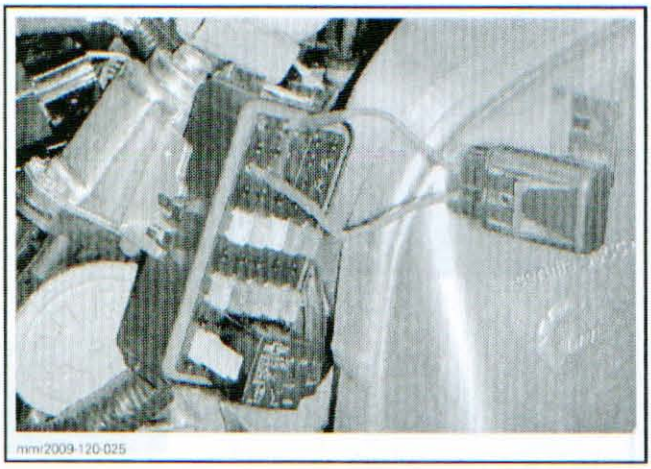
Remove relay 1 from fuse box.



1. Relay 1

Temporarily install an appropriate fused jumper between terminals as per table.

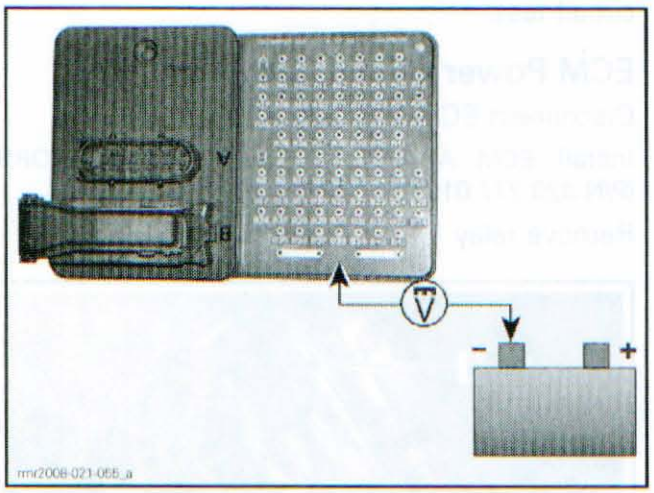
FUSE BOX TERMINAL COORDINATES	
10D	12E



Use a multimeter and select Vdc.

Read voltage.

ECM CONNECTOR B	BATTERY	MEASUREMENT
Pin B-11	Battery ground	Battery voltage



If voltage is out of specification, check wiring and connectors from battery to ECM. Refer to *WIRING DIAGRAM* subsection.

If voltage is as per specification, check ECM grounds.

Remove jumper and reinstall relay.

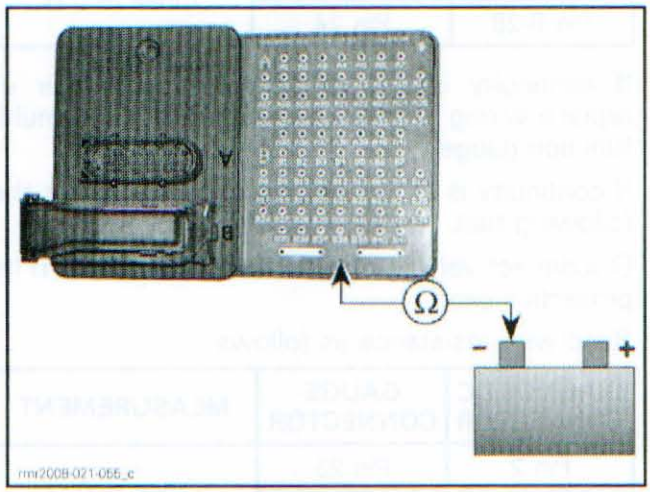
ECM Ground Test

Disconnect B connector from ECM.

Use a multimeter and select Ω.

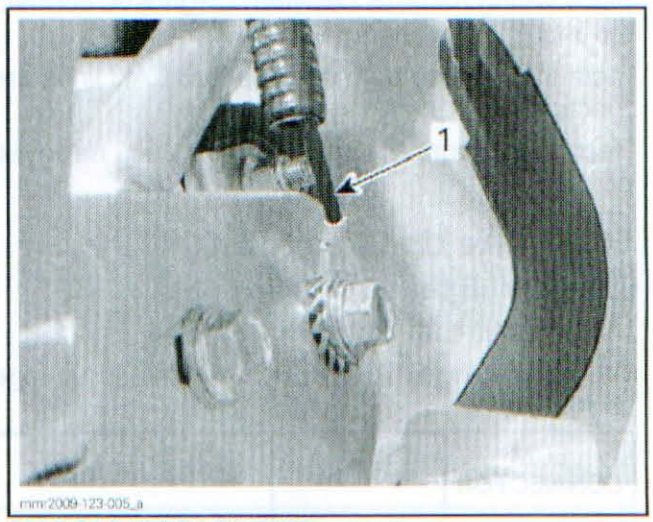
Check continuity of wiring as follows.

ECM CONNECTOR PIN	BATTERY	MEASUREMENT
B-1	Battery ground	Close to 0 Ω (continuity)
B-2		
B-32		
B-41		



If test succeeded, ECM grounds are adequate.

If test failed, check ECM ground on chassis.



REAR OF BATTERY SUPPORT
1. Chassis ground

ECM Removal

NOTE: If a new ECM is to be installed, first read the procedures in the *ECM REPLACEMENT*.

Move fuel tank rearward. Refer to *FUEL PUMP AND FUEL TANK* subsection.

Disconnect battery cables.

⚠ WARNING

Battery BLACK (-) cable must always be disconnected first and connected last.

Disconnect ECM connectors.

Remove ECM retaining screws.

Pull out ECM.

ECM Installation

Reverse removal procedure and pay attention to the following.

Install ECM as follows.

1. Reconnect ECM connectors to ECM, and then battery cables.
2. If a new ECM has been installed, refer to *ECM REPLACEMENT* below.

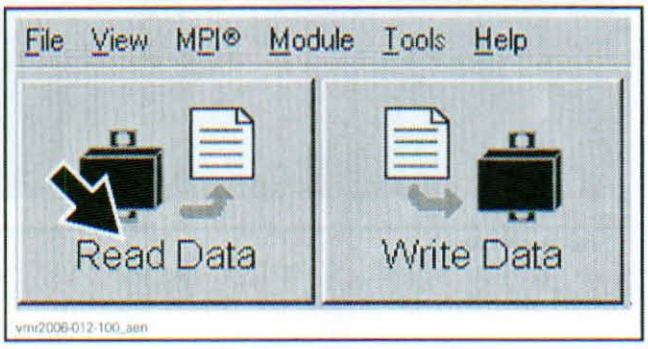
ECM Replacement

NOTE: Before replacing an ECM, ensure all testing procedures has been done.

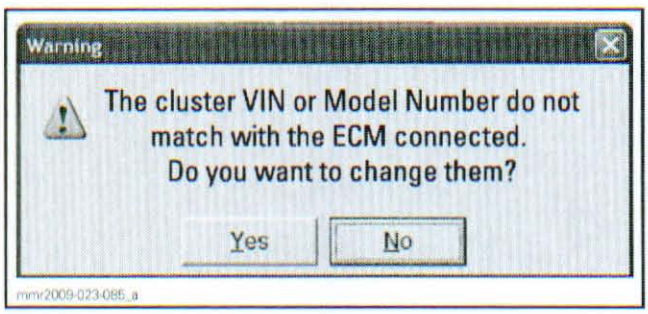
Transfer the data from the previous ECM to the new one using B.U.D.S.

If you are unable to transfer the data, proceed as follows.

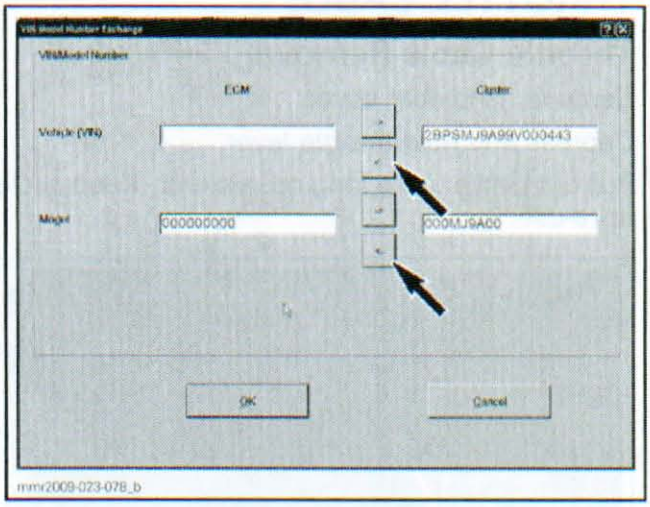
1. Use B.U.D.S. software.
2. Click the **Read Data** button to read the new "empty" ECM.



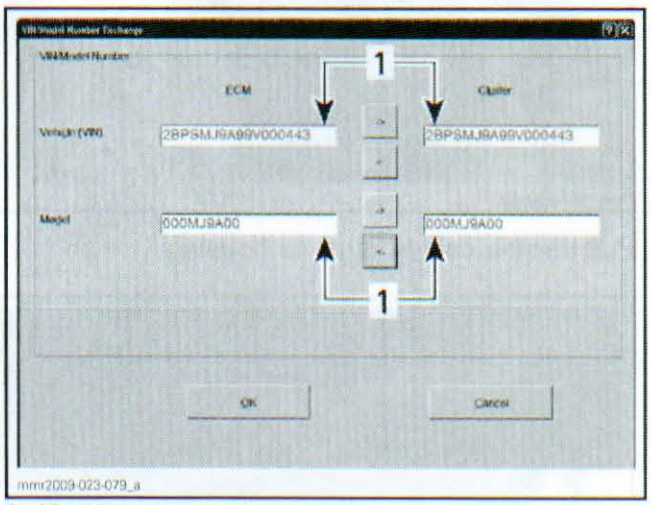
3. The following message will appear on B.U.D.S. screen.



4. Click **Yes** to match ECM and gauge.
5. The serial numbers are purposely missing as seen in B.U.D.S. Click the arrows shown to transfer the gauge numbers into the ECM.



6. Now the information numbers between ECM and gauge properly matches.



1. Matching numbers

7. Enter the required information in **Vehicle** upper tab and the **ECM** lower tab.

NOTICE **Pay particular attention when typing the V.I.N. and model numbers. Once Write Data button is pressed, numbers cannot be modified.**

8. Reprogram D.E.S.S. key(s). Refer to *DE.S.S. SYSTEM.*
9. Perform the closed throttle reset. Refer to *CLOSED THROTTLE RESET* in this subsection.
10. Set the multifunction gauge units. Refer to *LIGHTS, GAUGE AND ACCESSORIES.*

11. Start the engine and increase engine speed above 6000 RPM to be sure no fault appears.
12. Reinstall removed parts.

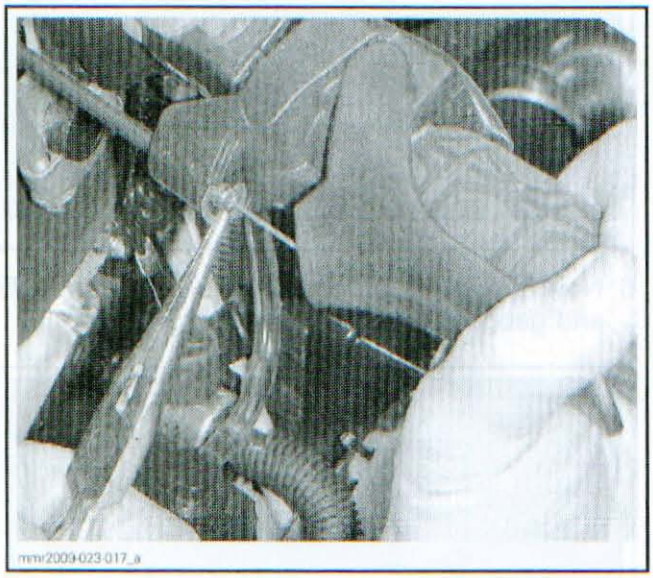
THROTTLE CABLE

Throttle Cable Removal

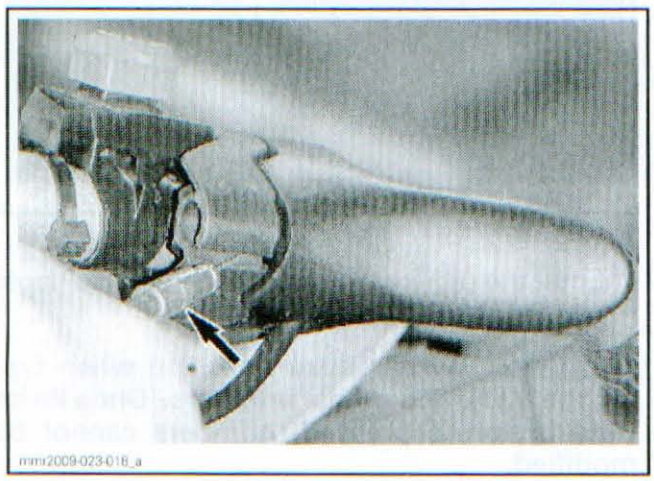
Remove handlebar cover.

Depress and hold throttle lever.

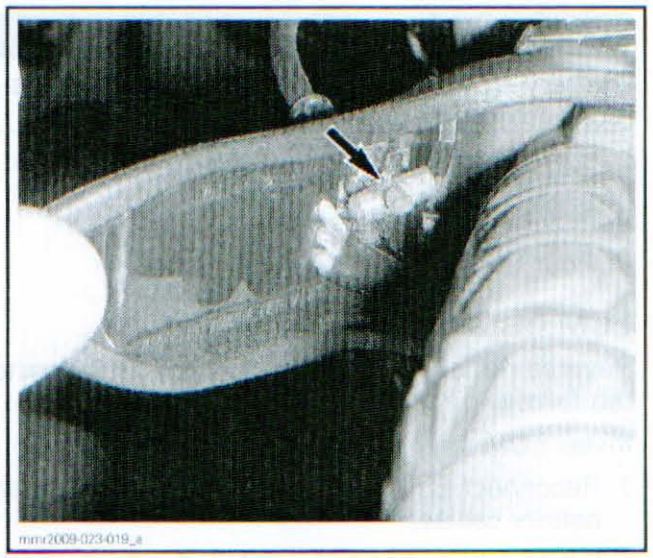
Pull out circlip using long nose pliers. Keep circlip to re-use.



Pull throttle cable out of its housing.



Unhook cable end barrel from throttle lever and remove cable.

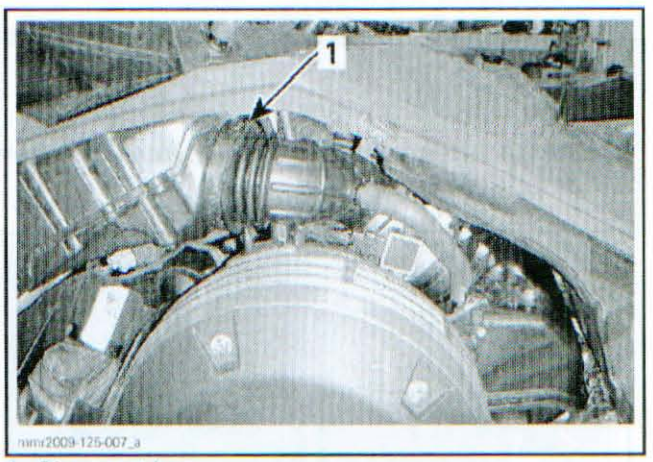


Note cable routing before removal.

Remove drive belt guard. Refer to *DRIVE BELT*.

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

Disconnect intake adapter from air intake silencer and both hoses connected to it.

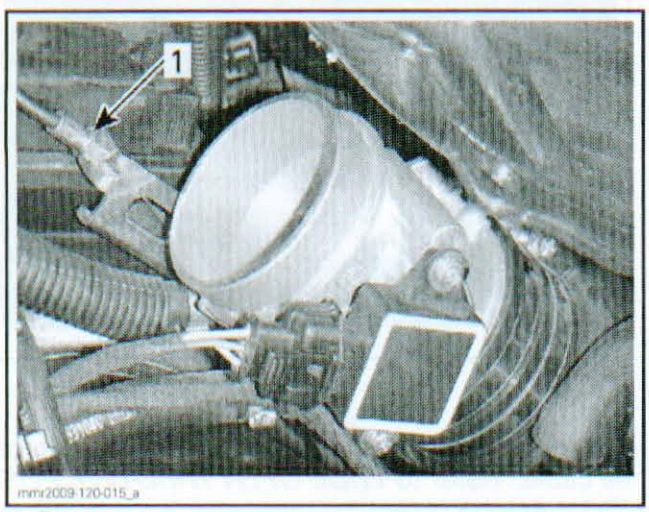


1. Disconnect here

1. Disconnect both hoses

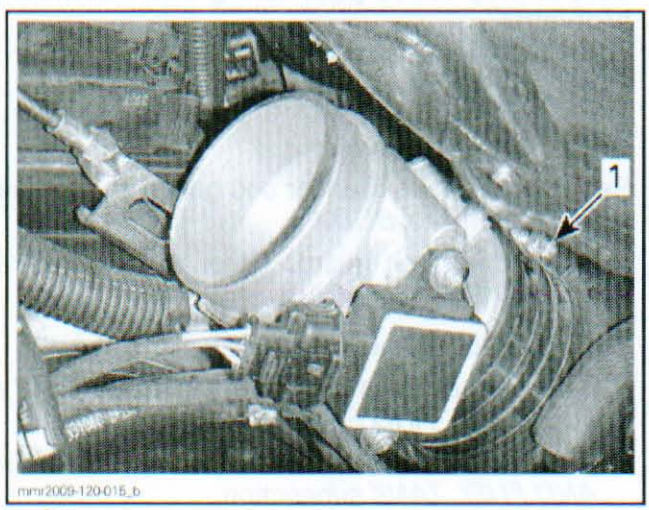
Pull out adapter from throttle body.

At throttle body, unlock top nut.



1. Top nut

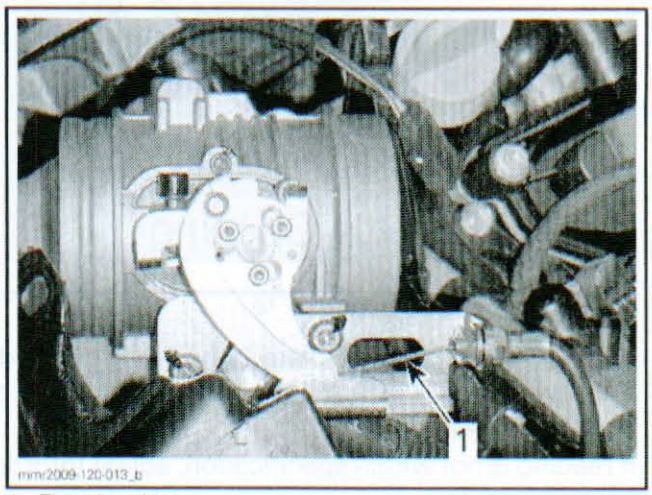
Loosen throttle body clamp.



1. Clamp

Pull out throttle body enough to have access to throttle cable attachment.

Detach throttle cable from throttle body.



1. Throttle cable

Remove throttle cable.

Throttle Cable Installation

Reverse removal procedure but pay attention to the following.

Route cable as noted before removal.

Ensure that cable ends are properly secured in their levers.

Proceed with throttle cable adjustment.

Throttle Cable Adjustment

Handlebar must be in the straight ahead position and throttle cable routing must be at its factory position.

NOTICE Do not alter throttle cable routing. It may cause poor startability and erratic idling.

Wide Open Throttle Position Adjustment

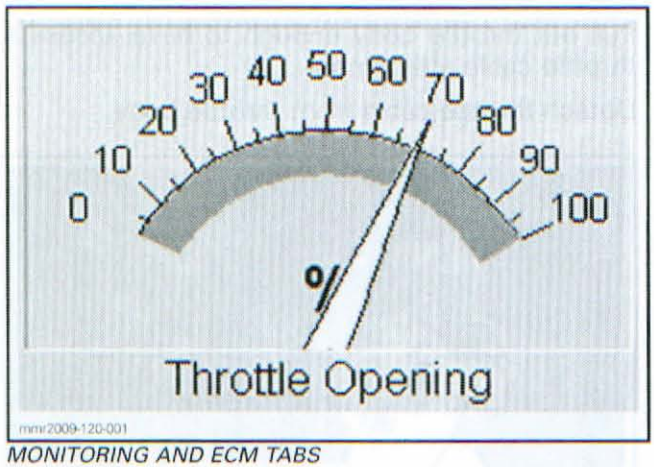
Connect B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE*.

Use the B.U.D.S. software.

Observe the throttle opening in B.U.D.S. while holding throttle lever at wide open throttle (WOT).

The displayed value must be within the following specification.

THROTTLE OPENING (WIDE OPEN THROTTLE)
68 - 72%



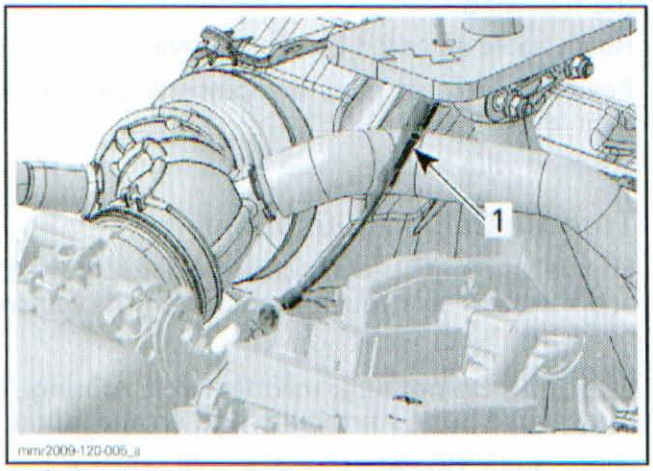
MONITORING AND ECM TABS

NOTE: Even if throttle plate is not fully opened, there will be no performance loss as long as it is within the specification.

If reading is not within specification, adjust throttle cable.

NOTE: If value is below the minimum, tighten throttle cable adjuster. If value is above the maximum value, loosen throttle cable adjuster.

Loosen lock nut on the cable adjuster.



1. Cable adjuster

Set cable adjuster as required then tighten lock nut.

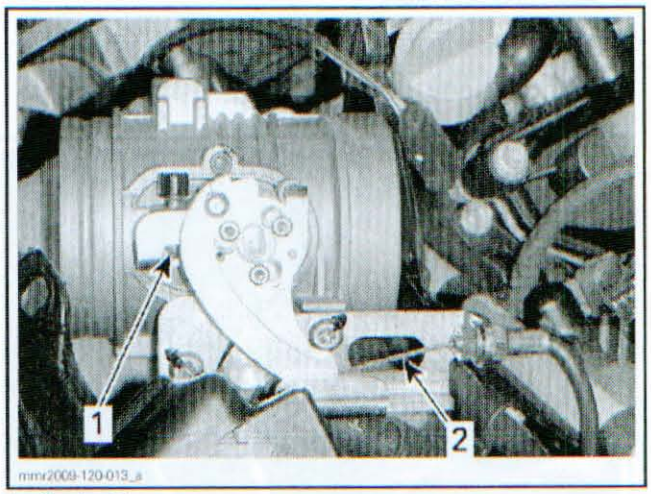
Turn handlebar side to side and ensure adjustment is still within the specification in each position while at WOT.

Idle Position Verification

Activate and release throttle lever a few times.

While throttle is released, make sure stopper of throttle cam rests against the idle stop screw and there is some free-play in the cable.

NOTE: Use a flashlight and look from the RH side to see the throttle cam and the idle stop screw.



1. Contact here
2. Free-play here

If the above conditions are not met, adjust throttle cable. Refer to *WIDE OPEN THROTTLE POSITION ADJUSTMENT.*

NOTICE **If there is no free-play at idle position, it may cause poor idling and startability problems.**

FUEL RAIL

Fuel Rail Removal

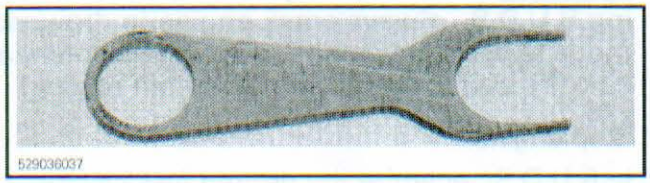
Remove air intake silencer and gauge support assembly. Refer to *BODY.*

Remove drive belt guard. Refer to *DRIVE SYSTEM AND BRAKE.*

Fuel Rail Hose Disconnection

1. Release fuel pressure. Refer to *FUEL PUMP* in *FUEL TANK AND FUEL PUMP* subsection.
2. Move fuel tank rearward. Refer to *FUEL PUMP AND FUEL TANK* subsection.

3. Disconnect fuel hose from fuel rail using the FUEL HOSE DISCONNECT TOOL (P/N 529 036 037).

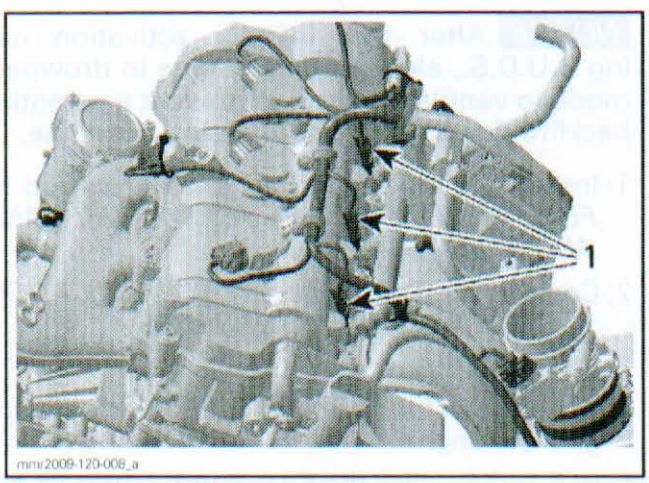


NOTE: It may be necessary to rotate fuel hose fitting to align the tool ends with the openings of the locking mechanism.

NOTE: Wrap a rag around the hose end to catch fuel leakage.

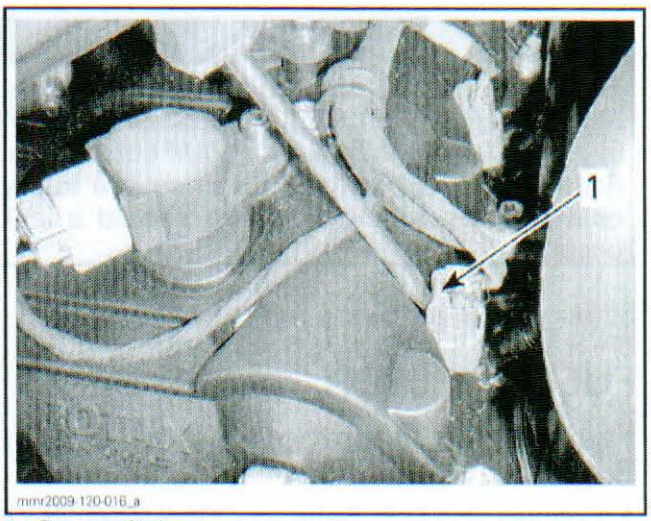
Fuel Rail Removal

Unplug all injector connectors.



1. Injector connectors

NOTE: Carefully use a screwdriver and gently pry the top of the connector tab to unlock it.



1. Pry top of tab

Remove ECM support.

Remove retaining screws of fuel rail.

Gently pull fuel rail side to side (wiggle).

Pull fuel rail out with fuel injectors.

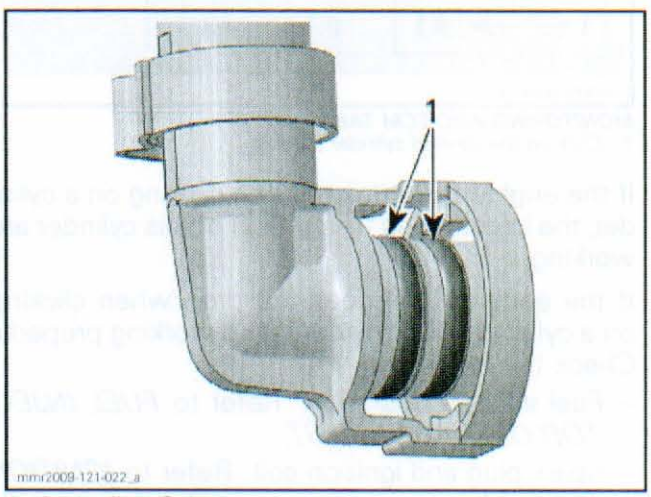
Fuel Rail Installation

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

Torque fuel rail retaining screws to 11 N•m (97 lbf•**in**).

Fuel Rail Hose Connection

1. Apply engine oil on O-rings of fitting.



1. Apply oil on O-rings

2. Connect fuel hose to fuel rail.

IMPORTANT: Push fuel hose fitting on fuel rail until you hear a "click". Try pulling fuel hose to ensure fitting is properly locked.

⚠ WARNING

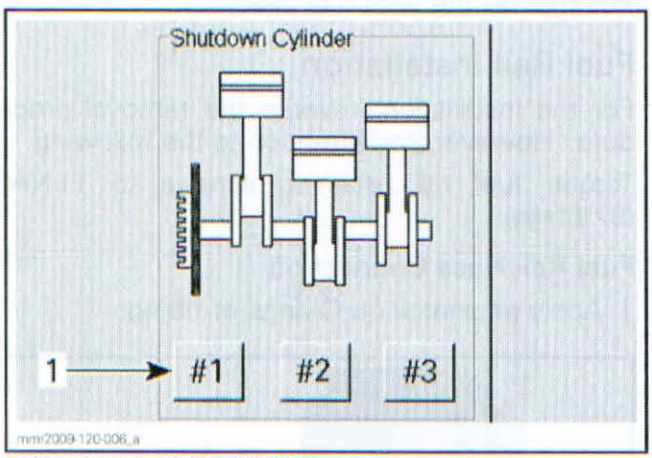
Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection. Failure to do so may result in severe injury or a life threatening situation should a leak occur.

3. Reinstall all remaining removed parts.

FUEL INJECTOR

Fuel Injector Operation Test with B.U.D.S. (Dynamic)

1. Connect B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE.*
2. Start engine.
3. Using the B.U.D.S. software, shut down each engine cylinder, one at a time.



MONITORING AND ECM TABS
1. Click on the desired cylinder number

If the engine RPM drops when clicking on a cylinder, the injector and the ignition of this cylinder are working.

If the engine RPM does not drop when clicking on a cylinder, this cylinder is not working properly. Check the following:

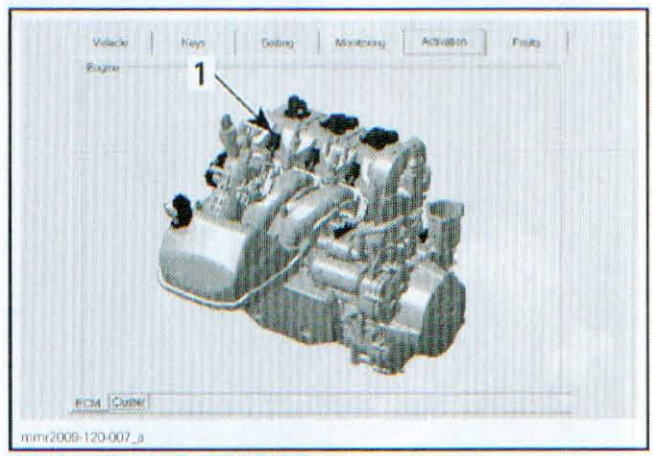
- Fuel injector operation. Refer to *FUEL INJECTOR OPERATION TEST.*
- Spark plug and ignition coil. Refer to *IGNITION SYSTEM.*
- Engine condition.

Fuel Injector Operation Test with B.U.D.S. (Static)

NOTICE **After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine to prevent a potential backfire due to fuel accumulation in engine.**

Stop engine.

In B.U.D.S., energize the desired fuel injector.



ACTIVATION AND ECM TABS
1. Injector of cylinder no. 1 shown

Listen to the injector.

If you can hear the injector, it validates its operation. Carry out the *FUEL INJECTOR BALANCE TEST* and the *FUEL INJECTOR LEAKAGE TEST.*

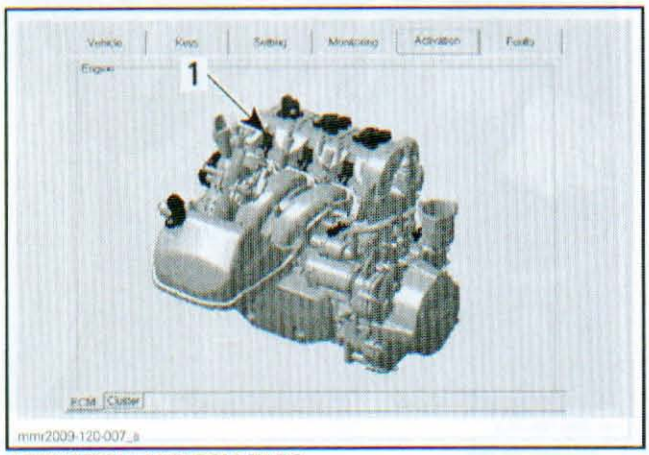
If you do not hear the injector, carry out the *INJECTOR INPUT VOLTAGE TEST.*

Fuel Injector Balance Test with B.U.D.S.

NOTICE **After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine to prevent a potential backfire due to fuel accumulation in engine.**

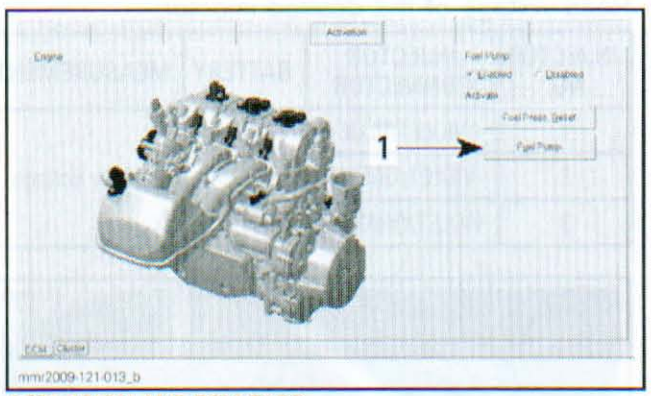
1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* of *FUEL TANK AND FUEL PUMP* subsection.
2. Connect B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE.*
3. Install D.E.S.S. key on its post.
4. Set engine stop switch to STOP to prevent engine starting.
5. In B.U.D.S., click the **Fuel Pump** button to activate fuel pump.
6. Fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.

7. In B.U.D.S., energize the fuel injector **no. 1**.



ACTIVATION AND ECM TABS
1. Injector of cylinder no. 1

8. Record the fuel pressure drop for injector **no. 1**.
9. In B.U.D.S., click the **Fuel Pump** button to activate fuel pump.



ACTIVATION AND ECM TABS
1. Click here

10. Repeat the procedure for fuel injectors **no. 2** and **no. 3** and record their pressure drops.
11. The maximum fuel pressure drop between injectors should not exceed the following specification:

MAXIMUM FUEL PRESSURE DROP ALLOWED BETWEEN FUEL INJECTORS
10 kPa (1.5 PSI)

12. If pressure drop of any fuel injector is greater than the specification, replace that injector then repeat the test.
13. Remove fuel pressure gauge and reinstall removed parts.

Fuel Injector Leakage Test

Preparation

First make sure fuel pressure is within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection.

NOTE: Keep the pressure gauge installed for the leakage test.

Install D.E.S.S. key on its post.

Set engine stop switch to STOP.

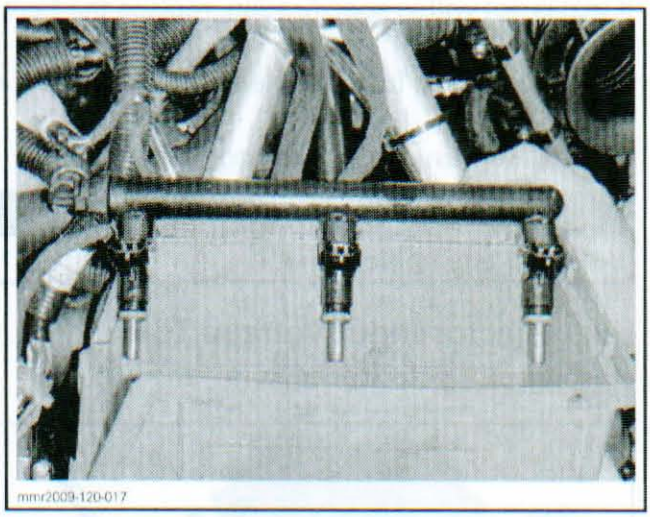
⚠ WARNING

The engine stop switch is set to STOP to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

Withdraw fuel rail and keep it connected. Refer to *FUEL RAIL* in this subsection.

Carefully lift fuel rail.

Place an appropriate container under injectors.



Ensure there is enough fuel in fuel tank.

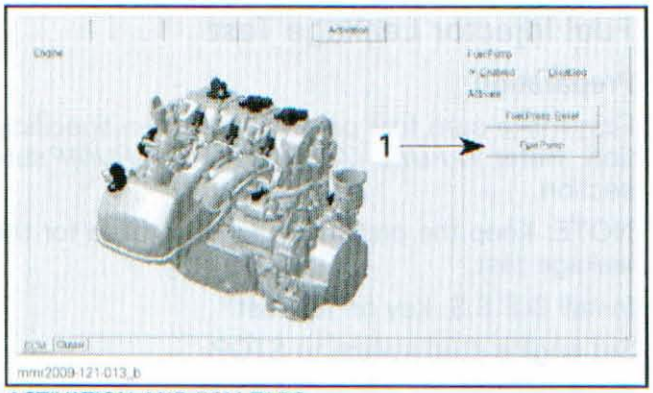
Connect B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE*.

Leakage Test

Use the B.U.D.S. software.

Briefly press the START/RER button.

Click the **Fuel Pump** button.



ACTIVATION AND ECM TABS
1. Click here

Check for fuel leakage from the injector nozzles.

Monitor fuel pressure at fuel pressure gauge. If pressure drops below 372 kPa (54 PSI) during the test, re-activate fuel pump as necessary.

FUEL INJECTOR LEAKAGE	
TEST DURATION	SPECIFICATION
2 minutes	0 - 1 drop per minute maximum

If test is not within specification, replace the faulty fuel injector.

Properly reinstall fuel rail. Refer to *FUEL RAIL* in this subsection.

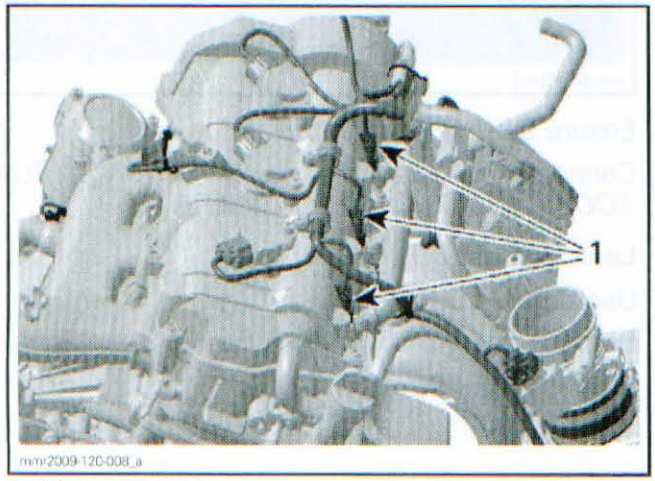
Reinstall remaining removed components.

⚠ WARNING

Wipe up any spilled fuel.

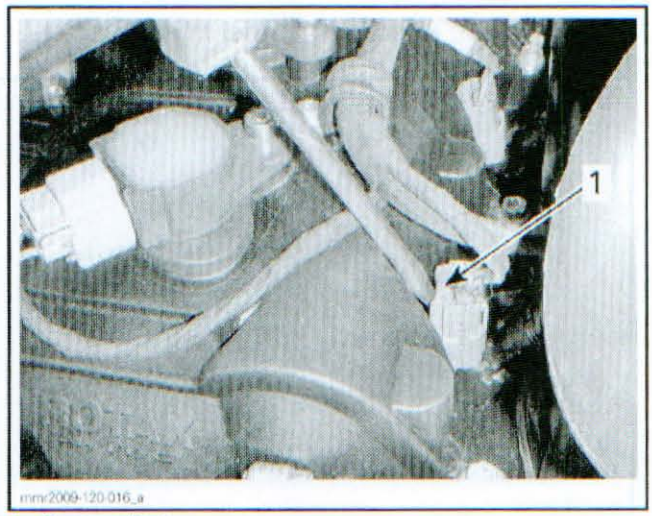
Fuel Injector Input Voltage Test

Disconnect injector connectors.



1. Injector connectors

NOTE: Carefully use a screwdriver and gently pry the top of the connector tab to unlock it.



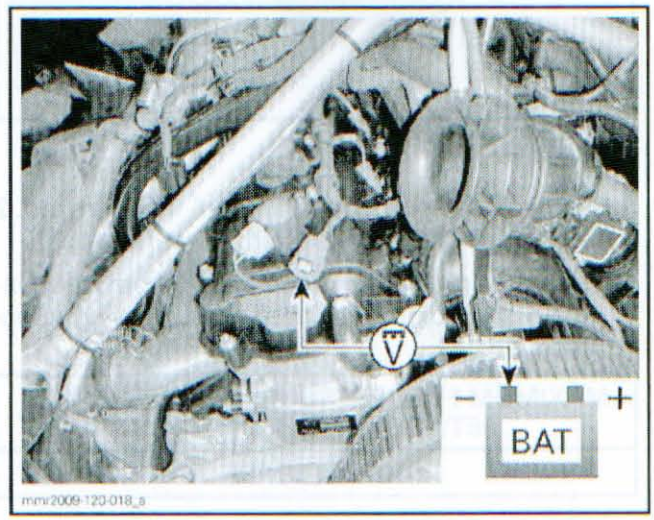
1. Pry top of tab

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and select Vdc.

Briefly press the START/RER button to wakeup ECM.

Read voltage of the desired injector.

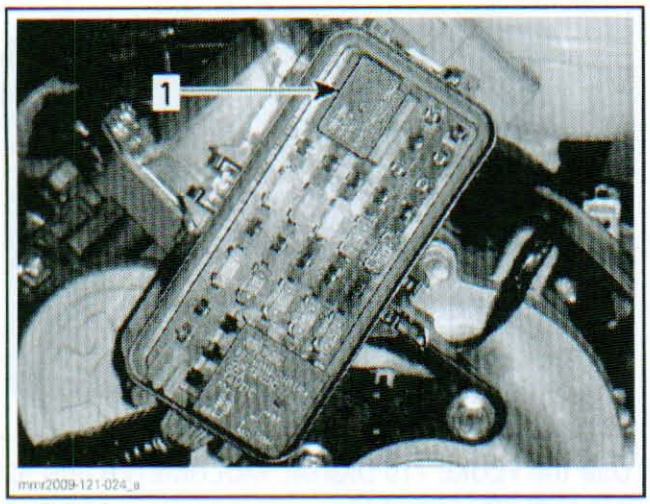
INJECTOR NO.	INJECTOR CONNECTOR	BATTERY	MEASUREMENT
1	VIOLET/BLUE	Ground terminal	Battery voltage
2	VIOLET/GREEN		
3	VIOLET/ORANGE		



If input voltage is good, carry out the *INJECTOR CONTROL CIRCUIT TEST.*

If input voltage is not good, check continuity between relay 1 and injector as follows.

Remove relay 1 from fuse box.

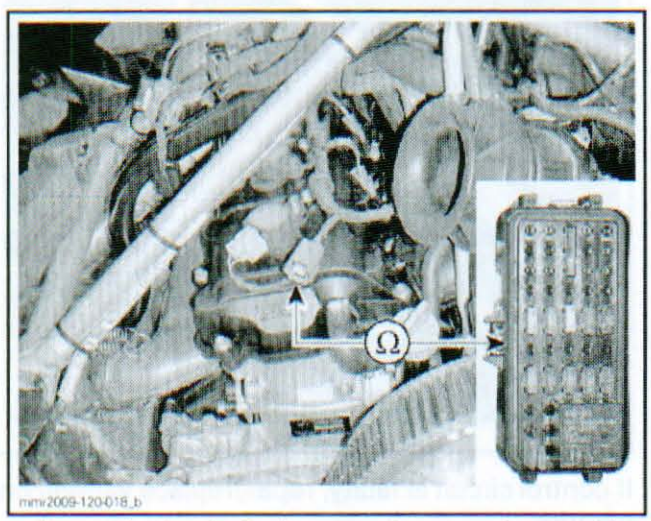


1. *Relay 1*

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and select Ω.

Read the resistance of the desired injector circuit.

INJECTOR NO.	INJECTOR CONNECTOR	BATTERY	MEASUREMENT
1	VIOLET/BLUE	Terminal 12E	Close to 0 Ω
2	VIOLET/GREEN		
3	VIOLET/ORANGE		



- If continuity is faulty, repair or replace wiring from fuse box to injector.
- If continuity is good, check relay and wiring from battery to fuse box. Refer to *ECM* in this subsection.

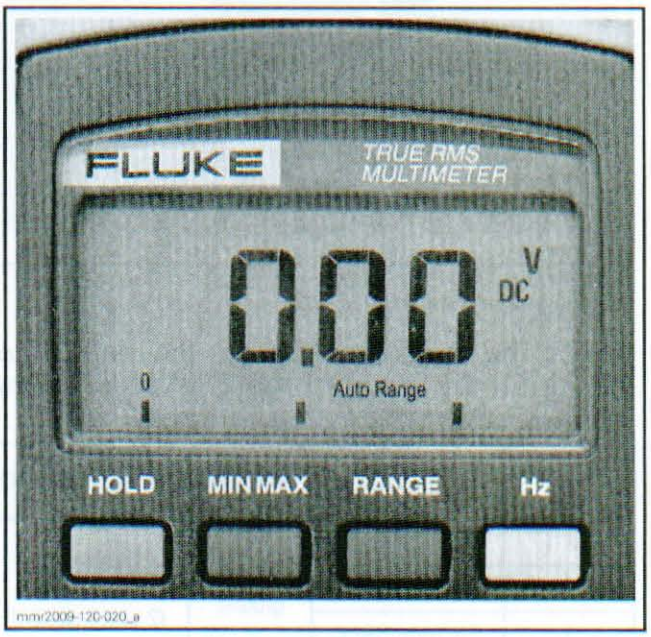
Reinstall relay 1.

Fuel Injector Signal Test

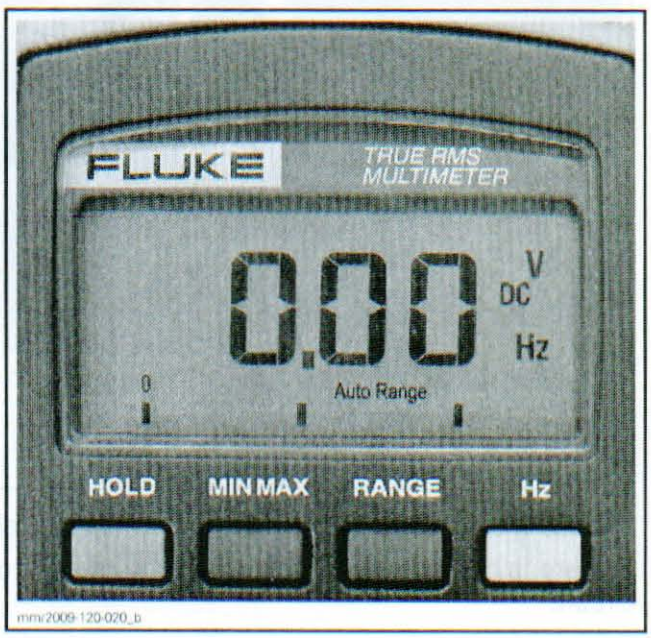
Connect B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE.*

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and set it to Vdc (Hz).

NOTE: Make sure multimeter is in the **Auto Range** mode.

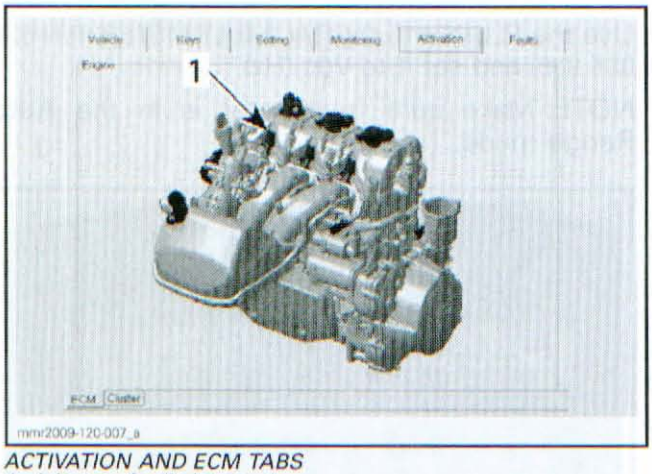


Press the **Hz** button so that the display shows Hz.



Use the B.U.D.S. software.

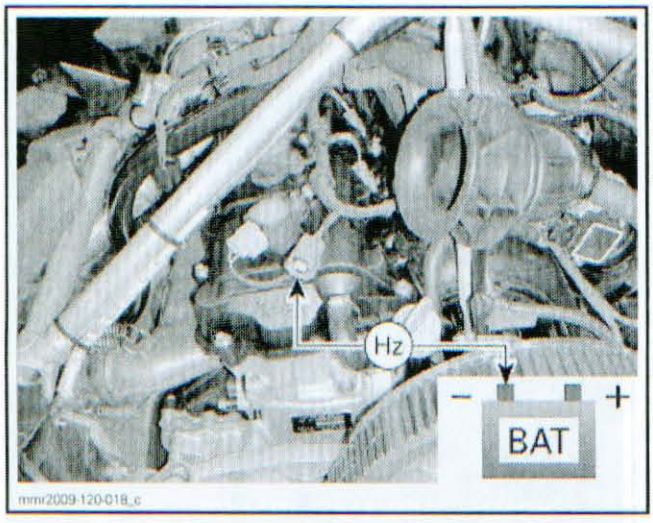
Activate injector and read the frequency on the multimeter.



ACTIVATION AND ECM TABS
1. Injector of cylinder no. 1

NOTE: The multimeter counts the pulses per minute (Hertz) of current the ECM sends to the injector.

INJECTOR NO.	INJECTOR CONNECTOR	BATTERY	MEASUREMENT
1	BROWN/RED	Battery ground	Approximately 60 Hz (2 short pulses)
2	BROWN/BLUE		
3	BROWN/GREY		



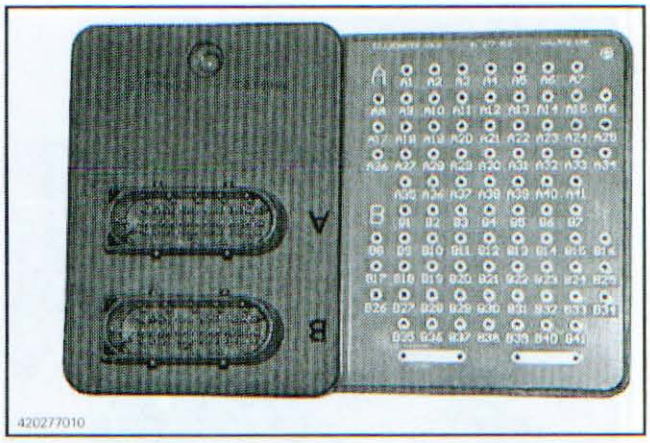
If reading is good, the control circuit is functional.

If there is no reading, check continuity of control circuit.

Fuel Injector Control Circuit Test

Disconnect ECM A connector. Refer to *ECM* in this subsection.

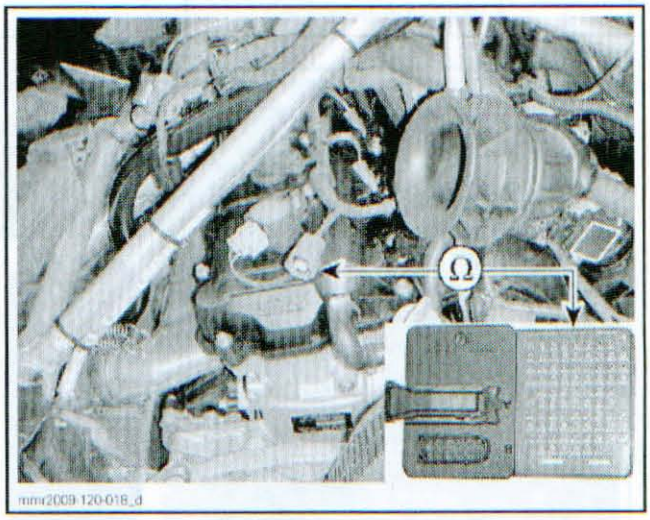
Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.



Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and select Ω.

Probe terminals as follows.

INJECTOR NO.	ECM CONNECTOR PIN	INJECTOR CONNECTOR	MEASUREMENT
1	A-15	BROWN/RED	Close to 0 Ω
2	A-33	BROWN/BLUE	
3	A-14	BROWN/GREY	



If control circuit is faulty, repair/replace wiring/connectors.

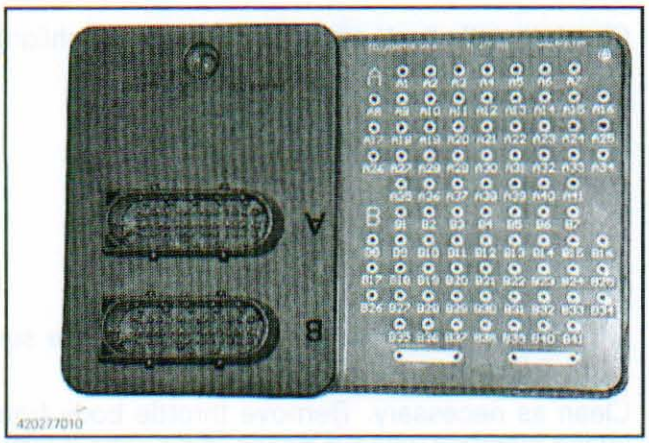
If control circuit and all tests applicable to the injector are good, try a new ECM. Refer to *ECM*.

Fuel Injector Resistance Test (at ECM Connector)

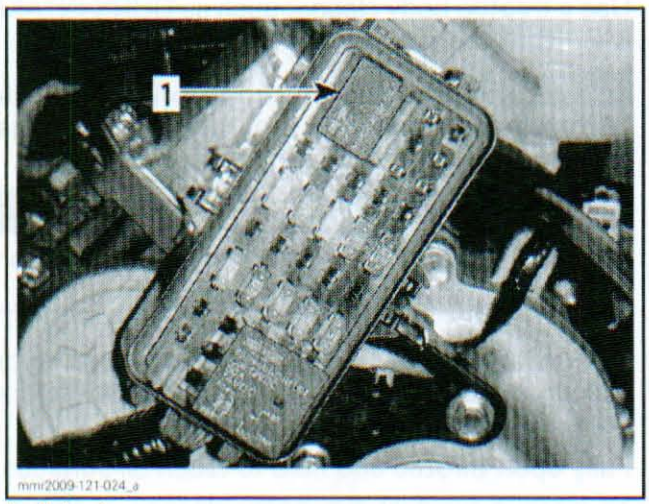
Reconnect the injector connector.

Disconnect the ECM A connector.

Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.



Remove relay 1 from fuse box.



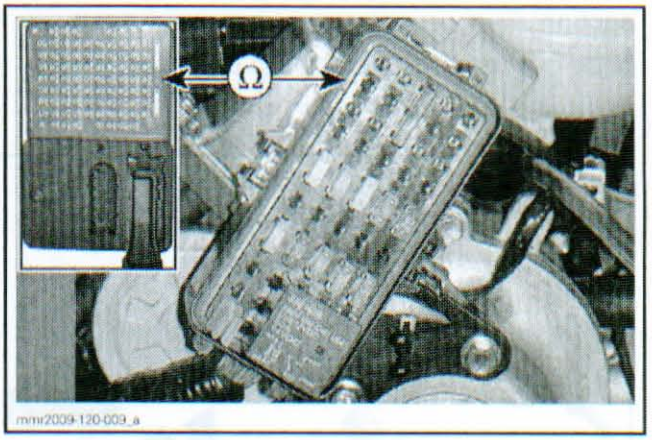
1. Relay 1

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868)

Set multimeter to Ω.

Check resistance value between terminals as follows.

INJECTOR	FUSE BOX	ECM CONNECTOR	RESISTANCE @ 20°C (68°F)
1	Terminal 12E	A-15	Approximately 12.6 Ω
2		A-33	
3		A-14	



If resistance value is correct, injector coil is in good condition.

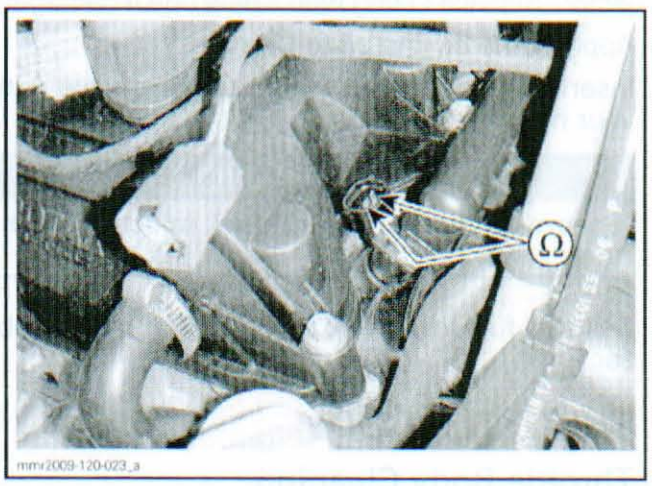
If resistance value is incorrect, repeat test at injector connector.

Reinstall relay 1.

Fuel Injector Resistance Test (at Component)

Remove injector connector and check resistance value between injector pins as follows.

INJECTOR PIN		RESISTANCE @ 20°C (68°F)
1	2	See above



If reading is out of specification, replace injector.

If reading is good but the test failed at ECM, repair/replace wiring/connectors from fuse box to injector.

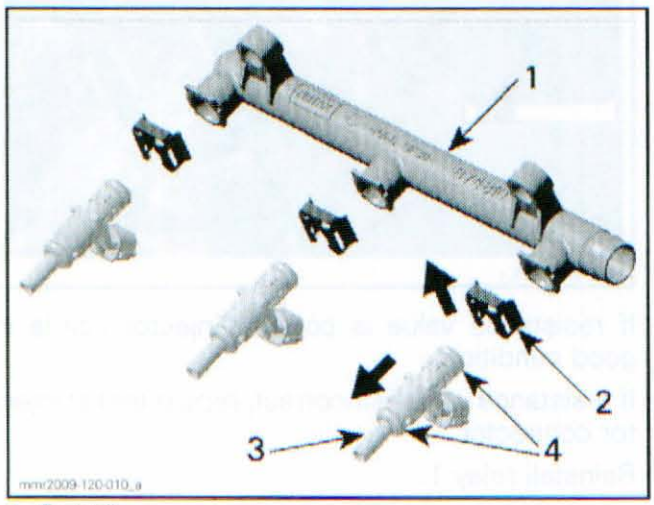
Reinstall relay 1 and remaining removed parts.

Fuel Injector Removal

Remove fuel rail. Refer to *FUEL RAIL* in this subsection.

Slide out the fuel injector clip (see illustration).

Pull out fuel injector from fuel rail.



1. *Fuel rail*
2. *Fuel injector clip*
3. *Fuel injector*
4. *O-ring*

Fuel Injector Installation

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

NOTE: If you reinstall a used injector, carefully inspect O-ring condition before reinstalling fuel injector. Replace O-ring with a new one if damaged.

Apply some engine oil to O-rings.

Insert and secure the fuel injector in place with your hand.

⚠ WARNING

Ensure to properly lock fuel injectors with their clips.

Reinstall fuel rail. Refer to *FUEL RAIL* in this subsection.

THROTTLE BODY

Throttle Body Cleaning

Remove air intake silencer.

Check throttle body cleanliness using a flashlight. Fully open throttle plate and verify:

- Throttle body bore
- Throttle plate edge
- Air orifice.

Look for:

- Dirt
- Oily surfaces
- Carbon deposits on throttle plate and the surrounding bore.

Clean as necessary. Remove throttle body from intake manifold without disconnecting the throttle cable, hoses and wires.

Use a throttle body cleaner such as GUNK INTAKE MEDIC or the equivalent.

NOTICE Only use an appropriate throttle body cleaner that will not damage O-rings, MAPTS sensor and idle air control valve.

⚠ WARNING

Use the product in well ventilated area. Refer to product manufacturer's warnings.

To avoid getting dirt into engine, spray cleaner on a clean rag then rub rag against throttle plate and bore. A toothbrush works well too.

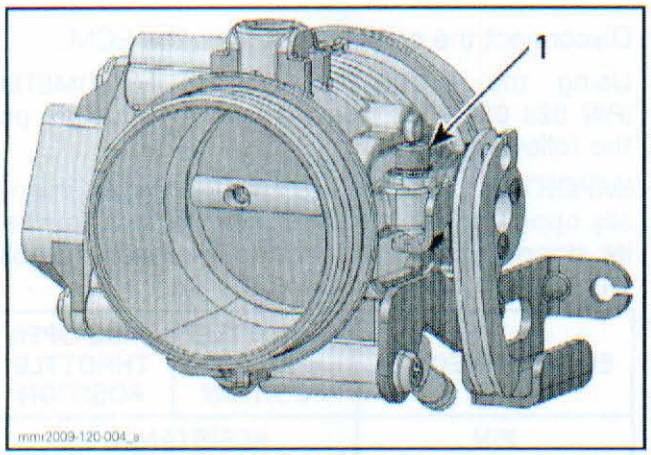
Fully open throttle and hold to reach all surfaces.

To remove residual dirt, spray cleaner on throttle plate and on bore.

Reinstall removed parts.

Throttle Body Inspection

NOTICE Never attempt to adjust the capped idle stop screw. It is calibrated at the factory. If the screw adjustment is changed, the throttle body must be replaced.



1. Capped screw (DO NOT TAMPER)

- Check if throttle body idle stop screw is loose or worn. If so, throttle body must be replaced.
- Check if TPS (throttle position sensor) is loose).
- Check for corroded or damaged wiring or connectors of TPS and IACV.

Throttle Body Removal

1. Remove LH side panel. Refer to *BODY*.
2. Remove drive belt guard. Refer to *DRIVE SYSTEM AND BRAKE*.
3. Remove air intake silencer. Refer to *AIR INTAKE SYSTEM*.
4. Disconnect TPS connector.
5. Detach throttle body from intake manifold.
6. Disconnect throttle cable from throttle body.
7. Install a SMALL HOSE PINCHER (P/N 295 000 076) on each coolant hoses connected to throttle body.
8. Disconnect coolant hoses from throttle body.
9. Remove throttle body.

Throttle Body Installation

Installation of the throttle body is the reverse of the removal procedure. However, pay attention for the following details.

Install throttle cable to throttle body.

Install throttle body on intake manifold.

Ensure throttle cable is properly locked. Activate throttle lever several times.

Check throttle cable adjustment.

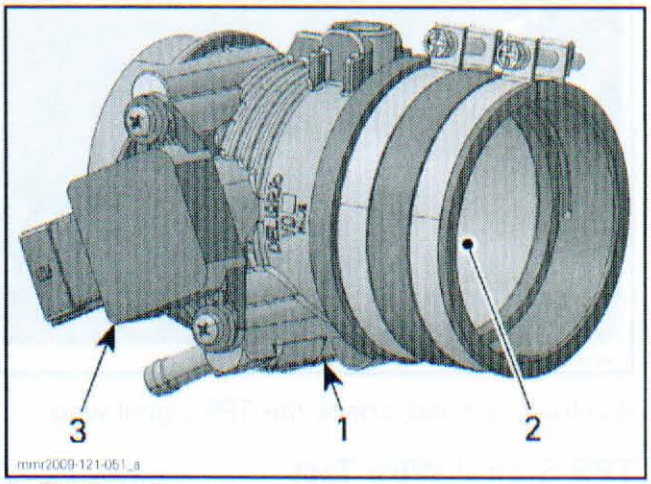
Install new clamps on heating hoses using OETIKER PLIERS (P/N 295 000 070).

Refill and bleed cooling system if necessary. Refer to *COOLING SYSTEM*.

THROTTLE POSITION SENSOR (TPS)

Description

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



1. Throttle body
2. Throttle plate
3. TPS (Throttle Position Sensor)

TPS Wear Test

Ensure TPS connector is plugged.

While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.

Use B.U.D.S. software.

Use the **Throttle Opening** display under **Monitoring**.

Slowly and regularly depress the throttle. Observe the needle movement. It must change gradually and regularly as you move the throttle. If the needle "sticks", bounces, suddenly drops or if any discrepancy between the throttle movement and the needle movement is noticed, it indicates a worn TPS that needs to be replaced.

TPS Input Voltage Test

Check the voltage output from ECM to the throttle position sensor.

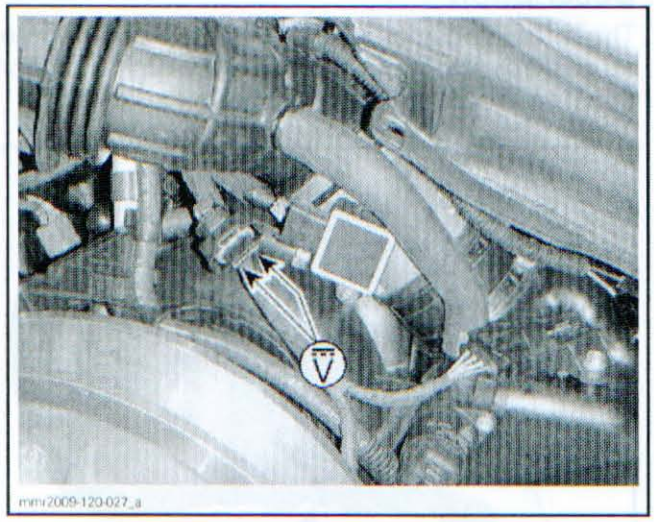
Disconnect TPS connector.

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and set it to Vdc.

Briefly press the START/RER button.

Read voltage at TPS harness connector as follows.

TPS HARNESS CONNECTOR		VOLTAGE
Pin 1	Pin 2	5.0 Vdc



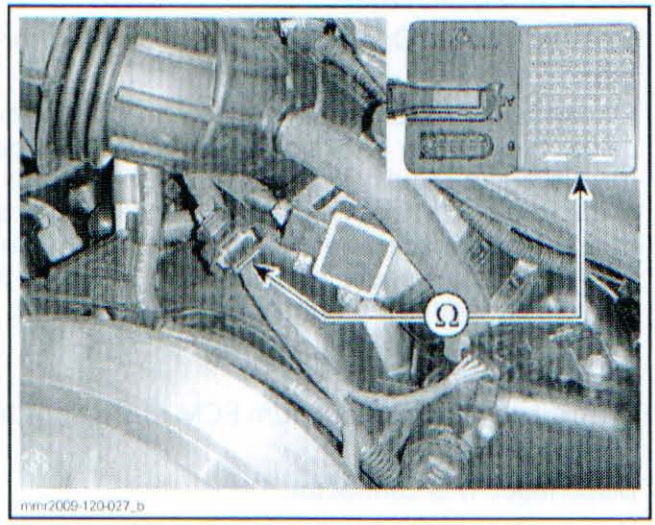
If voltage is good, check the TPS signal wire.

TPS Signal Wire Test

Disconnect the A connector from ECM.

Check the wiring continuity as follows

TPS HARNESS CONNECTOR	ECM A CONNECTOR	RESISTANCE
Pin 3	Pin A-24	Close to 0 Ω (continuity)



If tests are good, replace the TPS.

If tests are not good, continue to check the resistance of the rest of the TPS circuit.

TPS Resistance Test

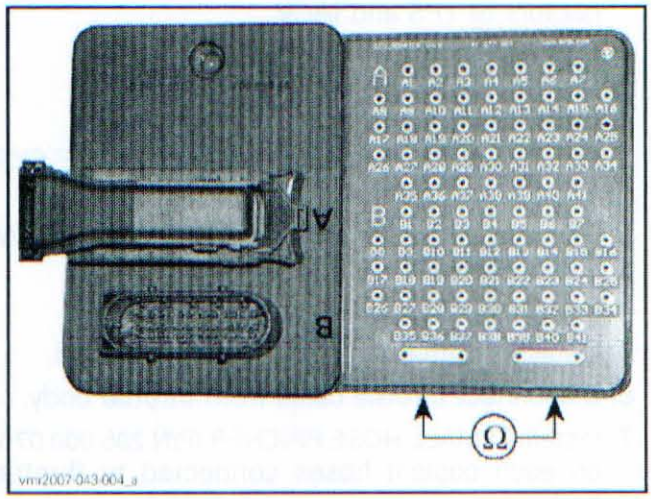
Reconnect the TPS.

Disconnect the connector A from the ECM.

Using the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868), check resistive value as per the following table.

IMPORTANT: For the WOT measurement, manually open the throttle plate until the cam touches its stopper. Using the throttle lever at handlebar will not fully open the throttle plate.

ECM CONNECTOR		THROTTLE IDLE POSITION	WIDE OPEN THROTTLE POSITION
PIN		RESISTANCE Ω	
A-24	A-25	880 - 1300	2390 - 2810
A-25	A-39	1600 - 2400	1600 - 2460
A-24	A-39	2390 - 2810	880 - 1300



NOTE: The resistive value should change smoothly and proportionally to the throttle movement. Otherwise, replace TPS.

If resistive values are correct, try a new ECM. Refer to *ENGINE CONTROL MODULE (ECM)* elsewhere in this subsection.

If resistive values are incorrect, repair/replace wiring/connectors. If they are good, replace TPS.

TPS Removal

Remove the throttle body as described above.

Loosen TPS retaining screws.

Remove TPS.

Install the new TPS.

Apply Loctite 243 on the TPS retaining screws, then torque to 3 N•m (27 lbf•**in**).

Reinstall remaining removed parts.

Proceed with the **Closed Throttle Reset**.

TPS Installation

Install the new TPS.

Apply Loctite 243 on the TPS retaining screws, then torque to 3 N•m (27 lbf•**in**).

Reinstall remaining removed parts.

Proceed with the **Closed Throttle Reset**.

IDLE AIR CONTROL VALVE (IACV)

If IACV is to be removed, refer to *IACV REMOVAL* in this subsection. Important instructions are given to prevent damaging the IACV.

IACV Auto Setting

When engine is stopped, just before the ECM turns off, the IACV will completely close to find its zero position. It will then back out a number of steps and park to this reference position. When the ECM is powered, it assumes the IACV is at its reference position. For this reason, it is important to stop the engine by removing the D.E.S.S. key or by using the engine stop switch.

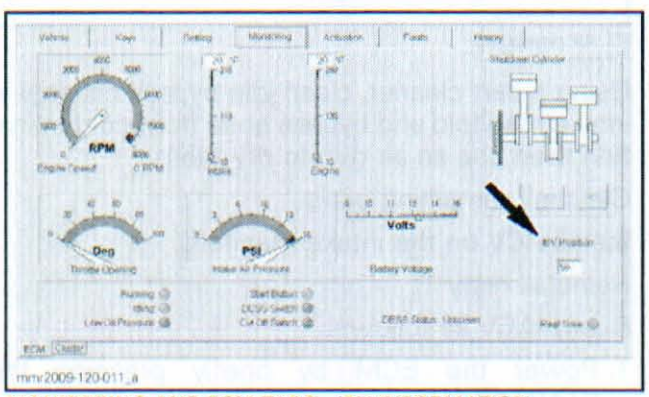
If idle speed is not stable or is inaccurate, reset the IACV as follows:

1. Power the ECM by briefly pressing the START/RER button.
2. Remove D.E.S.S. key.
3. Wait until multifunction gauge turns off.
4. Repeat the procedure 2 - 3 times.

IACV Information in B.U.D.S. Software

Start engine and let warm up.

Use B.U.D.S. and read IACV position while engine is idling.



MONITORING AND ECM TABS - IBV INFORMATION

NOTE: The **IACV Position** is displayed for information purposes only.

The IACV is controlled by a stepper motor (via the ECM) and the value given is the position of the stepper motor.

The value is given in steps. See chart.

IACV STEPS IN B.U.D.S.	VALVE POSITION
0	Fully closed
Typical values: 15 - 50 (1)	Partially open
150	Fully open

(1) Typical IACV values at idle are given for a warm engine and vary depending on altitude, air temperature, throttle body and production tolerances.

The ECM constantly controls the IACV to maintain engine target idle speed when the throttle is closed.

NOTE: An engine giving an IACV position outside of this range is not necessarily faulty. It may only give clues if poor idle or light throttle behavior is experienced. Lower values may indicate a leakage in the air intake system or in the idle air control system. Higher values may suggest a dirty throttle body, obstructed idle bypass passages etc.

IACV Resistance Test (at Component)

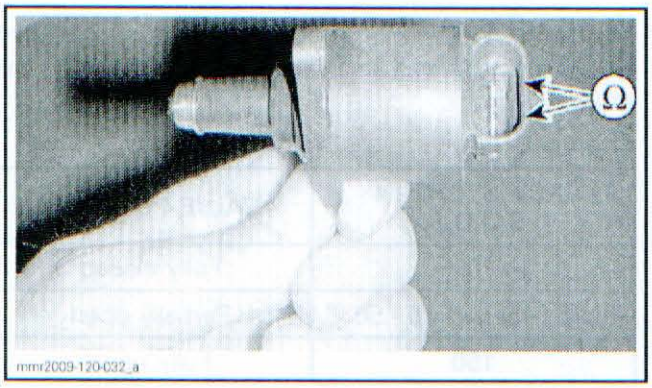
An idle air control valve with good resistance measurement can still be faulty. It is also possible that a mechanical failure occurs which is not detectable without measuring the air flow. Replacing the IACV may be necessary as a test.

Disconnect IACV connector.

Remove IACV from intake manifold.

Check the resistance between pins as follows.

IACV		MEASUREMENT
PIN		RESISTANCE @ 20°C (68°F)
1	4	Approximately 50 Ω
2	3	



If the resistance of any winding is inadequate, replace the IACV.

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

IACV Resistance Test (at ECM Connector)

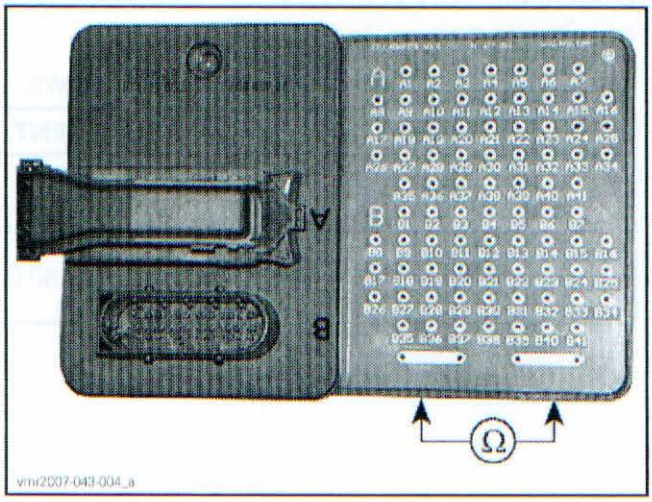
Reconnect IACV connector.

Disconnect ECM A connector.

Use ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) and a multimeter.

Set multimeter to Ω and read resistance as follows.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE @ 20°C (68°F)
A-35	A-36	See above
A-37	A-38	



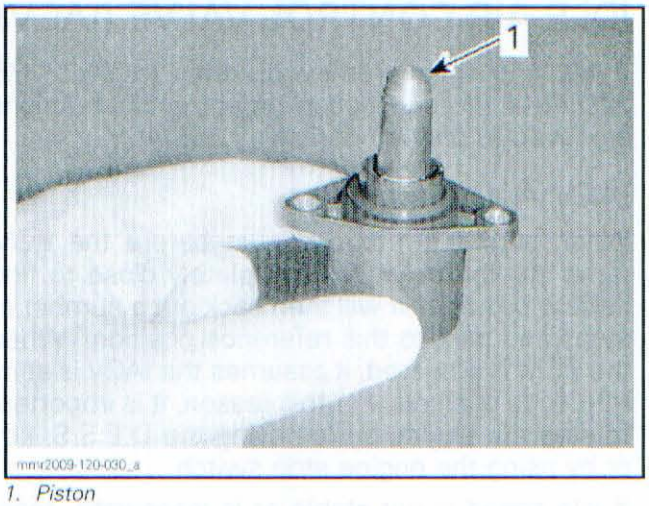
If any resistance test failed, repair/replace wiring/connectors between IACV and ECM.

If resistance test are good and all valve tests has been done, check ECM. Refer to *ECM*.

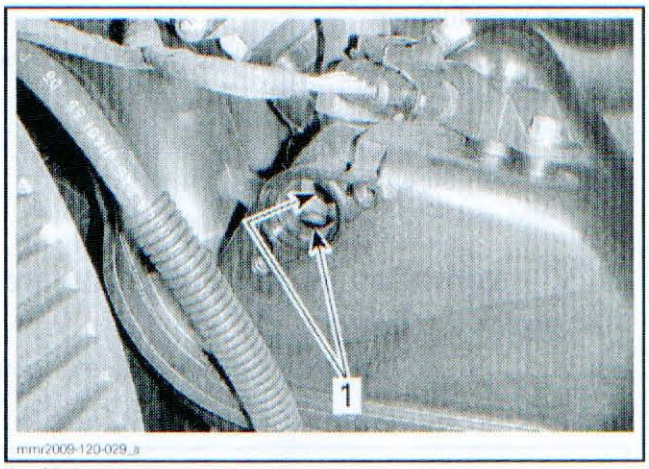
IACV Visual Inspection and Cleaning

Remove IACV from intake manifold. Refer to *IACV REMOVAL* in this subsection. Important instructions are given to prevent damaging the IACV.

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



1. Piston



1. Air passages

Using a part cleaner, clean idle bypass channel in intake manifold and bypass hose from contamination then use an air gun to dry them.

Clean all remaining parts.

Install ACV on the intake manifold.

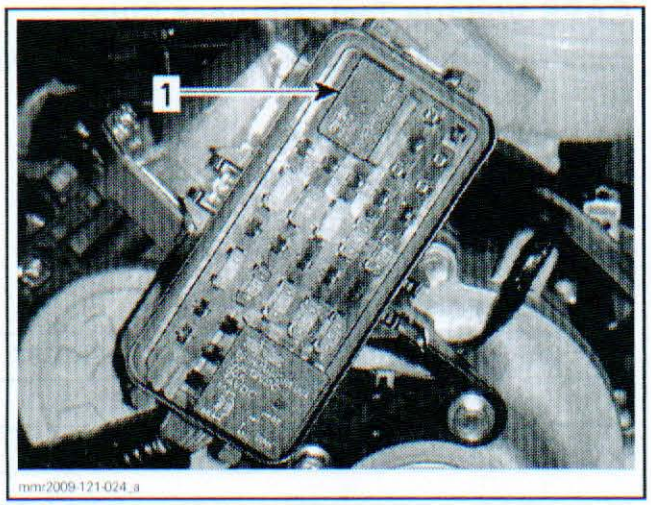
Reinstall relay 1.

Reset IACV as follows:

1. Power the ECM by briefly pressing the START/RER button.
2. Remove D.E.S.S. key.
3. Wait until multifunction gauge turns off.
4. Repeat the procedure 2 - 3 times.

IACV Removal

Remove relay 1.



1. Relay 1

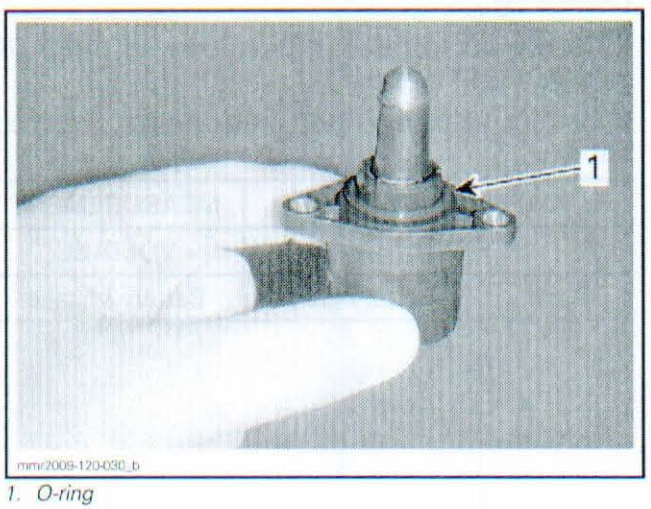
NOTICE Always make sure relay 1 is not installed while the IACV is removed. Do not try to operate the piston of the IACV when it is dismounted. Also do not move the piston by hand. The screw drive is very sensitive and will be damaged.

Remove retaining screw.

Pull out IACV.

IACV Installation

Check IACV O-ring condition. Replace as necessary.



1. O-ring

Install IACV.

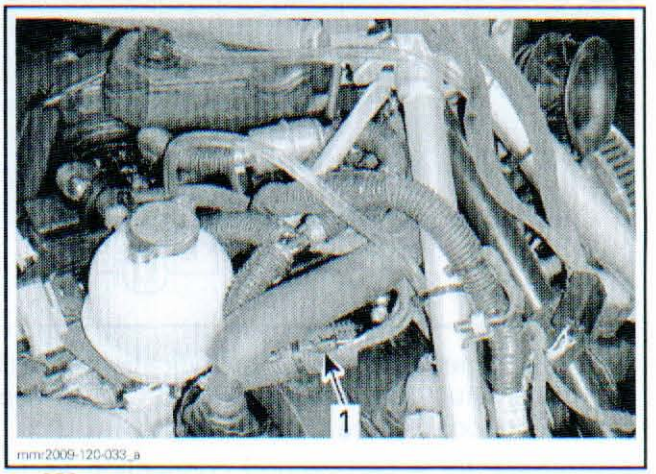
Torque screws to 3 N•m (27 lbf•**in**).

CRANKSHAFT POSITION SENSOR (CPS)

NOTE: If fault code P0339 is present and CPS succeeded to all tests below, refer to *MONITORING SYSTEM AND FAULT CODES*.

CPS Output Voltage Test

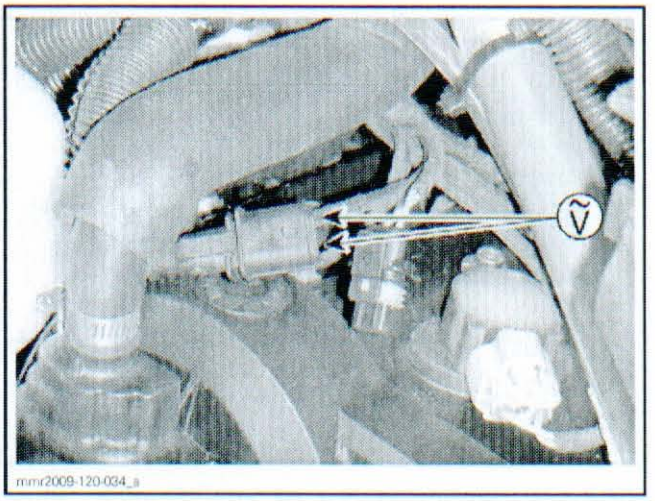
Disconnect CPS connector.



1. CPS connector

Probe terminals coming from CPS while cranking engine.

CPS CONNECTOR		VOLTAGE
Pin 1	Pin 2	1 - 2 Vac min.



If voltage is out of specification, inspect wiring/connectors. Replace CPS if wiring is good.

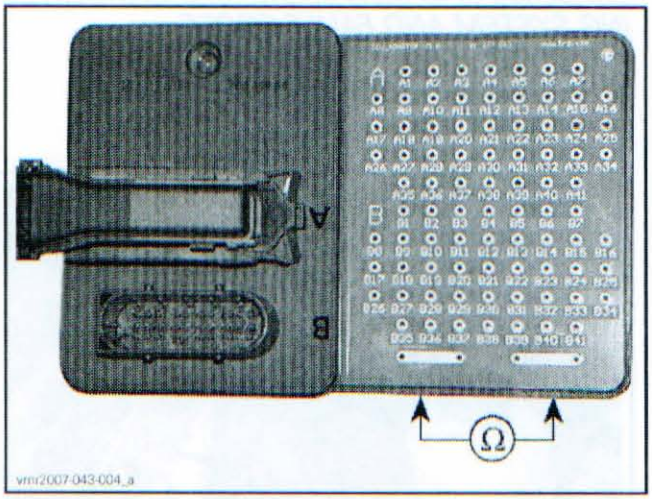
CPS Resistance Test

Disconnect connector A from ECM.

Reconnect CPS connector.

Measure the resistance of the sensor itself.

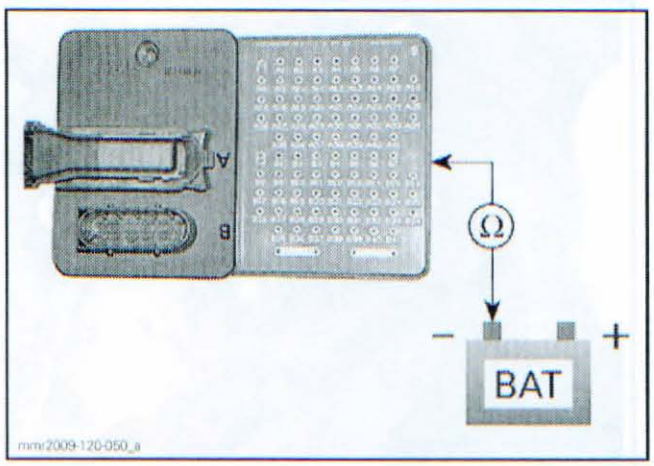
ECM A CONNECTOR		RESISTANCE @ 20°C (68°F)
Pin A-5	Pin A-19	775 - 950 Ω



If measurement is out of specification, check wiring continuity between ECM and CPS. If continuity is good, replace CPS.

Also check for a bad ground connection as follows.

ECM A CONNECTOR		RESISTANCE @ 20°C (68°F)
Pin A-5	Engine ground	Open circuit (OL)
Pin A-19	Engine ground	



If measurement is out of specification, check wiring between ECM and CPS.

CPS Replacement

Refer to *MAGNETO SYSTEM*.

CAMSHAFT POSITION SENSOR (CAPS)

CAPS Voltage Test (Harness Side)

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

Disconnect CAPS connector.

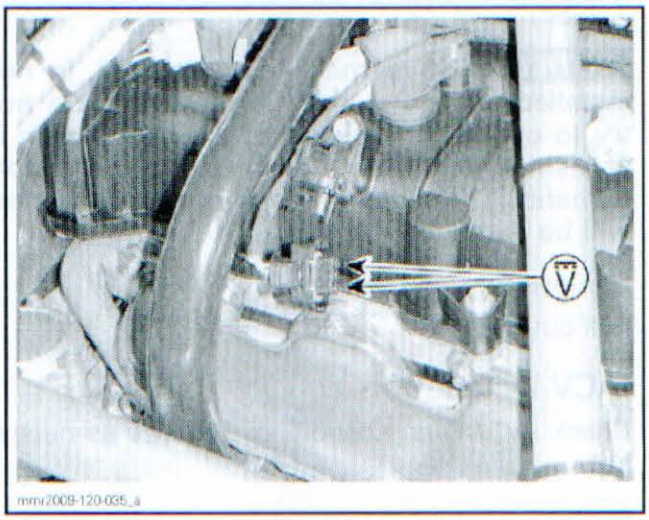
Briefly press START/RER button.

NOTE: Do not install D.E.S.S. key.

Use a multimeter and select Vdc.

Probe terminals as shown.

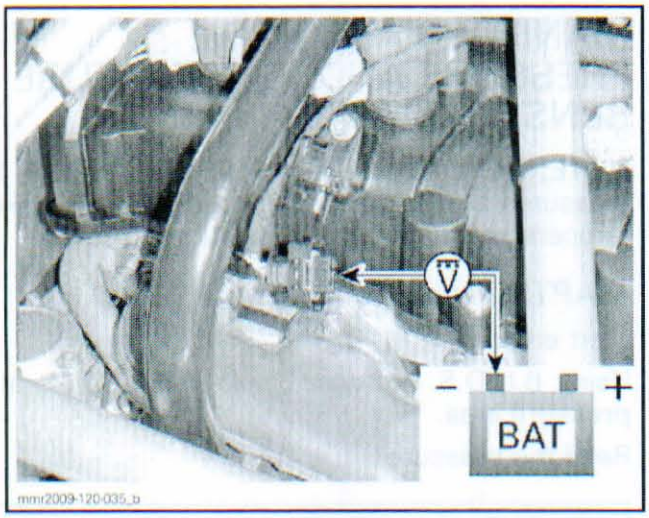
CAPS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
1	3	Battery voltage



If battery voltage is read, proceed with *CAPS DYNAMIC TEST* further.

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

CAPS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
3	Battery ground	Battery voltage

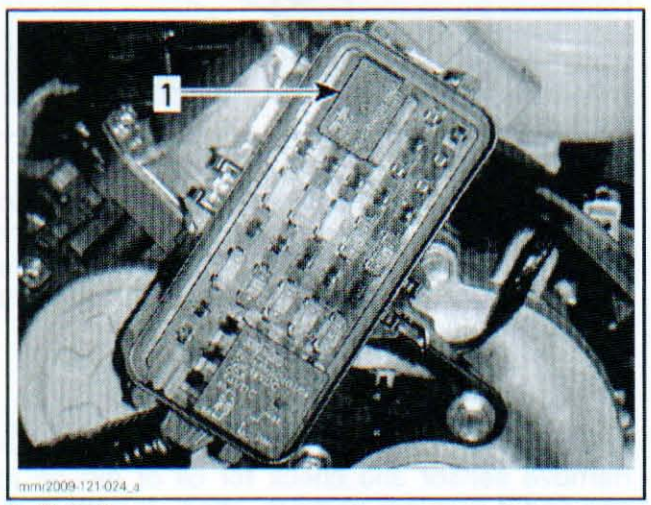


If battery voltage is read, check ground circuit for continuity. Repair wire/connector if defective.

If voltage is not read, check power supply circuit for continuity.

Power Supply Circuit Test

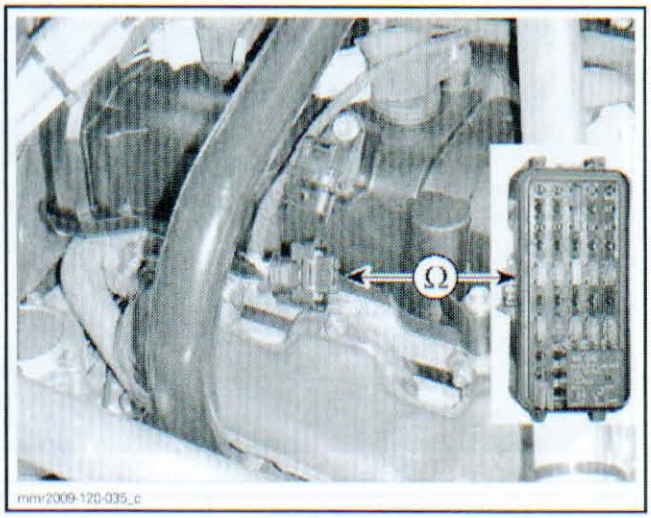
Remove relay 1 from fuse box.



1. Relay 1

Use a multimeter and select Ω.

RELAY FUSE BOX	CAPS CONNECTOR	RESISTANCE
TERMINAL	PIN	Ω
12E	3	Close to 0 Ω (continuity)



Reinstall relay 1.

If resistance is out of specification, repair wire/connector between fuse box and CAPS.

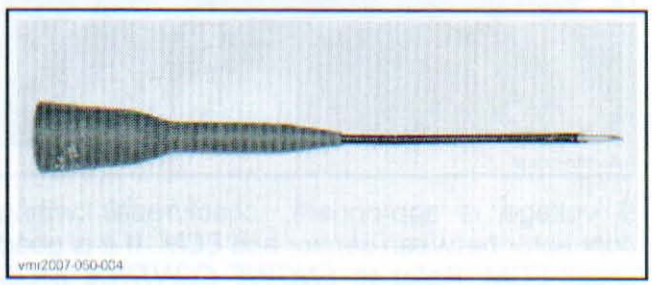
If resistance is as per specification, power circuit is functional.

CAPS Dynamic Test

Remove CAPS sensor from engine.

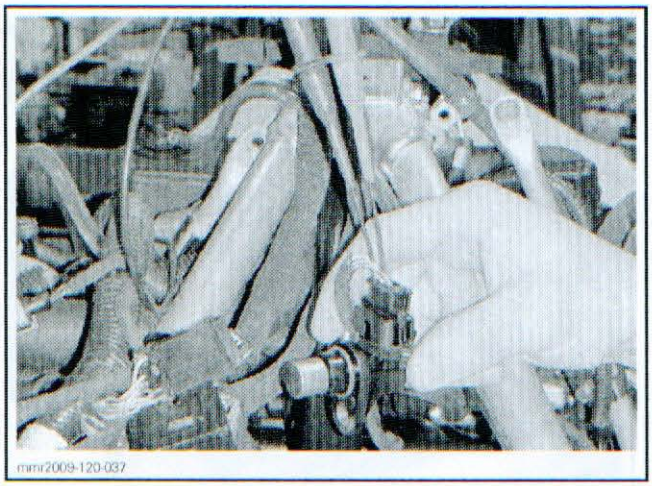
Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868).

Back-probe connector using FLUKE RIGID BACK PROBE (P/N TP88) or the equivalent.

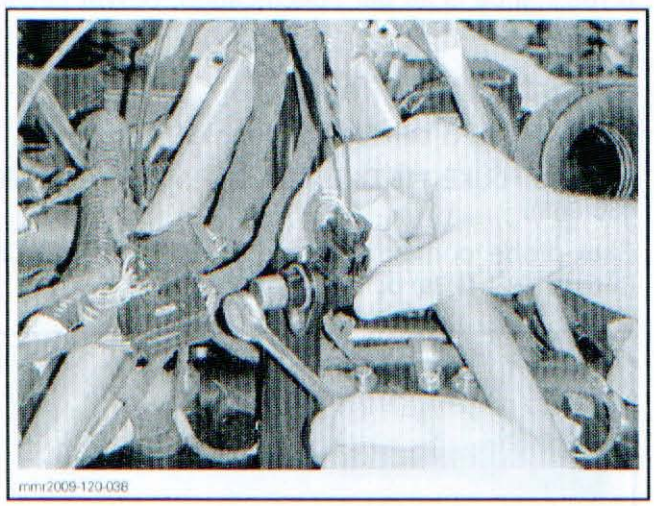


Set multimeter to Vdc and read voltage.

CAPS CONDITION	CAPS CONNECTOR		VOLTAGE
Free	2	3	Close to 0 Vdc



CAPS CONDITION	CAPS CONNECTOR		VOLTAGE
Metallic object on sensor	2	3	Battery voltage



If voltage is appropriate, check/repair wiring/connector between sensor and ECM. If it is good, check ECM. Refer to *ENGINE CONTROL MODULE (ECM).*

If voltage is wrong, try a new CAPS.

CAPS Removal

Unscrew the retaining screw and pull out CAPS.

CAPS Installation

Apply engine oil on CAPS O-ring.

Apply Loctite 243 (blue) on threads and torque screws to 11 N•m (97 lbf•**in**).

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR (MAPTS)

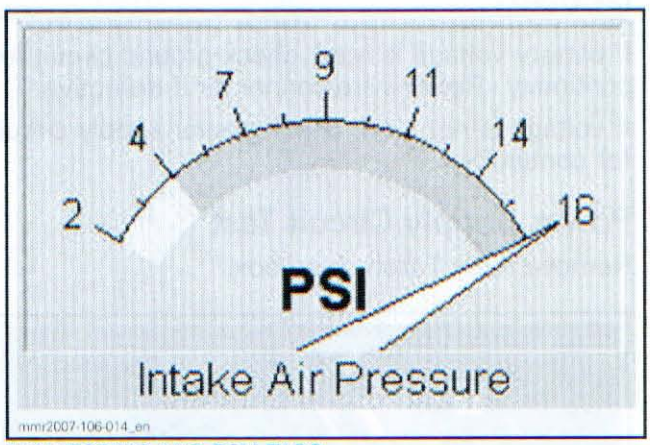
NOTE: This sensor is a multifunction device. It measures manifold absolute pressure and intake temperature for air flow calculations.

MAPTS Pressure Test with B.U.D.S.

Start engine.

Using B.U.D.S. software, look at the **Intake air pressure** area.

Read the pressure.



MONITORING AND ECM TABS

The intake pressure should be equal to the atmospheric pressure when the engine is stopped and within 34.47 kPa - 48.26 kPa (5 PSI - 7 PSI) at idle. Otherwise, carry out the test pertaining to the sensor pressure function.

MAPTS Pressure Function

Remove drive belt guard. Refer to *DRIVE BELT.*

Remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

MAPTS Input Voltage Test

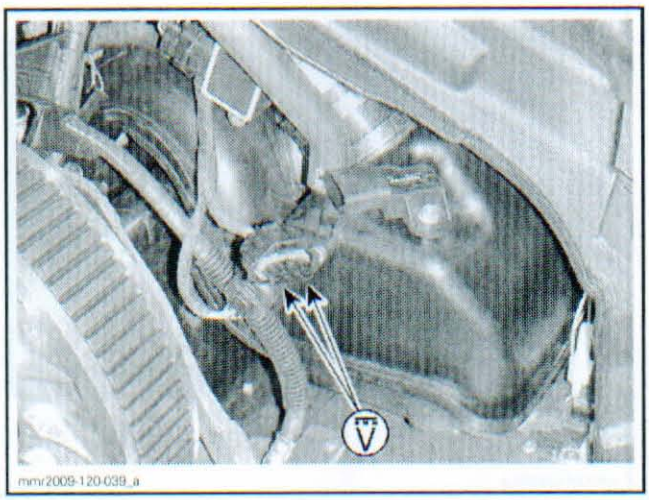
Disconnect connector from MAPTS.

Use a multimeter and select Vdc.

Briefly push START/RER button.

Read voltage as follows.

MAPTS CONNECTOR		**MEASUREMENT**
PIN		VOLTAGE
1	3	5 Vdc



If voltage test is good, Check continuity of wiring from pin 4 to ECM. If it is good, replace the MAPTS.

If voltage test is not good, check the continuity of the MAPTS circuit.

MAPTS Circuit Continuity Test

Disconnect the connector A from the ECM.

Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.

Use a multimeter and select Ω.

Check continuity of sensor pin circuits 1, 3 and 4. Refer to *WIRING DIAGRAM*.

If wiring harness is good, try a new ECM. Refer to *ECM*.

Otherwise, repair or replace wiring harness between ECM and MAPTS. Refer to *WIRING DIAGRAM*.

MAPTS Temperature Function

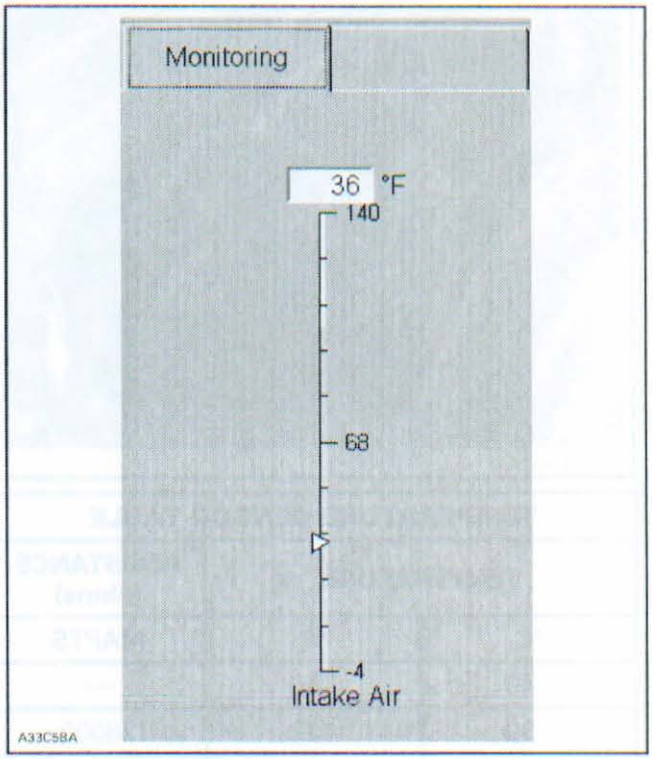
The sensor also monitors the temperature at intake manifold.

Temperature Test with B.U.D.S.

Using B.U.D.S. software, look at the **Intake** area.

Briefly press START/RER button.

Read the temperature value in B.U.D.S.



MONITORING AND ECM TABS

If the complete vehicle is at room temperature, B.U.D.S. should display the ambient temperature at the intake manifold. Otherwise, carry out the test pertaining to the sensor temperature function.

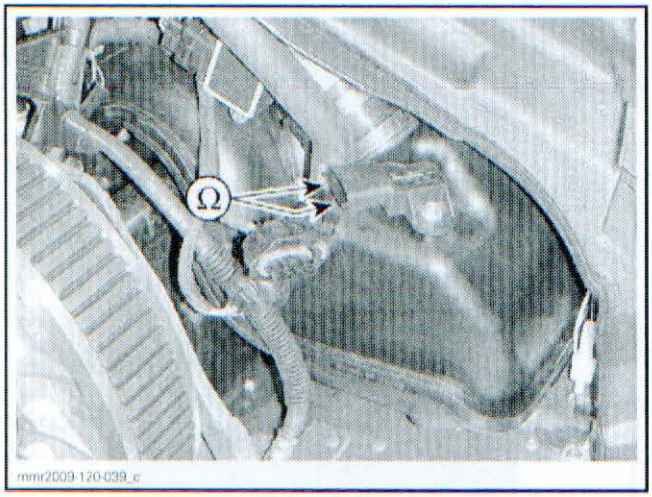
MAPTS Resistance Test

Disconnect the connector from MAPTS.

Use a multimeter and select Ω.

Read resistance of sensor.

MAPTS		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
1	2	Use table according to temperature



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TEMPERATURE SENSOR TABLE		
TEMPERATURE		RESISTANCE (ohms)
°C	°F	MAPTS
- 40	- 40	—
- 30	- 22	28000
- 20	- 4	15000
0	32	5500
20	68	2500
40	104	1200
60	140	600
80	176	320
100	212	180
130	266	90

If resistance is not within specification, replace the MAPTS.

If resistance tests good, reconnect the MAPTS.

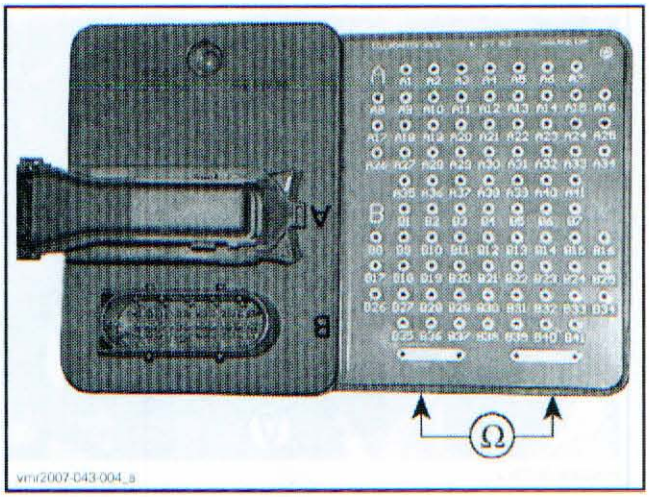
Disconnect the connector A from the ECM.

Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.

Use a multimeter and select Ω.

Check resistance value between ECM pins as shown.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-7	A-28	See above



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If resistance value is incorrect, inspect/repair/replace wiring harness between ECM connector and the MAPTS.

If resistance value is correct, try a new ECM. Refer to *ECM*.

MAPTS Removal

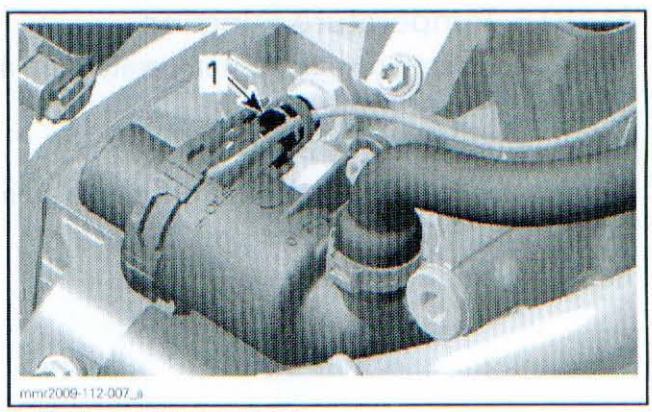
Disconnect MAPTS connector and remove the MAPTS.

MAPTS Installation

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw then torque to 6 N•m (53 lbf•**in**).

COOLANT TEMPERATURE SENSOR (CTS)

The coolant temperature sensor is located on rear side of the cylinder head.



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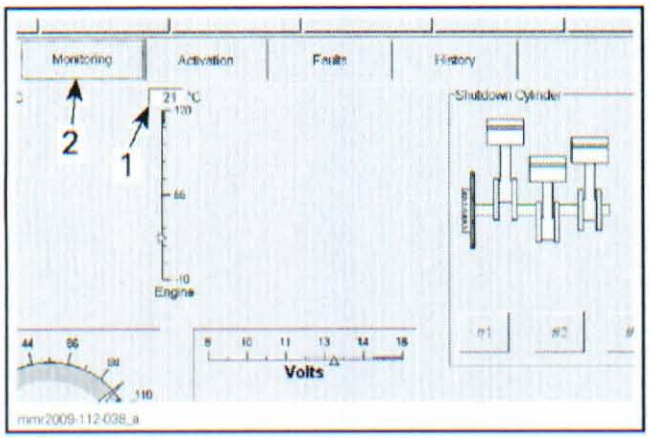
1. Coolant temperature sensor

NOTE: Overheat signals will appear when coolant temperature reaches 110°C (230°F).

CTS Sensor Dynamic Test

Use B.U.D.S. software.

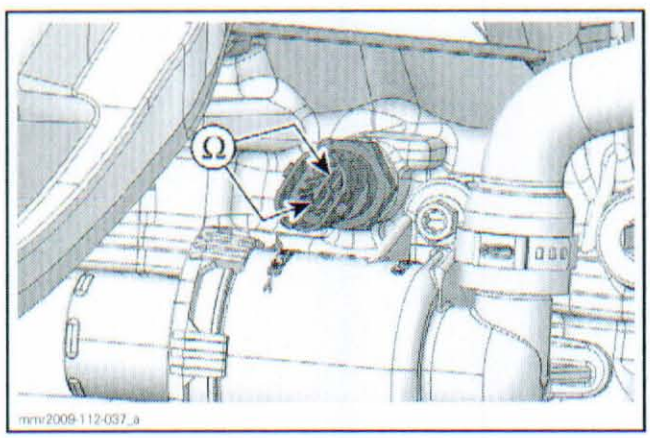
Look engine temperature in **ECM** page in the **Monitoring** tab. It should show the coolant temperature. Otherwise, perform the *CTS RESISTANCE TEST.*



1. *Engine temperature*
2. *Monitoring tab*

CTS Sensor Resistance Test

1. Move fuel tank rearward. Refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Remove the driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
3. Disconnect the connector from the CTS sensor and check the resistance of the sensor itself.



The resistance should be as per following chart.

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

NOTE: To test sensor at different temperatures, remove sensor and use a heat gun and cold ice as required.

If resistance is out of specification, replace the CTS sensor.

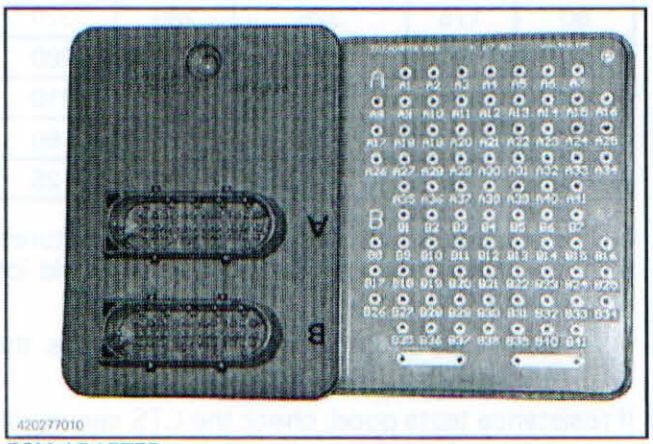
If resistance tests good, check the CTS sensor circuit continuity.

CTS Sensor Circuit Continuity Test (with Sensor)

1. Connect the CTS sensor.
2. Remove the air intake silencer and disconnect the ECM connector A on the ECM.
3. Using the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) and the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010), check the circuit resistance as per the following table.

ECM ADAPTER		MEASUREMENT
PIN		RESISTANCE Ω
A-11	A-27	See table above

FLUKE 115 MULTIMETER



ECM ADAPTER

If resistance value is correct, check ECM. See procedure in this subsection.

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

CTS Sensor Replacement

1. Move fuel tank rearward. Refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Remove the driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
3. Disconnect the connector from the CTS sensor.
4. Unscrew and remove the CTS sensor.
5. Install the new CTS sensor.
6. Tighten CTS sensor to 16 N•m (142 lbf•**in**).
7. Reinstall removed parts.
8. Refill engine coolant. If an important quantity of coolant is spilled, bleed cooling system. Refer to *ENGINE COOLANT* in this subsection.

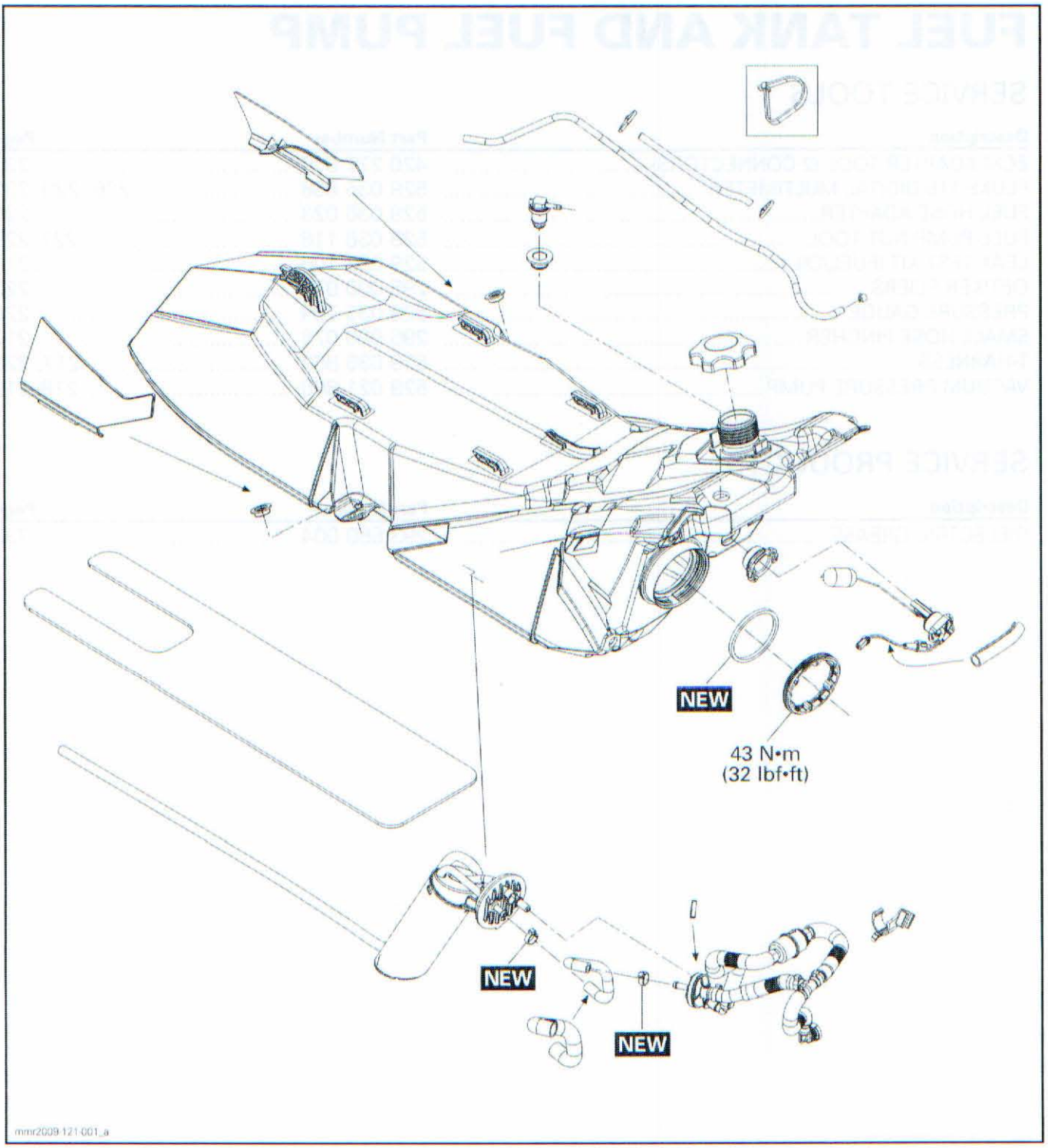
FUEL TANK AND FUEL PUMP

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	227
FLUKE 115 DIGITAL MULTIMETER	529 035 868	226, 229, 231
FUEL HOSE ADAPTER	529 036 023	220
FUEL PUMP NUT TOOL	529 036 118	227–228
LEAK TEST KIT (FUEL/OIL)	529 033 100	218
OETIKER PLIERS	295 000 070	222
PRESSURE GAUGE	529 035 709	220
SMALL HOSE PINCHER	295 000 076	217
T-HARNESS	529 035 869	217, 220
VACUUM PRESSURE PUMP	529 021 800	218–219

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	233


NEW
43 N•m
(32 lbf•ft)
NEW
NEW
mmr2009-121-001_a

GENERAL

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

⚠ WARNING

Always disconnect battery prior to working on the fuel system.

⚠ WARNING

Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses and work in a well ventilated area. Fuel lines remain under pressure at all times.

Always release fuel pressure before disconnecting a fuel hose. Refer to *FUEL PUMP* in this subsection.

⚠ WARNING

The fuel hose may be under pressure. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the remaining pressure. Do not allow fuel to spill on hot parts. Fuel is flammable and explosive under certain conditions. Wipe off any fuel spillage inside engine compartment.

⚠ WARNING

After working on the fuel system, pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION.* Failure to do so may result in severe injury or a life threatening situation should a leak occur.

SYSTEM DESCRIPTION

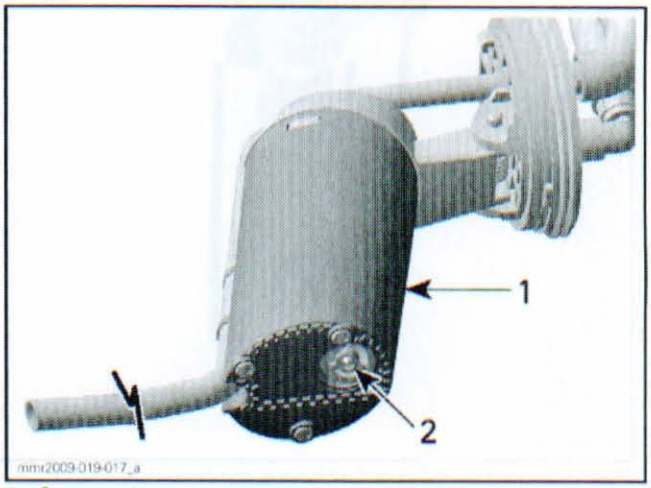
Electric Fuel Pump

The electric fuel pump is mounted in the front RH upper part of fuel tank.

A 12 V fuel pump with a jet pump is used.

As soon as the START/RER button is depressed, the electric fuel pump turns on and when engine runs, the fuel pump is continuously on to provide fuel to the injectors.

To ensure a constant delivery of fuel to the engine for uphill, downhill or sideways riding conditions when the fuel quantity is low, a rear pickup and a sump tank at the bottom of the fuel pump module is used. A combination check valve allows the pump to draw fuel either from the front inlet or from the rear pickup.

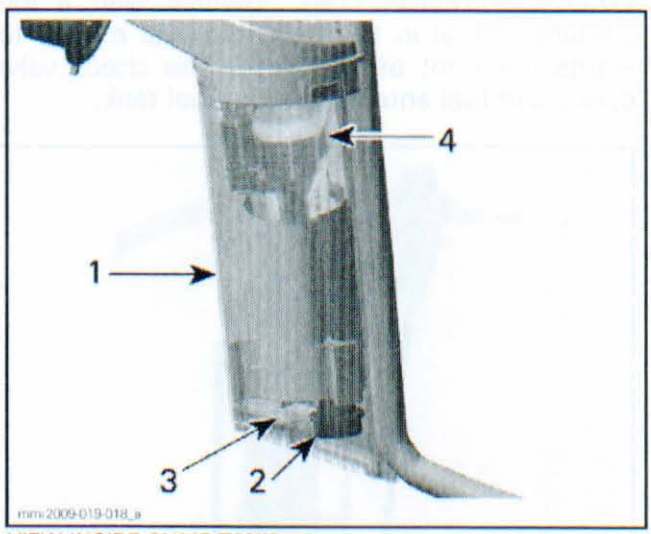


1. *Sump tank*
2. *Check valve*

The sump tank encompasses the fuel pump.

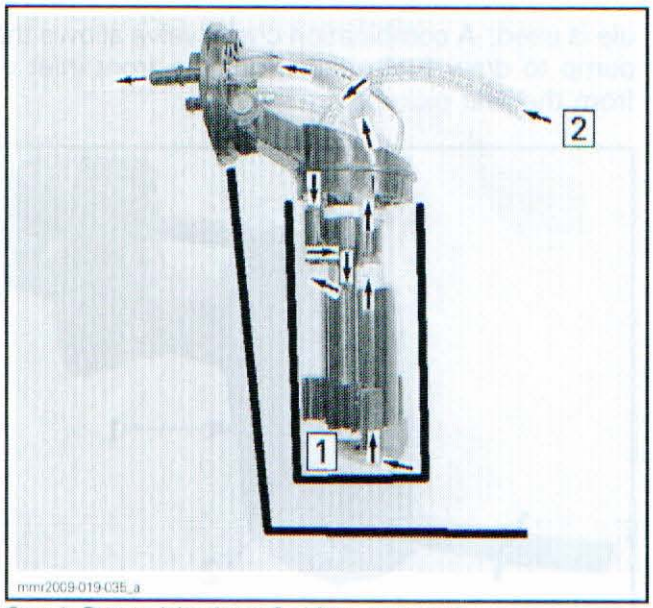
When there is enough fuel in the fuel tank, the bottom inlet of the fuel pump draws fuel from the sump tank.

When the fuel pump runs in this condition, fuel from the electric pump flows through a jet pump that contains a restrictor.



VIEW INSIDE SUMP TANK
1. *Sump tank*
2. *Bottom inlet*
3. *Check valve (open upwards)*
4. *Restrictor*

As the fuel accelerates through the restrictor, it generates a low pressure area at a connection to the rear pickup, which draws in fuel to fill the sump tank.

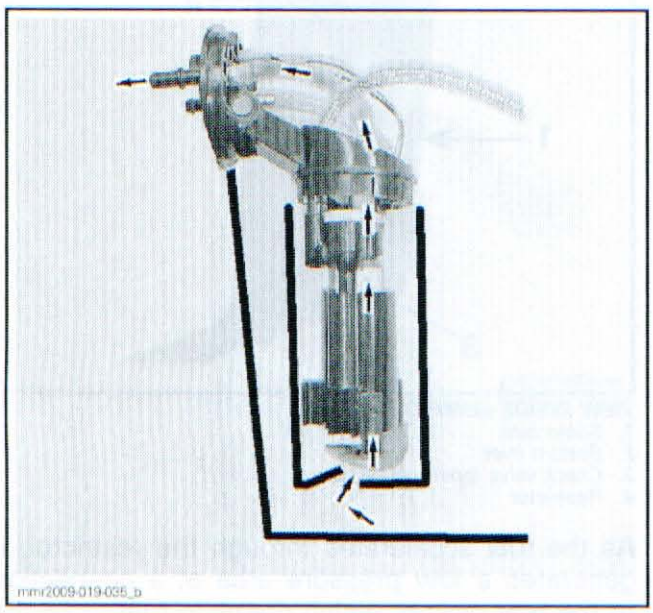


Step 1: Bottom inlet draws fuel from sump tank
Step 2: Low pressure from restrictor draws fuel from rear pickup to fill sump tank

At the bottom of the sump tank, a check valve allows the fuel in the fuel tank to enter the sump tank.

As the fuel is drawn out of the sump tank by the electric pump, fuel in the vehicle tank naturally enters the sump tank through the sump tank check valve.

When the vehicle rides downhill with a low amount of fuel in the tank, the fuel moves towards the front of fuel tank. The check valve opens and fuel enters from the fuel tank.



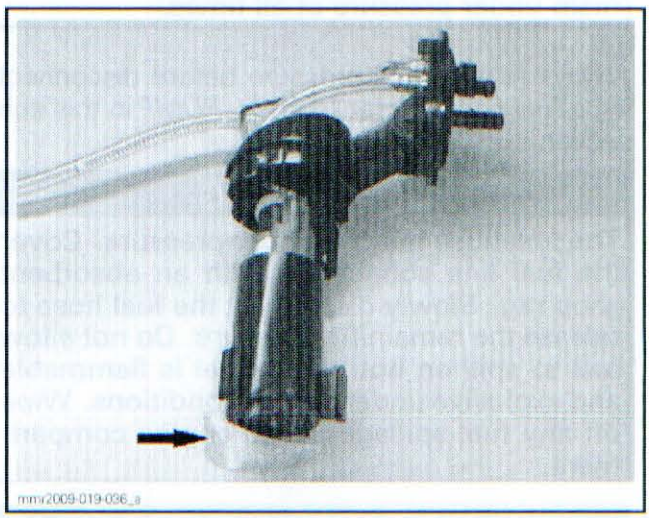
When the vehicle rides uphill with a low amount of fuel in the tank, the gas moves towards the rear of the fuel tank. The check valve closes and traps the fuel in the sump tank. The fuel pump draws fuel from the sump tank, which is fed by the rear pickup (as explained above). This prevents air from being drawn into the fuel lines from the fuel tank.

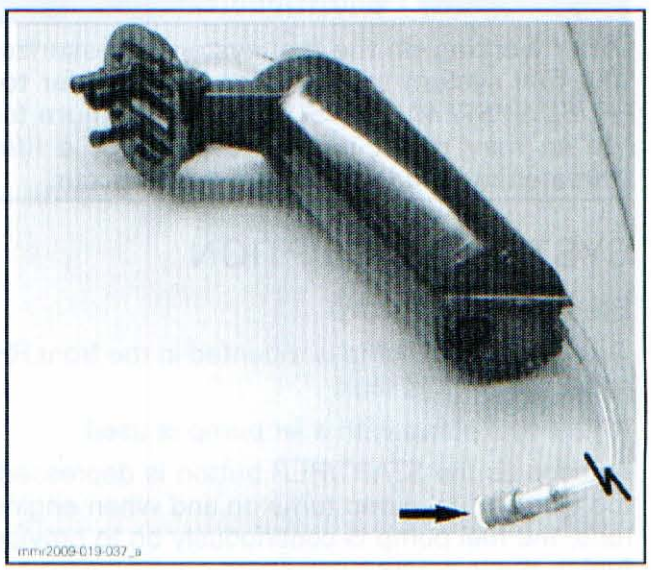
The continuous fuel flow cools down the fuel pump.

Fuel Pickup

Fuel enters into the sump tank from either an inlet at the bottom of the sump tank, or from a remote pickup in the rear portion of the fuel tank.

The bottom fuel pump inlet uses a nylon mesh filter, and the rear pickup uses a replaceable strainer to filter out relatively large dirt particles.





Fuel Pressure Regulator

An external in-line fuel pressure regulator made of plastic is mounted in front of fuel tank. It is basically a spring loaded valve that opens and closes the path of fuel returning to the tank, thus maintaining a constant fuel pressure in the system.

FUEL PRESSURE
Approximately 400 kPa (58 PSI)

Fuel Tank Vent

The fuel tank is vented through a combination type check valve that allows ambient air pressure to enter fuel tank at all times.

As fuel is consumed by the engine, a negative pressure would occur in the fuel tank. This could eventually prevent the engine from receiving proper fuel pressure. The **zero pressure relieve function** of the valve allows the higher outside air pressure in.

If pressure builds up and exceeds 2.0 to 4.8 kPa (.3 to .7 PSI) in the fuel tank, the check valve opens and lets the excess pressure vent out of the tank.

In-Line Fuel Filter

An in-line filter is located in front of fuel tank.

It is a replaceable metallic canister type filter used to deliver dirt-free fuel to the injectors.

The fuel filter is sold as a kit that comprises an assembly of hoses, the filter, and the quick connect fittings.

Fuel Level Indication

A float type fuel level sensor varies its resistance with fuel level thus providing a signal to the multifunction gauge for fuel level indication.

INSPECTION

FUEL SYSTEM PRESSURIZATION

⚠ WARNING

Before starting the engine, carry out a fuel system pressurization as follows each time a component has been removed from the fuel system.

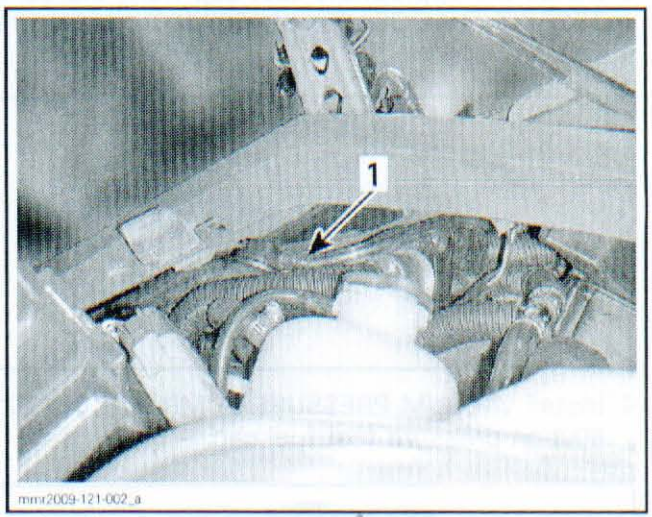
1. Ensure all fuel lines are properly connected.
2. Set engine stop switch to RUN.

NOTE: Do NOT install the D.E.S.S. key.

3. Install the T-HARNESS (P/N 529 035 869) to the vehicle diagnostic connector. This will pressurize the fuel system. It may be necessary to disconnect and reconnect T-harness 3 - 4 times to cycle fuel pump to bleed air.
4. Inspect engine compartment to detect any fuel leakage or an abnormally strong fuel odor which may be an indication of a fuel leak that is not readily visible.
5. Repair any leak before using vehicle.

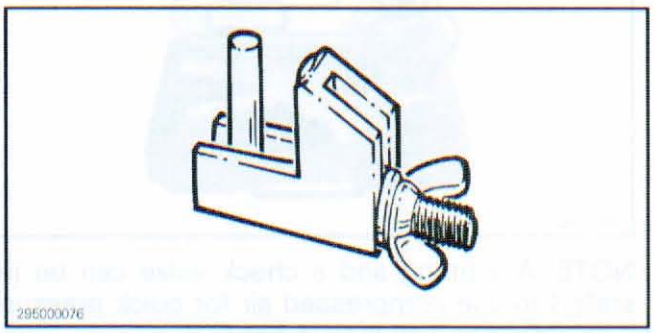
FUEL TANK LEAK TEST

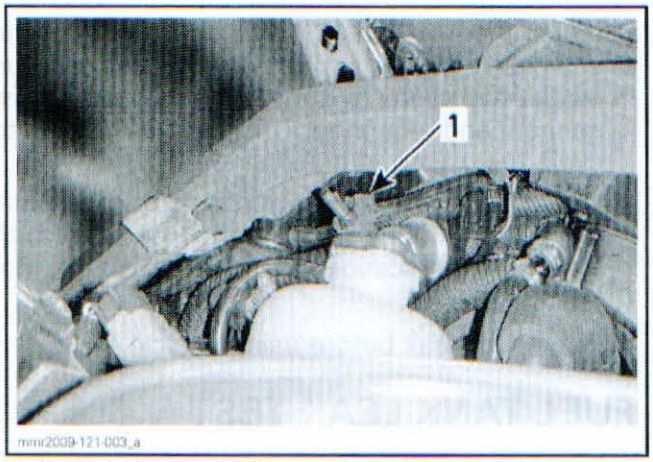
1. Remove the RH side panel to access the fuel vent line.



1. Vent line

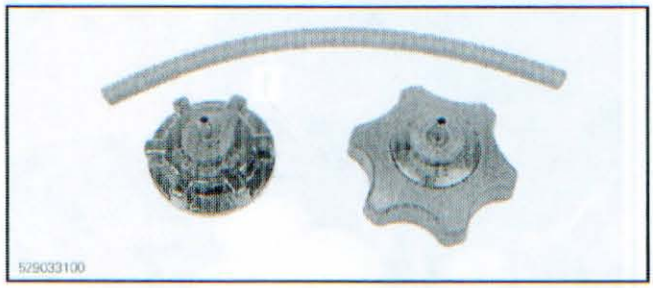
2. Install a SMALL HOSE PINCHER (P/N 295 000 076) on the vent line.





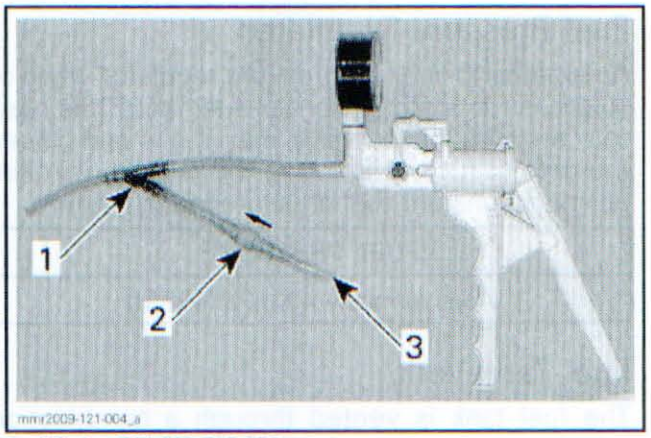
1. Hose pincher on vent line

3. Install the appropriate test cap from the LEAK TEST KIT (FUEL/OIL) (P/N 529 033 100) on fuel tank neck.



4. Install VACUUM PRESSURE PUMP (P/N 529 021 800) on pressure test fuel cap.

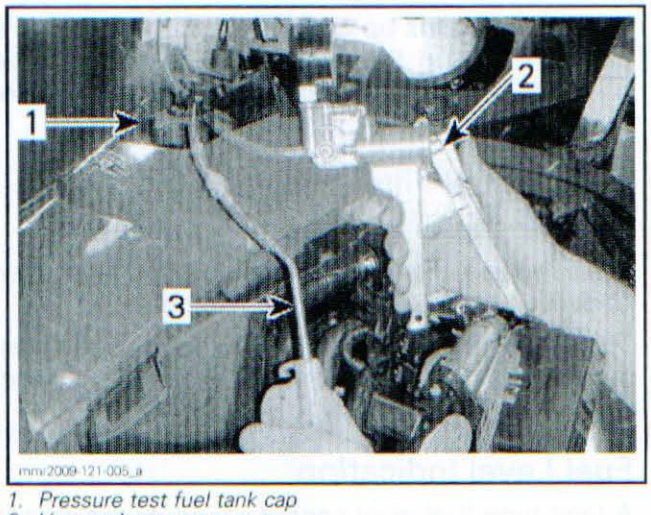
NOTE: A Y-fitting and a check valve can be installed to use compressed air for quick pressure build-up when fuel tank is not full.



1. Y-fitting P/N 293 710 059
2. Check valve P/N 275 500 505
3. Apply compressed air here

5. Slowly apply pressurized air close to the pressure specification.

NOTICE Do not exceed the specification when pressurizing the fuel tank.



1. Pressure test fuel tank cap
2. Vacuum/pressure pump
3. Compressed air supply

6. Set pump selector to pressure.
7. Finish pressurizing fuel tank with the pump.

PRESSURE	TIME WITHOUT PRESSURE DROP
21 kPa (3 PSI)	3 minutes

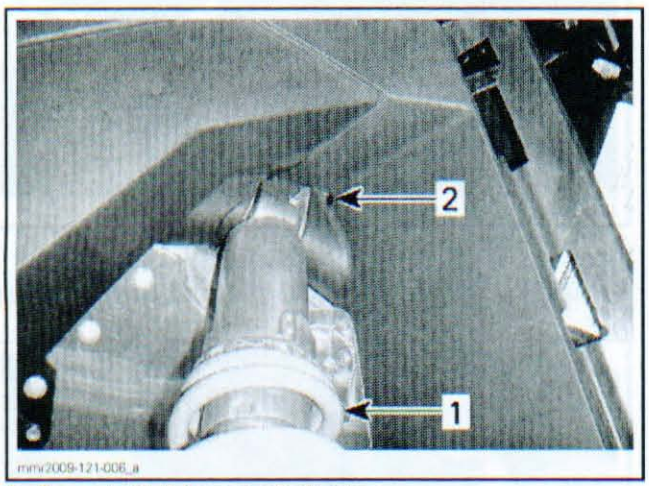
If pressure drops, locate fuel leak and repair or replace leaking component.

To ease locating a leak, spray soapy water on components; bubbles will indicate leak location.

Fuel Tank Check Valve Test

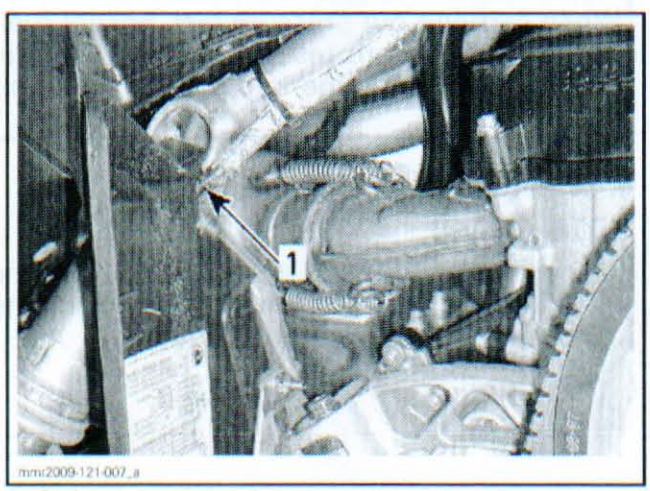
While the fuel tank is still pressurized from the previous test, carry out the following:

1. Place a finger over the fuel tank vent hose outlet on LH side of bottom pan above shock absorber.



1. Top part of LH front shock absorber
2. Fuel tank vent outlet

2. While someone is removing the hose pincher, alternately touch and release vent hose outlet. You should feel pressurized air flowing out indicating the pressure relief valve function is working. Otherwise, replace valve.
3. Release any remaining pressure in the fuel tank by slowly unscrewing pressure test cap.
4. Remove the pressure test cap.
5. Disconnect the fuel tank vent line from its fitting.



1. Fuel tank vent line end

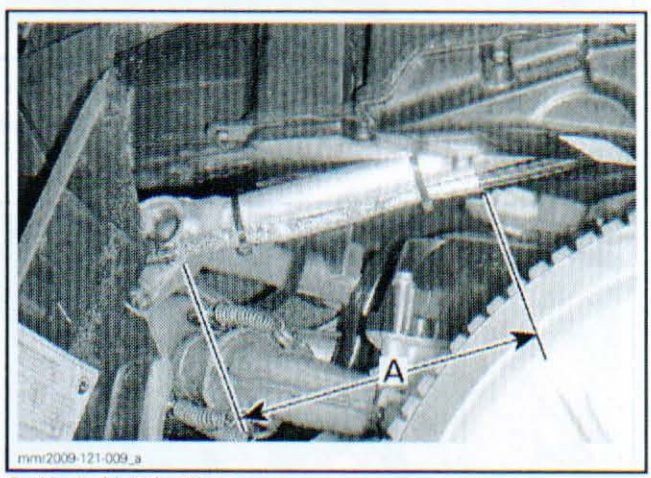
6. Install the VACUUM PRESSURE PUMP (P/N 529 021 800) on the vent line end and apply air pressure through check valve. Air must flow freely towards the fuel tank neck.

1. Apply pressure through vent line end

If fuel vent check valve does not function as indicated in test, replace check valve.

7. Remove vacuum/pressure pump.
8. Secure vent line on its fitting.
9. Install the vehicle fuel tank cap.

NOTE: Ensure there is a heat shield on vent tube where shown and it is in good condition.



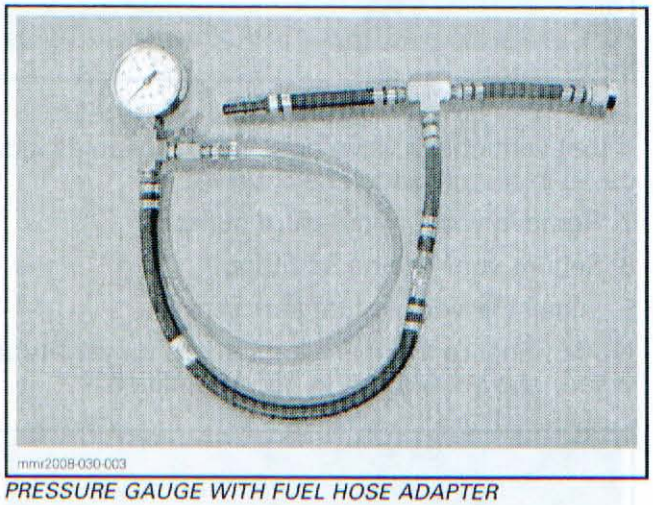
A. Heat shield in this area

NOTICE A damaged or missing heat shield could allow the tube to melt and if fuel leaks by the vent tube, it could create a fire if fuel comes in contact with hot parts.

FUEL PUMP PRESSURE TEST

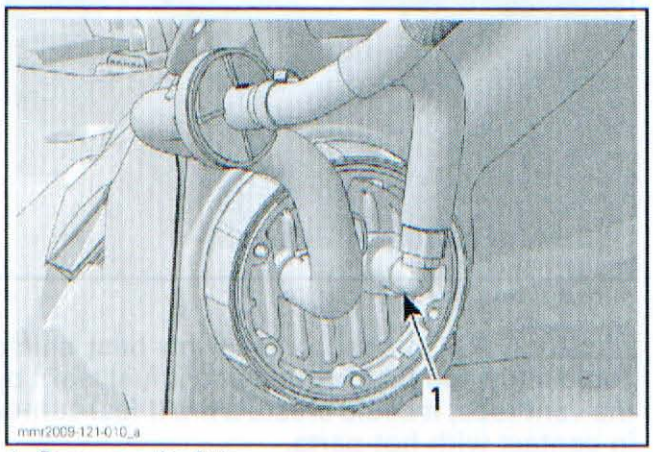
The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator and the fuel pump.

1. Ensure there is enough gas in fuel tank.
2. Connect B.U.D.S. to the vehicle diagnostic connector. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
3. Release the fuel pressure. Refer to *FUEL PUMP* in this subsection.
4. Move fuel tank rearward. Refer to *FUEL TANK* in this subsection.
5. Use the FUEL HOSE ADAPTER (P/N 529 036 023) and the PRESSURE GAUGE (P/N 529 035 709).



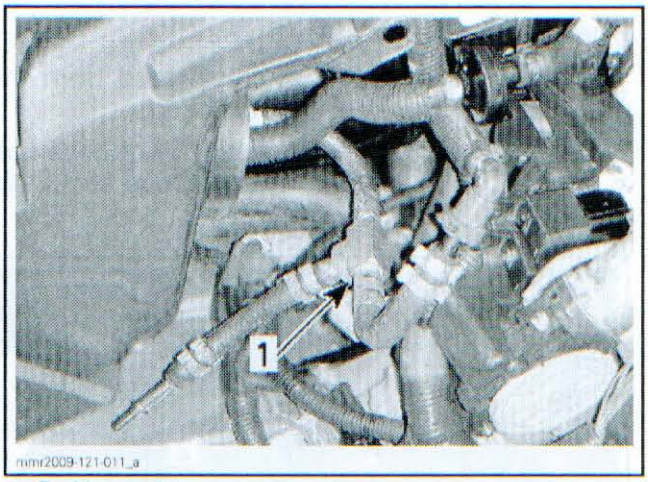
PRESSURE GAUGE WITH FUEL HOSE ADAPTER

6. Disconnect the quick connect fitting from fuel pump.



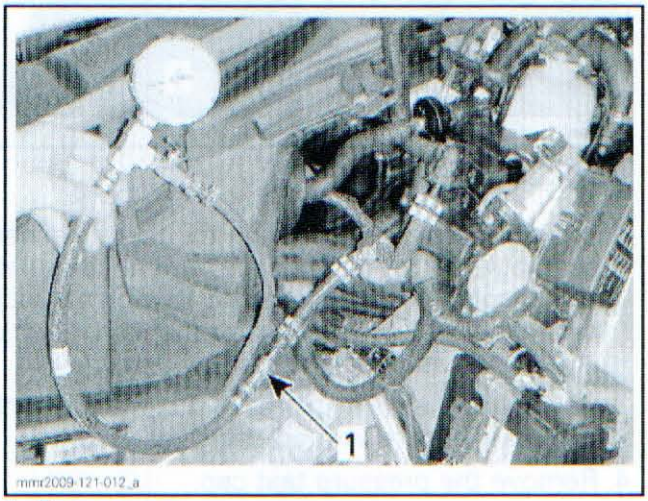
1. Disconnect this fitting

7. Install fuel hose adapter between the disconnected hose and the fuel pump fitting.



1. Fuel hose adapter

8. Install pressure gauge to the fuel hose adapter.



1. Pressure gauge

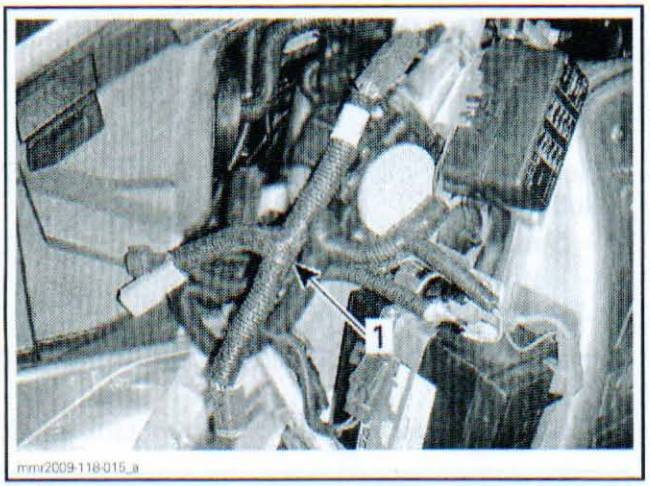
⚠ WARNING

When carrying out pressure test, ensure fuel is not leaking from test equipment. Ensure fuel hose do not come into contact with hot parts.

9. Set engine stop switch to RUN.

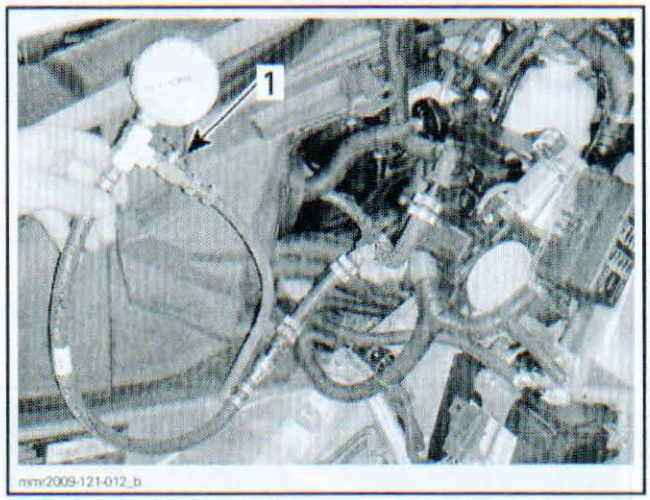
NOTE: Do NOT install the D.E.S.S. key.

10. Install the T-HARNESS (P/N 529 035 869) to the vehicle diagnostic connector. This will activate fuel pump. **Do not crank engine.**



1. T-harness

11. Note pressure reading while pump is running.
    11.1 Disconnect T-harness.
    11.2 Release pressure from bleed valve of fuel pressure gauge so that gauge needle returns to zero (0).



1. Pressure gauge bleed valve

    11.3 Reconnect T-harness.
    11.4 Note pressure reading again while pump is running.
12. Install D.E.S.S. key on its post.
13. **Start engine** and observe pressure reading. The fuel pressure should be the same as when engine was not running. Also, fuel pressure should remain stable.

FUEL PRESSURE
400 kPa (58 PSI)

14. Stop engine.

FUEL PRESSURE TEST	
RESULT	POSSIBLE CAUSE
Pressure above specifications	Defective fuel pressure regulator.
Pressure below specifications	Clogged fuel filter.
	Defective fuel pressure regulator.
	Leak in the fuel system circuit.
	Defective fuel pump.
	Leak of fuel injector(s).

15. If fuel pressure drops, check the following for leaks:
    - Hoses
    - Fuel injectors for leaks
    - Fuel pressure regulator
    - Fuel pump.
16. Bleed away any remaining fuel in the pressure gauge and fuel hose adapter using the bleed valve on the fuel hose adapter.

1. Pressure gauge bleed valve

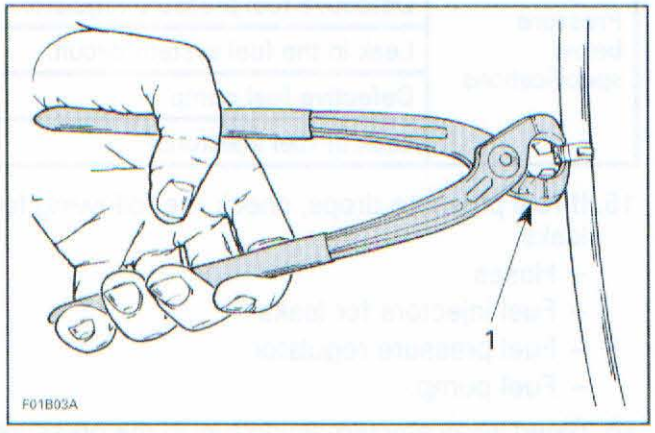
17. Remove pressure gauge and fuel hose adapter.
18. Reconnect fuel hose to fuel pump.
19. Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION*.
20. Reinstall all remaining removed parts.

PROCEDURES

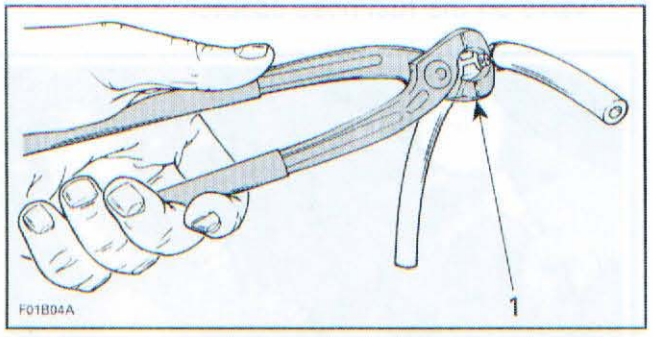
OETIKER CLAMPS

Clamp Replacement

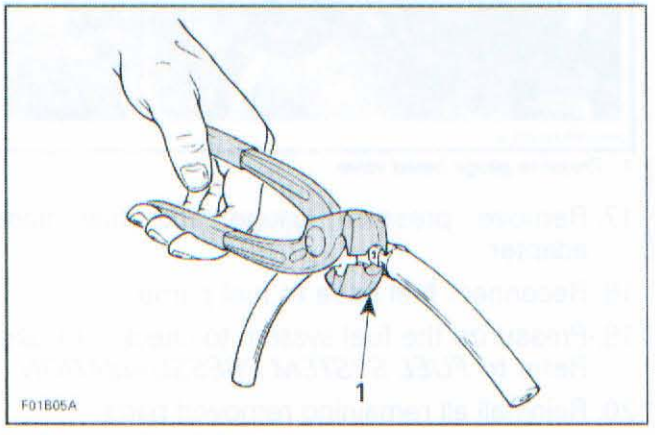
To secure or cut Oetiker clamps on fuel lines, use OETIKER PLIERS (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



1. Securing clamp in limited access

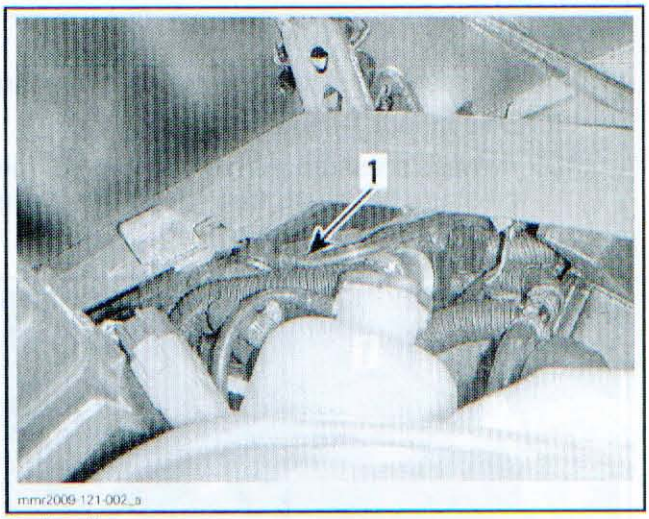
⚠ WARNING

Use of improper fuel lines could compromise fuel system integrity.

FUEL TANK

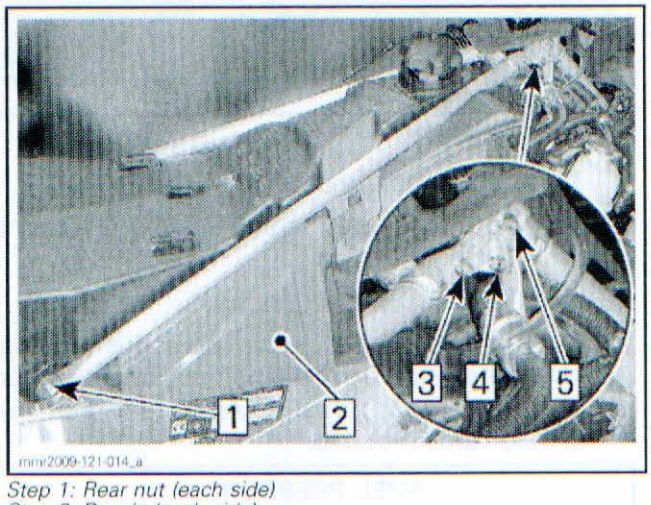
Moving Fuel Tank Rearward for Servicing

1. Remove the following items. Refer to *BODY* subsection:
   - Seat(s)
   - Both side panels
   - Hood
   - Gauge support, console and windshield altogether.
2. Disconnect fuel vent line from fuel tank elbow.



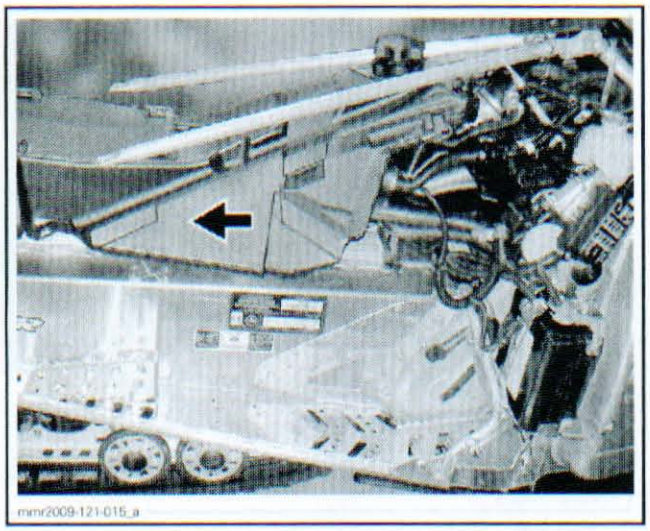
1. Vent line

3. Detach both rear frame members as per the following sequence.



Step 1: Rear nut (each side)
Step 2: Panels (each side)
Step 3: Screw and nut
Step 4: Screw and nut of upper column support (each side)
Step 5: Loosen nut

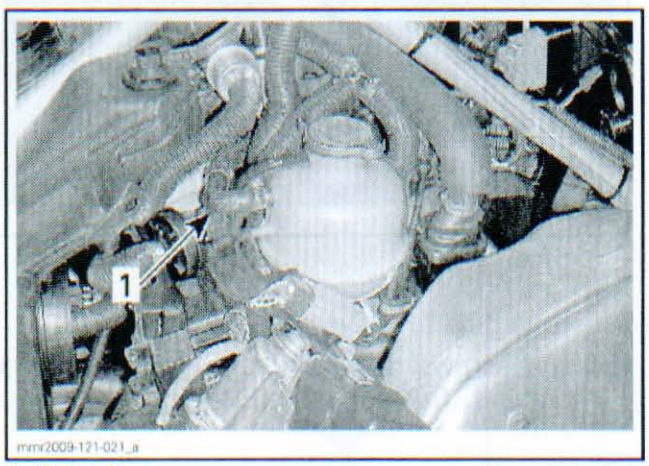
4. Raise the ends of rear frame members and move fuel tank rearward as much as possible.



Fuel Tank Removal

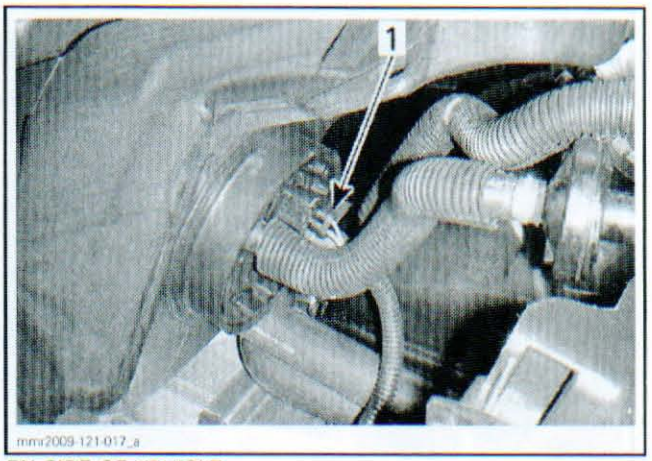
Follows the steps described in *FUEL TANK* then continue with the following steps.

1. Release fuel pressure. Refer to *FUEL PUMP* in this subsection.
2. Disconnect ground cable from battery. Refer to *CHARGING SYSTEM.*
3. Disconnect fuel hose from fuel rail. Refer to *FUEL RAIL* in *ELECTRONIC FUEL INJECTION* subsection.
4. Disconnect return hose from coolant reservoir.



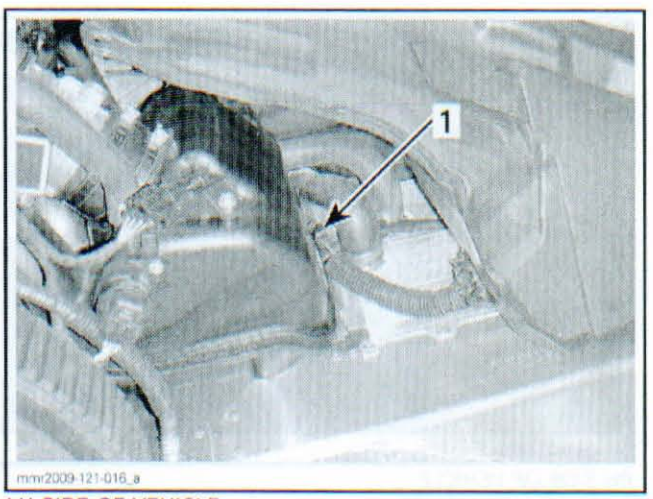
1. Return hose

5. Disconnect fuel pump connector.



RH SIDE OF VEHICLE
1. Fuel pump connector

6. Disconnect fuel level sensor connector between fuel tank and intake manifold.



LH SIDE OF VEHICLE
1. Sensor connector

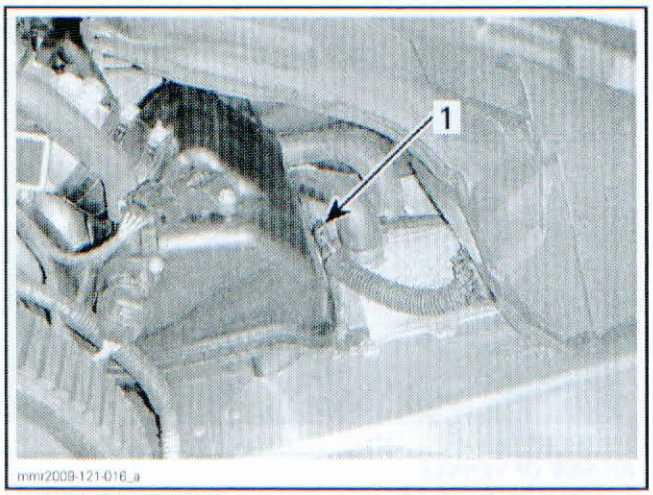
7. Pull out fuel tank.

Fuel Tank Installation

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

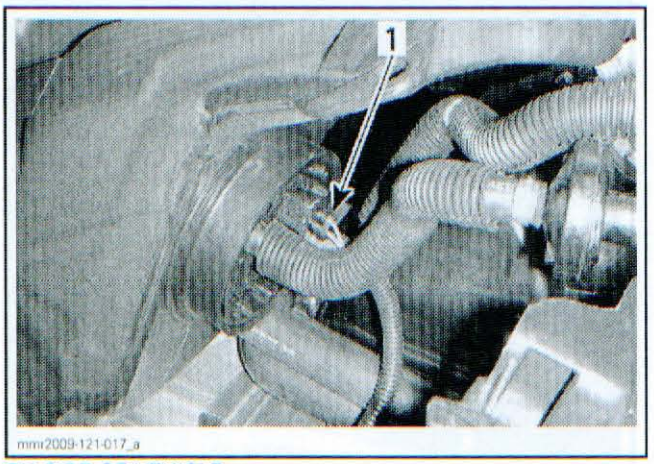
If Fuel Tank was Completely Removed

1. Position fuel tank on vehicle.
2. Reconnect fuel level sensor connector.



LH SIDE OF VEHICLE
1. Sensor connector

3. Reconnect fuel pump connector.

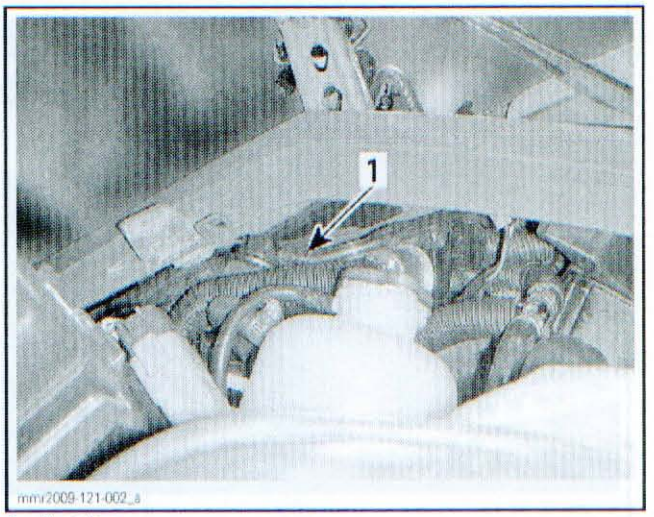


RH SIDE OF VEHICLE
1. Fuel pump connector

4. Continue the installation by following the instructions described in *IF FUEL TANK WAS MOVED REARWARD FOR SERVICING.*

If Fuel Tank was Moved Rearward for Servicing

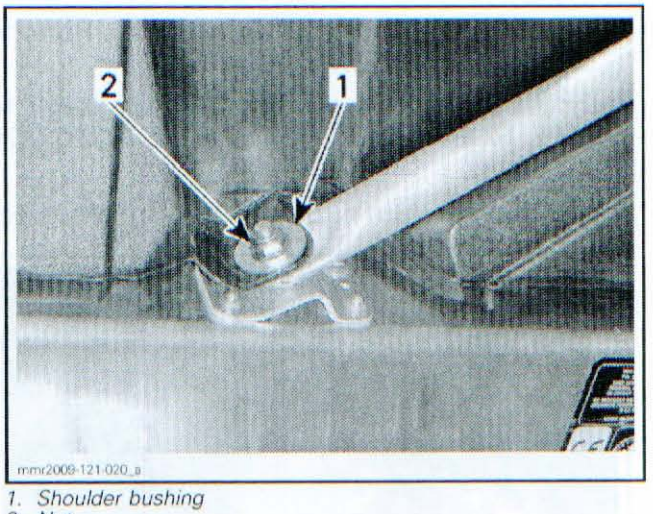
1. Move tank forward in normal position.
2. Connect the fuel tank vent line at the fuel tank elbow.



1. Vent line

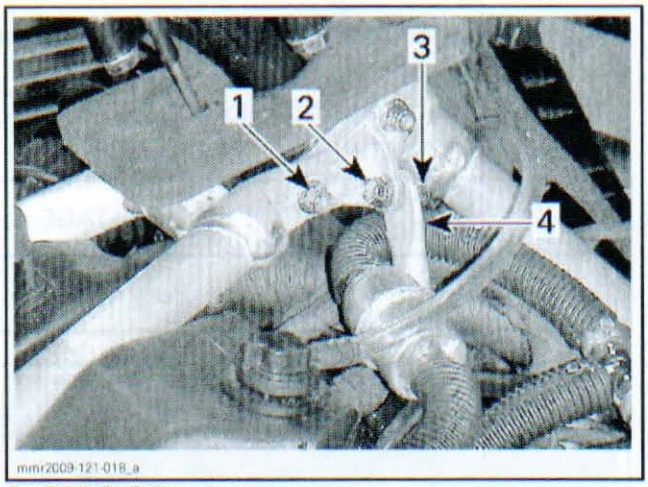
NOTICE **Ensure vent tube is not kinked or pinched.**

3. Install shoulder bushings and **NEW** nuts on the rear end or rear frame members.



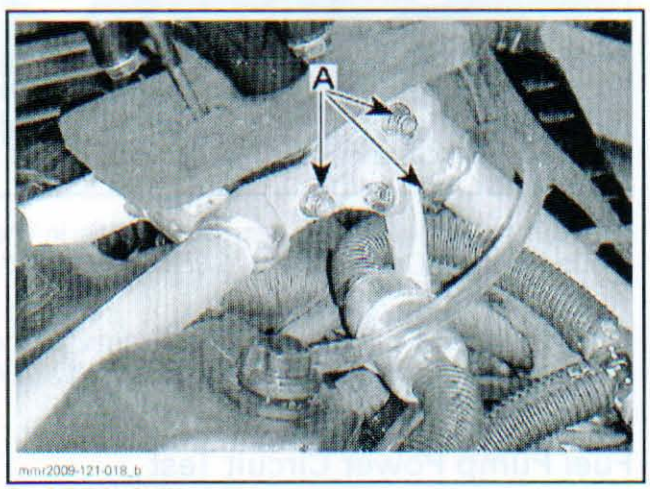
1. Shoulder bushing
2. Nut

4. Torque nuts to 34 N•m (25 lbf•ft).
5. Insert screws on the front end of rear frame members. Secure with **NEW** nuts.



RH SIDE SHOWN
1. *Screw with new nut*
2. *Screws*
3. *New nuts*
4. *Place upper column supports as shown*

6. Torque all nuts.



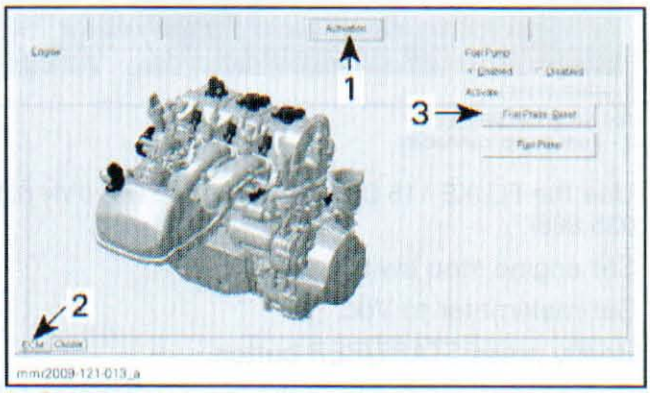
RH SIDE SHOWN
A. 18 N•m (159 lbf•in)

7. Reconnect fuel hose to fuel rail. Refer to *FUEL RAIL* in *ELECTRONIC FUEL INJECTION* subsection.
8. Install remaining parts.
9. At console installation, torque the fuel tank filler neck nut to 11 N•m (97 lbf•**in**).
10. Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION*.
11. Carry out a fuel tank leak test. Refer to *FUEL TANK LEAK TEST* in this subsection.
12. Refuel tank.

ELECTRIC FUEL PUMP

Releasing Fuel Pump Pressure

1. Connect B.U.D.S. to the vehicle diagnostic connector. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
2. Release the fuel pressure by selecting the following in B.U.D.S.:
   - 2.1 **Read Data**
   - 2.2 **Activation** tab
   - 2.3 **ECM** tab in the lower LH corner of the **Activation** page
   - 2.4 **Fuel Press. Relief** button in the **Activate** area.



1. *Activation tab*
2. *ECM tab*
3. *Fuel Press. Relief button*

Release fuel pressure by running engine until it runs out of gas.

Fuel Pump Operation Test

Set engine stop switch to RUN.

NOTE: Do not install D.E.S.S. key to its post to prevent engine starting.

Briefly press START/RER button.

You should hear the fuel pump running for approximately 2 seconds.

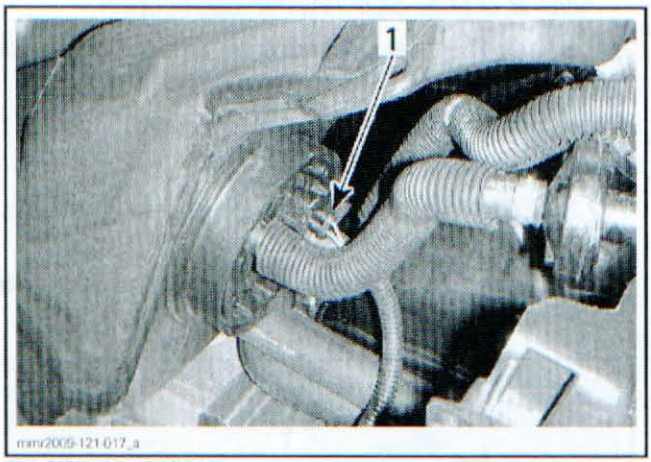
If pump runs, carry out the *FUEL PUMP PRESSURE TEST* in this subsection.

If the pump does not run:
- Ensure ECM is powered. Refer to *ELECTRONIC FUEL INJECTION* subsection.
- Check fuse F2. If fuse is faulty, replace it and repeat test. If fuse is good, carry out the *FUEL PUMP INPUT VOLTAGE TEST* in this subsection.

Fuel Pump Input Voltage Test

Move fuel tank rearward to reach fuel pump connector. Refer to *FUEL TANK* in this subsection.

Disconnect fuel pump connector.



RH SIDE OF VEHICLE
1. Fuel pump connector

Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868).

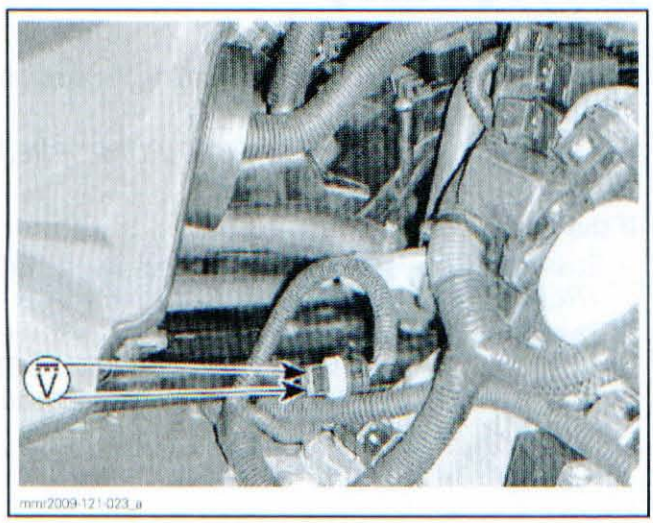
Set engine stop switch to RUN.

Set multimeter to Vdc.

Briefly press START/RER button.

Probe terminals and read the input voltage as follows.

FUEL PUMP HARNESS CONNECTOR		VOLTAGE
Pin 2 (+ probe)	Pin 1 (- probe)	Battery voltage for approximately 2 seconds, then voltage should drop by approximately 0.5 V

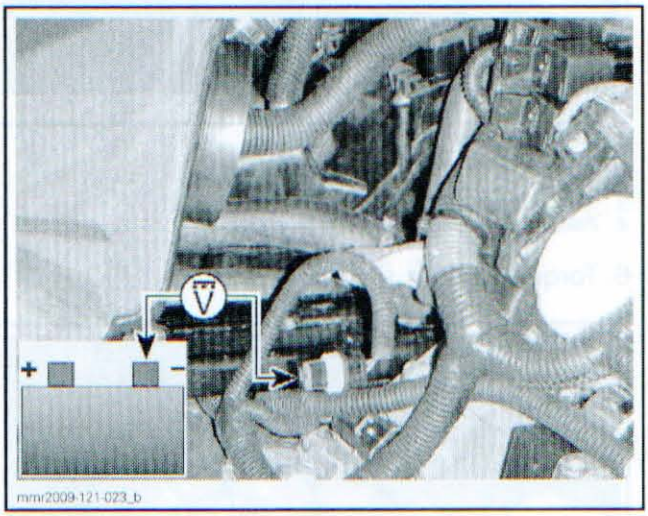


If test succeeded, power and ground circuits are good. Replace fuel pump.

If test failed, carry out the following test.

Briefly press START/RER button.

FUEL PUMP HARNESS CONNECTOR		VOLTAGE
Pin 2 (+ probe)	Battery ground (- probe)	Battery voltage

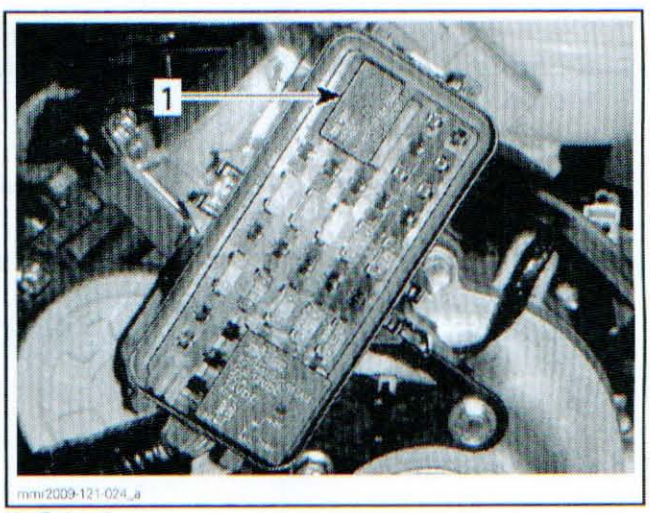


If battery voltage is read, the problem is in the ground circuit. Carry out the *GROUND CIRCUIT TEST*.

If battery voltage is not read, the problem is in the power circuit. Carry out the *FUEL PUMP POWER CIRCUIT TEST*.

Fuel Pump Power Circuit Test

Remove relay 1 from fuse box.



1. Relay 1

Use the multimeter and select Ω.

Check continuity of power circuit as follows.

FUSE BOX	FUEL PUMP CONNECTOR	RESISTANCE @ 20°C (68°F)
Pin 12E	Pin 2	Close to 0 Ω

mmr2009-121-023_d

If test succeeded, power circuit is good.

If test failed, check wiring harness and connections between fuse box and fuel pump connector. See *WIRING DIAGRAM*.

Reinstall relay 1.

Fuel Pump Ground Circuit Test

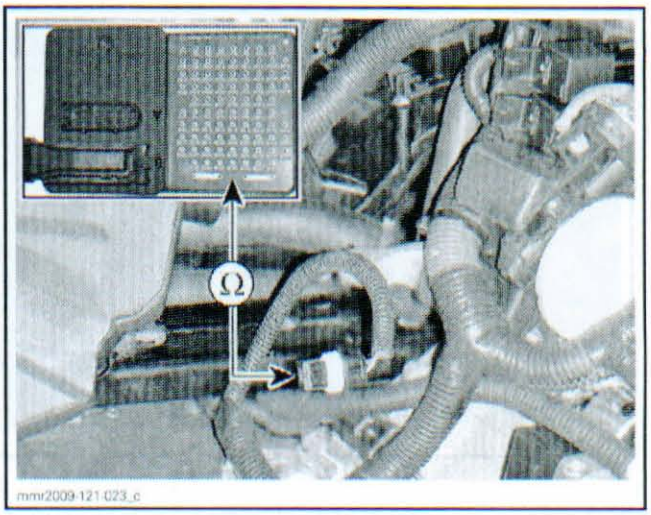
Disconnect the B connector from ECM. Refer to *ELECTRONIC FUEL INJECTION*.

Install the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.

Use the multimeter and select Ω.

Check continuity of ground circuit as follows.

ECM CONNECTOR	FUSE PUMP CONNECTOR	RESISTANCE @ 20°C (68°F)
Pin B29	Pin 1	Close to 0 Ω



mmr2009-121-023_c

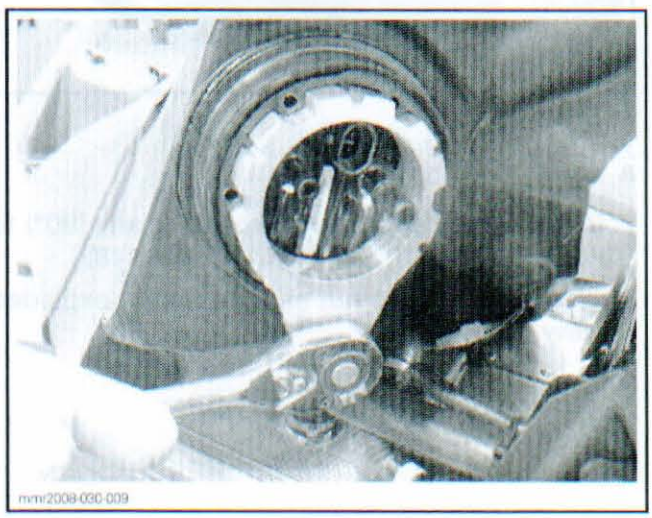
If test failed, check wiring harness and connections between ECM connector and fuel pump connector.

If test succeeded, ground circuit is good. If all other tests are good, check the ECM. Refer to *ELECTRONIC FUEL INJECTION*.

Reinstall ECM and fuel pump connectors.

Fuel Pump Removal

1. Release the fuel pressure. Refer to *FUEL PUMP*
2. Disconnect ground cable from battery. Refer to *CHARGING SYSTEM*.
3. Remove fuel tank. Refer to *FUEL TANK REMOVAL* in this subsection.
4. Empty fuel tank.
5. Using the FUEL PUMP NUT TOOL (P/N 529 036 118), remove fuel pump nut.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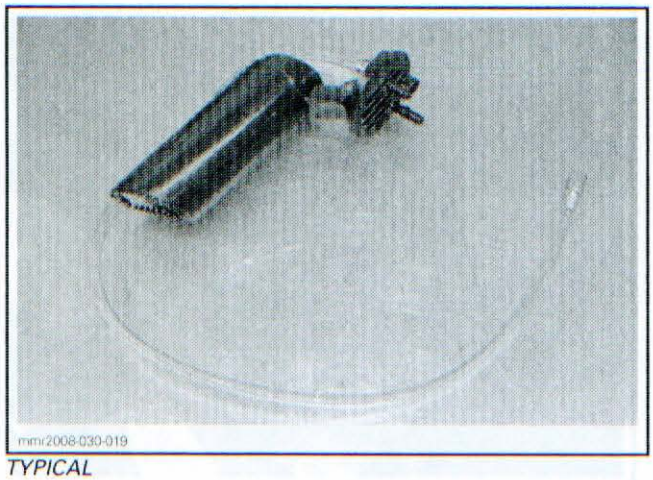
6. Remove fuel pump.



TYPICAL

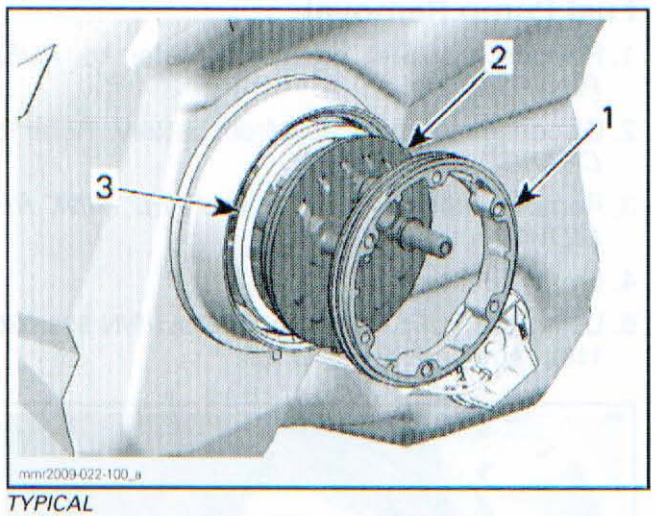
7. Remove and discard fuel pump gasket.

Fuel Pump Installation

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

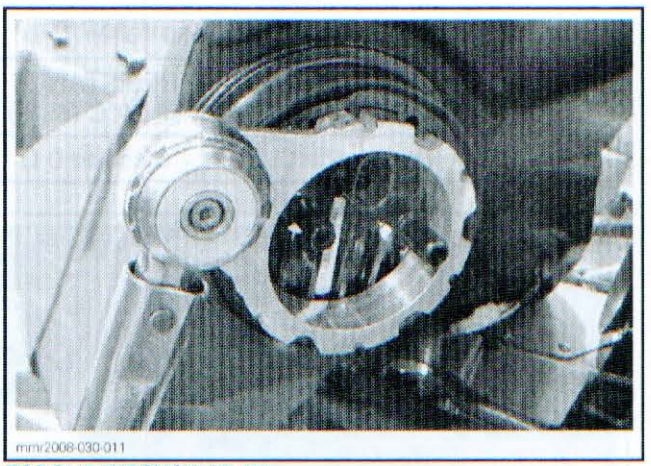
1. Install a **NEW** gasket on the fuel pump.

NOTE: Locate gasket between the pump and the fuel tank.



TYPICAL
1. *Nut*
2. *Fuel pump*
3. *Gasket*

2. Install a torque wrench perpendicularly (90°) to FUEL PUMP NUT TOOL (P/N 529 036 118).
3. Torque fuel pump nut as specified in exploded view.



TORQUE WRENCH AT 90°

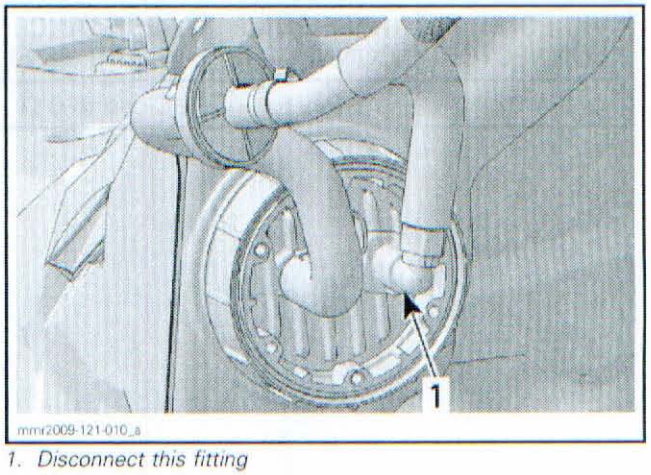
4. Reinstall fuel tank. Refer to the *FUEL TANK INSTALLATION* in this subsection.

FUEL PRESSURE REGULATOR

The fuel pressure regulator is an in-line type and is acquired as an assembly with the fuel filter.

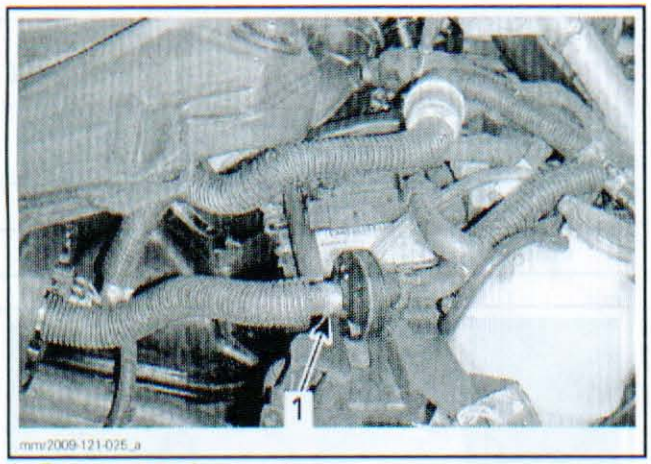
Fuel Pressure Regulator Removal

1. Release the fuel pressure. Refer to *FUEL PUMP*
2. Disconnect ground cable from battery. Refer to *CHARGING SYSTEM.*
3. Move fuel tank rearward as described in *FUEL TANK.*
4. Disconnect fuel hose from fuel rail. Refer to *FUEL RAIL* in *ELECTRONIC FUEL INJECTION* subsection.
5. Disconnect the quick connect fitting from fuel pump.



1. *Disconnect this fitting*

6. Remove the Oetiker clamp from pressure regulator hose.



1. Remove clamp from regulator

7. Remove fuel pressure regulator hose assembly from vehicle.

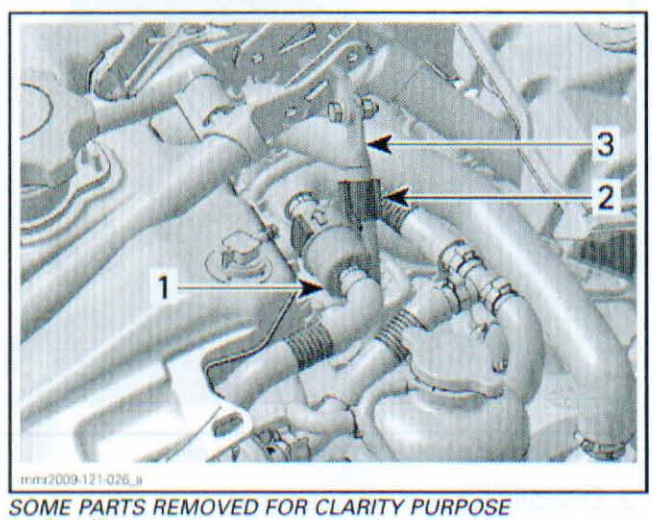
Fuel Pressure Regulator Installation

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

1. Reconnect fuel hose to fuel rail. Refer to *FUEL RAIL* in *ELECTRONIC FUEL INJECTION* subsection.
2. Reconnect fuel hose to fuel pump.
3. Install a NEW Oetiker clamp to retain fuel hose to pressure regulator.

NOTICE **Ensure hose clamp is tight and hose cannot turn on the fitting.**

4. Secure fuel filter in its holder and make sure that holder is attached to the upper column support.



SOME PARTS REMOVED FOR CLARITY PURPOSE
1. Fuel filter
2. Filter holder
3. Upper column support

⚠ CAUTION **Ensure fuel filter is always secured as described to allow proper conductivity of static electricity.**

5. Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION*.

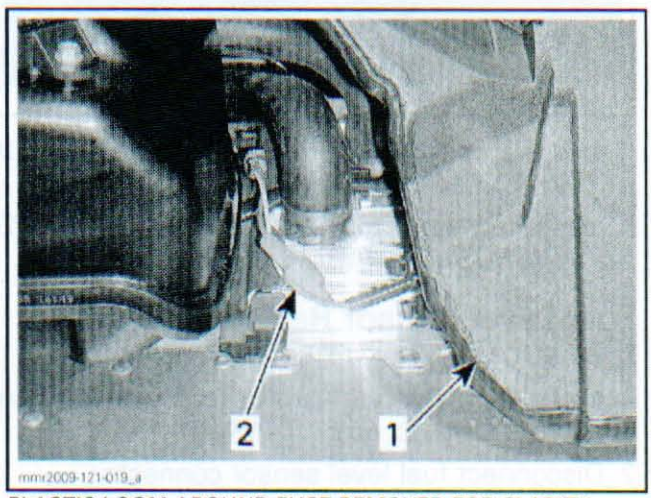
IN-LINE FUEL FILTER

The in-line fuel filter is part of the fuel pressure regulator assembly. For replacement, refer to *FUEL PRESSURE REGULATOR* in this subsection.

FUEL LEVEL SENSOR

Sensor Fuse

The fuel level sensor circuit is protected by an in-line 0.25 A. Fuse is located ahead of LH side of fuel tank near the sensor.



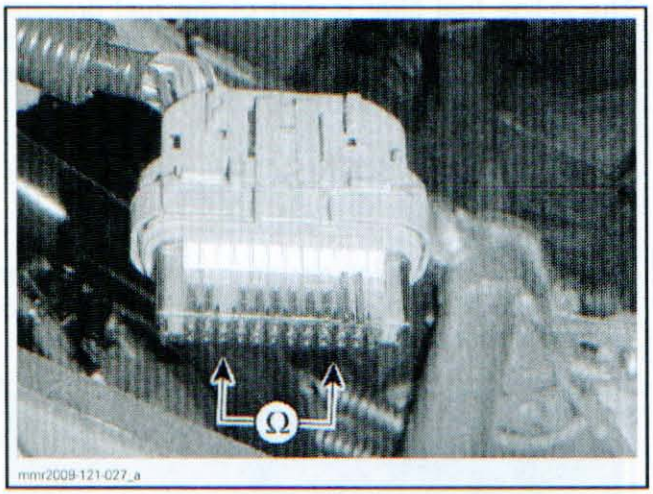
PLASTIC LOOM AROUND FUSE REMOVED FOR CLARITY
1. Front of fuel tank
2. Fuse

To access the fuel level sensor fuse, move fuel tank rearward. Refer to *FUEL TANK*.

Fuel Level Sensor Resistance Test (in Circuit)

1. Disconnect the multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.
2. Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868).
3. Set multimeter to Ω.
4. Probe terminals and read the sensor resistance as follows.

FLOAT POSITION (ACCORDING TO FUEL LEVEL)	MULTIFUNCTION GAUGE HARNESS CONNECTOR		RESISTANCE @ 20°C (68°F)
Full	Pin 12	Pin 15	7 Ω ± 3 Ω
Empty			95 Ω ± 5 Ω

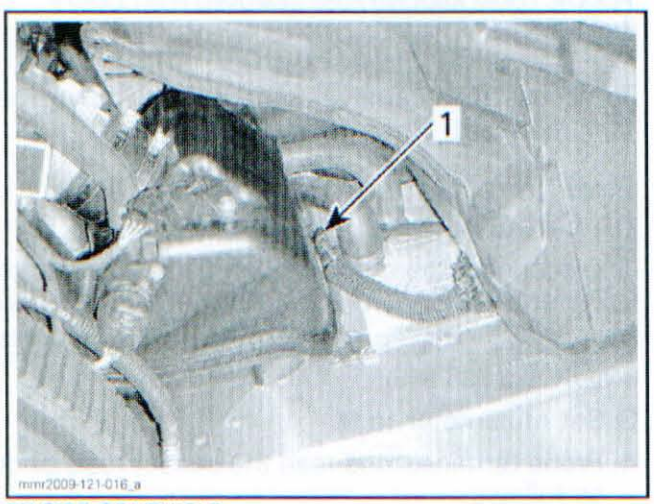


If test succeeded, refer to *FUEL LEVEL SENSOR INPUT VOLTAGE TEST.*

If test failed, refer to *FUEL LEVEL SENSOR RESISTANCE TEST (SENSOR ONLY).*

Fuel Level Sensor Resistance Test (Sensor Only)

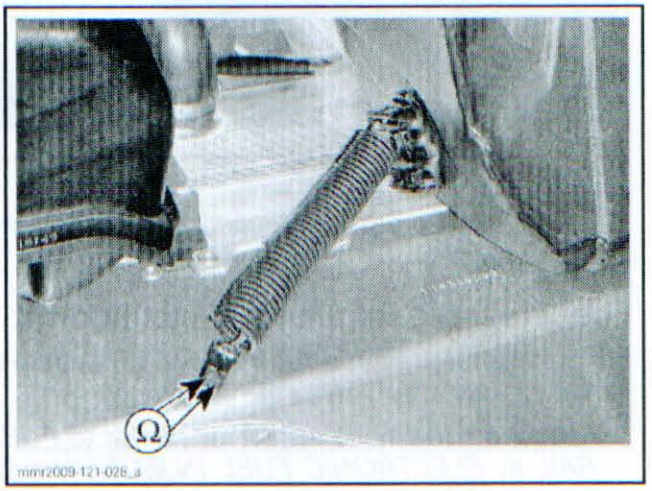
1. Move fuel tank rearward to reach sensor connector. Refer to *FUEL TANK.*
2. Disconnect fuel level sensor connector.



LH SIDE OF VEHICLE
1. Sensor connector

3. Probe sensor terminals and read the resistance as follows.

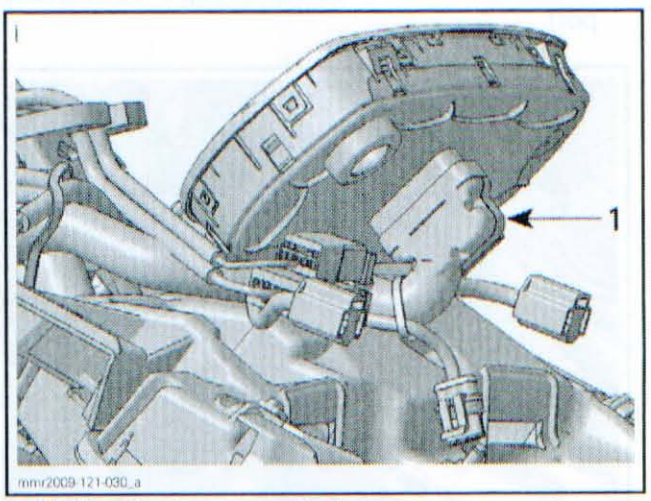
FLOAT POSITION (ACCORDING TO FUEL LEVEL)	SENSOR CONNECTOR		RESISTANCE @ 20°C (68°F)
Full	Pin 1	Pin 2	7 Ω ± 3 Ω
Empty			95 Ω ± 5 Ω



4. If test failed, replace sensor.
5. If test succeeded, check wiring continuity between multifunction gauge and sensor. See *WIRING DIAGRAM.*

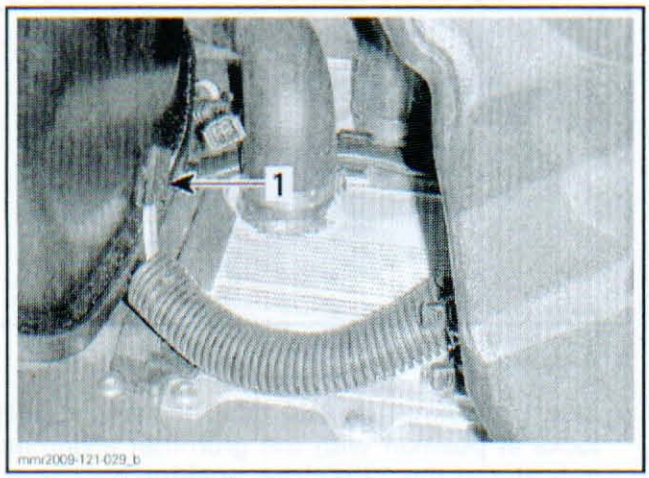
Fuel Level Sensor Input Voltage Test

1. Make sure main wiring harness connector is plugged on multifunction gauge.



1. Multifunction gauge connected

2. Disconnect fuel level sensor.



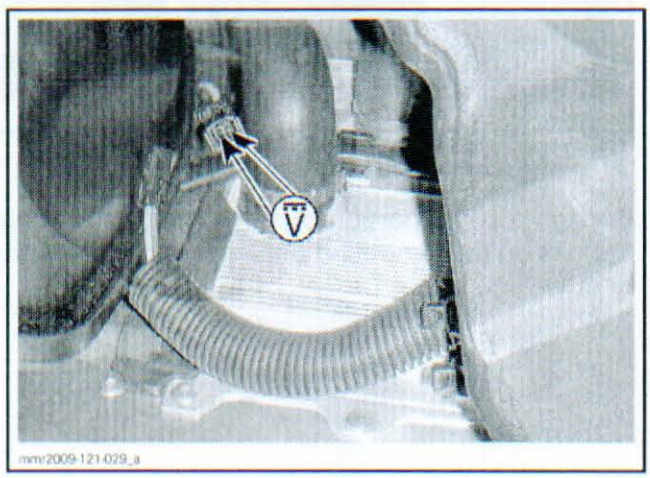
1. Sensor disconnected

3. Use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868).
4. Select Vdc.
5. Set engine stop switch to RUN.

NOTE: Do NOT install the D.E.S.S. key.

6. Briefly press START/RER button to wake up multifunction gauge.
7. Probe terminals of main wiring harness connector and read the voltage as follows.

SENSOR MAIN WIRING HARNESS CONNECTOR		VOLTAGE
Pin 1	Pin 2	5 Vdc

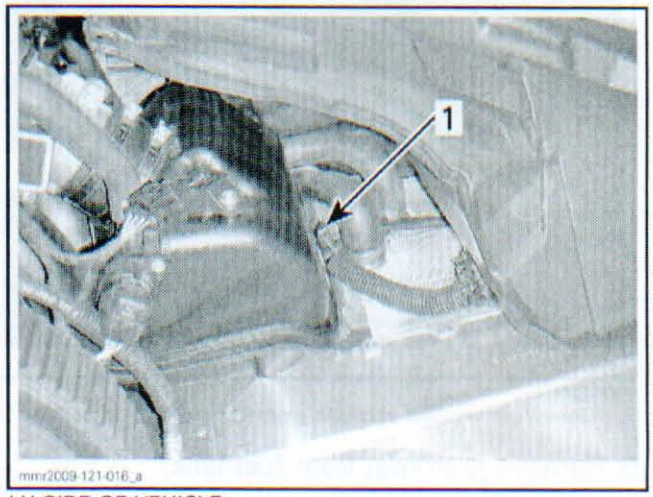


If test failed, replace multifunction gauge.

If test succeeded, multifunction gauge provides proper voltage to the sensor.

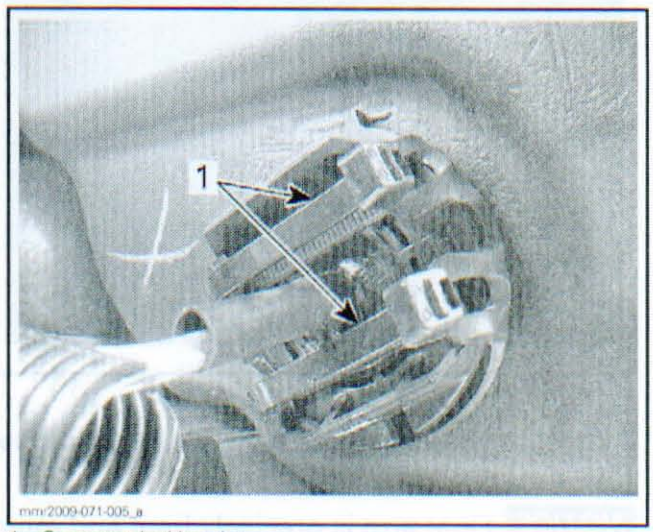
Fuel Level Sensor Removal

1. Drain fuel tank.
2. Move fuel tank rearward. Refer to *FUEL TANK* in this subsection.
3. Disconnect fuel level sensor connector.



LH SIDE OF VEHICLE
1. Sensor connector

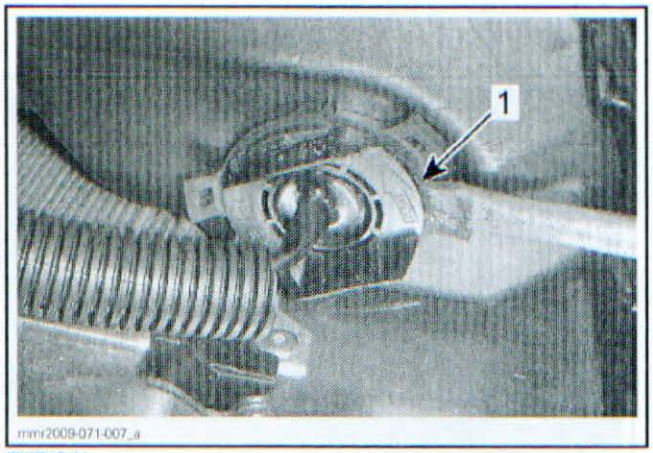
4. Cut locking ties securing grommet.



1. Grommet locking ties

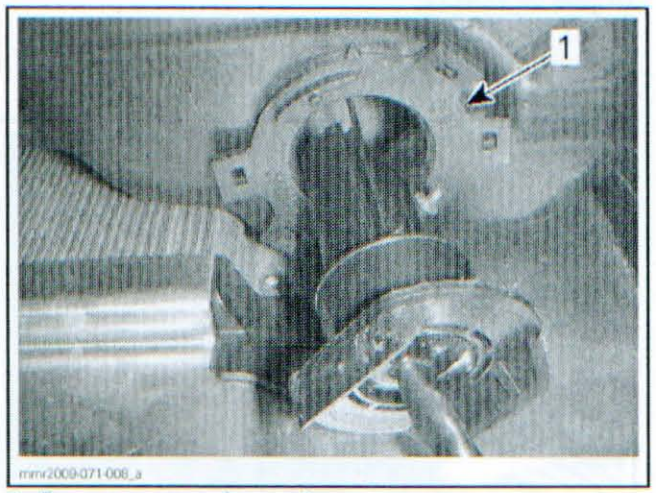
5. Insert a screwdriver between grommet and sensor face plate. Gently pry sensor loose in grommet.

NOTE: Do not try to remove sensor from grommet at this time.



TYPICAL
1. *Screwdriver inserted between grommet and face of sensor*

6. Remove grommet from fuel tank.



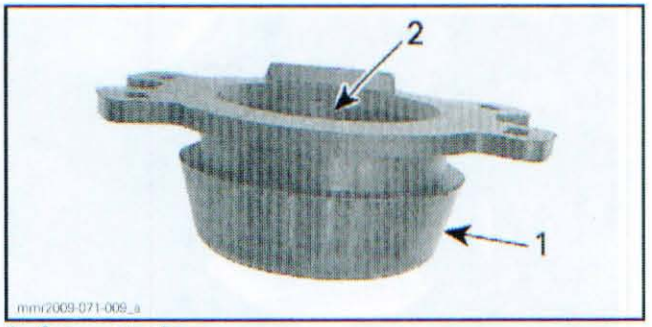
1. *Remove grommet from tank*

7. Carefully rotate sensor as you pull it out of fuel tank.

NOTICE **Float arm is precisely bent and must not be altered on removal or installation.**

Fuel Level Sensor Installation

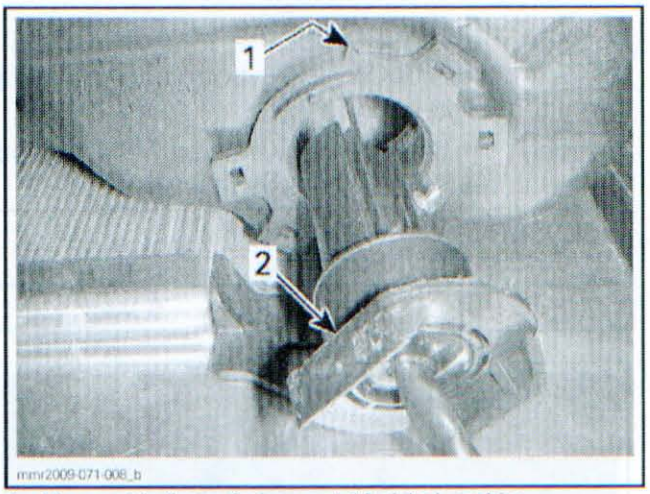
1. Fuel level sensor installation is the reverse of removal procedure. However, pay attention to the following.
2. Carry out a resistance test of sensor before installation. Refer to *FUEL LEVEL SENSOR RESISTANCE TEST* in this subsection.
3. To ease grommet and fuel level sensor installation, spray water (**NO SOAP**) on outer beveled surface and inner surface of grommet.



1. *Spray water here*
2. *Spray water on inner diameter*

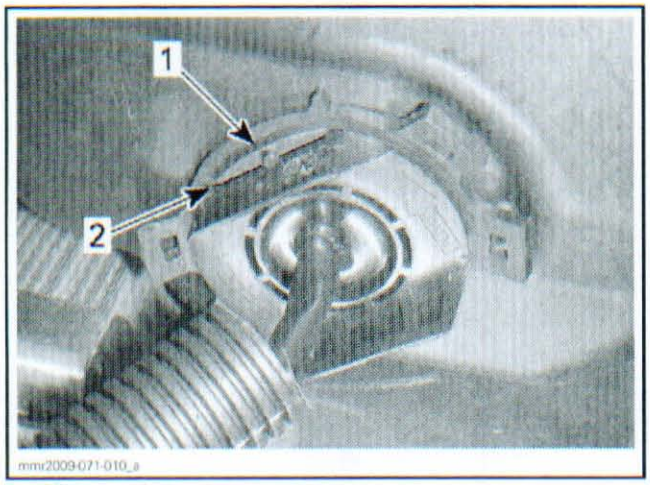
4. Insert grommet in fuel tank ensuring it fully locks in position with the grommet alignment indicator at the **12 o'clock position**.
5. Carefully insert float sensor through hole in grommet gently rotating it in position.

NOTE: Ensure the flat side of sensor is pointing in a general upwards direction.



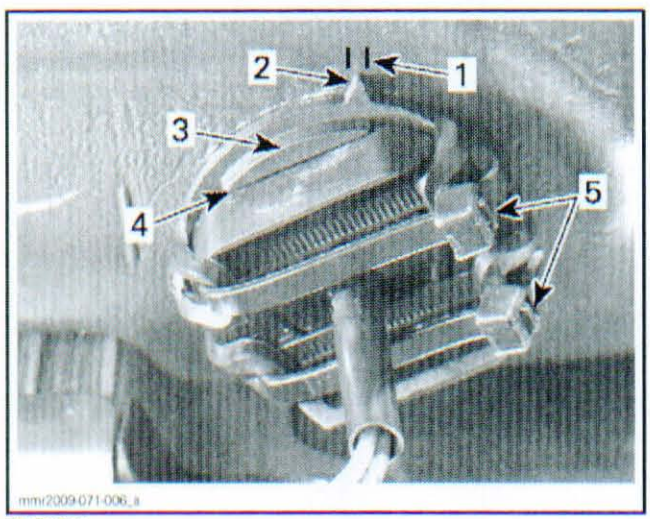
1. *Alignment indicator facing up at 12 o'clock position*
2. *Flat side of sensor upwards position*

6. Align top flat portion of sensor with alignment boss on grommet and push it in until it bottoms out.



1. *Alignment boss on grommet*
2. *Flat side of sensor aligned to grommet*

7. Install locking ties to secure grommet on fuel level sensor. Do not overtighten locking ties, just tighten without stretching them.



TYPICAL
1. *Disregard alignment index marks on fuel tank*
2. *Grommet alignment indicator must be at 12 o'clock*
3. *Sensor alignment boss on grommet*
4. *Sensor aligned to grommet boss*
5. *Locking ties secured*

8. Apply DIELECTRIC GREASE (P/N 293 550 004) in connector to prevent corrosion.
9. Carry out a fuel system leak test. Refer to *FUEL TANK LEAK TEST* in this subsection.
10. Test fuel level indication as you fill fuel tank before you complete reassembly of vehicle.

IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	238
FLUKE 115 DIGITAL MULTIMETER	529 035 868	236

GENERAL

Cables and locking ties removed during a procedure must be reinstalled as per factory standards.

NOTICE **Never force a multimeter probe into an electrical terminal.**

SYSTEM DESCRIPTION

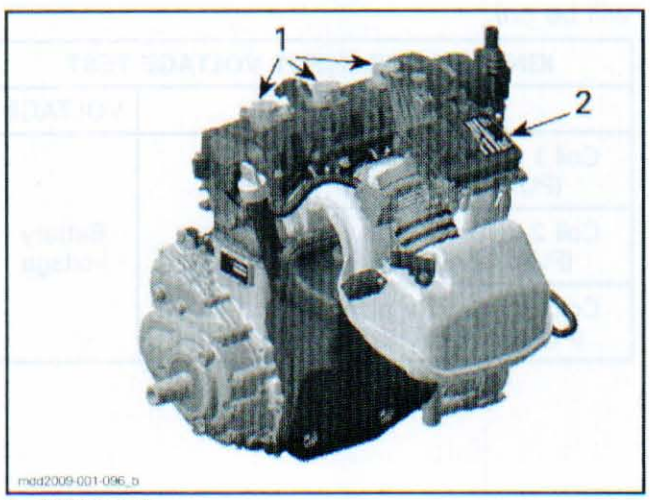
The ignition system is a digital inductive type (IDI) system.

Ignition system parameters such as ignition timing, spark duration, and firing order, are controlled by the ECM in order to meet engine operational requirements.

Three separate ignition coils (stick coils) receive power from three separate fuses.

When a ground signal is provided by the ECM to an ignition coil primary winding, a high voltage is induced in the coil secondary winding that is used to produce a spark at the spark plug electrode.

Cylinder 1 is on the PTO side of engine.



1. Ignition coils
2. ECM

Ignition Timing

Ignition timing is not adjustable.

The ECM is programmed with data (ignition mappings), used along with data received from a variety of sensors to establish optimum ignition timing under all engine operating conditions.

The firing of each spark plug is independent of the others.

TROUBLESHOOTING

IGNITION SYSTEM TESTING

The ECM controls the ignition system.

If a fault is detected by the ECM, the check engine light will turn on.

On a premium gauge, a check engine message will be displayed and beep code will be emitted. Refer to *ENGINE MANAGEMENT SYSTEM* section for details.

The ECM can detect a problem on the primary winding or circuit of the ignition coils.

The secondary winding of the ignition coils is not monitored by the ECM.

Other sensors in relation with the ignition system are also monitored by the ECM.

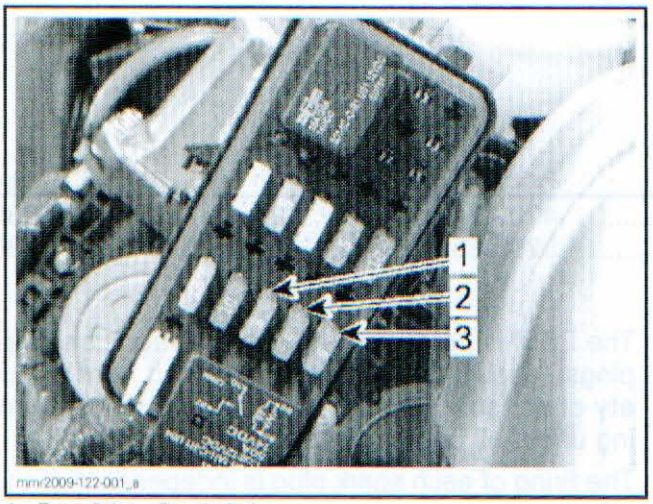
Ignition System Testing Sequence

Check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *ENGINE MANAGEMENT SYSTEM* section.

Check the following fuses:

- Fuse 3
- Fuse 4
- Fuse 5.

If a fuse is burnt, test for a short circuit or faulty component on that fuse circuit before replacing the fuse.



1. *Fuse 3 (no. 3 cylinder)*
2. *Fuse 4 (no. 2 cylinder)*
3. *Fuse 5 (no. 1 cylinder)*

Check ignition spark, refer to *IGNITION COIL QUICK TEST USING B.U.D.S.* in this subsection.

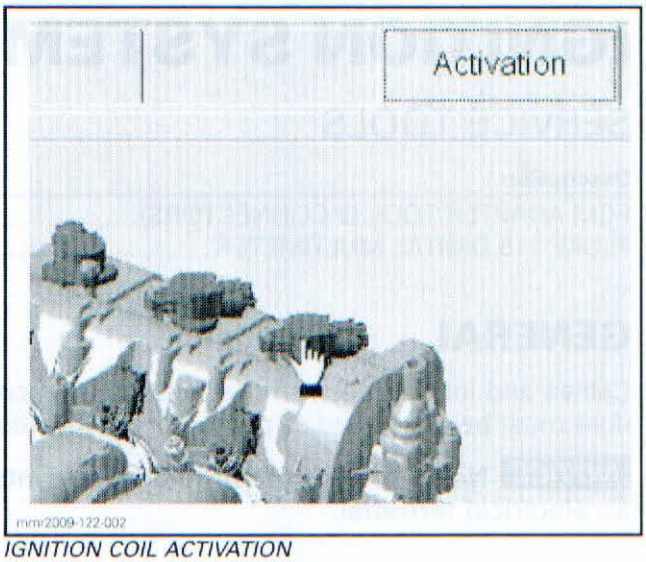
PROCEDURES

IGNITION COILS

Ignition Coil Quick Test using B.U.D.S.

This test confirms the working condition of the ignition circuit and coil for the cylinder tested.

1. Remove coil, refer to *IGNITION COIL REMOVAL* in this subsection.
2. Install a spark tester on the ignition coil.
3. Connect to the latest applicable B.U.D.S. software, refer to *COMMUNICATION TOOLS/ B.U.D.S. SOFTWARE* subsection.
4. In B.U.D.S., select **Read Data**.
5. Select the **Activation** tab.
6. Energize the **ignition** coil by selecting it on the engine illustration.



IGNITION COIL ACTIVATION

If there is no spark, carry out the following tests.

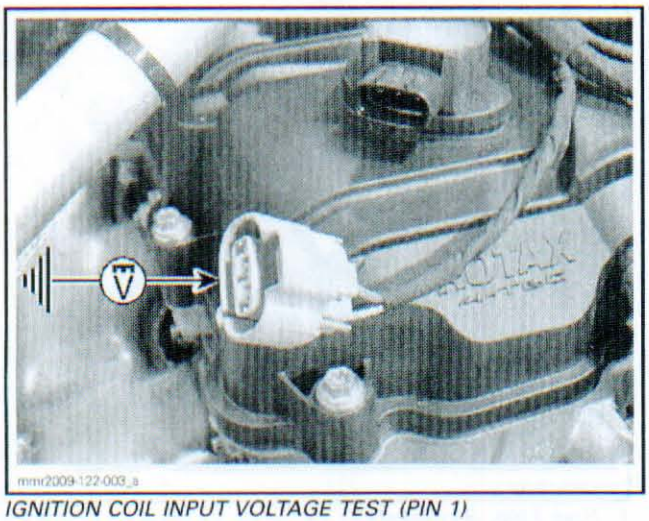
Ignition Coil Input Voltage Test

1. Remove air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.
2. Disconnect the ignition coil connector.
3. Install D.E.S.S. key on post and set engine stop switch to ON.
4. Quickly press on START/RER switch to wake up ECM.

Using a FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) set to Vdc, measure voltage as per following table.

NOTE: Test is valid only if ECM is active (gauge will be on).

IGNITION COIL INPUT VOLTAGE TEST		
TEST PROBES		VOLTAGE
Coil 1 connector pin 1 (PURPLE/BLUE)	Battery ground	Battery voltage
Coil 2 connector pin 1 (PURPLE/GREEN)		
Coil 3 connector pin 1 (PURPLE/ORANGE)		



IGNITION COIL INPUT VOLTAGE TEST (PIN 1)

If battery voltage is read, test coil ground signal. Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST.*

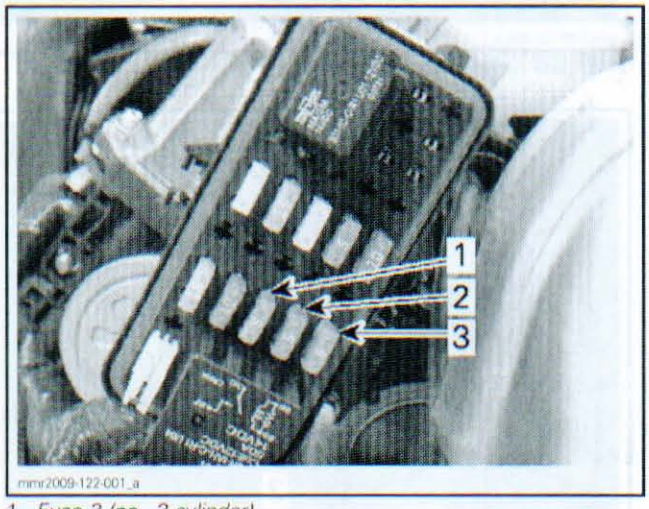
If battery voltage is NOT read, test ignition coil power input wire. Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST.*

5. Remove D.E.S.S. post.

Ignition Coil Circuit Continuity Test

Power Input Wire (Coil)

1. Make sure that D.E.S.S. key is removed from post and engine stop switch is set to OFF.
2. Locate the applicable ignition/injector fuse located in the fuse box.

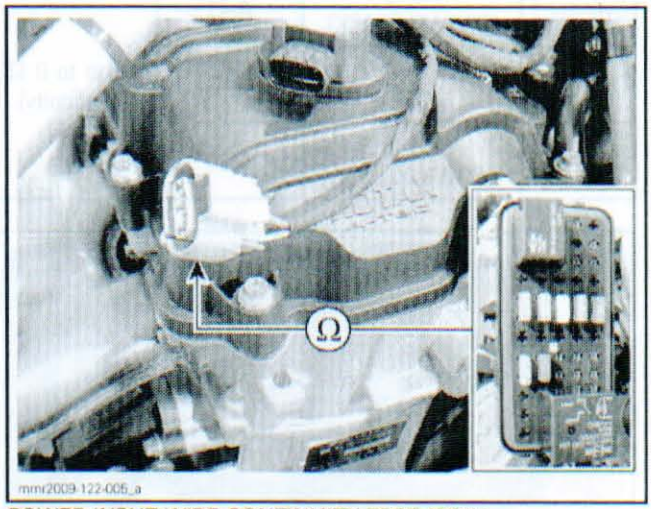


1. *Fuse 3 (no. 3 cylinder)*
2. *Fuse 4 (no. 2 cylinder)*
3. *Fuse 5 (no. 1 cylinder)*

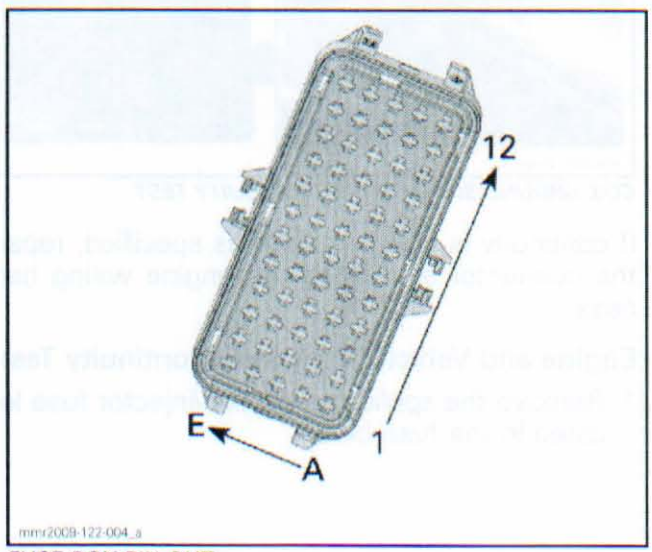
3. Remove air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.
4. Disconnect ignition coil connector.
5. Test for continuity of circuit as per following table.

NOTE: Probe the metallic part on top of the fuse.

POWER INPUT WIRE CONTINUITY TEST (COIL)			
COIL	COIL CONNECTOR	FUSE BOX CONTACT	RESISTANCE
Cylinder 1	Pin 1 (PURPLE/BLUE)	4A (fuse 5)	Close to 0 Ω (continuity)
Cylinder 2	Pin 1 (PURPLE/GREEN)	4B (fuse 4)	
Cylinder 3	Pin 1 (PURPLE/ORANGE)	4C (fuse 3)	



POWER INPUT WIRE CONTINUITY TEST (COIL)



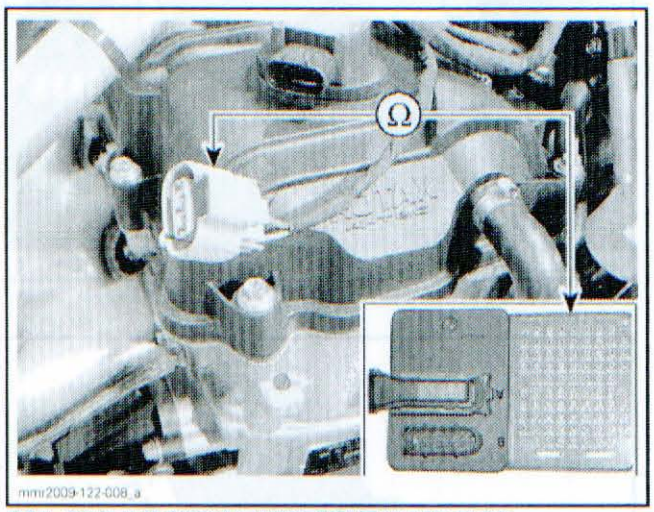
FUSE BOX PIN-OUT

If continuity is not measured as specified, test the engine and vehicle harnesses. Reinstall removed fuses.

Ground Signal Wire (Ignition Coil)

1. Remove air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.
2. Disconnect ECM connector A and install it on the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010).
3. Disconnect ignition coil connector.
4. Test for continuity of coil ground signal circuit as per following table.

GROUND WIRE CONTINUITY TEST (COIL)			
COIL	COIL CONNECTOR	ECM PIN	RESISTANCE
Cylinder 1	Pin 3 (BROWN/BLACK)	A-41	Close to 0 Ω (continuity)
Cylinder 2	Pin 3 (BROWN/GREEN)	A-1	
Cylinder 3	Pin 3 (BROWN/YELLOW)	A-29	

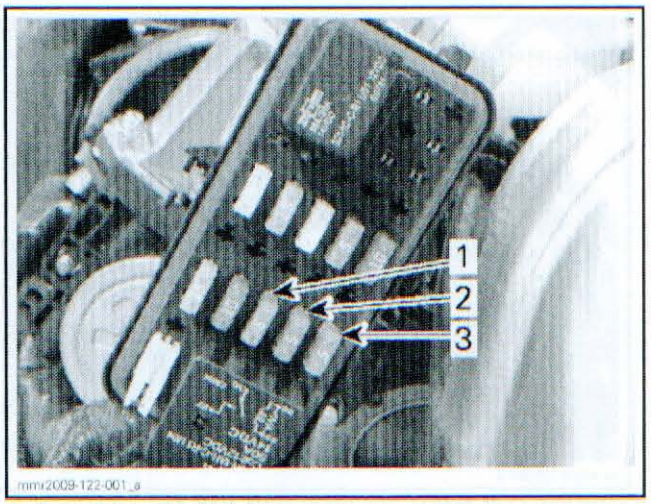


COIL GROUND SIGNAL WIRE CONTINUITY TEST

If continuity is not measured as specified, repair the connector or replace the engine wiring harness.

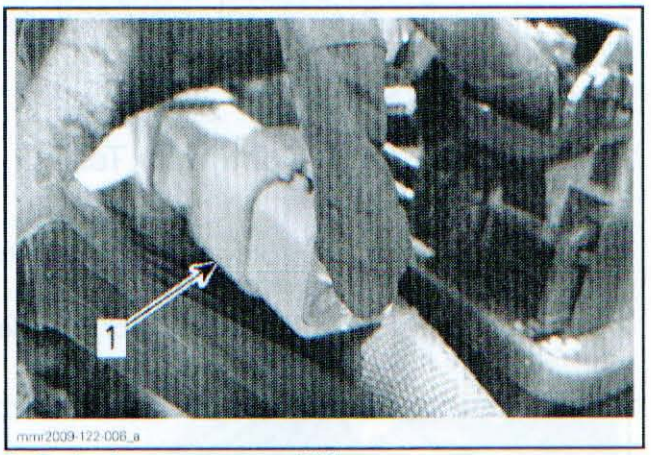
Engine and Vehicle Harnesses Continuity Test

1. Remove the applicable ignition/injector fuse located in the fuse box.

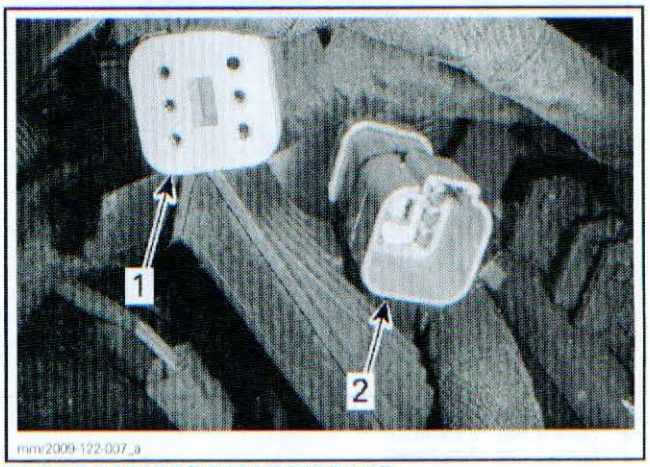


1. *Fuse 3 (no. 3 cylinder)*
2. *Fuse 4 (no. 2 cylinder)*
3. *Fuse 5 (no. 1 cylinder)*

2. Disconnect the engine connector located in front of the ECM connectors.



1. *Engine harness connector (HIC)*



ENGINE HARNESS CONNECTOR (HIC)
1. *Vehicle harness side*
2. *Engine harness side*

3. Test for continuity of circuit as per following tables.

POWER INPUT WIRE CONTINUITY TEST (ENGINE HARNESS)			
COIL	COIL CONNECTOR	ENGINE HARNESS CONNECTOR	RESISTANCE
Cylinder 1	Pin 1 (PURPLE/BLUE)	Pin1 (PURPLE/BLUE)	Close to 0 Ω (continuity)
Cylinder 2	Pin 1 (PURPLE/GREEN)	Pin 2 (PURPLE/GREEN)	
Cylinder 3	Pin 1 (PURPLE/ORANGE)	Pin 3 (PURPLE/ORANGE)	

POWER INPUT WIRE CONTINUITY (VEHICLE HARNESS)			
COIL	VEHICLE HARNESS CONNECTOR	RELAY FUSE BOX CONTACT	RESISTANCE
Cylinder 1	Pin1 (PURPLE/BLUE)	4A	Close to 0 Ω (continuity)
Cylinder 2	Pin 2 (PURPLE/GREEN)	4B	
Cylinder 3	Pin 3 (PURPLE/ORANGE)	4C	

Repair or replace wiring or connector as required.

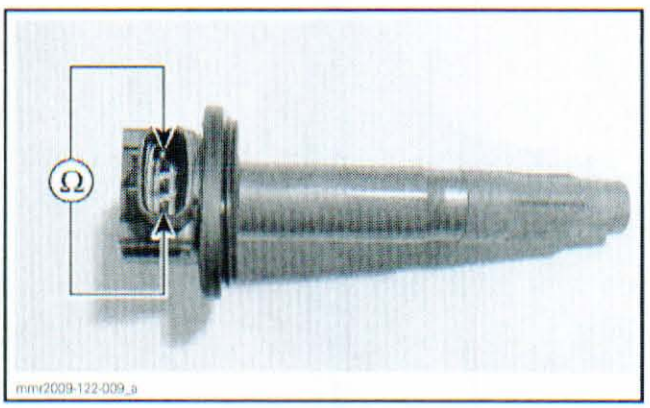
4. Reinstall removed fuses.

Ignition Coil Resistance Test

An ignition coil with a good resistance measurement can still be faulty. Current leakage can occur at high voltage levels which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

Primary Winding

1. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.
2. Set the multimeter to Ω and measure primary winding resistance as specified.



CIRCUIT	PIN	RESISTANCE @ 20°C (68°F)
Primary	1 and 3	0.8 - 0.97 Ω

If resistance is not within specification, replace ignition coil.

Secondary Winding

The secondary winding on this type of ignition coil cannot be tested.

Ignition Coil Removal

1. Refer to *AIR INTAKE SYSTEM* subsection and remove air intake silencer.
2. Disconnect ignition coil connector.
3. Remove coil retaining screw.

NOTICE **Do not pry on ignition coil with a tool.**

4. Remove ignition coil from spark plug by rotating coil side to side as you pull up.

NOTE: For cylinder 2, turn steering column to ease ignition coil removal.

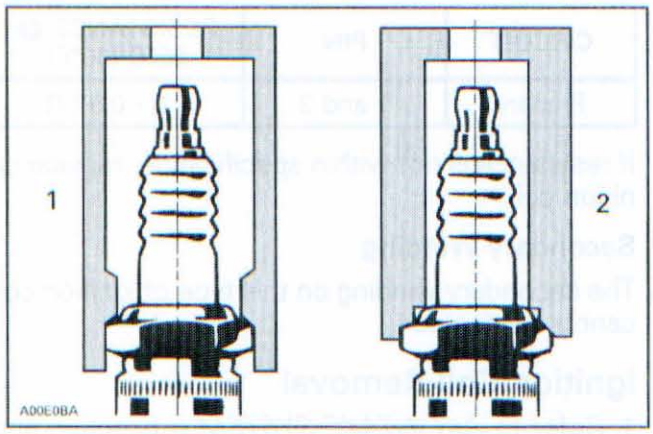
Ignition Coil Installation

1. Align the retaining screw hole of the ignition coil with the threaded hole on the valve cover.
2. Install the ignition coil on the spark plug and push it all the way down until it rests on the valve cover.
3. Install the retaining screw an tighten to 11 N•m (97 lbf•**in**).
4. Connect ignition coil connector.

SPARK PLUGS

Spark Plug Removal

1. Remove ignition coil as explained in this subsection.
2. Using an approved spark plug socket, release the torque applied to the spark plug and unscrew a few turns.



1. Aproved socket
2. Improper socket

3. Clean the spark plug and cylinder head with pressurize air.
4. Remove spark plug.

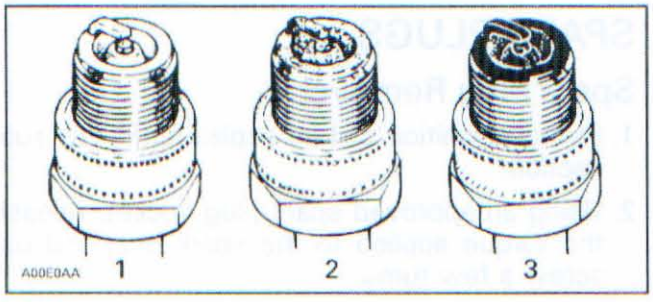
Troubleshooting a Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running or misfiring of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption.

Other possible causes are: a incorrect or bad fuel, defective ignition system, incorrect spark plug gap, loss of compression, or lubricating oil entering the combustion chamber.

The plug face of a fouled spark plug has either a wet or dry black carbon deposit. Such coatings form a conductive connection between the center electrode and the ground electrode.

Spark Plug Analysis



TYPICAL
1. Overheated (light grey, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, grey, melted coating)

The plug face reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at prescribed intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

Spark Plug Installation

Prior to installation, ensure the contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, check electrode gap as specified in the following chart.

NOTICE **Do not adjust gap on this type of spark plug. The adjustment could weaken negative electrodes which may lead to electrode breakage and severe engine damage.**

ENGINE	SPARK PLUG	TORQUE	GAP mm (in)
1203 4-TEC	NGK CR8EKB	11 N•m (97 lbf•in)	0.7 mm (.028 in)

2. Hand screw spark plug into cylinder head. Then, tighten the spark plug clockwise to specified torque with an approved spark plug socket.
3. Carry out *IGNITION COIL INSTALLATION* procedure as explained in this subsection.
4. Complete the installation in the reverse order of the removal.

CHARGING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 DIGITAL MULTIMETER	529 035 868	242, 244–245

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
EXTECH AMMETER	380941	242
FLUKE RIGID BACK PROBES	TP88	245
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	248

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	249

GENERAL

SYSTEM DESCRIPTION

Magneto

A magneto provides the primary source of electrical energy. It transforms a magnetic field into an alternating current (AC).

The magneto is comprised of a 3 phase delta wound stator.

AC current is rectified and regulated by a voltage regulator between 13.8 and 14.5 volts DC for primary power to the vehicle electrical system and to charge the battery.

Voltage Regulator

The voltage regulator has two connectors.

- An AC input connector coming from the magneto stator (YELLOW wires).
- A DC output connector that holds the supply wire (RED/WHITE) and the ground wire (BLACK).

The voltage regulator DC output (RED/WHITE wire) supplies to all the vehicle needs in current when engine is running and charges the battery through the 30 A main fuse (FA).

The voltage regulator is grounded to the chassis through the black wire.

The voltage regulator is located on the RH side of tunnel in front of the fuel tank.

Battery

A battery is installed as a secondary power source. It is primarily used for energizing the ECM, gauge and starter.

The battery also provides a stable voltage to the voltage regulator to ensure the ECM operates normally.

On vehicles equipped with a high end multifunction gauge, it also provides power to maintain the clock function within the gauge.

NOTE: Never use a battery charger to temporarily substitute the battery as it may cause the ECM (engine control module) to function erratically or not at all.

INSPECTION

CHARGING SYSTEM OUTPUT

DC Voltage Output Test

NOTE: The charging system can have an adequate voltage output while being unable to provide enough current for the vehicle's needs. In doubt, perform the current output test.

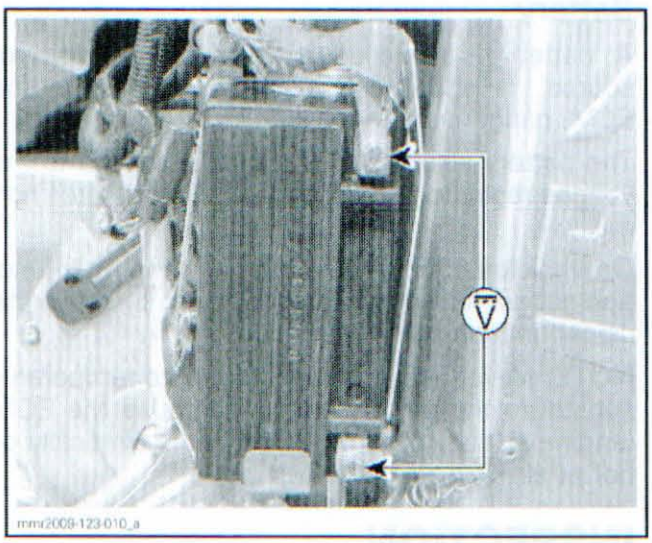
1. Raise vehicle and ensure the track is off the ground and can turn freely.

⚠ WARNING

Make sure vehicle track is completely raised off ground. If track should come into contact with ground when engine is at high RPM, equipment damage and severe injury may result.

2. Remove RED rubber boot protector from positive battery post.
3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc scale.
4. Connect multimeter to battery posts.
5. Start engine and read voltage as follows.

DC VOLTAGE OUTPUT TEST			
TEST ENGINE SPEED	TEST PROBES		VOLTAGE
4000 RPM	Battery (+)	Battery (-)	13.8 - 14.8 Vdc



If voltage is above specification, replace voltage regulator.

If voltage is below specification, check the following:

- Check stator wires (YELLOW) and terminals at voltage regulator for damage.
- Test stator, refer to *MAGNETO AND STARTER* subsection.
- Perform wiring tests. Refer to *VOLTAGE REGULATOR* in this subsection.

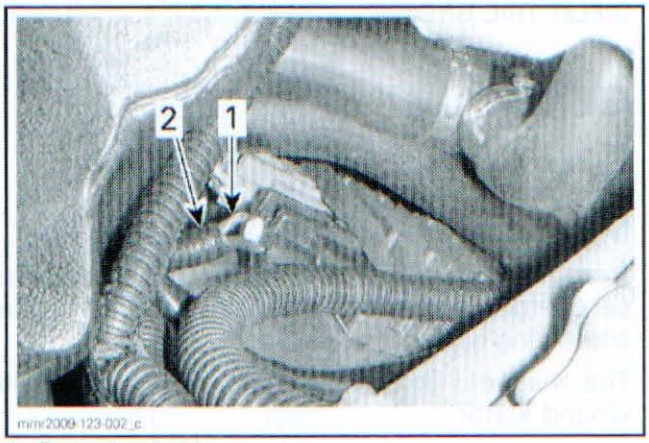
DC Current Output Test

1. Move fuel tank back, refer to *FUEL TANK AND FUEL PUMP* section.
2. Raise vehicle and ensure the track is off the ground and can turn freely.

⚠ WARNING

Make sure vehicle track is completely raised off ground. If track should come into contact with ground when engine is at high RPM, equipment damage and severe injury may result.

3. Carefully open the protective sheath covering the wires enough to allow ammeter clamp installation.
4. Measure current using an inductive ammeter such as the EXTECH AMMETER (P/N 380941).
   4.1 Install ammeter clamp over the RED/WHITE wire nearby the voltage regulator.



1. *Protective sheath*
2. *RED/WHITE wire*

   4.2 Start engine.
   4.3 Set the heated grips and throttle lever to the highest intensity and the headlights to high beam.
   4.4 Rev engine at 4000 RPM and read ammeter.

DC CURRENT OUTPUT TEST	
TEST ENGINE SPEED	MINIMUM CURRENT
4000 RPM	25 A

If current reading is significantly below specification, do the following:

- Check stator wires (YELLOW) and terminals at voltage regulator for damage.

- Test stator, refer to *MAGNETO AND STARTER* subsection.
- Perform wiring tests. Refer to *VOLTAGE REGULATOR* in this subsection.

TROUBLESHOOTING

NOTE: It is good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *MONITORING SYSTEM/FAULT CODES*.

DIAGNOSTIC TIPS

Weak or Discharged Battery

If the battery is weak or discharged, check the following:

- Check battery. Refer to *BATTERY* in this subsection.
- Check items in *LOW OR NO CHARGING SYSTEM VOLTAGE*.
- Check charging current output, refer to *INSPECTION* in this subsection.

Low or No Charging System Voltage

If charging system voltage is low, the engine may be unstable, or stall.

Test the following items:

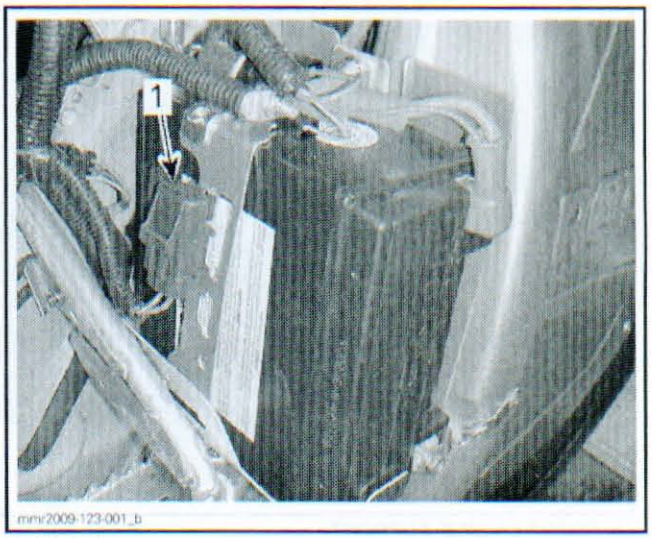
- Charging system voltage, refer to *INSPECTION* in this subsection
- Test stator, refer to *MAGNETO AND STARTER* subsection
- Wiring and connections, refer to *VOLTAGE REGULATOR* in this subsection.

PROCEDURES

MAIN FUSE

Fuse Location

The 30 A main system fuse is located on the battery retaining plate.



1. Main fuse

NOTE: If fuse blows while engine is running, engine will stall. If engine is not running and the fuse is blown, engine will not start.

Troubleshooting a Blown Main Fuse

A defective voltage regulator, loose connection, damaged wires or terminals can cause the fuse to blow.

1. Disconnect regulator connectors and inspect wires and terminals for damage.

NOTE: It may be necessary to move fuel tank back make room. Refer to *FUEL TANK AND FUEL PUMP*.

2. Keep the regulator disconnected and install a new fuse.

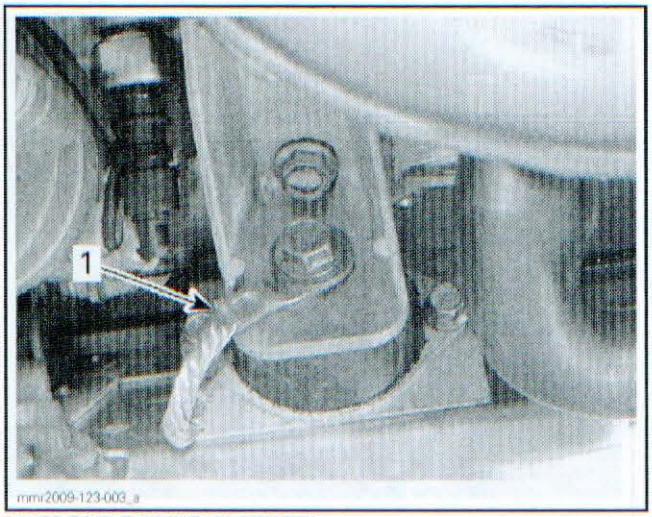
If the fuse still burns, check the DC wiring between main fuse and fuse box for a short circuit to ground. Refer to *WIRING DIAGRAM* for details.

If fuse does not burn with a disconnected voltage regulator, replace regulator.

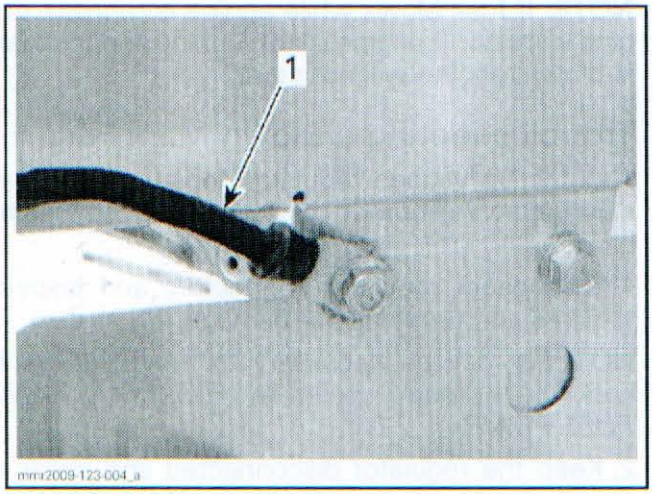
MAIN GROUND CABLES

Main Ground Cables Inspection

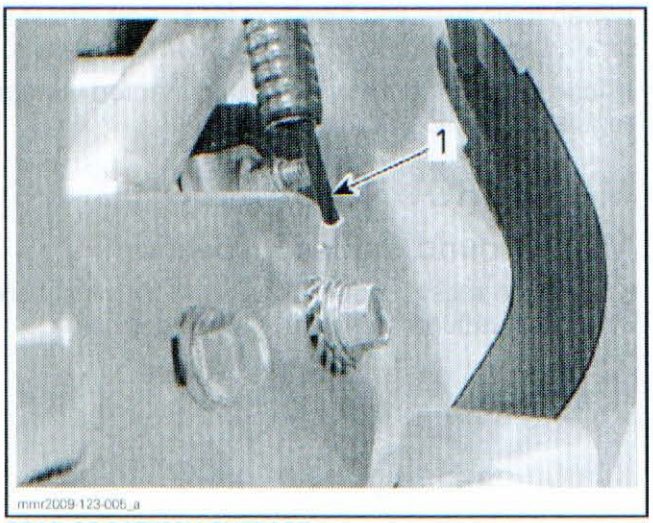
Make sure main ground cables and terminals are in good condition, tight and free of corrosion.



LH FRONT ENGINE SUPPORT
1. Engine ground



FRONT OF BATTERY SUPPORT
1. Battery ground



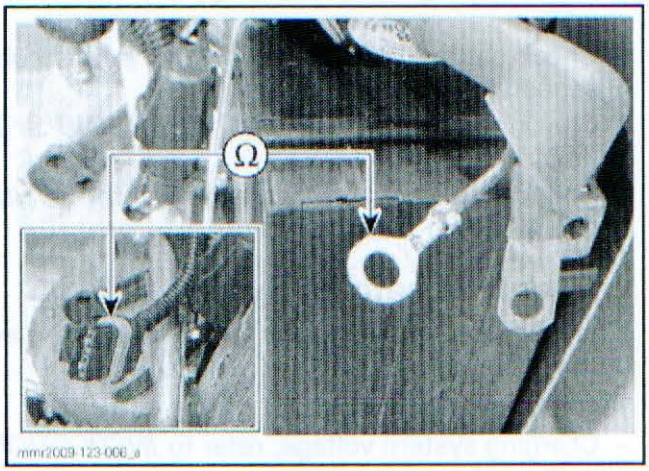
REAR OF BATTERY SUPPORT
1. Chassis ground

VOLTAGE REGULATOR

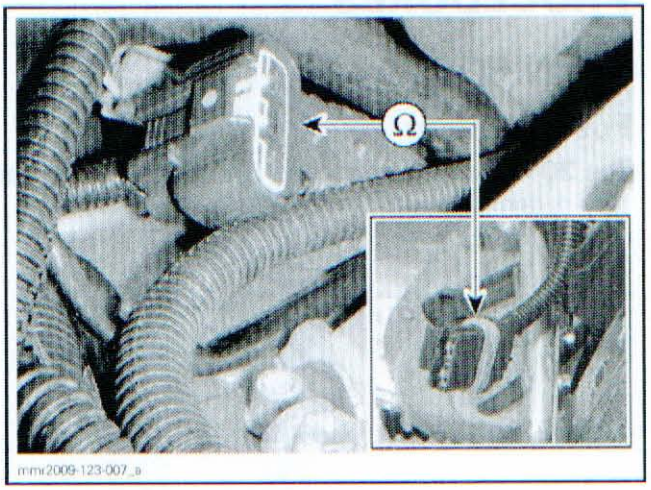
Wiring Continuity Verification (Voltage Regulator)

1. Disconnect battery.
2. Disconnect regulator DC connector.
3. Remove the main fuse from its holder.
4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω and measure resistance as follows:

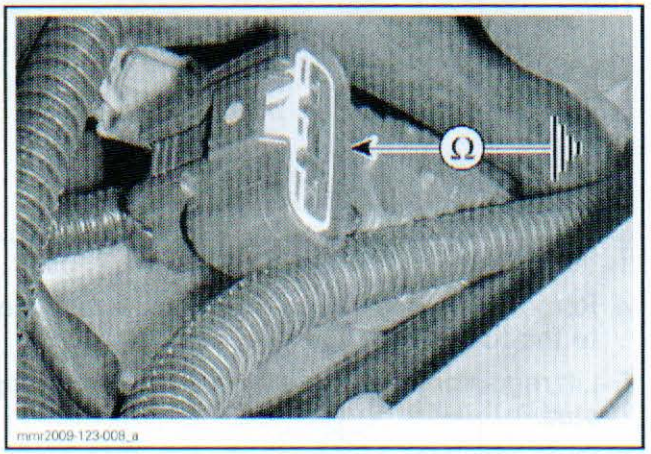
TEST PROBES		RESISTANCE
Charge wire (RED) at battery	Fuse holder pin B (RED wire)	Close to 0 Ω



TEST PROBES		RESISTANCE
Regulator DC connector pin 1 (RED/WHITE wire)	Fuse holder pin A (RED/WHITE wire)	Close to 0 Ω



TEST PROBES		RESISTANCE
Regulator DC connector pin 3 (BLACK wire)	Chassis ground	Close to 0 Ω



If a high resistance is read, check wire for corrosion or damage.

Wiring Voltage Drop Verification (Voltage Regulator)

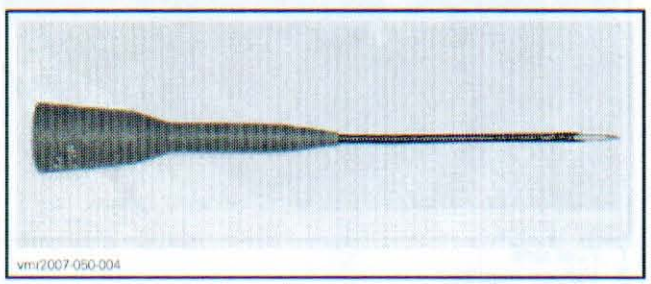
In some cases, even if the continuity tests good, a parasitic resistance may affect the circuit. In these cases, a voltage drop test is more accurate.

Supply Wire Voltage Drop Test

1. Move fuel tank back, refer to *FUEL TANK/FUEL PUMP* section.

NOTE: Do not disconnect the regulator DC connector.

2. Back probe pin 1 (RED/WHITE wire) of the DC connector at voltage regulator using the FLUKE RIGID BACK PROBES (P/N TP88).

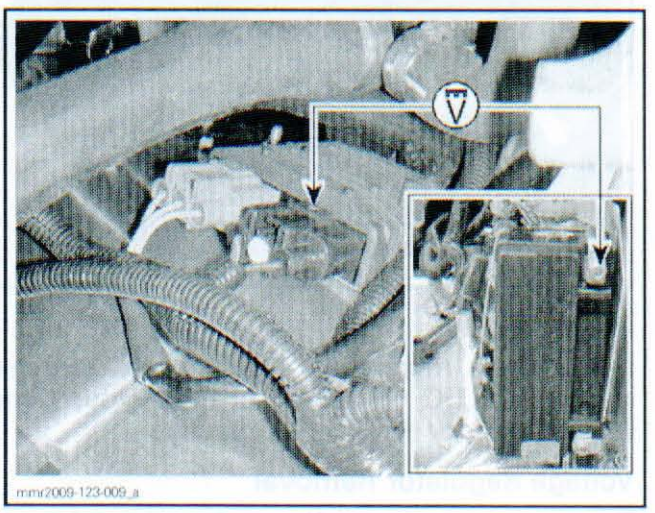


3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
4. Start engine.
5. Set the heated grips and throttle lever to the highest intensity and the headlights to high beam.

NOTE: On models equipped with a premium gauge, heated throttle lever and grips are enabled from 2000 RPM.

6. Measure voltage between the following points.

REGULATOR DC CONNECTOR	BATTERY	VOLTAGE DROP
Pin 1 (RED/WHITE wire)	Positive Post (+)	Maximum 1 volt



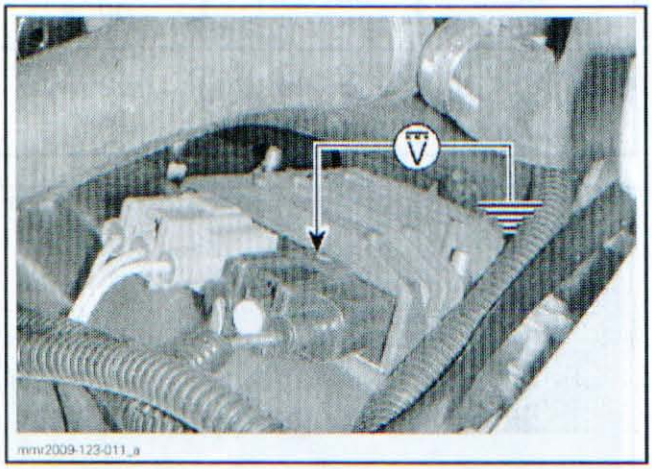
7. Stop engine.

If reading is more than 1 volt, check terminals at regulator DC connector, RED/WHITE wire and fuse holder for corrosion or damage.

Ground Circuit Voltage Drop Test

1. Back probe pin 3 (BLACK wire) of the DC connector at voltage regulator using the FLUKE RIGID BACK PROBES (P/N TP88).
2. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
3. Start engine.
4. Set the heated grips and throttle lever to the highest intensity and the headlights to high beam.
5. Measure voltage between the following points.

REGULATOR DC CONNECTOR	CHARGING SYSTEM FUSE HOLDER (FA)	VOLTAGE DROP
Pin 3 (BLACK wire)	Chassis ground	Maximum 1 volt



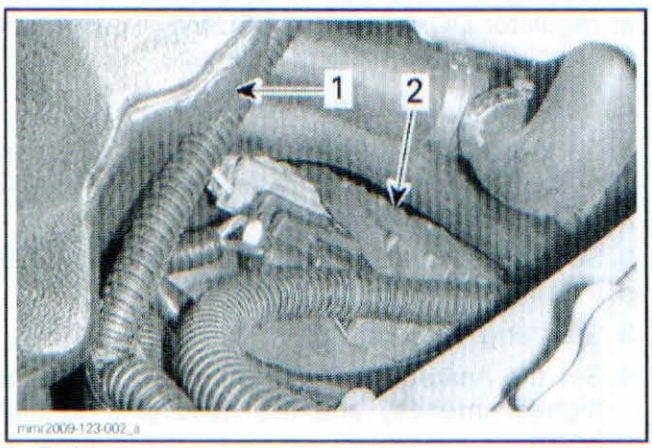
mmr2009-123-011_a

6. Stop engine.

If reading is more than 1 volt, check terminal at regulator DC connector, chassis ground and BLACK wire for corrosion or damage.

Voltage Regulator Removal

The voltage regulator is located on the right side of the frame just ahead of the fuel tank.



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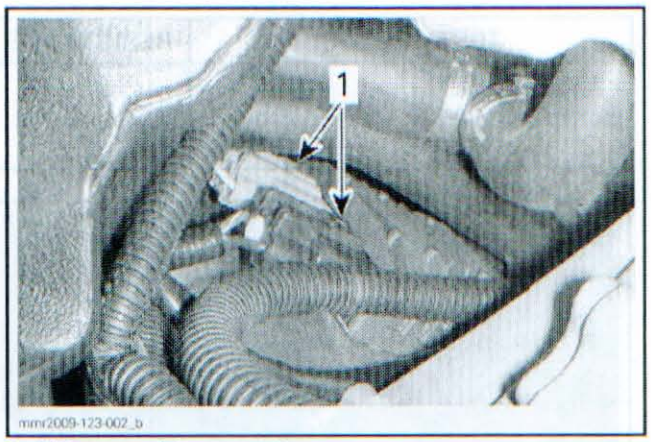
1. Fuel tank
2. Voltage regulator

1. Disconnect battery.
2. Move fuel tank back, refer to *FUEL TANK/FUEL PUMP* section.
3. Disconnect the voltage regulator connectors.



mmr2009-123-002_b

1. Voltage regulator connectors

4. Remove both elastic nut retaining the regulator to the tunnel.
5. Lift regulator up to free it from the LH mounting stud.
6. Pivot regulator counterclockwise, then free it from the RH mounting stud.

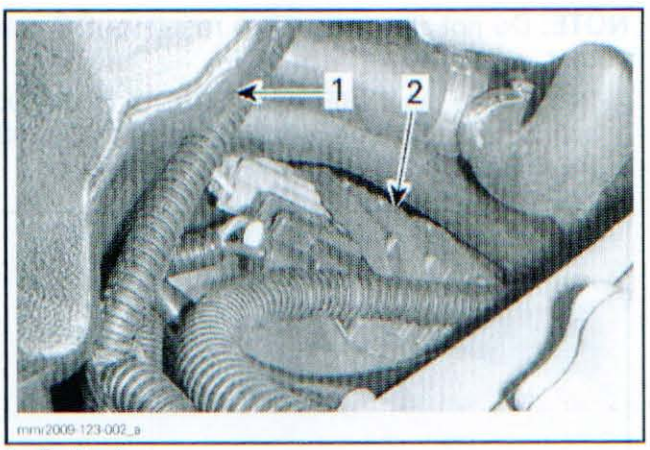
Voltage Regulator Installation

Installation is the reverse order of removal procedure.

Torque voltage regulator screws to 5 N•m (44 lbf•**in**).

Voltage Regulator Removal

The voltage regulator is located on the right side of the frame just ahead of the fuel tank.



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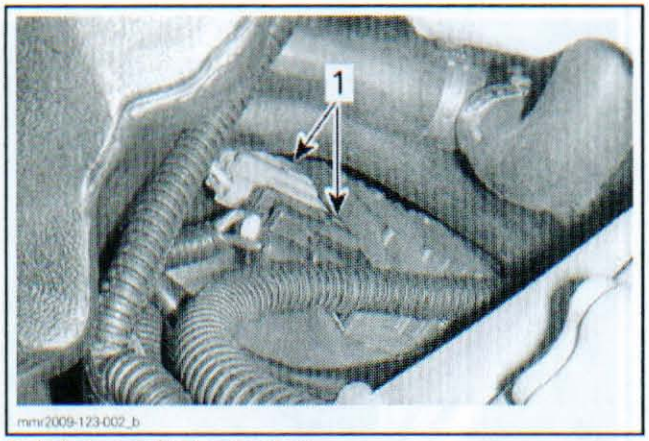
1. Fuel tank
2. Voltage regulator

1. Disconnect battery.
2. Move fuel tank back, refer to *FUEL TANK/FUEL PUMP* section.
3. Disconnect the voltage regulator connectors.



1. Voltage regulator connectors

4. Remove both elastic nut retaining the regulator to the tunnel.
5. Lift regulator up to free it from the LH mounting stud.
6. Pivot regulator counterclockwise, then free it from the RH mounting stud.

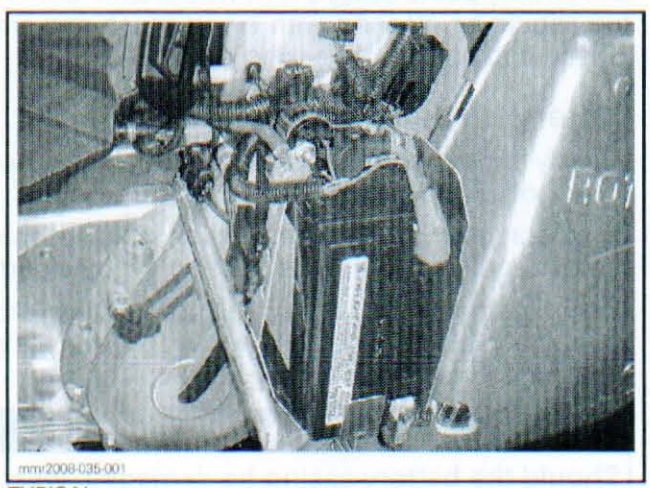
Voltage Regulator Installation

Installation is the reverse order of removal procedure.

Torque voltage regulator screws to 5 N•m (44 lbf•**in**).

BATTERY

The battery type is a sealed valve regulated lead acid (VRLA). It a non-spillable, maintenance reduced type (no electrolyte level to be checked and readjusted). No ventilation tube is attached to the battery.



TYPICAL

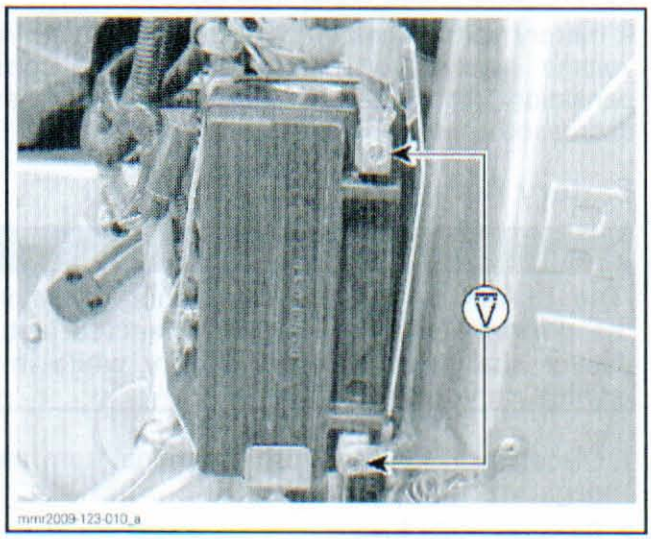
Battery Testing

Battery Voltmeter Test (No Load Applied)

NOTE: An unloaded voltmeter test is carried out on a battery without discharging current. It is the simplest and most commonly used. However, be aware that a voltage test can indicate that the battery is in good condition even though the battery does not have enough power to crank the engine. A voltage reading provides an instant indication of the state of charge of the battery, not of its current storage capacity. A battery load test gives a more accurate indication of the battery condition.

If the battery has just received a charge, allow it to rest for 1 - 2 hours before taking a voltage reading.

Set multimeter to Vdc and connect to battery terminals. Always respect polarity.



Batteries with a voltage above 12.8 V do not need to be charged.

Batteries with a voltage of 12.8 V and below need to be charged. Refer to *BATTERY CHARGING* in this section.

Battery Testing (Load Applied) Quick Test

The battery must be fully charged before testing.

1. Disconnect the regulator DC connector.
2. Set the multimeter to Vdc.
3. Start engine.
4. Set the heated grips and throttle lever to the highest intensity and the headlights to high beam.

NOTE: On models equipped with a premium gauge, heated throttle lever and grips are enabled from 2000 RPM.

5. Measure voltage on the battery terminals.

The battery voltage should be more than 10 Vdc.

If battery voltage reading is below 10 Vdc, storage capacity has decreased appreciably and battery should be replaced.

Battery Testing (Load Applied) Using a Load Tester

This is the best test used to determine the battery condition.

Using a load testing device such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260), test the storage capacity of the battery. It has a 500 Amp carbon pile adjustable load.

The battery must be fully charged before testing.

If battery has just been recharged, allow battery to rest for at least one hour.

Follow battery load tester instructions.

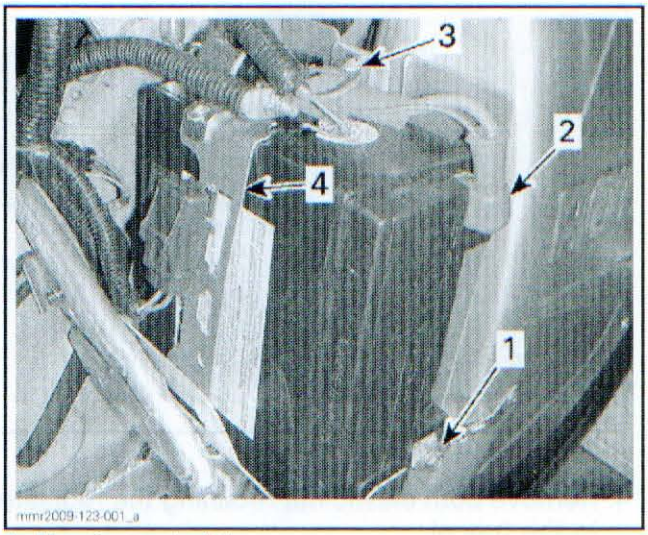
If battery voltage has dropped below 10 Vdc (or voltage indicated on battery temperature compensation chart), battery storage capacity has decreased appreciably and should be replaced.

Battery Removal

⚠ WARNING

The BLACK (–) battery cable must always be disconnected first and reconnected last. Never charge or boost a battery while installed on vehicle.

1. Disconnect BLACK (–) cable terminal from the negative battery post.
2. Remove main fuse.
3. Slide the RED rubber boot off the (+) cable terminal and disconnect it from the battery post.
4. Remove the battery retaining plate nut and bolt.



1. *Negative terminal (-)*
2. *Red rubber boot protector and positive terminal (+)*
3. *Battery retaining plate bolt*
4. *Battery retaining plate*

5. Lift the retaining plate and unhook it from the battery support to remove it.
6. Move retaining plate aside.
7. Remove battery.

NOTICE Should any electrolyte spillage occur, immediately wash off with a solution of baking soda and water to prevent damage to vehicle components.

Battery Cleaning

Clean the battery, battery casing, cables and battery posts using a solution of baking soda and water.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Battery top should be cleaned with a soft brush and any grease-cutting soap or baking soda solution.

Battery Inspection

Visually inspect battery casing for cracks, leaks or other possible damage.

Discoloration, warping or raised top, indicates that the battery has overheated or been overcharged.

If the casing is damaged, replace battery and thoroughly clean battery tray and surrounding area with a water and baking soda solution.

⚠ WARNING

Should the battery casing be damaged, wear a suitable pair of non-absorbent gloves when removing the battery by hand.

Inspect the battery posts for security of mounting.

Battery Storage

NOTICE A discharged battery will freeze and may damage its casing. A damaged casing will allow electrolyte spillage that may damage surrounding parts.

1. Disconnect and remove battery from the vehicle.
2. Clean battery terminals and cable connections using a wire brush. Apply a light coat of DIELECTRIC GREASE (P/N 293 550 004) or petroleum jelly on terminals.
3. Clean battery casing using a solution of baking soda and water. Rinse battery with clear water and dry thoroughly using a clean cloth.

NOTE: The battery must always be stored in fully a charged condition.

4. Charge the battery every month if stored at a temperature **below** 15°C (60°F).
5. Charge the battery every two week if stored at a temperature **above** 15°C (60°F).

New Battery Activation

Refer to the instructions provided with the battery.

Battery Charging

⚠ WARNING

Always wear safety glasses and charge the battery in a ventilated area. Never charge or boost a battery while installed on a vehicle. Do not open the sealed caps during charging. Do not place battery near an open flame.

NOTICE If battery becomes hot to the touch, stop charging and allow it to cool before continuing.

NOTE: Sealed VRLA batteries have an internal safety valve. If battery pressure increases due to overcharging, the valve opens to release excess pressure, preventing battery damage.

Carry out a battery *UNLOADED VOLTMETER TEST* as described in this section, then proceed as described here.

An automatic charger is the fastest and most convenient way for error-proof charging.

When using a constant current charger, charge battery according to the chart below.

Battery Voltage Below 12.8 V and Above 11.5 V

STANDARD CHARGING (RECOMMENDED)		
BATTERY TYPE	TIME	CHARGE
YTX20HL-BS	5 - 10 hours	2 A

QUICK CHARGING		
BATTERY TYPE	TIME	CHARGE
YTX20HL-BS	50 minutes	10 A

Battery Voltage Below 11.5 V

A battery with a voltage below 11.5 V requires a special procedure to recharge. In charging an over discharged battery, its internal resistance may be too high to charge at a normal charging rate.

Set charger to the 10 A charging rate and monitor charging current for approximately 30 minutes. If there is no change in charging current or battery becomes abnormally hot, the battery is most likely at the end of its service life and should be replaced.

Battery Installation

Reinstall battery and secure retaining plate to support properly.

Connect **RED (+) cables FIRST** to positive battery terminal.

Connect **BLACK (–) cable LAST**.

⚠ WARNING

Battery BLACK (–) cable must always be disconnected first and reconnected last.

Cover the RED (+) cable terminal with the protective rubber boot.

Apply DIELECTRIC GREASE (P/N 293 550 004) on battery posts and connectors.

STARTING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	253, 255
FLUKE 115 DIGITAL MULTIMETER	529 035 868	252, 254

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	TP88	254–255

GENERAL

BASIC STARTING SYSTEM OPERATION

When the START/RER button is pressed, a 12 Vdc signal is sent to the ECM, which completes the starter solenoid circuit by providing a ground. The battery then supplies current to the starter through the starter solenoid to crank the engine.

Conditions for Engine Cranking

- Engine stop switch to RUN
- D.E.S.S. cap installed
- Press START/RER button.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *MONITORING SYSTEM AND FAULT CODES*.

NOTE: Some tests require fuses removal which may lead to a fault code occurrence. Clear fault codes if needed.

Starter Does Not Turn

Carry out the following procedure to check if engine can be rotated.

1. Set engine stop switch to STOP.
2. Make sure D.E.S.S. key is **not installed**.
3. Manually rotate the engine using the drive pulley.

⚠ WARNING

When manually rotating engine, the engine stop switch MUST BE set to STOP and D.E.S.S. cap MUST NOT be installed or severe injury may occur.

If the engine can be rotated, test starting system as per *STARTING SYSTEM TESTING SEQUENCE*.

If the engine cannot be rotated, check engine.

Starter Turns Slowly

Check the following:

- Battery and connections condition, refer to *CHARGING SYSTEM*.
- Starter solenoid contacts. Refer to *SOLENOID VOLTAGE DROP TEST*.

Starter or RER Engage Accidentally

Carry out the *START/RER SWITCH GROUND TEST*.

STARTING SYSTEM TESTING SEQUENCE

Test starting system in the following order:

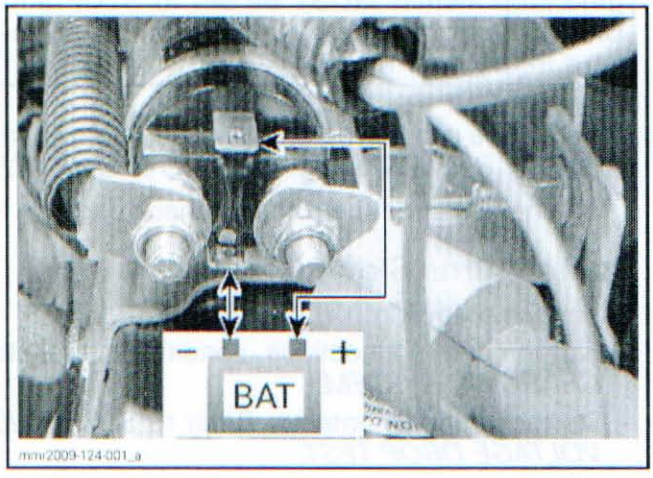
- Fuse 9 (in fuse box). If fuse 9 is blown, gauge will not turn on.
- Fuse 2 (in fuse box).
- Main fuse (on battery retaining plate). A blown main fuse cuts the current flow to the entire electrical system.
- Battery and connections condition, refer to *CHARGING SYSTEM*.
- Starter. Refer to *MAGNETO AND STARTER*.
- Starter solenoid. Refer to *SOLENOID QUICK TEST*.
- Start switch. Refer to *START/RER SWITCH TEST USING B.U.D.S.*

PROCEDURES

STARTER SOLENOID

Solenoid Quick Test

1. Remove D.E.S.S. cap from D.E.S.S. post.
2. Disconnect the small positive connector (VIOLET/GREY wire) from starter solenoid.
3. Install a jumper wire (with insulated clips) between the positive solenoid terminal and the positive battery terminal.
4. Disconnect the small negative connector (ORANGE/BLACK wire) from starter solenoid.
5. Install a jumper wire on the battery negative terminal and momentarily touch the negative solenoid terminal.



NOTICE **The two small solenoid coil terminals are close to each other. When installing the jumper wires, ensure the ends of the jumper wires are insulated and cannot come into contact with each other or a short circuit will occur.**

If the starter engages, test solenoid input voltage. Refer to *INPUT VOLTAGE TEST (STARTER SOLENOID)*.

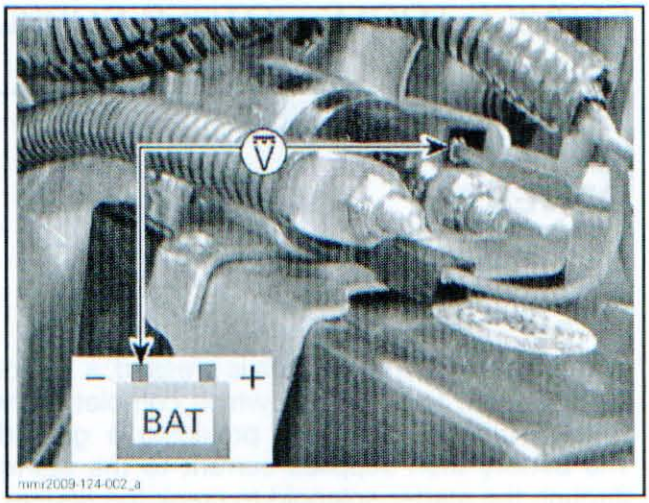
If the starter did not engage, refer to *STARTER SOLENOID STATIC TESTS*, or try a known good solenoid.

Input Voltage Test (Starter Solenoid)

1. Install D.E.S.S. cap on D.E.S.S. post.
2. Set engine stop switch to RUN.
3. Set FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
4. Quickly press on START/RER button to wake up the ECM.
5. Back probe the solenoid input terminal (VIOLET/GREY wire) and measure voltage as per following table.

TEST PROBES		VOLTAGE
VI/GY wire	Battery ground	Battery voltage

NOTE: Test is valid only if the ECM is powered (gauge will turn on).



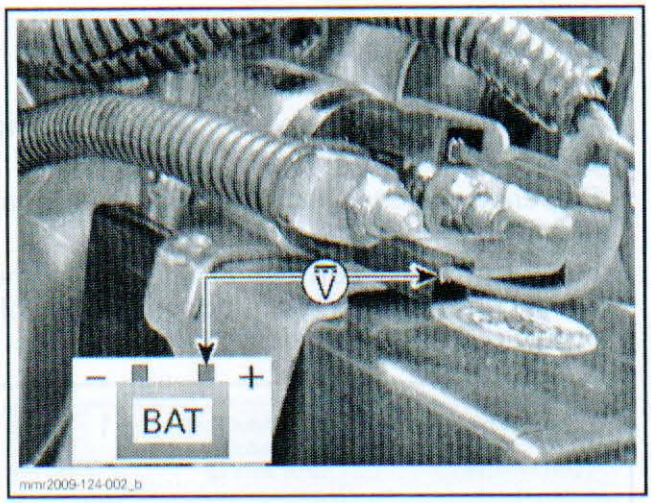
If voltage is not as specified, repair open circuit. Refer to *WIRING DIAGRAM* for details.

If the solenoid input voltage is as specified, refer to *SOLENOID GROUND SIGNAL TEST*.

Solenoid Ground Signal Test (Starter Solenoid)

1. Carry out steps 1 to 4 of *INPUT VOLTAGE TEST (STARTER SOLENOID)*.
2. Back probe solenoid negative terminal (ORANGE/BLACK wire) and measure voltage as per following table.
3. Press and hold START/RER button and measure voltage as per following table to confirm ground signal.

TEST PROBES		VOLTAGE
OR/BK	Battery positive terminal	Battery voltage



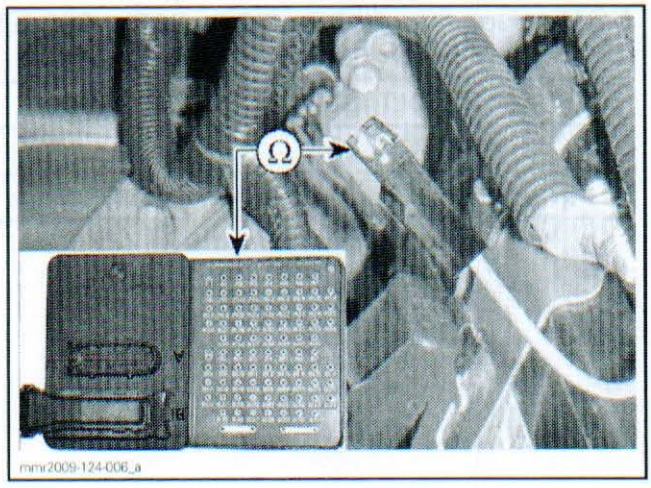
mmr2009-124-002_b

If voltage is not as specified, carry out *GROUND SIGNAL WIRE CONTINUITY TEST.*

Ground Wire Continuity Test (Starter Solenoid)

1. Disconnect battery negative terminal.
2. Disconnect ECM connector B, refer to *ELECTRONIC FUEL INJECTION.*
3. Connect ECM connector B to the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010).
4. Disconnect ground signal wire (ORANGE/BLACK) from starter solenoid.
5. Set mutimeter to Ω.
6. Measure wire continuity as follows:

TEST PROBES		RESISTANCE
Ground wire (OR/BK)	ECM connector B pin 31	Close to 0 Ω



mmr2009-124-006_a

If resistance is not as specified, repair open circuit. Refer to *WIRING DIAGRAM* for wiring and connector details.

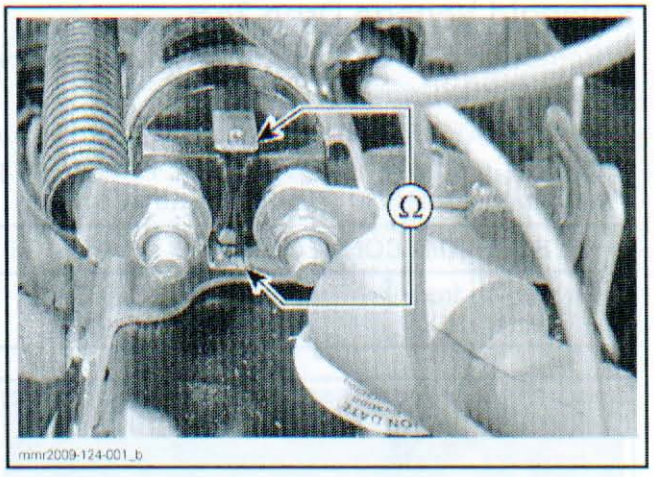
If resistance is as specified, test ECM grounds, refer to *ECM* in *ELECTRONIC FUEL INJECTION* subsection.

Solenoid Static Tests

Solenoid Winding Resistance Verification

1. Disconnect the small terminals from the starter solenoid.
2. With a multimeter set to Ω, test coil winding resistance as follows.

TEST PROBES		MEASUREMENT
SOLENOID COIL TERMINALS		RESISTANCE @ 20°C (68°F)
A	B	Approximately 7.5 Ω



mmr2009-124-001_b

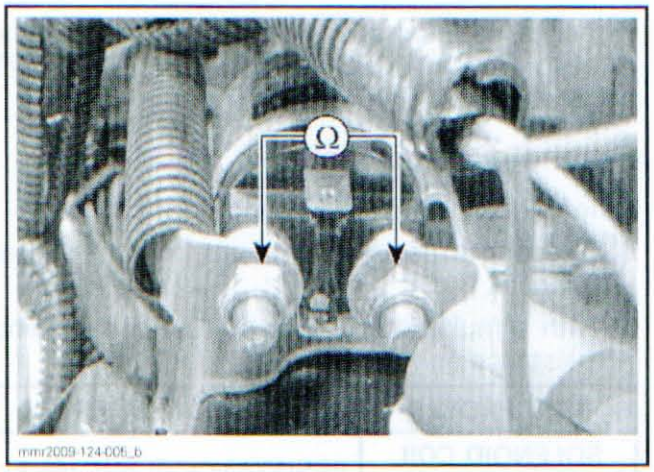
If resistance is not as specified, replace solenoid.

If resistance is as specified, refer to *SOLENOID VOLTAGE DROP TEST.*

Solenoid Plunger Verification

1. Disconnect battery ground cable.
2. Check for a stuck solenoid plunger by measuring the resistance through the solenoid main contacts as follows.

SOLENOID CONNECTOR		MEASUREMENT
Battery post	Starter post	Open circuit

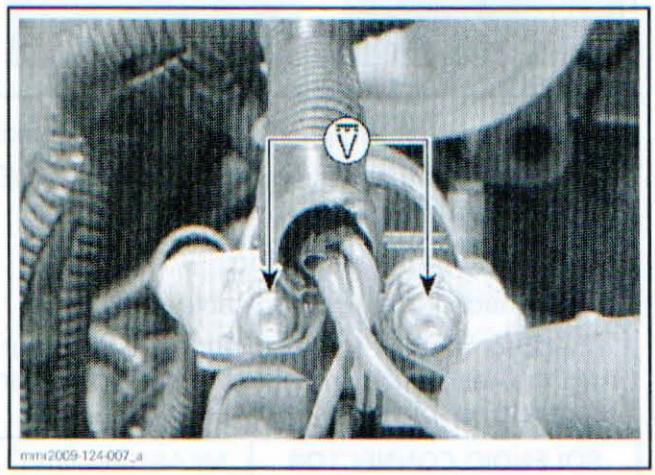


If a reading other than an open circuit is measured, replace solenoid.

Solenoid Voltage Drop Test

1. Remove fuses 3, 4 and 5 to prevent engine from starting.
2. Press START/RER button and hold. While engine is cranking, measure the voltage drop across the solenoid main contacts as follows.

SOLENOID CONNECTOR		VOLTAGE
Post coming from battery	Post going to starter	0.2 Vdc max.



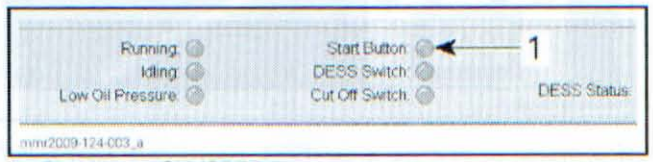
If voltage is out of specification, replace solenoid.

If solenoid tests good, test starter. Refer to *MAGNETO AND STARTER*.

START/RER SWITCH

START/RER Switch Test Using B.U.D.S.

1. Connect the vehicle to the latest B.U.D.S. software available from BOSSWeb. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* for proper connection instructions.
2. In B.U.D.S., select the **Read Data** button.
3. Select the **Monitoring** tab.
4. At the bottom LH corner of the **Monitoring** page, select the **ECM** tab.
5. Set engine stop switch to RUN and install D.E.S.S. cap on D.E.S.S. post.
6. Press the START/RER button and look for the **START Button** LED in the bottom section. It should come ON (turn GREEN).



1. Should turn ON (GREEN)

If the START Button LED turns green, the ECM receives the START/RER positive signal. This confirms that:

- The voltage input reaches the START/RER switch.
- The START switch is good.
- The signal wiring is good.

Refer to *STARTING SYSTEM TESTING SEQUENCE* and test other components.

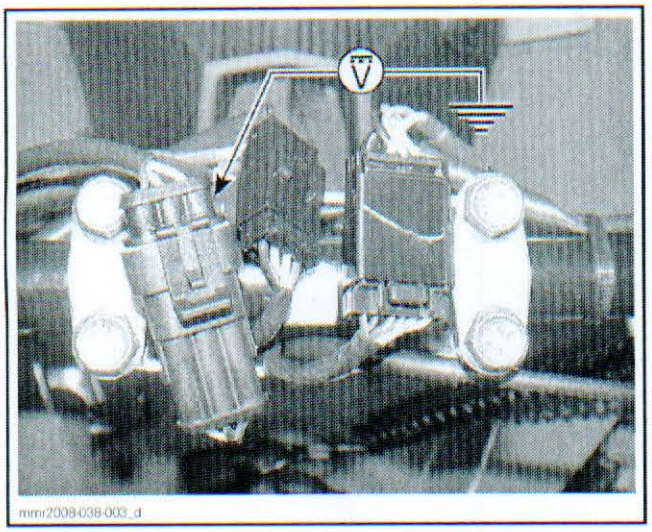
If the START/RER LED does **not** turn green refer to *START/RER INPUT VOLTAGE TEST*.

START/RER Switch Input Voltage Test

1. Remove steering cover from top of handlebars.
2. Set FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc
3. Back probe switch input wire at SB connector and measure voltage as per following table.

NOTE: Use the FLUKE RIGID BACK PROBES (P/N TP88) or equivalent to back probe wire.

INPUT VOLTAGE (SB CONNECTOR)		
TEST PROBES		VOLTAGE
Pin 3 (WH)	Battery ground	Battery voltage



mmr2008-038-003_d

If voltage is as specified, refer to *START/RER SWITCH OUTPUT TEST.*

If voltage is not as specified, repair open circuit. Refer to *WIRING DIAGRAM* for wiring and connectors details.

START/RER Switch Output Voltage Test

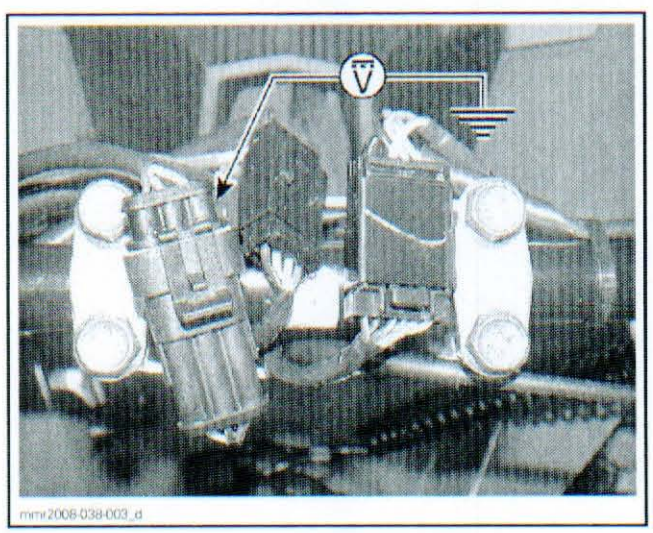
Make sure Input voltage reaches START/RER switch.

1. Set multimeter to Vdc
2. Back probe switch output (signal) wire at SB connector.

NOTE: Use the FLUKE RIGID BACK PROBES (P/N TP88) or equivalent to back probe wire.

3. Press and hold START/RER button while measuring voltage as per following table.

SWITCH OUTPUT VOLTAGE (SB CONNECTOR)		
TEST PROBES		VOLTAGE
Pin 1 (BK)	Battery ground	Battery voltage



mmr2008-038-003_d

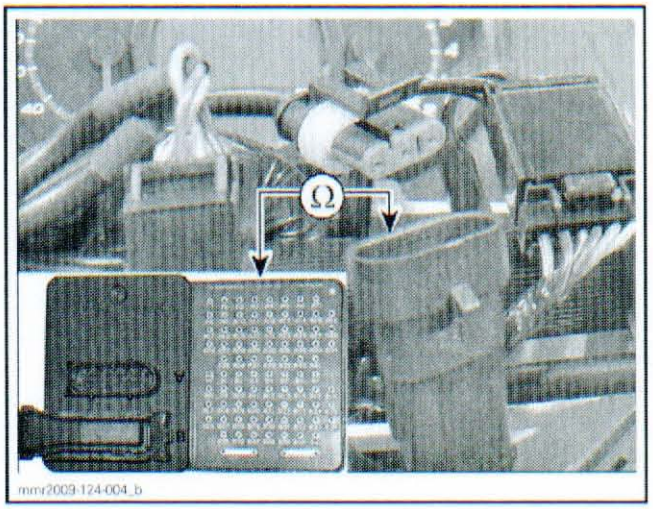
If voltage is as specified, refer to *START/RER SIGNAL WIRE CONTINUITY TEST.*

If voltage is not as specified, replace switch.

START/RER Signal Wire Continuity Test

1. Disconnect battery negative terminal.
2. Disconnect ECM connector B, refer to *ELECTRONIC FUEL INJECTION* section.
3. Install ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector B.
4. Disconnect SB connector.
5. Set multimeter to Ω and measure resistance as per following table.

TEST PROBES		RESISTANCE
SB connector Pin 1 (BE)	ECM connector B Pin 19	Close to 0 Ω



mmr2009-124-004_b

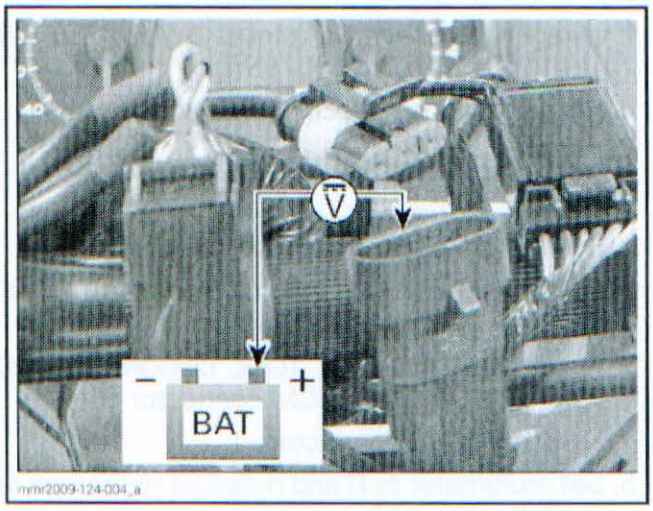
If resistance is as specified and switch input and output are good, try another ECM.

If resistance is not as specified, repair open circuit. Refer to *WIRING DIAGRAM* for wiring and connector details.

START/RER Switch Ground Test

1. Set multimeter to Vdc.
2. Disconnect SB connector.
3. Measure voltage as per following table.

TEST PROBES		VOLTAGE
SB connector Pin 2 (BK/BU)	Battery positive terminal	Battery voltage



If voltage is not as specified, repair open circuit. Refer to *WIRING DIAGRAM* for wiring and connector details.

DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	261
FLUKE 115 DIGITAL MULTIMETER	529 035 868	260

GENERAL

SYSTEM DESCRIPTION

The following components are specially designed for this system: ECM, D.E.S.S. key and D.E.S.S. post.

This system allows the engine to reach pulley engagement speed only if a D.E.S.S. key is installed on D.E.S.S. post and the key is recognized as valid by the ECM.

The D.E.S.S. key contains a magnet and a ROM chip.

- The magnet closes the reed switch inside the D.E.S.S. post. It is the equivalent of a rotary mechanical ignition switch.
- The ROM chip owns a unique digital code. It is the equivalent of the tooth-pattern cut on a conventional ignition key.

The D.E.S.S. system is quite flexible. Up to 8 D.E.S.S. keys may be programmed in the memory of the ECM using the B.U.D.S. software. The keys can also be erased individually.

NOTE: If desired, a D.E.S.S. key can be used on another vehicle equipped with the D.E.S.S. It only needs to be programmed for that vehicle.

D.E.S.S. Beeper Codes

When starting the engine with a D.E.S.S. key on the post, the key is identified by the ECM and D.E.S.S. signals will be issued according to the key recognition. See table.

D.E.S.S. SIGNAL		DESCRIPTION	COMMENT
BEEPER	DISPLAYED MESSAGE (1)		
2 shorts beeps	SKI-DOO	Welcome message, good key	Working D.E.S.S. key. Vehicle can be driven. It allows engine to rev above 3000 RPM.
Slow short repetitive beeps	CHECK KEY	Unable to read key (bad connection)	Vehicle cannot be driven. Make sure the key contacts are free of dirt, snow or ice. Reinstall key and restart engine. Vehicle can not be driven.
Fast short repetitive beeps	BAD KEY	Invalid key or key not programmed	Use the proper key for this vehicle or have the key programmed. Vehicle can not be driven.
(1) Only available on premium gauge			

PROCEDURES

D.E.S.S. KEY

D.E.S.S. Key Programming

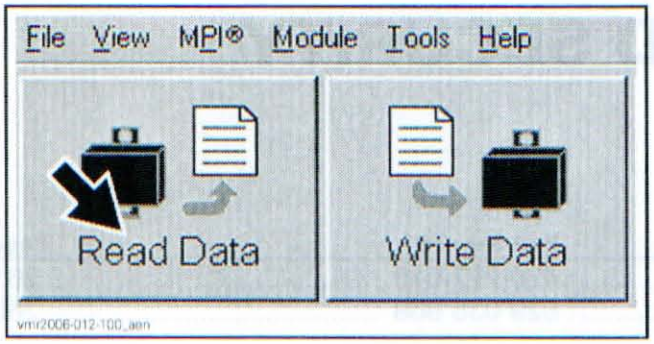
Use the latest B.U.D.S. software available from BOSSWeb.

Carry out the proper connections to use B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE.*

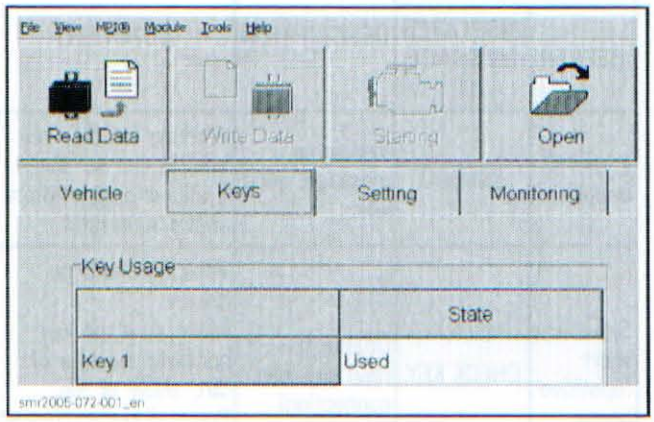
IMPORTANT: Ensure all connections have been made **before starting B.U.D.S.** to allow proper operation.

Start B.U.D.S. and logon.

To read the ECM, click the **Read Data** button.

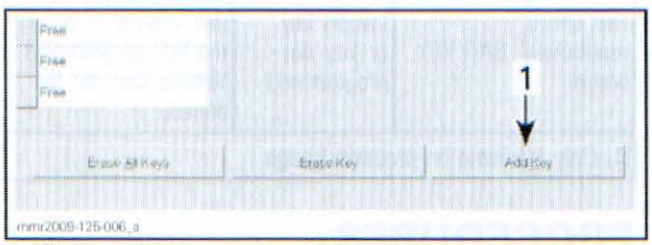


Click on **Keys** tab.



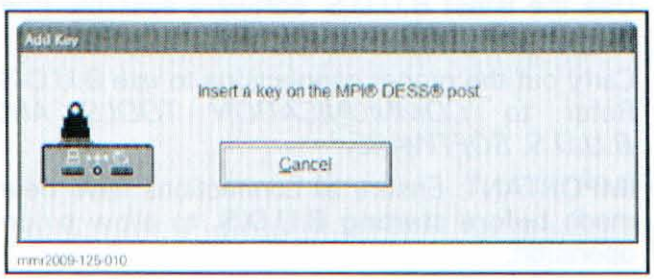
Adding a Key

1. Click on **Add Key** button at bottom of screen.



1. Click on this button

2. When the following window pops up, install the new key to be programmed on the D.E.S.S. post interface.



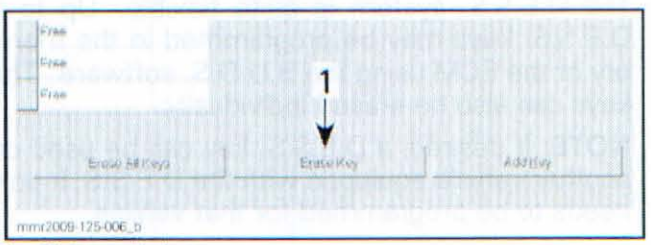
1. Key to be added
2. D.E.S.S. post interface

3. A new key is now saved in the PC computer.
4. Remove key from D.E.S.S. post interface.
5. If this is the 1st key programmed in ECM, install it on vehicle D.E.S.S. post.
6. To program any other key, click again on **Add Key** button and repeat the procedure.
7. Write the changes to the ECM. Refer to *WRITING CHANGES IN ECM* in this subsection.
8. Ensure the newly programmed key(s) work on the vehicle.

Erasing a Key

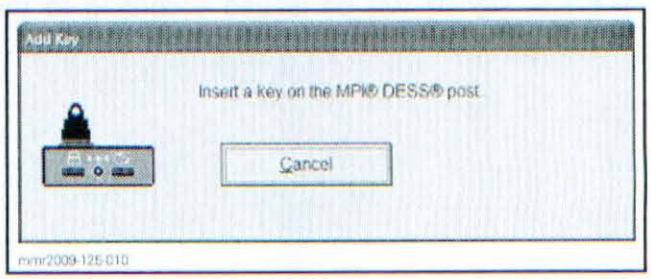
To erase one key, proceed as follows:

1. Click on **Erase Key** button at bottom of screen.



1. Click on this button

2. When the following window pops up, install the key to be erased on the D.E.S.S. post interface.

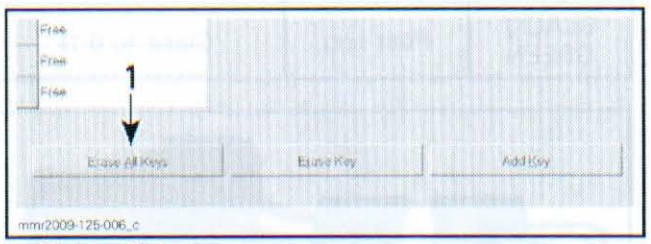


1. Key to be erased
2. D.E.S.S. post interface

3. The key is now erased in the PC computer.
4. Repeat procedure to erase other key(s).
5. Write the changes to the ECM. Refer to *WRITING CHANGES IN ECM* in this subsection.
6. Ensure the erased key(s) do not work anymore on the vehicle.

Erasing all Keys

1. Click on **Erase All Keys** button at bottom of screen.

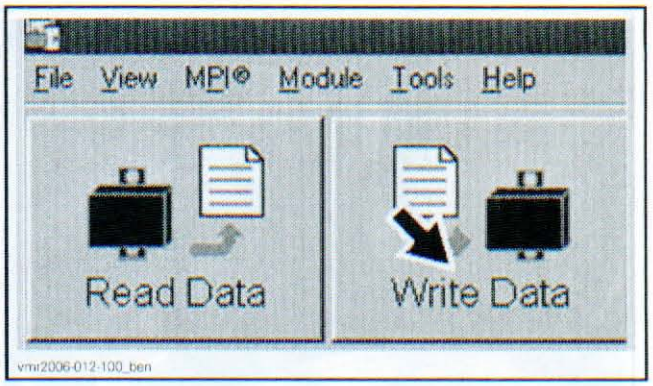


1. Click on this button

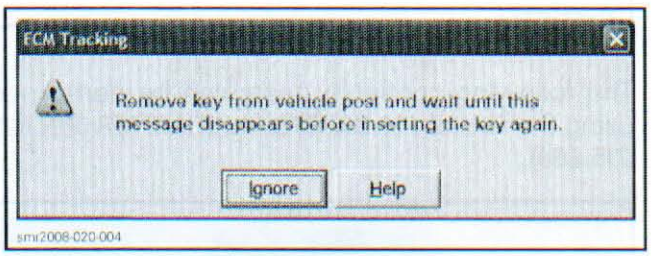
2. When done, add at least a new key to the vehicle. Refer to *ADDING A KEY* in this subsection.
3. Write the changes to the ECM. Refer to *WRITING CHANGES IN ECM* in this subsection.
4. Ensure the erased keys do not work anymore on the vehicle (if possible) and ensure the newly added key(s) work.

Writing Changes in ECM

Save the changes in the ECM by clicking the **Write Data** button.



There will be an ECM Tracking box that will say "Remove key from the vehicle...".



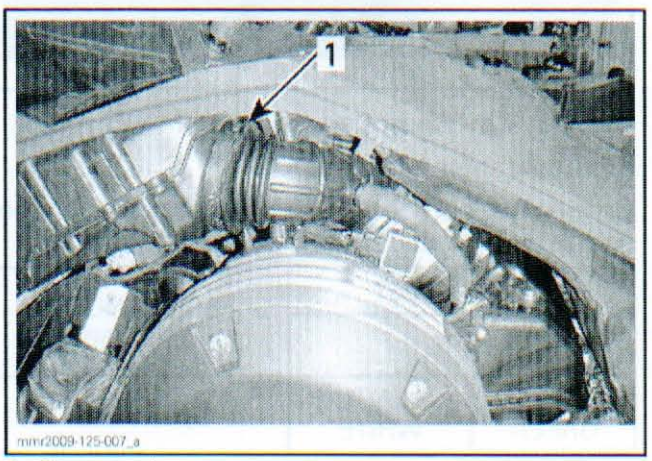
When this occurs, remove D.E.S.S. key and wait until the message disappears (it lasts approximately 20 seconds after key removal).

D.E.S.S. POST

D.E.S.S. Post Continuity Test

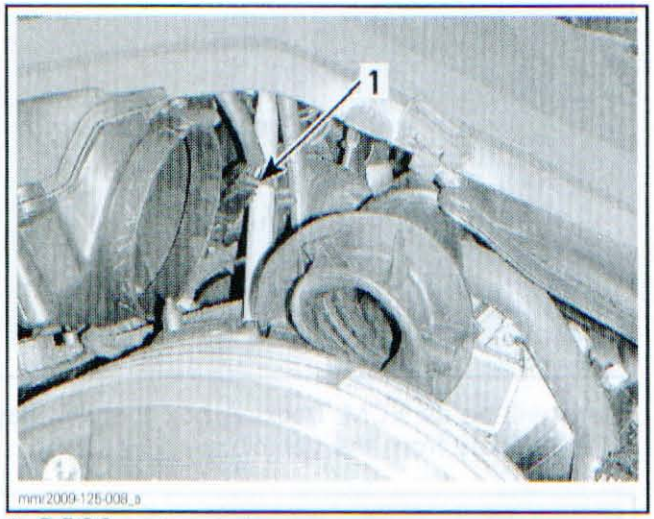
Remove LH side panel. Refer to *BODY*.

Disconnect intake adaptor from air intake silencer.



1. Disconnect here

Disconnect D.E.S.S. post connector.



1. D.E.S.S. post connector

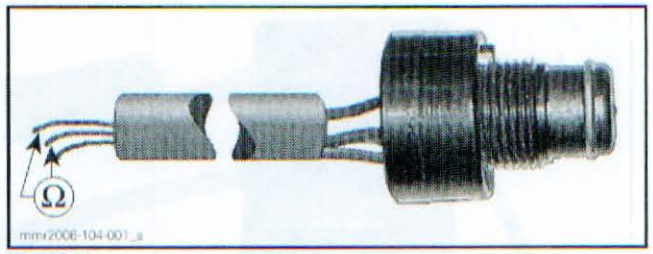
The following continuity tests can be performed using the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868).

D.E.S.S. Key Removed from Post

Set multimeter to Ω.

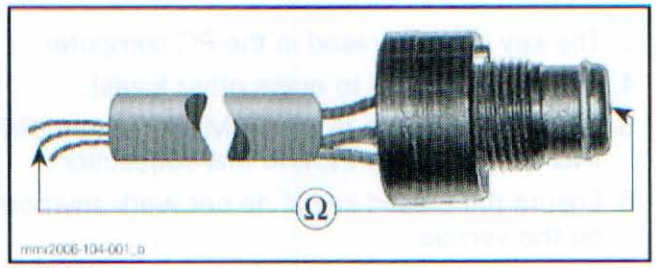
Connect test probes to D.E.S.S. post and its connector as per tables and measure resistance.

D.E.S.S. POST		RESISTANCE Ω @ 20°C (68°F)
WIRE		
BLACK/ GREEN	BLACK/ WHITE	Open circuit



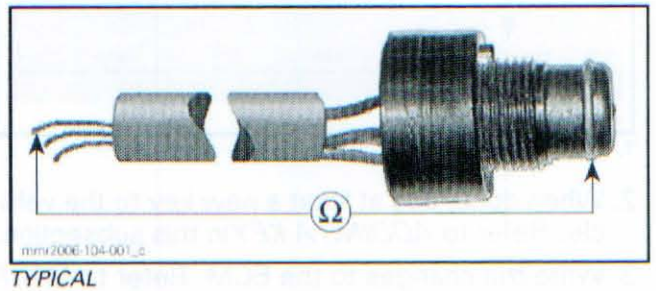
TYPICAL

D.E.S.S. POST		RESISTANCE Ω @ 20°C (68°F)
WIRE		
WHITE/ GRAY	Post terminal	Close to 0 Ω



TYPICAL

D.E.S.S. POST		RESISTANCE Ω @ 20°C (68°F)
WIRE		
BLACK/ GREEN	Post ring	Close to 0 Ω

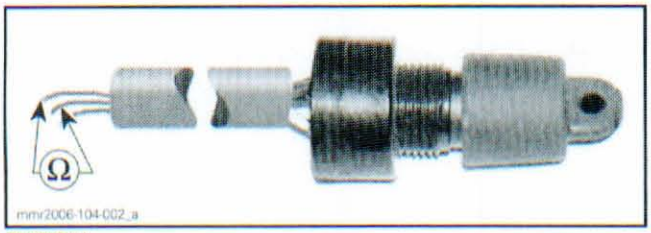


TYPICAL

D.E.S.S. Key on Post

Connect test probes to D.E.S.S. post connector as per table and measure resistance.

D.E.S.S. POST		RESISTANCE Ω @ 20°C (68°F)
WIRE		
BLACK/ GREEN	BLACK/ WHITE	Close to 0 Ω



TYPICAL

If any resistance test fails, replace D.E.S.S. post.

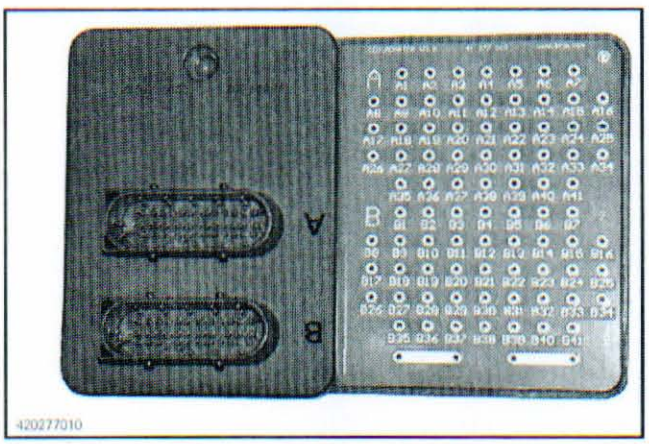
D.E.S.S. Post Vehicle Harness Continuity Test

Remove both side panels. Refer to *BODY*.

Disconnect D.E.S.S. post connector. Refer to *D.E.S.S. POST CONTINUITY TEST* in this subsection.

Disconnect the B connector from ECM. Refer to *ELECTRONIC FUEL INJECTION* subsection.

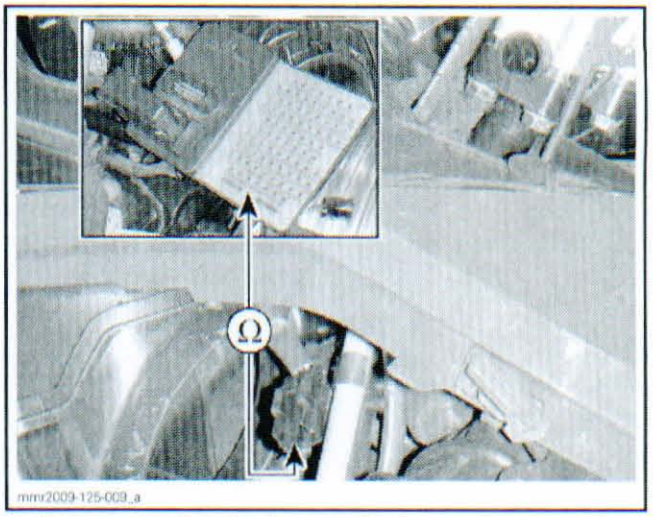
Install the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010) on ECM connector.



Set multimeter to Ω.

Check wire continuity between D.E.S.S. post connector of main wiring harness and ECM as follows.

D.E.S.S. POST CONNECTOR (MAIN WIRING HARNESS SIDE)	ECM ADAPTER	RESISTANCE Ω @ 20°C (68°F)
WIRE	PIN	
WHITE/GRAY	38	Close to 0 Ω
BLACK/WHITE	26	
BLACK/GREEN	39	



- If any continuity test failed, repair or replace wiring connectors/terminals.
- If problem persists and all tests have been performed, try a new ECM. Refer to *ECM REPLACEMENT*.

Reinstall removed parts.

BEEPER

The beeper is integrated in the multifunction gauge and cannot be replaced alone.

If the beeper does not sound when starting engine, check the beeper operation. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.

LIGHTS, GAUGE AND ACCESSORIES

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	266
FLUKE 115 DIGITAL MULTIMETER	529 035 868	265, 268, 271, 274, 277–278, 280, 282, 287, 290–292, 294
T-HARNESS	529 035 869	263, 265, 274, 278

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
MULTILOCK - TERMINAL EXTRACTION TOOL	755430-2	283, 289, 292–293

GENERAL

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

NOTICE The main fuse should always be removed before carrying out any maintenance on the vehicle to prevent any unexpected electrical activation. Removal of this fuse isolates the battery from the vehicle electrical system, except for the starter relay input terminal.

⚠ 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.

TROUBLESHOOTING

LIGHTING AND ACCESSORIES SYSTEM TESTING

The gauge is powered from relay 1 (R1). The ECM grounds relay 1 winding when start button is depressed.

Accessories and lighting are powered from relay 2 (R2). The ECM grounds relay 2 winding as soon as engine reaches 500 RPM.

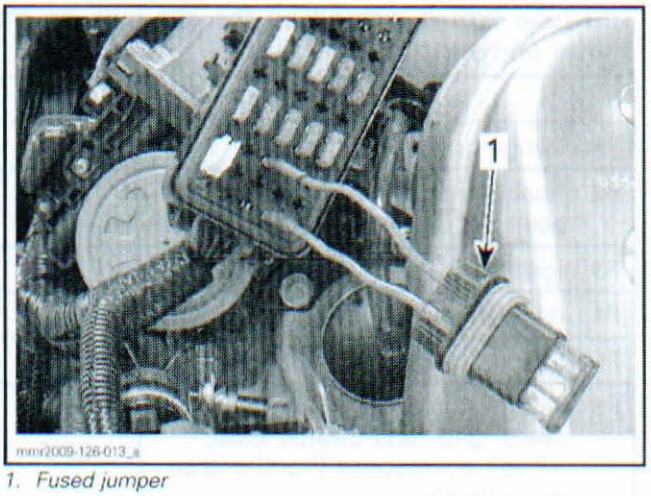
The rear accessories are powered from relay 2 through the jumper installed in the fuse box.

If more than one accessory stopped working, check applicable fuse. Refer to *FUSES* in this subsection.

Refer to *WIRING DIAGRAM* for circuit details.

To energize relay 1 (R1) for testing, install the T-HARNESS (P/N 529 035 869) on the diagnostic connector. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection for proper connection.

To test the accessories supplied by relay 2 (R2), replace relay by a suitable fused jumper between fuse box pin 1B and 3C as shown.



1. Fused jumper

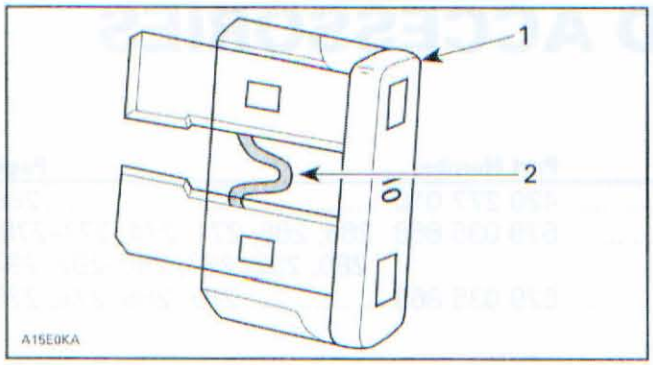
NOTE: On models equipped with a premium gauge, heated handlebar grips and throttle lever are supplied only if the engine is running at least 2000 RPM.

PROCEDURES

FUSES

Fuse Inspection

Check if filament is melted. Replace as necessary.



1. Fuse
2. Check if melted

NOTE: In some cases, a damaged filament can be hard to detect visually. In doubt, install fuse and measure voltage on both sides of the fuse by probing the exposed metal parts or try a known good one.

NOTICE If fuse has burnt out, the cause of the malfunction should be determined and corrected before restarting. Do not use a higher rated fuse as this can cause severe damage to electric components and/or a fire.

Fuse Location

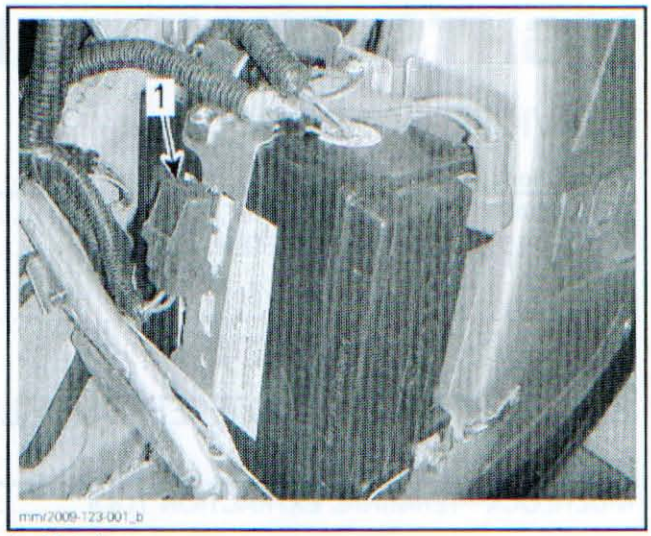
Fuse Box

The fuse box is located on the RH side on the shifter unit support.

FUSES	
F1: Gauge power input	15 A
F2: Fuel pump, CAPS and starter solenoid	10 A
F3: Ignition coil and injector 3	5 A
F4: Ignition coil and injector 2	5 A
F5: Ignition coil and injector 1	5 A
F6: Taillight, stop light, heated seats, grips and throttle lever, 12 volt accessories (front) and air suspension	20 A
F7: Headlights	15 A
F8: Electronic reverse actuator	20 A
F9: Relays 1 and 2	5 A
F10: Rear accessories	10 A
F11: Cooling fan (option)	15 A

Main Fuse

The 30 A main fuse is installed on the battery retaining plate.



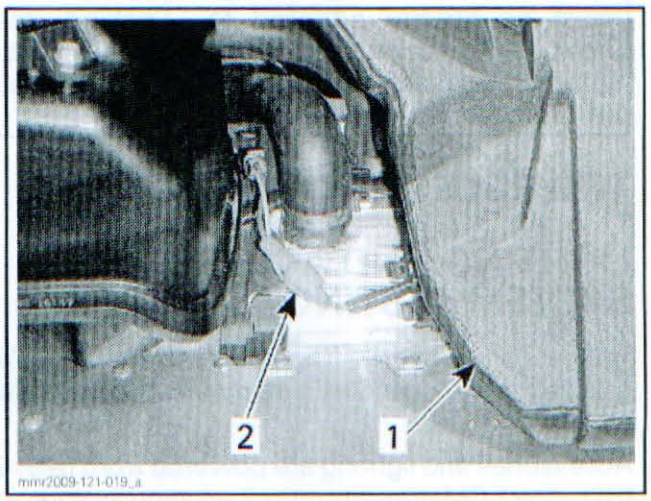
1. Main fuse

Fuel Level Sensor Fuse

The fuel level sensor circuit is protected by an in line fuse located near the sensor. It is an integral part of the wiring that comes with the sensor assembly.

NOTE: If you have a faulty fuel level indication, or a low fuel level warning light continuously ON even on a full fuel tank, test the fuse for continuity and ensure the fuse and its holder make good contact. Also check to ensure the fuse connector is properly connected.

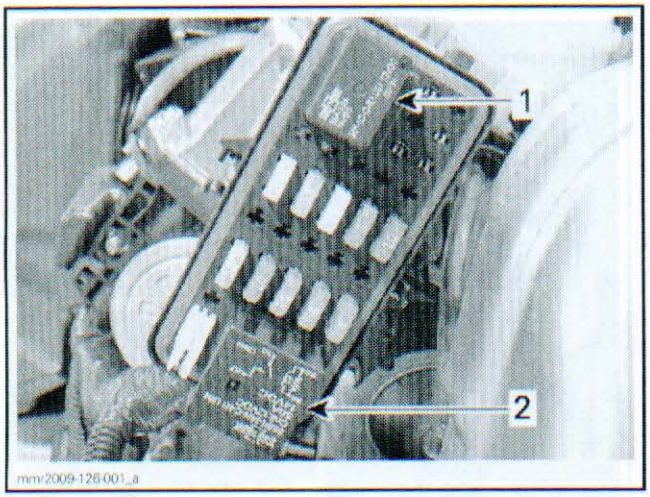
The fuel tank has to be moved back to access the fuse. Refer to *FUEL TANK AND FUEL PUMP* for details.



1. Fuel tank
2. In-line fuse

RELAYS

Both relays are in the fuse box.



1. Relay 1 (R1)
2. Relay 2 (R2)

Relay 1 Description

Relay 1 receives power on for its winding (pin 85) from fuse F9.

Power input for the contacts (pin 30) comes from the main fuse or charging system.

The ECM pin 17 grounds R1 winding (pin 86) when start button is depressed.

Once closed, it supplies power to:

- Starter solenoid
- Engine management components
- Gauge
- Electronic Reverse module.

Relay 2 Description

Relay 2 receives power on for its winding (pin 85) from fuse F9.

Power input for the contacts (pin 30) comes from the main fuse or charging system.

The ECM pin 16 grounds R2 winding (pin 86) when engine reaches 500 RPM.

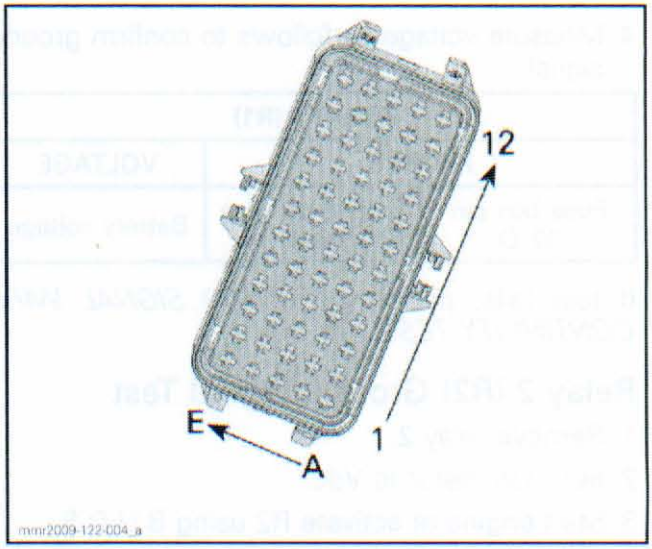
Once closed, it supplies power to the following accessories:

- Lights
- 12 volts outlet
- Heated seats
- Visor and boots outlets
- Air suspension
- Heated grips and throttle lever.

Relay Input Voltage Test

Remove relay from fuse box.

Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc and measure voltage between fuse box terminals and ground.



RELAY 1 (R1)		
PROBES		VOLTAGE
Winding input: Fuse box pin 10 E	Battery Ground	Battery voltage
Contact input: Fuse box pin 10 D	Battery Ground	

RELAY 2 (R2)		
PROBES		VOLTAGE
Winding input: Fuse box pin 1 C	Battery Ground	Battery voltage
Contact input: Fuse box pin 1 B	Battery Ground	

If input voltages are good, check the following:

- Relay, refer to *RELAY CONTINUITY TEST* in this subsection.
- ECM ground signal. Refer to *RELAY 1 (R1) GROUND SIGNAL TEST* or *RELAY 2 (R2) GROUND SIGNAL TEST.*
- ECM ground signal wire, refer to *GROUND WIRE CONTINUITY TEST (R1 AND R2)* in this subsection.
- Accessory supply wire for an open circuit. Refer to *WIRING DIAGRAM.*

If input voltages are not good, refer to *WIRING DIAGRAM* and check for an open circuit on the applicable relay winding supply wire.

Relay 1 (R1) Ground Signal Test

1. Remove relay 1.
2. Set multimeter to Vdc.
3. Quickly press on Start button to wake up ECM or install T-HARNESS (P/N 529 035 869) on diagnostic connector.

4. Measure voltage as follows to confirm ground signal:

RELAY1 (R1)		
PROBES		VOLTAGE
Fuse box pin 12 D	Battery positive terminal (+)	Battery voltage

If test fails, perform *GROUND SIGNAL WIRE CONTINUITY TEST.*

Relay 2 (R2) Ground Signal Test

1. Remove relay 2.
2. Set multimeter to Vdc.
3. Start engine or activate R2 using B.U.D.S.
4. Measure voltage as follows to confirm ground signal:

RELAY 2 (R2)		
PROBES		VOLTAGE
Fuse box pin 3 B	Battery positive terminal (+)	Battery voltage

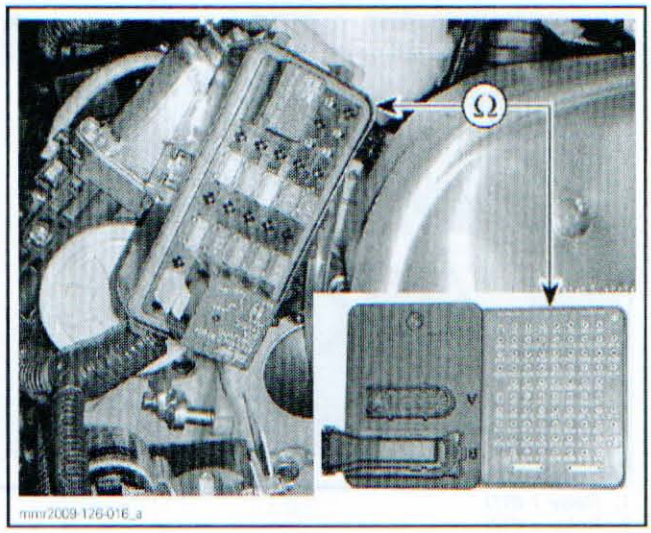
If test fails, perform *GROUND SIGNAL WIRE CONTINUITY TEST.*

Ground Wire Continuity Test (R1 and R2)

1. Disconnect ECM connector B and install it on the ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010). Refer to *ELECTRONIC FUEL INJECTION* section.
2. Remove applicable relay.
3. Set the multimeter to Ω.
4. Measure resistance as per the following table.

RELAY 1 (R1)		
PROBES		RESISTANCE
Fuse box pin 12 D	ECM pin B 17	Close to 0 Ω

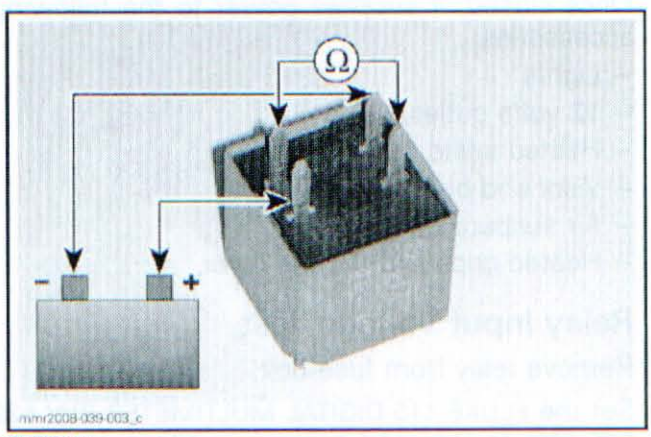
RELAY 2 (R2)		
PROBES		RESISTANCE
Fuse box pin 3 B	ECM pin B 16	Close to 0 Ω



Relay Continuity Test

1. Remove relay to be tested from fuse box.
2. Set multimeter to the beeper position.

3. Apply 12 volts on terminals 85 and 86 then place the RED probe on terminal 30 and the BLACK on the terminal 87.



TYPICAL

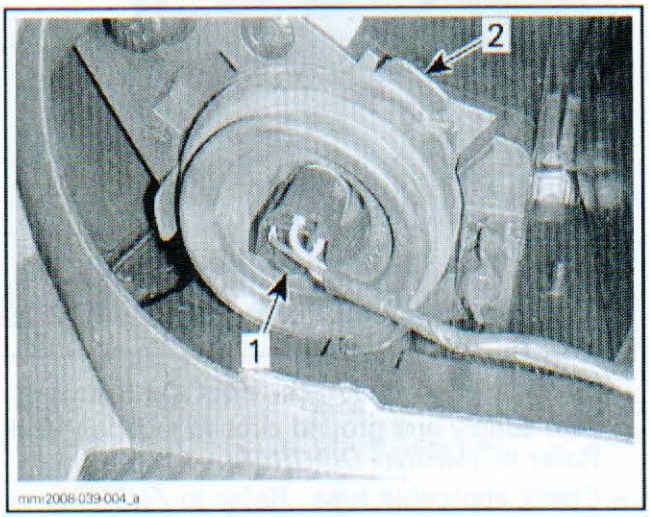
The audible signal should be continuous. If not, replace the relay.

HEADLIGHTS

Headlight Bulb Removal

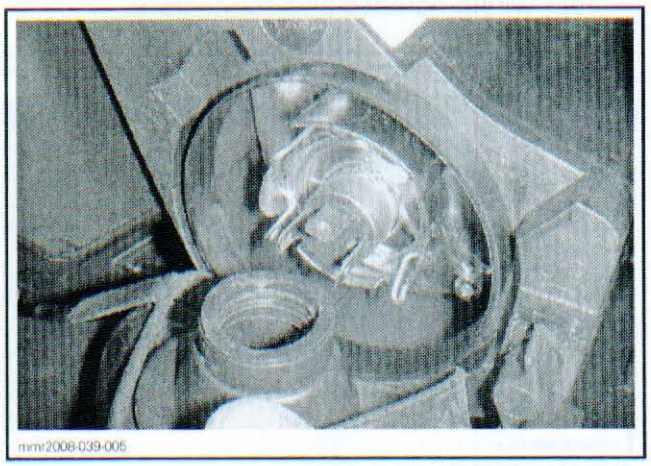
If a headlight bulb is burnt, proceed as follows.

1. Remove multifunction gauge, see procedure in this section.
2. Remove bulb connector.
3. Remove top and center portion of rubber boot from headlight assembly.

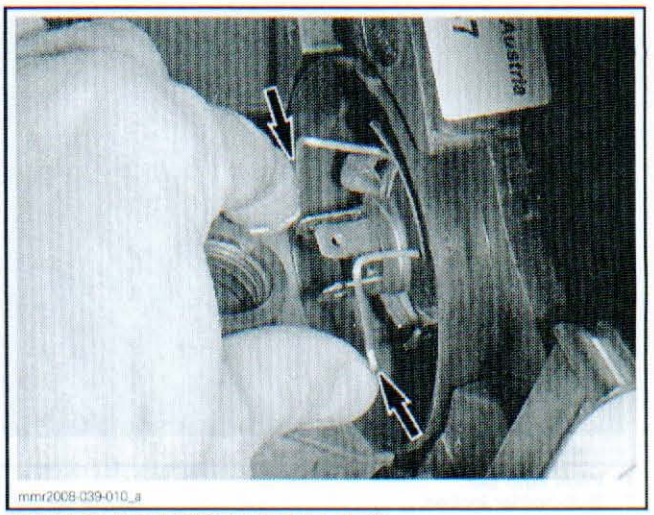


1. Remove headlight connector
2. Remove rubber boot

NOTE: It is not necessary to fully remove rubber boot.

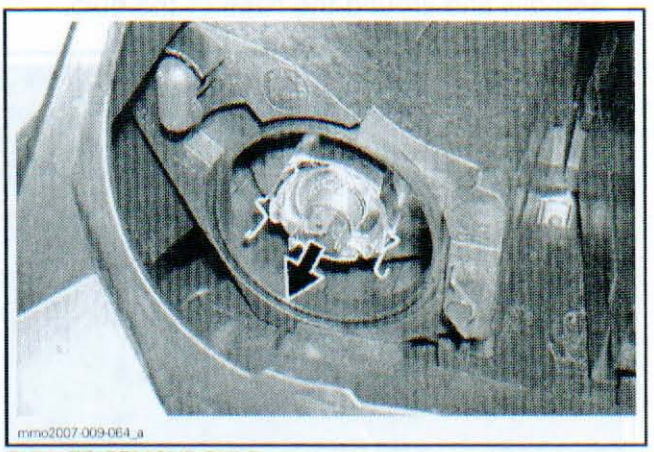


4. Press both sides of the bulb holder (spring clip) inwards at the same time, and pull it out to release it from the bulb support.



SQUEEZE INWARDS AND PULL OUT

5. Pull bulb from headlight assembly.



PULL TO REMOVE BULB

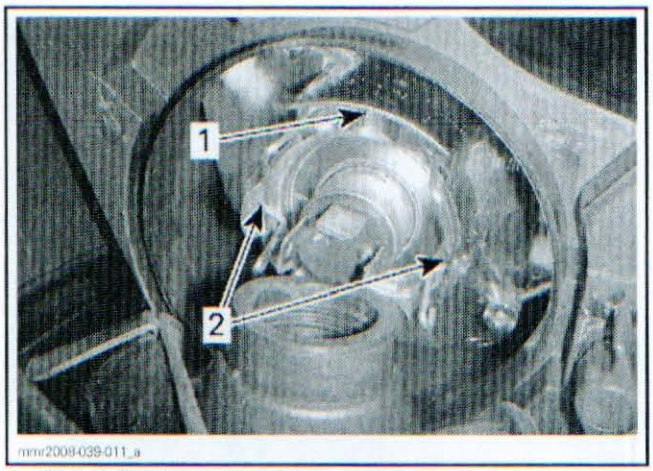
Headlight Bulb Installation

NOTICE **Never touch glass portion of a halogen bulb with bare fingers, it shortens its operating life. If glass is touched, clean it with isopropyl alcohol which will not leave a film on the bulb.**

1. Insert bulb in light assembly.

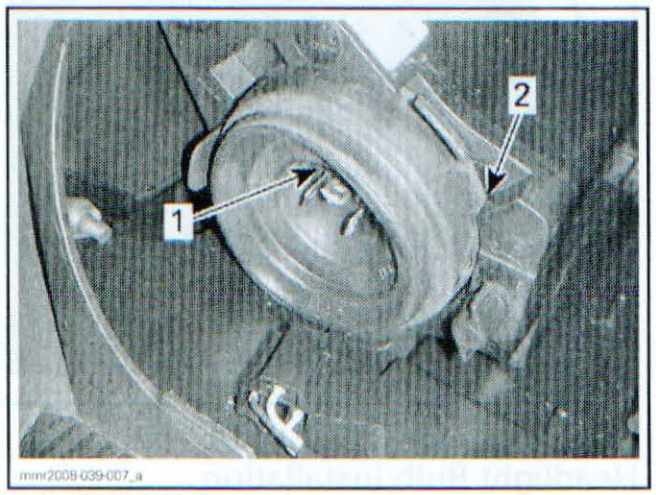
NOTE: Widest alignment tab on bulb should be at top of assembly.

2. Insert top of bulb holder (spring clip) as you squeeze the two sides inwards. Release bulb holder so that it locks in the grooves on either side of headlight assembly.



1. *Wide bulb tab*
2. *Bulb holder locked*

3. Install rubber boot. Ensure cover is properly inserted in groove provided in the headlight assembly, and around the base of the bulb.



1. *Insert around bulb*
2. *Insert in groove provided*

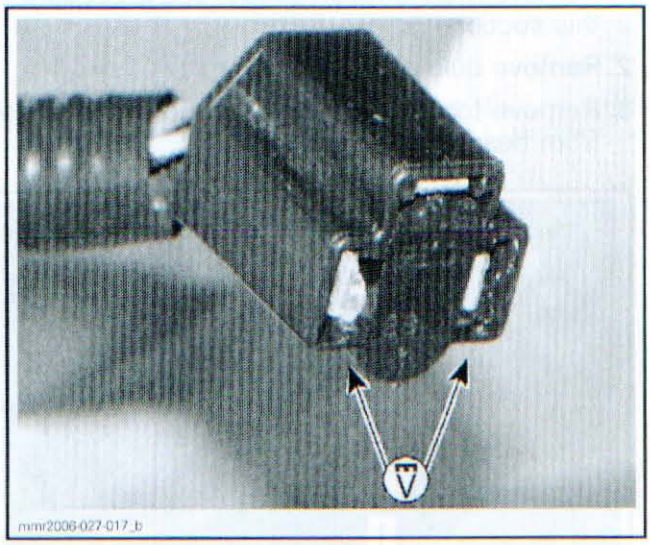
4. Install light connector.
5. Always test light operation after bulb replacement.
6. Install gauge, see procedure in this section.

Headlight Input Voltage Test

If headlight(s) does not function with a good bulb, proceed as follows.

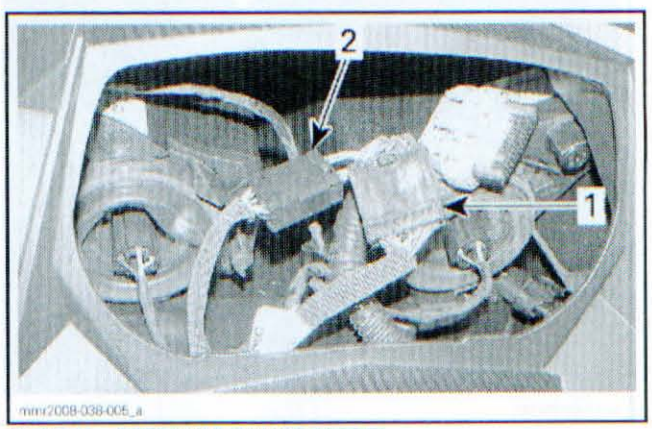
1. Remove multifunction gauge, see procedure in this subsection.
2. Disconnect headlight connector(s).
3. Apply electrical power to the headlights. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this section for proper procedure.
4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
5. Read voltage at headlight connector as follows:

SWITCH POSITION	WIRE COLOR (HEADLIGHT CONNECTOR)		VOLTAGE
LO beam	GY/VI	BK	Battery voltage
HI beam	GY	BK	



If voltage is inadequate, carry out the following:

- Test supply and ground circuits independently. Refer to *WIRING DIAGRAM*.
- Check applicable fuse. Refer to *FUSES* in this section.
- Test headlights dimmer switch from the HG connector located behind multifunction gauge. Refer to *WIRING DIAGRAM* for circuit details.
- Test wiring harness and connectors.



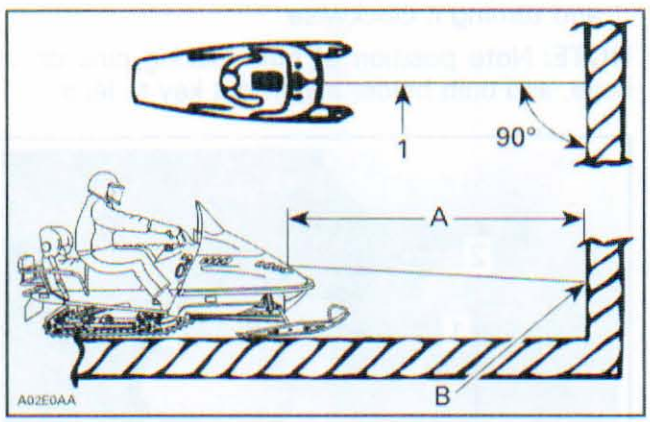
TYPICAL - PREMIUM GAUGE MODEL
1. *AC connector*
2. *HG connector*

NOTE: When testing headlights dimmer switch from HG connector, if an open circuit is found through the switch, remove the screws retaining the multifunction switch, disconnect the LA and LB connectors and test for continuity of switch and wiring separately. Dimmer switch is replaced with multifunction switch assembly.

Headlight Beam Aiming

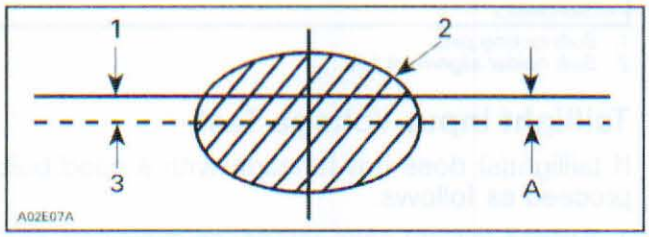
Beam aiming is correct when center of high beam is 25 mm (1 in) below the headlight horizontal center line, scribed on a test surface, 381 cm (12 ft 6 in) away.

1. Place the vehicle on a flat surface perpendicular to test surface (wall or screen) and 381 cm (12 ft 6 in) away from it.
2. Ask rider to sit rider on, or apply equivalent weight on the vehicle.
3. Select **high** beam.
4. Measure headlight center distance from ground. Scribe a line at this height on test surface (wall or screen). Light beam center should be 25 mm (1 in) below scribed line.



TYPICAL
1. *Headlight center line*

A. 381 cm (12 ft 6 in)
B. 25 mm (1 in) below center line

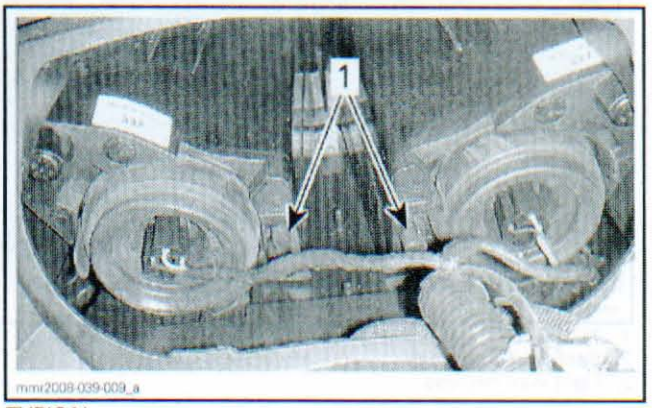


1. *Headlight horizontal*
2. *Light beam (high beam) (projected on the wall)*
3. *Light beam center*

A. 25 mm (1 in)

Beam Aiming Adjustment

1. Remove multifunction gauge.
2. Turn knob on light assembly to adjust beam height.



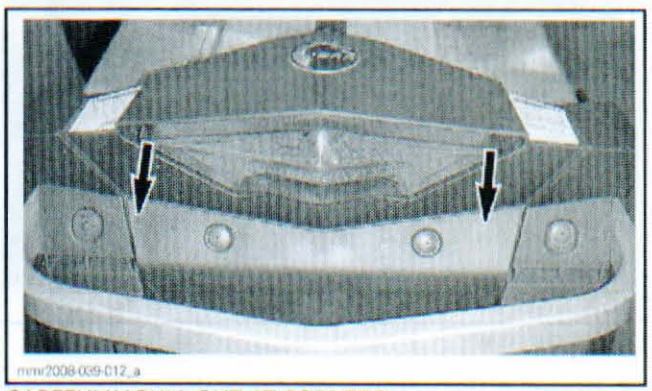
TYPICAL
1. *Beam height adjustment knobs*

TAILLIGHT AND BRAKE LIGHT

Taillight Bulb Replacement

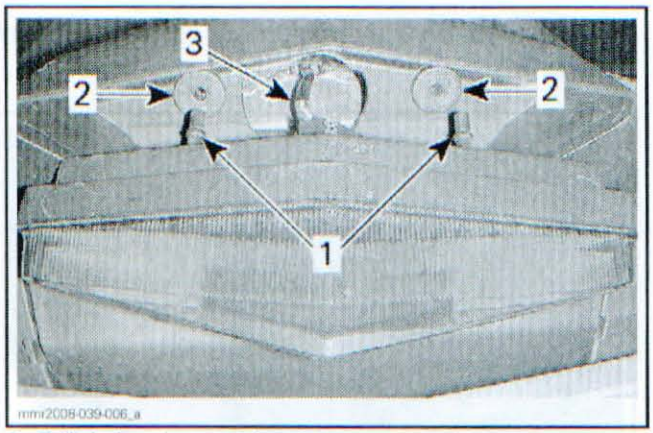
MX Z and GSX Models

Remove taillight housing by carefully pulling on lens at both ends.



CAREFULLY PULL OUT AT CORNERS

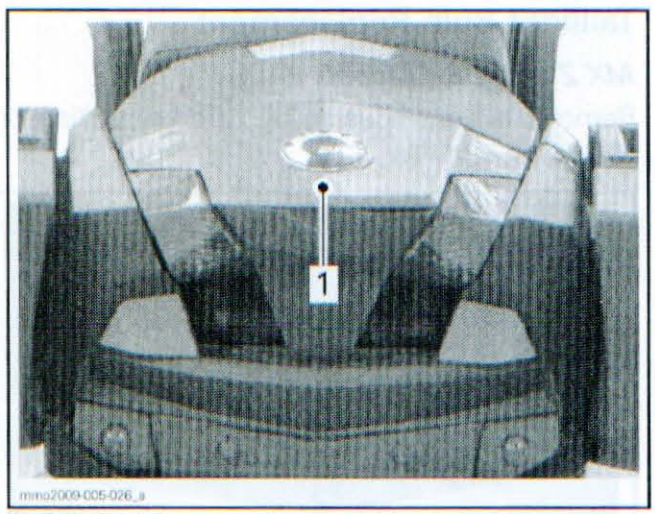
NOTICE Taillight housing is held in place by two plastic pins inserted in rubber grommets. If housing is forced too far sideways when removing, the lens mounting pins may break and housing will have to be replaced. Do not pull housing out too far to avoid damaging wiring.



1. *Taillight housing retaining pins*
2. *Retaining grommets*
3. *Light wire harness*

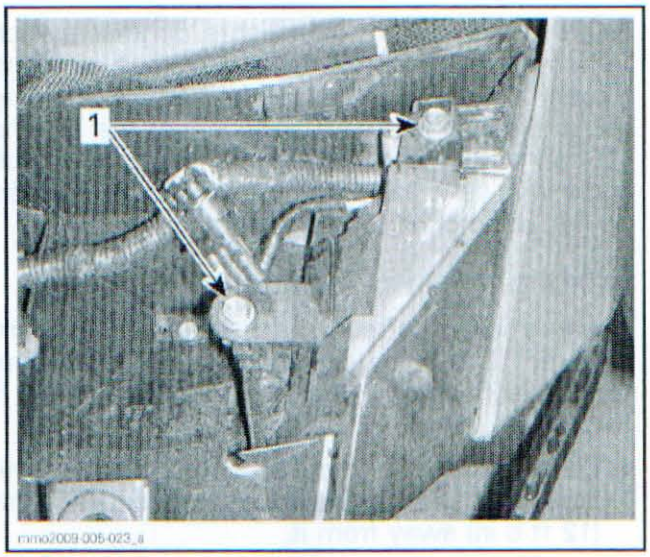
GTX Models

1. Remove the taillight cover by pulling up the rear end of cover.



1. *Taillight cover*

2. Remove the screws retaining the taillight housing.

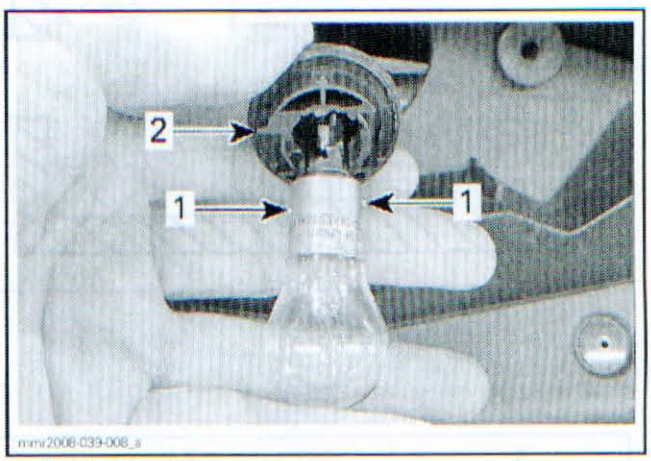


1. *Taillight housing retaining screws*

All Models

1. Rotate bulb socket counterclockwise to remove it from taillight housing.
2. Push in and rotate bulb counterclockwise to remove it from its socket.
3. Install the new bulb by pushing it in the socket and turning it clockwise.

NOTE: Note position of bulb locking pins on its base, and bulb holder alignment key to lens.



1. *Bulb locking pins*
2. *Bulb holder alignment key*

Taillight Input Voltage Test

If taillight(s) does not function with a good bulb, proceed as follows.

1. Access taillight connector(s) as explained *TAILLIGHT BULB REPLACEMENT.*
2. Disconnect connector(s).
3. Apply electrical power to the headlights. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this section for proper procedure.

4. Set FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
5. Read voltage at taillight connector(s) as follows:

PROBES		VOLTAGE
RED wire	BLACK wire	Battery voltage

Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check ground and supply circuits independently. Repair open circuit as needed.

Brake Light Input Voltage Test

1. If brake light(s) does not function with a good bulb, carry out steps 1 to 4 of *TAILLIGHT INPUT VOLTAGE TEST.*
2. Apply parking brake.
3. Read voltage at taillight connector(s) as follows:

PROBES		VOLTAGE
WHITE wire	BLACK wire	Battery voltage

Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check ground and supply circuits independently. Repair open circuit if needed. To check brake light switch, refer to *BRAKE* subsection.

Taillight Holder Replacement

If the taillight lens is broken, see the *TAILLIGHT BULB REPLACEMENT* procedure in this section.

MX Z and GSX Models

The taillight holder is part of the snow guard. If it needs to be replaced, refer to *BODY* subsection.

GTX Models

The taillight holder is part of the rear rack. If it needs to be replaced, refer to *BODY* section.

All Models

If the light bulb socket or wiring need to be replaced, you will have to lift up the rear of the fuel tank to access and disconnect the harness connector, refer to *FUEL TANK AND FUEL PUMP* section.

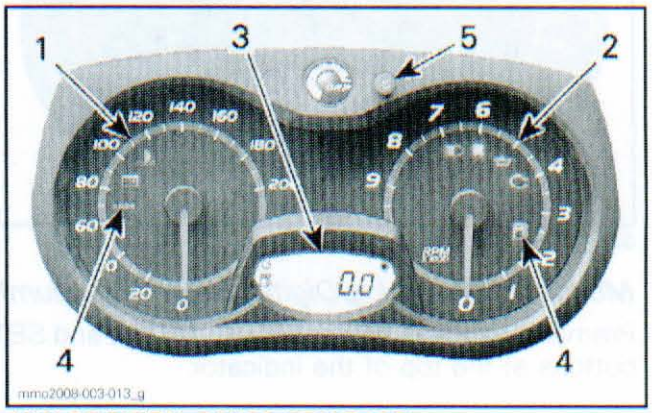
GAUGE

Gauge Description

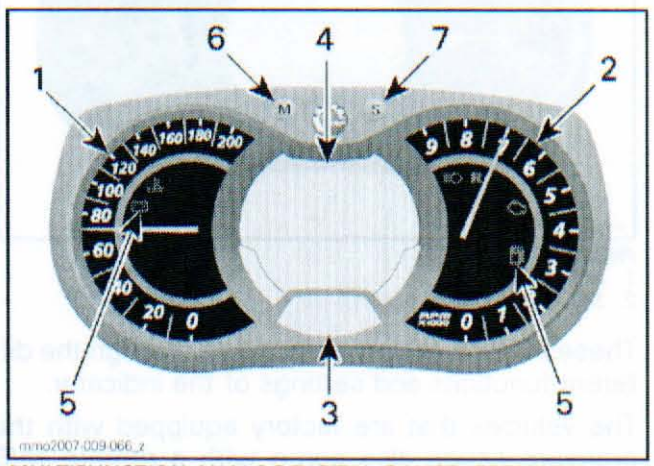
Two different type of gauges which provide all indications in a single unit are used. An **analog/digital gauge (standard gauge)** and a **multifunction analog/digital gauge (premium gauge)**.

The premium gauge provides more functions and display features.

Both units can be set to indicate in metric or imperial units.



ANALOG/DIGITAL GAUGE (STANDARD)
1. *Speedometer*
2. *Tachometer (RPM)*
3. *Gauge Digital Display*
4. *Gauge Pilot Lamps*
5. *Gauge SET "S" button*



MULTIFUNCTION ANALOG/DIGITAL GAUGE (PREMIUM)
1. *Speedometer*
2. *Tachometer (RPM)*
3. *Gauge Digital Display*
4. *Gauge Multifunction Digital Display*
5. *Gauge Pilot Lamps*
6. *Gauge MODE "M" button*
7. *Gauge SET "S" button*

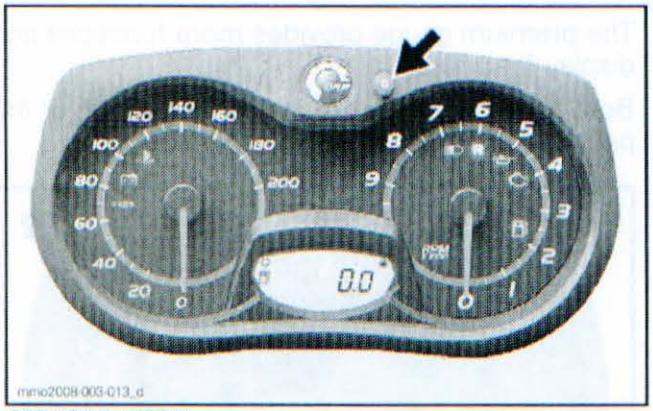
The premium gauge is also used to control 9 temperature settings for the heated hand grips and the heated throttle lever.

NOTE: On the premium gauge, the setups made on the multifunction digital display will not be stored in the memory unless they are performed with the engine running.

Mode and Set Buttons

Analog/Digital Gauge

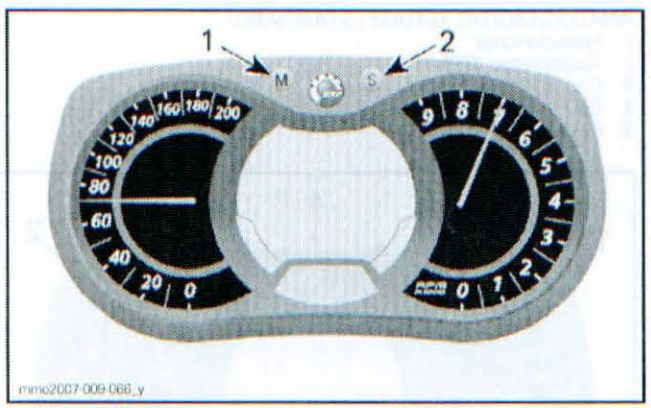
The standard gauge is equipped with a SET button only.



SET "S" BUTTON

Multifunction Analog/Digital Gauge (Premium)

Premium gauge is equipped with **MODE** and **SET** buttons at the top of the indicator.



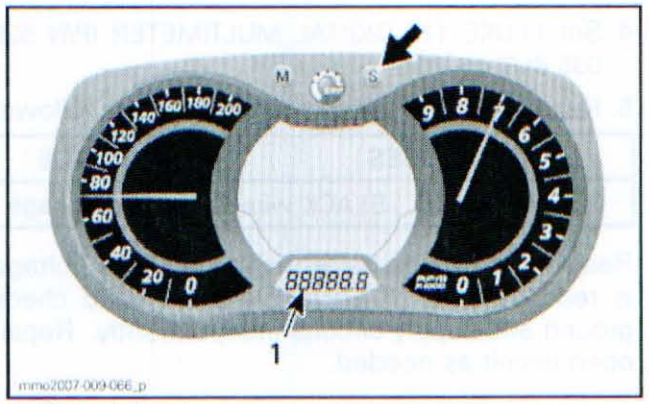
PREMIUM GAUGE
1. *MODE button*
2. *SET button*

These buttons allow you to toggle through the different functions and settings of the indicator.

The vehicles that are factory equipped with the premium gauge also come with a remote **M/S** button on the LH multifunction switch. It can be used instead of the buttons on the gauge simply by pressing the "**M**" for **MODE** and "**S**" for **SET**.

Clock Activation (Premium Gauge)

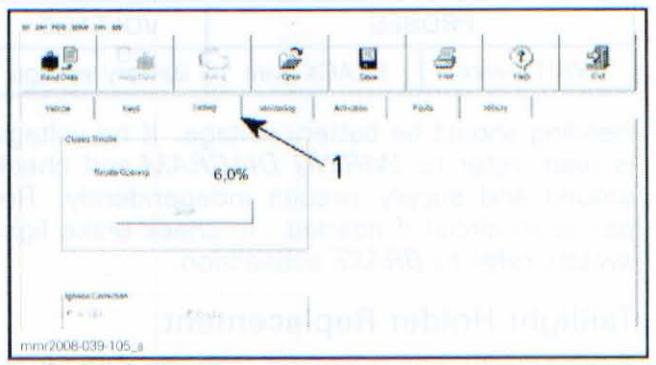
The gauge has an internal clock that can display the time of day in the lower digital display (when selected). This clock requires power from the vehicle battery to maintain the proper time of day.



1. *Clock displayed*

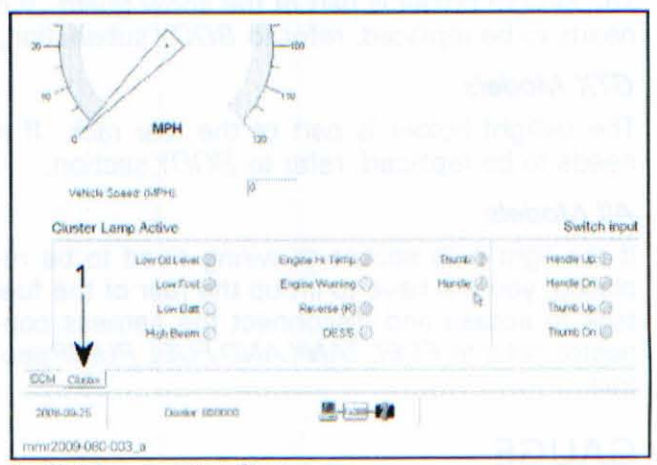
Without battery power, this clock resets every time the vehicle is shut down, then restarted. It is then only used as a timer.

1. To activate the clock function in B.U.D.S., choose the **Setting** tab.



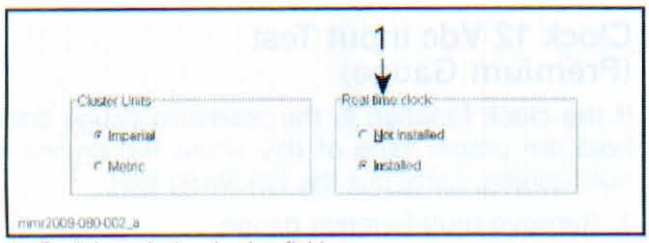
1. *Choose Setting tab*

2. At the bottom LH corner of the **Setting** page, choose the **Cluster** tab.



1. *Click here to select Cluster page*

3. At the bottom of the **Cluster** page, choose **Installed** in the **Real time clock** field if the vehicle is equipped with a battery. Choose **Not Installed** if the vehicle does not have a battery.

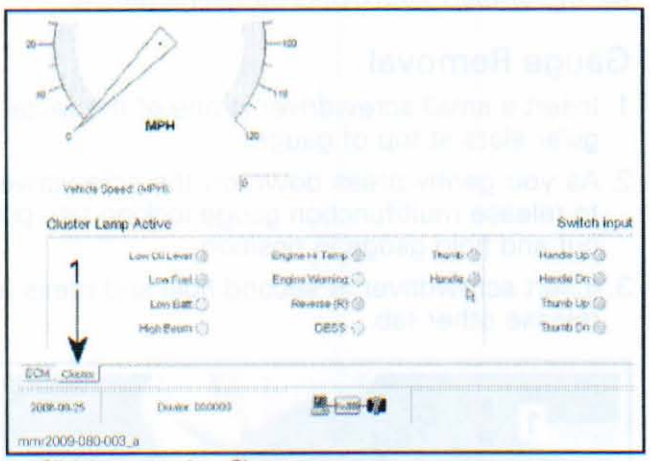


1. Real time clock selection field

Changing Gauge Units

The gauges are factory preset to indicate in imperial units and can be changed using the B.U.D.S. software.

1. To change the gauge units of measurement in B.U.D.S., first choose the **Setting** tab.
2. At the bottom LH corner of the **Setting** page, choose the **Cluster** tab.



1. Click here to select Cluster page

3. At the bottom of the **Cluster** page, select **Imperial** or **Metric** in the **Cluster Units** field.

1. Cluster Units field

NOTE: Speedometer, odometer and trip meter will have their units (kilometer or miles) changed all together.

Displaying "P" Codes (Premium Gauge Only)

1. To activate **P CODE** mode, push and hold the "M" button for 2 seconds.
2. As you hold the "**M**" button, quickly turn ON and OFF the high beams a few times. The gauge should enter **P CODE** mode.
3. While in **P CODE** mode, use the "**M**" or "**S**" button to scroll over available failure codes.
4. Push and hold the "**M**" button to exit **P CODE** mode.

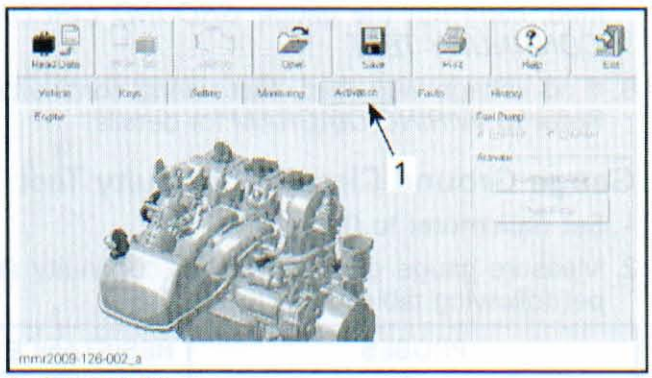
A **NO ACTIVE P CODE** message is displayed if there are no **P CODES** in memory.

Gauge Self-Test

On **ECM wake-up**, the gauge will perform a self-test. All indications will come ON. You will have a few seconds to ensure the indications (**LEDs** and **LCDs**) are functioning correctly.

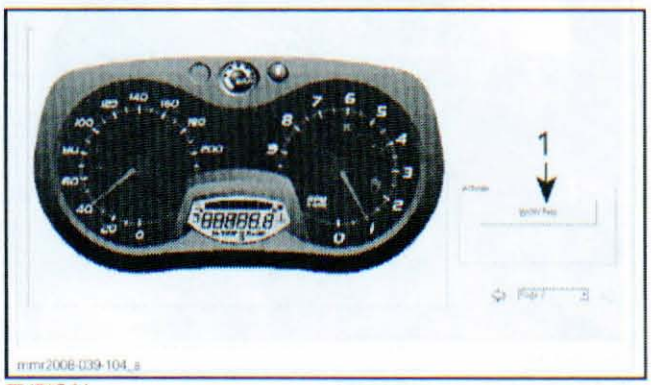
Gauge Test with B.U.D.S.

1. In B.U.D.S., choose the **Activation** tab.



1. Activation tab

2. On the bottom of the activation page on the left side, select **Cluster**.
3. On **Cluster** page, select the **WOW Test** button. All indications will come ON and stay ON allowing the time required to verify each indication.



TYPICAL
1. Select WOW Test button

NOTE: The **WOW Test** only test the gauges **LEDs** and **LCDs**. It does not test the actual circuit functions related to each indication.

Gauge Power Input Test (Main 12 Vdc)

If the gauge does not come on when the engine is started, carry out the following test.

1. Check fuse 1.
2. Remove multifunction gauge.
3. Disconnect the gauge connector.
4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
5. Press on start button or install T-HARNESS (P/N 529 035 869) on diagnostic connector.
6. Measure voltage as per following table.

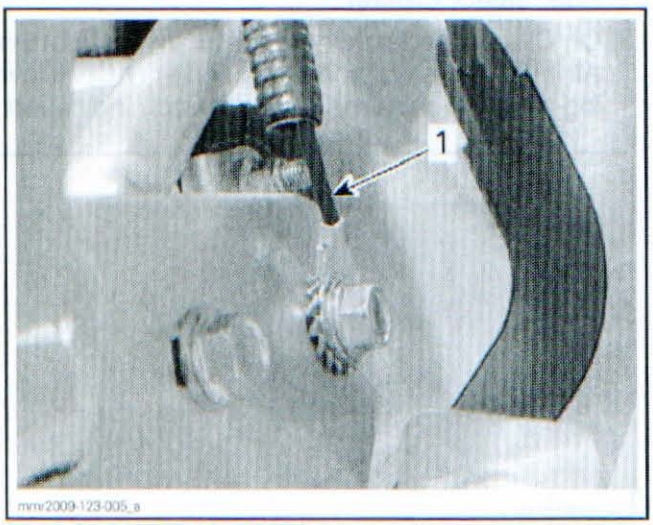
PROBES		VOLTAGE
Gauge connector pin 8 (RD/GY)	Battery ground	Battery voltage

7. If gauge main power input test was as specified, carry out the gauge *GROUND CIRCUIT CONTINUITY TEST.*
8. If no voltage was read, test wiring continuity. Refer to *WIRING DIAGRAM* for details.

Gauge Ground Circuit Continuity Test

1. Set multimeter to Ω.
2. Measure gauge ground wire for continuity as per following table.

PROBES		RESISTANCE
Gauge connector pin 11 (BK)	Battery ground	Close to 0 Ω



REAR OF BATTERY SUPPORT
1. Chassis ground

If gauge power input test and ground circuit continuity tests are good, replace gauge.

Clock 12 Vdc Input Test (Premium Gauge)

If the clock function in the premium gauge does hold the proper time of day when the engine is not running, carry out the following test.

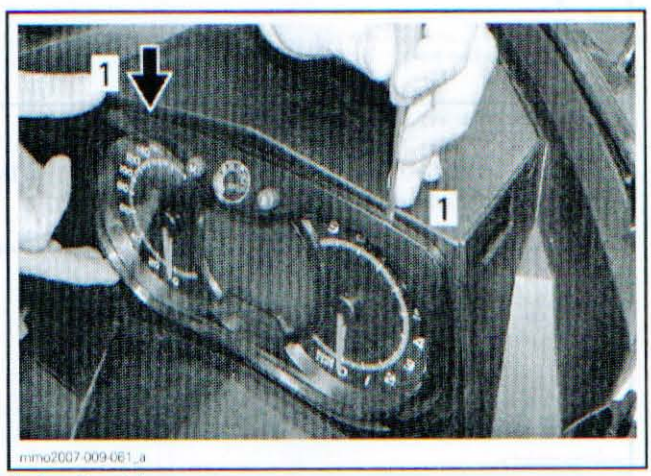
1. Remove multifunction gauge.
2. Disconnect the gauge connector.
3. Set multimeter to Vdc.
4. Measure voltage as per following table.

PROBES		VOLTAGE
Gauge connector pin 9 (RD/BR)	Battery ground	Battery voltage

If no voltage is read, test input wire continuity. Refer to *WIRING DIAGRAM* for circuit details.

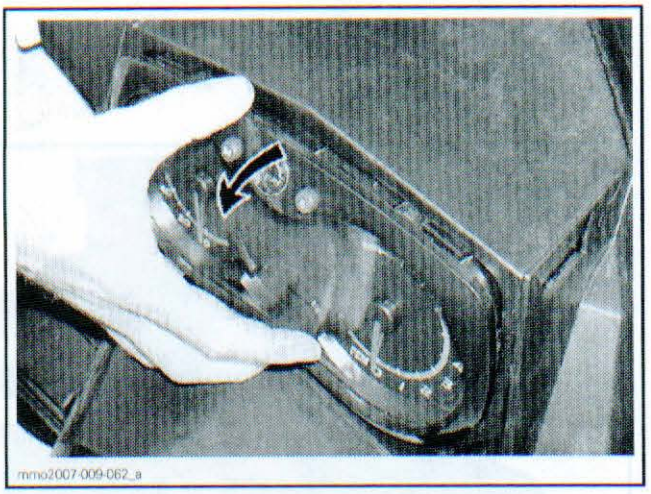
Gauge Removal

1. Insert a small screwdriver in one of the rectangular slots at top of gauge.
2. As you gently press down on the screwdriver to release multifunction gauge locking tab, pull out and hold gauge in position.
3. Insert screwdriver in second hole and press to release other tab.



1. Locking tabs

4. Gently pull multifunction gauge from gauge support.



5. Press on connector locking tab and pull connector off gauge.
6. Store gauge in a secure area to prevent it from being damaged.

Gauge Installation

1. Carefully align and install gauge connector, pressing it in until connector lock engages.
2. Insert bottom of gauge in gauge holder.
3. Press top of gauge in holder until you feel locking tabs engage in holder.
4. Start vehicle engine and test gauge functions.

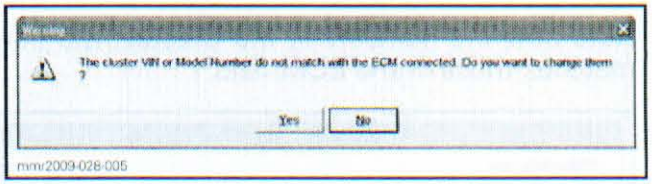
NOTE: If a new gauge is installed, refer to *GAUGE TO ECM MATCHING*.

Gauge to ECM Matching

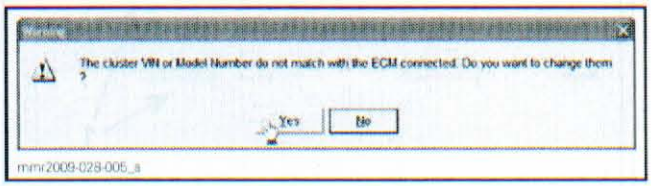
NOTE: If the gauge is replaced, the V.I.N. (Vehicle Identification Number) and the vehicle model number must be entered in the gauge memory so they match those stored in the vehicle ECM.

If the identification numbers stored in the gauge do not match those stored in the ECM, the gauge will operate normally however the ECM will send a message to B.U.D.S. through the diagnostic connector.

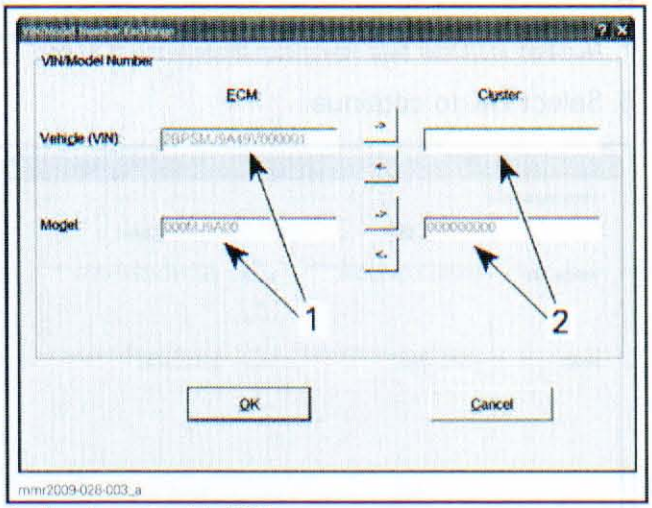
1. To write the V.I.N. number and model number into the gauge, connect to the latest B.U.D.S. software applicable to the vehicle. Refer to the *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* section.
2. Follow the instructions in the referenced section and in the software.
3. Once connected and activated, select the **Read Data** button. You will see a message similar to the following illustration.



4. Select **Yes** in the displayed window.

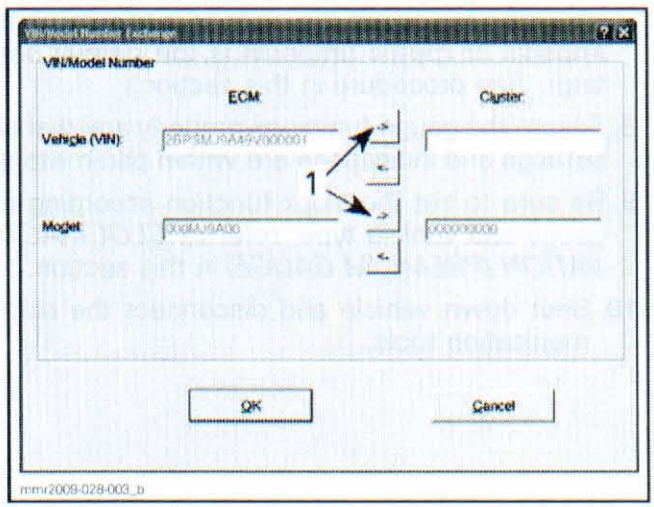


The following window illustrates that the V.I.N. number or model number in the ECM and cluster are not the same.



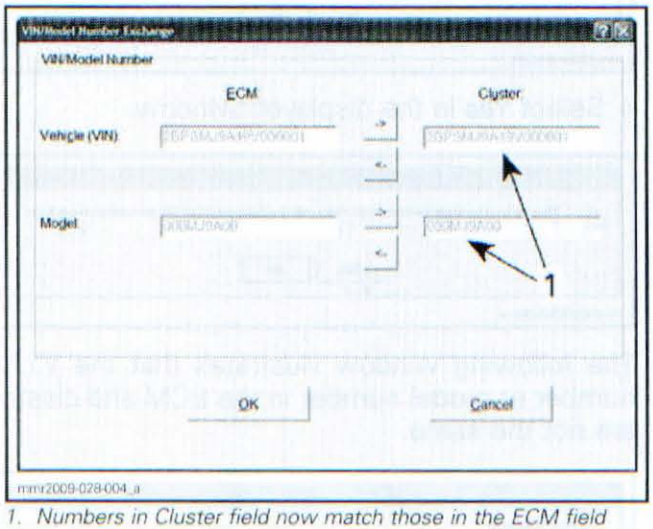
1. *Numbers stored in ECM*
2. *No numbers stored in new cluster*

5. Select each of the arrows indicated in the following illustration to copy the V.I.N. and model numbers from the ECM to the cluster.



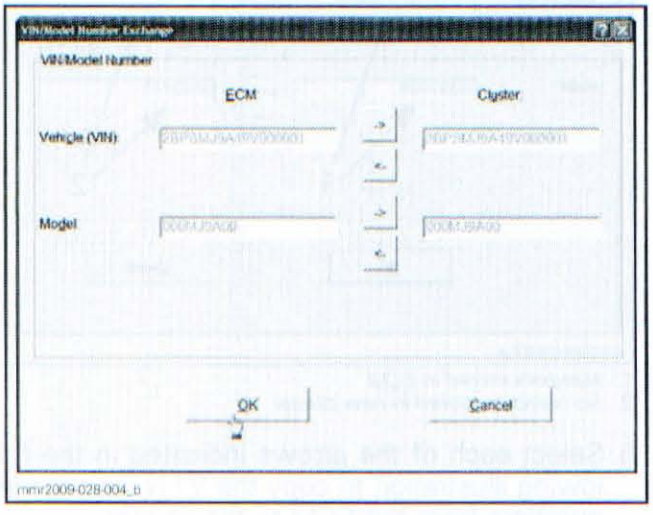
1. *Select each arrow button indicated*

Note how the numbers in the **Cluster** field now matches those in the **ECM** field.



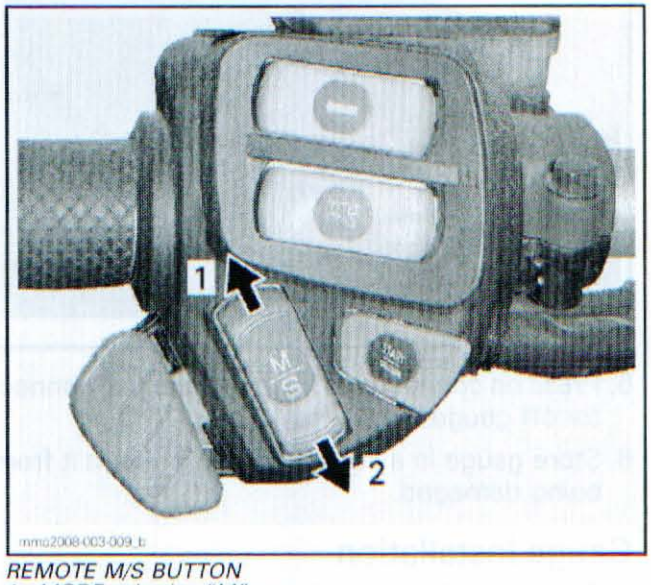
1. Numbers in Cluster field now match those in the ECM field

6. Select **OK** to continue.



7. Once the gauge has been matched to the ECM, you will need to set the units of measurement, imperial or metric (imperial is the default setting). See procedure in this section.
8. Ensure the gauge functions properly and that all settings and indications are within parameters.
9. Be sure to set the clock function according to gauge and vehicle type, refer to *CLOCK ACTIVATION (PREMIUM GAUGE)* in this section.
10. Shut down vehicle and disconnect the communication tools.

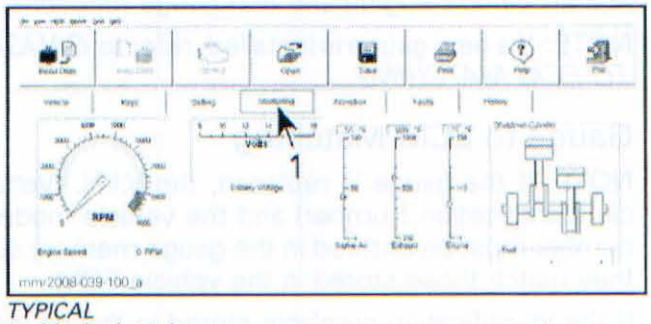
REMOTE MODE AND SET BUTTON



REMOTE M/S BUTTON
1. MODE selection "M"
2. SET selection "S"

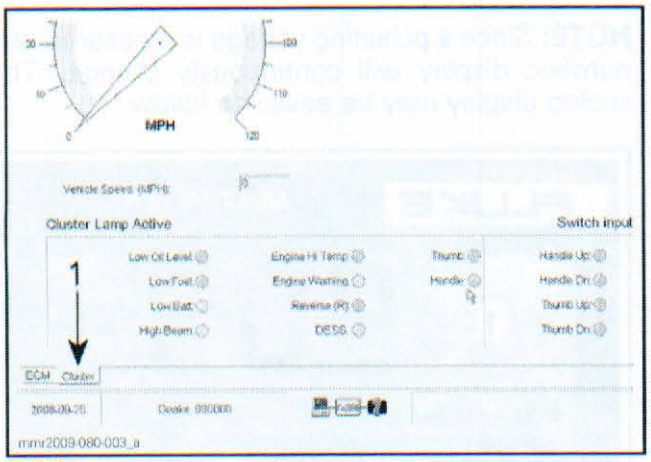
Remote Button Testing with B.U.D.S.

Using the B.U.D.S. software, select the **Monitoring** tab.



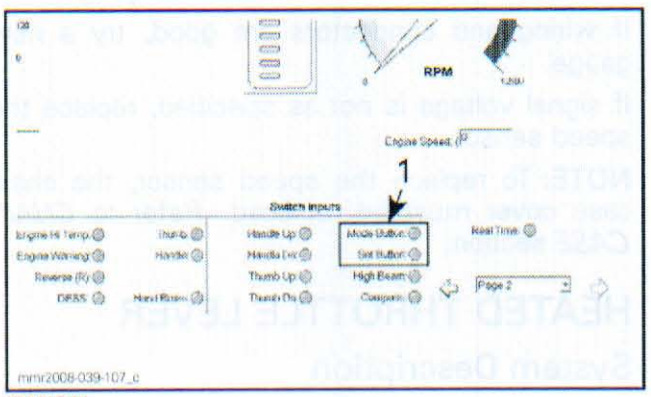
TYPICAL
1. Monitoring tab

On the lower LH side of the **Monitoring** page, choose the **Cluster** tab.



TYPICAL
1. Press here to select Cluster page

Alternately press on the "M" and "S" and look for applicable indicator light in the **Switch inputs** field to turn green.



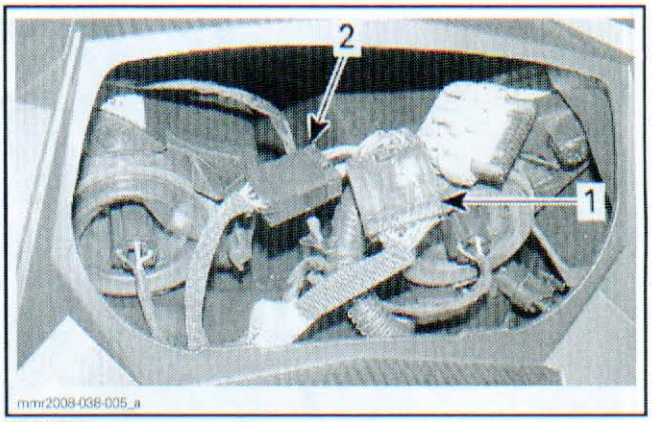
TYPICAL
1. Indicator lights

If the indicator lights come ON in B.U.D.S., the remote **M/S** button is functioning correctly.

If the indicator lights do not come ON, carry out the *REMOTE M/S BUTTON TESTING* procedure.

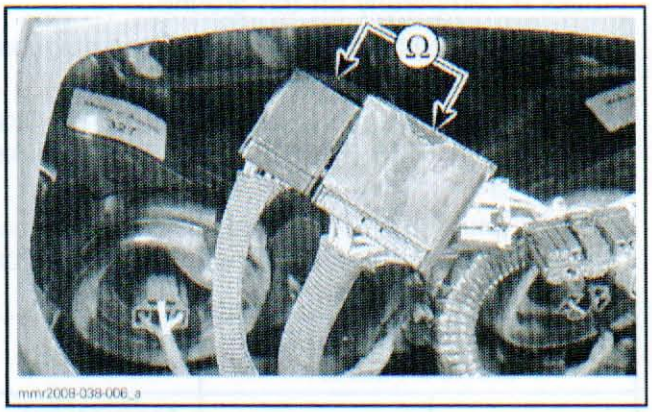
Remote Button Continuity Test

1. If using the **M/S** button does not affect the indication, try using the buttons on the gauge. If they function, the remote **M/S** button circuit may be open.
2. Remove the gauge.
3. Disconnect the HG and the AC connectors.



TYPICAL
1. AC connector
2. HG connector

4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω and carry out the following continuity test.



REMOTE M/S BUTTON TESTING			
SWITCH SELECTION	AC CONNECTOR WIRE	HG CONNECTOR WIRE	RESISTANCE
Centered	Pin 6 (YL/BR)	Pin 1 (BK/BU)	Infinite Ω
	Pin 7 (YL/GN)		
"M"	Pin 6 (YL/BR)	Pin 1 (BK/BU)	Close to 0 Ω
"S"	Pin 7 (YL/GN)		

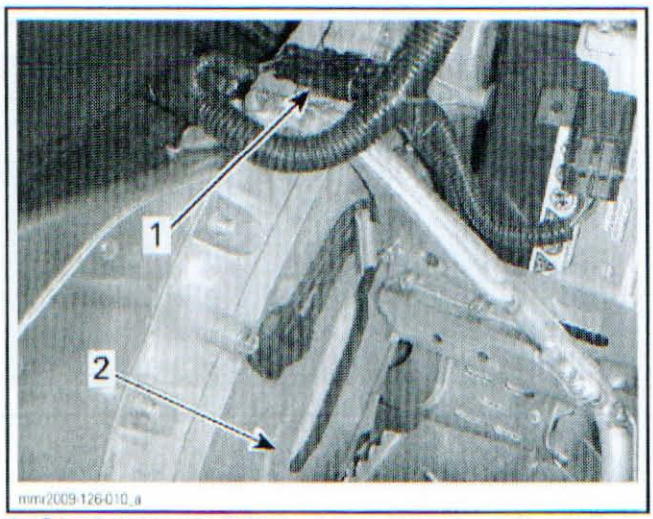
If you do not obtain the values as specified, repair or replace switch, wiring and connections.

SPEED SENSOR

The speed sensor is mounted in the chain case cover.

Speed Sensor Static Test

1. Locate speed sensor connector.



1. *Speed sensor connector*
2. *Speed sensor (inside cover)*

2. Lift and support back end of vehicle so that the track is completely off the ground.
3. Install T-HARNESS (P/N 529 035 869) on diagnostic connector.
4. To perform verifications, use the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) with Fluke TP88 rigid back probe pins or equivalent.
5. With multimeter set to Vdc, back-probe connector and read sensor supply voltage as follows.

SPEED SENSOR CONNECTOR (SENSOR SIDE)		VOLTAGE
RD	BK	Approximately 12 Vdc

If you do not have proper supply voltage, remove T-Harness and carry out a continuity test of wiring from sensor to gauge. Refer to *WIRING DIAGRAM* for circuit detail.

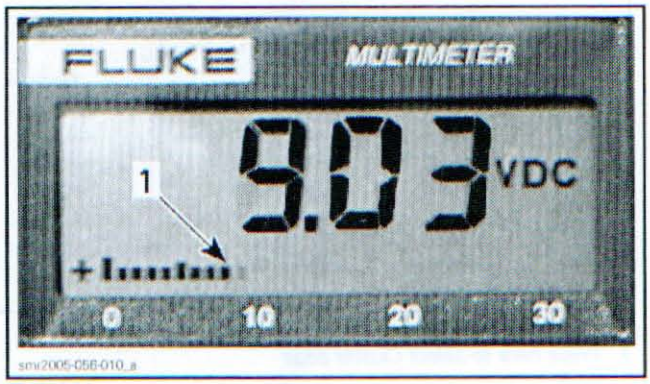
If supply voltage is good, measure the signal voltage as follows.

6. Back-probe connector between GREEN and BLACK wires, read voltage.
7. Rotate driven pulley by hand while watching multimeter display.

ROTATE TRACK	SPEED SENSOR CONNECTOR (SENSOR SIDE)		VOLTAGE
	GN	BK	Alternate 12 Vdc and 0 Vdc

The signal voltage should alternate between approximately 12 Vdc and 0 Vdc.

NOTE: Since a pulsating voltage is measured, the numeric display will continuously change. The analog display may be easier to follow.



TYPICAL
1. *Analog display*

If voltage is as specified, repair or replace wiring and connectors between sensor and gauge.

If wiring and connectors are good, try a new gauge.

If signal voltage is not as specified, replace the speed sensor.

NOTE: To replace the speed sensor, the chain case cover must be replaced. Refer to *CHAIN CASE* section.

HEATED THROTTLE LEVER

System Description

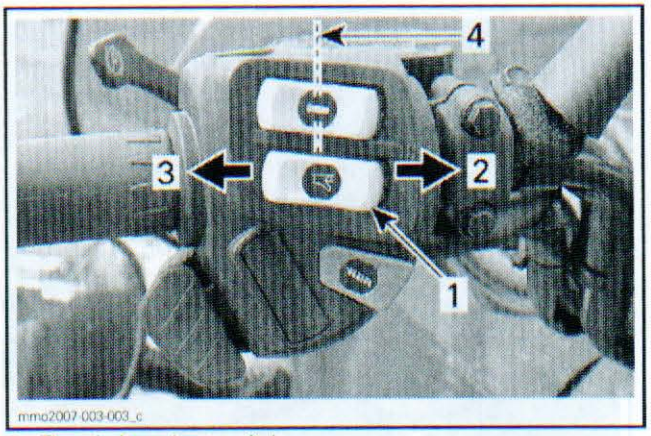
There are two types of throttle lever heating systems used on the REV-XR platform.

The type of system used is determined by the gauge package installed at the factory, standard gauge or premium gauge.

Models with Standard Gauge

On vehicles equipped with a "Standard" gauge, the throttle lever heater is controlled by a toggle switch on the LH multifunction switch assembly.

The switch allows you to select **High**, center (**Off**), and **Low** heat settings. The switch button will remain in the selected position until another selection is made.



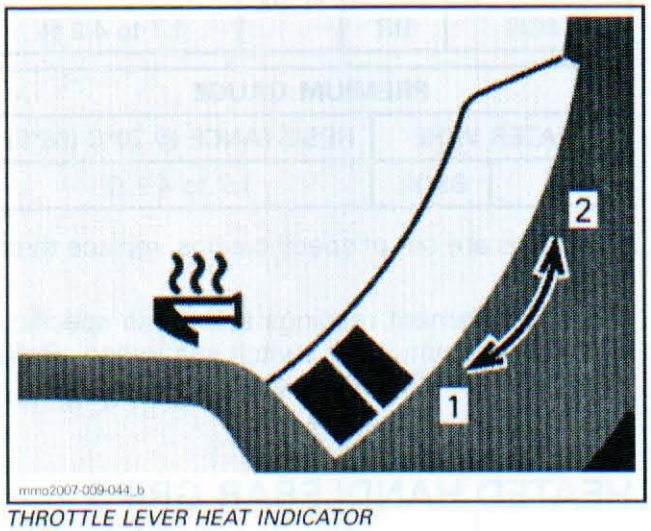
1. *Throttle lever heat switch*
2. *High*
3. *Low*
4. *Heat OFF (center position)*

Models with Premium Gauge

On vehicles factory equipped with a "Premium" gauge, the throttle lever heat is controlled through the gauge.

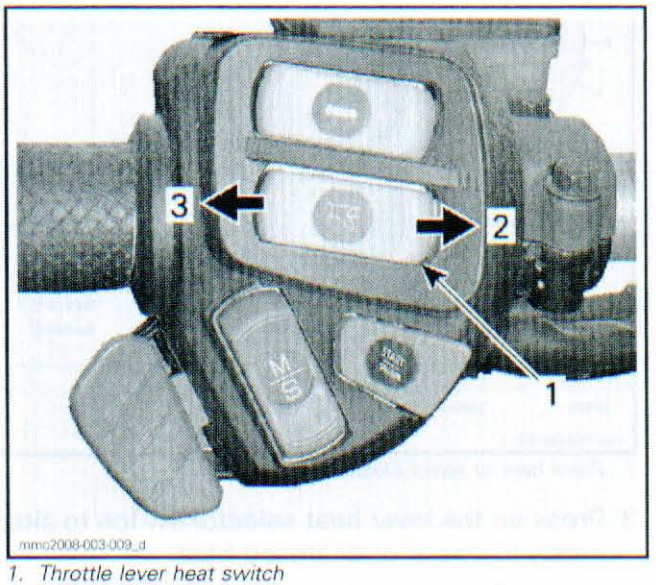
The heated throttle lever will not be powered until the engine runs at least 2000 RPM.

A three position switch on the LH multifunction switch assembly allows selection of 9 heat levels, which are displayed in the indicator.



THROTTLE LEVER HEAT INDICATOR
1. *Decrease heat*
2. *Increase heat*

The switch selection sends a signal to the premium gauge to increase or decrease heat.



1. *Throttle lever heat switch*
2. *Increase heat*
3. *Decrease heat*

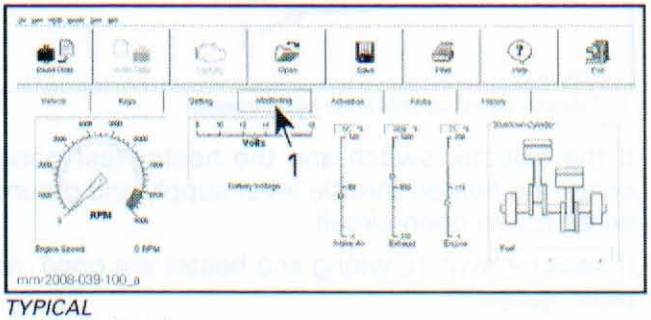
The gauge then applies the appropriate amount of current to the heater according to the selection.

To turn OFF the heaters, select heat down until there is no more indication on the bar graph.

When released, the switch springs back to the center neutral position.

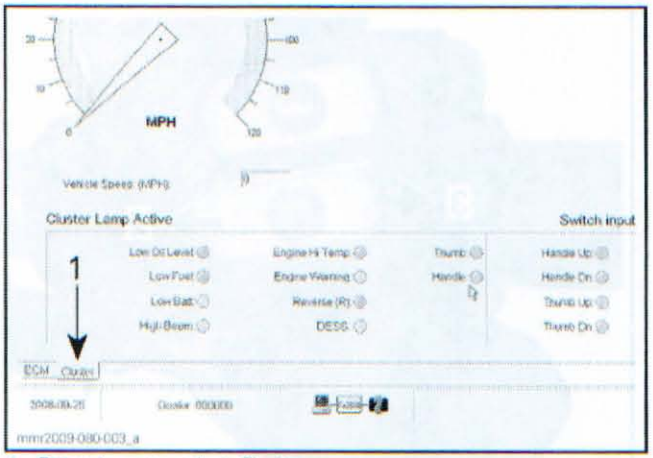
Heat Selector Switch Testing with B.U.D.S. (Premium gauge)

1. Using the B.U.D.S. software, select the **Monitoring** tab.



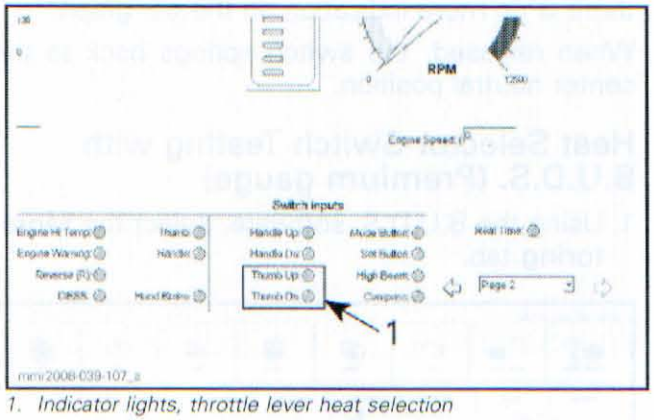
TYPICAL
1. *Monitoring tab*

2. On the lower LH side of the **Monitoring** page, choose the **Cluster** tab.



1. Press here to select Cluster page

3. Press on the lever heat selector switch to alternately increase or decrease heat.
4. In B.U.D.S., look for the applicable indicator light in the **Switch inputs** field to turn GREEN (**Thumb Up** or **Thumb Dn**). If they do, the heat selector switch for the throttle lever is functioning correctly.



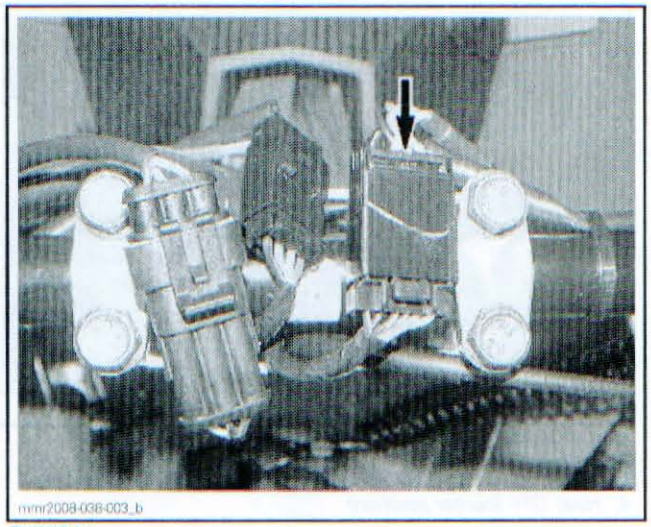
1. Indicator lights, throttle lever heat selection

If the selector switch and the heater test good, check the heated throttle lever supply and ground wires for an open circuit.

If selector switch, wiring and heater are good, replace gauge.

Lever Heating Element Testing

1. Disconnect the RH steering connectors located under the steering cover.



TYPICAL

2. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
3. Carry out a resistance check of the heating elements as follows.

STANDARD GAUGE			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	BR/YL	YL/BK	5.7 to 18.5 Ω
HIGH	BR		1.7 to 4.2 Ω

PREMIUM GAUGE		
HEATER WIRE		RESISTANCE @ 20°C (68°F)
BR	BK/YL	1.7 to 4.2 Ω

If readings are out of specifications, replace throttle lever.

If heating element readings are within specifications, test continuity of switch and wiring. Refer to *WIRING DIAGRAM* for details.

4. Reconnect connectors.

HEATED HANDLEBAR GRIPS

System Description

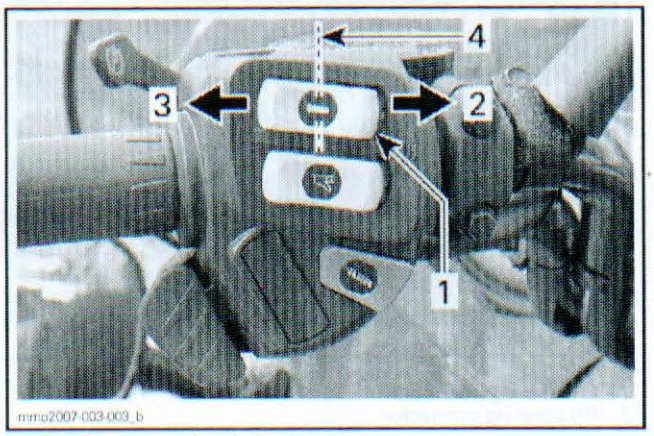
There are two types of grip heating systems used on the REV-XR platform.

The type of system used is determined by the gauge package installed at the factory, standard gauge or premium gauge.

Models with Standard Gauge

On vehicles equipped with a "Standard" gauge, the grip heater is controlled by a toggle switch on the LH multifunction switch assembly.

The switch allows you to select **High**, center (**Off**), and **Low** heat settings. The switch button will remain in the selected position until another selection is made.



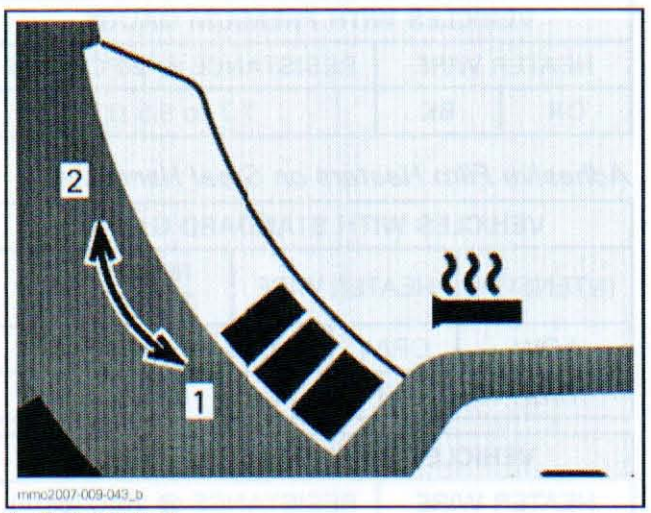
1. *Grip heat control switch*
2. *High*
3. *Low*
4. *Heat OFF (center position)*

Models with Premium Gauge

On vehicles factory equipped with a "Premium" gauge, the grip heat is controlled through the gauge.

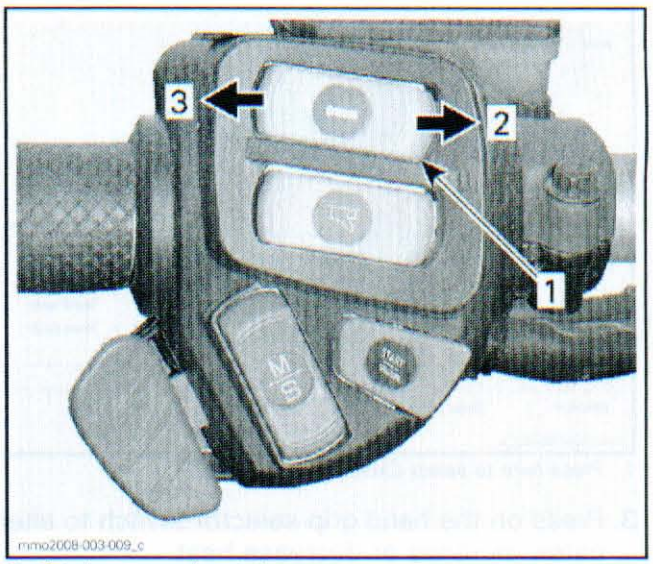
The heated hand grips will not be powered until the engine runs at 2000 RPM or above.

A three position switch on the LH multifunction switch assembly allows selection of 9 heat levels, which are displayed in the indicator.



1. *Decrease heat*
2. *Increase heat*

The switch selection sends a signal to the premium gauge to increase or decrease heat.



1. *Grip heat control switch*
2. *Increase heat*
3. *Decrease heat*

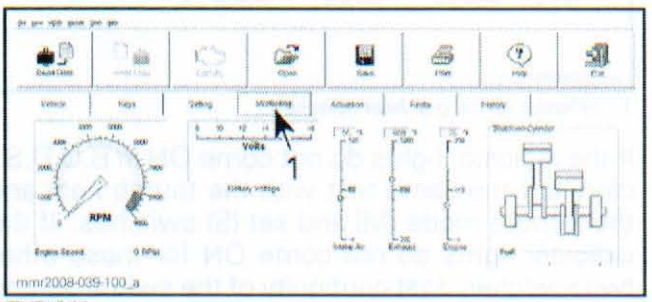
The gauge then applies the appropriate amount of current to the heater according to the selection.

To turn OFF the heaters, select heat down until there is no more indication on the bar graph.

When released, the switch springs back to the center neutral position.

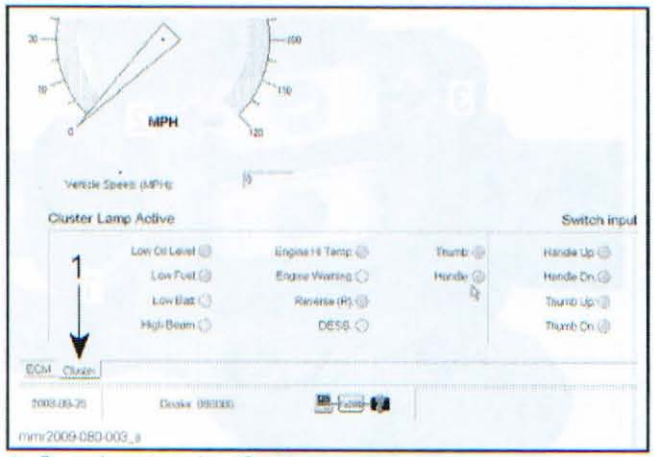
Heat Selector Switch Testing with B.U.D.S. (Premium Gauge)

1. Using the B.U.D.S. software, select the **Monitoring** tab.



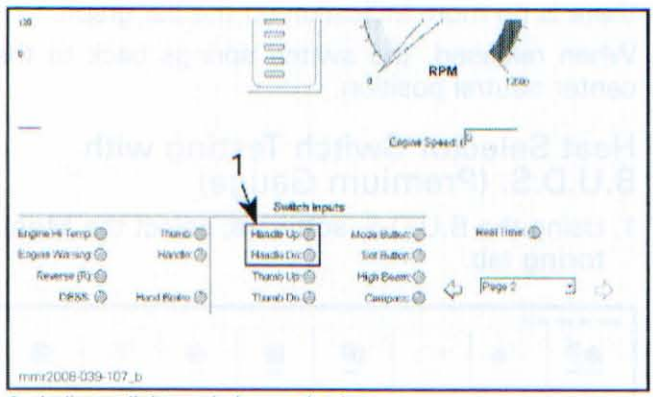
TYPICAL
1. *Monitoring tab*

2. On the lower LH side of the **Monitoring** page, choose the **Cluster** tab.



1. Press here to select Cluster

3. Press on the hand grip selector switch to alternately increase or decrease heat.
4. In B.U.D.S., look for the applicable indicator light in the **Switch inputs** box to turn green (Handle Up or Handle Dn). If they do, the heat selector switch for the hand grips is functioning correctly.



1. Indicator lights, grip heat selection

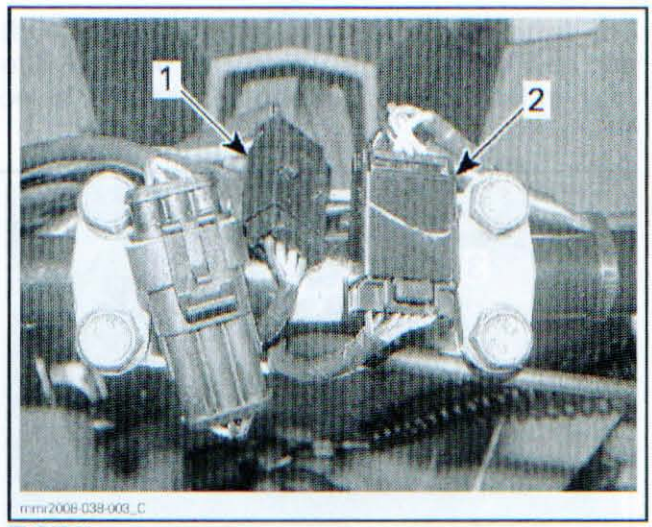
If the indicator lights do not come ON in B.U.D.S., carry out the same test with the thumb heat and the remote mode (M) and set (S) switches. If the indicator lights do not come ON for these other two switches, test continuity of the switch ground wire circuit. Refer to the *WIRING DIAGRAM* for circuit details.

If the selector switch, wiring and the heaters test good, replace the gauge.

Grip Heating Element Testing

If you cannot feel the temperature increase of a hand grip heating element, carry out the following steps.

1. Disconnect the two steering connectors located under the steering cover.



TYPICAL
1. LH steering connector
2. RH steering connector

2. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
3. Test heating elements on either side as per following specifications.

Integrated Heaters

VEHICLES WITH STANDARD GAUGE			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI	BK	15.5 to 19 Ω
HIGH	OR	BK	7.7 to 9.5 Ω

VEHICLES WITH PREMIUM GAUGE		
HEATER WIRE		RESISTANCE @ 20°C (68°F)
OR	BK	7.7 to 9.5 Ω

Adhesive Film Heaters on Steel Handlebar

VEHICLES WITH STANDARD GAUGE			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI	BK	17 to 21 Ω
HIGH	OR	BK	8.5 to 10.5 Ω

VEHICLES WITH PREMIUM GAUGE		
HEATER WIRE		RESISTANCE @ 20°C (68°F)
OR	BK	8.5 to 10.5 Ω

Adhesive Film Heaters on Aluminum Handlebar

VEHICLES WITH STANDARD GAUGE			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI	BK	10.7 to 13.1 Ω
HIGH	OR	BK	5.3 to 6.6 Ω

VEHICLES WITH PREMIUM GAUGE		
HEATER WIRE		RESISTANCE @ 20°C (68°F)
OR	BK	5.3 to 6.6 Ω

4. If readings are out of specifications, replace applicable handle grip heating element.

If heating element readings are within specifications, test continuity of switch and wiring. Refer to *WIRING DIAGRAM* for details.

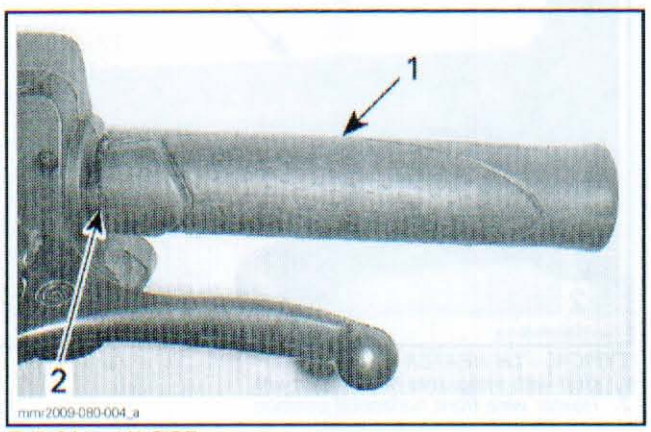
5. Reconnect connectors.

Grip Heater Element Removal

NOTICE **Heater wire routing may vary significantly due to different type handlebars and vehicles. Its highly important to take note of exact positioning of grip heaters, locking ties, and wire routing before removing them from the handle bars. Failure to properly route wires may lead to equipment damage or failure.**

Models with Integrated Heaters

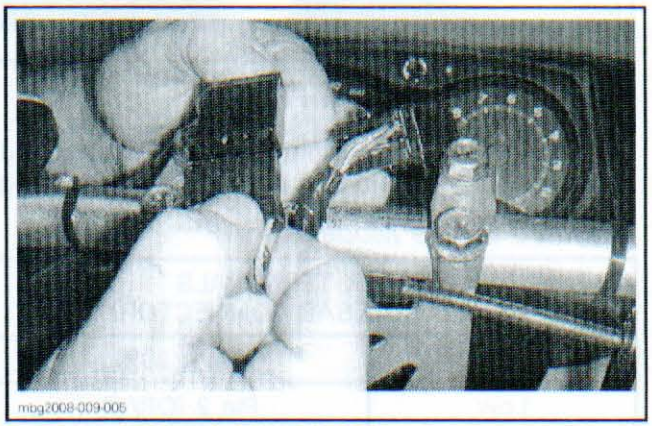
On models with heaters integrated within the rubber hand grip, refer to the *STEERING SYSTEM* section for removal procedure.



TYPICAL - LH SIDE
1. *Grip with integrated heater element*
2. *Heater wire*

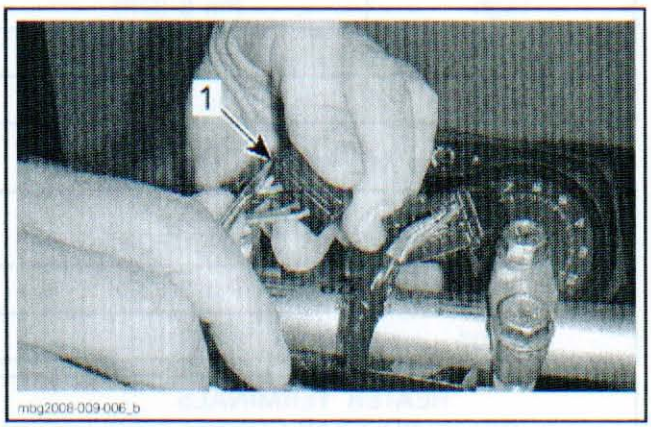
Models with Adhesive Film Heaters

1. Remove the following items as applicable, refer to *STEERING SYSTEM* section for details.
   - Steering cover
   - Rubber hand grip
   - Multifunction switch cover.
2. Disconnect the LH or RH steering connectors under the steering cover.



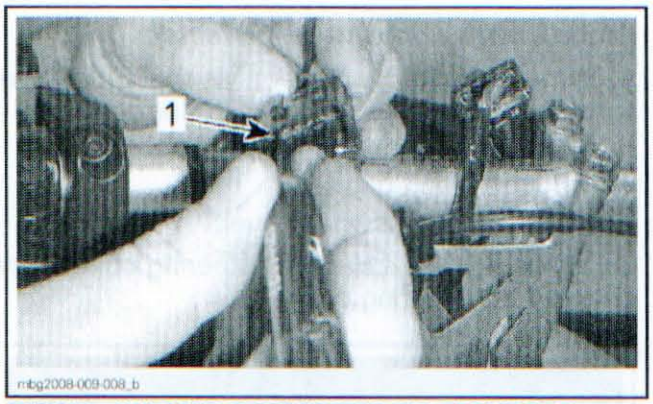
TYPICAL - STEERING CONNECTORS

3. Open the cover on the back of the connector housing using a small screwdriver or a suitable tool.



TYPICAL
1. *Connector housing cover locks (one each side)*

4. Using an appropriate tool such as the MULTILOCK - TERMINAL EXTRACTION TOOL (P/N 755430-2), unlock the heater wire terminals and push them out of the connector housing.



TYPICAL - UNLOCKING CONNECTOR PIN (FRONT SIDE)
1. Pin removal tool inserted above pin

NOTE: Terminals are unlocked and pushed out from the front (pin side) of the connector housing.

Standard Gauge Models

HEATER TERMINALS (LH HANDLEBAR CONNECTOR)	
High	Pin 1 (OR)
Low	Pin 2 (OR/VI)
Ground	Pin 3 (BK)

HEATER TERMINALS (RH HANDLEBAR CONNECTOR)	
High	Pin 6 (OR)
Low	Pin 5 (OR/VI)
Ground	Pin 4 (BK)

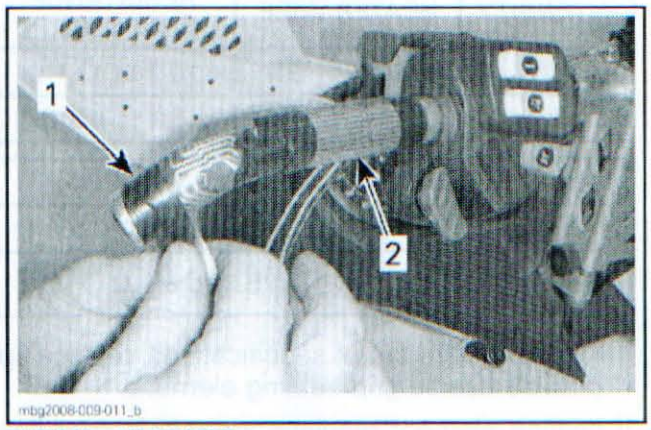
Premium Gauge Models

HEATER TERMINALS (LH HANDLEBAR CONNECTOR)	
Supply	Pin 2 (OR)
Ground	Pin 1 (BK)

HEATER TERMINALS (RH HANDLEBAR CONNECTOR)	
Supply	Pin 1 (OR)
Ground	Pin 4 (BK)

NOTICE Be sure to take note of exact positioning of grip heaters, locking ties, and wire routing before removing them from the handlebar.

5. Cut locking ties securing heater wires to handlebar.
6. Pull wires from harness protective sheath, multifunction switch housing or throttle lever housing.
7. Cut and remove BLACK electrical tape from heater element and remove heater from cork insulator.



TYPICAL - LH HEATER
1. Electrical tape
2. Heater element

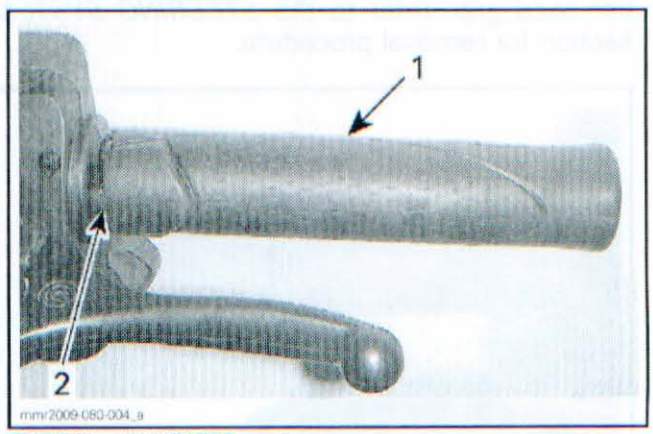
8. If damaged, remove cork insulator from handle bar and clean all adhesive residue from the handlebar.

Grip Heater Element Installation

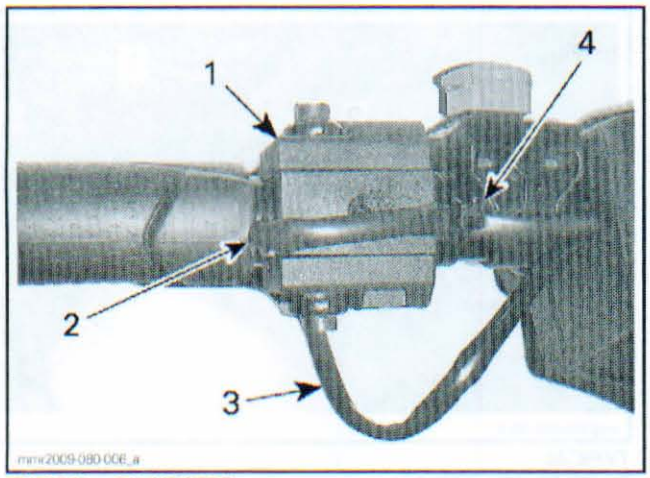
Models with Integrated Heaters

On models with heaters integrated within the rubber hand grip, refer to the *STEERING SYSTEM* section for installation procedures.

NOTE: When installing the hand grips with integrated heaters, be sure to position them with the heater wire horizontally at the front of the handlebar for proper routing, both sides.



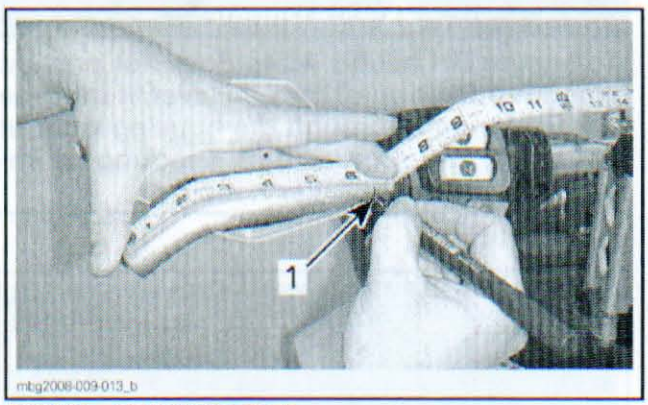
TYPICAL - LH HEATER
1. Grip with integrated heater element
2. Heater wire front horizontal position



TYPICAL - RH HEATER
1. *Throttle lever housing*
2. *Heater wire front horizontal position*
3. *Throttle lever heater wire*
4. *Locking tie*

Models with Adhesive Film Heaters

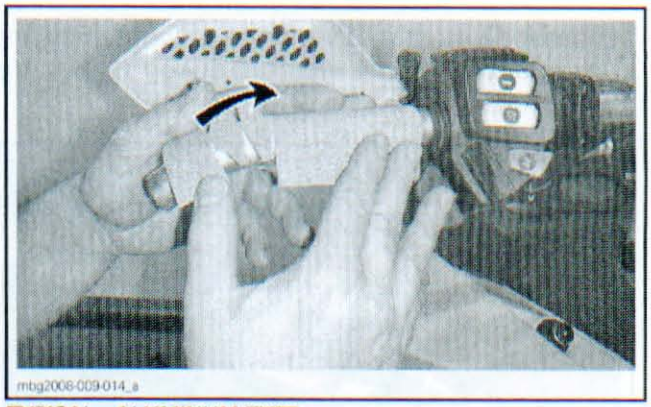
1. Measure specified distance from the end of the handlebar, and across the top of the bend in the bar (if applicable). Trace a reference line with a marker at that point on the handle bar as shown.



TYPICAL - ALUMINUM TYPE
1. *Trace reference line*

HANDLEBAR TYPE	REFERENCE LINE DISTANCE
STEEL	135 mm (5.3 in)
ALUMINUM	153 mm (6 in)

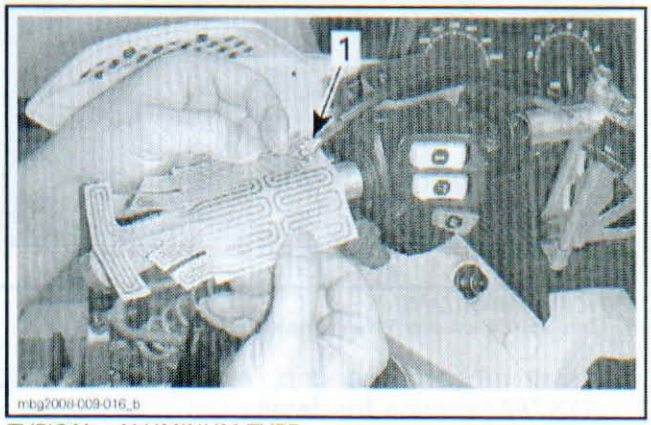
2. Align the edge of the cork insulator with the reference line centered with the handlebar folding axis as illustrated. The ends should meet to form the joint under the handlebar.



TYPICAL - ALUMINUM TYPE

3. Apply firm pressure to cork insulator to assure proper adherence to handlebar.
4. Install the film heater element on the cork insulator and center of handlebar folding axis as per following table.

HANDLEBAR TYPE	HEATER ALIGNMENT
STEEL	At 2.5 mm (3/32 in) of the inside edge of insulator
ALUMINUM	Flush to inside edge of insulator



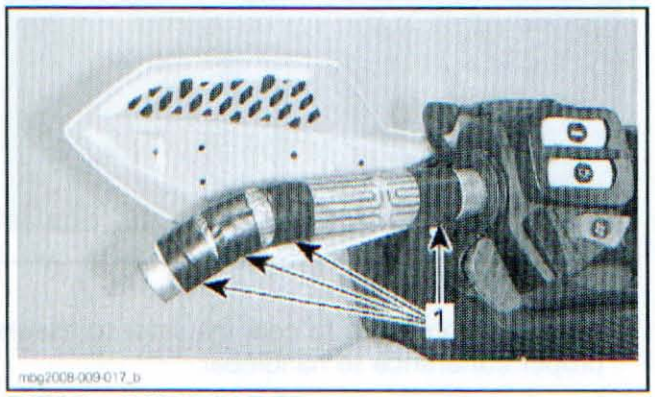
TYPICAL - ALUMINUM TYPE
1. *Heater wire position (LH front, RH rear)*

5. Apply firm pressure to heater to assure proper adherence to cork insulator.

NOTE: The same heater element is used for both the LH and RH sides. Therefore, the electrical wiring will be in front of the handlebar on the LH side, and behind the handlebar (towards driver) on the RH side.

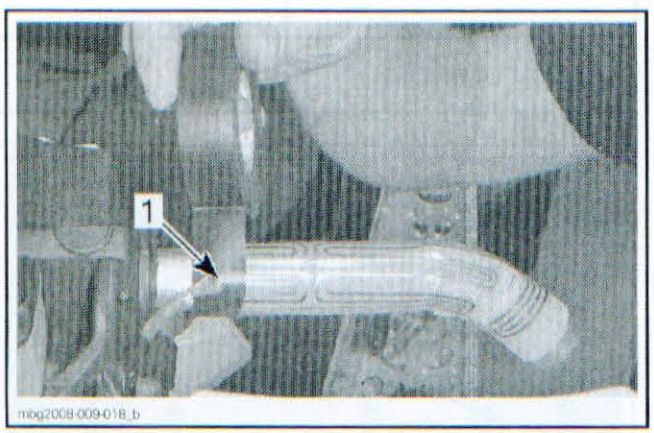
6. On aluminum handlebar, apply two turns of BLACK electrical tape at each of the four locations illustrated. On steel handlebar, apply tape at the outside and inside ends (two locations). The tape must cover the edges of the

heater element and welds to prevent snagging and damage to the element during rubber grip installation.



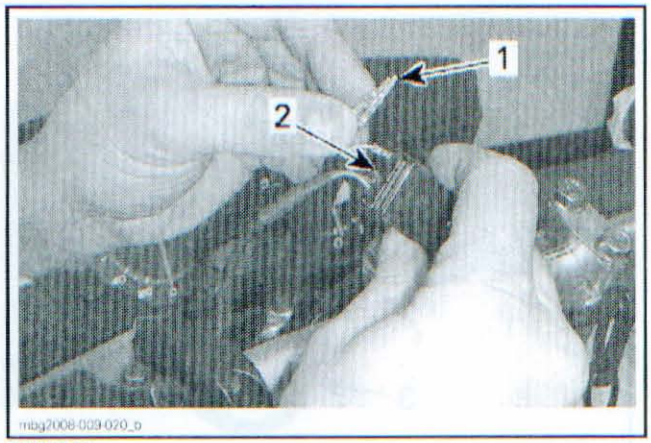
TYPICAL - ALUMINUM TYPE
1. Electrical tape application

NOTE: It is highly important to apply tape so that it fully secures the electrical wire connections and covers welds. This will ease installation of the rubber hand grip and prevent undue stress to the connections.



TYPICAL - IMPORTANT
1. Tape application over wire connections

7. Install rubber hand grip, refer to *STEERING SYSTEM* section for detail.
8. Route wiring as noted during the removal procedure.
9. Insert wire connectors in steering connector housing.



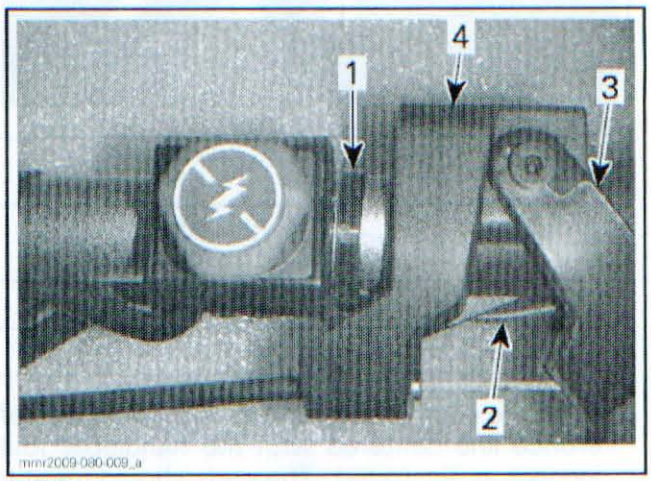
TYPICAL
1. Heater wire terminals
2. Insertion through back of connector

NOTE: On vehicles equipped with a premium gauge, only two of the heater wires are used. The ORANGE/VIOLET wire terminal will need to be cut off near the connector, insulated using heat shrink, a terminal end or electrical tape, then stored inside the wire harness protective sheath.

10. Install locking ties to secure the heater wire tightly against the handlebar.

⚠ WARNING

To ensure RH heater wires does not prevent smooth operation of throttle lever, it must be passed straight through the housing without any slack, and secured with a locking tie immediately after the lever housing.



TYPICAL
1. Locking tie
2. Heater wire straight through throttle lever housing
3. Throttle lever
4. Lever housing

NOTICE Ensure LH heater wires are properly routed through multifunction switch housing to prevent them from being pinched when installing housing cover. Pinched or damaged wires may result in a short circuit.

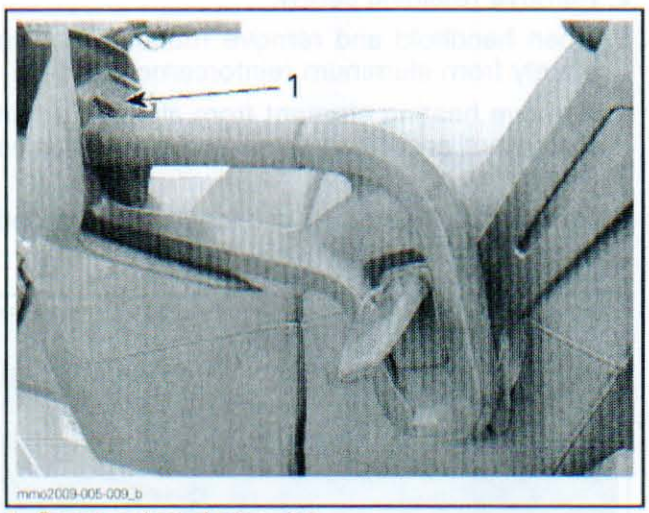
11. Start engine or apply power to the accessories, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.
12. Using the hand grip heat selector switch, turn on the hand grip heaters and ensure they are functioning correctly.

PASSENGER HEATED GRIPS

GTX Only

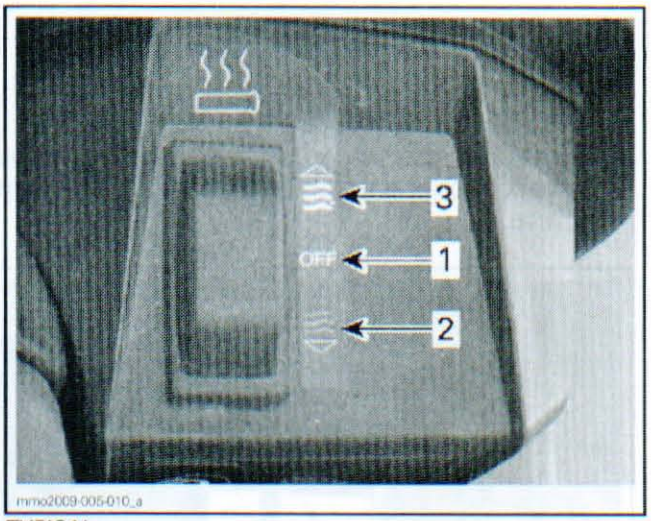
System Description

The grip heater is controlled by a toggle switch located on the LH handhold.



1. Passenger heated grip switch

Adjust heating intensity as shown.



TYPICAL
1. OFF
2. Low
3. High

Passenger Grips Voltage Input Test

1. Refer to *BODY* and remove passenger seat.
2. From under the seat, locate the applicable accessory connector and pull it out of its retaining clip.
3. Set FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
4. Start engine or apply power to the accessories, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.
5. Back probe connector and read voltage as follows:

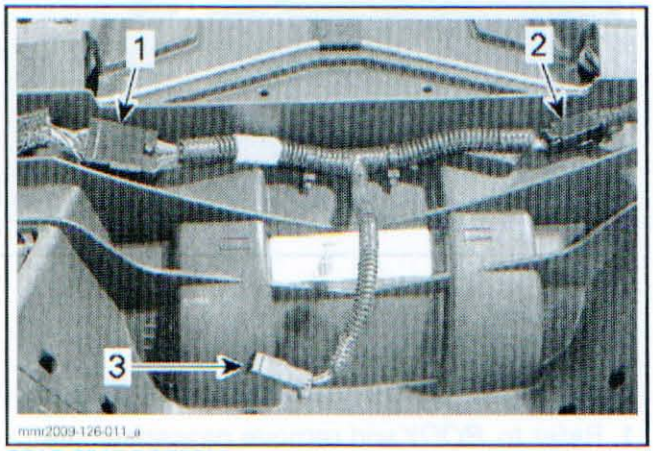
LH HEATED GRIP			
SWITCH POSITION	PROBES		VOLTAGE
Low	OR wire (pin 1)	BK (Pin 3)	Battery voltage
High	OR/VI wire (pin 2)		

LH HEATED GRIP			
SWITCH POSITION	PROBES		VOLTAGE
Low	OR wire (pin 3)	BK (Pin 1)	Battery voltage
High	OR/VI wire (pin 2)		

Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check switch, ground and supply circuits independently. Repair open circuit or replace switch as needed.

Passenger Grips Heating Element Testing

1. Refer to *BODY* and remove passenger seat.
2. From under the seat, disconnect the applicable accessory connector and pull it out of its retaining clip.



REAR SEAT BOTTOM
1. *LH accessory connector*
2. *RH accessory connector*
3. *Rear seat supply connector*

3. Set multimeter to Ω.
4. Test heating element as per following specifications.

LH PASSENGER GRIP HEATER			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI Pin 2	BK Pin 3	17 to 21 Ω
HIGH	OR Pin 1		8.5 to 10.5 Ω

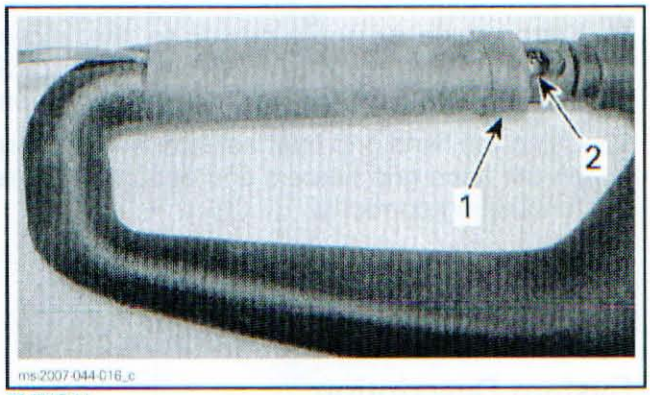
RH PASSENGER GRIP HEATER			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI Pin 2	BK Pin 1	17 to 21 Ω
HIGH	OR Pin 3		8.5 to 10.5 Ω

If heating element readings are not within specifications, replace heating element.

If heating element readings are within specifications, carry out *PASSENGER GRIPS VOLTAGE INPUT TEST*.

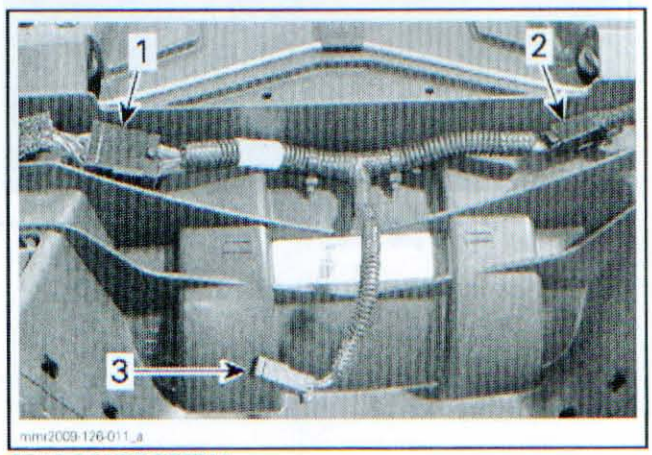
Passenger Grips Heating Element Replacement

1. Roll up rubber grip just enough to clear retaining screw.



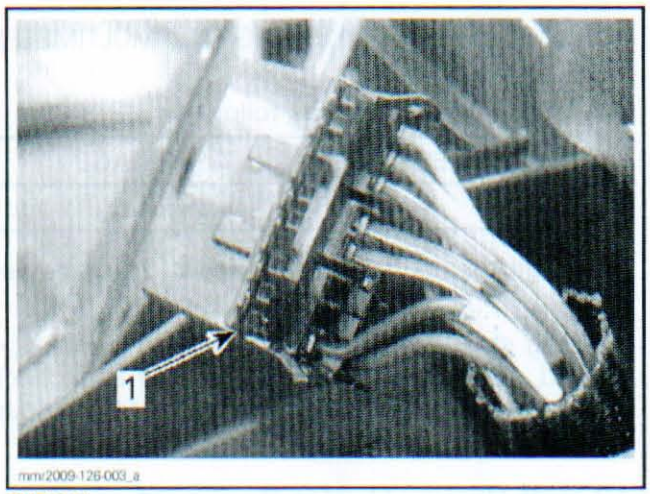
TYPICAL
1. *Rubber grip*
2. *Screw*

2. Remove retaining screw.
3. Open handhold and remove rubber grip completely from aluminum reinforcement.
4. Remove heating element from aluminum reinforcement and clean remaining glue if necessary.
5. Turn seat upside down and locate the appropriate connector.



REAR SEAT BOTTOM
1. *LH accessory connector*
2. *RH accessory connector*
3. *Rear seat supply connector*

6. Open connector cover.



TYPICAL
1. Connector cover

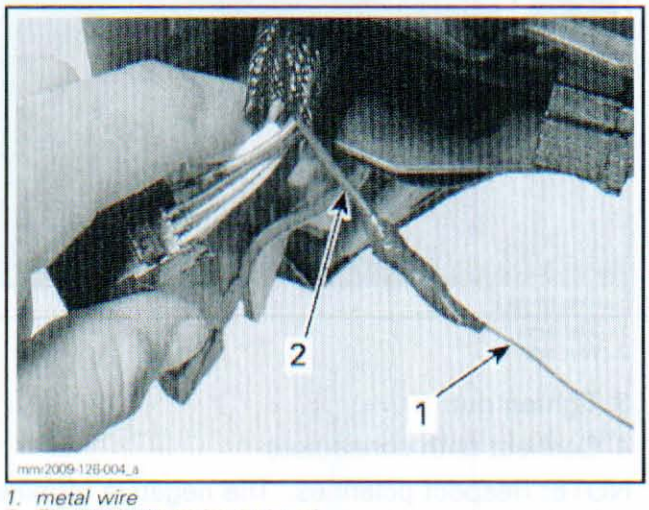
7. Using an appropriate tool such as the MULTILOCK - TERMINAL EXTRACTION TOOL (P/N 755430-2), unlock the heater wire terminals and push them out of the connector housing.

NOTE: On the RH connector, remove all three terminals.

LH CONNECTOR HEATER TERMINALS	
High	Pin 1 (OR)
Low	Pin 2 (OR/VI)
Ground	Pin 3 (BK)

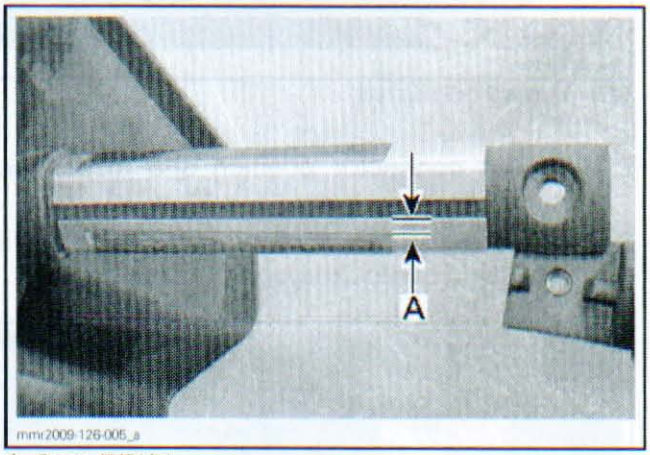
8. Securely Install the end of a metal wire length on the terminals and apply some electrical tape tightly over it. This will help routing the wires back through the sheath.

NOTE: The LH wires have to be pulled out one at time. The RH wires can be pulled out all together.



1. metal wire
2. Electrical wire to be removed

9. Carefully pull the wires out.
10. Remove the old heating element wires from the metal wire end.
11. Securely install the end of the metal wire on the new heating element wire terminals and apply tape.
12. Carefully route the new heating element wires through the sheath using the metal wire.
13. Stick the new heating element starting at approximately 2 mm (5/64 in) from the lower edge of the aluminum reinforcement.



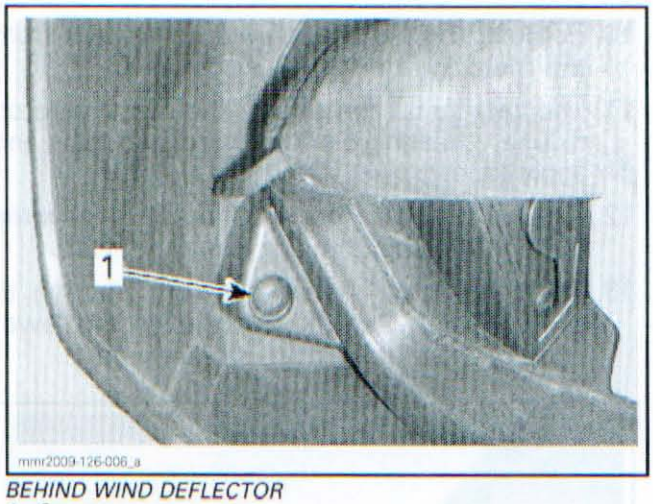
A. 2 mm (5/64 in)

14. Apply a solution of soap and water to the inside of the rubber hand grip.
15. Slide rubber grip back onto the aluminum reinforcement leaving room to install screw.
16. Close the handhold and tighten screw.
17. Finish the rubber grip installation.
18. Reinstall terminals into connector housing and close cover.
19. Reconnect connector and install seat.
20. Start engine or apply power to the accessories, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.
21. Operate heated grips to make sure they work properly.
22. Install remaining components.

Passenger Heated Grips Switch Replacement

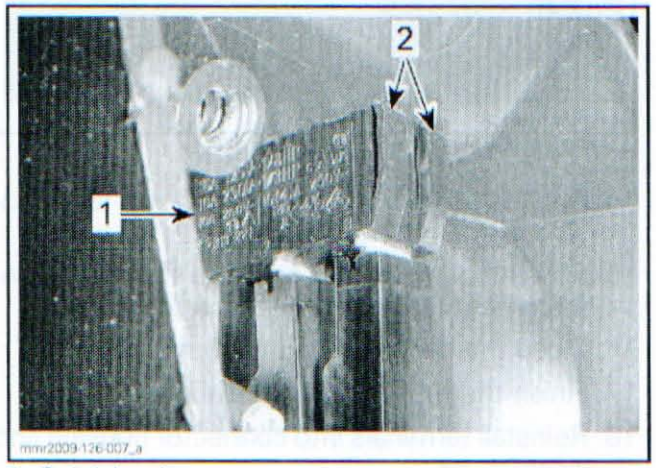
1. Remove all five LH wind deflector screws.

NOTE: The fifth screw is located inside wind deflector.



BEHIND WIND DEFLECTOR
1. Screw

2. Note the connector position and disconnect them.
3. Remove switch by pushing retaining clips in and passing switch through console.



1. Switch housing
2. Retaining clips

4. Install and connect the new switch.
5. Install other removed parts.

12-VOLT POWER OUTLET

12-Volt Power Outlet Testing

GSX and GTX Only

First try another accessory, if it does not function, test outlet as follows:

1. Remove console, refer to *BODY* section.
2. Disconnect both power outlet connectors.
3. Apply power to the accessories circuits, see *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this section.
4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868)
5. Measure the voltage as follows.

WIRES		VOLTAGE
RD/YL	BK	Approximately 12 Vdc

If voltage reading is good, replace 12 volt power outlet.

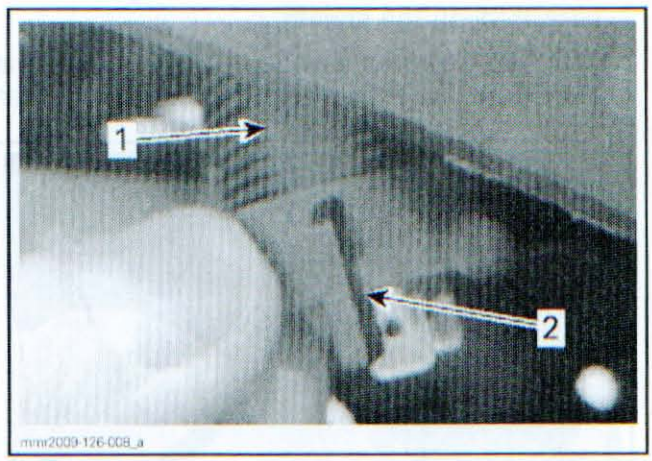
Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check ground and supply circuits independently. Repair open circuit as needed.

12-Volt Power Outlet Removal

1. Remove console, refer to *BODY* section.
2. Disconnect both connectors from the power outlet.
3. Unscrew the nut securing the power outlet to console until loose (maximum 1/2 turn), then pull it off.
4. Unlock power outlet by turning it counterclockwise, then remove it.

12-Volt Power Outlet Installation

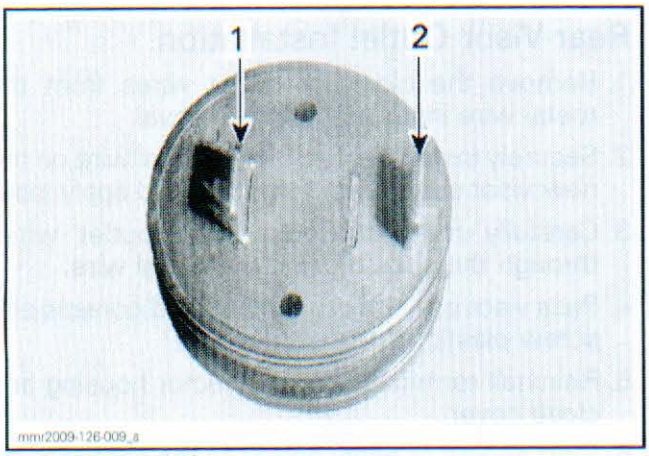
1. Install power outlet in bore, then lock it in place by turning it clockwise.
2. Align the nut tabs with the flat areas on the power outlet, then push nut up until it leans against the gauge support.



1. Flat area
2. Nut tab

3. Tighten nut.
4. Connect both connectors.

NOTE: Respect polarities. The negative terminal is located closest to the power outlet edge.



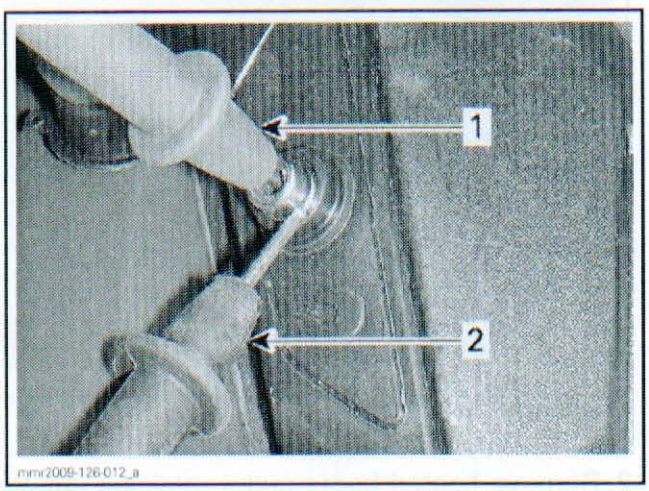
1. Positive terminal
2. Negative terminal (closer to the edge)

FRONT VISOR OUTLET (DRIVER)

GSX and GTX Only

Front Visor Outlet Testing

1. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
2. Apply power to the accessories circuits, see *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.
3. Measure voltage in visor outlet.
   - 3.1 Put multimeter RED probe in the outlet female terminal and hold.
   - 3.2 Touch the metal outer surface of the outlet with the BLACK multimeter probe.



1. RED probe
2. BLACK probe

Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check ground and supply circuits independently. Repair open circuit as needed.

Front Visor Outlet Removal

1. Remove console, refer to *BODY* section.
2. Refer to *AIR INTAKE SYSTEM* and disconnect intake hose.
3. Follow the visor outlet wires, locate connector and disconnect it.
4. Unscrew the visor outlet plastic cover, then remove outlet from gauge support.

Front Visor Outlet Installation

The installation is the reverse of the removal procedure. Refer to *AIR INTAKE SYSTEM* subsection for intake hose installation and *BODY* section for console installation.

REAR VISOR OUTLET (PASSENGER)

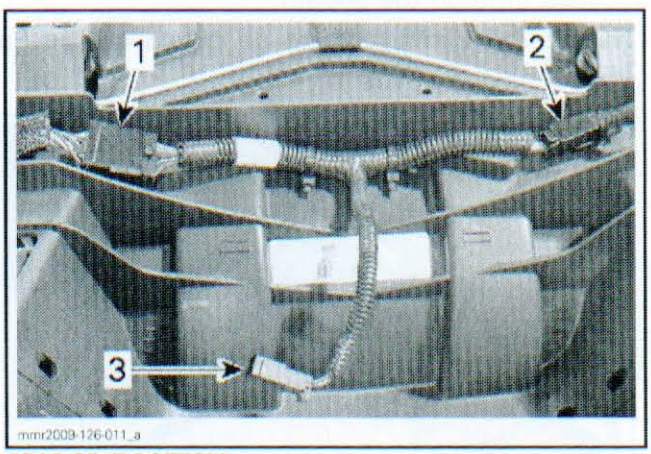
GTX Only

Rear Visor Outlet Testing

1. Apply the *FRONT DRIVER VISOR OUTLET TESTING (DRIVER)* method.

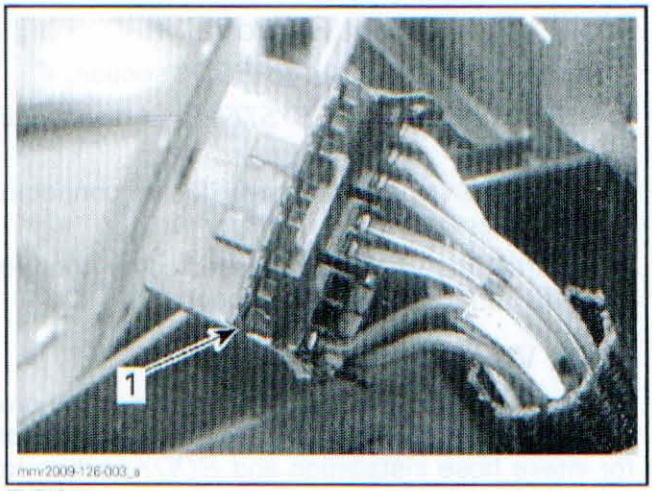
Rear Visor Outlet Removal

1. Refer to *BODY* and remove passenger seat.
2. Turn seat upside down and locate the LH connector.



REAR SEAT BOTTOM
1. LH accessory connector
2. RH accessory connector
3. Rear seat supply connector

3. Open connector cover.



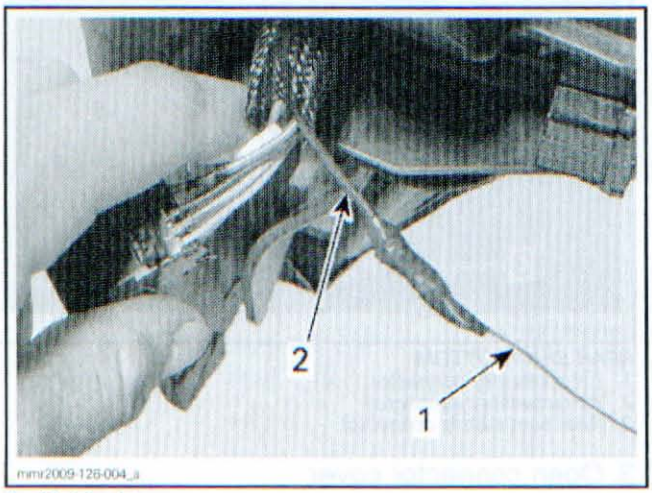
TYPICAL
1. *Connector cover*

4. Using an appropriate tool such as the MULTILOCK - TERMINAL EXTRACTION TOOL (P/N 755430-2), unlock the visor outlet wire terminals and push them out of the connector housing.

VISOR OUTLET CONNECTOR TERMINALS	
Positive	Pin 11 (RD/YL)
Ground	Pin 6 (BK)

5. Securely Install the end of a metal wire length on the terminals and apply some electrical tape tightly over it. This will help routing the wires back through the sheath.

NOTE: The wires have to be pulled out one at time.



1. *Metal wire*
2. *Electrical wire to be removed*

6. Carefully pull the wires out.

Rear Visor Outlet Installation

1. Remove the old visor outlet wires from the metal wire installed during removal.
2. Securely install the end of the metal wire on the new visor outlet wire terminals and apply tape.
3. Carefully route the new visor outlet wires through the sheath using the metal wire.
4. Pass visor outlet through handhold console and screw plastic cap to secure it.
5. Reinstall terminals into connector housing and close cover.
6. Start engine or apply power to the accessories, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.
7. Test visor outlet to make sure it works properly.
8. Install remaining components.

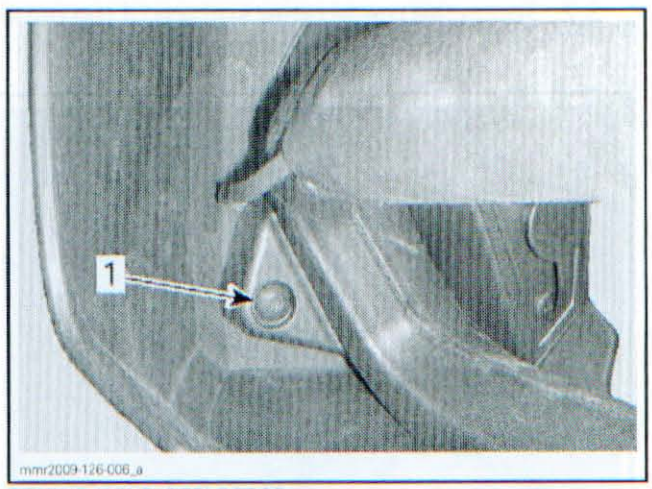
HEATED BOOTS OUTLET (GTX ONLY)

Heated Boots Outlet Testing

First, try another accessory, if it does not function, test visor outlet.

1. Remove all five LH wind deflector screws.

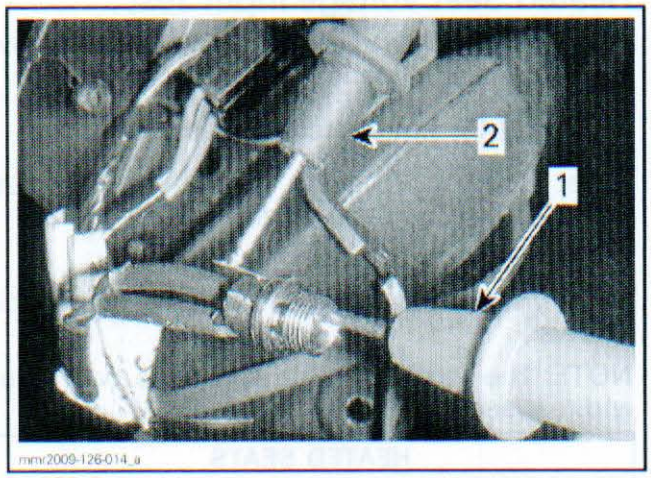
NOTE: The fifth screw is located inside wind deflector.



BEHIND WIND DEFLECTOR
1. *Screw*

2. Remove heated boots outlet retaining nut and washer, then remove outlet.
3. Set FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
4. Apply power to the accessories circuits, see *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.

5. Measure voltage on heated boots outlet.
   5.1 Put multimeter RED probe in the outlet making sure to touch the pin terminal (positive).
   5.2 Touch the metal tab (ground) on the outlet with the BLACK multimeter probe.

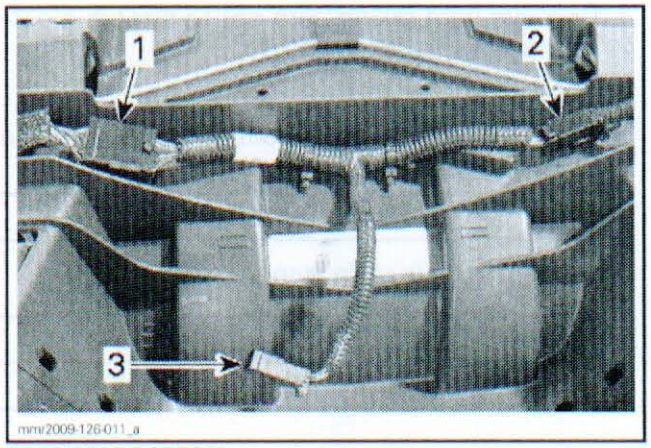


1. RED Probe
2. BLACK probe

Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check ground and supply circuits independently. Repair open circuit as needed.

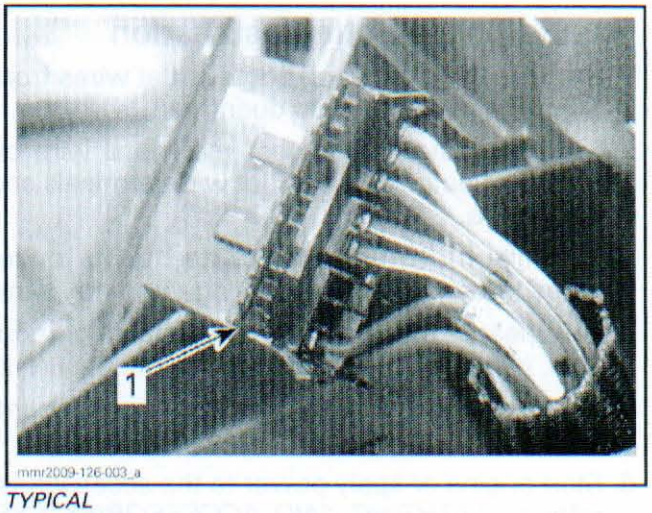
Heated Boots Outlet Removal

1. Carry out steps 1 and 2 of *HEATED BOOTS OUTLET TESTING*.
2. Refer to *BODY* and remove passenger seat.
3. Turn seat upside down and locate the LH connector.



REAR SEAT BOTTOM
1. LH accessory connector
2. RH accessory connector
3. Rear seat supply connector

4. Open connector cover.



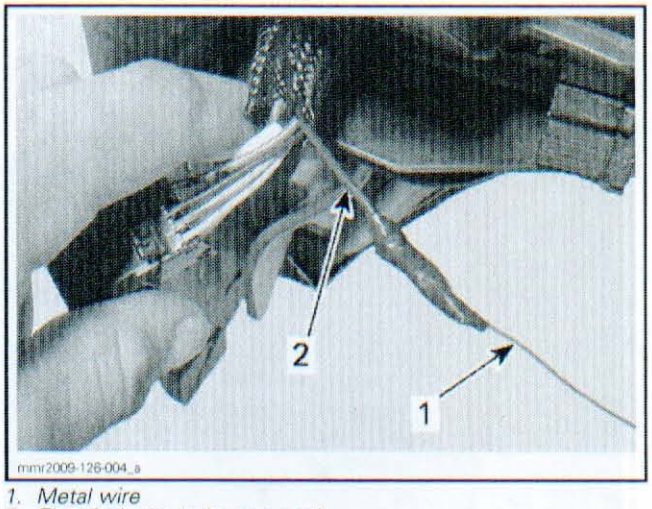
TYPICAL
1. Connector cover

5. Using an appropriate tool such as the MULTILOCK - TERMINAL EXTRACTION TOOL (P/N 755430-2), unlock the heated boots outlet wire terminals and push them out of the connector housing.

HEATED BOOTS OUTLET CONNECTOR TERMINALS	
Positive	Pin 10 (RD/YL)
Ground	Pin 14 (BK)

6. Securely Install the end of a metal wire length on the terminals and apply some electrical tape tightly over it. This will help routing the wires back through the sheath.

NOTE: The wires have to be pulled out one at time.



1. Metal wire
2. Electrical wire to be removed

7. Carefully pull the wires out.

Heated Boots Outlet Installation

1. Remove the old heated boots outlet wires from the metal wire installed during removal.
2. Securely install the end of the metal wire on the new heated boots outlet wire terminals and apply tape.
3. Carefully route the new heated boots outlet wires through the sheath using the metal wire.
4. Pass heated boots outlet through handhold console, install washer and screw nut to secure it.
5. Reinstall terminals into connector housing and close cover.
6. Start engine or apply power to the accessories, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in this subsection.
7. Test heated boots outlet to make sure it works properly.
8. Install remaining components.

HEATED SEATS

GTX SE Only

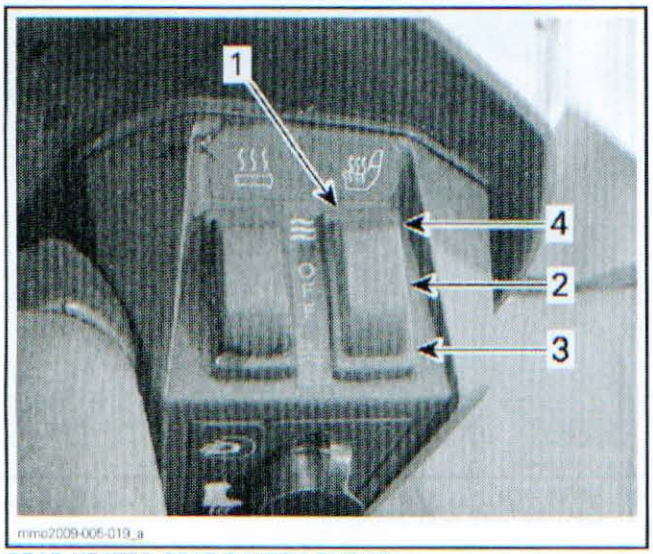
System Description

The heated seats are controlled by toggle switches.

The driver's seat switch is located on the RH side of gauge support.

The passenger seat switch is located on the LH passenger handhold.

Adjust heating intensity as shown.



REAR HEATED SEAT SWITCH SHOWN
1. *Heated seat switch*
2. *OFF*
3. *Low*
4. *High*

NOTE: A diode is installed between the low and the high intensity circuits to prevent a current bridge between these circuits. If no seat heating intensity is felt when toggling switch from LOW to HIGH, check diode. Refer to *WIRING DIAGRAM* for details.

Heated Seat Voltage Input Test

1. Refer to *BODY* and unlatch applicable seat leaving the heater connector connected.

NOTICE **Do not stretch harness.**

2. Set FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) multimeter to Vdc.
3. Start engine.
4. Back probe connector and read voltage as follows:

NOTE: The following table applies to both front and rear seat.

HEATED SEATS			
SWITCH POSITION	PROBES		VOLTAGE
Low	Pin 4 (YL)	Pin 1 (BK)	Battery voltage
High	Pin 3 (RD)		

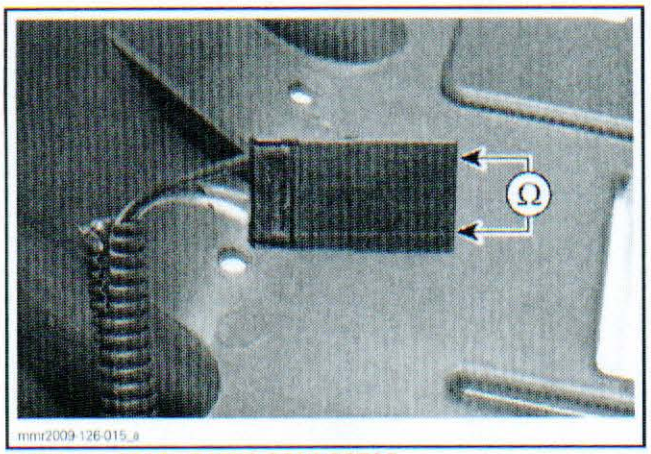
Reading should be battery voltage. If no voltage is read, refer to *WIRING DIAGRAM* and check switch, ground and supply circuits independently. Repair open circuit or replace switch as needed.

Seat Heating Element Testing

The heated seat connectors are located underneath the seats, see illustrations.

1. Remove seat taking care not to stretch electrical harness, refer to *BODY*.
2. Set multimeter to Ω.
3. Measure resistance in heating element as per following table.

SEAT HEATERS			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	YL	BK	29 to 35 Ω
HIGH	RD	BK	16 to 19 Ω



TYPICAL - SEAT HEATER CONNECTOR

If heating element readings are not within specifications, replace heating element.

If heating element readings are within specifications, carry out *HEATED SEATS VOLTAGE INPUT TEST.*

Seat Heating Element Replacement

The heating elements are part of the seat covers. To replace a defective seat heating element, replace seat cover. Refer to *BODY* for procedure.

Driver Heated Seat Switch

Driver Heated Seat Switch Replacement

1. Remove the console, refer to *BODY* section.
2. Remove switch from gauge support by releasing the retaining tabs and pushing switch out.
3. Disconnect connectors from old switch and connect them to the new switch one at a time.
4. install the new switch in the gauge support.
5. Install other removed parts.

Passenger Heated Seat Switch

Passenger Heated Seat Switch Replacement

Use the same method as the *PASSENGER HEATED GRIPS SWITCH REPLACEMENT* (in this subsection).

DRIVE BELT

SERVICE TOOLS

Description	Part Number	Page
DRIVEN PULLEY OPENING TOOL	529 017 200	299
DRIVEN PULLEY OPENING TOOL	529 036 127	299, 301

GENERAL

APPLICATION CHART

MODEL	DRIVE BELT (P/N)
All REV-XR 1200	417 300 383

PROCEDURES

DRIVE BELT GUARD

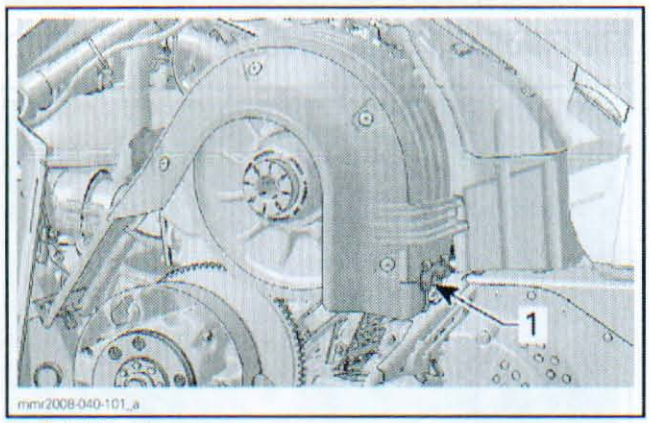
Drive Belt Guard Removal

⚠ WARNING

NEVER operate the snowmobile without the drive belt guard securely installed.

Open the LH side panel.

Remove retaining pin.



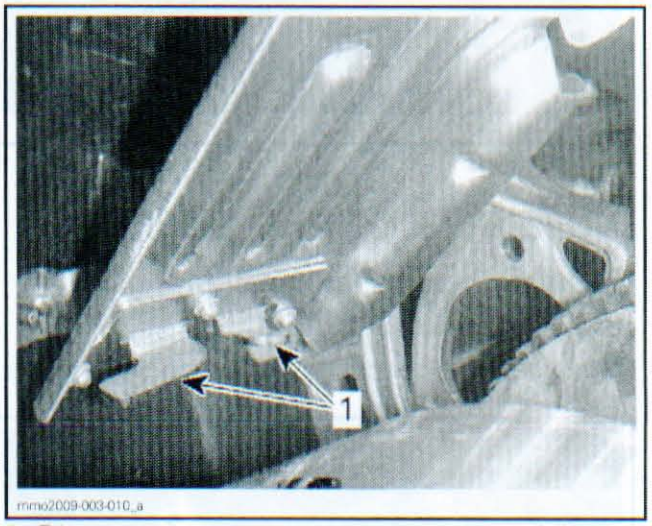
1. Retaining pin

Lift rear portion of guard then release from front tabs by pivoting the guard outwards.

Drive Belt Guard Installation

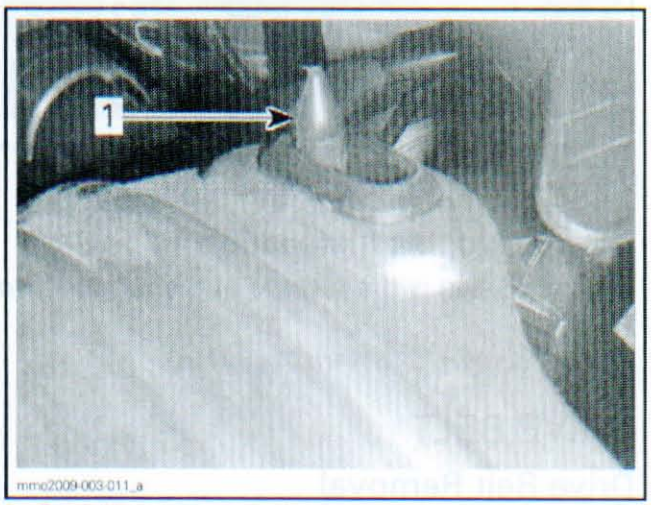
Place the front LH slot of the guard over the longest tab.

Pivot the guard inward to engage the shortest tab in the RH slot.



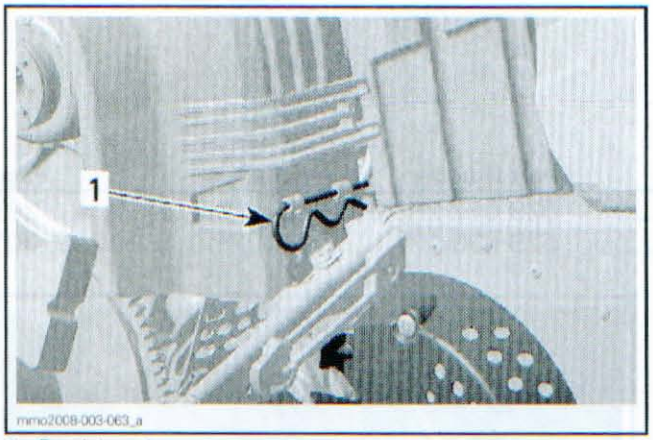
1. Tabs

Position the grommet over the retaining rod. It may be necessary to slightly lift the console to make room.



1. Retaining rod

Position rear portion of the drive belt guard over the retainer and secure it using the retaining pin.



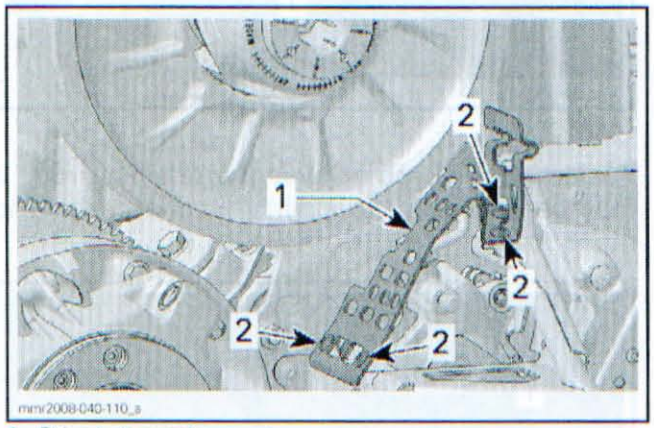
1. Retaining pin

DRIVE BELT GUARD SUPPORT

Guard Support Removal

Remove the drive belt guard.

Remove screws securing the support to vehicle.



1. Drive belt guard support
2. Screws

Guard Support Installation

The installation is the reverse of the removal procedure.

Tighten screws to 5 N•m (44 lbf•**in**).

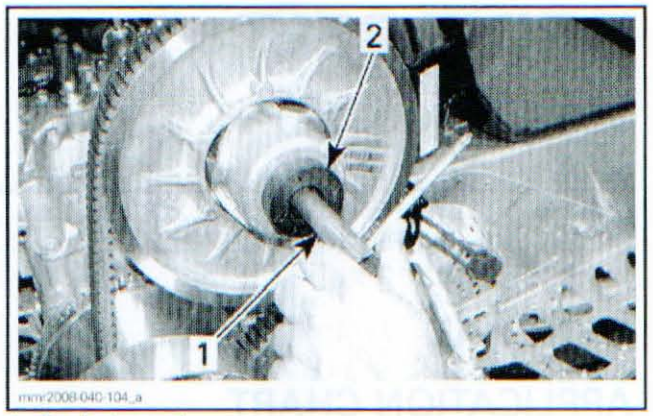
DRIVE BELT

Drive Belt Removal (Ring Type Pulley Adjuster)

Open the LH side panel.

Remove the drive belt guard.

Using the spark plug tool (included in the tool kit) or an 11/16 in thin wall socket, loosen (± 4 turns) the adjustment ring adapter located inside adjustment ring.

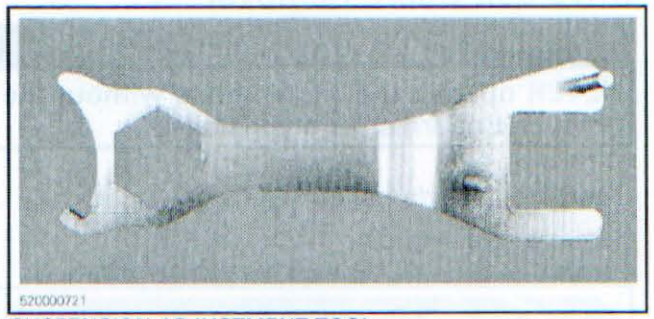


1. Spark plug tool
2. Driven pulley adjustment ring

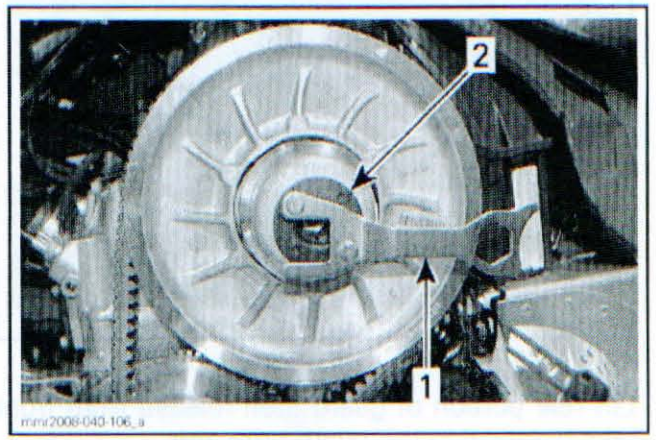
To open the driven pulley, proceed as follows with one of the following tools.

Procedure with Suspension Adjustment Tool

Using the suspension adjustment tool (included in the tool kit), open the driven pulley by turning the tool clockwise.

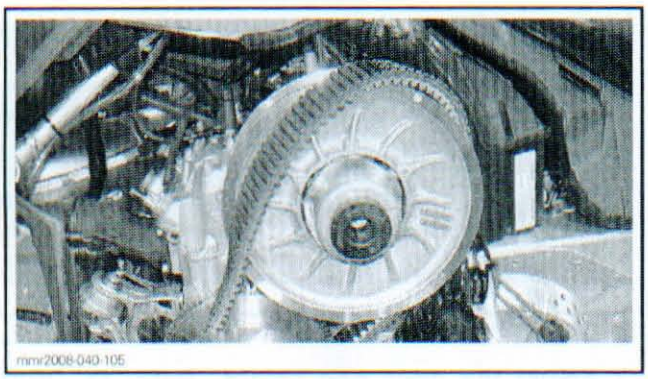


SUSPENSION ADJUSTMENT TOOL



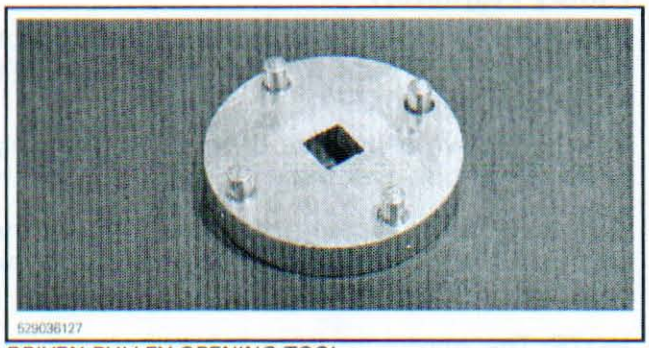
1. Suspension adjustment tool
2. Driven pulley adjustment ring

To remove belt, slip the belt over the top of driven pulley.

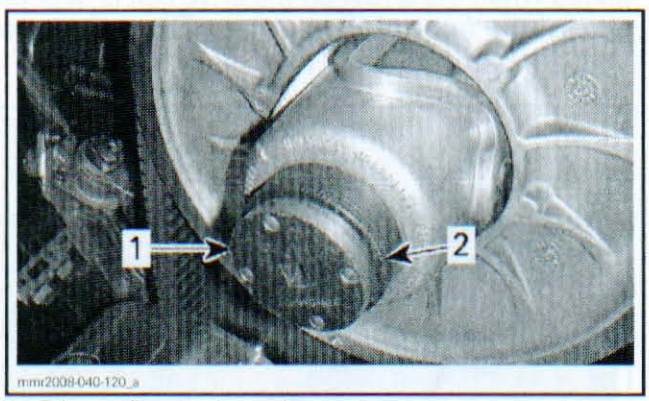


Procedure with Driven Pulley Opening Tool

Using the DRIVEN PULLEY OPENING TOOL (P/N 529 036 127), open the driven pulley by turning the tool clockwise.

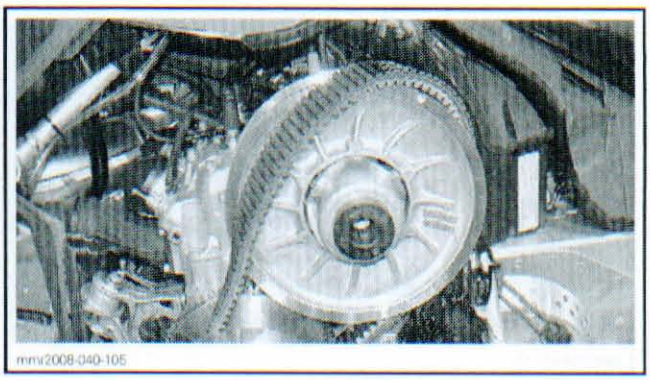


DRIVEN PULLEY OPENING TOOL



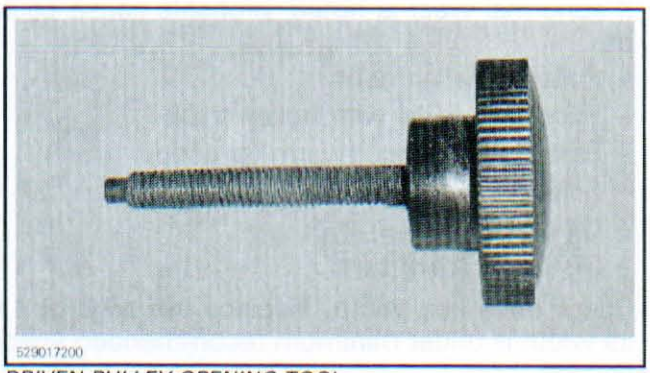
1. *Driven pulley opening tool*
2. *Driven pulley adjustment ring*

To remove belt, slip the belt over the top of driven pulley, then over the drive belt pulley.

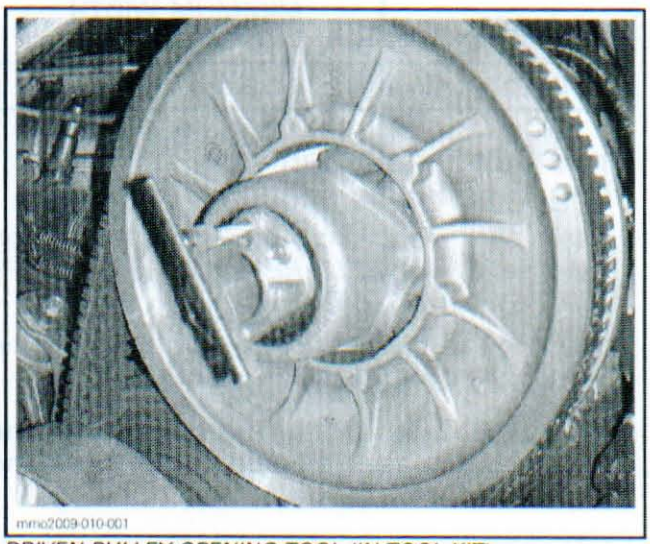


Drive Belt Removal (Screw Type Pulley Adjuster)

1. Remove the drive belt guard.
2. Insert the DRIVEN PULLEY OPENING TOOL (P/N 529 017 200) (or the tool provided in the tool box) in the threaded hole on the adjuster hub.

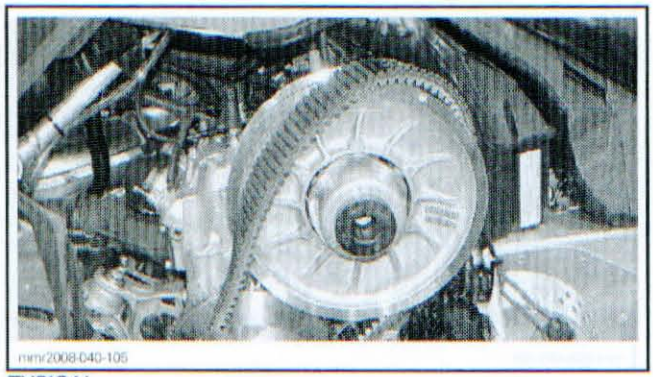


DRIVEN PULLEY OPENING TOOL



DRIVEN PULLEY OPENING TOOL (IN TOOL KIT)

3. Open the driven pulley by screwing the tool in.
4. To remove belt, slip the belt over the top of driven pulley, then over the drive pulley.


mmr2008-040-105

TYPICAL

Drive Belt Inspection

Inspect belt for:

- Cracks
- Fraying
- Abnormal wear (uneven wear, wear on one side, missing cogs, cracked fabric).

If abnormal wear is noted, probable cause could be:

- Pulley misalignment
- Excessive RPM with frozen track
- Fast starts without warm-up period
- Scratched or rusty sheave
- Oil on belt
- Distorted spare belt.

Check drive belt width. Replace the drive belt if its width is under minimum recommended specification.

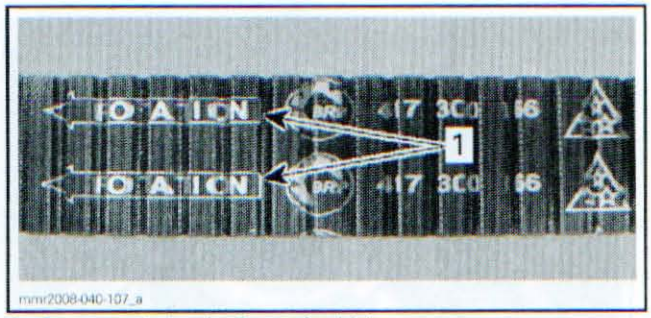
MODEL	MINIMUM WIDTH (WEAR LIMIT)
All REV-XR 1200	35.9 mm (1.413 in)

Drive Belt Installation (Ring Type Pulley Adjuster)

1. Make sure the driven pulley is opened. If not, refer to *DRIVE BELT REMOVAL (RING TYPE PULLEY ADJUSTER)* above.
2. Place the belt inside drive pulley, then slip the top of belt over the driven pulley.

NOTICE Do not force or use tools to pry the belt into place, as this could cut or break the cords in the belt.

NOTE: The maximum drive belt life span is obtained when the arrows on the drive belt are directed toward the front of vehicle. This will ensure that correct direction of rotation is respected.



mmr2008-040-107_a

1. Arrows pointing the front of vehicle

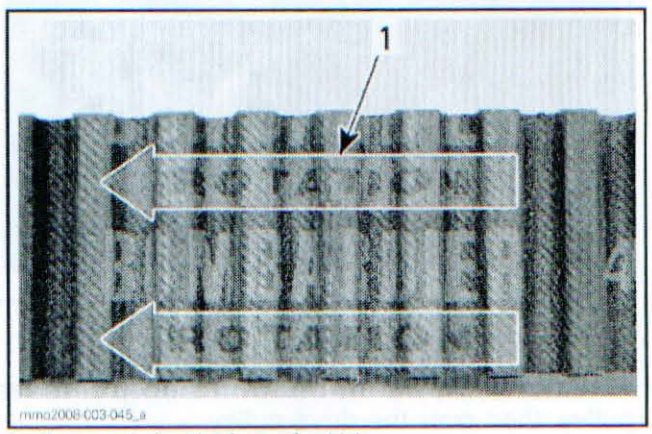
3. Adjust the drive belt height. Refer to *DRIVE BELT HEIGHT ADJUSTMENT (RING TYPE PULLEY ADJUSTER)* and follow steps 4 to 10.

Drive Belt Installation (Screw Type Pulley Adjuster)

1. Make sure the driven pulley is opened. If not, refer to *DRIVE BELT REMOVAL (SCREW TYPE PULLEY ADJUSTER)*.
2. Set the drive belt inside drive pulley, then slip the top of belt over the driven pulley.

NOTICE Do not force or use tools to pry the belt into place, as this could cut or break the cords in the belt.

NOTE: The maximum drive belt life span is obtained when the arrow on the drive belt is directed toward the front of the vehicle. This will ensure that correct direction of rotation is respected.



mmr2008-003-045_a

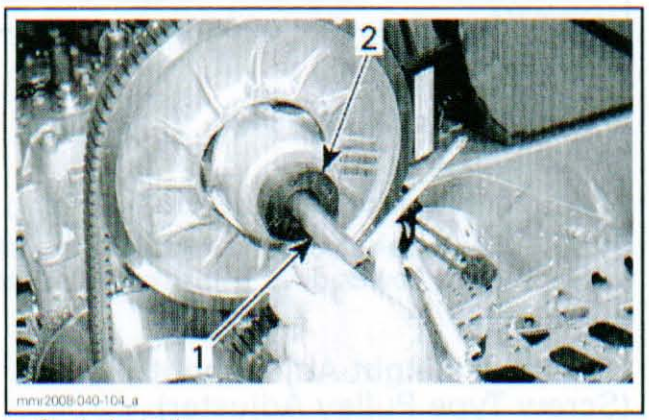
1. Arrow pointing the front of vehicle

3. Unscrew and remove the driven pulley opening tool from the pulley.
4. Rotate the driven pulley several times to properly set the belt between the sheaves.
5. Adjust the drive belt height. Refer to *DRIVE BELT HEIGHT ADJUSTMENT (SCREW TYPE PULLEY ADJUSTER)* and follow steps 3 to 8.

Drive Belt Height Adjustment (Ring Type Pulley Adjuster)

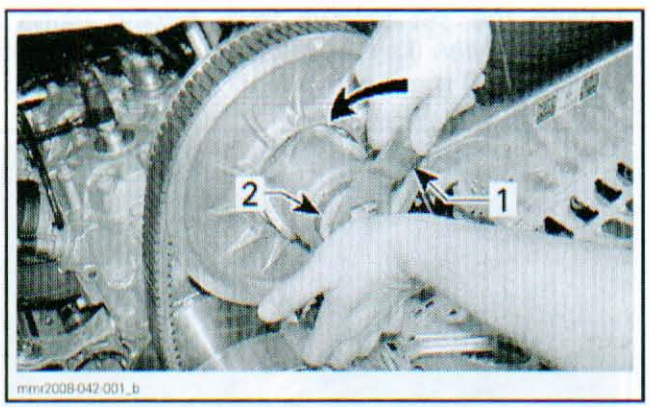
NOTE: Adjust drive belt height every time drive belt is installed.

1. Open the LH side panel.
2. Remove the drive belt guard.
3. Using the spark plug tool (included in the tool kit) or an 11/16 in thin wall socket, loosen (± 4 turns) the adjustment ring adapter located inside adjustment ring.



1. *Spark plug tool*
2. *Driven pulley adjustment ring*

4. Using the suspension adjustment tool or the DRIVEN PULLEY OPENING TOOL (P/N 529 036 127), turn the driven pulley adjuster accordingly to achieve the required drive belt height.



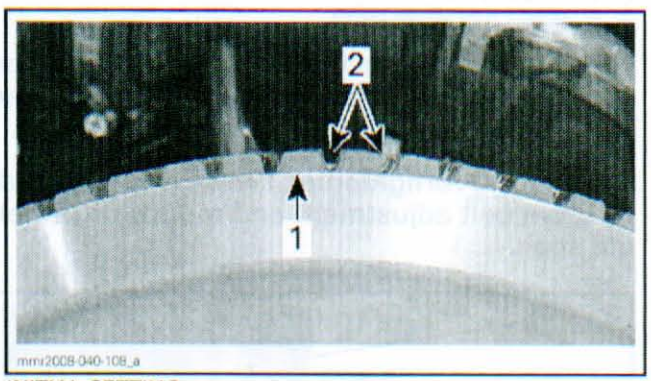
1. *Suspension adjustment tool*
2. *Adjustment ring*

5. Manually rotate drive belt to position it properly inside pulley sheaves.

MANUALLY ROTATE DRIVE BELT

Models with a Mechanical Reverse

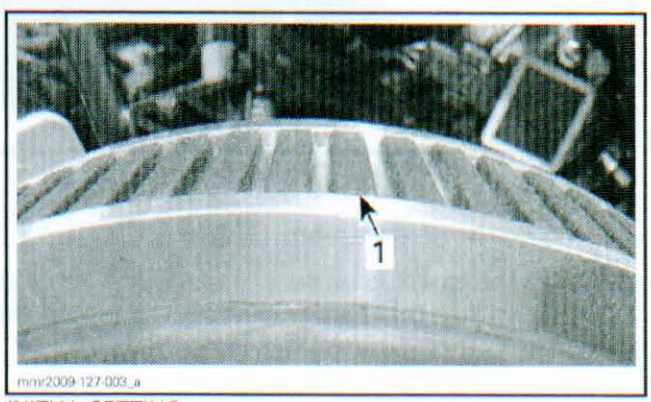
Repeat steps 4 and 5 until the bottom of grooves on the external side of drive belt are flush with the driven pulley edges.



INITIAL SETTING
1. *Driven pulley edge*
2. *External drive belt grooves*

Models with an Electronic Reverse

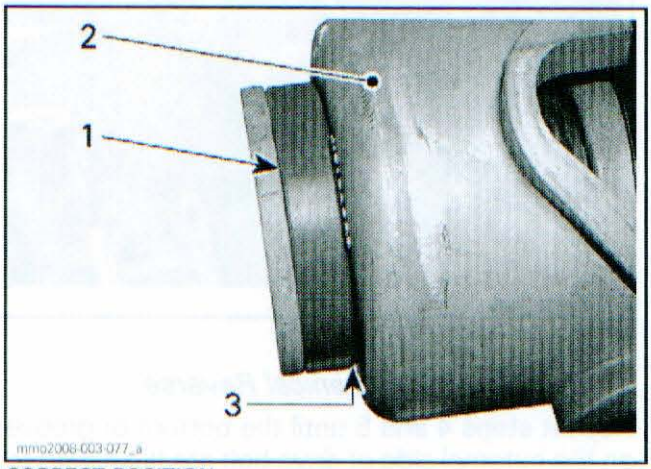
Repeat steps 4 and 5 until the external side of drive belt is flush with the driven pulley edges.



INITIAL SETTING
1. *Flush with driven pulley edge*

All Models

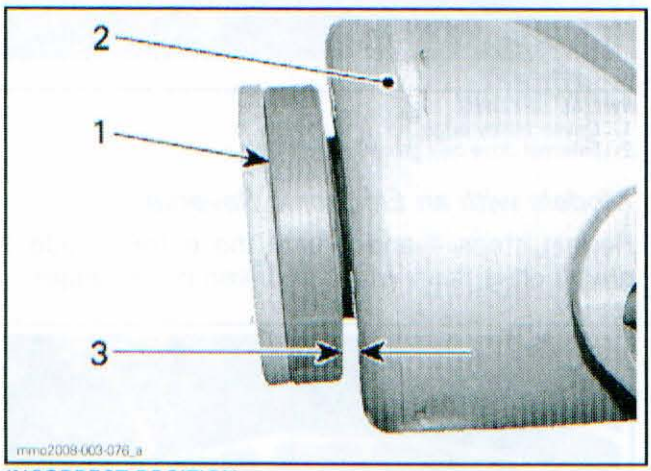
6. When the drive belt is properly positioned, ensure that the swivel ring leans against the driven pulley cam.



CORRECT POSITION
1. *Swivel ring*
2. *Driven pulley cam*
3. *In contact with driven pulley*

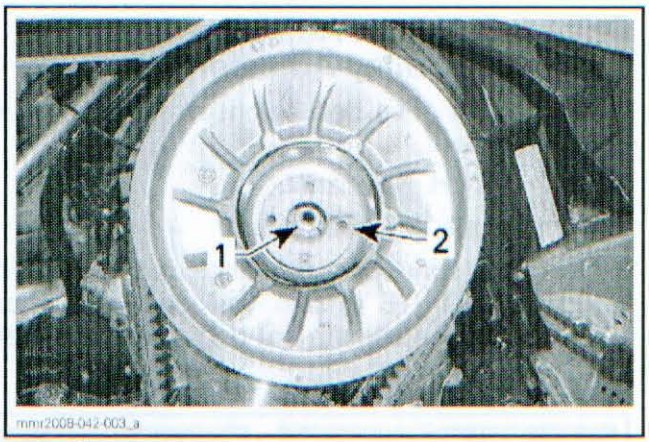
7. If the swivel ring is not in contact with the cam, turn adjustment ring clockwise to lean the swivel ring against the driven pulley cam.

NOTICE **Overtightening swivel ring will modify drive belt adjustment and reduce drive belt life span.**



INCORRECT POSITION
1. *Swivel ring*
2. *Driven pulley cam*
3. *Not in contact with driven pulley*

8. Using the spark plug tool (included in the tool kit) or an 11/16 in thin wall socket, snug up the locking nut (± 4 turns).



1. *Locking nut*
2. *Adjustment ring*

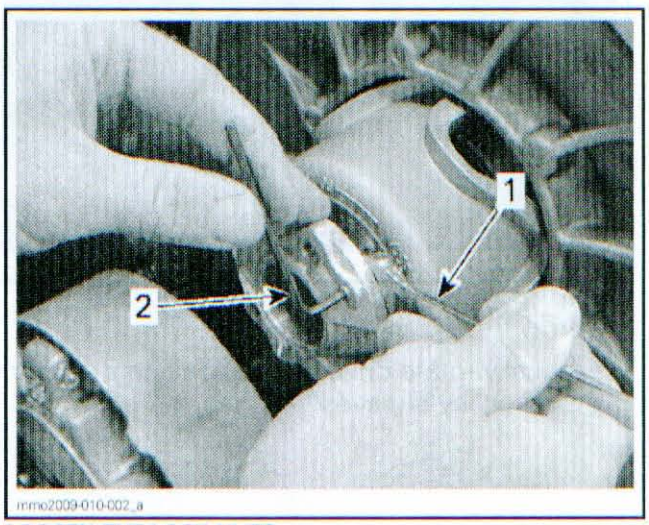
9. Reinstall the drive belt guard.
10. Close LH side panel.
11. Start engine and check if vehicle is creeping.
    11.1 If vehicle creeps, readjust drive belt height (lower drive belt from initial setting).

Drive Belt Height Adjustment (Screw Type Pulley Adjuster)

NOTE: The drive belt height adjustment must be performed every time a new belt is installed.

To adjust the drive belt height, proceed as follows:

1. Open the LH side panel.
2. Remove the drive belt guard.
3. Keep the set screws from turning using a 3 mm Allen key and loosen both lock nuts using a 10 mm open wrench.



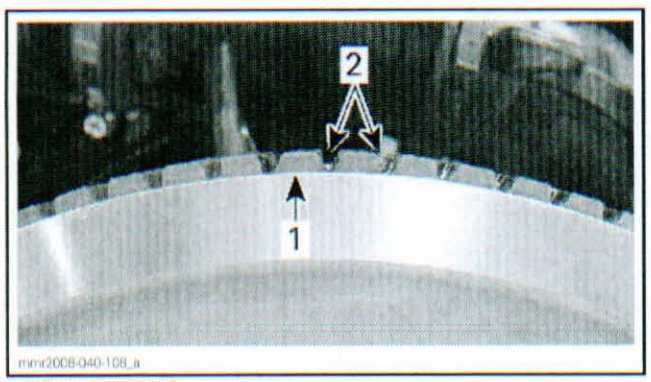
LOOSEN THE LOCK NUTS
1. *3 mm Allen key*
2. *10 mm open wrench*

4. Turn one set screw 1/4 turn at a time then rotate the driven pulley to properly set the belt between the pulley sheaves. Repeat until the belt reaches the recommended height.

NOTE: Turning the set screws clockwise lowers the belt in the pulley. Turning the set screws counterclockwise raises the belt in the pulley.

Models with a Mechanical Reverse

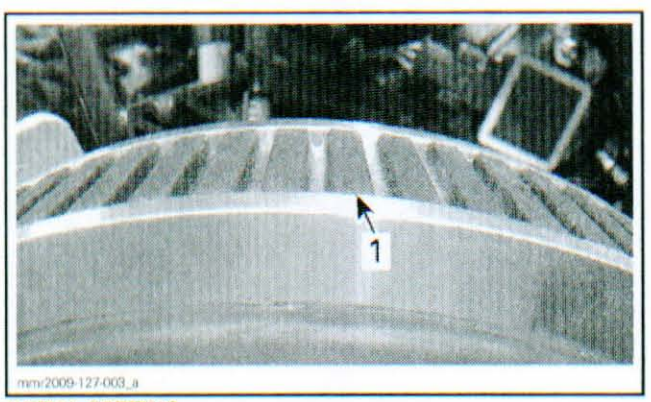
The bottom of grooves on the external side of drive belt should reach the driven pulley edges.



INITIAL SETTING
1. Driven pulley edge
2. External drive belt grooves

Models with an Electronic Reverse

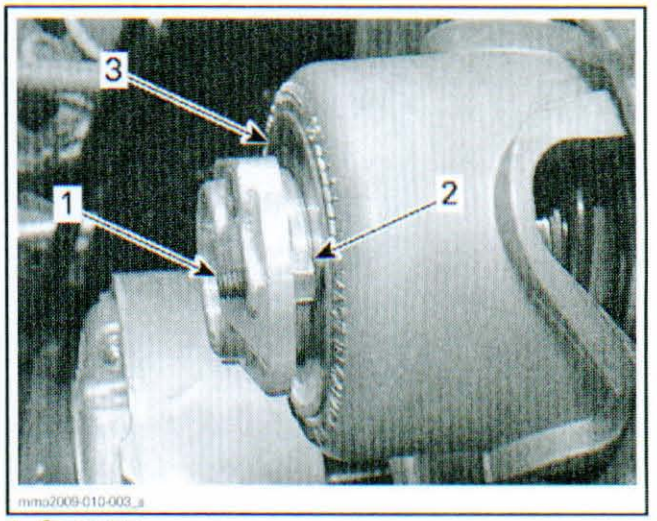
The external side of drive belt should be flushed with the driven pulley edges.



INITIAL SETTING
1. Flush with driven pulley edge

All Models

5. Set the other set screw so that it rests on the steel ring.



1. Set screw
2. Lock nut
3. Steel ring

6. Keep the set screws from turning and tighten the lock nuts towards the adjuster hub to 5 N•m (44 lbf•**in**)
7. Install the drive belt guard.
8. Close side panel.
9. Start engine and check if vehicle is creeping.
   9.1 If vehicle creeps, readjust drive belt height (lower drive belt from initial setting).

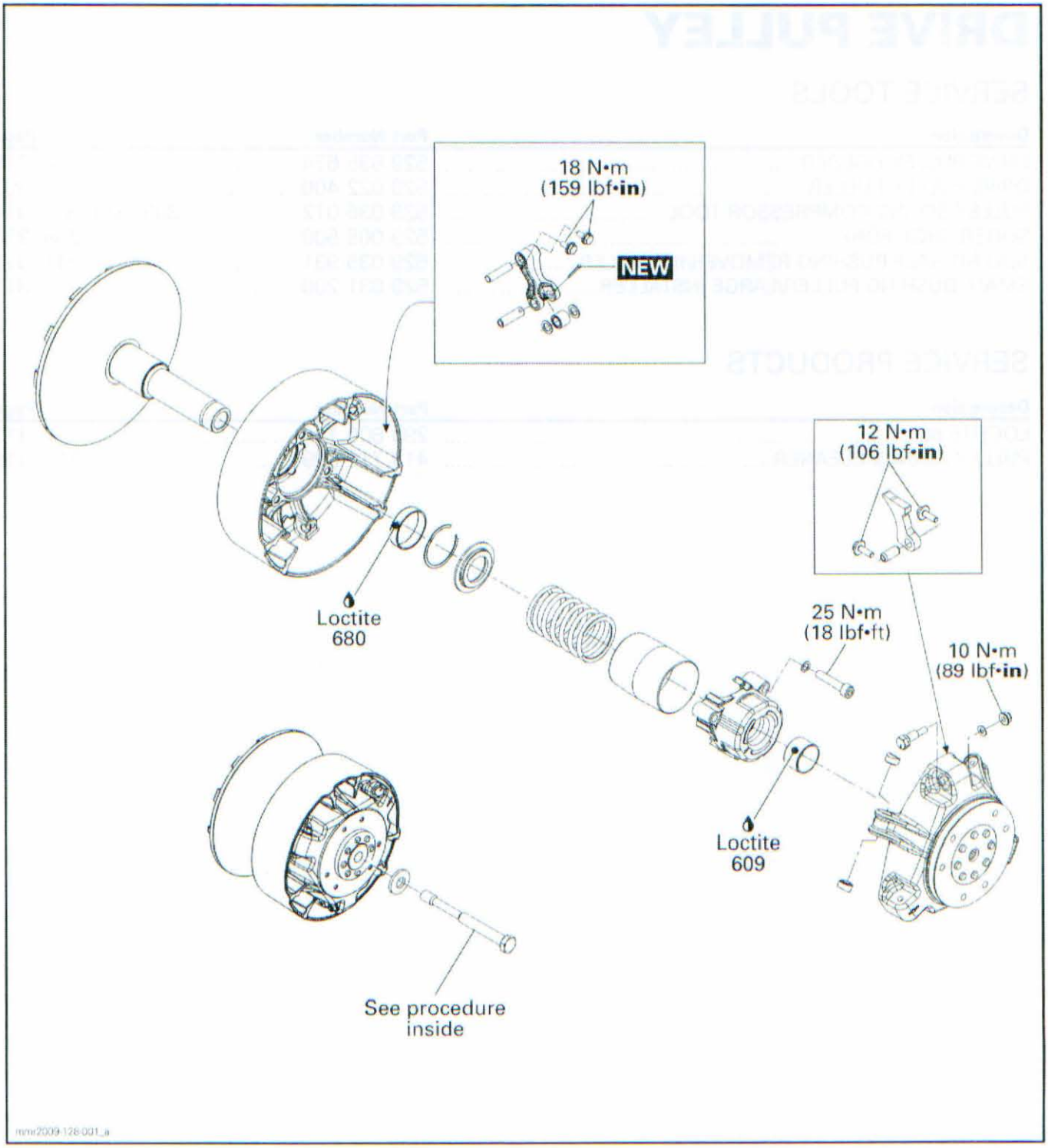
DRIVE PULLEY

SERVICE TOOLS

Description	Part Number	Page
DRIVE PULLEY HOLDER	529 035 674	307–308, 316
DRIVE PULLEY PULLER	529 022 400	307
PULLEY SPRING COMPRESSOR TOOL	529 036 012	309, 311, 313–314
SLIDER SHOE FORK	529 005 500	308, 314
SLIDING HALF BUSHING REMOVER/INSTALLER	529 035 931	311, 313
SMALL BUSHING PULLER/LARGE INSTALLER	529 031 200	311

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 680	293 800 114	313
PULLEY FLANGE CLEANER	413 711 809	311, 316


18 N•m
(159 lbf•in)
NEW
12 N•m
(106 lbf•in)
25 N•m
(18 lbf•ft)
10 N•m
(89 lbf•in)
Loctite
680
Loctite
609
See procedure
inside
mmr2009-128-001_a

GENERAL

TRA drive pulley stands for **Total Range Adjustable** drive pulley.

These are lubrication free drive pulleys. Do not lubricate any component.

Always refer to appropriate *PARTS CATALOG* for replacement part.

Most parts of TRA IV are not interchangeable with those of the other TRA pulley type.

NOTICE **Never use any type of impact wrench at drive pulley removal and installation. The use of impact wrench could damage the drive pulley and modify the calibration.**

Some drive pulley components (return spring, ramp) can be changed to improve vehicle performance in high altitude regions. A Service Bulletin gives information about calibration according to altitude.

NOTICE **Such modifications should only be performed by experienced mechanics since they can greatly affect vehicle performance. Verify spring specifications before installation. Do not only refer to the spring color code.**

⚠ WARNING

Any drive pulley repairs must be performed by an authorized Ski-Doo dealer. Subcomponent installation and assembly tolerances require strict adherence to procedures detailed.

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, cotter pins, etc.) must be replaced with new ones.

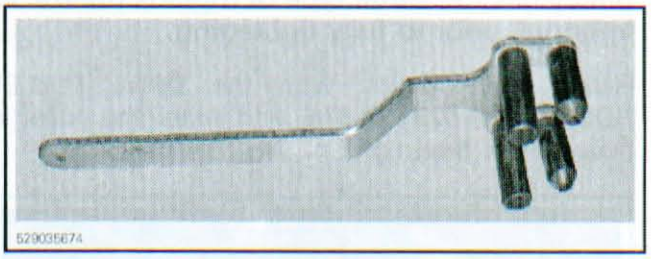
PROCEDURES

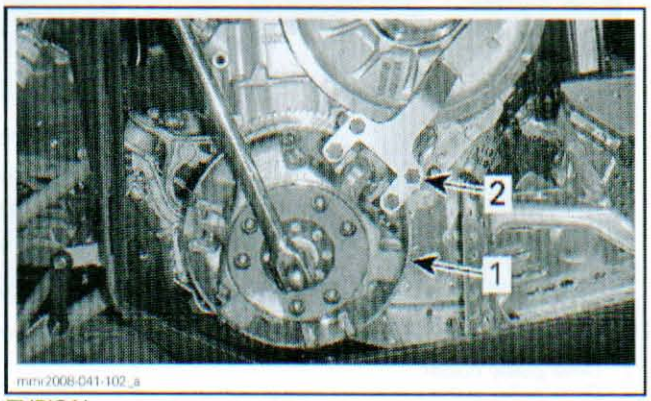
DRIVE PULLEY

Drive Pulley Removal

Remove drive belt. Refer to *DRIVE BELT* subsection.

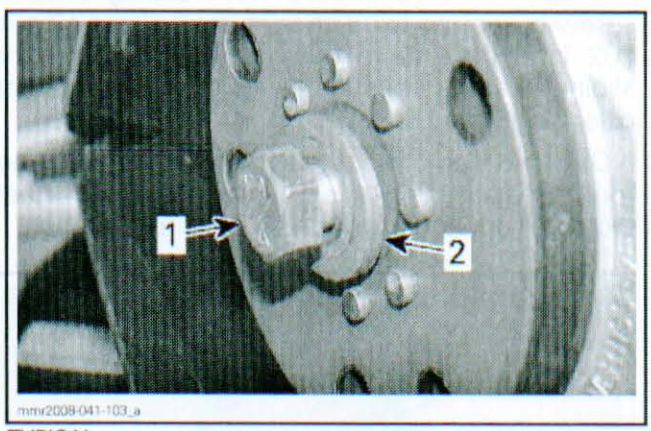
Secure drive pulley with the DRIVE PULLEY HOLDER (P/N 529 035 674). Install it over a sliding sheave tower.





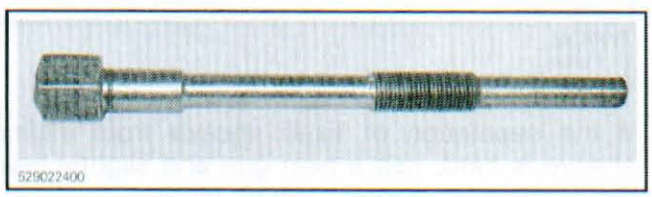
TYPICAL
1. *Drive pulley*
2. *Drive pulley holder*

Remove the drive pulley bolt and its conical spring washer.



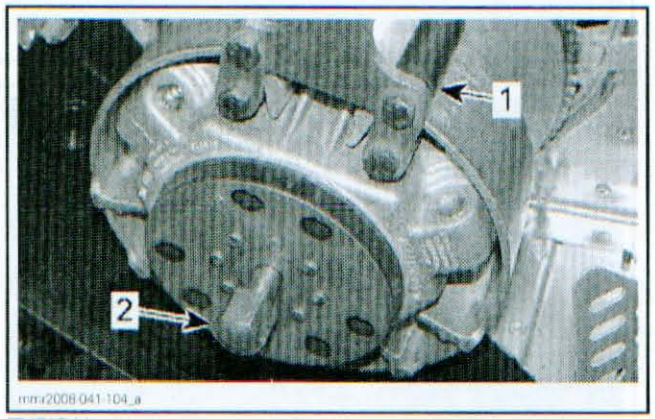
TYPICAL
1. *Drive pulley bolt*
2. *Conical spring washer*

To remove drive pulley from engine, use the DRIVE PULLEY PULLER (P/N 529 022 400).



NOTICE These pulleys have metric threads. Do not use imperial threads puller. Always tighten puller by hand to ensure that the drive pulley has the same type of threads (metric vs imperial) prior to fully tightening.

Retain drive pulley with the DRIVE PULLEY HOLDER (P/N 529 035 674), and install the puller in pulley shaft then tighten.



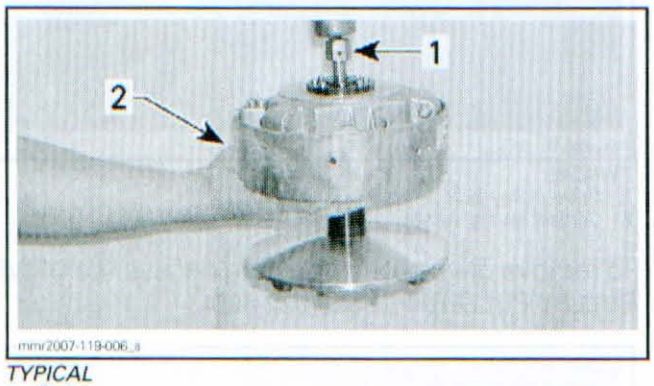
TYPICAL
1. *Drive pulley holder*
2. *Drive pulley puller*

Drive Pulley Disassembly

NOTICE NEVER tap on governor cup.

To separate fixed sheave from sliding sheave, screw puller into fixed sheave shaft about 13 mm (1/2 in). Raise drive pulley and hold it by the sliding sheave while knocking on puller head to disengage fixed sheave.

NOTE: No components marking is required before disassembling this drive pulley since it has factory mark and arrows as indexing reference.



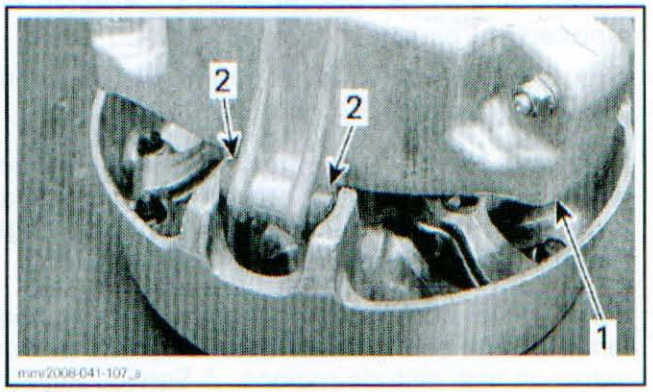
TYPICAL
1. *Puller*
2. *Holding sliding sheave*

If the separation of fixed sheave from sliding sheave is hard, use a heat gun and slightly heat the governor cup to expand its taper.

NOTICE Never use any type of torch to heat governor cup.

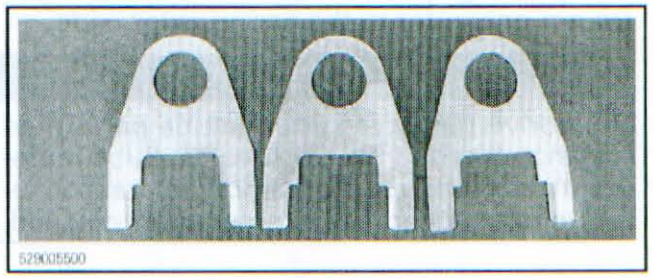
Slider Shoes and Governor Cup

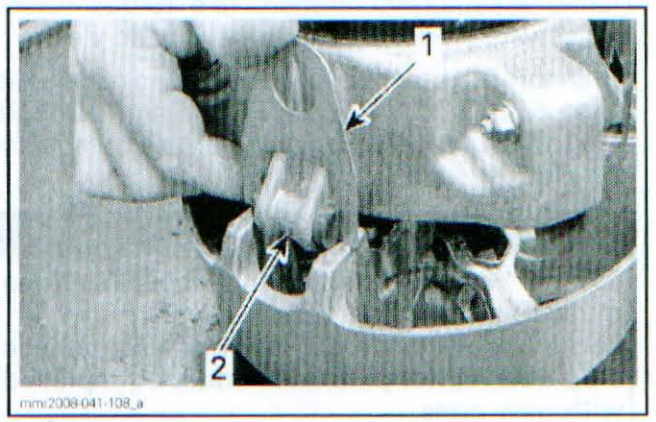
Carefully lift governor cup until slider shoes come at their highest position into guides.



1. *Governor cup*
2. *Slider shoes*

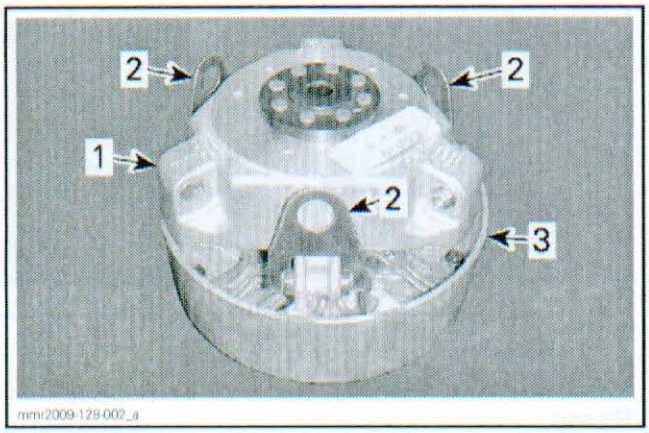
Hold a slider shoe set then carefully lift its housing and install a SLIDER SHOE FORK (P/N 529 005 500). Proceed the same way for other housings lifting one at a time.





1. *Governor cup*
2. *Slider shoe forks*

When all slider shoes are held with the forks, remove the governor cup.



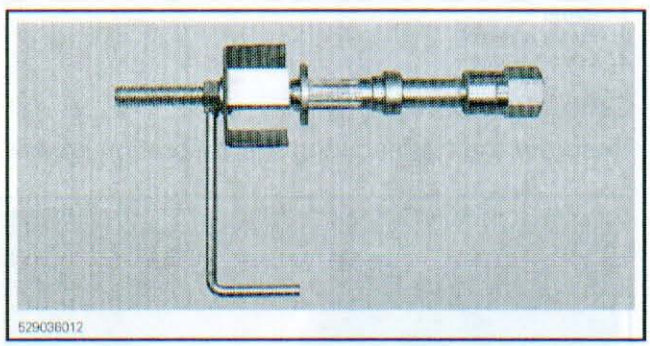
1. *Governor cup*
2. *Slider shoe forks*
3. *Sliding sheave*

Spring Cover

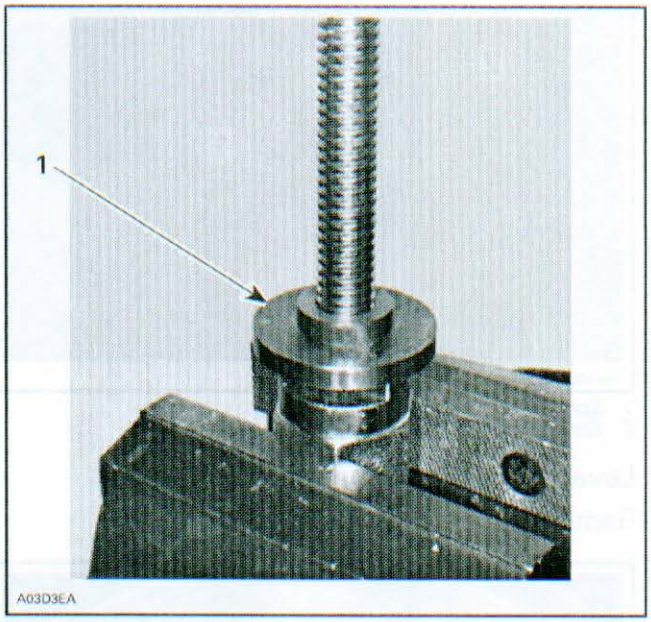
To remove the spring cover, always use the PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012). The spring cover is under high clutch spring preload.

⚠ WARNING

Clutch spring is very strong. Never attempt to remove spring cover without the recommended tools.



Install support guide of spring compressor in a vice.

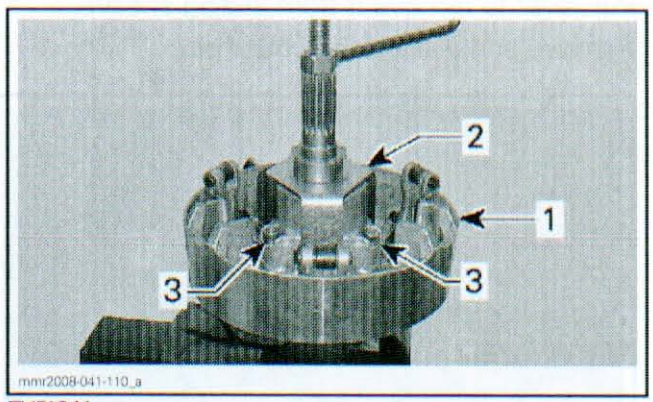


1. *Support guide*

NOTE: The support guide will prevent bushing damages.

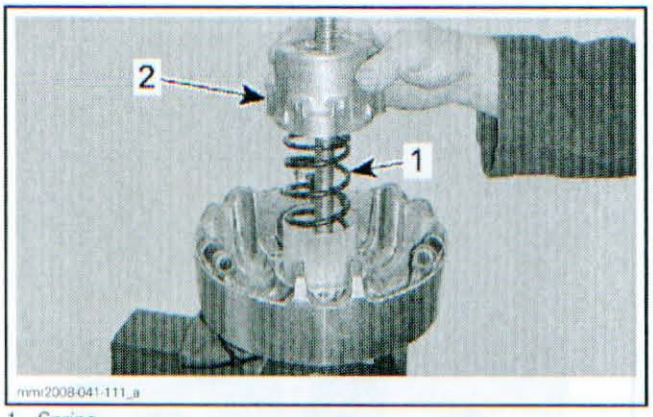
Install sliding sheave then the support cup over spring cover.

Remove 3 Allen screws retaining spring cover then unscrew compressor.



TYPICAL
1. *Sliding sheave*
2. *Support cup*
3. *Spring cover screws*

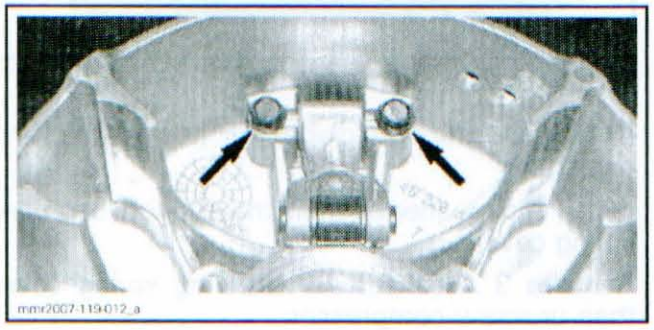
Remove spring cover, spring and spring seat.



1. *Spring*
2. *Spring cover*

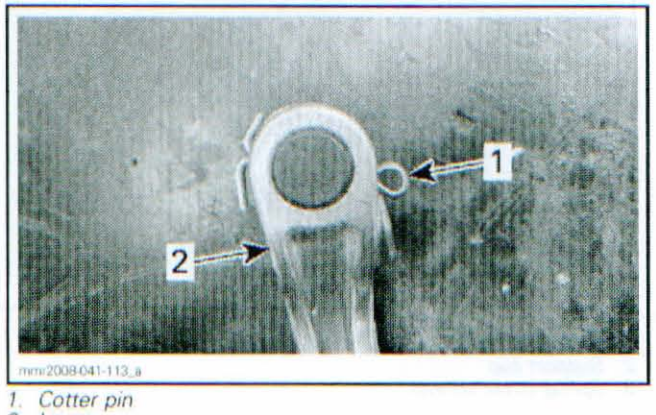
Lever, Roller and Pin

Remove lever screws.



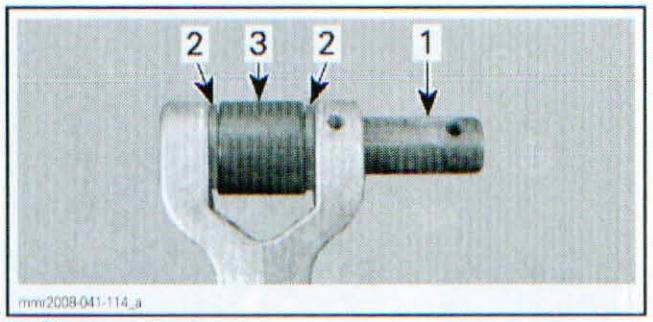
Pull lever to remove it from sliding sheave.

Remove and discard the cotter pin.



1. *Cotter pin*
2. *Lever*

Remove pin, thrust washers and roller.

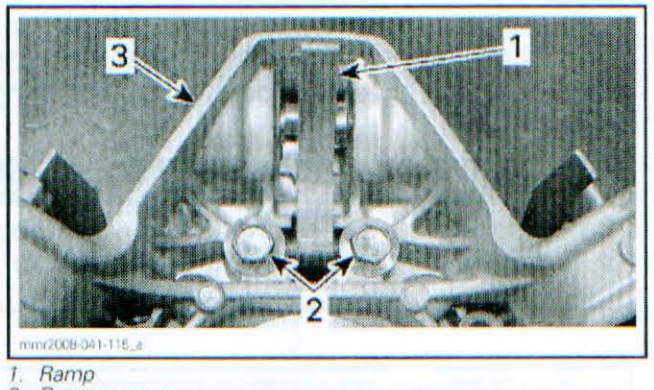


1. *Pin*
2. *Thrust washers*
3. *Roller*

Ramp

Turn the governor cup up side down.

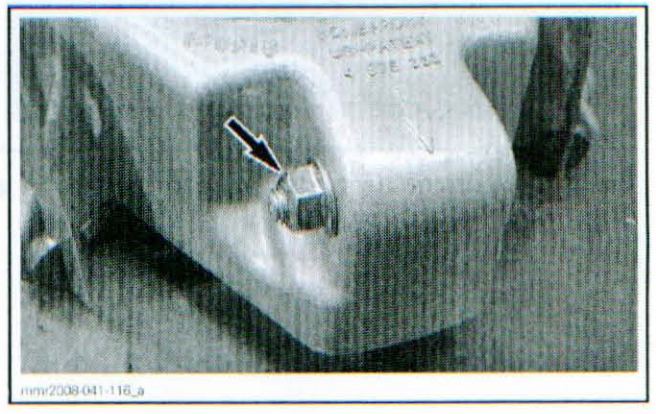
Remove screws retaining ramp to governor cup.



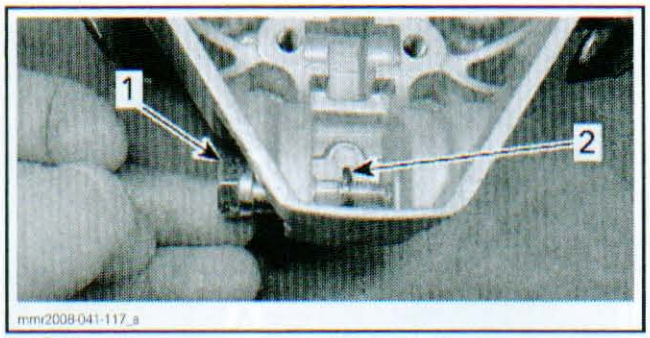
1. *Ramp*
2. *Ramp screws*
3. *Governor cup*

Calibration Screw

Unscrew the nut securing the calibration screw.



Remove calibration screw and its washer.



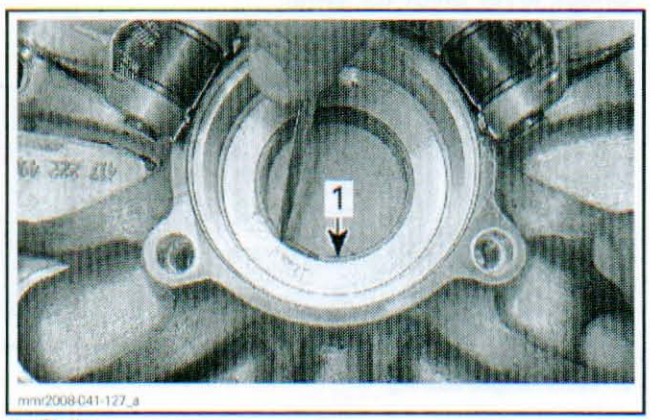
1. Calibration screw
2. Washer

Sliding Sheave Bushing Removal

NOTE: In case of worn out bushing, it is advisable to replace whole sliding sheave assembly as replacing just the bushing may reduce the drive pulley performance.

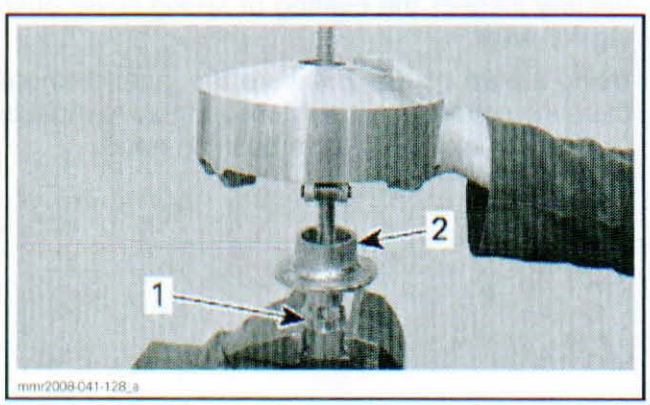
If bushing is out of specifications, remove it as follows:

1. Remove circlip from the sliding sheave.



1. Circlip

2. Secure the PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012) in a vice.
3. Mount the SMALL BUSHING PULLER/LARGE INSTALLER (P/N 529 031 200) and the sliding sheave assembly on it.

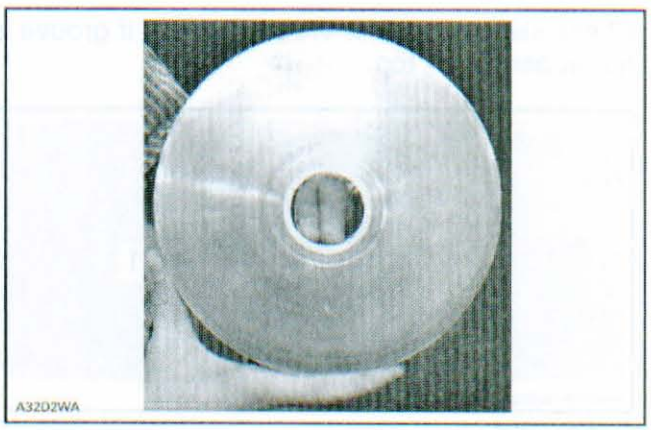


1. Spring compressor
2. Bushing remover/installer

4. Use the SLIDING HALF BUSHING REMOVER/INSTALLER (P/N 529 035 931) to press out old bushing.

NOTE: Make sure to use the tool as marked; to remove the bushing press using the side marked "OUT", as shown below in the picture.

5. Use a soft sand paper to clean sliding sheave bushing mounting surface.



6. Clean sliding sheave bushing mounting surface with PULLEY FLANGE CLEANER (P/N 413 711 809).
7. Clean the circlip groove.

Drive Pulley Cleaning

Parts must be at room temperature before cleaning.

Clean pulley sheaves and shaft with fine steel wool and dry cloth.

Using a paper towel with PULLEY FLANGE CLEANER (P/N 413 711 809), clean crankshaft tapered end and the taper inside the fixed sheave of the drive pulley, crankshaft threads and retaining screw threads.

NOTICE **Avoid contact between cleaner and crankshaft seal because damage may occur.**

Remove all hardened oil deposits that have baked on crankshaft and pulley tapered surfaces with coarse or medium steel wool and/or sand paper no. 600.

NOTICE **Do not use any other type of abrasive.**

Reclean mounting surfaces with paper towel and cleaning solvent.

Wipe off the mounting surfaces with a clean, dry paper towel.

NOTICE **Mounting surfaces must be free of any oil, cleaner or towel residue.**

Drive Pulley Inspection

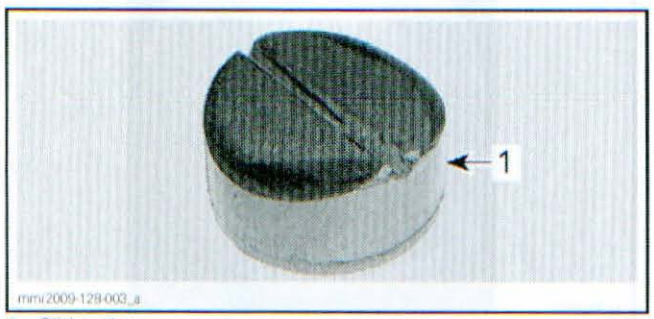
NOTE: During inspection, replace any component if found defective or out of specifications.

Fixed Sheave and Governor Cup

Inspect fixed sheave for marks or scratches.

Slider Shoes

Check slider shoes for wear. Replace if groove is not apparent on top.



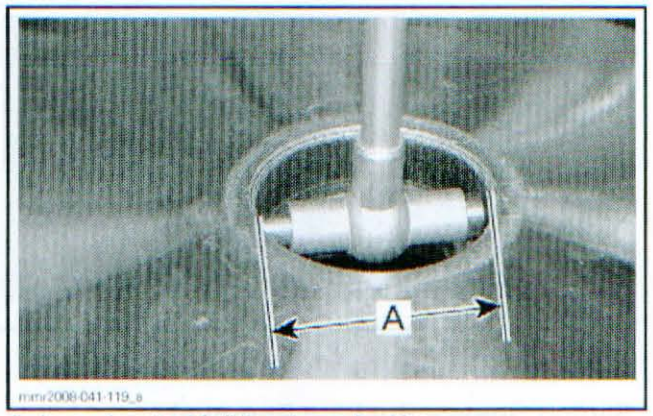
1. Slider shoe

Sliding Sheave

Inspect pulley sheave for marks or scratches.

Visually inspect coating of bushings.

Using a bore gauge, measure the inner diameter of sliding sheave bushing. Measuring point must be at least 5 mm (1/4 in) from bushing edge.



A. Inner diameter of sliding sheave bushing

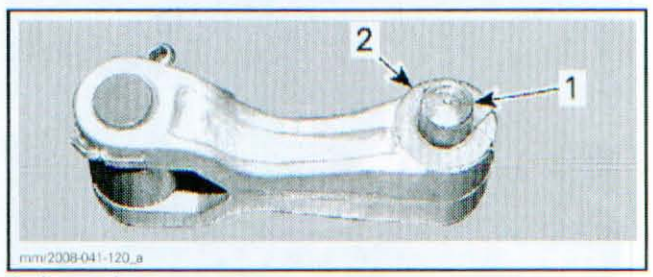
SLIDING SHEAVE BUSHING	
Service limit	40.3 mm (1.587 in)

Lever, Roller and Pin

Check levers for cracks, distortion or other damages.

Check lever pivot for wear.

Check lever flanged bushing for wear.



1. Lever pivot
2. Lever flanged bushing

Check rollers for roundness of external diameter.

Check thrust washers for thickness wear.

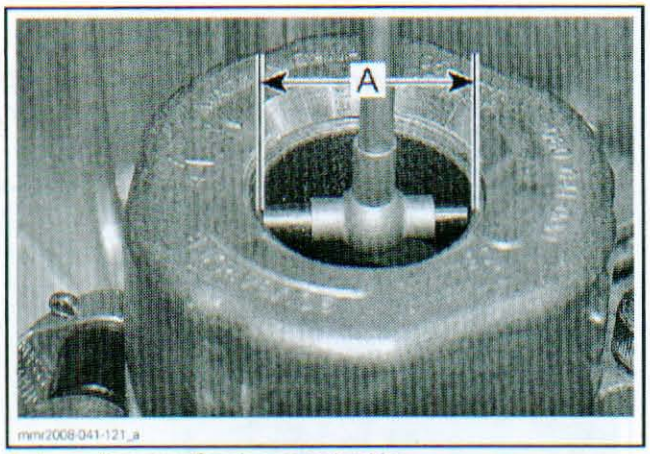
Check roller pins for wear.

Spring Cover

Check spring cover for cracks or wear.

Visually inspect the coating of spring cover bushing for wear.

Using a bore gauge, measure the inner diameter of spring cover bushing. Measuring point must be at least 5 mm (1/4 in) from bushing edge.



A. Inner diameter of spring cover bushing

SPRING COVER BUSHING	
Service limit	30.4 mm (1.197 in)

Replace the spring cover if the inner diameter of bushing is out of specification.

Spring Inspection

Check spring color code and its free length. Replace if necessary.

DRIVE PULLEY SPRING		
MODEL	COLOR CODE	FREE LENGTH
GSX and GTX	YL/BU	90.7 mm (3-9/16 in)
MX Z	BU/BU	99.8 mm (3-15/16 in)

Drive Pulley Assembly

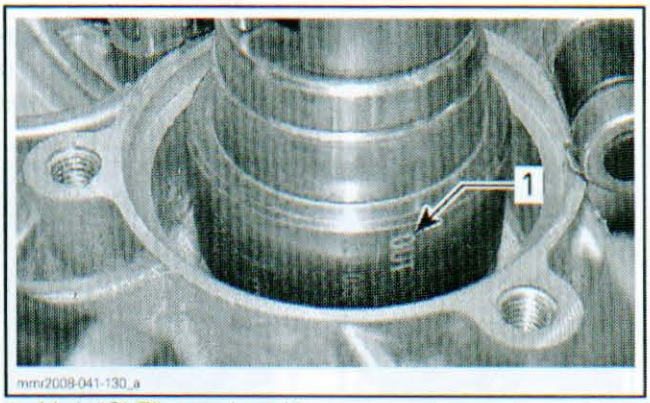
Sliding Sheave Bushing Installation

To install a **NEW** bushing, secure the PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012) in a vice and mount the sliding sheave.

Apply LOCTITE 680 (P/N 293 800 114) on the outside of bushing face.

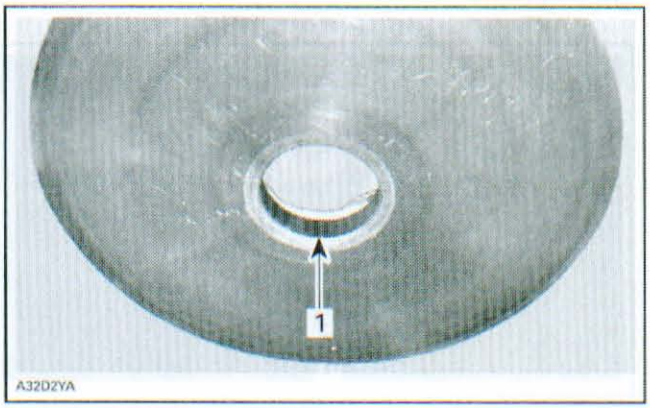
Insert the bushing from inner side of sliding sheave.

Mount the SLIDING HALF BUSHING REMOVER/INSTALLER (P/N 529 035 931) with side marked "IN" to press in a new bushing.



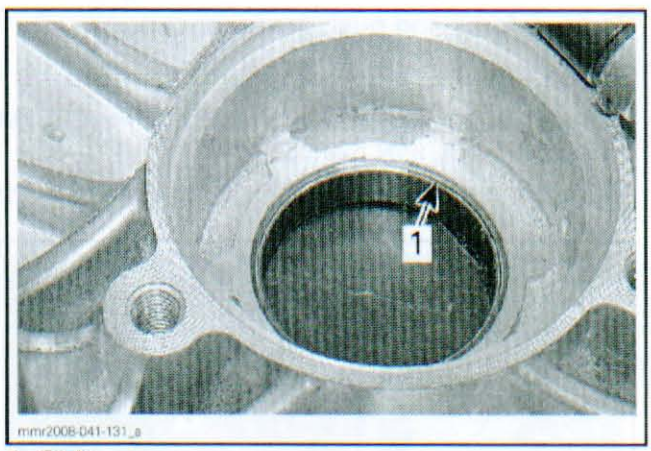
1. Mark "OUT" toward outside

NOTE: Make sure that the bushing is well seated on the sliding sheave.



1. Bushing

Install the circlip.



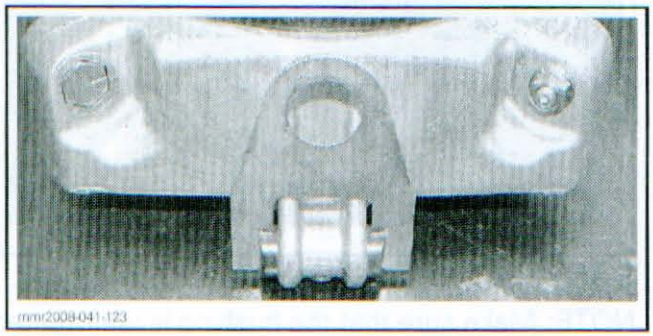
1. Circlip

NOTICE **Make sure that the circlip is properly position in its groove.**

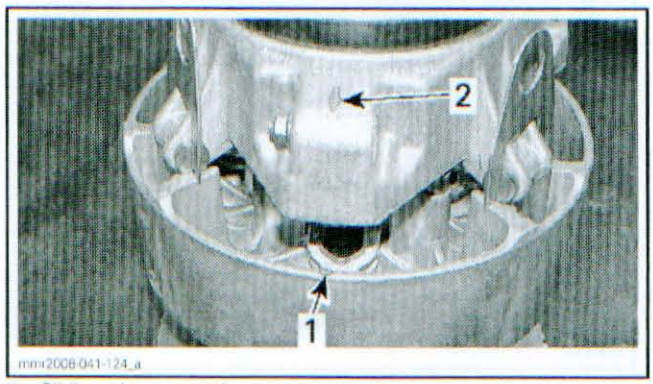
Sliding Sheave, Slider Shoes and Governor Cup

Insert slider shoes into governor cup so that groove in each slider shoe is vertical to properly slide in guides.

Install a SLIDER SHOE FORK (P/N 529 005 500) into slider shoe grooves to maintain them for governor cup installation. Proceed on 3 set of slider shoes.



Make sure to align governor cup arrow with sliding sheave mark.



1. *Sliding sheave mark*
2. *Governor cup arrow*

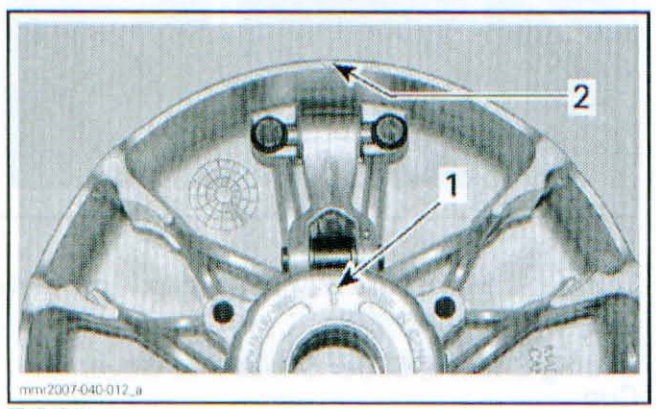
Carefully slide governor cup into sliding sheave.

Remove forks and push governor cup.

Spring Cover

To install spring cover, use PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012).

Align spring cover arrow with sliding sheave mark.



TYPICAL

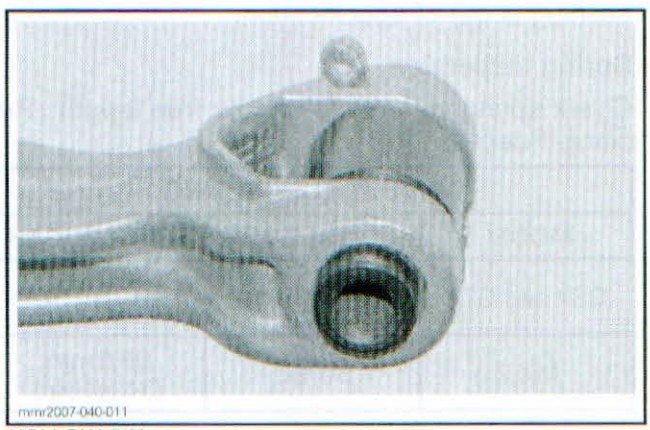
1. *Spring cover arrow*
2. *Sliding sheave mark*

Tighten screws to 25 N•m (18 lbf•ft).

Lever, Roller and Pin

Always use the same type of pin as originally installed when servicing. Refer to *TECHNICAL SPECIFICATIONS*.

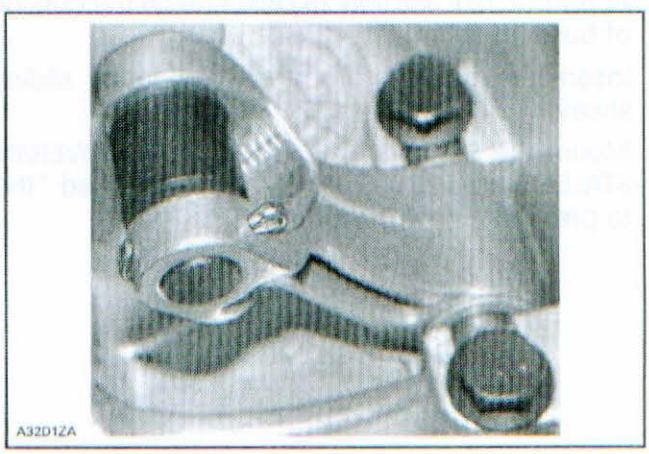
SOLID PIN



HOLLOW PIN

NOTE: Different types have different weights for calibration purpose. Refer to *HIGH ALTITUDE BULLETIN*.

While installing lever make sure that the curved sides of the levers are outwards as shown.

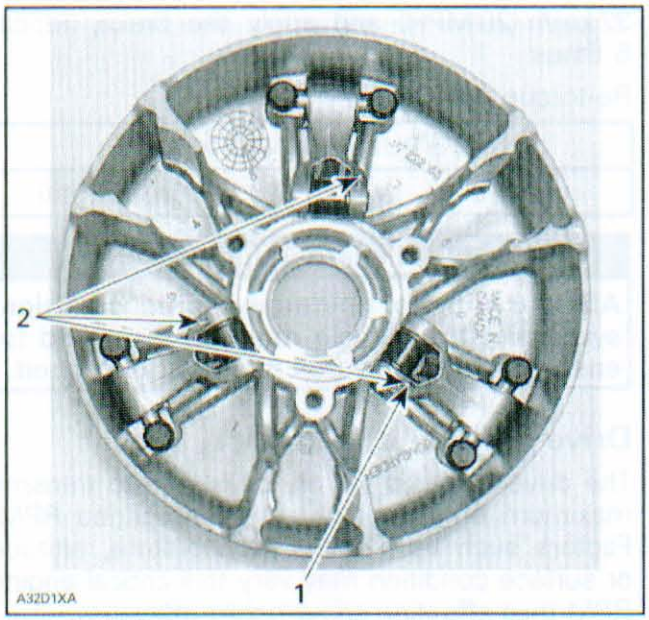


Always install lever assemblies so cotter pin heads are oriented on top when lever is set at the bottom of sliding sheave.

Bend cotter pin ends to sit perfectly against lever.

⚠ WARNING

Whenever replacing centrifugal levers, always replace all 3 at the same time. Otherwise, drive pulley unbalance will occur because of levers difference.



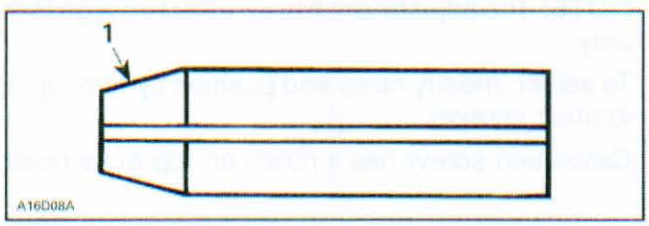
1. Cotter pin head on top
2. All on the same side

Torque lever screws to 18 N•m (159 lbf•**in**).

NOTICE **Levers and rollers must move easily after installation.**

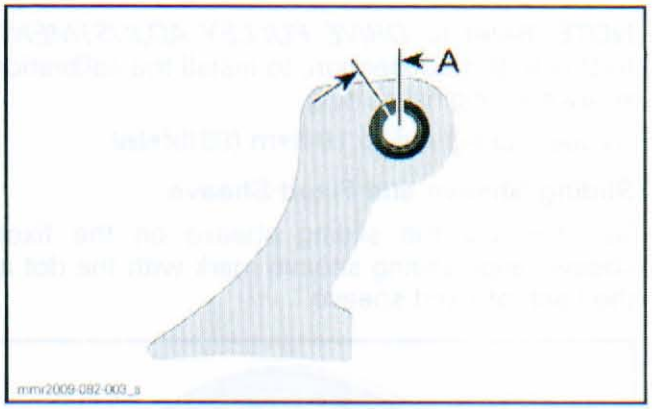
Ramp

Insert dowel tube from chamfered side.



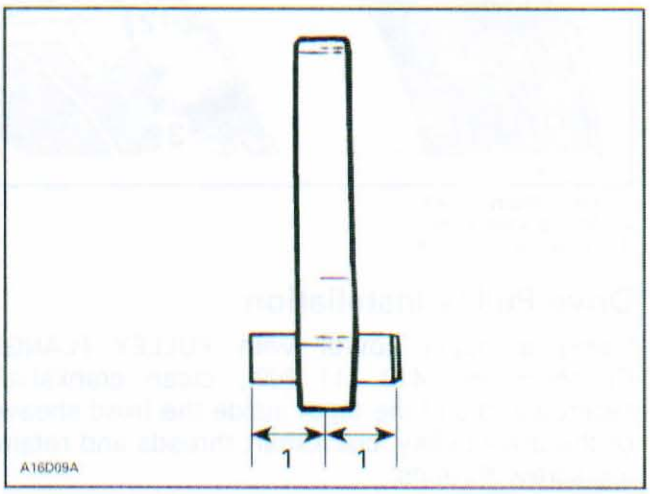
1. Chamfered side

Position dowel tube split at the angle "A".



MODEL	ANGLE "A"
TRA IV	45 ± 3°

Make sure ramp is centered on dowel tube.

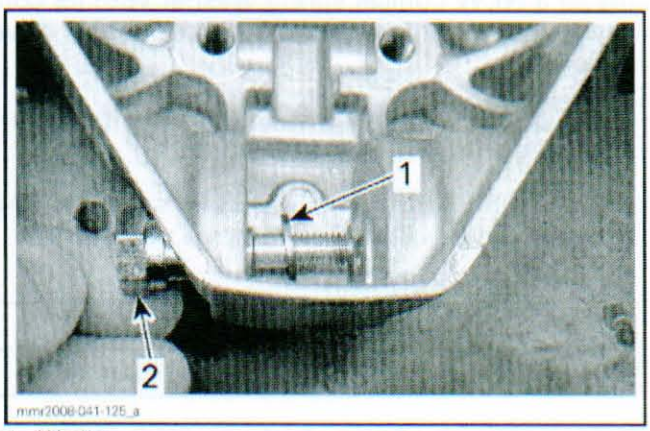


1. Equal distance

Torque ramp screws to 12 N•m (106 lbf•**in**).

Calibration Screw

When installing calibration screw, make sure to install washer as shown.



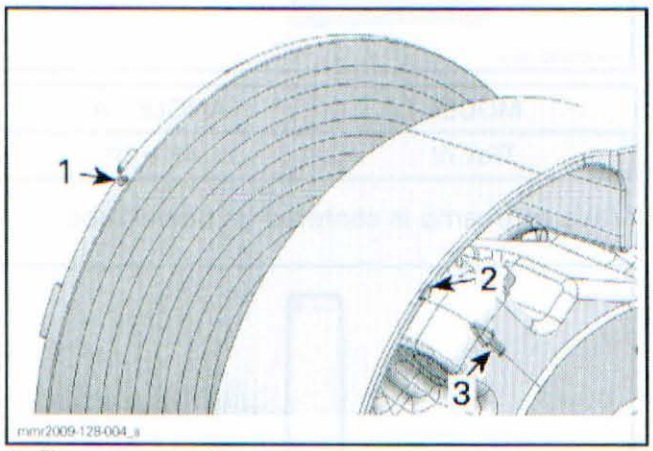
1. Washer
2. Calibration screw

NOTE: Refer to *DRIVE PULLEY ADJUSTMENT*, further in this subsection, to install the calibration screws in original setting.

Torque locking nut to 10 N•m (89 lbf•**in**).

Sliding Sheave and Fixed Sheave

To assemble the sliding sheave on the fixed sheave, align sliding sheave mark with the dot at the back of fixed sheave.



1. *Fixed sheave mark*
2. *Sliding sheave mark*
3. *Governor cup mark*

Drive Pulley Installation

Using a paper towel with PULLEY FLANGE CLEANER (P/N 413 711 809), clean crankshaft tapered end and the taper inside the fixed sheave of the drive pulley, crankshaft threads and retaining screw threads.

NOTICE **Do not apply antiseize or any lubricant on crankshaft and drive pulley tapers. Mounting surfaces must be free of any oil, cleaner or towel residue.**

Install drive pulley on crankshaft extension.

Install a **NEW** conical spring washer with its concave side towards drive pulley then install drive pulley bolt.

NOTICE **Always use BRP genuine parts for conical spring washer and bolt.**

Use the DRIVE PULLEY HOLDER (P/N 529 035 674) to retain drive pulley. See removal procedure.

Torque drive pulley bolt.

DRIVE PULLEY FIRST TORQUE	
TRA IV	120 N•m (89 lbf•ft)

Before starting engine, perform drive pulley adjustment, see further in this subsection.

Install drive belt and guard.

Raise the rear of the vehicle and support it with a mechanical stand.

⚠ WARNING

Ensure that the track is free of particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Ensure nobody is standing near the vehicle.

Accelerate the vehicle at low speed (maximum 32 km/h (20 MPH) and apply the brake, repeat 5 times.

Re-torque drive pulley bolt.

DRIVE PULLEY FINAL TORQUE	
TRA IV	120 N•m (89 lbf•ft)

⚠ WARNING

After 10 hours of operation the transmission system of the vehicle must be inspected to ensure drive pulley bolt is properly torqued.

Drive Pulley Adjustment

The drive pulley is factory calibrated to transmit maximum engine power at a predefined RPM. Factors such as ambient temperature, altitude or surface condition may vary this critical engine RPM thus affecting snowmobile efficiency.

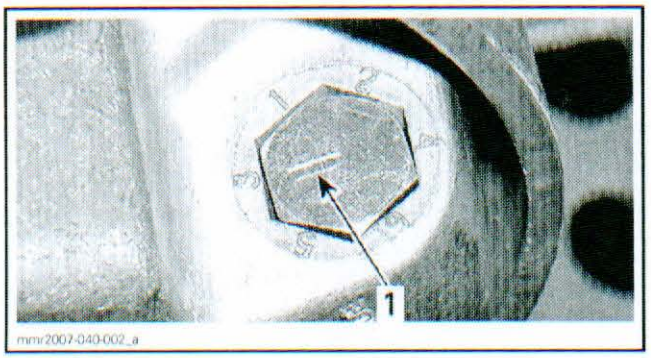
This adjustable drive pulley allows setting maximum engine RPM in the vehicle to maintain maximum power. Refer to *ENGINE MANAGEMENT SYSTEM* for engine RPM adjustment.

Calibration screws should be adjusted so that actual maximum engine RPM in vehicle matches the maximum horsepower RPM given in *TECHNICAL SPECIFICATIONS*.

NOTE: The adjustment has an effect on high RPM only.

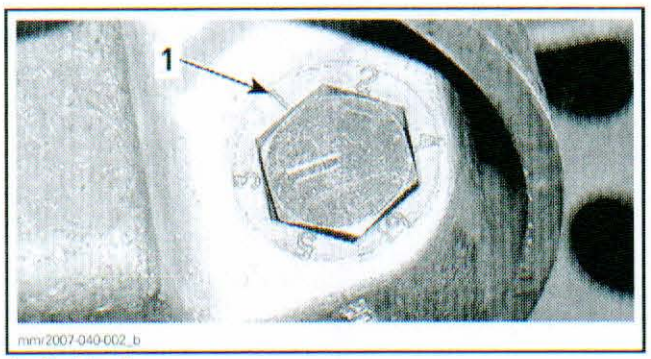
To adjust, modify ramp end position by turning calibration screws.

Calibration screw has a notch on top of its head.



1. Notch

Governor cup has 6 positions numbered 1 to 6.



1. Position 1

See the following table for original setting.

CALIBRATION SCREW	
MODEL	POSITION
All	3

Each number modifies maximum engine RPM by about 200 RPM.

Lower numbers decrease engine RPM in steps of 200 RPM and higher numbers increase it in steps of 200 RPM.

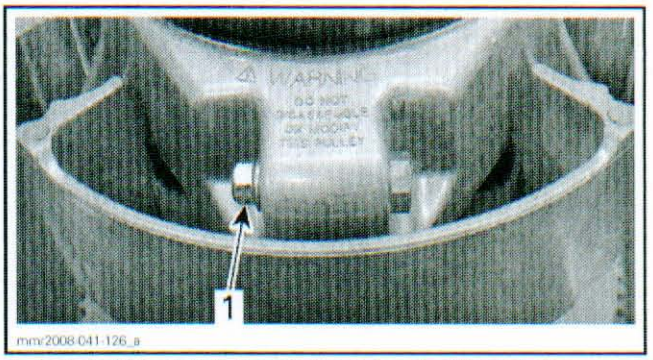
Example:

Calibration screw is set at position 3 and is changed to position 5. So maximum engine RPM is increased by about 400 RPM.

To Adjust:

Just loosen locking nut enough to pull calibration screw **partially** out. Do not completely remove the locking nut.

NOTICE **Do not completely remove calibration screw otherwise its inside washer will fall off.**



1. Loosen just enough to permit rotating of calibration screw

Adjust to desired position.

NOTICE **Always adjust all 3 calibration screws and make sure they are all set at the same number.**

Torque locking nuts to 10 N•m (89 lbf•**in**).

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DRIVEN PULLEY AND COUNTERSHAFT

SERVICE TOOLS

Description	Part Number	Page
CHAINCASE GEAR RETAINING TOOL	529 036 152	322
COUNTERSHAFT BEARING INSTALLER	529 036 066	331
COUNTERSHAFT BEARING REMOVER	529 036 065	330
COUNTERSHAFT RETAINING TOOL	529 036 165	328
COUNTERSHAFT SUPPORT	529 036 067	330
DRIVEN PULLEY SPRING COMPRESSOR	529 036 064	324
ENGINE LIFTING TOOL	529 036 151	331
PRELOAD TESTER	529 036 164	328
QRS HUB TORQUING TOOL	529 036 147	323, 330

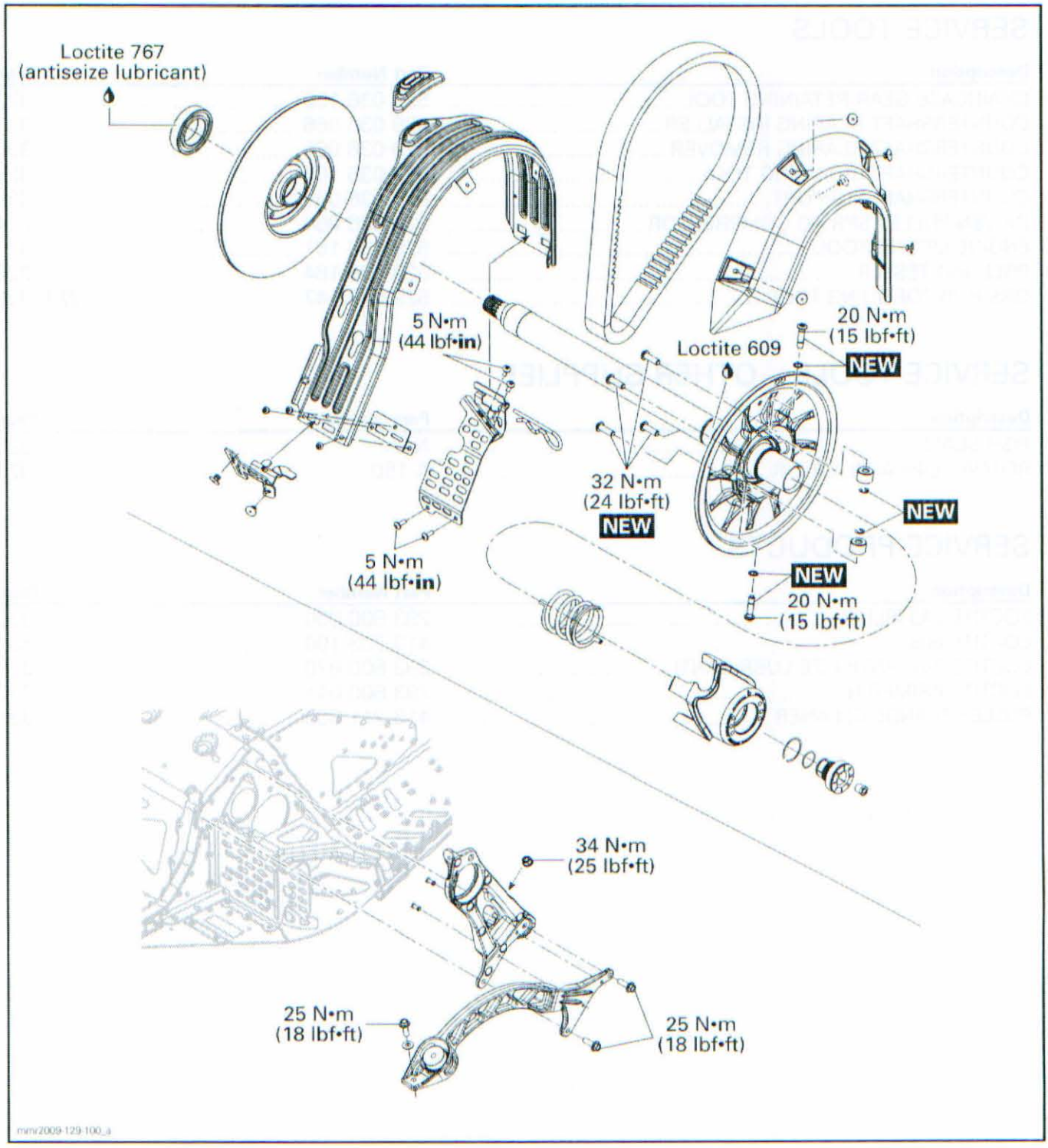
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FISH SCALE	N. A.	328
ROTOR CLIP® APPLICATOR	A-150	327

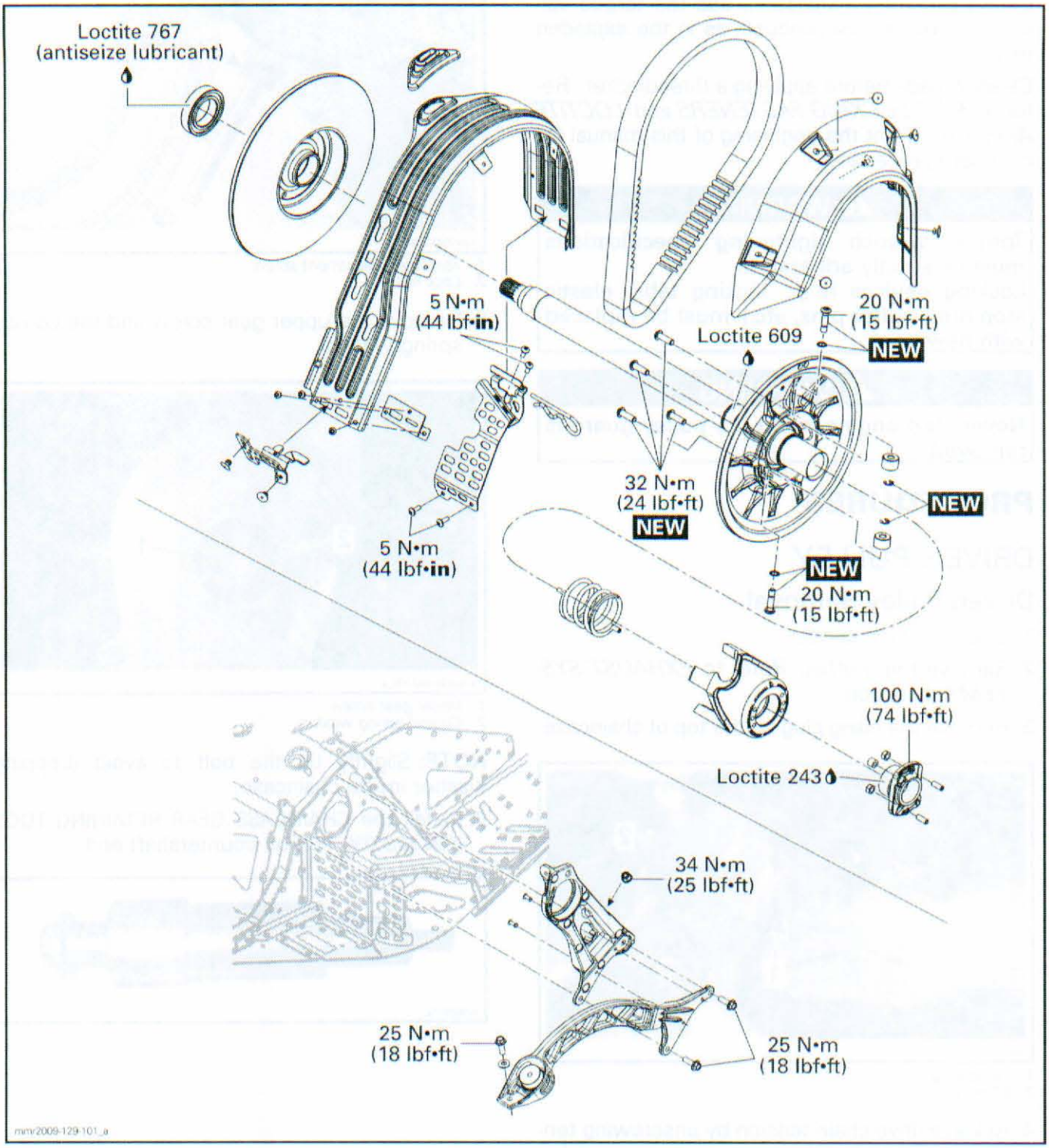
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	330
LOCTITE 609	413 703 100	331
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	329
LOCTITE PRIMER N	293 800 041	330
PULLEY FLANGE CLEANER	413 711 809	326, 331

DRIVEN PULLEY (RING TYPE PULLEY ADJUSTER)



DRIVEN PULLEY (SCREW TYPE PULLEY ADJUSTER)



GENERAL

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

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

⚠ WARNING

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

⚠ WARNING

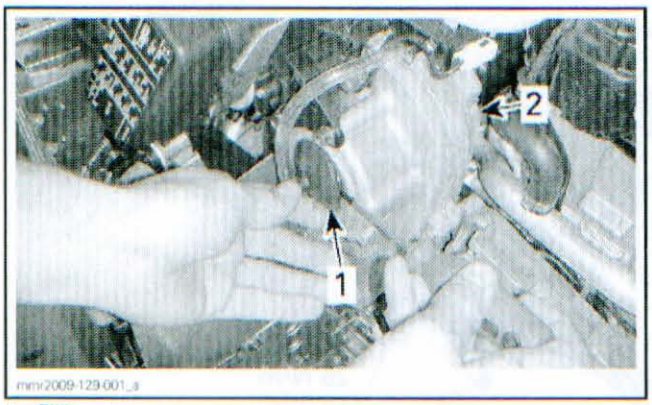
Never start engine when the pulley guard is removed.

PROCEDURES

DRIVEN PULLEY

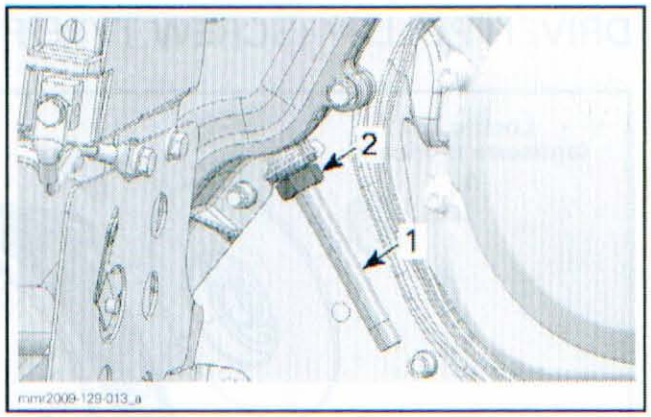
Driven Pulley Removal

1. Open left side panel.
2. Remove the muffler. Refer to *EXHAUST SYSTEM* subsection.
3. Remove the filling plug on the top of chaincase.



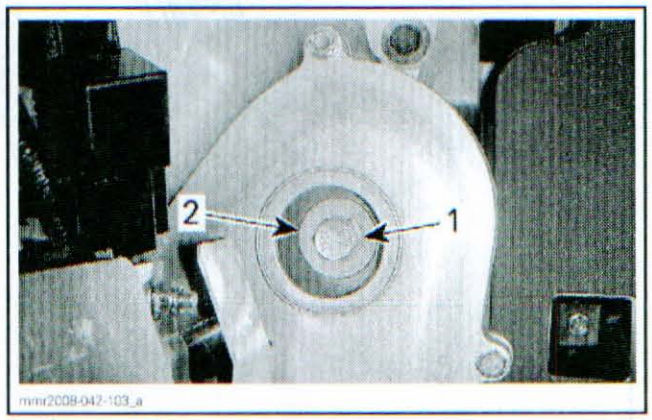
1. *Filling plug*
2. *Chaincase*

4. Release drive chain tension by unscrewing tensioner adjustment screw.



1. *Tensioner adjustment screw*
2. *Lock nut*

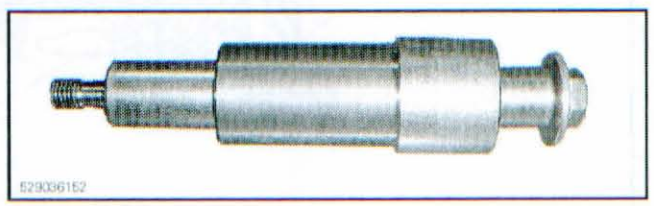
5. Remove the upper gear screw and the conical spring washer.

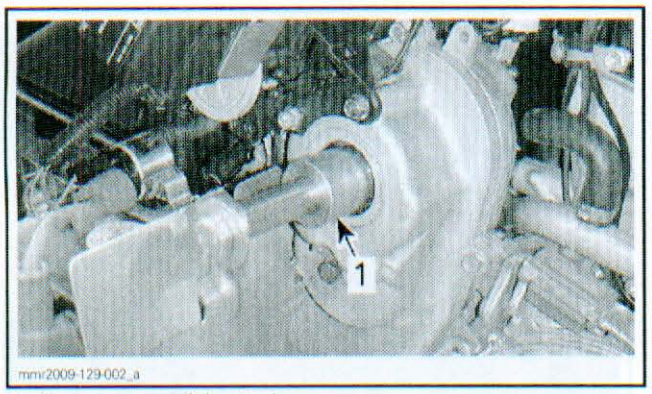


1. *Upper gear screw*
2. *Conical spring washer*

NOTE: Slightly tilt the bolt to avoid dropping washer inside chaincase.

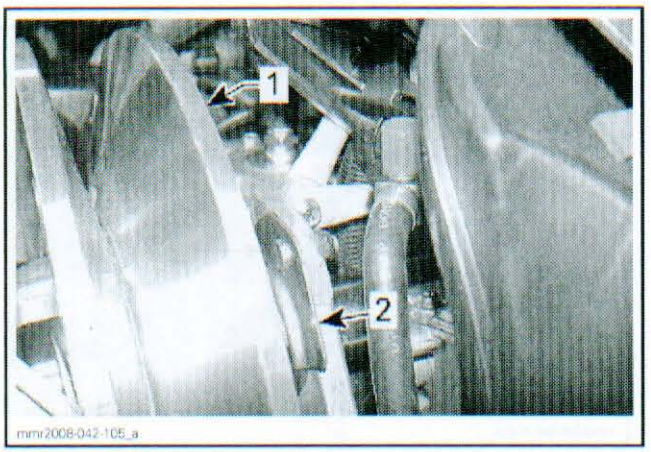
6. Install the CHAINCASE GEAR RETAINING TOOL (P/N 529 036 152) on countershaft end.





1. Upper gear retaining tool

7. Open right side panel.
8. Remove the drive belt. Refer to *DRIVE BELT* subsection.
9. Behind driven pulley, remove screw securing the countershaft bearing flange.



1. Driven pulley
2. Countershaft bearing flange

10. Pull the driven pulley to disengage countershaft and upper gear.

NOTE: If necessary, tap the upper gear retaining tool with a plastic hammer.

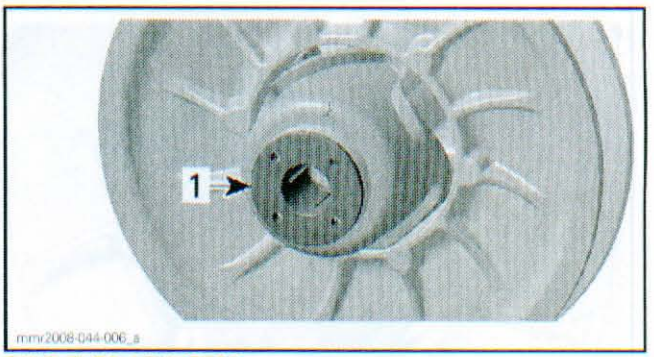
11. Unscrew countershaft from the upper gear retaining tool. Do not remove tool.

NOTE: While countershaft is removed from vehicle, the upper gear retaining tool keeps the drive chain and the upper gear in position inside chaincase.

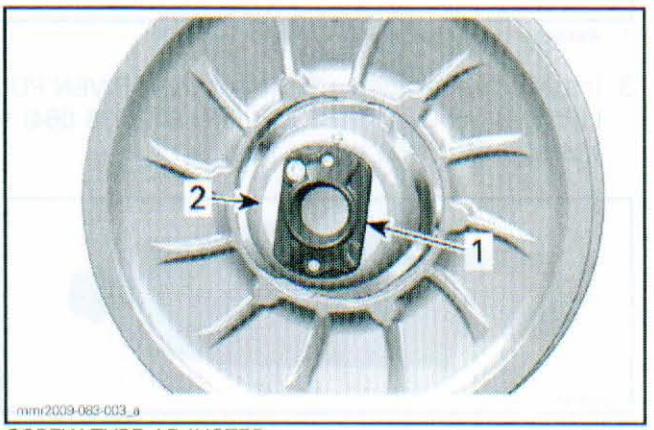
Driven Pulley Disassembly

Cam and Spring

1. Unscrew and remove the following parts according to pulley adjuster type.

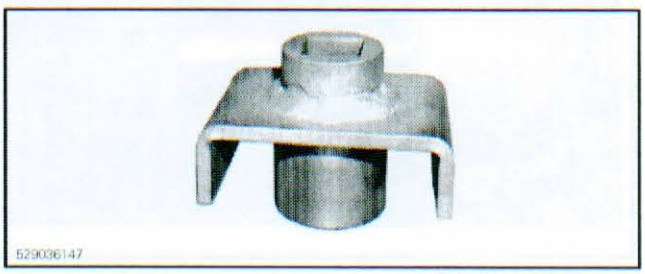


RING TYPE ADJUSTER
1. Adjusting ring

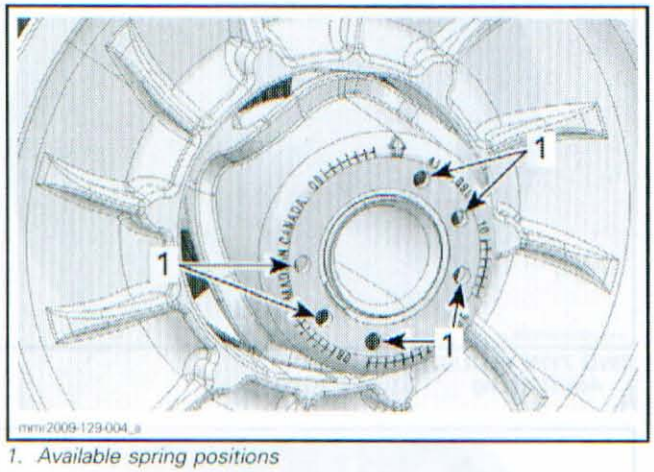


SCREW TYPE ADJUSTER
1. Adjuster hub
2. Washer

NOTE: To remove the screw type adjuster, use the QRS HUB TORQUING TOOL (P/N 529 036 147).

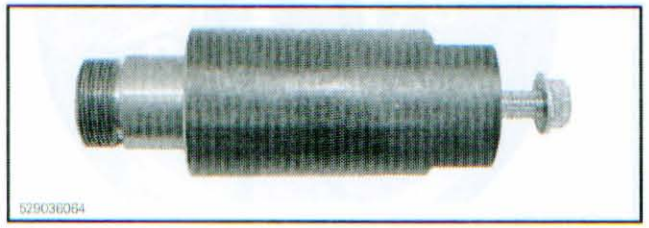


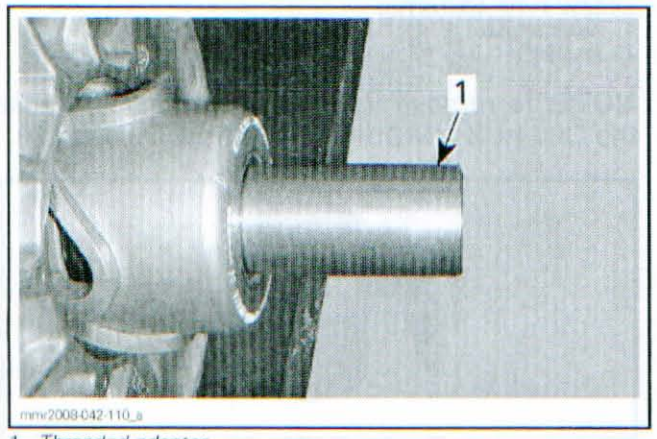
2. Remember spring position for reinstallation.



1. Available spring positions

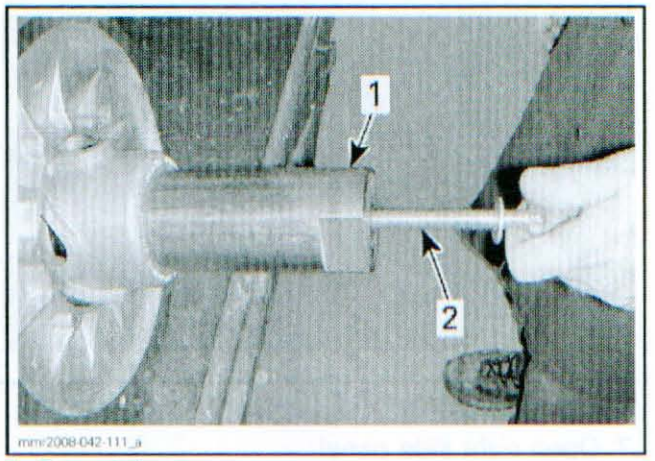
3. Install the threaded adapter of the DRIVEN PULLEY SPRING COMPRESSOR (P/N 529 036 064) at the end of driven pulley.





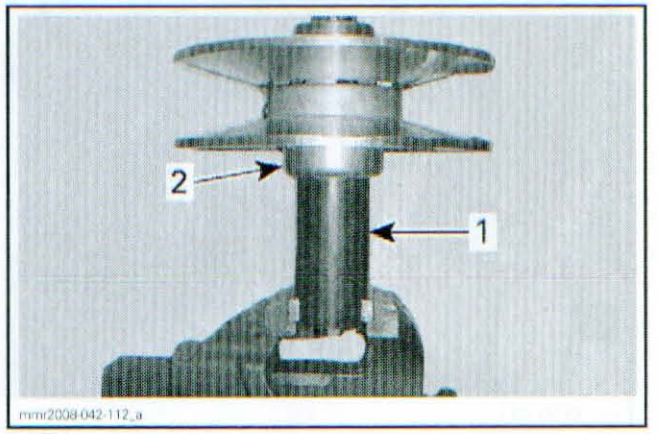
1. Threaded adapter

4. Install the external sleeve over the threaded adapter and secure sleeve with the driven spring compressor screw.



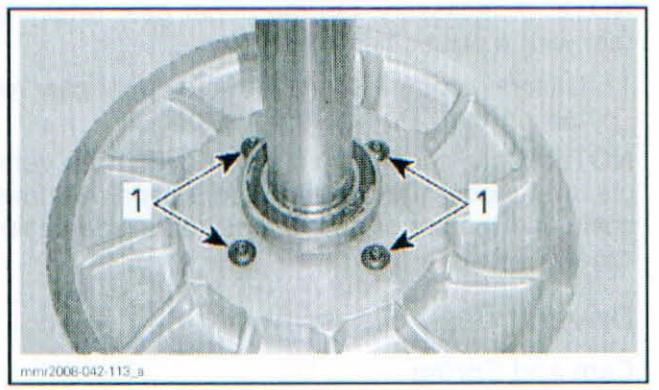
1. External sleeve
2. Driven spring compressor screw

5. Tighten the driven spring compressor screw to compress the cam.
6. Install the driven spring compressor in a vice.



1. Driven spring compressor
2. Driven pulley

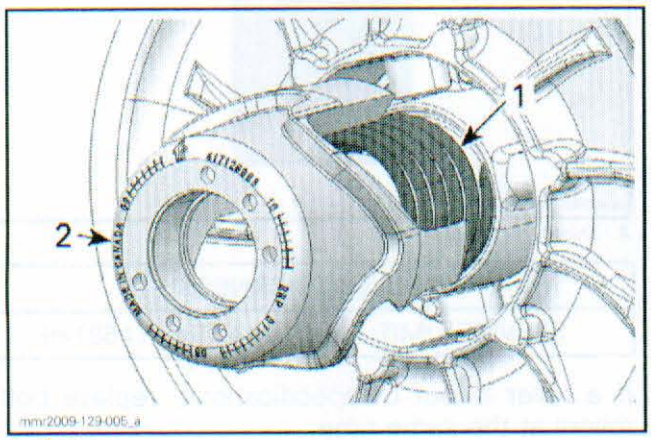
7. Using a heat gun, heat cam screws to break the thread locker.



1. Heat cam screws

8. Remove and discard cam screws.
9. Unscrew the driven spring compressor screw completely.
10. Retain cam and spring in position.

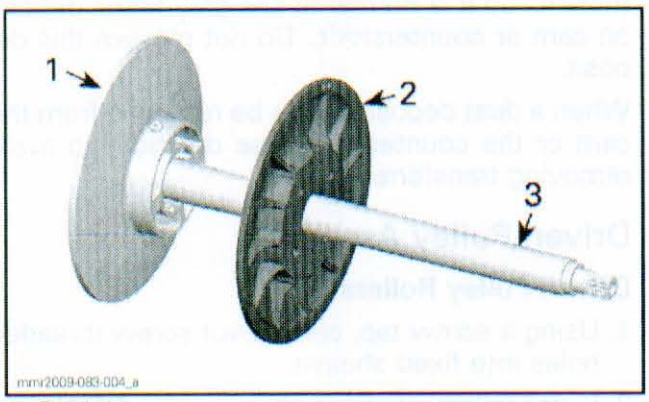
11. Hold spring against the fixed sheave and remove cam.
12. Remember spring position before removing it from fixed sheave.



1. Spring
2. Cam

Sliding Sheave

1. Remove the cam and spring. See procedure in this subsection.
2. Remove the *COUNTERSHAFT BEARING*, see procedure in this subsection.
3. Remove sliding sheave.



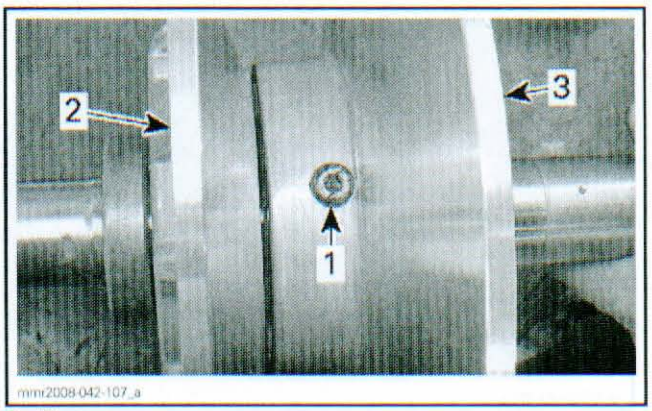
1. Fixed sheave
2. Sliding sheave
3. Countershaft

Fixed Sheave

The fixed sheave and countershaft are sold as an assembly. They are not available separately.

Driven Pulley Rollers

1. Move apart sliding and fixed sheaves.
2. Remove and **discard** pivot screws.



1. Pivot screw
2. Sliding sheave
3. Fixed sheave

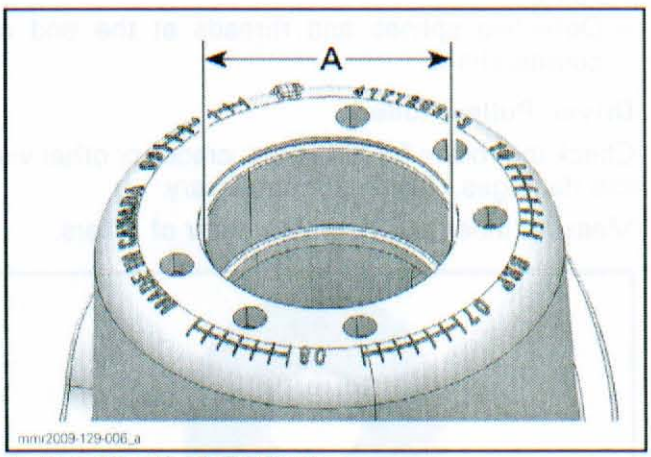
3. Remove rollers.
4. Discard E-clips.

Driven Pulley Inspection

Cam and Spring

Verify contact surfaces of cam for visible damages. Replace cam if necessary.

Using a dial bore gauge, measure the inner diameter of cam bushing. Measuring point must be at least 5 mm (1/4 in) from bushing edge.



A. Inner diameter of cam bushing

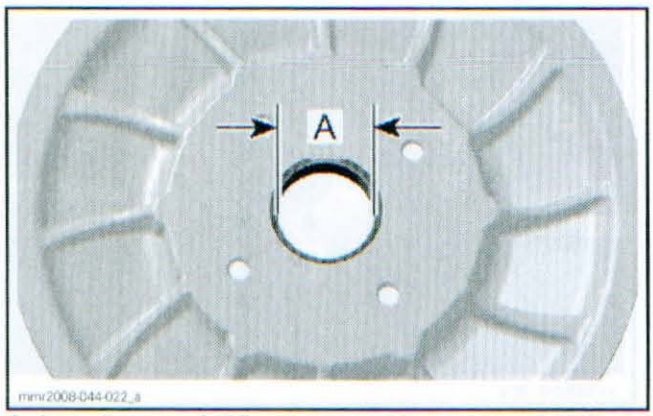
BUSHING	SERVICE LIMIT
Cam bushing	41.5 mm (1.634 in)

Replace the cam if the inner diameter of bushing is out of specification.

Sliding Sheave

Inspect pulley sheave for marks or scratches.

Using a dial bore gauge, measure the inner diameter of sliding sheave bushing. Measuring point must be at least 5 mm (1/4 in) from bushing edge.



A. Inner diameter of sliding sheave bushing

BUSHING	SERVICE LIMIT
Sliding sheave bushing	41.5 mm (1.634 in)

Replace the sliding sheave if the inner diameter of bushing is out of specification.

Fixed Sheave

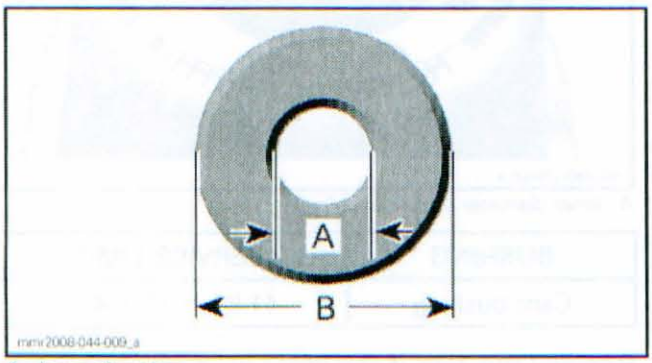
Replace fixed sheave and countershaft if one of the following problem is detected:

- Marks or scratches on pulley sheave
- Bent, twisted or otherwise damaged countershaft
- Defective splines and threads at the end of countershaft.

Driven Pulley Rollers

Check the rollers for flat spots, cracks or other visible damages. Replace if necessary.

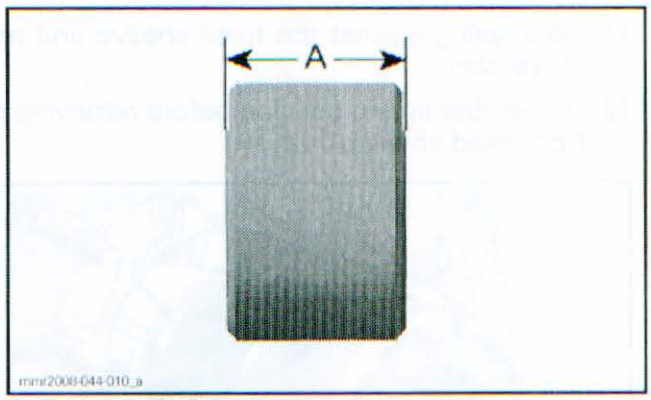
Measure inner and outer diameter of rollers.



A. Inner diameter
B. Outer diameter

ROLLER DIAMETER	SERVICE LIMIT
Inner diameter	8.5 mm (.335 in)
Outer diameter	21.5 mm (.846 in)

Measure the roller thickness.



A. Thickness of roller

ROLLER THICKNESS	
SERVICE LIMIT	14.75 mm (.581 in)

If a roller is out of specifications, replace both rollers at the same time.

Driven Pulley Cleaning

Use the PULLEY FLANGE CLEANER (P/N 413 711 809) and a clean rag to clean pulley sheaves.

Cam and Spring

During break-in period, teflon from bushing moves to cam or countershaft surface. A teflon over teflon running condition occurs, leading to low friction. So it is normal to see gray teflon deposit on cam or countershaft. Do not remove this deposit.

When a dust deposit has to be removed from the cam or the countershaft, use dry cloth to avoid removing transferred teflon.

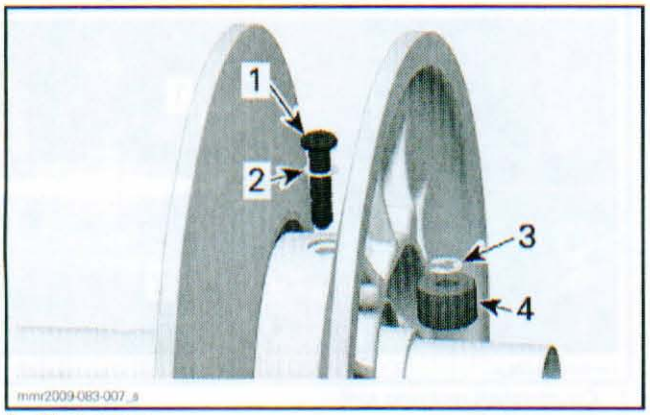
Driven Pulley Assembly

Driven Pulley Rollers

1. Using a screw tap, clean pivot screw threaded holes into fixed sheave.
2. Install rollers into fixed sheave using **NEW** pivot screws with ribbed lock washers.

NOTICE **Always use new pivot screws with pre-applied threadlocker.**

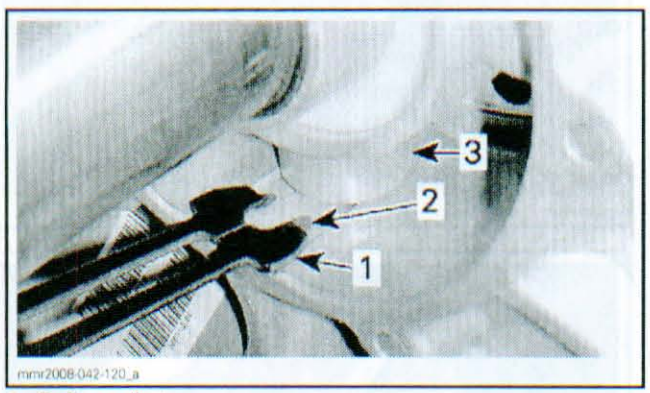
3. Torque pivot screws to 20 N•m (15 lbf•ft).



1. *Pivot screw*
2. *Ribbed lock washer*
3. *E-clip*
4. *Roller*

4. Using a ROTOR CLIP® APPLICATOR (P/N A-150), install **NEW** E-clips to lock pivot screws.

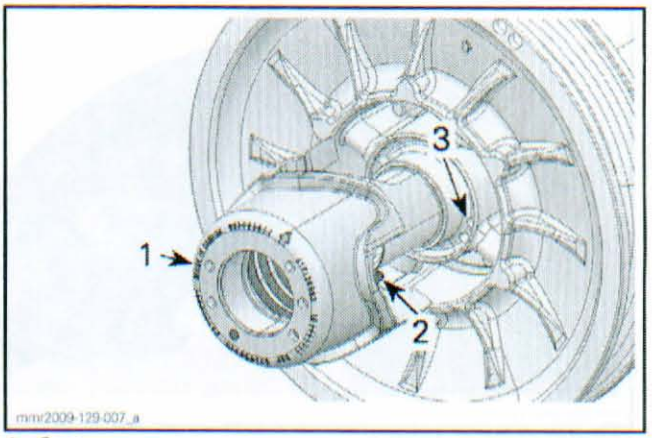
NOTE: To purchase an applicator, contact Rotor Clip Company at **www.rotorclip.com**.



1. *E-clip applicator*
2. *E-clip*
3. *Roller*

Cam and Spring

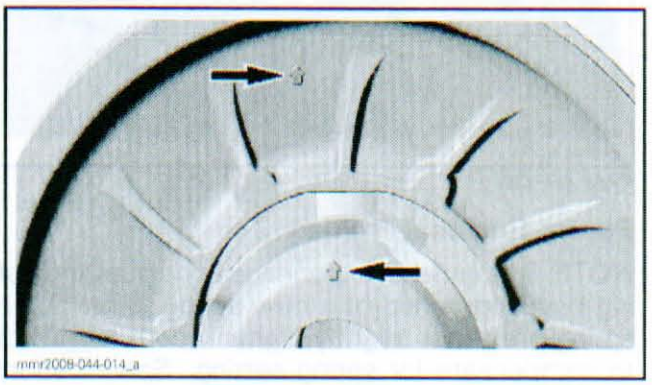
1. Insert one end of the spring into the appropriate cam locating hole (previously noted during removal).
2. Install cam and spring. Enter the other end of the spring in its fixed sheave locating hole previously noted during removal.



1. *Cam*
2. *End of spring*
3. *Fixed sheave locating holes*

3. Push and turn the cam to align its arrow with the arrow on fixed sheave.

At the end of cam installation, the arrow on the cam should be move clockwise (± 30°).



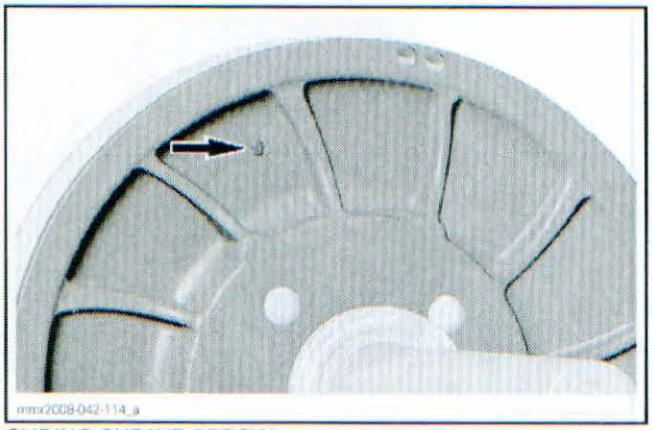
4. Install the driven spring compressor sleeve and tighten the driven spring compressor screw until cam is completely pressed against sliding sheave.
5. Check the *SPRING TORSIONAL PRELOAD*.
6. When preload is within specification, install 4 **NEW** cam screws.
7. Torque cam screws to 32 N•m (24 lbf•ft).
8. Remove the driven spring compressor.

Sliding Sheave

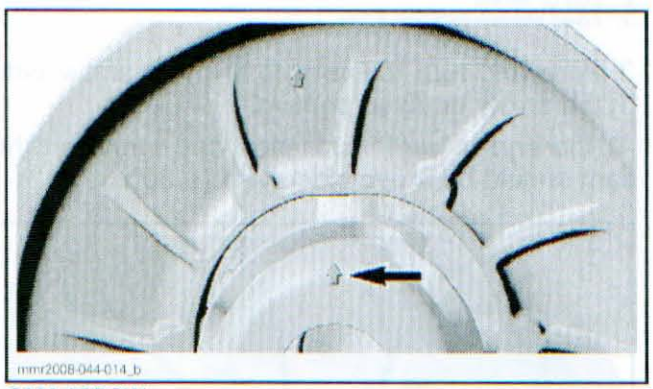
The assembly of sliding sheave is the reverse of the disassembly. However, pay attention to the following.

When installing sliding sheave, make sure to align its arrow with the arrow on cam.

Rotor Clip® is a trademark of Rotor Clip Company, Inc.



SLIDING SHEAVE ARROW

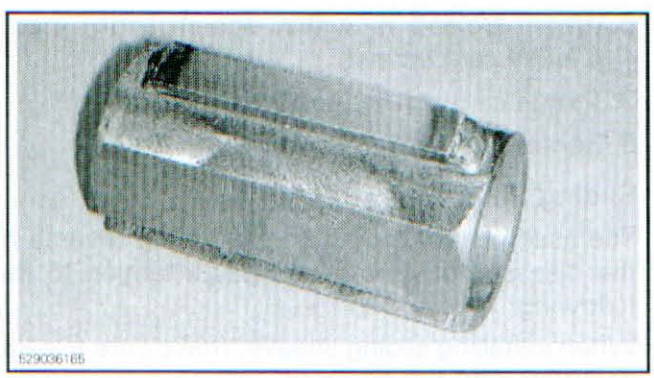


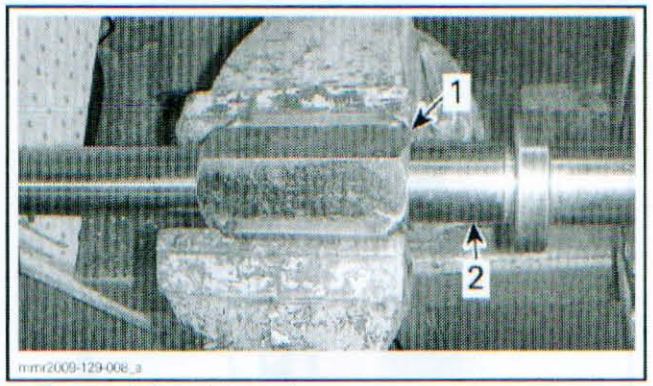
CAM ARROW

Spring Torsional Preload

NOTE: It is usual to experience spring setting during breaking period of a new spring. The factory spring preload is slightly higher (about 1 kg (2 lb)) to compensate for spring setting. Specifications in *TECHNICAL SPECIFICATIONS* are applicable after break-in period (about 10 hours of use).

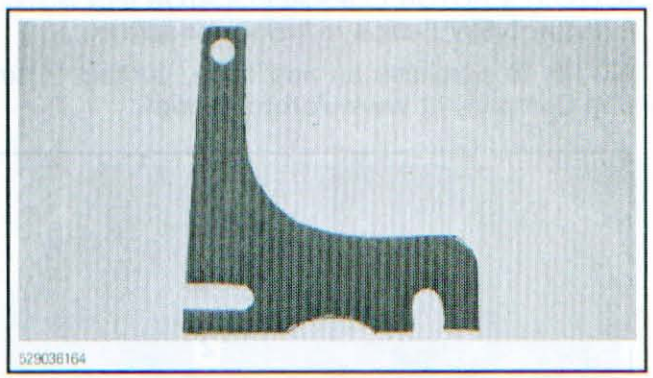
1. Secure the countershaft in a vise using the COUNTERSHAFT RETAINING TOOL (P/N 529 036 165).

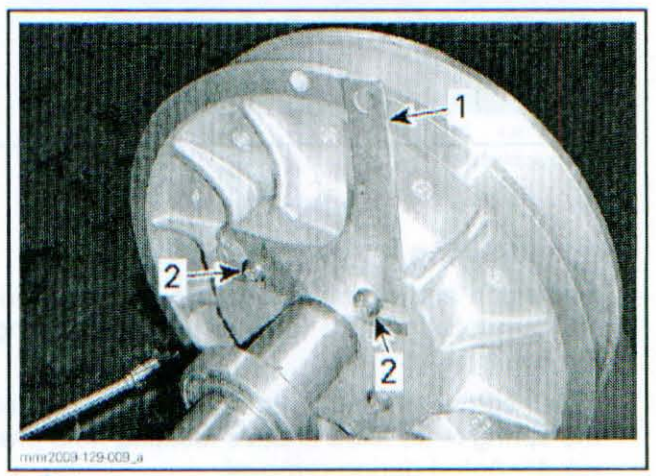




1. Countershaft retaining tool
2. Countershaft

2. Install the PRELOAD TESTER (P/N 529 036 164) using old cam screws.





1. Preload tester
2. Cam screws

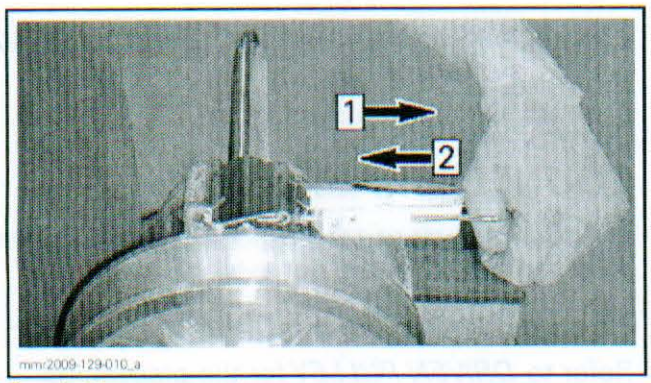
3. Pull sliding sheave with a FISH SCALE (P/N N. A.) perpendicularly with pulley axle.

   NOTE: The fish scale can be purchased locally.

   3.1 Take 1st measurement when sliding sheave begins to turn.

   3.2 Hold fish scale at this position.

   3.3 Slowly release tension from fish scale and take the 2nd measurement when sliding sheave begins to return.



Step 1: 1st measurement
Step 2: 2nd measurement

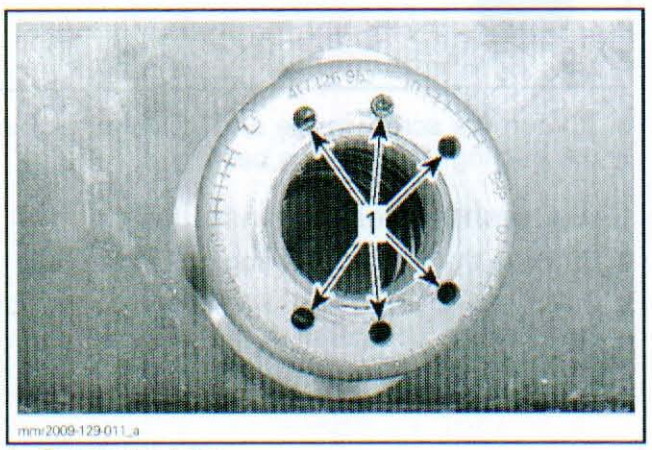
Spring preload is the average measurement between these 2.

$$\frac{\text{1ST MEASUREMENT (WHEN OPENING)} + \text{2ND MEASUREMENT (WHEN CLOSING)}}{2} = \text{SPRING PRELOAD}$$

Example:

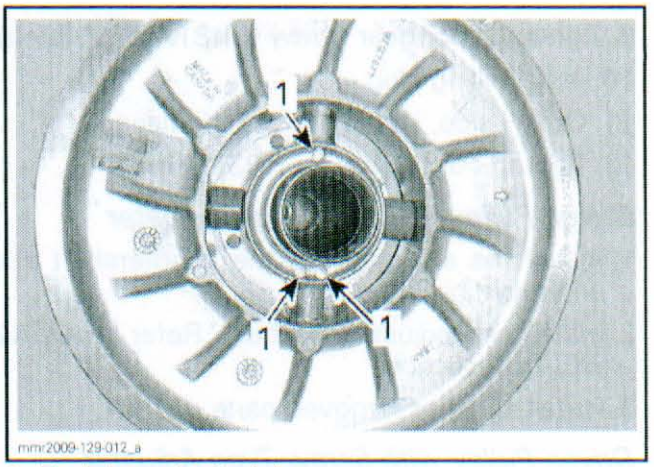
$$\frac{\text{8.2 KG (18 LB) (WHEN OPENING)} + \text{6.5 KG (14 LB) (WHEN CLOSING)}}{2} = \text{7.3 KG (16 LB) ACTUAL SPRING PRELOAD}$$

To adjust spring preload, relocate spring end in cam, moving it clockwise to increase the preload and counterclockwise to decrease it. Always recheck torsional preload after adjusting.



1. Cam locating holes

If spring preload can not be adjusted, try to relocate the other end of spring in fixed sheave.

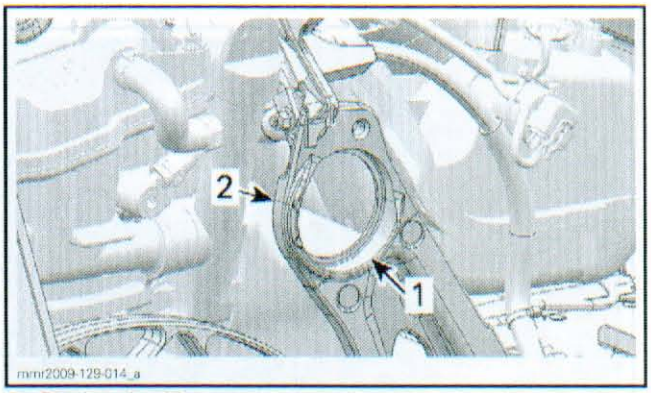


1. Fixed sheave locating holes

4. Finalize driven pulley assembly.

Driven Pulley Installation

1. Using sand paper (600-grit or 1000-grit) or steel wool, remove any rust on bearing shoulder of countershaft bearing support.



1. Bearing shoulder
2. Countershaft bearing support

2. Apply a thin layer of LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on bearing shoulder.
3. Insert countershaft through countershaft bearing support.
4. Fasten the end of countershaft to upper gear retaining tool.
5. Align countershaft splines with upper gear splines.
6. Using the upper gear retaining tool as a puller, install countershaft into upper gear. Ensure countershaft bearing is installed properly into countershaft bearing support.
7. Remove the upper gear retaining tool.
8. Install the upper gear screw and the conical spring washer.

NOTE: The conical spring washer must be installed with its concave side towards upper gear.

9. Tighten upper gear screw to 48 N•m (35 lbf•ft).
10. Install filling plug.
11. On LH side, install the bearing flange.
12. Tighten nut to 15 N•m (133 lbf•**in**).

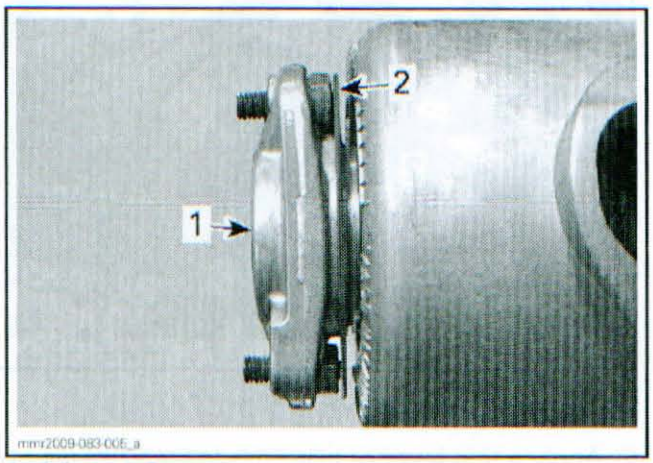
Driven Pulley with Ring Type Adjuster

1. Install the adjuster into the countershaft end and fully tight it.
2. Install and adjust drive belt. Refer to *DRIVE BELT* subsection.
3. Install all other removed parts.

Driven Pulley with Screw Type Adjuster

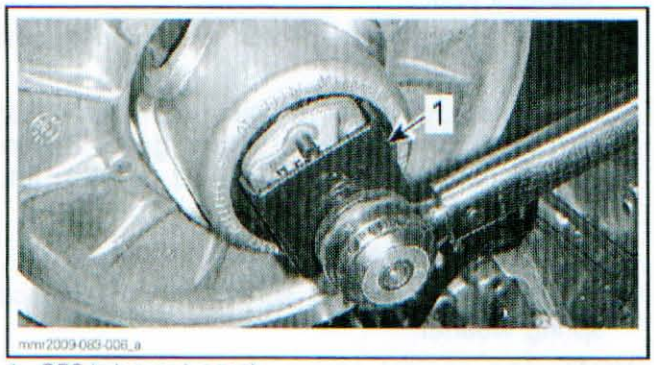
1. First, apply LOCTITE PRIMER N (P/N 293 800 041) then LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of adjuster hub.
2. Install the adjuster hub with its washer into the countershaft end and fully tight it.

NOTE: Ensure to position the washer against the adjuster nuts. Washer must turns freely.



1. Adjuster hub
2. Washer against adjuster nuts

3. Using the QRS HUB TORQUING TOOL (P/N 529 036 147), torque adjuster hub to 100 N•m (74 lbf•ft).



1. QRS hub torquing tool

4. Install and adjust drive belt. Refer to *DRIVE BELT* subsection.
5. Install all other removed parts.

COUNTERSHAFT

The countershaft and the fixed sheave are sold as an assembly. They are not available separately.

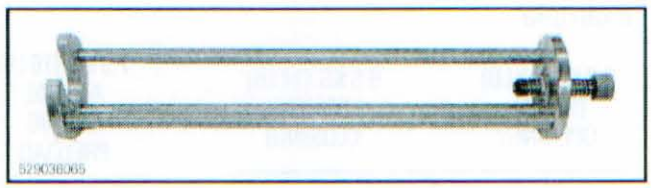
Countershaft Removal and Installation

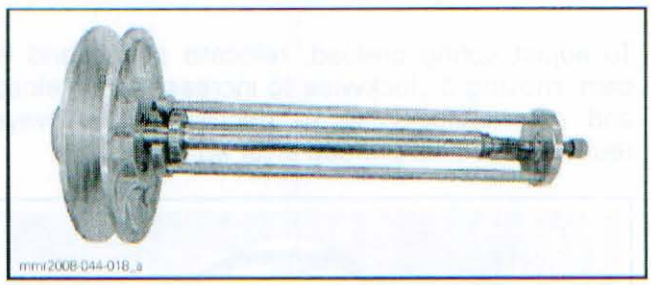
Refer to *DRIVEN PULLEY* for the procedures.

COUNTERSHAFT BEARING

Countershaft Bearing Removal

1. Remove *DRIVEN PULLEY*, see procedure in this subsection.
2. Install the COUNTERSHAFT BEARING REMOVER (P/N 529 036 065) on countershaft.

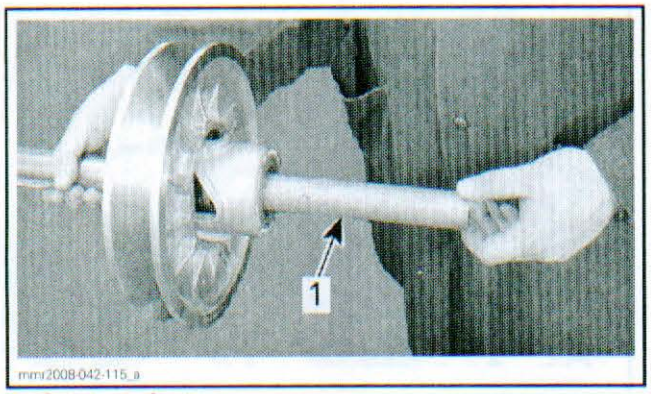




3. Tighten the screw at the end of tool to extract the bearing. Discard the bearing.

Countershaft Bearing Installation

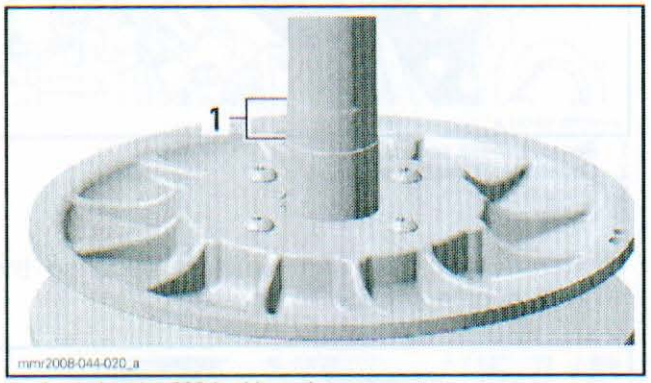
1. Remove the adjustment ring on cam.
2. Insert the COUNTERSHAFT SUPPORT (P/N 529 036 067) into countershaft.



1. Countershaft support

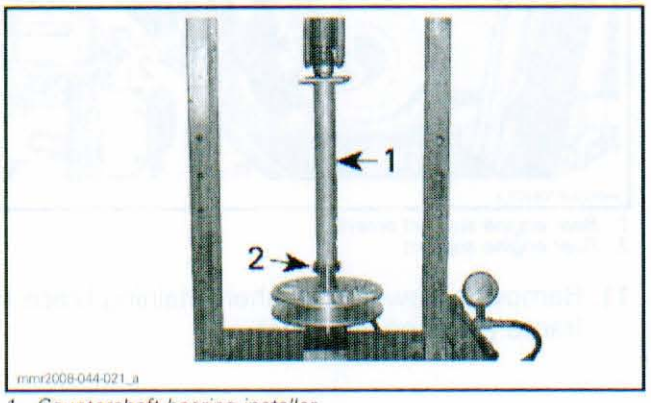
NOTICE **The countershaft support is mandatory to avoid damaging the countershaft threaded end and the cam during bearing installation.**

3. Using PULLEY FLANGE CLEANER (P/N 413 711 809), clean residues on countershaft bearing surface.
4. Check countershaft bearing surface for wear.
5. Apply LOCTITE 609 (P/N 413 703 100) on countershaft bearing surface.



1. Apply Loctite 609 in this region

6. Using a press and the COUNTERSHAFT BEARING INSTALLER (P/N 529 036 066), install the **NEW** bearing on countershaft.



1. Countershaft bearing installer
2. NEW bearing

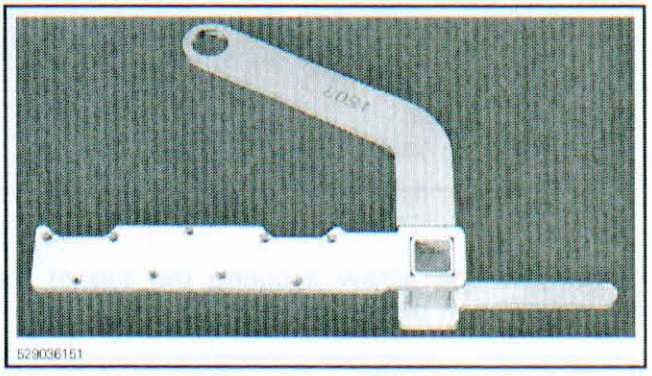
NOTICE **Use a press only, never tap on countershaft bearing installer with an hammer to avoid damaging bearing and countershaft.**

7. Clean the surplus of Loctite with a rag to avoid having Loctite on sliding sheave bushing.

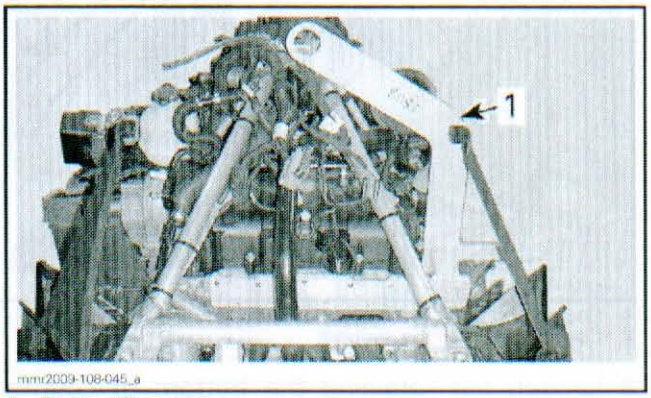
COUNTERSHAFT BEARING SUPPORT

Countershaft Bearing Support Removal

1. Remove the exhaust manifold. Refer to *EXHAUST SYSTEM* subsection.
2. Remove the drive pulley. Refer to *DRIVE PULLEY* subsection.
3. Remove the driven pulley, see procedure in this subsection.
4. Install the ENGINE LIFTING TOOL (P/N 529 036 151).
   4.1 Install the tool instead of exhaust manifold.

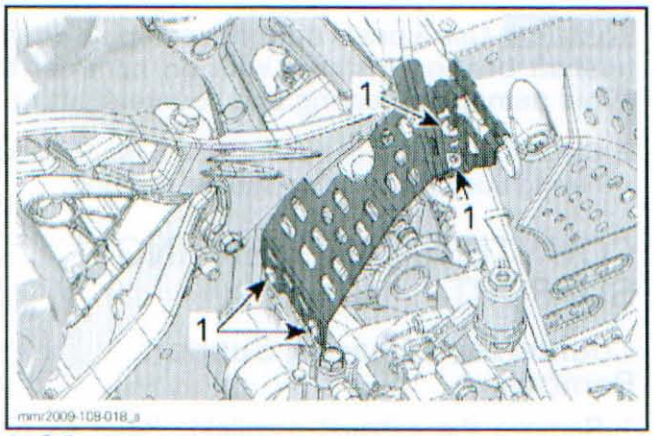


   4.2 Using exhaust manifold nuts, secure the tool.



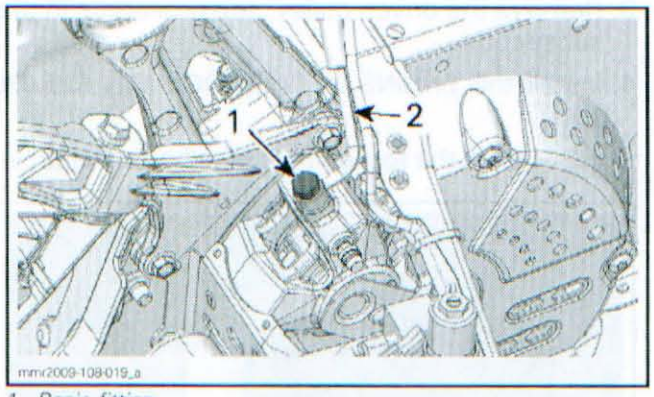
1. Engine lifting tool

   4.3 Install a hoist.
5. Remove the caliper protector.



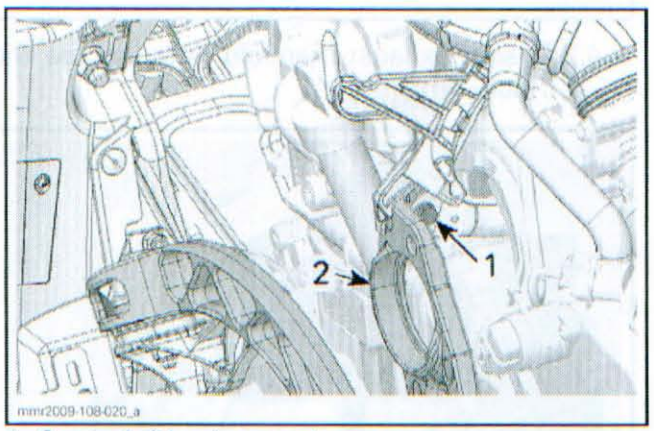
1. Caliper protector screws

6. Remove the Banjo fitting then move the brake hose aside. Discard sealing washers.



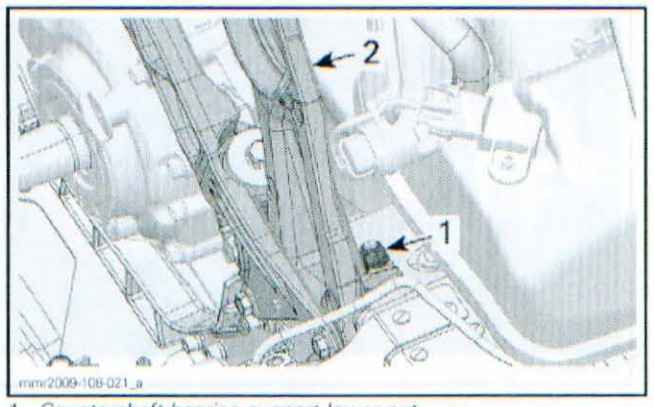
1. Banjo fitting
2. Brake hose

7. Remove the screw securing the top of the countershaft bearing support.



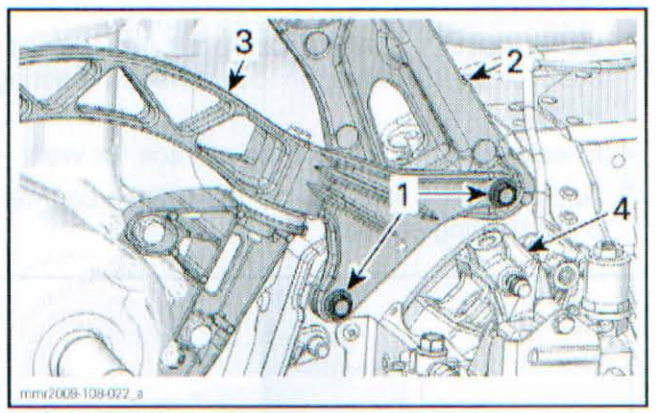
1. Countershaft bearing support upper screw
2. Countershaft bearing support

8. Loosen nut retaining the bottom of countershaft bearing support to frame.



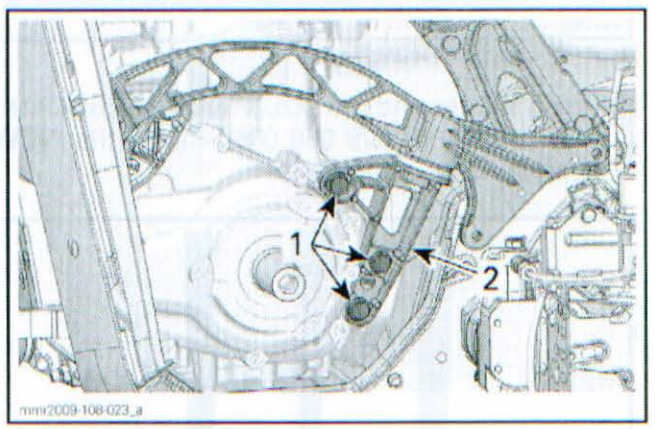
1. Countershaft bearing support lower nut
2. Countershaft bearing support

9. Remove both screws retaining the brace and the countershaft bearing support to frame.



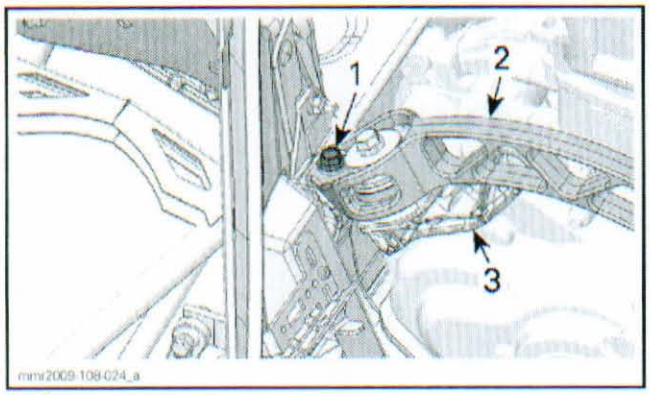
1. Remove these screws
2. Countershaft bearing support
3. Brace
4. Caliper

10. Remove screws and washers securing the rear engine support to engine.



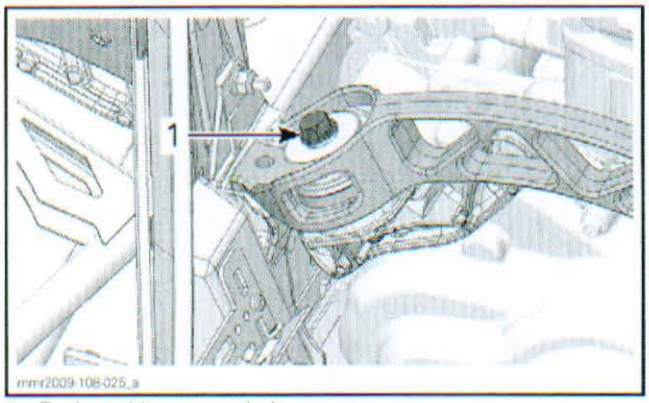
1. Rear engine support screws
2. Rear engine support

11. Remove screw and washer retaining brace to frame (front engine side).



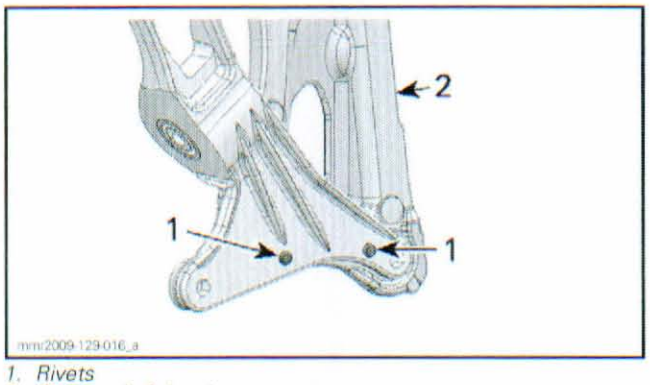
1. Brace screw
2. Brace
3. Front engine support

12. Unscrew the engine front rubber mount.



1. Engine rubber mount bolt

13. Remove the brace with countershaft bearing support and rear engine support.
14. Drill rivets securing countershaft bearing support to brace.



1. Rivets
2. Countershaft bearing support

15. Remove the support.

Countershaft Bearing Support Installation

1. Install countershaft bearing support to brace with two rivets.
2. Install brace on vehicle using procedure describes in *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Install all other removed parts.

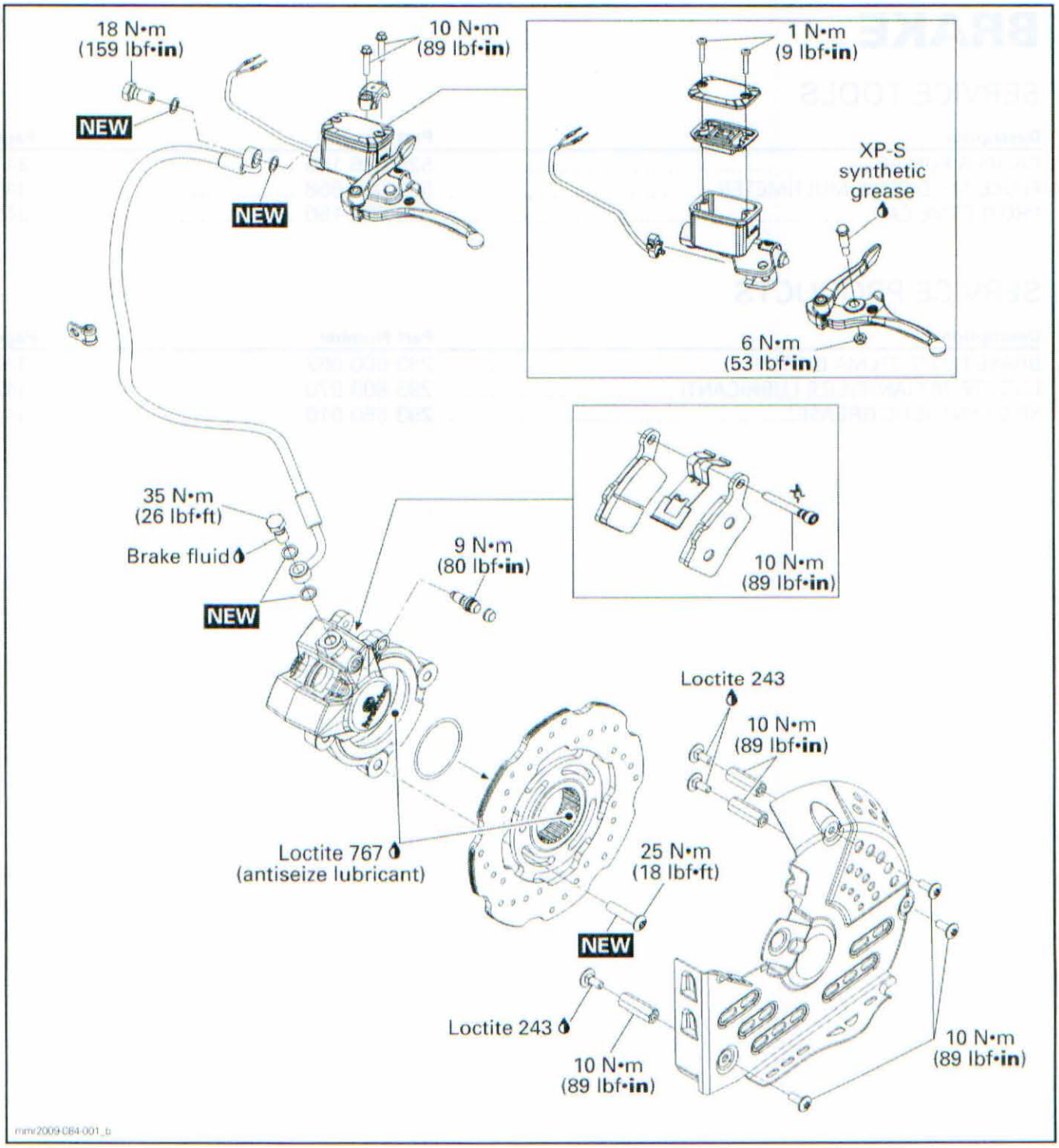
BRAKE

SERVICE TOOLS

Description	Part Number	Page
CALIPER PULLER	529 036 145	341
FLUKE 115 DIGITAL MULTIMETER	529 035 868	345
PROTECTIVE CAP	529 036 150	341

SERVICE PRODUCTS

Description	Part Number	Page
BRAKE FLUID GTLMA (DOT 4)	293 600 062	337
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	342
XP-S SYNTHETIC GREASE	293 550 010	344


18 N•m
(159 lbf•in)
NEW
10 N•m
(89 lbf•in)
NEW
1 N•m
(9 lbf•in)
XP-S
synthetic
grease
6 N•m
(53 lbf•in)
35 N•m
(26 lbf•ft)
Brake fluid
NEW
9 N•m
(80 lbf•in)
10 N•m
(89 lbf•in)
Loctite 243
10 N•m
(89 lbf•in)
Loctite 767
(antiseize lubricant)
25 N•m
(18 lbf•ft)
NEW
Loctite 243
10 N•m
(89 lbf•in)
10 N•m
(89 lbf•in)
mmr2009-084-001_b

GENERAL

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

Clean threads before applying a threadlocker. Refer to *SELF-LOCKING 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, cotter pins, etc.) must be replaced with new ones.

Hoses or cables removed or disconnected must be installed and routed at the same place.

NOTICE Locking ties removed during a procedure must be replaced and installed at the same location.

⚠ WARNING

Never apply anything to brake fittings, The use of threads sealant or Teflon tape could cause brake system failure. Severe injury or death can occur.

⚠ WARNING

A contaminated brake disc or pad reduces stopping power. Discard contaminated pads and clean contaminated disc with a high quality brake degreasing agent.

NOTICE Avoid spilling brake fluid on plastic, rubber or painted parts. Protect these parts with a rag when servicing brake system.

NOTICE Wipe up any brake fluid spillage.

NOTICE To avoid serious damage to the brake system, use only DOT 4 brake fluid from a sealed container. Do not use brake fluid taken from old or already opened containers, nor mix different fluids for topping off.

NOTICE Sealing washers must be discarded and replaced with NEW ones every time a Banjo fitting is unscrewed.

Dispose brake fluid as per your local environmental regulation.

MAINTENANCE

BRAKE FLUID

The brake fluid must be changed in accordance with the maintenance chart.

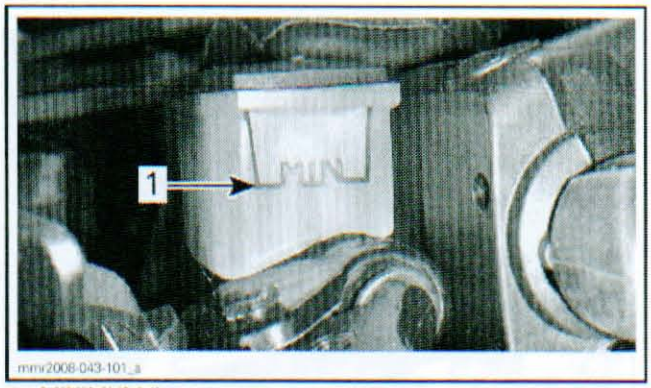
Recommended Brake Fluid

Always use brake fluid meeting the specification DOT 4 such as BRAKE FLUID GTLMA (DOT 4) (P/N 293 600 062).

Brake Fluid Level Verification

With the vehicle on a level surface, position steering in straight-ahead position to ensure reservoir is level.

Brake fluid must always be above the MIN. line when brake lever is squeezed.



1. MINIMUM line

Add fluid as required. Do not overfill.

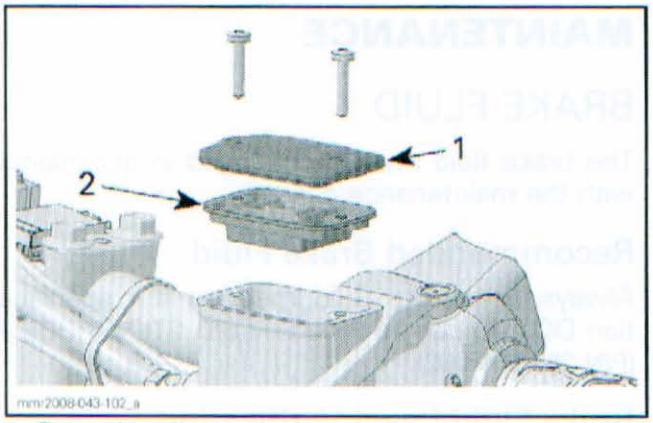
NOTE: A low level may indicate leaks or worn brake pads.

Brake Fluid Replacement

NOTE: Make sure not to contaminate brake lever with brake fluid. The brake lever pivot must always be properly lubricated. Refer to *BRAKE LEVER REPLACEMENT* in this subsection.

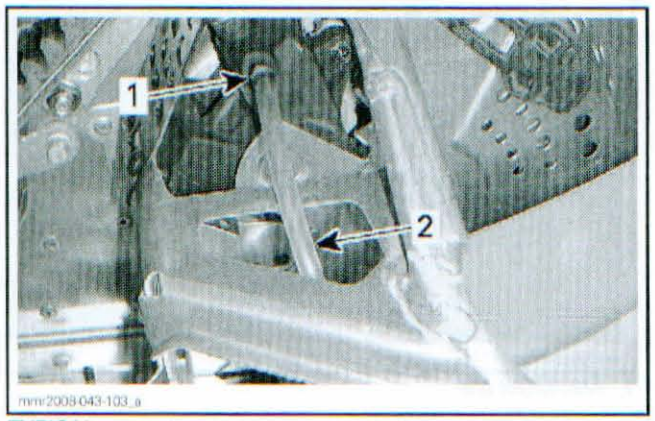
Draining

1. Place vehicle on a level surface.
2. Remove reservoir cover with its diaphragm.



1. Reservoir cover
2. Diaphragm

3. Connect a clear hose to caliper bleeder.
4. Place the other end of hose in a container.
5. Loosen bleeder and pump brake lever until no more fluid flows out of bleeder.

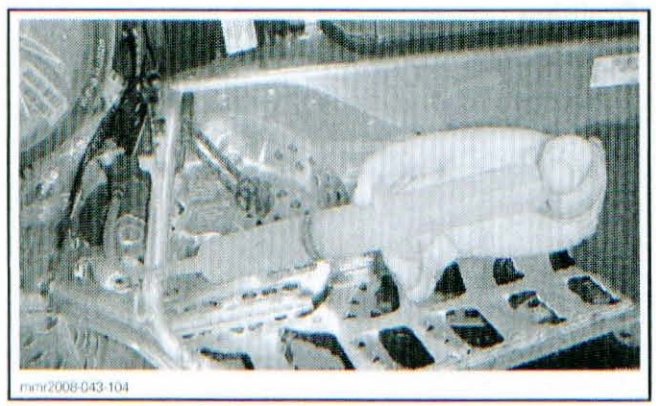


TYPICAL
1. Bleeder
2. Clear hose to catch used brake fluid

Filling

To fill brake circuit when it is empty do the following:

1. Ensure reservoir cover is removed.
2. Using a big syringe, push brake fluid slowly into the caliper.



3. Continue to push brake fluid until reservoir is half full.
4. Close bleeder.
5. Add brake fluid into reservoir and install cover.
6. Squeeze brake lever.
   - 6.1 If brake lever is firm, it is not required to bleed brake system. Tighten bleeder to 9 N•m (80 lbf•**in**).
   - 6.2 If brake lever is spongy, bleed brake system as per following procedure.

Bleeding

1. Install a clear hose on bleeder.
2. Place the other end in a container partially filled with clean brake fluid.
3. Pump up circuit pressure with brake lever until lever resistance is felt.
4. Squeeze brake lever and open bleeder. When lever touches the handlebar, do not release lever and close bleeder.
5. Release brake lever slowly.
6. Repeat the procedure until no more air bubbles appear in hose.

NOTE: Check fluid level often to prevent air from being pumped into the circuit.

7. Install cover on reservoir.
8. Squeeze brake lever.
   - 8.1 If brake lever is firm, bleeding procedure is completed. Tighten bleeder to 9 N•m (80 lbf•**in**).
   - 8.2 If brake lever is still spongy, go to step 9.
9. Push back brake pads with caliper in place and squeeze brake lever.
10. Repeat step 2 to step 5.
11. Tighten bleeder to 9 N•m (80 lbf•**in**).
12. Install diaphragm and cover on reservoir.

PROCEDURES

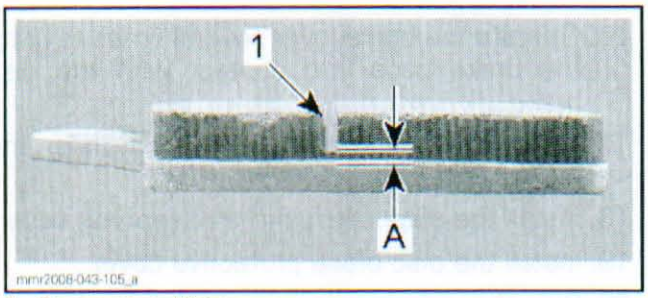
BRAKE PADS

Brake Pads Inspection

1. Measure brake pad lining thickness.

SERVICE LIMIT	
Brake pad thickness	1 mm (1/32 in)

NOTICE Brake pads must always be replaced in pairs.

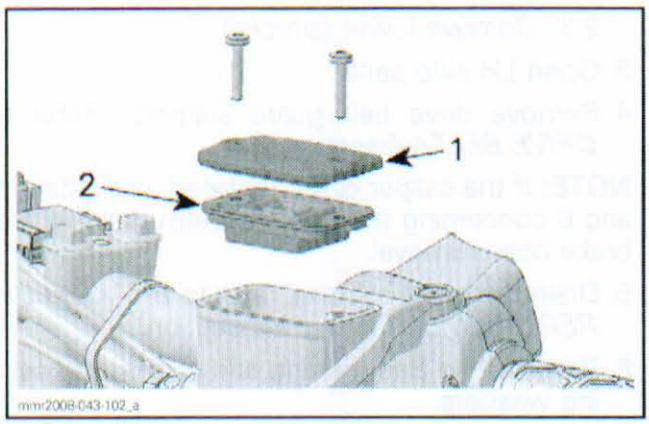


1. Groove on pad lining
A. Brake pad minimum thickness 1 mm (1/32 in)

2. Inspect brake disc at the same time.

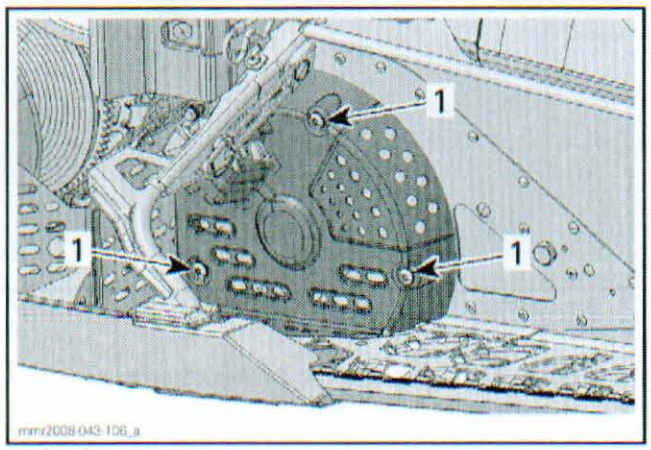
Brake Pads Replacement

1. Place the vehicle on a level surface.
2. Cover the plastic parts under and near master cylinder in the event that brake fluid would be spilled.
3. Remove reservoir cover with its diaphragm.



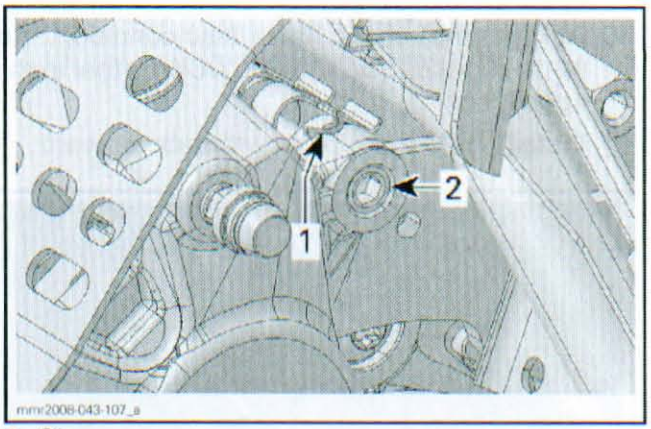
1. Reservoir cover
2. Diaphragm

4. Remove the disc brake protective cover.



1. Retaining screws

5. Remove the clip securing pad pin.
6. Unscrew and remove the pad pin.

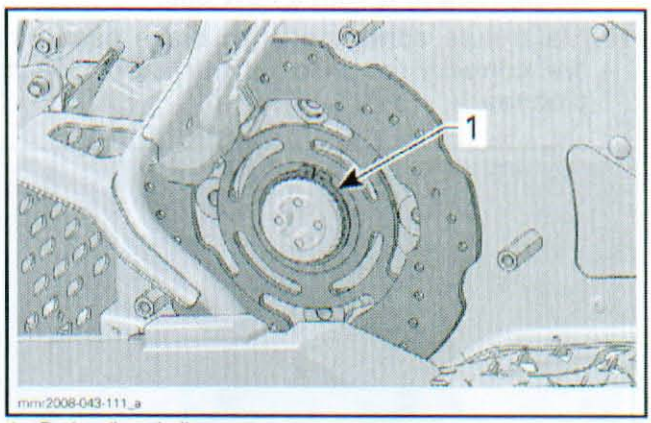


1. Clip
2. Brake pad pin

7. Using a flat screwdriver, retract pistons into their bores.

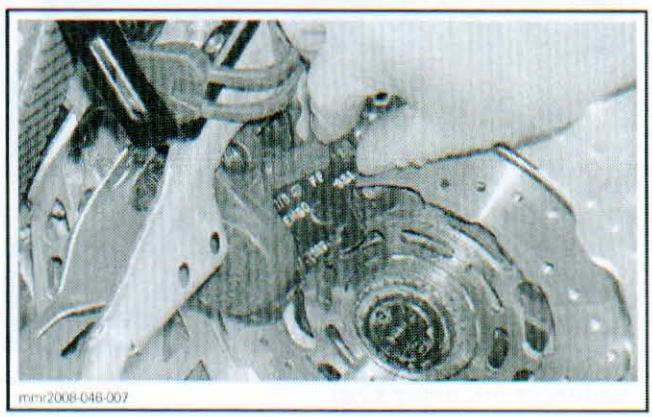
NOTICE Pay attention to avoid scratching brake disc.

8. Remove the circlip securing disc brake to drive shaft.

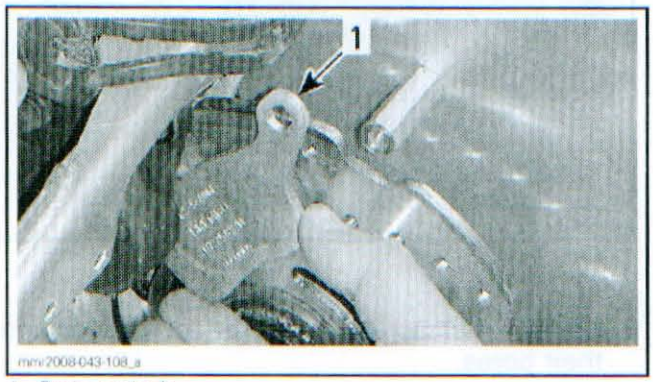


1. Brake disc circlip

9. Remove brake pads.
   - 9.1 Remove the external pad first.
   - 9.2 Pull the brake disc and remove the internal pad.

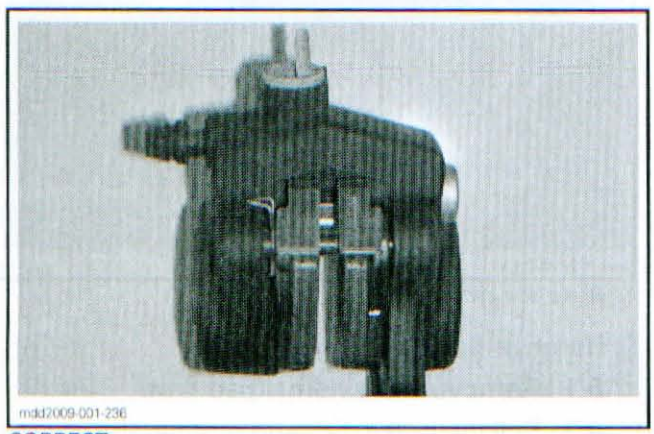


10. At this time, check brake disc condition. Refer to *BRAKE DISC INSPECTION* further in this subsection.
11. Install **NEW** brake pads with tabs upward.

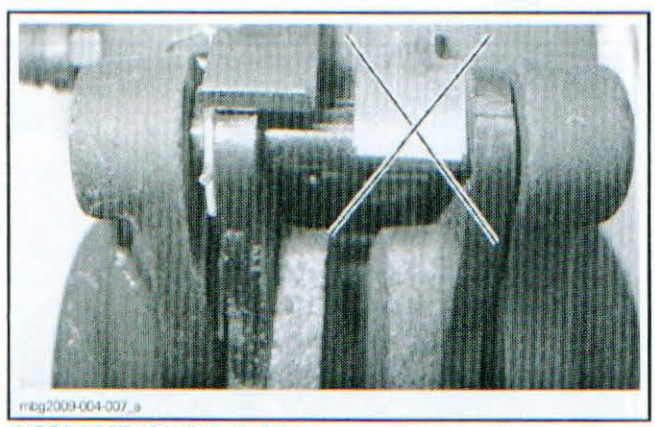


1. Brake pad tab

12. Install brake pad pin.
13. Tighten pin to 10 N•m (89 lbf•**in**).
14. Install clip on brake pad pin. If the clip seems loose, replace it with a new one.
15. Make sure spring ends on brake pads pins are correctly installed as per the following pictures.



CORRECT



INCORRECT (ON RIGHT SIDE)

16. Operate the brake lever several times to bring the brake pads into contact with the disc brake.
17. Check brake fluid level in master cylinder and refill if necessary.
18. Install the diaphragm and the reservoir cover.
19. Install the disc brake protective cover.
20. Ride the vehicle a few minutes to make sure the repair is successful.

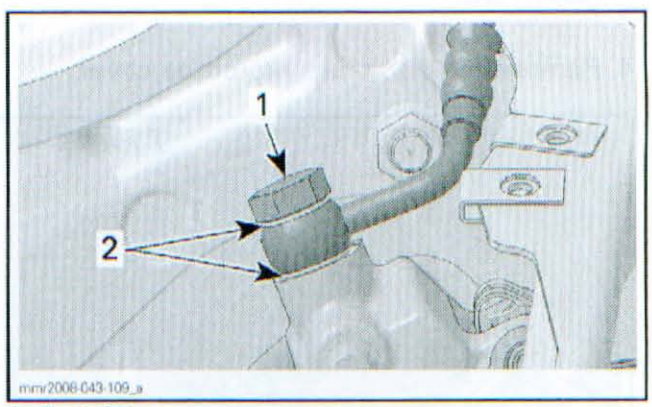
CALIPER

Caliper Removal

1. Open the RH side panel.
2. Refer to *CHAINCASE AND REVERSE* subsection and carry out the following steps.
   - 2.1 Remove chaincase cover.
   - 2.2 Loosen drive chain.
   - 2.3 Remove lower sprocket.
3. Open LH side panel.
4. Remove drive belt guard support. Refer to *DRIVE BELT* subsection.

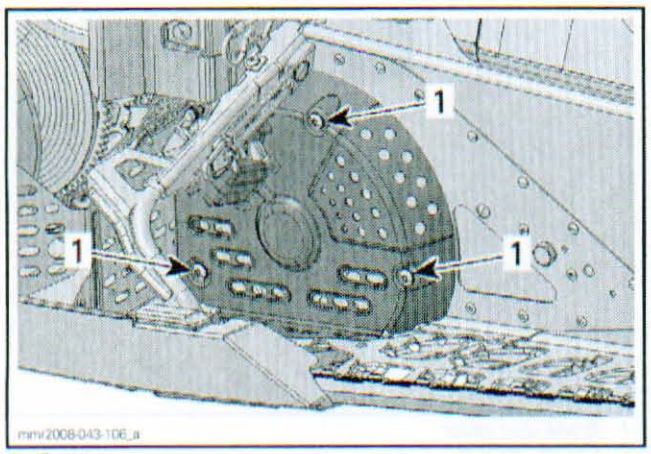
NOTE: If the caliper is not replaced, omit steps 5 and 6 concerning the brake system draining and brake hose removal.

5. Drain the brake system, refer to *BRAKE FLUID REPLACEMENT* in this subsection.
6. Remove the Banjo fitting and discard the sealing washers.



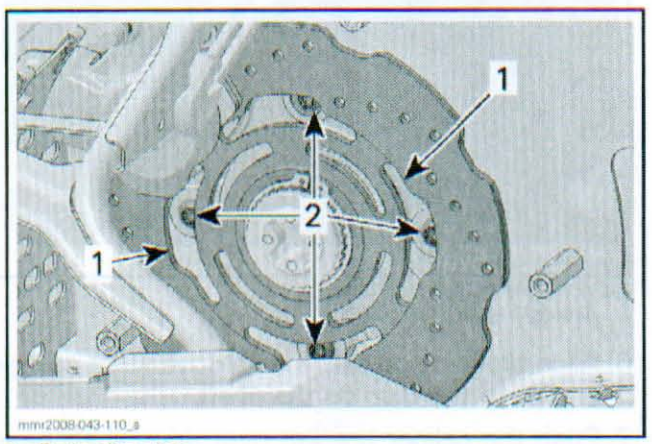
1. Banjo fitting
2. Sealing washers

7. Remove the brake disc protective cover.



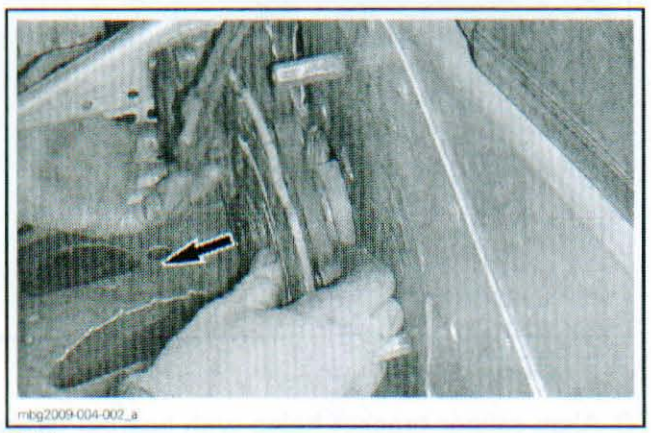
1. Screws

8. Lift the rear of vehicle and release track tension completely. Refer to *TRACK* subsection.
9. Turn driven pulley to align brake disc slots with caliper bracket screws.
10. Remove caliper screws (4) behind brake disc.



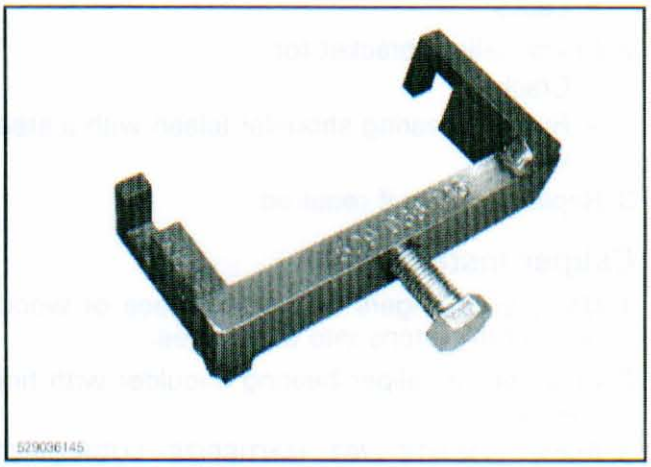
1. Brake disc slots
2. Caliper screws behind brake disc

11. Pull the drive axle assembly (brake disc, caliper and bearing) from LH side.



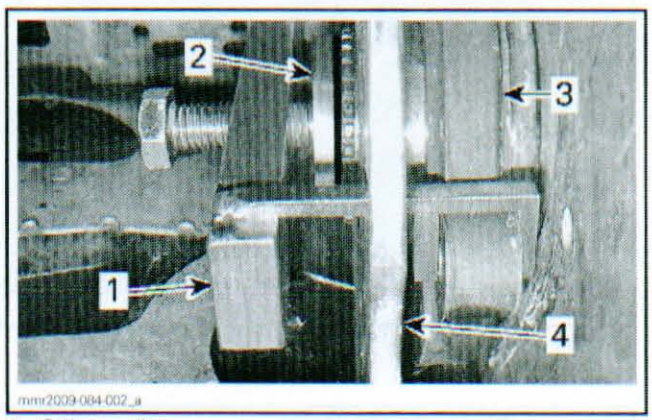
PULL

12. Remove *BRAKE PADS*, see procedure in this section.
13. Install the CALIPER PULLER (P/N 529 036 145) on the brake caliper through brake disc slots.



NOTE: Make sure puller tabs are correctly engaged on caliper.

14. Install the PROTECTIVE CAP (P/N 529 036 150) between caliper puller bolt and plastic cap.



1. Caliper puller
2. Protective cap
3. Caliper bracket
4. Brake disc

15. Tighten caliper puller bolt to separate caliper from drive axle bearing.

NOTICE **Never use an impact tool to operate caliper puller. The caliper or the puller could break.**

16. When brake disc is out of splines, remove it.
17. Remove caliper.

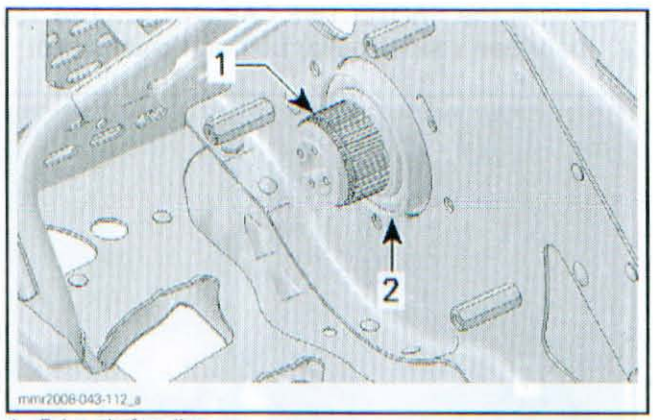
NOTICE **Do not let caliper hangs by the hose and do not stretch or twist the hose.**

Caliper Inspection

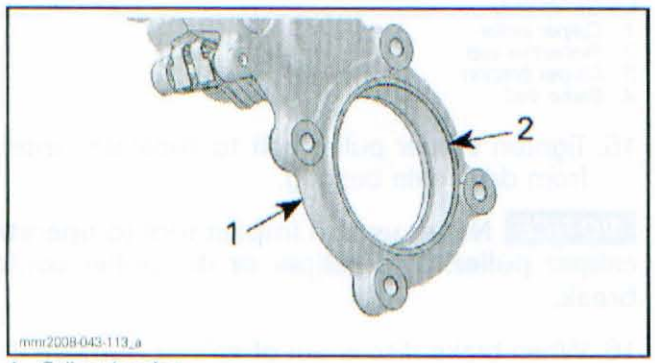
1. Check pistons for:
   - Rust
   - Scratches
   - Leaks.
2. Check caliper bracket for:
   - Cracks
   - Rust on bearing shoulder (clean with a steel wood).
3. Replace caliper if required.

Caliper Installation

1. Using your fingers or a small piece of wood, push both pistons into their bores.
2. Clean brake caliper bearing shoulder with fine steel wool.
3. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on drive shaft splines and on caliper bracket bearing shoulder.

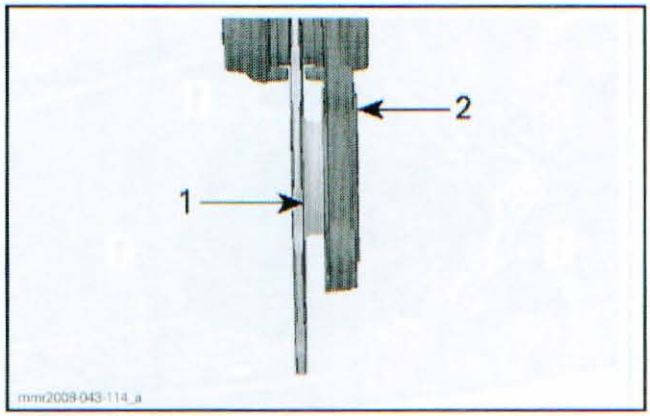


1. Drive shaft splines
2. Drive shaft bearing



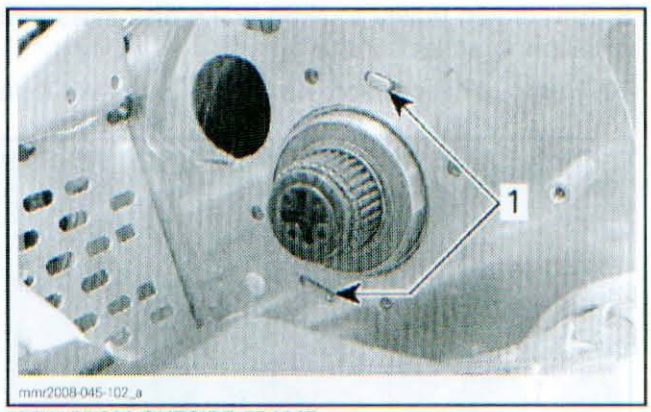
1. Caliper bracket
2. Bearing shoulder

4. Insert brake disc into caliper. The brake disc collar must be inserted into caliper bracket.



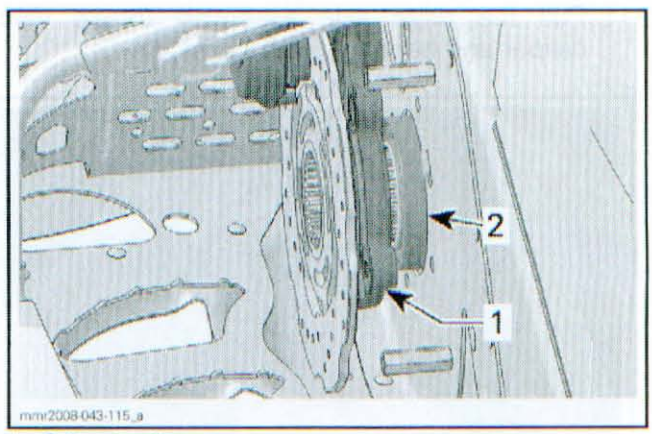
1. Brake disc collar
2. Caliper bracket

5. Ensure bearing flange is properly locked. Tabs must be properly inserted in frame.



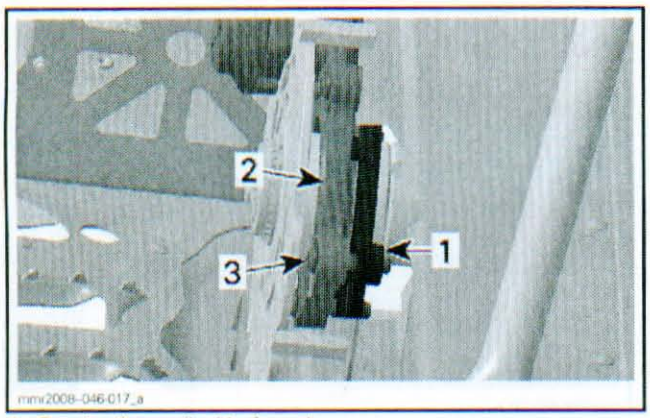
VIEW FROM OUTSIDE FRAME
1. Bearing flange locking tabs

6. Align brake disc splines with drive shaft splines and push the disc on the shaft.
7. Push the caliper bracket over drive shaft bearing.



1. Caliper bracket
2. Drive shaft bearing

8. Align caliper bracket holes with bearing flange holes and install caliper screws.



1. Bearing flange (inside frame)
2. Caliper bracket
3. Caliper screws

9. **HAND TORQUE** each caliper bracket screws evenly in a criss-cross pattern until bracket is correctly positioned against frame.

NOTICE Never use an air tool to tighten caliper screws. The caliper bracket could crack.

10. Torque screws to 25 N•m (18 lbf•ft).
11. Install *BRAKE PADS*, see procedure above in this section.
12. Install the brake disc circlip.
13. Apply brake fluid on Banjo fitting threads.
14. Install the Banjo fitting with two **NEW** sealing washers.
15. Torque Banjo fitting to 35 N•m (26 lbf•ft).
16. Fill and bleed the brake system. Refer to *BRAKE FLUID REPLACEMENT* in this section.
17. Install all other removed parts.
18. Check the operation of the brake carefully before riding the snowmobile.

BRAKE DISC

Brake Disc Inspection

Prior Brake Disc Removal

1. Remove the disc brake protective cover.
2. Check for scoring, cracking or bending, replace as required.
3. Measure brake disc thickness. If the brake disc is out of specification, replace it with a new one.

NOTICE Brake disc should never be machined.

BRAKE DISC THICKNESS	
Minimum thickness	4.5 mm (.177 in)

After Brake Disc Removal

1. Check brake disc splines and drive shaft splines for wear or other damages. Replace defective parts.

Brake Disc Removal and Installation

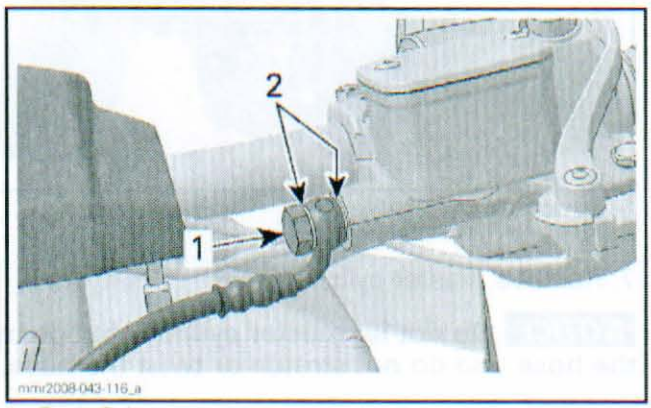
Use the same procedure as for the caliper.

MASTER CYLINDER

Master Cylinder Removal

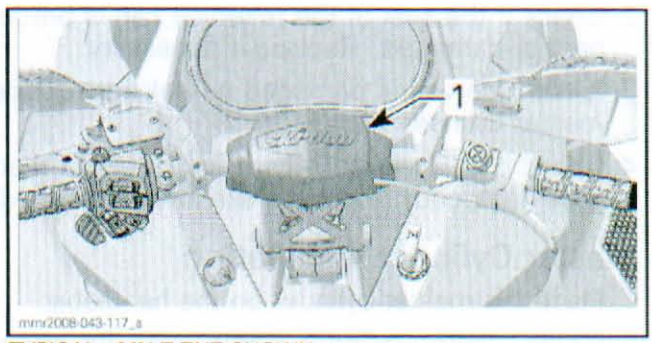
NOTE: If the master cylinder is not replaced, omit the next steps concerning the brake system draining and brake hose removal.

1. Drain the brake system, refer to *BRAKE FLUID REPLACEMENT* at the beginning of this section.
2. Remove the Banjo fitting and discard the sealing washers.



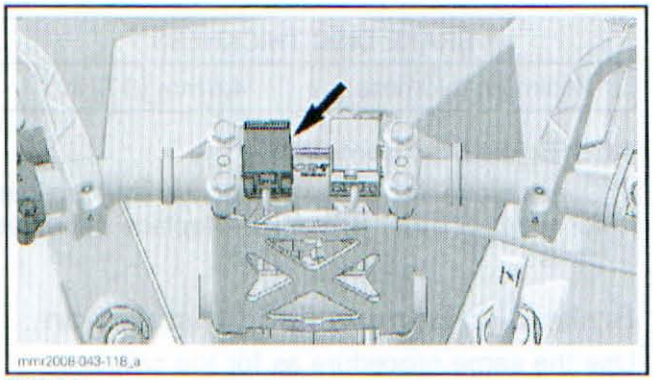
1. Banjo fitting
2. Sealing washers

3. Remove steering pad.



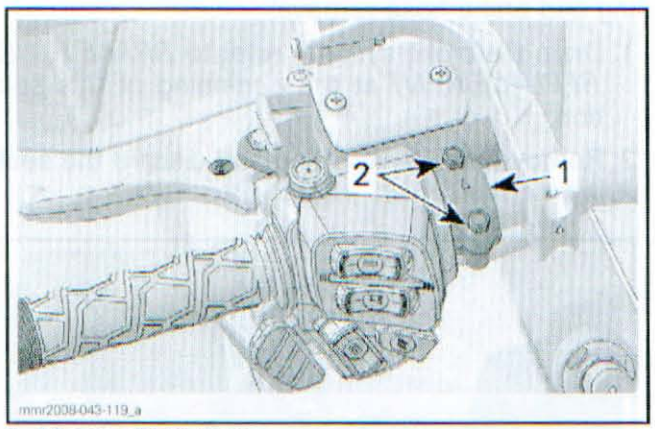
TYPICAL - MX Z TNT SHOWN
1. Steering pad

4. Unplug the LH connector.



TYPICAL

5. Cut locking tie securing brake light switch wiring to handlebar.
6. Remove screws and clamp securing master cylinder to handlebar.



1. *Master cylinder clamp*
2. *Master cylinder clamp screws*

7. Remove master cylinder.

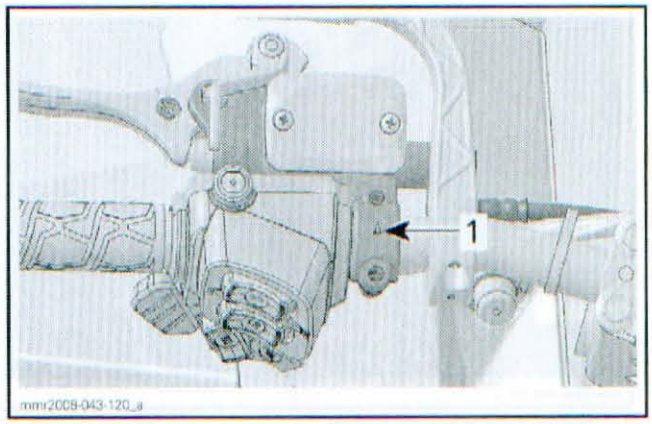
NOTICE **Do not let master cylinder hangs by the hose and do not stretch or twist the hose.**

Master Cylinder Inspection

1. Discard all remaining fluid inside master cylinder reservoir.
2. Check if the seal of the reservoir cap is brittle, hard or damaged. Replace if necessary.
3. If the reservoir is damaged or leaking, replace master cylinder.
4. Check if brake lever is bent, cracked or otherwise damaged. Replace brake lever if required.

Master Cylinder Installation

1. Place the master cylinder on the handlebar.
2. Install master cylinder clamp with its arrow pointing toward the front of vehicle.



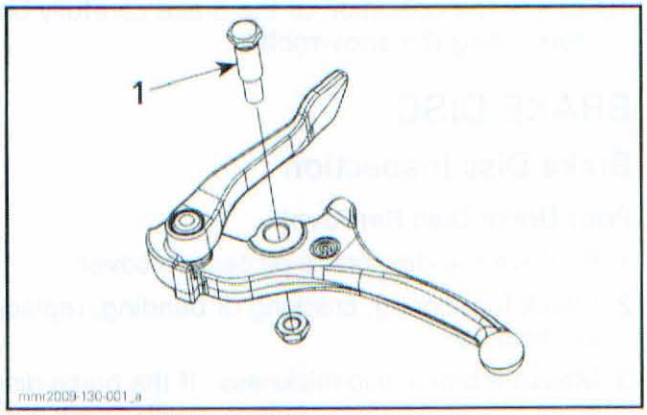
1. *Arrow on clamp*

3. Install master cylinder clamp screws and tighten loosely.
4. With the handlebar in a straight ahead position, place the reservoir parallel to the ground.
5. Tighten brake lever clamp screws to 10 N•m (89 lbf•**in**).
6. Install the Banjo fitting with two **NEW** sealing washers.
7. Torque Banjo fitting to 18 N•m (159 lbf•**in**).
8. Fill and bleed the brake system. Refer to *BRAKE FLUID REPLACEMENT* at the beginning of this subsection.
9. Connect brake light switch connector.
10. Install steering cover.

BRAKE LEVER

Brake Lever Replacement

Lubricate brake lever pivot using XP-S SYNTHETIC GREASE (P/N 293 550 010).



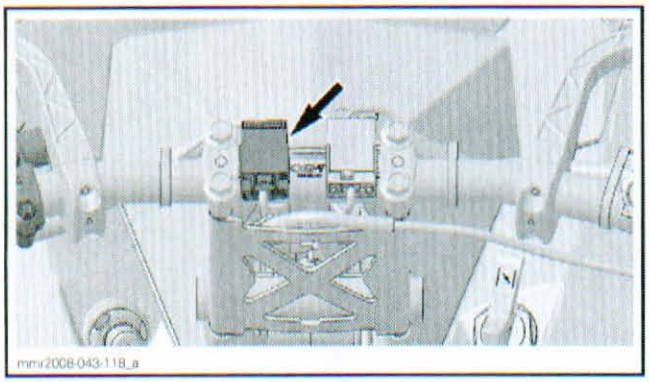
1. *Lubricate brake lever pivot*

Torque pivot nut of brake lever to 6 N•m (53 lbf•**in**).

BRAKE LIGHT SWITCH

Brake Light Switch Continuity Test

1. Remove steering cover.
2. Disconnect brake light switch connector.



TYPICAL

3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
4. Release brake lever.
5. Measure resistance as per the following table.

TEST PROBES	RESISTANCE
Pin 2 (WH)	Open (OL)
Pin 3 (RD/YL)	

6. Press and hold brake lever.
7. Measure resistance as per the following table.

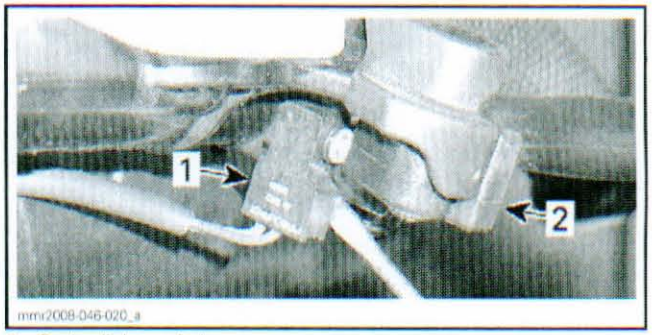
TEST PROBES	RESISTANCE
Pin 2 (WH)	Close to 0 Ω
Pin 3 (RD/YL)	

If readings do not correspond to the above tables, replace switch.

If readings correspond to the above tables, check fuse, wiring and connectors going to switch. Repair or replace defective part(s). Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

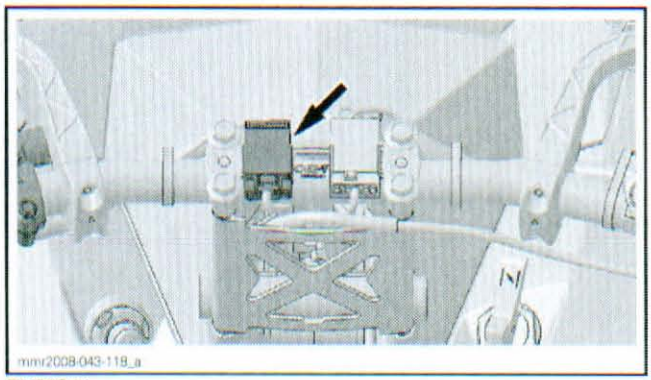
Brake Light Switch Removal

1. Slip a small screwdriver between brake light switch and brake lever and separate them.



1. Brake light switch
2. Brake lever

2. Remove the steering cover and unplug the LH connector.



TYPICAL

3. Cut all locking ties securing switch wires.
4. Remove switch wires from connector.

NOTE: Check wires location for reinstallation.

Brake Light Switch Installation

1. Plug switch wires into connector.
2. Squeeze brake lever.
3. Insert the both tabs of switch into brake lever body.
4. Plug the connector.
5. Check if switch is working properly.
6. Install new locking ties and the steering cover.

CHAINCASE AND REVERSE

SERVICE TOOLS

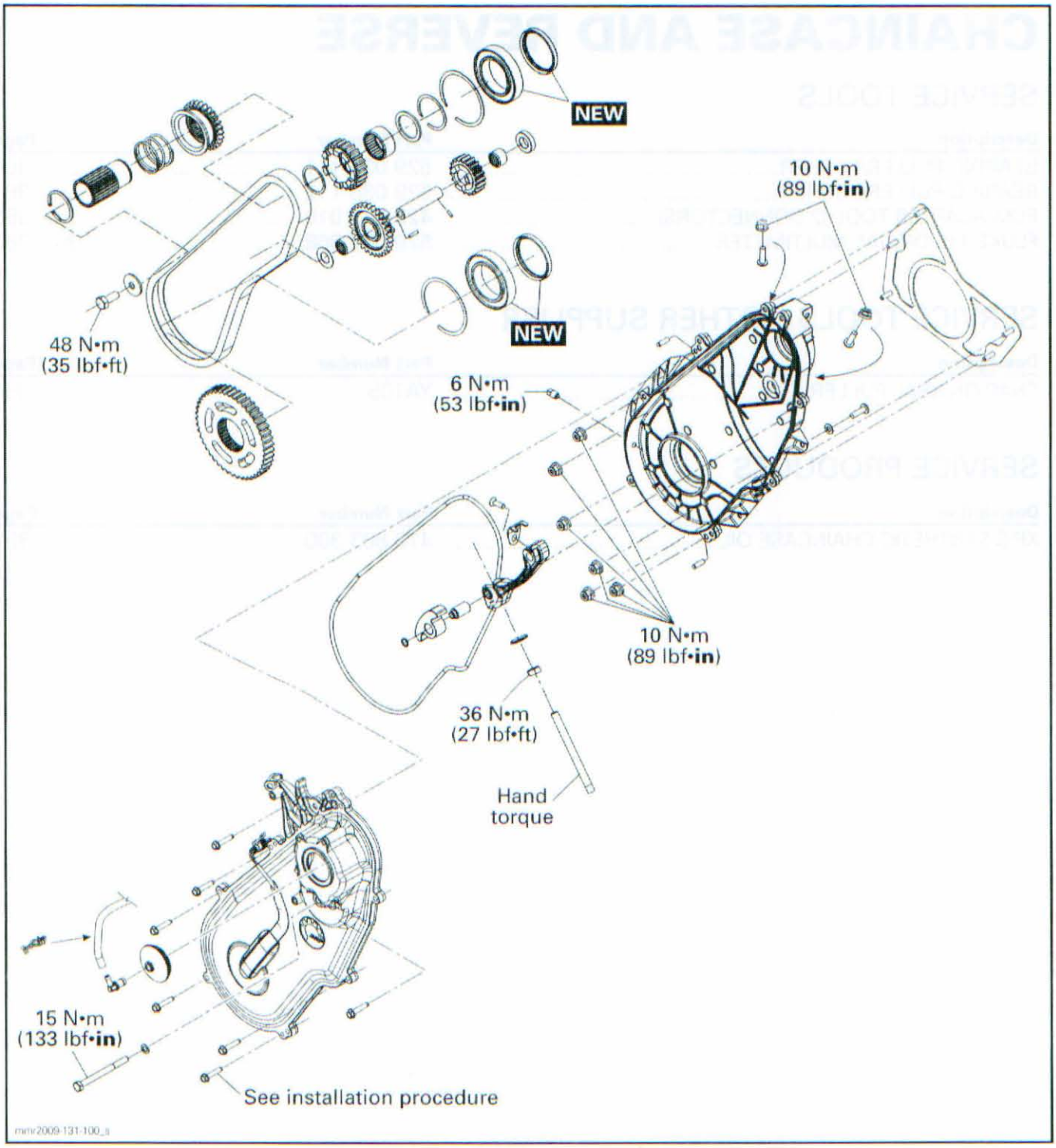
Description	Part Number	Page
BEARING PULLER/PUSHER	529 036 111	364
BEARING PULLER/PUSHER	529 036 112	364
ECM ADAPTER TOOL (2 CONNECTORS)	420 277 010	359
FLUKE 115 DIGITAL MULTIMETER	529 035 868	357–360

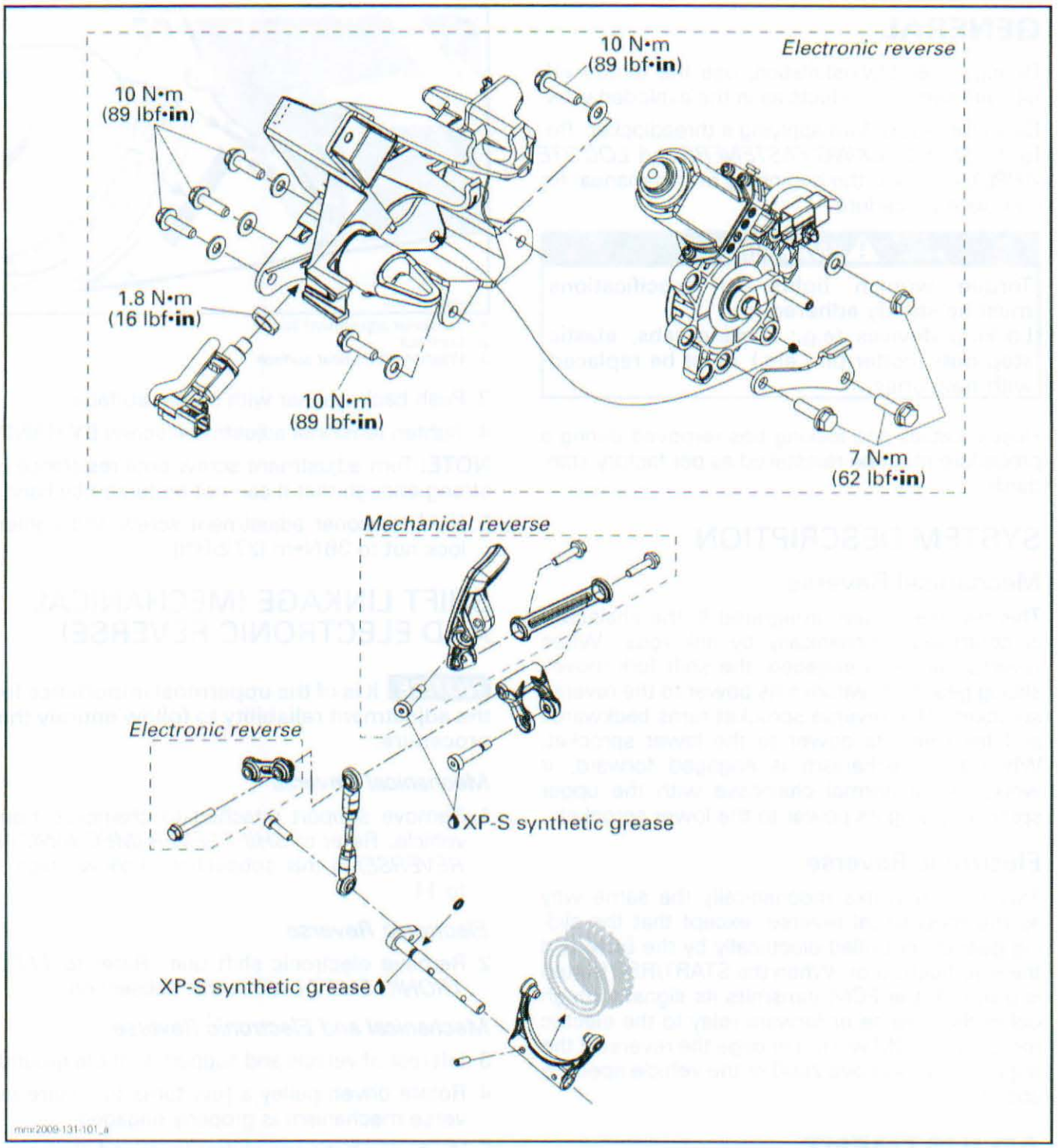
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON SEAL PULLER	YA105	364

SERVICE PRODUCTS

Description	Part Number	Page
XP-S SYNTHETIC CHAINCASE OIL	413 803 300	351


NEW
NEW
10 N•m
(89 lbf•in)
48 N•m
(35 lbf•ft)
6 N•m
(53 lbf•in)
10 N•m
(89 lbf•in)
36 N•m
(27 lbf•ft)
Hand
torque
15 N•m
(133 lbf•in)
See installation procedure
mmr2009-131-100_a


10 N•m
(89 lbf•in)
Electronic reverse
10 N•m
(89 lbf•in)
1.8 N•m
(16 lbf•in)
10 N•m
(89 lbf•in)
7 N•m
(62 lbf•in)
Mechanical reverse
Electronic reverse
XP-S synthetic grease
XP-S synthetic grease
mmr2009-131-101_a

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

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

SYSTEM DESCRIPTION

Mechanical Reverse

This reverse system integrated in the chaincase is controlled mechanically by link rods. When reverse handle is engaged, the shift fork moves sliding gear and switches its power to the reverse sprocket. This reverse sprocket turns backwards and transmits its power to the lower sprocket. When the mechanism is engaged forward, it works like a normal chaincase with the upper sprocket giving its power to the lower sprocket.

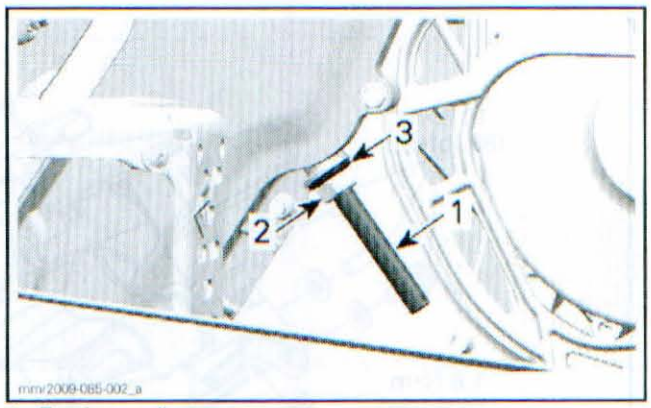
Electronic Reverse

This system works mechanically the same way as the mechanical reverse, except that the sliding gear is controlled electrically by the ECM and the electrical motor. When the START/RER button is pressed, the ECM transmits its signal through either the reverse or forward relay to the electric motor. The ECM will not engage the reverse if the engine RPM is above 2000 or the vehicle speed is above 1 km/h.

ADJUSTMENT

DRIVE CHAIN

1. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.
2. Unscrew lock nut on tensioner adjustment screw.



1. *Tensioner adjustment screw*
2. *Lock nut*
3. *Washer with rubber surface*

3. Push back washer with rubber surface.
4. Tighten tensioner adjustment screw **BY HAND**.

NOTE: Turn adjustment screw until resistance is strong enough that it can not be turned by hand.

5. Hold tensioner adjustment screw and tighten lock nut to 36 N•m (27 lbf•ft).

SHIFT LINKAGE (MECHANICAL AND ELECTRONIC REVERSE)

NOTICE It is of the uppermost importance for the adjustment reliability to follow entirely this procedure.

Mechanical Reverse

1. Remove support attached to chaincase from vehicle. Refer to *SHIFT LEVER (MECHANICAL REVERSE)* in this subsection. Follow steps 1 to 11.

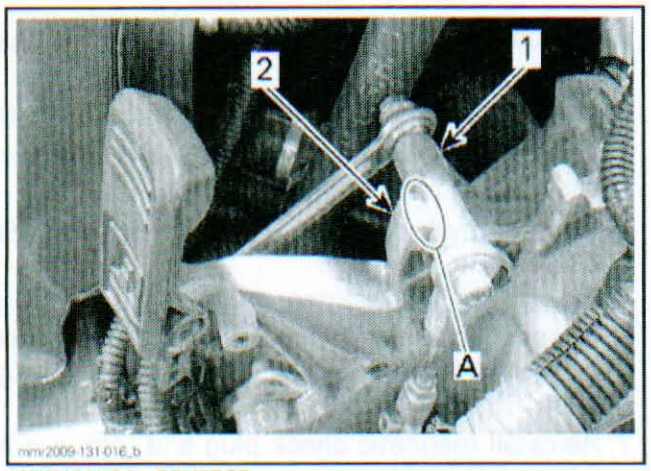
Electronic Reverse

2. Remove electronic shift unit. Refer to *ELECTRONIC SHIFT UNIT* in this subsection.

Mechanical and Electronic Reverse

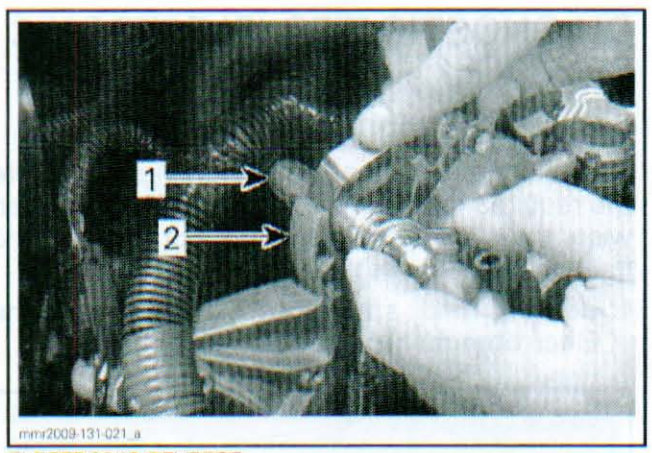
3. Lift rear of vehicle and support it off the ground.
4. Rotate driven pulley a few turns to ensure reverse mechanism is properly engaged.
5. Verify gap between shifter lever and chaincase front stopper using a feeler gauge. Refer to the following table.

SHIFT LINKAGE ADJUSTMENT	
Gap no. A	0.4 mm to 0.6 mm (.016 in to .024 in)



MECHANICAL REVERSE
1. *Shifter lever*
2. *Chaincase front stopper*

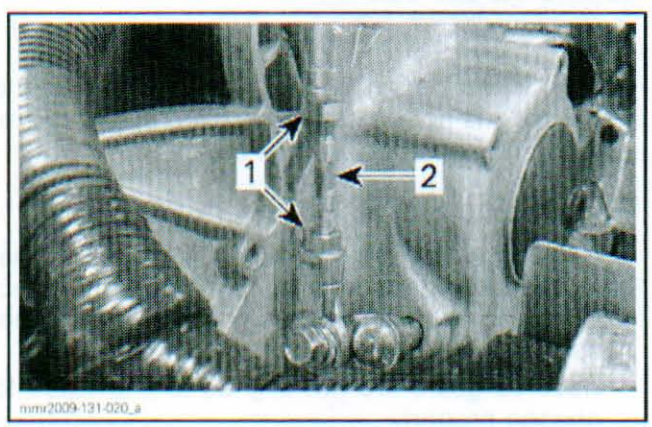
A. *Gap = 0.4 mm to 0.6 mm (.016 in to .024 in)*



ELECTRONIC REVERSE
1. *Shifter lever*
2. *Chaincase front stopper*

6. If gap is out of specification, adjust shifter link rod as follows.

6.1 Unscrew link rod lock nuts.



1. *Lock nuts*
2. *Link rod*

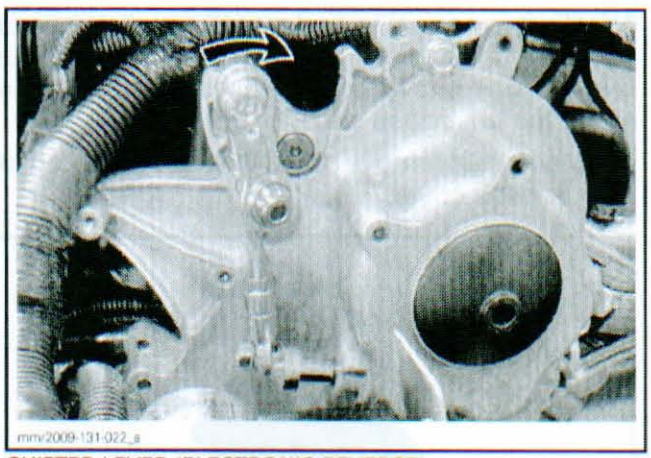
6.2 Turn link rod accordingly.

NOTE: Turn the link rod clockwise to reduce the gap and counterclockwise to increase the gap.

6.3 Tighten link rod lock nuts.

7. Engage and release reverse mechanism 10 times using reverse handle or shifter lever.

REVERSE HANDLE (MECHANICAL REVERSE)



SHIFTER LEVER (ELECTRONIC REVERSE)

8. Rotate driven pulley a few turns to ensure reverse mechanism is properly engaged.
9. Verify again adjustment gap as per step 5. Readjust if necessary.

MAINTENANCE

CHAINCASE OIL

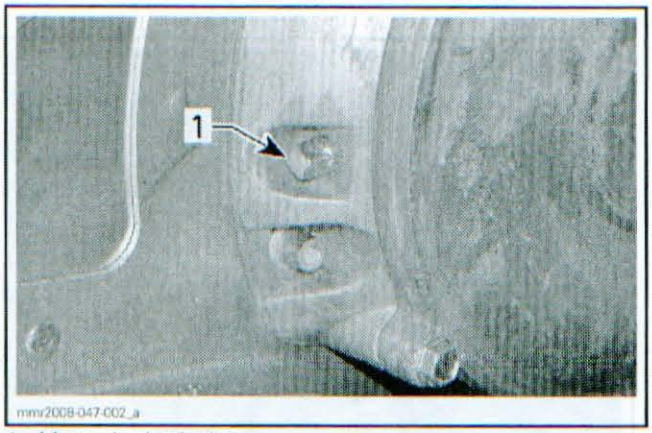
Recommended Chaincase Oil

Use XP-S SYNTHETIC CHAINCASE OIL (P/N 413 803 300).

NOTICE Use only the recommended type oil when servicing. Do not mix synthetic oil with other types of oil.

Chaincase Oil Level Verification

1. Place vehicle on a level surface.
2. Remove magnetic check plug on the left side of chaincase. Oil level must be equal with the lower edge.

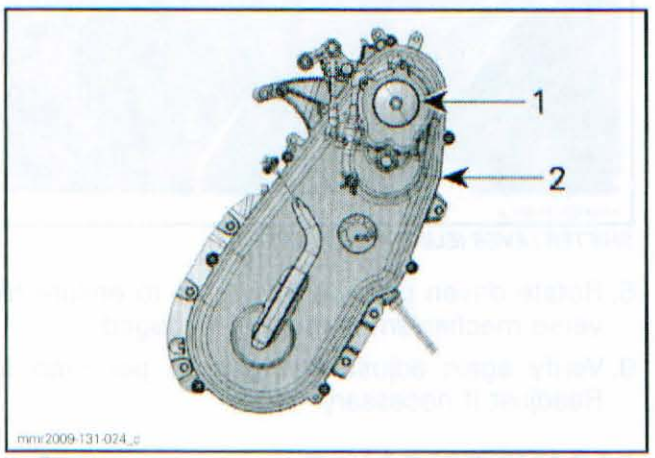


1. Magnetic check plug

3. Remove metal particles from magnetic check plug.

NOTE: It is normal to find metallic particles stuck to magnetic check plug. If bigger pieces of metal are found, remove the chaincase cover and inspect the chaincase parts.

4. To add oil, remove the filling plug on top of chaincase cover.



1. Filling plug
2. Chaincase cover

5. Pour recommended oil in chaincase by the filler hole until oil comes out by the magnetic check plug hole.
6. Reinstall magnetic check plug and torque it to 6 N•m (53 lbf•**in**).

Chaincase Oil Replacement

1. Place vehicle on a level surface.
2. Position a drain pan under chaincase drain plug area.
3. Loosen chaincase cover screws and pull cover.
4. Wait a while to allow oil to flow out of chaincase.
5. Tighten cover correctly. Refer to *CHAINCASE COVER*.
6. Pour approximately 250 ml (8.5 U.S. oz) of recommended oil in chaincase by the filling hole until oil comes out by the magnetic check plug hole.
7. Reinstall magnetic check plug and torque it to 6 N•m (53 lbf•**in**).

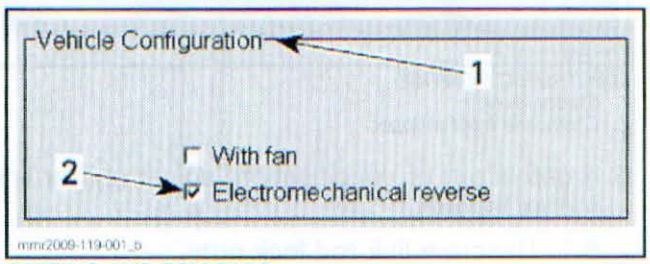
TROUBLESHOOTING

DIAGNOSTIC TIPS (ELECTRONIC REVERSE)

B.U.D.S. Configuration

If the electronic reverse is not working, make sure the required option is selected in B.U.D.S. Otherwise, the electronic reverse will not work and no fault code will be set.

1. Connect and start B.U.D.S. to check the **Electromechanical reverse** option.



SETTING AND ECM TABS
1. Vehicle Configuration area
2. Check Electromechanical reverse

NOTE: If the option is checked in B.U.D.S. and the vehicle is not equipped with the electronic reverse, false fault code(s) will be set.

Fault Code P0736

The fault code P0736 can appear for different reasons that are not necessarily a failure of the electronic reverse. It can appear for the following reasons:

– Reverse gears are not aligned in chaincase to engage properly.

If fault code appears:

– Clear the fault using B.U.D.S.
– Lift rear of vehicle and support it off the ground.

- Rotate driven pulley a few turns to move gears in chaincase.
- Retry changing gears.

If fault code appears again:

- Check drive belt height. (Refer to *DRIVE BELT* subsection)
- Check shift linkage adjustment. (see procedure in this subsection).

If fault code persist:

- Refer to *TESTING SEQUENCE* below.

TESTING SEQUENCE (ELECTRONIC REVERSE)

Electronic Reverse Does Not Engage

First, make sure the following settings are as per specifications:

- Drive belt height
- Shift linkage adjustment.

If B.U.D.S is properly configured, drive belt and shift linkage are properly adjusted, follow this testing sequence to diagnose problem:

1. Check reverse position switch (RVPS) continuity.
2. Check electronic reverse fuse.
3. Check engine connector.
4. Check electronic reverse relays continuity.
5. Check electronic reverse motor operation.
6. Check input voltage to electronic reverse motor.
7. Check input voltage to electronic reverse relays.
8. Check electronic reverse relays ground (motor actuation).
9. Check electronic reverse relays ground signal.
10. Check ECM ground continuity (relay).

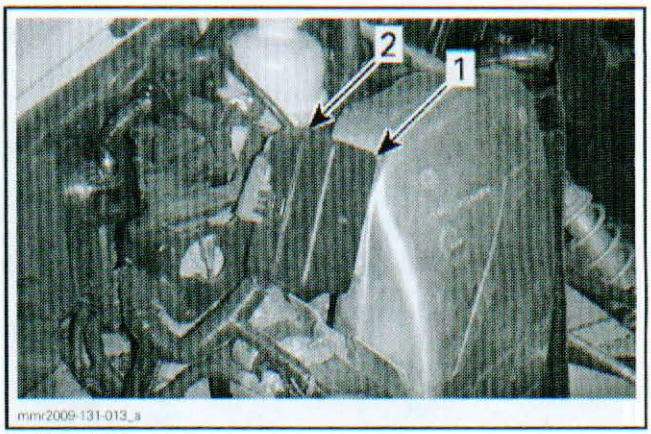
Refer to the appropriate topic to see the complete testing procedures.

PROCEDURES

SHIFT LEVER (MECHANICAL REVERSE)

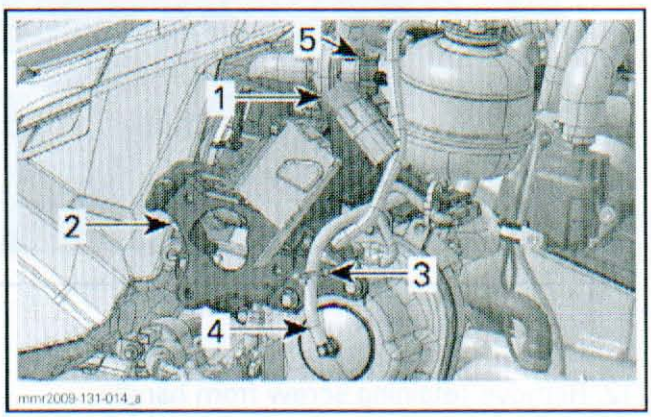
Shift Lever Removal

1. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.
2. Remove fuse box from fuse box holder using upper retaining clip.



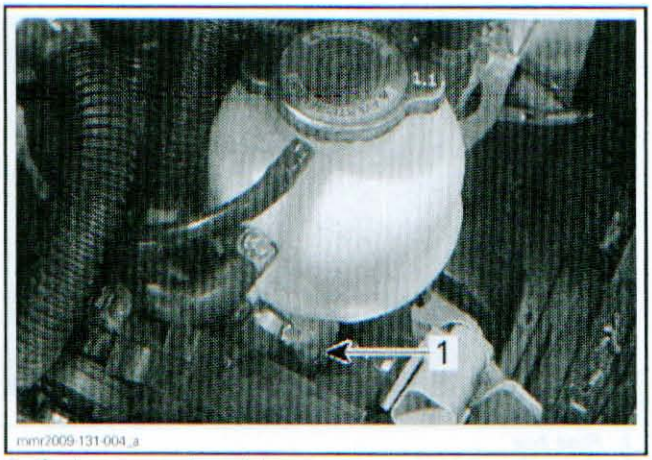
1. *Fuse box*
2. *Upper retaining clip*

3. Remove communication connector from its housing.
4. Cut main harness locking tie.
5. Detach retaining tie from chaincase vent hose.
6. Remove chaincase vent hose from filling plug.
7. Detach fuel pressure regulator hose from support.



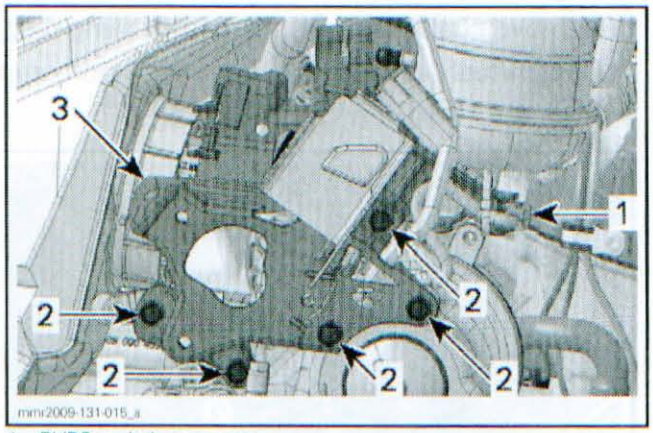
1. *Communication connector*
2. *Main harness locking tie*
3. *Retaining tie*
4. *Chaincase vent hose*
5. *Fuel pressure regulator hose*

8. Remove coolant reservoir retaining screw.



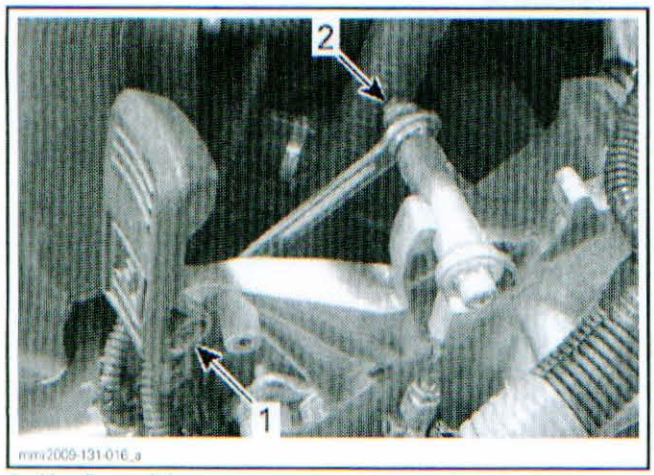
1. Coolant reservoir retaining screw

9. Disconnect RVPS switch connector.
10. Remove retaining screws from support.
11. Remove support from vehicle.



1. RVPS switch connector
2. Support retaining screws
3. Support

12. Remove retaining screw from handle.
13. Remove shift lever screw.



1. Handle retaining screw
2. Shift lever screw

14. Remove shift lever from vehicle.

Shift Lever Installation

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

Lubricate shift lever pivots and moving parts.

Torque retaining screws of support attached to chaincase to 10 N•m (89 lbf•**in**).

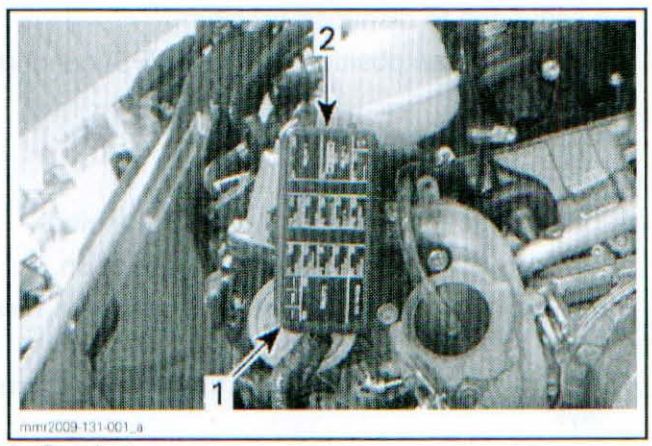
ELECTRONIC SHIFT UNIT

Electronic Shift Unit Removal

⚠ WARNING

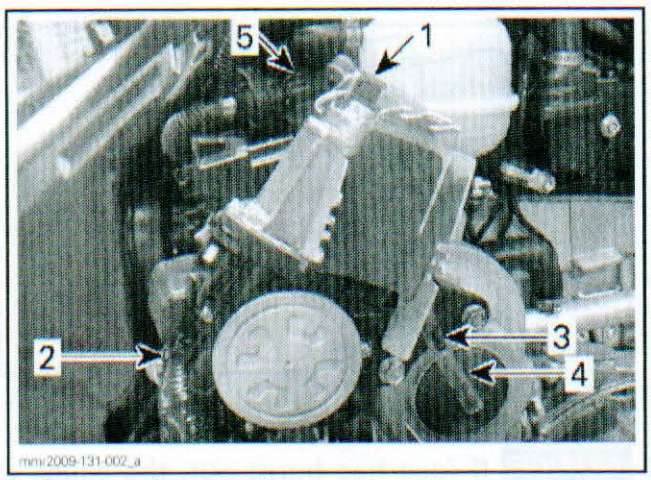
Battery BLACK (–) cable must always be disconnected first and connected last.

1. Disconnect BLACK negative cable from battery negative post.
2. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.
3. Remove fuse box from fuse box holder using upper retaining clip.



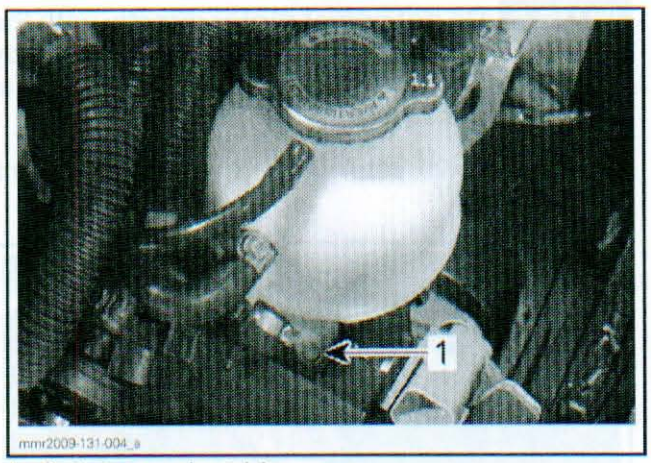
1. Fuse box
2. Upper retaining clip

4. Remove communication connector from its housing.
5. Cut main harness locking tie.
6. Detach retaining tie from chaincase vent hose.
7. Remove chaincase vent hose from filling plug.
8. Detach fuel pressure regulator hose from support.



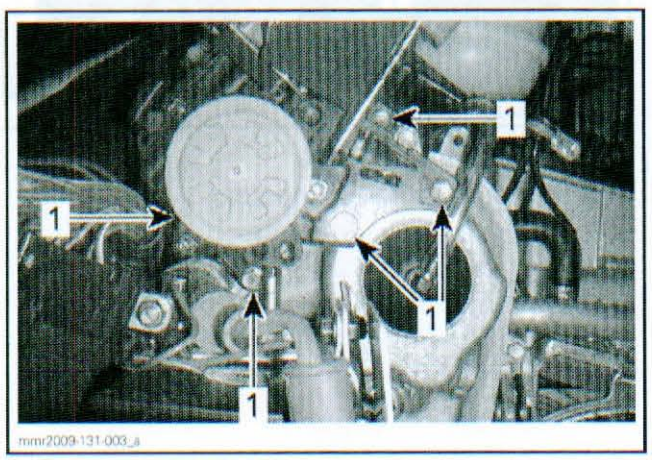
1. *Communication connector*
2. *Main harness locking tie*
3. *Retaining tie*
4. *Chaincase vent hose*
5. *Fuel pressure regulator hose*

9. Remove coolant reservoir retaining screw.



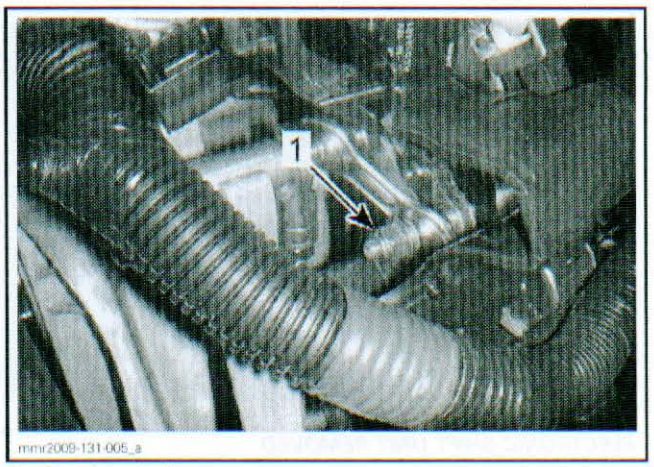
1. *Coolant reservoir retaining screw*

10. Remove retaining screws from support.



1. *Support retaining screws*

11. Remove nut from coupling shaft.

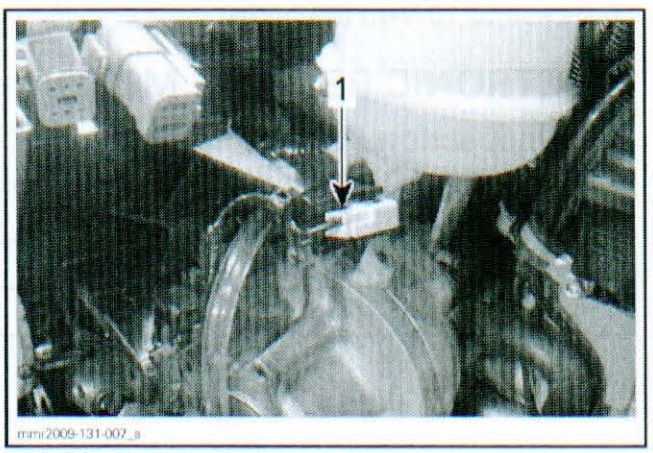


1. *Coupling shaft nut*

12. Disconnect motor connector.

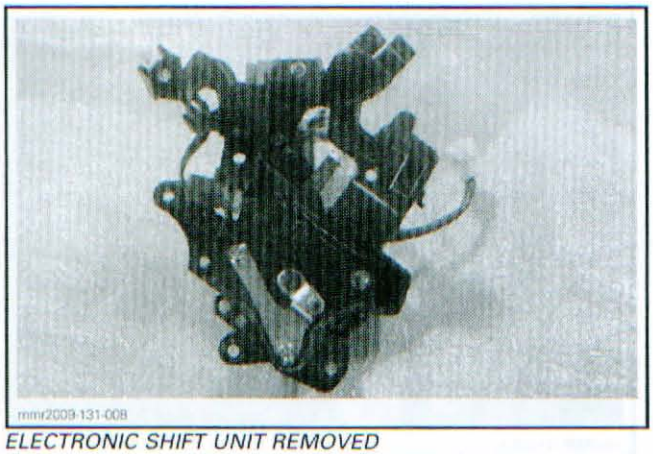
1. *Motor connector*

13. Disconnect RVPS switch connector.



1. *RVPS switch connector*

14. Remove electronic shift unit from vehicle.



ELECTRONIC SHIFT UNIT REMOVED

Electronic Shift Unit Inspection

Inspect motor connectors for corrosion, clean if necessary.

Inspect RVPS switch for correct spring tension when pressed and released, replace if necessary.

Inspect motor coupling shaft for straightness, replace if necessary.

Inspect stopping bracket of electronic shift unit for straightness, replace if necessary.

Electronic Shift Unit Installation

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

Lubricate shifter pivots and moving parts.

Torque coupling shaft nut to 7 N•m (62 lbf•**in**).

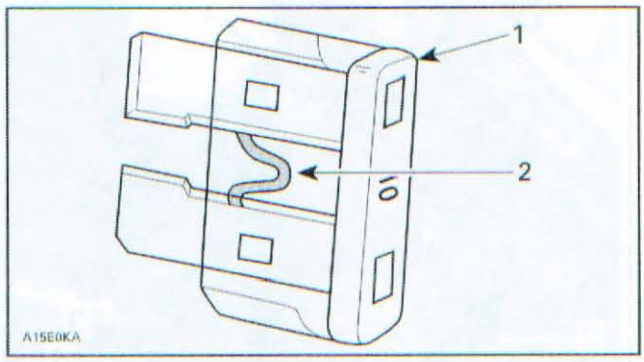
Torque retaining screws of support attached to chaincase to 10 N•m (89 lbf•**in**).

ELECTRONIC REVERSE MOTOR

Fuse Inspection (Motor)

1. Check motor fuse (F8) located in the fuse box. Replace if necessary.

MOTOR FUSE	
F8	20 A



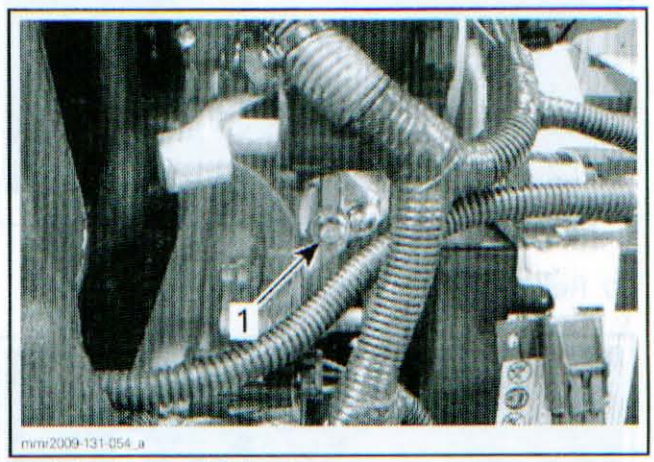
1. Fuse
2. Check if melted

NOTICE If fuse has burnt out, the cause of the malfunction should be determined and corrected before restarting.

Motor Operation Test (Electronic Reverse)

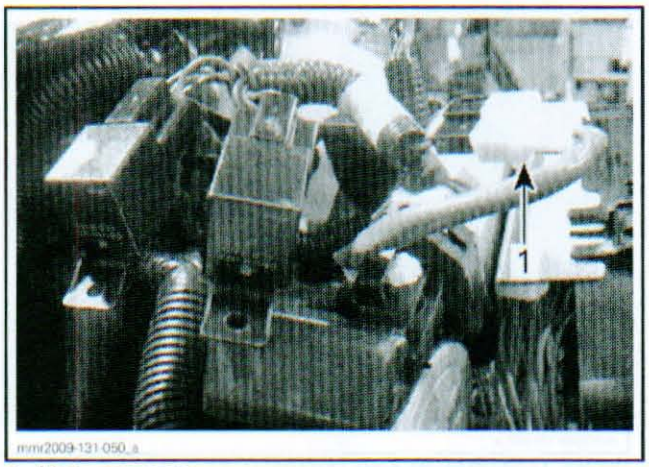
NOTICE Do not power motor directly with the battery for a long period. Apply voltage quickly to ensure that the motor will not overheat at the end of its stroke.

1. Remove lower retaining screw from shifter link rod.



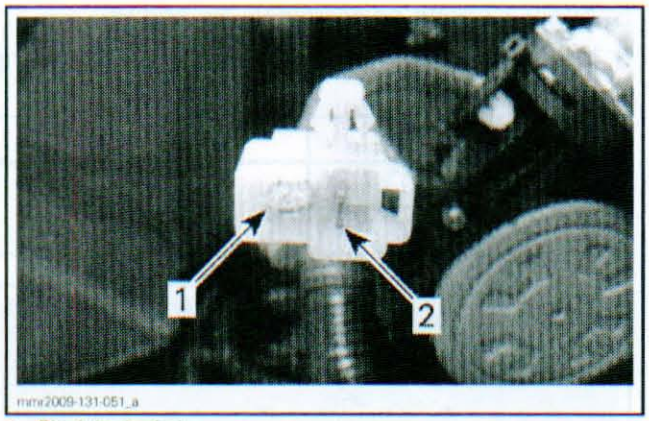
1. Link rod lower retaining screw

2. Disconnect motor connector.



1. Motor connector

3. Connect motor connector pin 2 (BLACK wire) to a 20 A suitable fuse jumper and then directly to the positive battery post.
4. Connect motor connector pin 1 (RED wire) directly to the negative battery post.



1. Pin 1 (red wire)
2. Pin 2 (black wire)

5. Verify if motor works properly and engages the reverse mechanism (link rod moves upwards).
6. Invert battery polarities and verify if motor works properly and disengages the reverse mechanism (link rod moves downwards).

Motor Input Voltage Test (Electronic Reverse)

1. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
2. Disconnect motor connector.

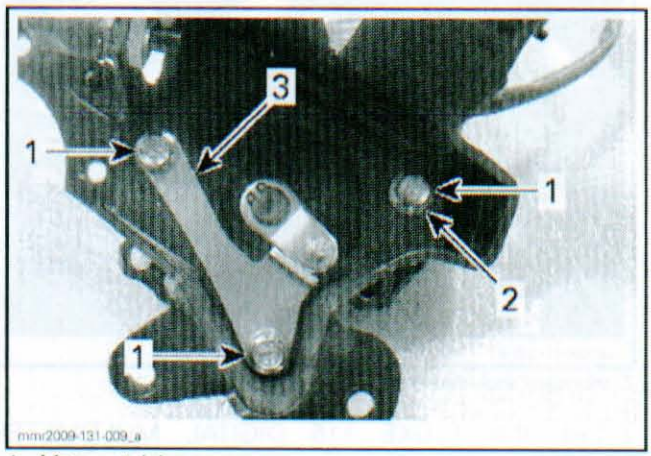
1. Motor connector

3. Start engine.
4. Press on START/RER button while engine run at idle.
5. Measure voltage between motor harness connector terminals as per the following table.

TEST PROBES	VOLTAGE
RD/YL	Battery voltage (± 12 Vdc)
BK/BU	

Motor Removal (Electronic Reverse)

1. Remove electronic shift unit. Refer to *ELECTRONIC SHIFT UNIT* in this subsection.
2. Remove motor retaining screws.



1. Motor retaining screws
2. Washer
3. Stopping bracket

3. Remove motor from unit.

Motor Installation (Electronic Reverse)

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

Install washer onto retaining screw which is in contact with support.

Torque motor retaining screws to 7 N•m (62 lbf•**in**).

Ensure that the stopping bracket is positioned with the stopping surface toward the motor coupling shaft.

NOTE: Do not install washers onto screws which are in contact with stopping bracket.

FORWARD AND REVERSE RELAYS (ELECTRONIC REVERSE)

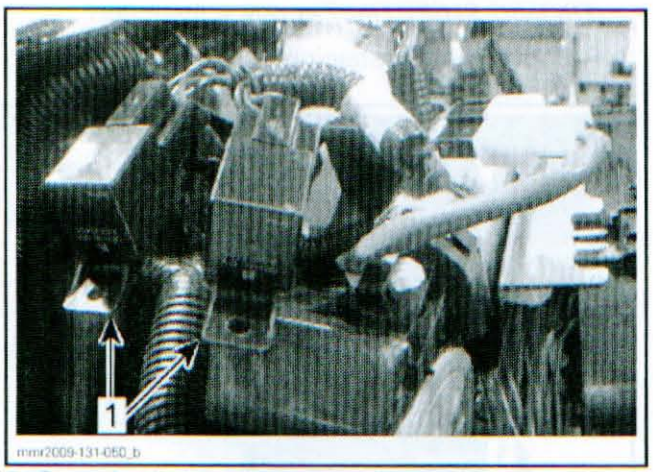
NOTE: Forward and reverse relays work together to control motor. Make sure to test both relays to ensure proper diagnostic.

Refer to the following table to identify forward and reverse relays.

RELAY PIN	FORWARD RELAY WIRE COLOR	REVERSE RELAY WIRE COLOR
85	BE/YL	BE/RD
30	RD/YL	BK/BU

Relay Continuity Test

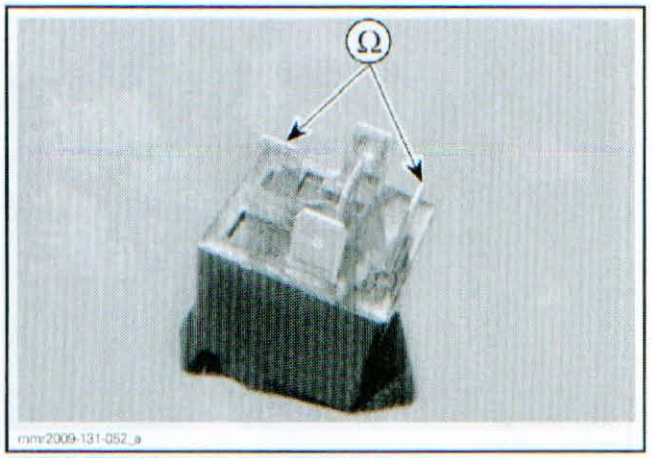
1. Remove relay.



1. Forward and reverse relays

2. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
3. Measure resistance as per the following table.

TEST PROBES	RESISTANCE
Terminal 30	Open (OL)
Terminal 87	



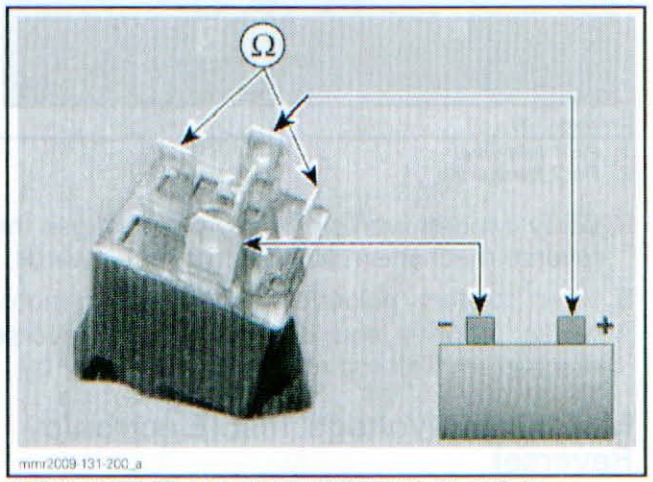
PROBE TERMINAL 30 AND TERMINAL 87

4. Measure resistance as per the following table.

TEST PROBES	RESISTANCE
Terminal 30	Close to 0 Ω
Terminal 87a	

5. Apply 12 volts on terminals 85 and 86.
6. Measure resistance again as per the following table.

TEST PROBES	RESISTANCE
Terminal 30	Close to 0 Ω
Terminal 87	



APPLY VOLTAGE AND PROBE TERMINAL 30 AND 87

7. Apply 12 volts on terminals 85 and 86.
8. Measure resistance again as per the following table.

TEST PROBES	RESISTANCE
Terminal 30	Open (OL)
Terminal 87a	

If results are not as per the above tables, replace relay.

Relay Input Voltage Test

1. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
2. Start engine.
3. Measure voltage as per the following tables.

FORWARD AND REVERSE RELAYS	
TEST PROBES	VOLTAGE
Pin 86 (RD)	Battery voltage (± 12 Vdc)
Battery negative (-) post	

FORWARD AND REVERSE RELAYS	
TEST PROBES	VOLTAGE
Pin 87 (RD)	Battery voltage (± 12 Vdc)
Battery negative (-) post	

If voltage is not as specified, repair open circuit in wiring. Refer to *WIRING DIAGRAM*.

Relay Ground Test (Motor Actuation)

1. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
2. Start engine.
3. Measure voltage as per the following table.

FORWARD AND REVERSE RELAYS	
TEST PROBES	VOLTAGE
Pin 87a (BK)	Battery voltage (± 12 Vdc)
Battery positive (+) post	

If voltage is not as specified, repair open circuit in wiring. Refer to *WIRING DIAGRAM*.

Relay Ground Signal Test

Forward Relay

NOTE: For this test, electronic reverse must be set in reverse position.

NOTE: The measured voltage will be transmitted during a short period of time.

1. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
2. Start engine and let it run at idle.
3. Press on START/RER button while measuring voltage as per the following table.

FORWARD RELAY	
TEST PROBES	VOLTAGE
Pin 85 (BE/YL)	Battery voltage (± 12 Vdc)
Battery positive (+) post	

If voltage is not as specified, repair open circuit in wiring. Refer to *WIRING DIAGRAM*.

Reverse Relay

NOTE: For this test, electronic reverse must be set in forward position.

NOTE: The measured voltage will be transmitted during a short period of time.

1. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
2. Start engine and let it run at idle.
3. Press on START/RER button while measuring voltage as per the following table.

REVERSE RELAY	
TEST PROBES	VOLTAGE
Pin 85 (BE/RD)	Battery voltage (± 12 Vdc)
Battery positive (+) post	

If voltage is not as specified, repair open circuit in wiring. Refer to *WIRING DIAGRAM*.

ECM Ground Continuity Test (Relay)

Forward Relay

1. Disconnect ECM connector A.
2. Install connector A on ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010).
3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
4. Measure resistance as per the following table.

FORWARD RELAY	
TEST PROBES	RESISTANCE
ECM pin A-13	Close to 0 Ω
Relay pin 85 (BE/YL)	

Reverse Relay

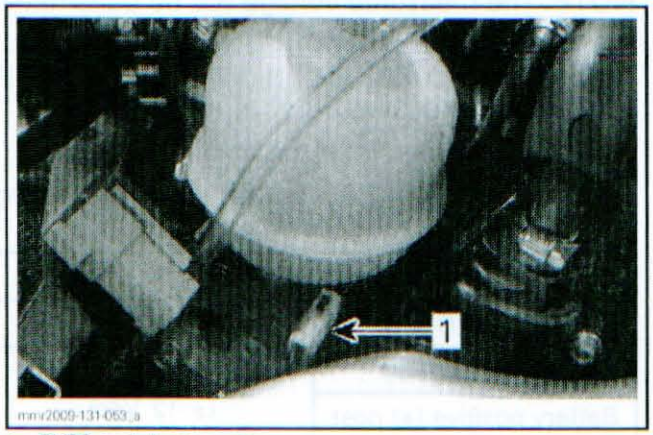
1. Disconnect ECM connector B.
2. Install connector B on ECM ADAPTER TOOL (2 CONNECTORS) (P/N 420 277 010).
3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
4. Measure resistance as per the following table.

REVERSE RELAY	
TEST PROBES	RESISTANCE
ECM pin B-33	Close to 0 Ω
Relay pin 85 (BE/RD)	

REVERSE POSITION SWITCH (ELECTRONIC REVERSE)

RVPS Switch Continuity Test

1. Disconnect RVPS switch connector.



1. RVPS switch connector

2. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
3. Release RVPS switch.
4. Measure resistance as per the following table.

TEST PROBES	RESISTANCE
Pin 1	Open (OL)
Pin 2	

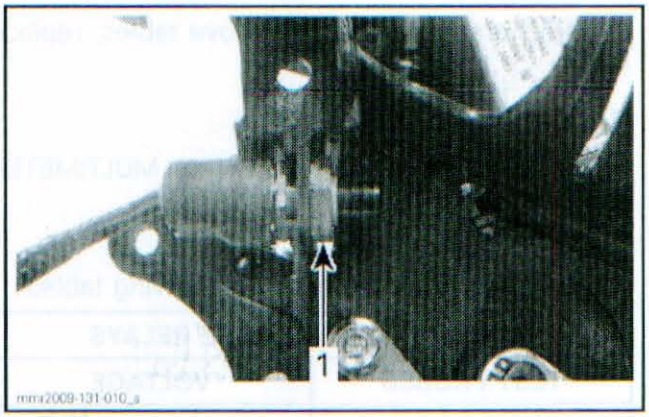
5. Press RVPS switch.
6. Measure resistance again as per the following table.

TEST PROBES	RESISTANCE
Pin 1	Close to 0 Ω
Pin 2	

If results are not as per the above tables, replace RVPS switch.

RVPS Switch Removal

1. Remove electronic shift unit. Refer to *ELECTRONIC SHIFT UNIT* in this subsection.
2. Remove RVPS switch lock nut.

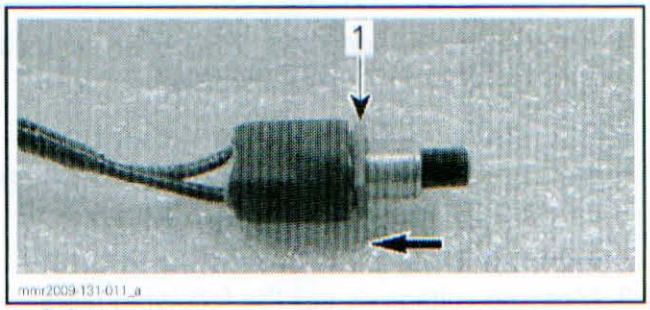


1. RVPS switch lock nut

3. Remove RVPS switch from unit.

RVPS Switch Installation

1. Remove lock nut from threaded shaft.
2. Screw adjusting nut completely onto threaded shaft.



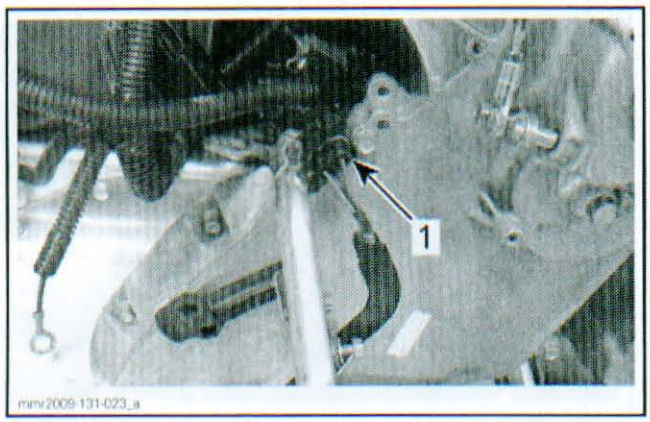
1. Adjusting nut

3. Install RVPS switch into electronic shift unit hole.
4. Torque RVPS switch lock nut to 1.8 N•m (16 lbf•**in**).

CHAINCASE

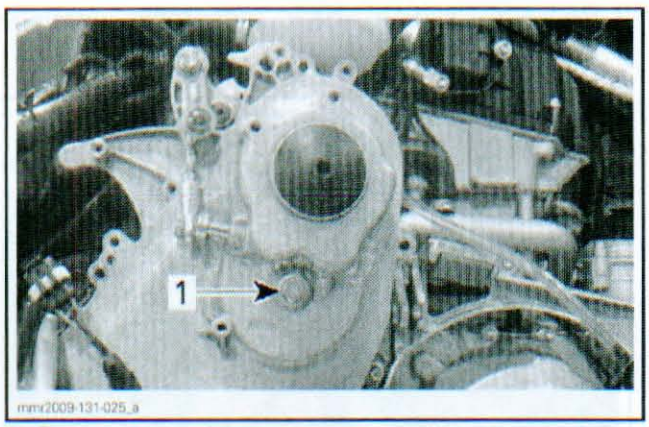
Chaincase Cover Removal

1. Apply parking brake.
2. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.
3. Remove battery and battery rack. Refer to *CHARGING SYSTEM* subsection.
4. Remove shift lever (mechanical reverse) or electronic shift unit depending on the type of vehicle. See procedure in this subsection.
5. Disconnect the speed sensor connector.



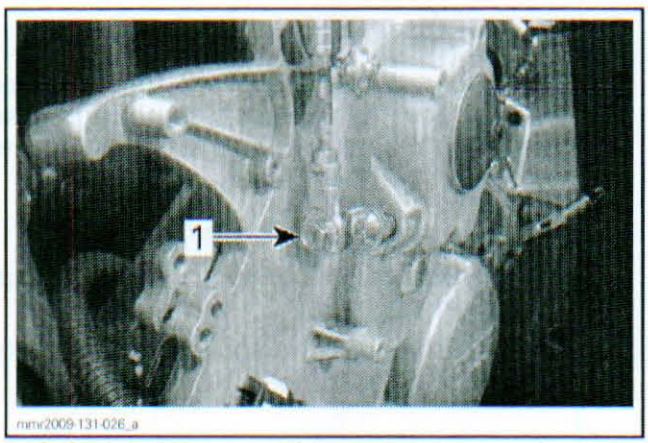
1. Speed sensor connector

6. Remove reverse gear retaining screw.



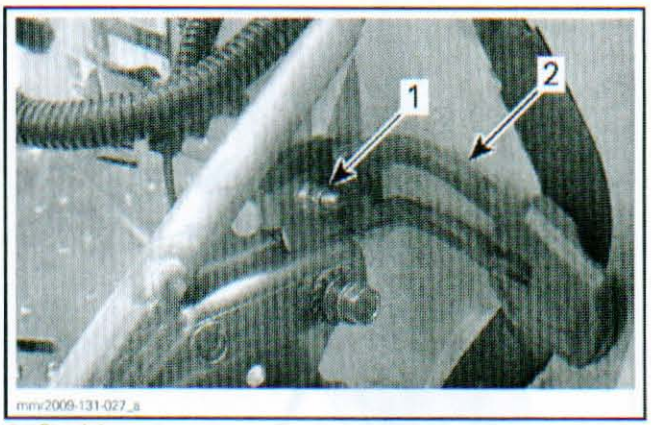
1. Reverse gear retaining screw

7. Remove lower retaining screw from shifter link rod.



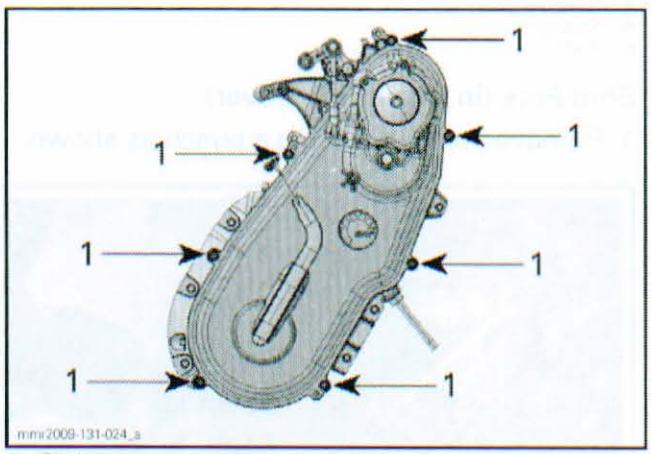
1. Shifter link rod lower retaining screw

8. Remove RH side panel strap from frame.



1. Retaining nut
2. Side panel strap

9. Place a container under vehicle in line with chaincase to catch chaincase oil.
10. Unscrew and remove chaincase cover screws.

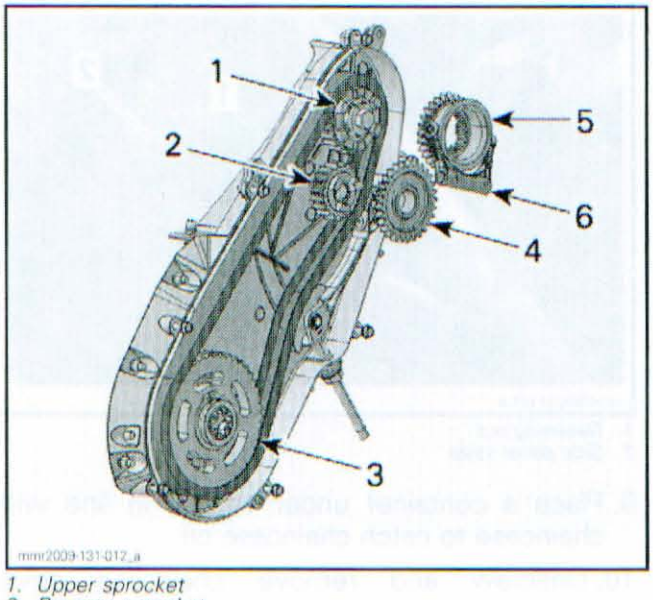


1. Chaincase cover screws

11. Pull the bottom of chaincase cover to drain oil.
12. Wait a moment then remove the cover completely.

Chaincase Disassembly

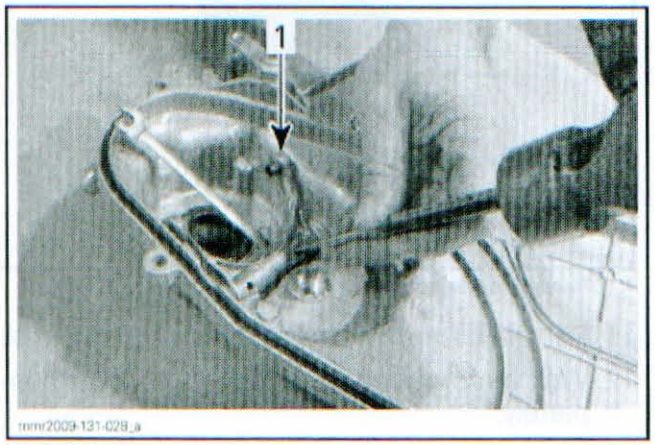
1. Apply parking brake.
2. Remove chaincase cover. Refer to *CHAINCASE COVER REMOVAL* in this subsection.



1. *Upper sprocket*
2. *Reverse sprocket*
3. *Lower sprocket*
4. *Reverse gear*
5. *Sliding gear*
6. *Shift fork*

Shift Fork (in Chaincase Cover)

1. Remove spring pin using a punch as shown.



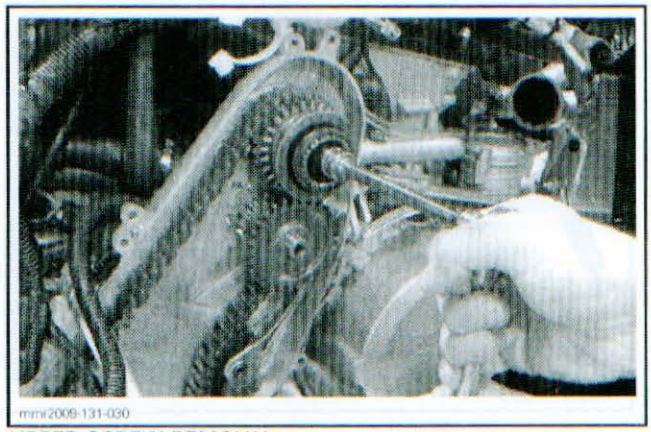
1. *Shift fork*

2. Pull out shift rod from chaincase cover.
3. Remove shift fork.

Gears and Sprockets

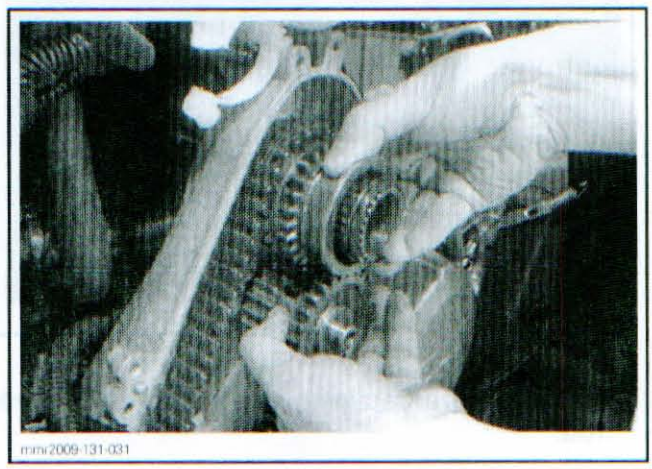
NOTE: Do not remove tension on drive chain for the moment.

1. Remove upper screw and washer that hold sliding gear assembly.



UPPER SCREW REMOVAL

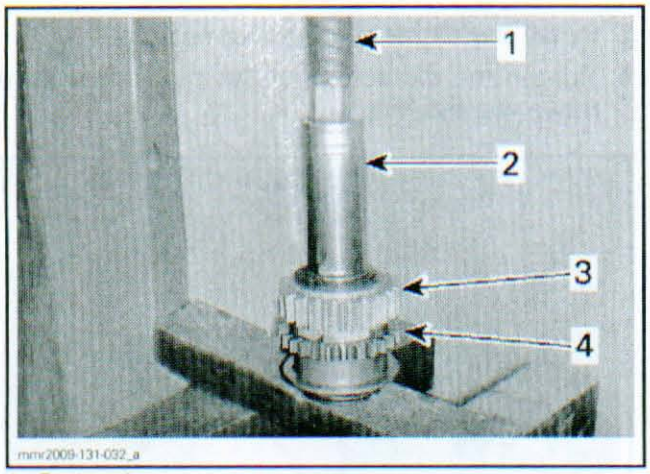
2. Remove chain tensioner from chaincase.
3. Remove sliding gear assembly, reverse sprocket and reverse gear simultaneously.



Sliding Gear Disassembly

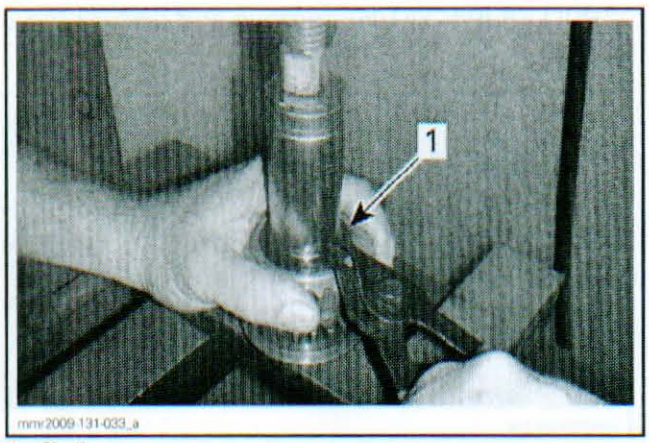
NOTICE **Do not use the press to compress the sliding gear while disassembling. Use the press ONLY as a guide to ensure that the spring tension will be released safely.**

1. Install sliding gear assembly on a press.
2. Position a 25 mm (1 in) deep socket on the upper sprocket side.
3. Adjust press rod on the socket, do not apply pressure on the assembly.



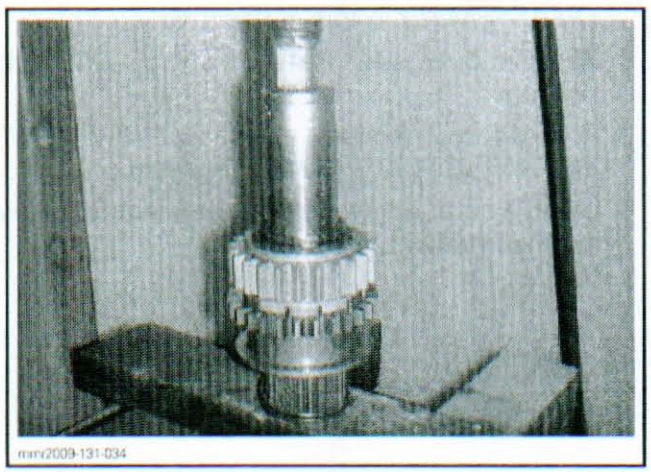
1. *Press rod*
2. *Deep socket (1 in)*
3. *Upper sprocket*
4. *Sliding gear*

4. Firmly retain upper sprocket with one hand.
5. Remove circlip from coupling shaft.



1. *Circlip*

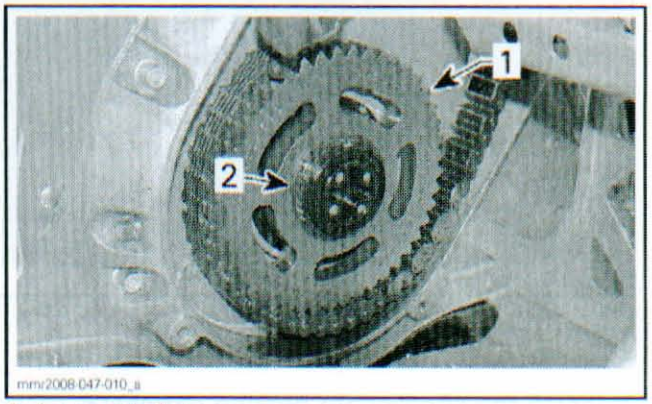
6. Carefully release spring tension.



7. Remove upper sprocket and sliding gear from press.

Chain and Lower Sprocket

1. Remove the lower sprocket circlip.

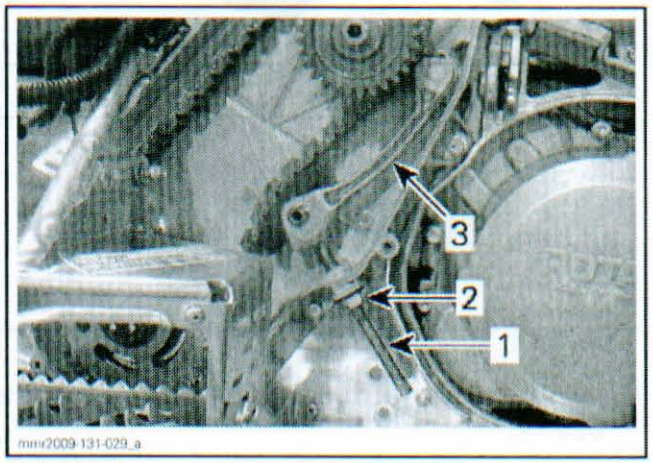


1. *Lower sprocket*
2. *Circlip*

2. Remove lower sprocket and drive chain simultaneously.

Chain Tensioner

1. Unscrew lock nut from tensioner adjustment screw.
2. Remove tensioner adjustment screw from tensioner arm.
3. Remove tensioner arm from chaincase.

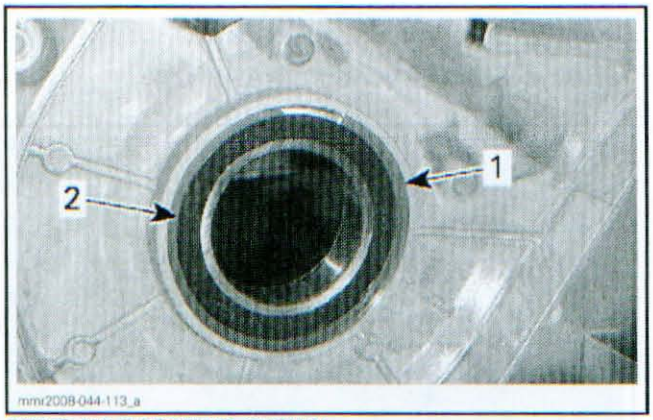


1. *Lock nut*
2. *Tensioner adjustment screw*
3. *Tensioner arm*

Chaincase Bearings

NOTE: This procedure can be applied either for the countershaft bearing or the drive shaft bearing.

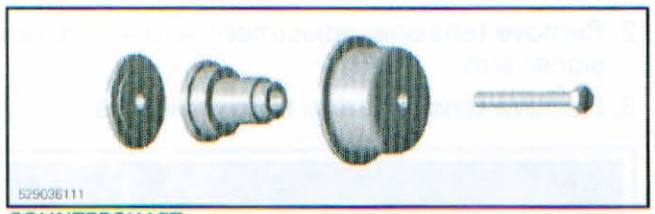
1. Remove the countershaft or the drive axle, depending which bearing is replaced. Refer to appropriate section, *DRIVEN PULLEY AND COUNTERSHAFT* or *DRIVE AXLE*.
2. Remove the snap ring securing bearing into chaincase.



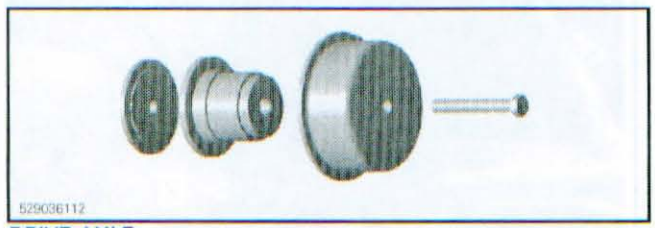
DRIVE AXLE BEARING SHOWN
1. *Snap ring*
2. *Bearing*

3. Install the appropriate bearing extractor:

BEARING	TOOL
Countershaft	BEARING PULLER/PUSHER (P/N 529 036 111)
Drive axle	BEARING PULLER/PUSHER (P/N 529 036 112)

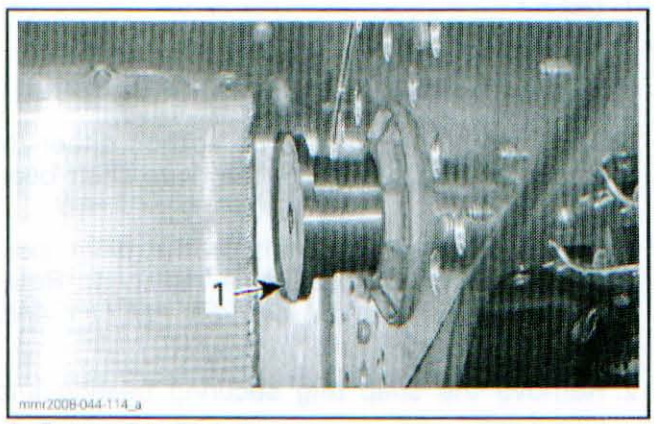


COUNTERSHAFT



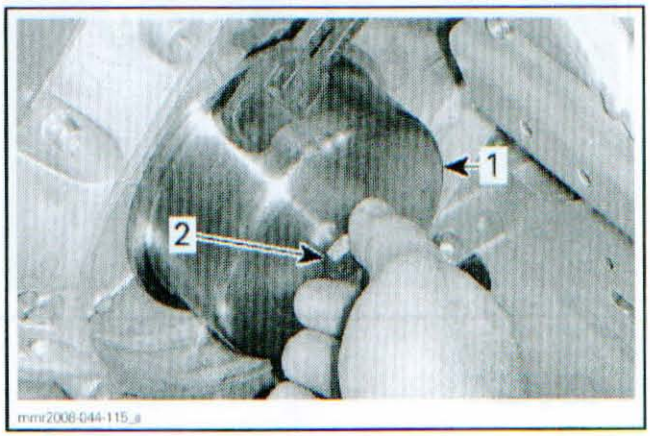
DRIVE AXLE

4. Install the extractor/installer tool behind the bearing.



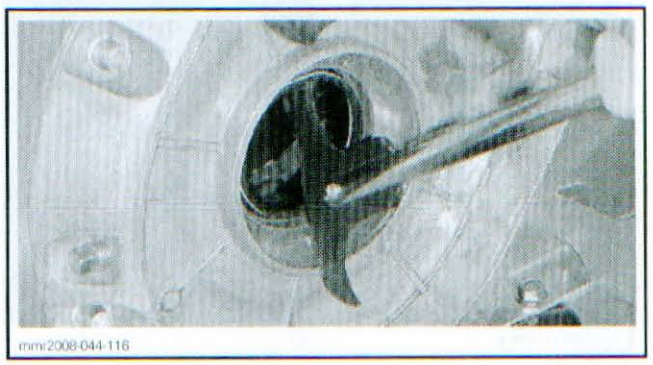
1. *Extractor/installer tool*

5. Install the extractor cup over bearing.
6. Tighten the extractor/installer tool screw to remove the bearing.



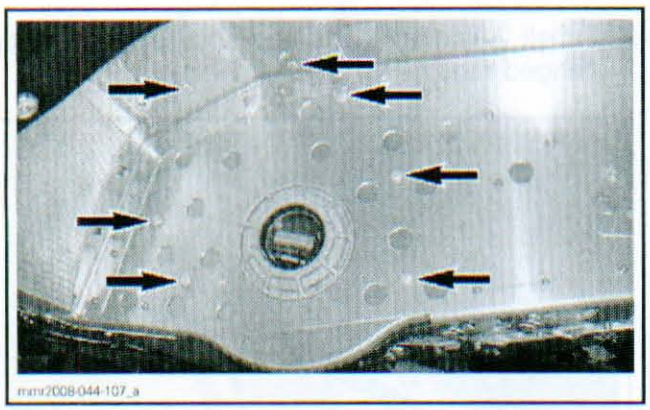
1. *Extractor cup*
2. *Tighten to remove bearing*

7. Using a seal puller such as the SNAP-ON SEAL PULLER (P/N YA105), remove and discard the oil seal.

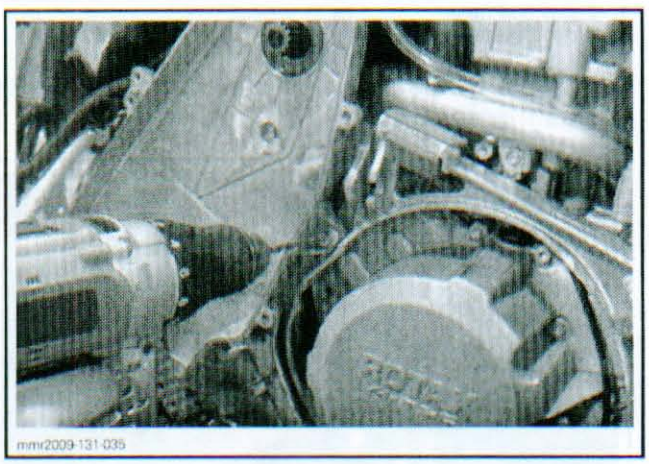


Chaincase Removal

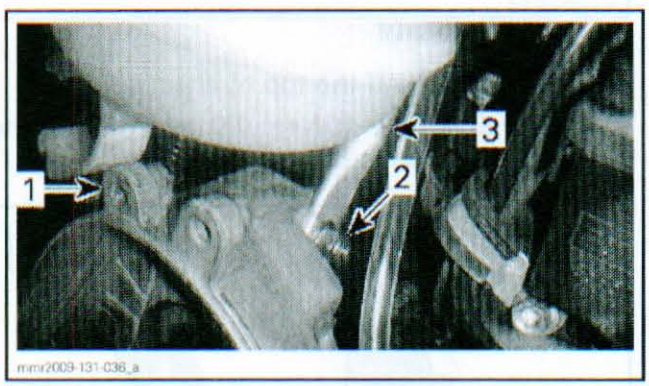
1. Disassemble chaincase. Refer to *CHAINCASE DISASSEMBLY* in this subsection.
2. Remove drive axle. Refer to *DRIVE AXLE* subsection.
3. Remove countershaft. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
4. Using a small angle grinder, remove the following rivet heads.



5. Using a 1/4 in drill bit, remove rivet located on right side of chaincase.



6. Unscrew bolt behind the top of chaincase.



1. Chaincase
2. Retaining bolt
3. RH side frame member

7. Using 2 large pry bars inserted between chaincase and frame, pry chaincase out of vehicle.

Chaincase Inspection

Chaincase Cover

Inspect cover for cracks or other damages, replace if necessary.

Inspect cover front and rear stopper for crack, replace if necessary.

Inspect O-ring inside cover is brittle, hard or damaged, replace if necessary.

Shift Fork, Lever and Link Rod

Inspect shift fork for straightness, replace if necessary.

Inspect shift fork wear or other damages, replace if necessary.

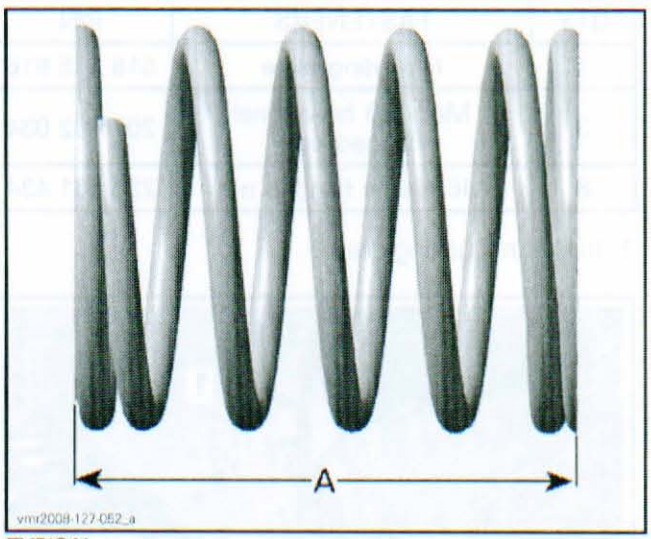
Inspect shift lever for straightness and for rotation movement, replace if necessary.

Inspect link rod for straightness and other damages, replace if necessary.

Spring

Measure spring free length, replace if out of specification.

SPRING FREE LENGTH	
SERVICE LIMIT	48 mm ± 1 mm (1.89 in ± .039 in)



TYPICAL
A. Free length

Chain, Gears and Sprockets

Inspect the chain, gears and sprockets for:
- Wear
- Cracks
- Damages teeth
- Missing links.

If a problem is detected:
- Replace drive chain and sprockets as an assembly.

- Replace upper sprocket and sliding gear as an assembly.
- Replace reverse sprocket and reverse gear as an assembly.

Chain Tensioner

Inspect chain tensioner sliders for wear or other damages, replace if necessary.

Inspect threads of tensioner adjustment screw for damages or wear, replace if necessary.

Inspect rubber washer condition, replace if necessary.

Bearings

Inspect all bearings for smooth operation:

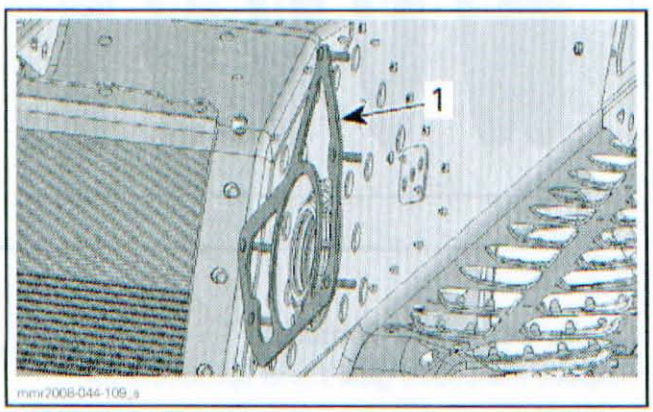
- If rough or excessive play is detected, replace bearing.

Chaincase Installation

To install the chaincase, have the following parts in hands:

PARTS TO INSTALL CHAINCASE		
QTY	FASTENERS	P/N
1	Mounting plate	518 325 816
3	M6 x 20 hexagonal flanged bolt	207 662 034
8	M6 elastic flanged nut	233 261 434

1. Install mounting plate.

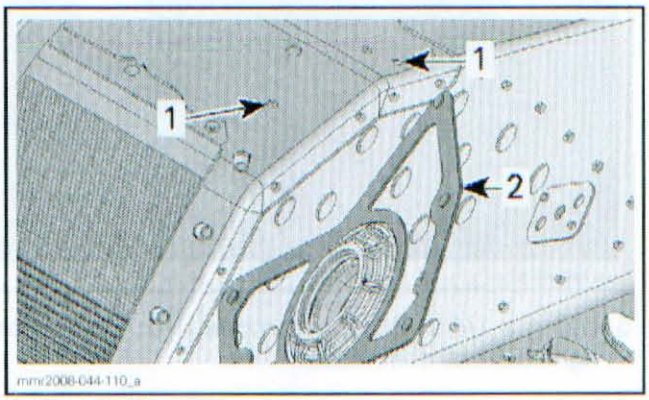


UNDERNEATH FRAME
1. Mounting plate

2. Install chaincase.
3. Install 5 elastic flanged nuts to secure chaincase.

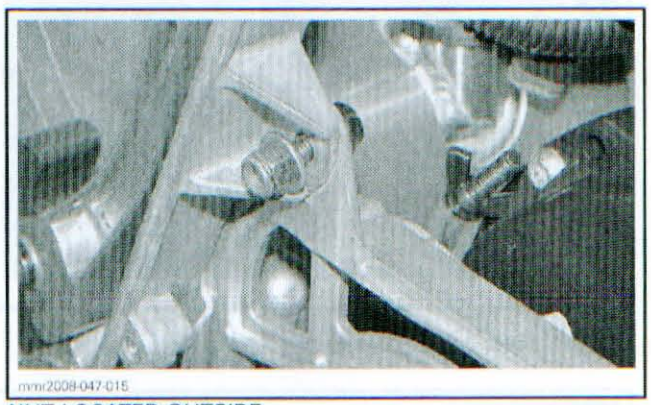
NOTE: Unless otherwise noted, bolts and nuts holding the chaincase must be installed loosely FIRST.

4. Install 2 flanged bolts and secure with elastic flanged nuts.



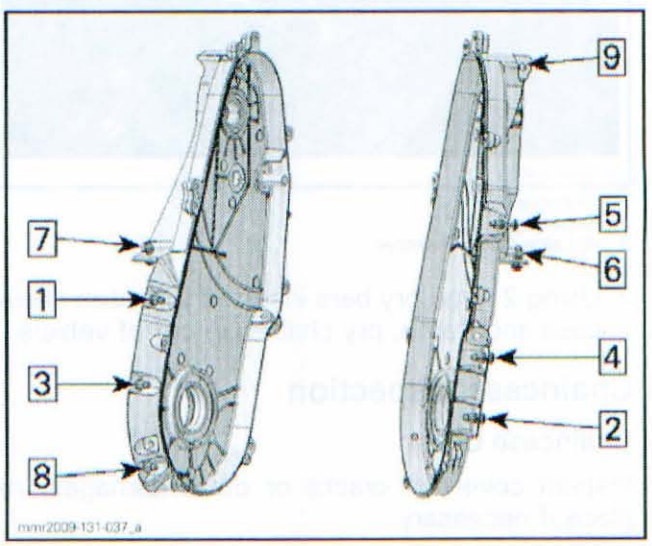
1. Install bolt here
2. Mounting plate

5. Install a flange bolt to secure chaincase to RH side member.



NUT LOCATED OUTSIDE

6. Install bolt behind the top of chaincase.
7. Torque all nuts to 10 N•m (89 lbf•**in**) using the following sequence.



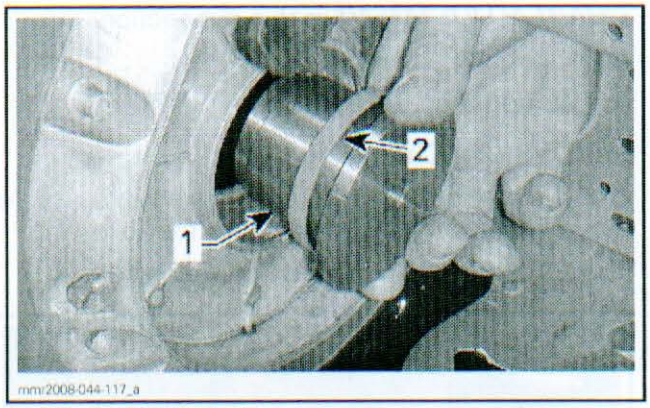
8. Install countershaft. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
9. Install drive axle. Refer to *DRIVE AXLE* subsection.
10. Assemble chaincase. Refer to *CHAINCASE ASSEMBLY* in this subsection.

Chaincase Assembly

Chaincase Bearings

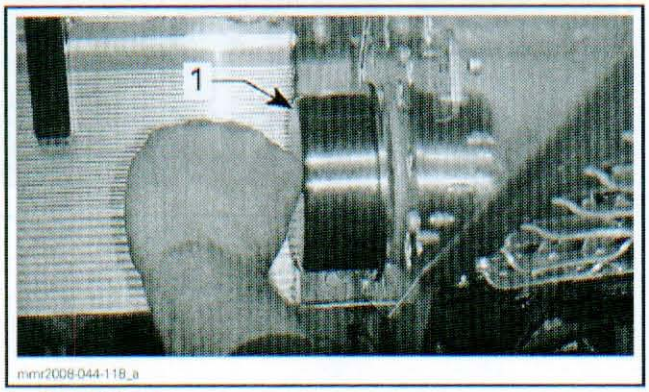
NOTE: This procedure can be applied either for the countershaft bearing or the drive shaft bearing.

1. Install the **NEW** oil seal on the extractor/installer tool. Position the lips toward bearing.



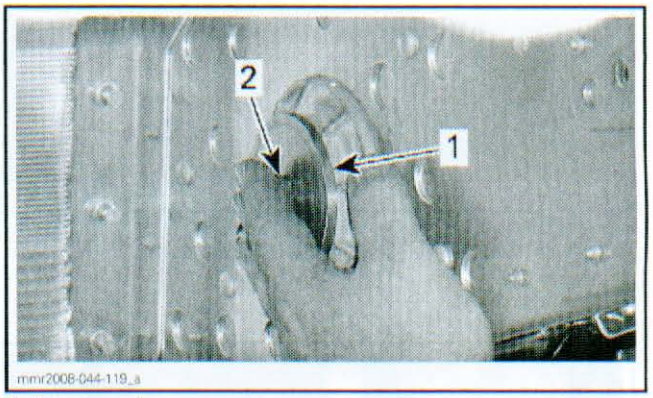
1. Extractor/installer tool
2. Oil seal lips on this side

2. Install extractor cup inside frame.



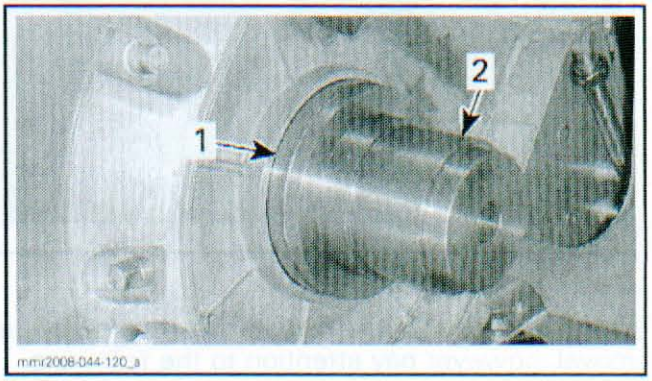
1. Extractor cup

3. Tighten extractor/installer tool screw to install the oil seal.
4. Install large washer and extractor/installer tool screw inside frame.



1. Large washer
2. Extractor/installer tool screw

5. In chaincase, install **NEW** bearing and extractor/installer tool.



1. Bearing
2. Extractor/installer tool

6. Tighten extractor/installer tool screw to install the bearing.
7. Remove tool.

Chain Tensioner

The installation procedure is the reverse of removal.

Chain and Lower Sprocket

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

Install sprocket with its inscription outward.

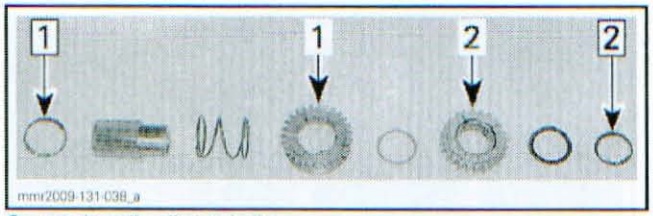
Sliding Gear

NOTICE Do not use the press to compress the sliding gear while assembling. Use the press ONLY as a guide to ensure that the spring tension will be applied safely.

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

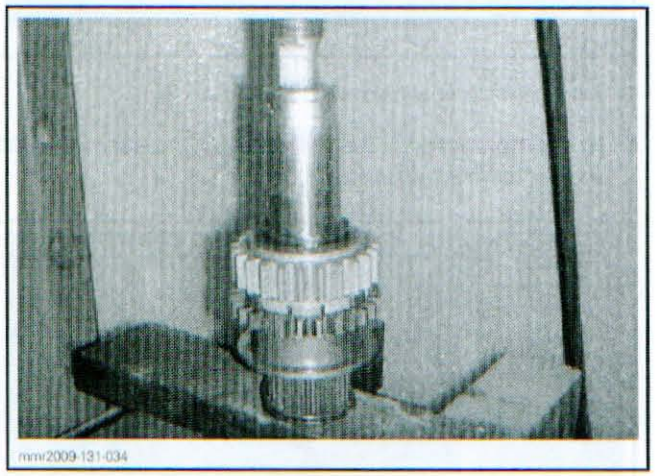
Install coupling shaft circlip on the splines side.

Install upper sprocket circlip on a press.



Step 1: Install splines circlip
Step 2: Install upper sprocket circlip on a press

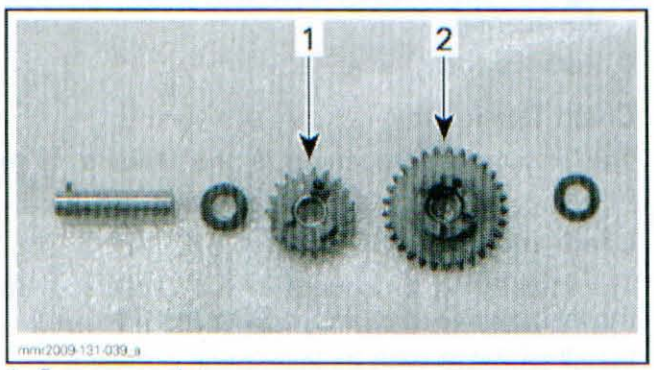
1. *Sliding gear*
2. *Upper sprocket*



Gears and Sprockets

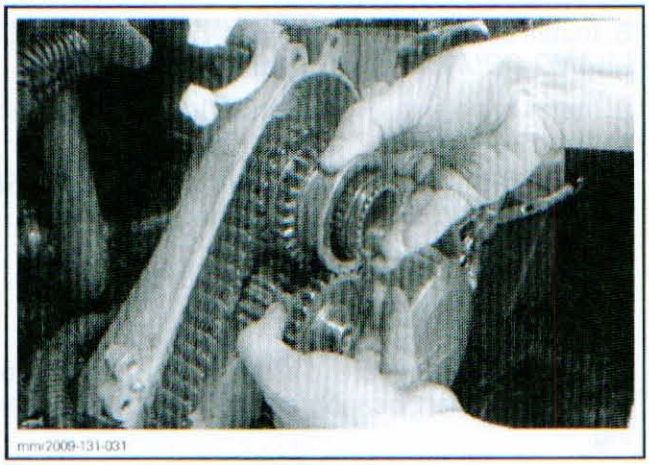
The installation procedure is the reverse of removal, however pay attention to the following.

Assemble reverse sprocket and reverse gear as per the following illustration.



1. *Reverse sprocket*
2. *Reverse gear*

Install sliding gear assembly, reverse sprocket and reverse gear simultaneously.



Install upper screw and washer that hold sliding gear assembly. (do not tighten for the moment).

Adjust tension on the drive chain. Refer to *DRIVE CHAIN ADJUSTMENT* in this subsection.

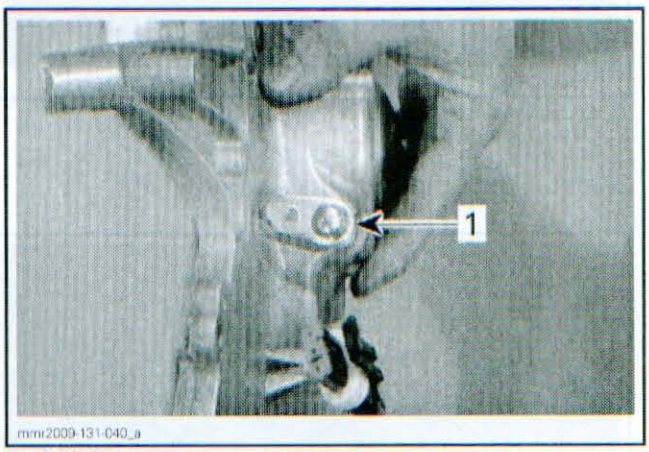
Apply parking brake.

Torque upper screw to 48 N•m (35 lbf•ft).

Shift Fork (in Chaincase Cover)

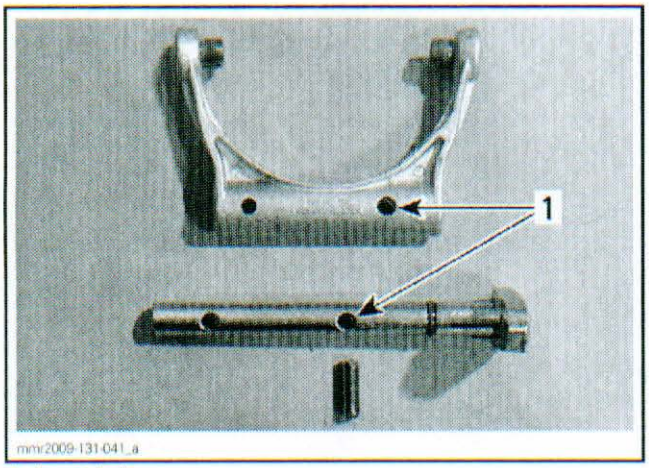
The installation procedure is the reverse of removal, however pay attention to the following.

Position shift fork lever toward the inside.



1. *Shift fork lever*

Install spring pin into the large hole.



1. Large hole

Ensure that seal is properly seated on the chaincase cover.

Chaincase Cover

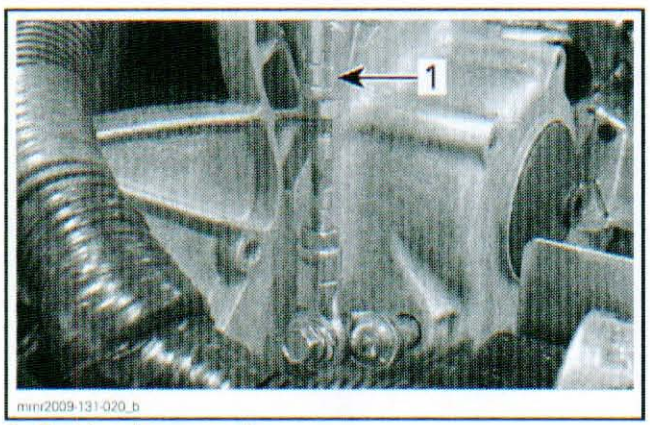
Install chaincase cover. Refer to *CHAINCASE COVER* in this subsection.

Chaincase Cover Installation

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

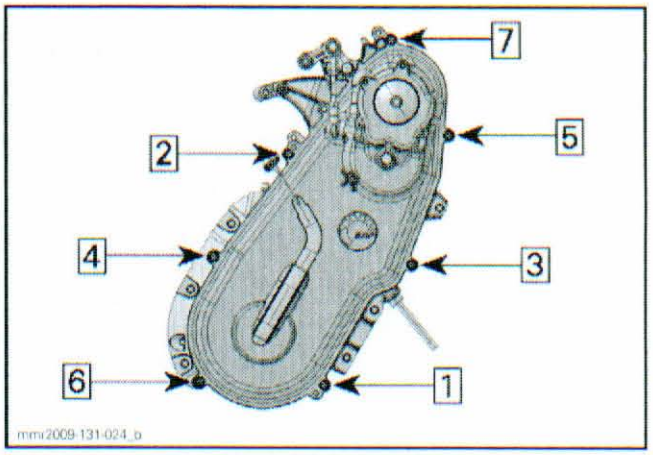
Ensure cover O-ring is positioned correctly in its groove.

Ensure that link rod is positioned with the double reference marks upwards.



1. Double reference marks

Torque chaincase cover screws in accordance with the following sequence.



CHAINCASE COVER SCREWS TORQUE	
SAME CHAINCASE	10 N•m (89 lbf•**in**)
NEW CHAINCASE	15 N•m (133 lbf•**in**)

Torque reverse gear retaining screw to 15 N•m (133 lbf•**in**).

Install the shift lever (mechanical reverse) or electronic shift unit depending on the type of vehicle. See procedure in this subsection.

Adjust shift linkage, refer to *SHIFT LINKAGE (MECHANICAL AND ELECTRONIC REVERSE)* in this subsection.

Install battery and battery rack. Refer to *CHARGING SYSTEM* subsection.

Install muffler. Refer to *EXHAUST SYSTEM* subsection.

Refill chaincase. Refer to *CHAINCASE OIL* in this subsection.

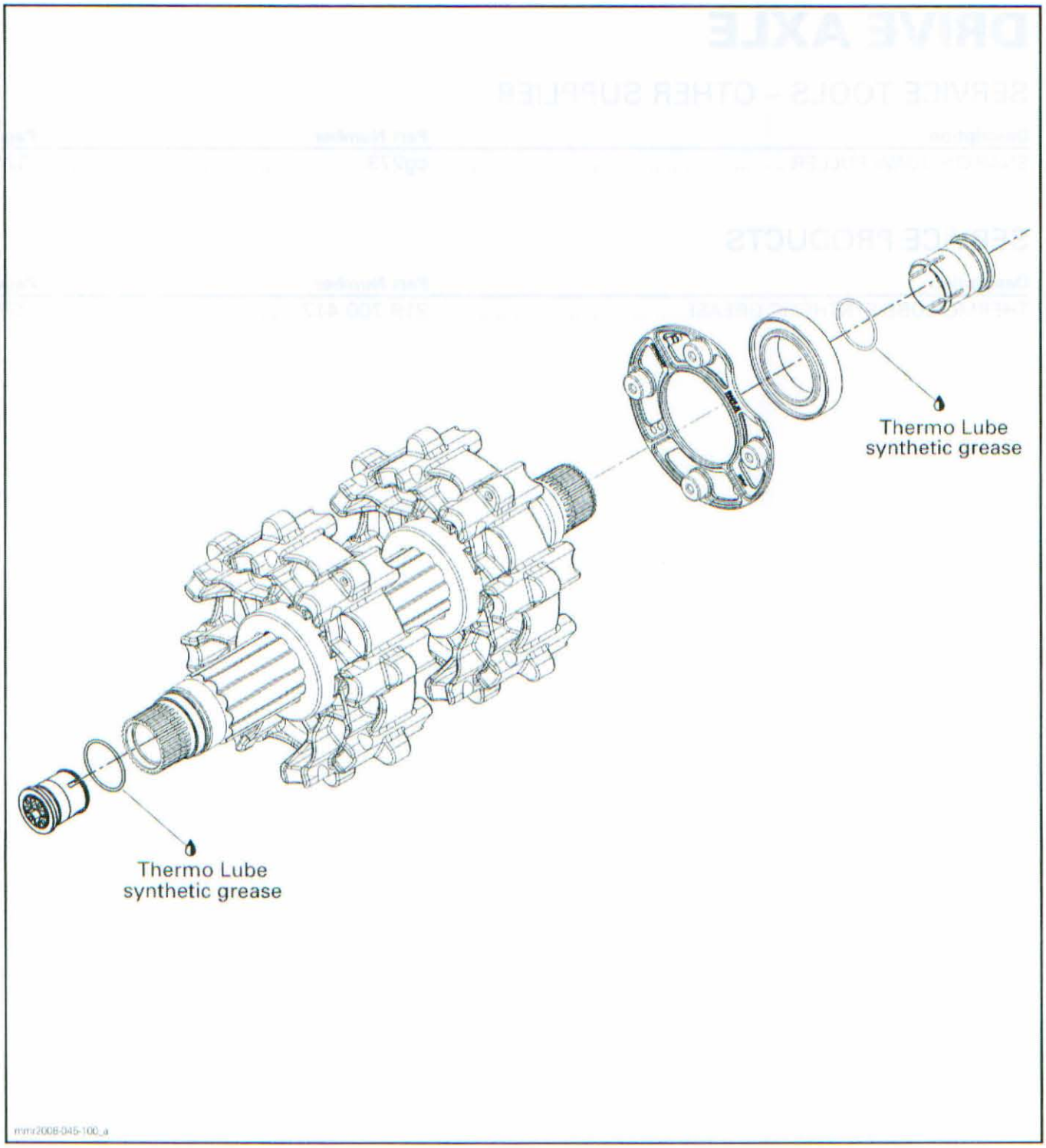
DRIVE AXLE

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON 3-JAW PULLER	cg273	374

SERVICE PRODUCTS

Description	Part Number	Page
THERMO LUBE SYNTHETIC GREASE	219 700 417	375


Thermo Lube
synthetic grease
Thermo Lube
synthetic grease
mmr2008-045-100_a

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

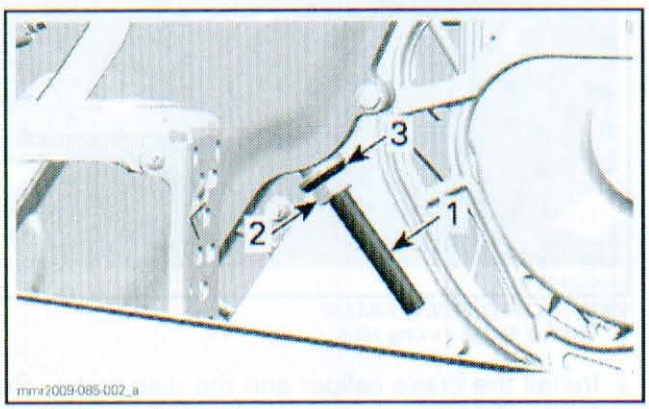
Torque wrench tightening specifications must be strictly adhered to.
Locking devices (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced with new ones.

PROCEDURES

DRIVE AXLE

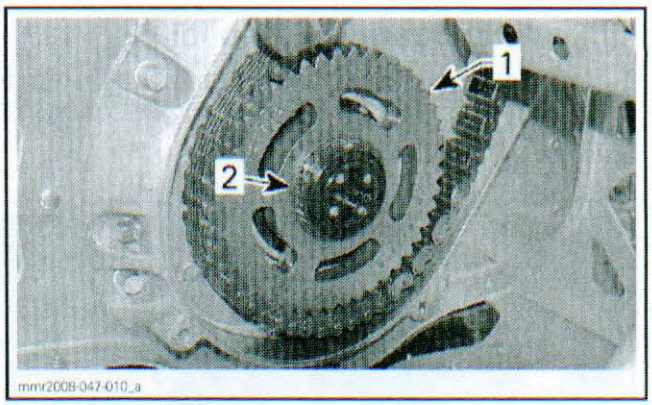
Drive Axle Removal

1. Remove the rear suspension. Refer to *REAR SUSPENSION* subsection.
2. Remove the brake caliper. Refer to *BRAKE* subsection.
3. Remove the chaincase cover. Refer to *CHAINCASE AND REVERSE* subsection.
4. Release tension from drive chain by unscrewing the tensioner adjustment screw.



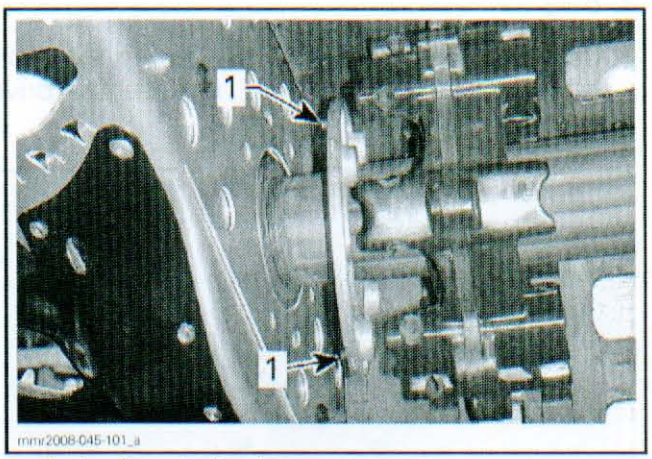
1. *Tensioner adjustment screw*
2. *Lock nut*
3. *Washer with rubber surface*

5. Remove the lower sprocket circlip.



1. *Lower sprocket*
2. *Circlip*

6. Remove lower sprocket.
7. From underneath of vehicle, turn the LH bearing flange counterclockwise to unlock it from frame.



1. *Bearing flange locking tabs*

8. Release drive axle sprockets from track and at the same time, push the drive axle toward the LEFT side.
9. Move the drive axle towards the right side to remove it from vehicle.

Drive Axle Inspection

Check if bearing turns smoothly and freely. Replace if necessary.

Check if bearing seals are not damaged. Replace if necessary.

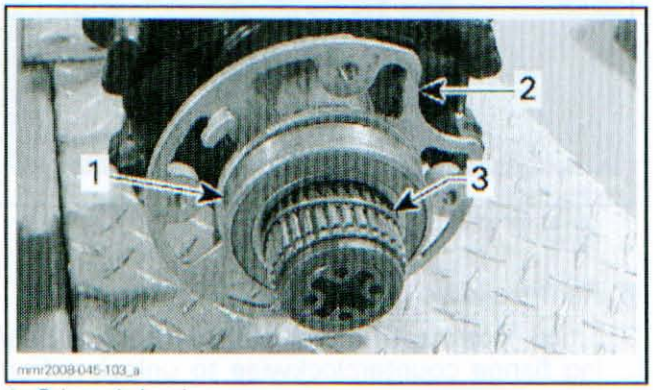
Check if the bearing flange is cracked, bent or otherwise damaged. Replace if necessary.

Replace drive axle if one of the following situations is detected:

- Cracked, worn or damaged drive axle
- Worn or damaged drive axle splines
- Worn or damaged sprockets
- Worn bearing journal.

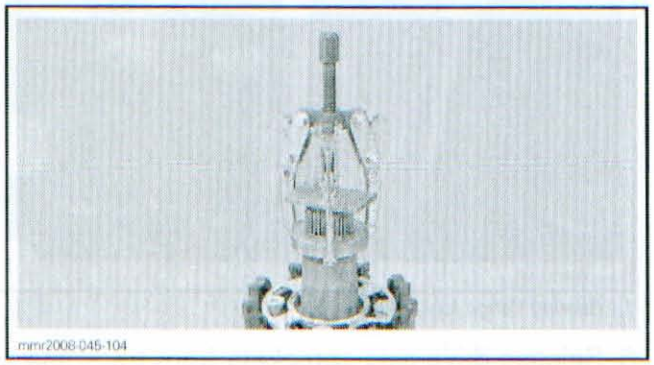
Drive Axle Bearing Removal

1. Remove drive axle from vehicle. Refer to *DRIVE AXLE REMOVAL* in this subsection.
2. Remove the O-ring.



1. Drive axle bearing
2. Bearing flange
3. O-ring

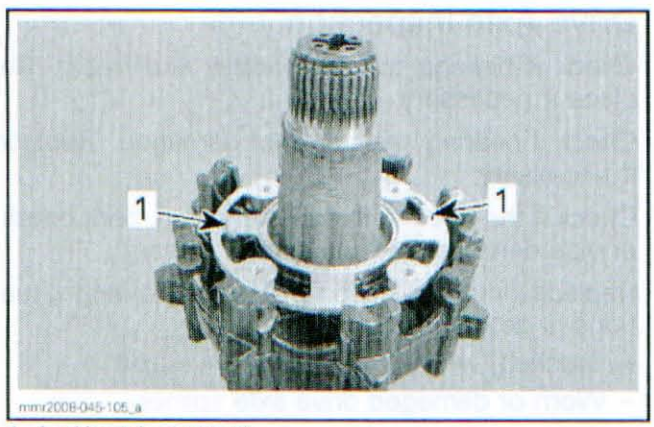
3. Using a 3 legs jaw puller such as the SNAP-ON 3-JAW PULLER (P/N CG273), remove the drive axle bearing.



4. Remove the bearing flange.

Drive Axle Bearing Installation

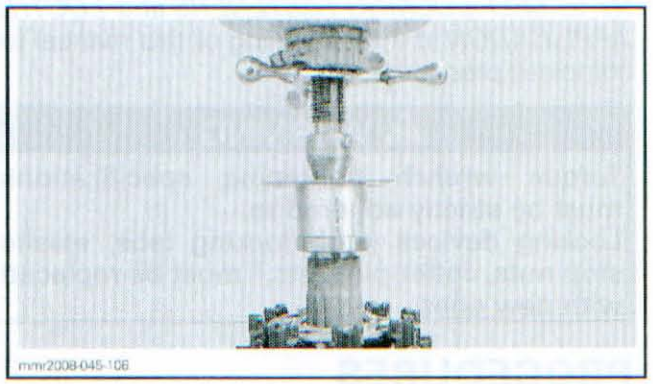
1. Install bearing flange on drive axle.



1. Locking tabs outwards

2. Using a press and a suitable pipe, push the bearing.

NOTICE Always push the bearing by inner race.

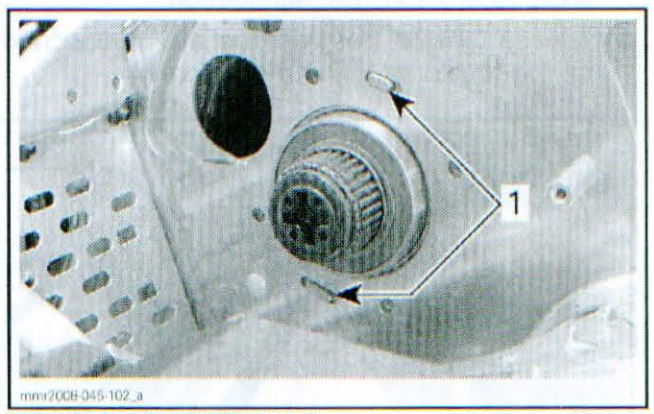


Drive Axle Installation

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

1. Install drive axle then lock the bearing flange on frame.
2. Ensure bearing flange is properly locked.

NOTICE Locking tabs must be properly inserted into frame.



VIEW FROM OUTSIDE FRAME
1. Bearing flange locking tabs

3. Install the brake caliper and the disc brake. Refer to *BRAKE* subsection.
4. Install all other removed parts. Refer to the appropriate subsections.

MAGNETIC CAPS

Magnetic Cap Removal

1. For the RH cap, remove brake disc protective cover. Refer to *BRAKE* subsection.

2. For the LH cap, remove the chaincase cover. Refer to *CHAINCASE AND REVERSE* subsection.
3. Using 2 screwdrivers or pliers, pry or pull the magnetic cap out of drive axle end.
4. Discard the magnetic cap.

Magnetic Cap Installation

1. Apply THERMO LUBE SYNTHETIC GREASE (P/N 219 700 417) on O-ring.
2. Insert the magnetic cap into drive axle.
3. Install all other removed parts.

TRACK

SERVICE TOOLS

Description	Part Number	Page
TENSIOMETER	414 348 200	378
TRACK CLEAT INSTALLER	529 036 044	377

PROCEDURES

TRACK

Track Inspection

1. Visually inspect track for:
   - Cuts and abnormal wear
   - Broken rods
   - Broken or missing track cleats
   - Perforations in the track
   - Tears in the track (particularly around traction product holes)
   - Lugs that are broken or torn off, exposing portion of rods
   - Delamination of the rubber
   - Broken studs
   - Bent studs
   - Studs that are torn off the track
   - Missing track guide(s).

If track is damaged or rods are broken, replace track.

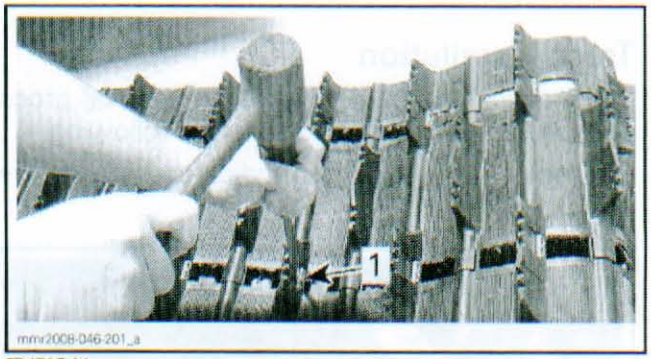
For damaged or missing cleats, replace by new ones.

⚠ WARNING

Do not operate a snowmobile with a cut, torn or damaged track.

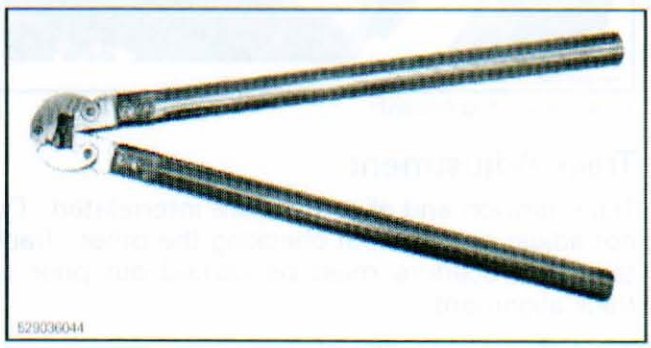
Track Cleat Replacement

1. Raise rear of vehicle off the ground.
2. Lift snow guard.
3. Rotate track to expose a cleat to be replaced.
4. Remove cleat from track using plastic hammer and a big screwdriver.

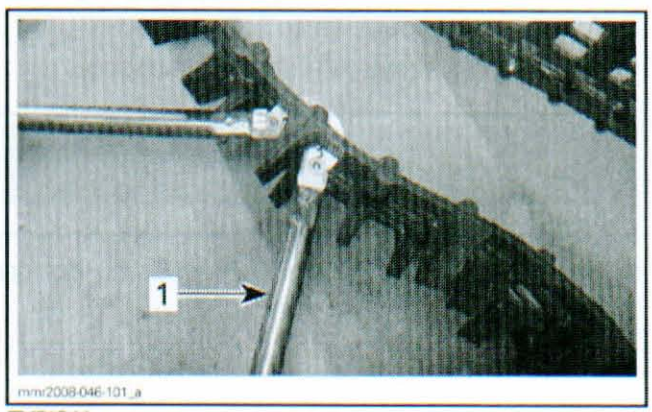


TYPICAL
1. Cleat

5. Place new cleat in position on the track.
6. Secure cleat using the TRACK CLEAT INSTALLER (P/N 529 036 044).



7. Bend cleat and push tabs into rubber.



TYPICAL
1. Narrow-cleat installer

8. Reopen narrow-cleat installer.
9. Position cleat tabs on open end of tool.

10. Squeeze tabs until they are indented in rubber.

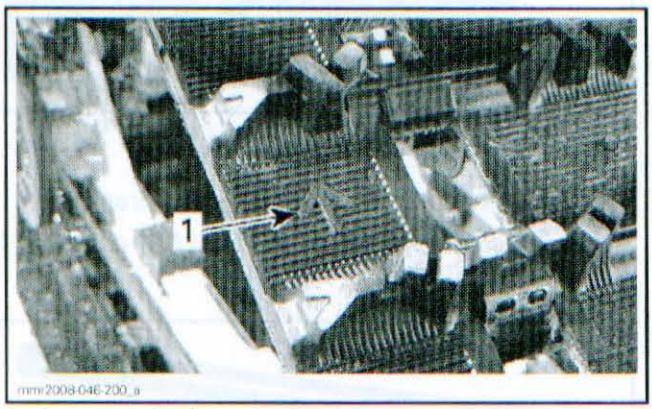
Track Removal

1. Remove rear suspension from vehicle. Refer to *REAR SUSPENSION* subsection.
2. Remove drive axle from vehicle. Refer to *DRIVE AXLE* subsection.
3. Remove track.

Track Installation

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

Respect rotation direction indicated by an arrow on track thread.



1. Arrow pointing forwards

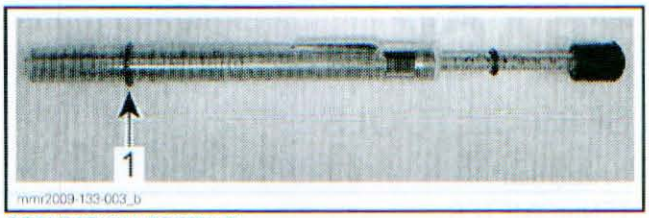
Track Adjustment

Track tension and alignment are interrelated. Do not adjust one without checking the other. Track tension procedure must be carried out prior to track alignment.

Track Tension Verification

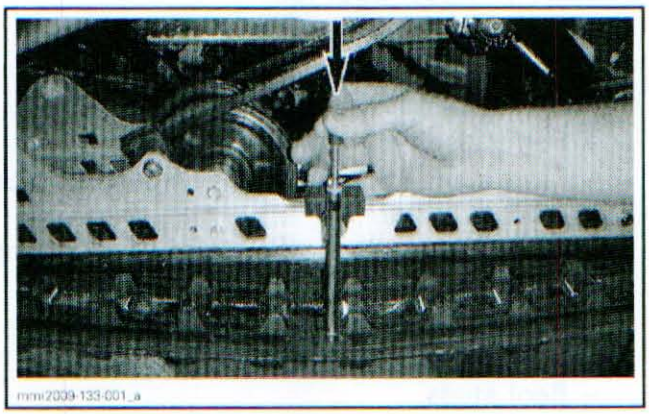
1. Lift rear of vehicle and support it off the ground.
2. Allow rear suspension to fully extend.
3. Use the TENSIOMETER (P/N 414 348 200).

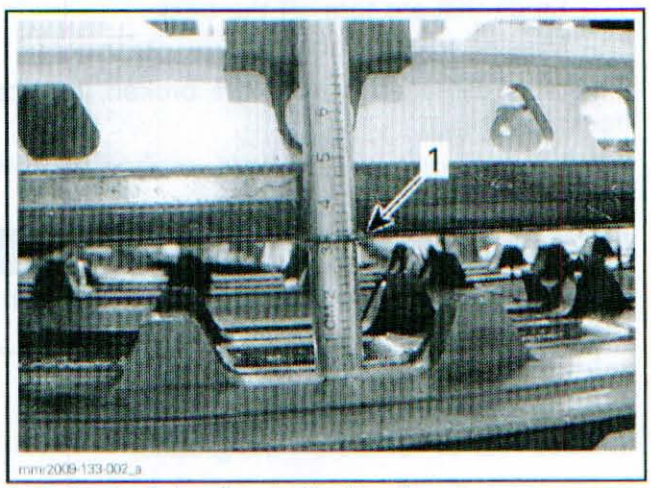
4. Set deflection to 3.2 cm (1.26 in) using bottom O-ring.



DEFLECTION SETTING
1. Bottom O-ring

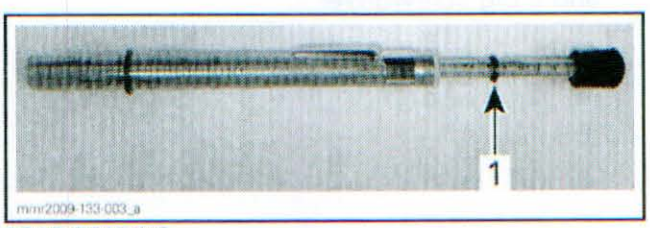
5. Place upper O-ring to 0 kgf (0 lbf).
6. Position the tensiometer on track, halfway between front and rear idler wheels.
7. Push the tensiometer downwards until bottom O-ring (deflection) be aligned with the bottom of slider shoe.





1. Deflection O-ring aligned with slider shoe

8. Read load recorded by the upper O-ring on the tensiometer.



LOAD READING
1. Upper O-ring

9. Load reading must be as per the following table.

TRACK ADJUSTMENT SPECIFICATION	
Track deflection setting	3.2 cm (1.26 in)
Track load reading	6.0 kgf to 8.5 kgf (13 lbf to 19 lbf)

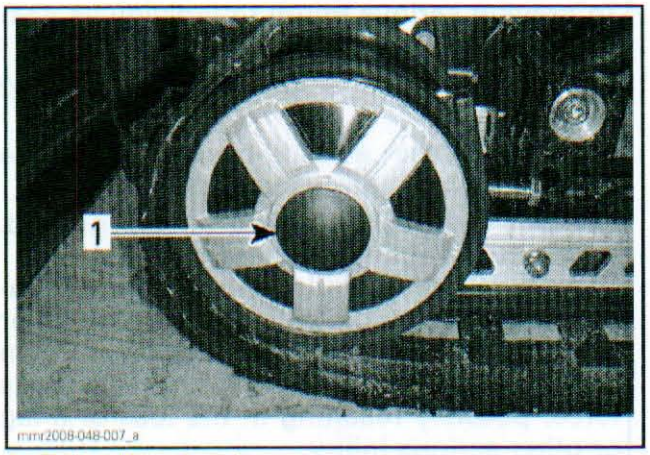
10. If load reading is not in accordance with the specification, adjust track tension. Refer to *TRACK TENSION ADJUSTMENT*.

NOTICE **Too much tension will result in power loss and excessive stresses on suspension components.**

Track Tension Adjustment

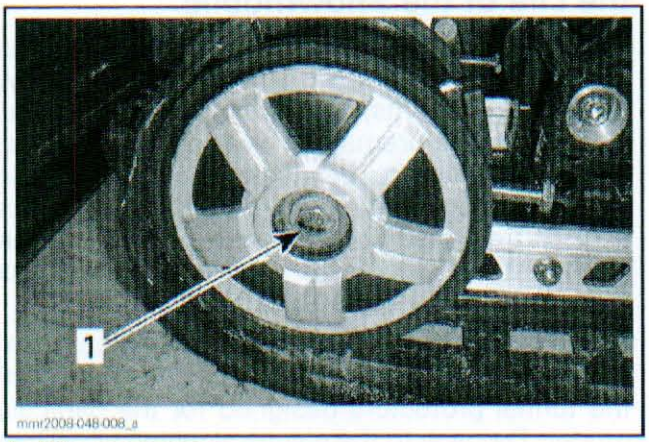
NOTE: After track tension adjustment, ride the snowmobile in snow about 15 to 20 minutes and recheck track tension.

1. Lift rear of vehicle and support it off the ground.
2. Remove rear idler wheel caps.



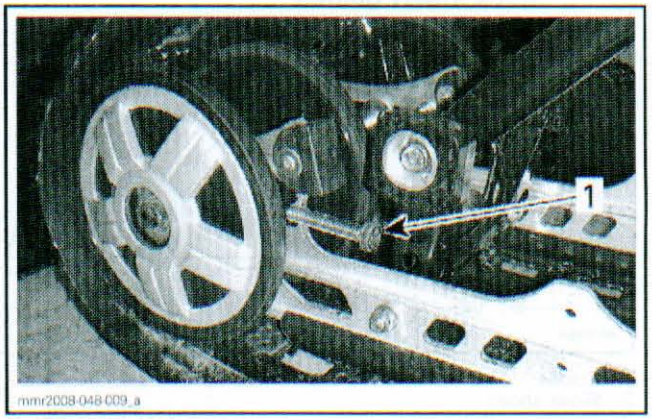
1. RH rear idler wheel cap

3. Loosen rear axle screws (one each side).



1. RH rear axle screw

4. Tighten or loosen both adjustment screws to increase or decrease track tension.



1. RH adjustment screw

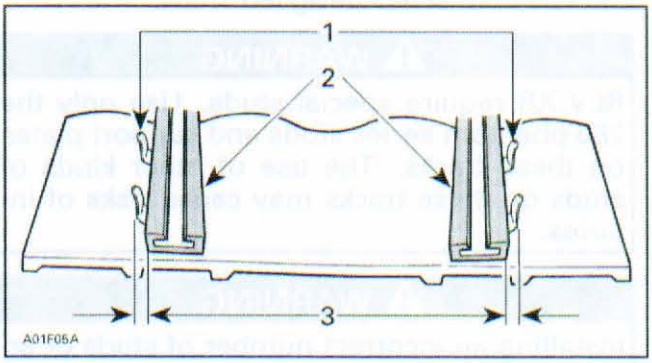
5. Verify track tension, refer to *TRACK TENSION VERIFICATION*.

Track Alignment

⚠ WARNING

Before checking track alignment, ensure that the track is free of all particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Ensure no one is standing in close proximity to the vehicle. Never rotate at high speed.

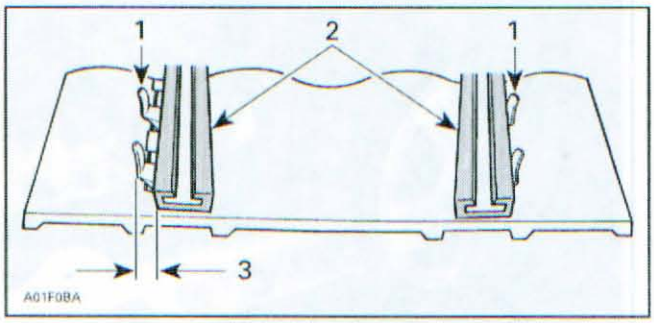
1. Start engine and accelerate slightly so that track barely turns. This must be done in a short period of time (1 to 2 minutes).
2. Check that the track is well centered; equal distance on both sides between edges of track guides and slider shoes.



1. Guides
2. Slider shoes
3. Equal distance

3. To correct track alignment:
   3.1 Stop engine.
   3.2 Loosen rear wheel screws.

3.3 Tighten adjustment screw on side where the slider shoe is the farthest from the track insert guides.



1. *Guides*
2. *Slider shoes*
3. *Tighten on this side*

4. Restart engine.
5. Rotate track slowly and recheck alignment.
6. If the satisfactory alignment is achieved:
   - 6.1 Tighten idler wheel retaining screws to 48 N•m (35 lbf•ft).
   - 6.2 Reinstall wheel caps.

TRACTION ENHANCING PRODUCTS (STUDS)

Important Safety Rules

All REV-XR tracks use special single ply of fabric track to reduce weight and rolling resistance. The conventional track design is a 2 layers of fabric and one layer of high strength tensile cord. These new tracks design is a single layer of fabric and one layer of tensile cord. This results in a thinner track and if studded, absolutely requires the use of the 286 Phantom series designed studs.

⚠ WARNING

REV-XR require special studs. Use only the 286 phantom series studs and support plates on these tracks. The use of other kinds of studs on these tracks may cause risks of injuries.

⚠ WARNING

Installing an incorrect number of studs or an improper installation could reduce the track life and possibly resulting in serious injury or death.

⚠ WARNING

Never stud a track that has not been approved for studs. Installing studs on an unapproved track could increase the risk of the track tearing or severing, possibly resulting in serious injury or death. Approved tracks can be identified by a stud symbol molded into the track surface.
Studs should only be installed in the locations indicated by molded bulges in the track surface.
Never stud a track with a profile of 35 mm (1.378 in) or more.
The maximum allowable stud penetration range is 6.4 mm to 9.5 mm (1/4 in to 3/8 in).
The number of studs installed must match the number of molded bulges in the track.
Strictly adhere to the specified tightening torque.

⚠ WARNING

To prevent serious injury to individuals near the snowmobile:
- **NEVER stand behind or near a moving track.**
- **ALWAYS use a wide-base snowmobile stand with a rear deflector panel.**
- **When the track is raised off the ground, only run it at lowest possible speed.**

Centrifugal force could cause debris, damaged or loose studs, pieces of torn track, or an entire severed track to be violently thrown backwards out of the tunnel with tremendous force, possibly resulting in the loss of a leg or other serious injury.

Effects of Having a Studded track on the Life of the Snowmobile

The use of traction enhancing products can increase the load and the stress on certain snowmobile components, as well as the vibration level. This can cause premature wear on parts such as belts, brake lining, bearings, chain, and chaincase sprockets, and on approved studded tracks, shorten track life. For this reason, it is even more important to follow the detailed maintenance program given in the *MAINTENANCE CHART.*

Studs on the track can also cause serious damage to the snowmobile if it is not equipped with the tunnel protectors designed for the particular model. Damage to the electrical wiring or perfora-

tion of the heat exchangers are potential hazards, that could cause the engine to overheat and be severely damaged.

⚠ WARNING

If tunnel protectors are excessively worn or not installed, the gas tank could be punctured, causing a fire.

Studs and Track Inspection

A visual inspection of the track should be performed before each use. Refer to *TRACK INSPECTION*.

Replace broken or damaged studs immediately. If the track shows signs of deterioration, it must be replaced immediately. In doubt, replace the track.

⚠ WARNING

Riding with a damaged track or studs could lead to loss of control, resulting in a risk of serious injury or death.

Stud Installation Tables

Use the following table for appropriate size and quantity of studs.

APPROVED STUDS ACCORDING TO TRACK LUG HEIGHT			
LUG HEIGHT	STUD SIZE	QTY OF STUDS FOR A 120" TRACK	QTY OF STUDS FOR A 137" TRACK
1.000"	1.075"	84	96
1.250"	1.325"	84	96

Use the following table for appropriate tunnel protector kits.

TUNNEL PROTECTOR KITS		
CHASSIS TYPE	TRACK DIMENSION	KIT P/N
REV-XR	All 120" and 137" (up to 1.250")	860 200 267

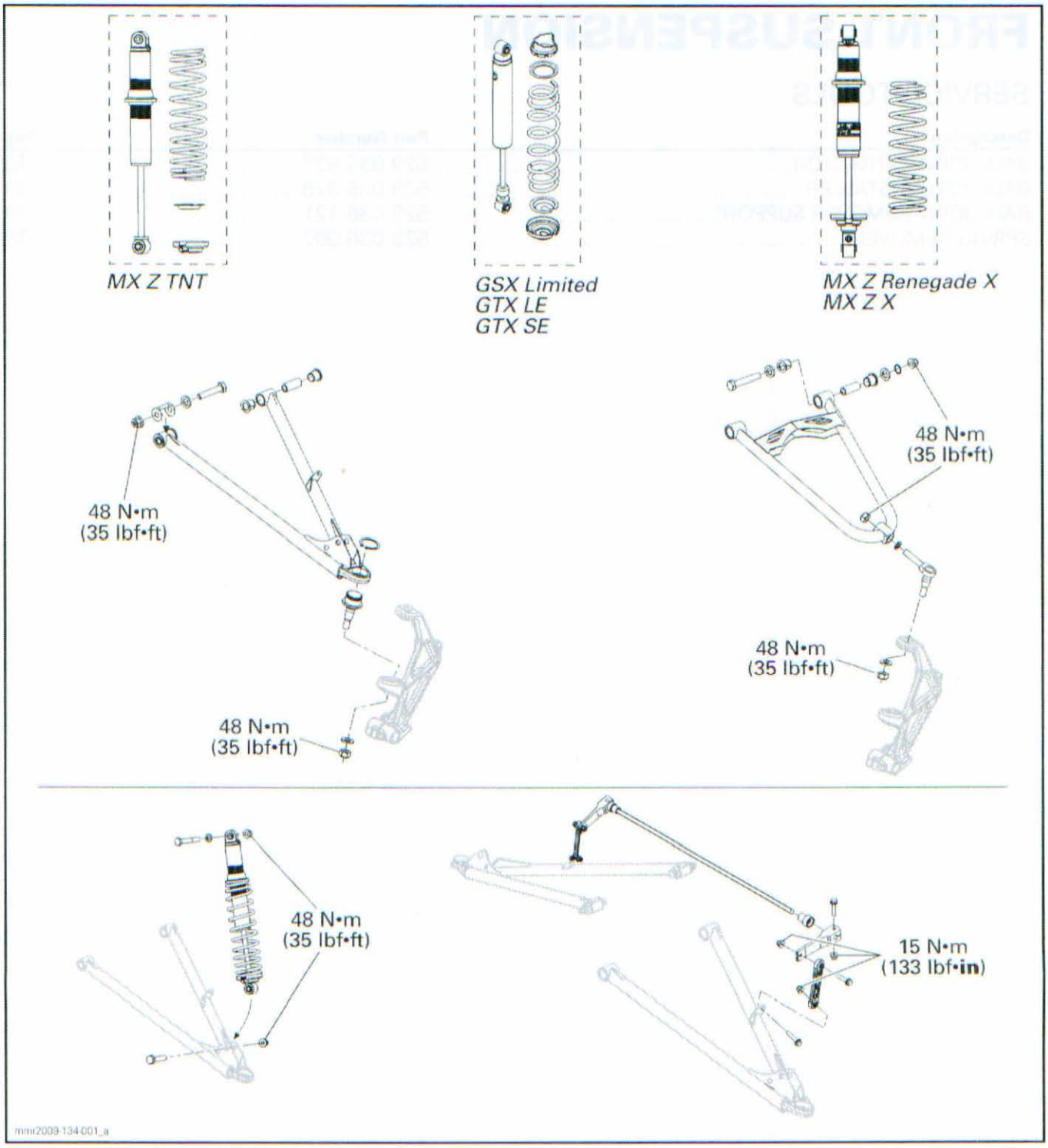
Stud Installation Procedure

Refer to manufacturer's instruction for complete installation procedure.

FRONT SUSPENSION

SERVICE TOOLS

Description	Part Number	Page
BALL JOINT EXTRACTOR	529 035 827	389
BALL JOINT INSTALLER	529 035 975	391
BALL JOINT REMOVER SUPPORT	529 036 121	391
SPRING REMOVER	529 036 007	386


MX Z TNT
GSX Limited
GTX LE
GTX SE
MX Z Renegade X
MX Z X
48 N•m
(35 lbf•ft)
48 N•m
(35 lbf•ft)
48 N•m
(35 lbf•ft)
48 N•m
(35 lbf•ft)
48 N•m
(35 lbf•ft)
15 N•m
(133 lbf•in)
mmr2009-134-001_a

GENERAL

The procedure explained below is the same for the RH and LH sides unless otherwise noted.

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, cotter pins, etc.) must be replaced with new ones.

Check for loose, bent, worn out, rusted or otherwise damaged components. Replace the faulty components.

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

ADJUSTMENT

SPRING

SPRINGS ADJUSTMENT GUIDELINE		
HANDLING	STEERING	SOLUTION
Too soft	Too easy to turn	Increase spring preload
Too hard	Hard to turn	Decrease spring preload

⚠ WARNING

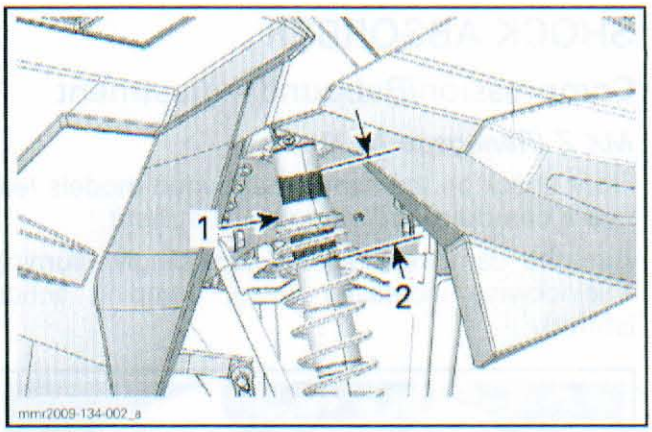
Adjust both springs to the same load. Uneven adjustment can cause poor handling and loss of stability, and/or control, and increase the risk of an accident.

Spring Preload Adjustment

Screw Type Adjustment

MX Z (Renegade X, TNT, X)

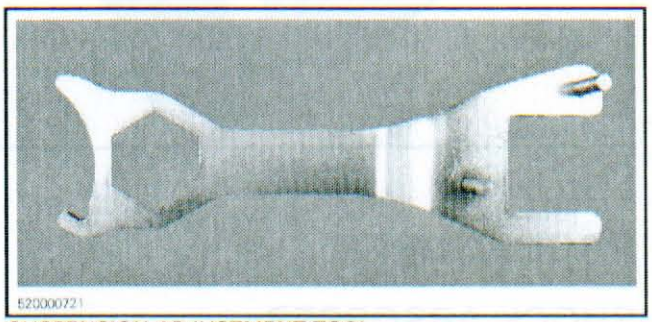
Grab and turn the spring to increase or decrease spring preload.



1. Adjustment ring
2. Ring positions

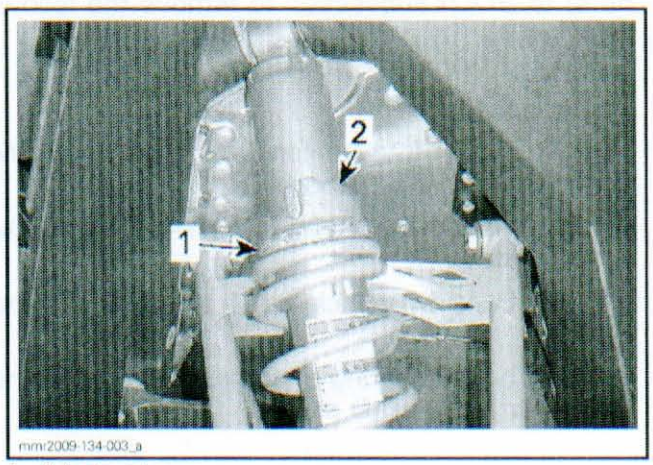
Cam Type Adjustment

Using the suspension adjustment tool (included in the tool kit), turn the cam to increase or decrease spring preload.



SUSPENSION ADJUSTMENT TOOL

GSX (Limited), GTX (LE, SE), MX Z (Renegade)



1. Adjustment cam
2. Cam positions

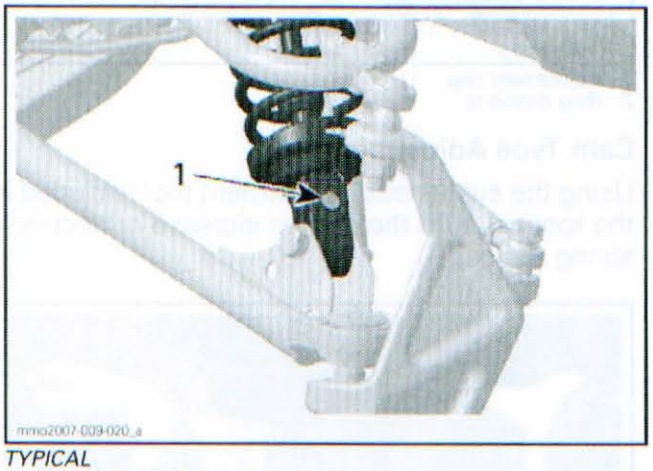
SHOCK ABSORBER

Compression/Rebound Adjustment

MX Z (Renegage X, X)

Front shock on the above mentioned models feature a compression/rebound adjustment.

Turn the damping adjuster accordingly. Turning it clockwise increases shock damping action (stiffer).



TYPICAL
1. Damping adjuster

PROCEDURES

SHOCK ABSORBER

Shock Absorber Removal

Refer to *BODY* subsection to remove the following:

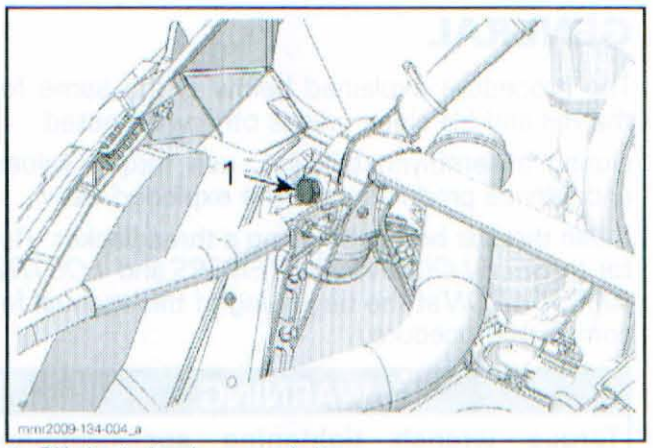
- Hood
- Side panel(s).

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

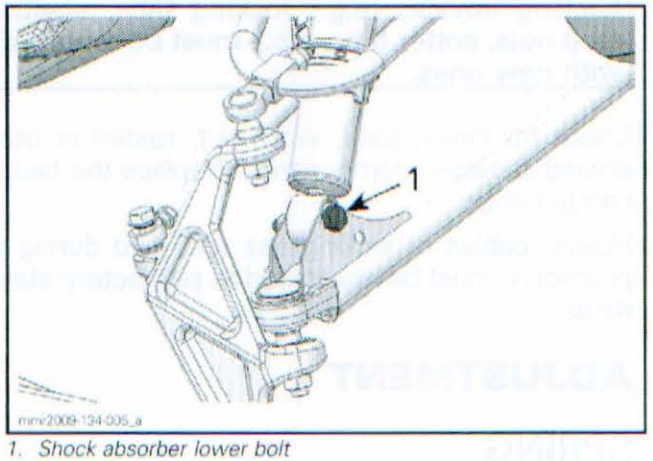
Remove the muffler. Refer to *EXHAUST SYSTEM* subsection.

Lift the front of vehicle until skis are off the ground.

Remove bolts securing shock absorber to frame and lower suspension arm.



1. RH shock absorber upper bolt

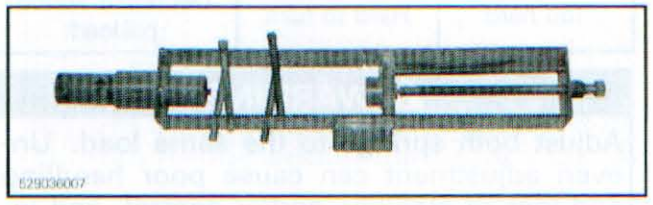


1. Shock absorber lower bolt

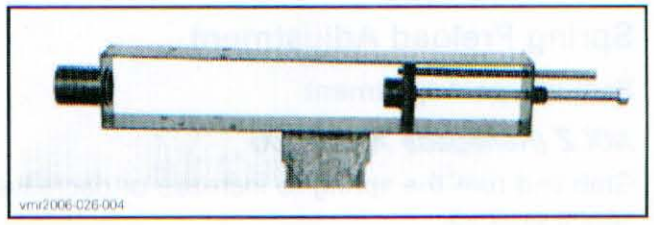
Remove the shock absorber.

Shock Absorber Disassembly

To remove spring from the shock absorber, use the SPRING REMOVER (P/N 529 036 007).

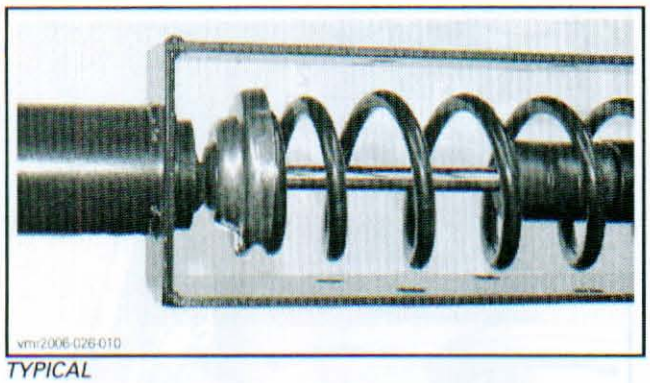


Place the tool in a vise.



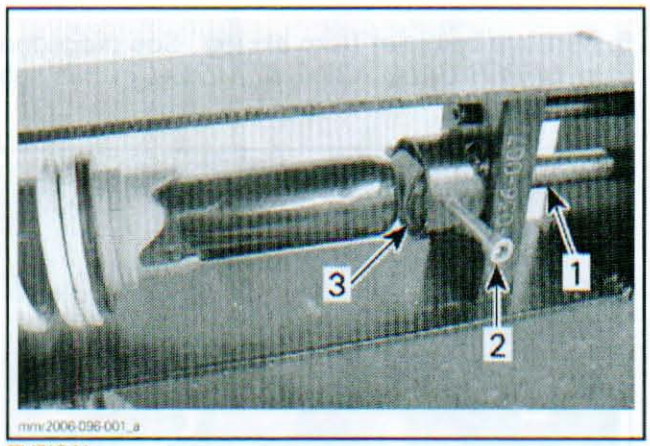
On models with a screw type adjuster, unscrew the adjuster completely.

Position the shock absorber in the tool and install the spring compressor pins.



TYPICAL

Lock the end of the shock absorber with a bolt or a steel pin.



TYPICAL
1. *Spring compressor tool screw*
2. *Locking device (bolt or steel pin)*
3. *Shock absorber end*

Tighten the spring compressor tool screw until the spring is sufficiently compressed to remove spring locking devices.

Remove spring stopper then release the spring compressor tool screw.

TYPICAL

NOTE: On **MX Z (Renegade X, TNT, X) models**, front shock absorbers can be rebuilt. Refer to *REAR SUSPENSION* for complete procedure.

Shock Absorber Inspection

Inspect the spring for damage. Replace if necessary.

Inspect shock as following:

Hydraulic Shock

1. Examine shock for leaks. Extend and compress the piston at least 5 complete strokes with its rod upward.
2. After, check that shock moves smoothly and with uniform resistance over its entire stroke.

NOTE: For the first 5 complete strokes, it could be normal to note uneven resistance.

3. Check the following conditions that will denote a defective shock:
   - A skip or a hang back when reversing stroke at mid travel.
   - Seizing or binding condition except at extreme end of either stroke.
   - Oil leakage.
   - A gurgling noise, after completing one full compression and extension strokes.
4. If suspecting a shock is freezing, place it in a freezer (temperature below 0°C (32°F)) for 4 hours.
5. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
6. Renew if any faults are present.

Gas Shock

NOTE: Because of gas pressure, strong resistance is felt when compressing shock.

To inspect shock operation, or if suspecting an internal leak between oil chamber and gas chamber, check shock as follows:

1. Install shock in a vise clamping on its bottom eyelet with its rod upward. Verify the compression stroke when the rod is fully extended.
2. Completely push down the shock rod then release.
3. The shock should extend unassisted. Rod must come out at a steady speed. If speed suddenly increases particularly at end of extension, replace shock.
4. If suspecting a shock is freezing, place it in a freezer (temperature below 0°C (32°F)) for 4 hours.
5. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.

Shock Absorber Assembly and Installation

For assembly and installation, reverse the disassembly and removal procedures.

NOTE: Always install shock valve outwards when applicable.

UPPER SUSPENSION ARM

Upper Suspension Arm Inspection

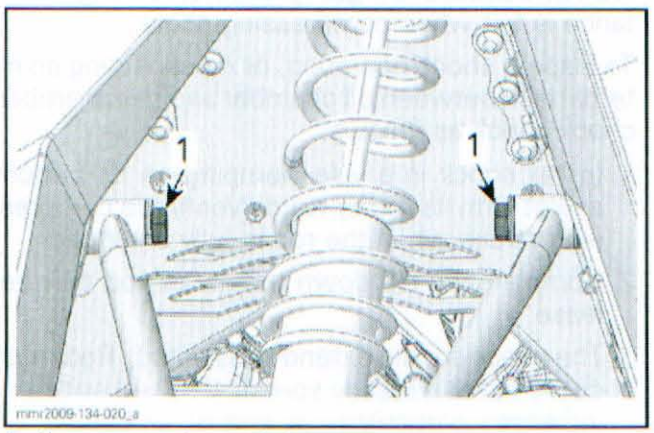
1. Check suspension arm for distortion or damage. Replace if necessary.
2. Move suspension arm from side to side then up and down. There should be no noticeable looseness. Replace bushings and/or sleeves if necessary.

NOTE: A play of 2 mm (.079 in) is acceptable when the suspension arm is moved forward and backward.

3. Check sleeves inside suspension arm attachments for wear or damage.

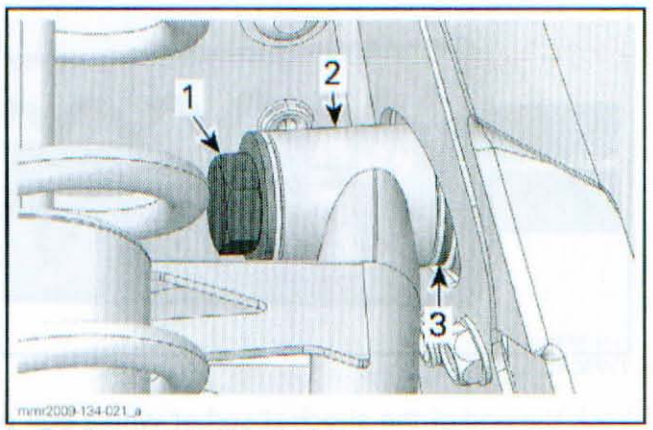
Upper Suspension Arm Removal

1. Lift the front of vehicle until skis are off the ground.
2. Remove muffler and tuned pipe. Refer to *EXHAUST SYSTEM* subsection.
3. Remove shock absorber upper bolt. See procedure in *SHOCK ABSORBER REMOVAL* in this subsection.
4. Remove the upper suspension arm bolts.



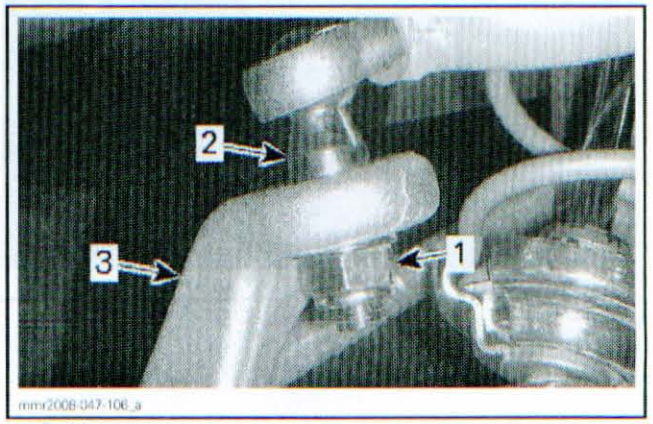
1. Upper suspension arm bolts

NOTE: Ensure not to lose the washer located between rear attachment and frame.



1. Rear upper suspension arm bolt
2. Rear attachment
3. Washer

5. Remove ball joint from ski leg. See procedure in *UPPER BALL JOINT REMOVAL* in this subsection.



1. Ball joint nut
2. Ball joint
3. Ski leg

6. Remove upper suspension arm.

Upper Suspension Arm Installation

The installation is the reverse of the removal procedure.

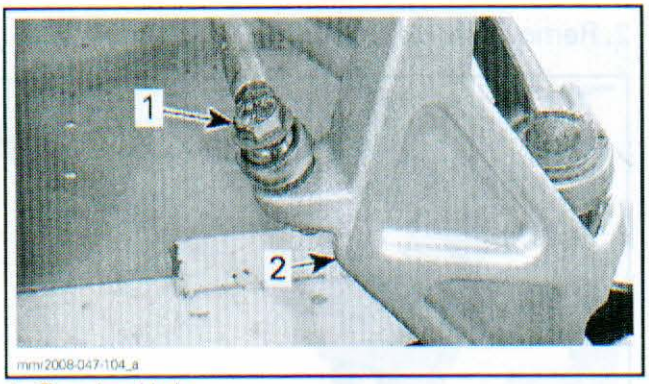
UPPER BALL JOINT

Upper Ball Joint Inspection

Check both upper ball joints for damage, pitting, looseness and roughness. If so, replace with a new one.

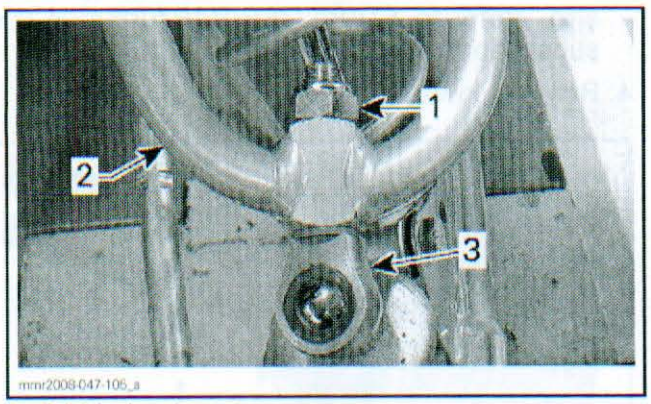
Upper Ball Joint Removal

1. Position upper suspension arm so that ball joint becomes parallel with ski leg.
2. Detach tie-rod end from ski leg.



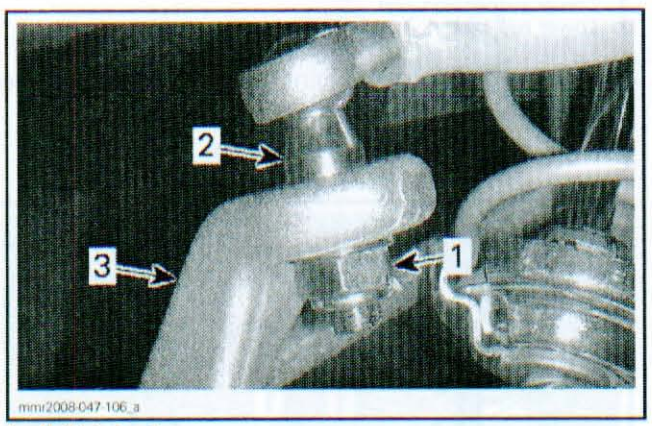
1. *Tie-rod end bolt*
2. *Ski leg*

3. Unscrew nut retaining ball joint housing to upper suspension arm.



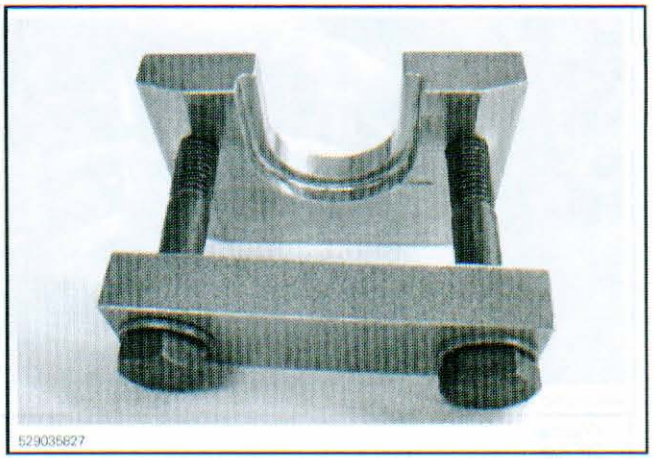
1. *Ball joint housing nut*
2. *Upper suspension arm*
3. *Ball joint housing*

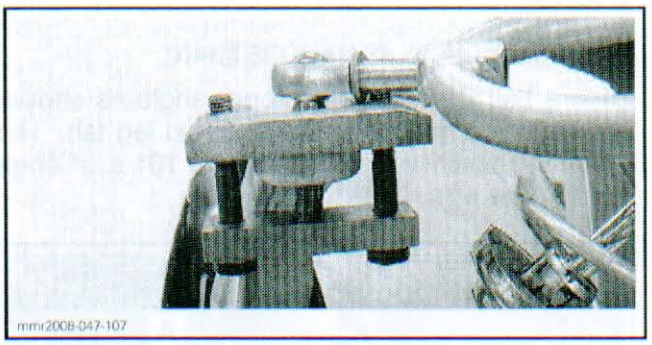
4. Remove nut securing ball joint to ski leg.



1. *Ball joint nut*
2. *Ball joint*
3. *Ski leg*

5. Install the BALL JOINT EXTRACTOR (P/N 529 035 827) and detach ball joint from ski leg.

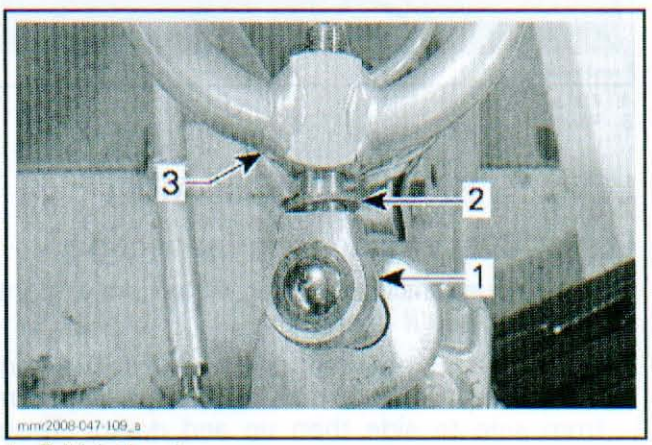




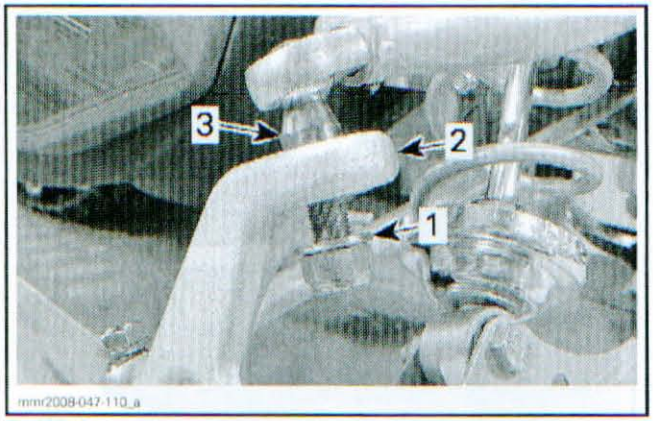
6. Remove ball joint.

Upper Ball Joint Installation

1. Install ball joint washers as shown.



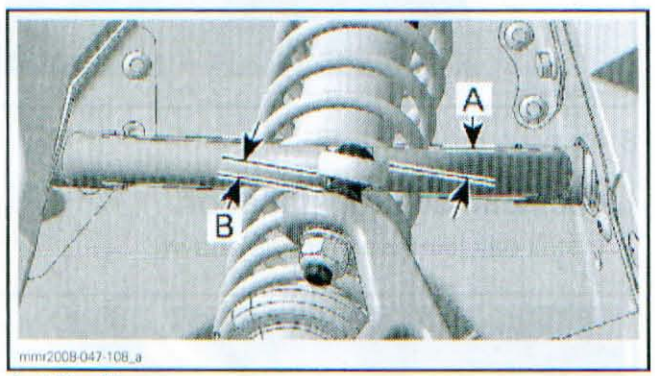
1. *Ball joint housing*
2. *Washer*
3. *Upper suspension arm*



1. Washer
2. Ski leg
3. Ball joint

2. Tighten nuts to 48 N•m (35 lbf•ft).

Ensure ball joint has the proper angle as shown. The ball joint must be parallel to ski leg tab. This mounting position corresponds to 10° ± 3° angle from upper arm.



A. 10° ± 3°
B. Parallel

LOWER SUSPENSION ARM

Lower Suspension Arm Inspection

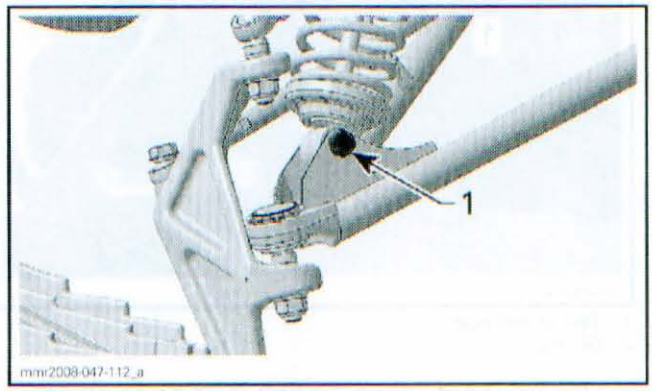
1. Check suspension arm for distortion or damage. Replace if necessary.
2. Detach shock absorber and stabilizer bar from lower suspension arm. Move suspension arm from side to side then up and down. There should be no noticeable loose. Replace bushings and/or sleeves if necessary.

NOTE: A play of 2 mm (.079 in) is acceptable when the suspension arm is moved forward and backward.

3. Check sleeves inside suspension arm attachments for wear or damage.

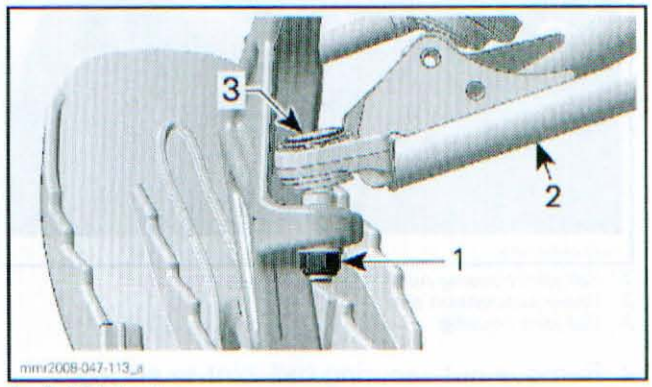
Lower Suspension Arm Removal

1. Lift the front of vehicle until skis are off the ground.
2. Remove shock absorber lower bolt.



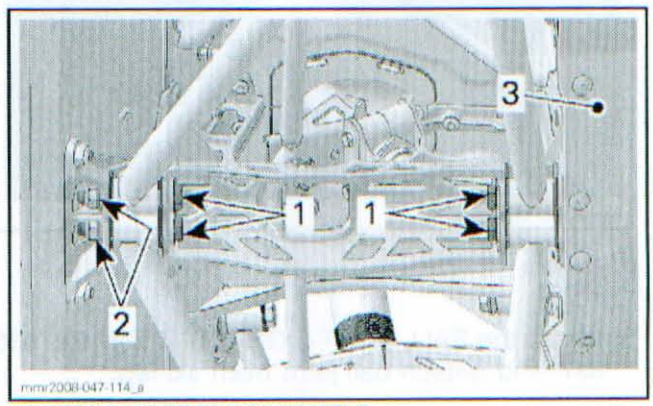
1. Shock absorber lower bolt

3. Detach stabilizer link from lower suspension arm. Refer to *STABILIZER BAR* further in this subsection.
4. Remove lower ball joint nuts.



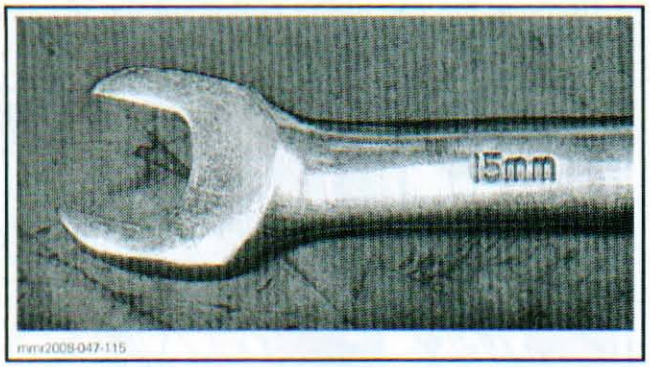
1. Ball joint nut
2. Lower suspension arm
3. Lower ball joint

5. Using a suitable ball joint remover, detach lower ball joint from ski leg.
6. Remove suspension arm bolts.



UNDERNEATH FRONT OF VEHICLE
1. Suspension arm bolts
2. Rear nuts
3. Bottom pan

NOTE: To hold rear nuts, modify a 15 mm opened wrench as shown.

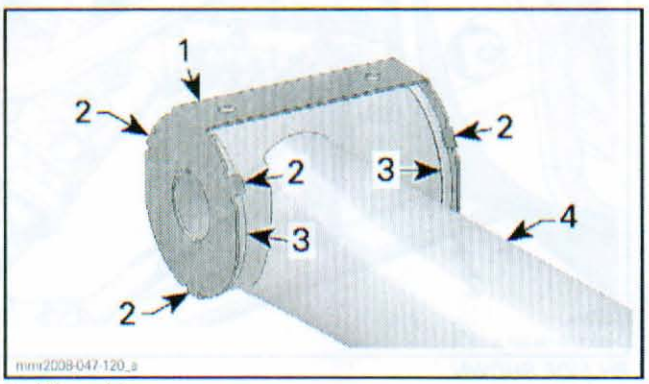


7. Remove lower suspension arm from vehicle.

Lower Suspension Arm Installation

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

1. Install a wear plate over bushings.
2. Position the wear plate on top.
3. Fold all tabs against bushings.



1. *Wear plate*
2. *Wear plate tabs*
3. *Bushings*
4. *Lower suspension arm*

Install all other removed parts.

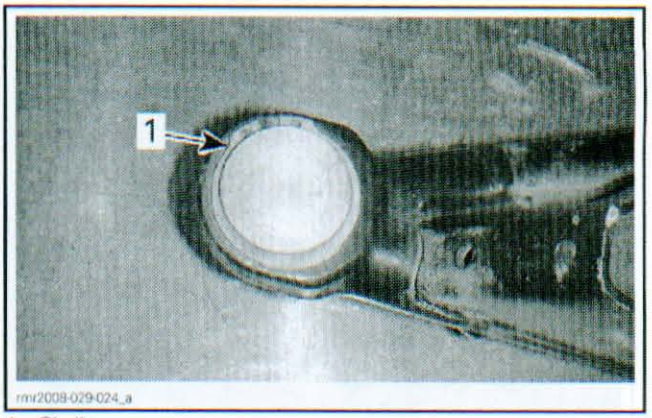
LOWER BALL JOINT

Lower Ball Joint Inspection

Inspect ball joint end for damage. Ensure it's moving freely without play. Replace ball joints as required.

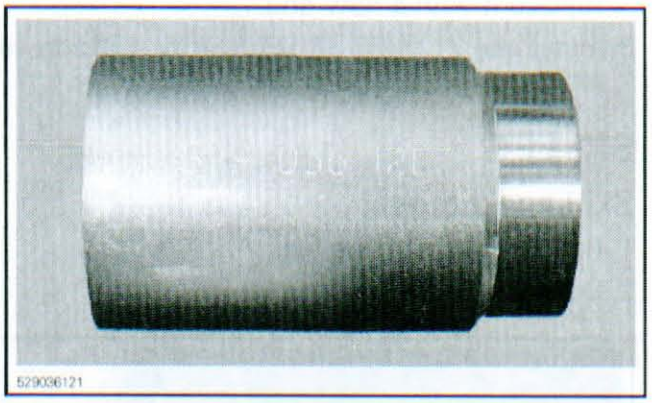
Lower Ball Joint Removal

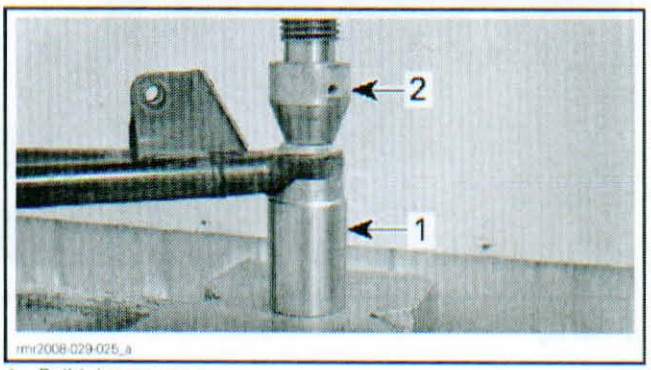
1. Remove the *LOWER SUSPENSION ARM*, see procedure in this subsection.
2. Remove circlip securing ball joint to suspension arm.



1. *Circlip*

3. Using a press and the BALL JOINT REMOVER SUPPORT (P/N 529 036 121), press ball joint out of the lower suspension arm.

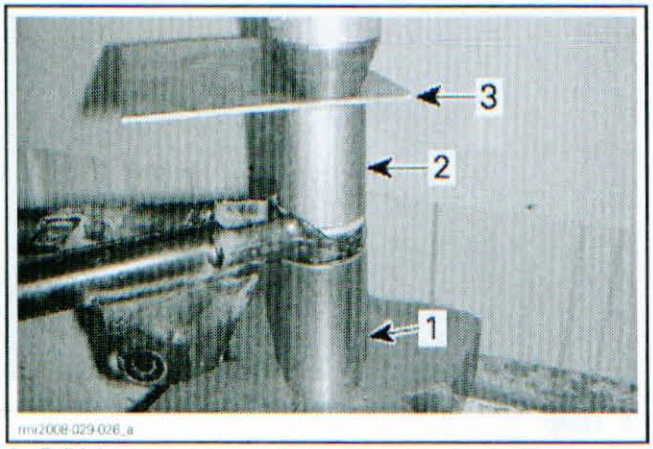




1. *Ball joint remover*
2. *Press*

Lower Ball Joint Installation

1. Using a press, the BALL JOINT REMOVER SUPPORT (P/N 529 036 121) and the BALL JOINT INSTALLER (P/N 529 035 975), press ball joint into the suspension arm end.



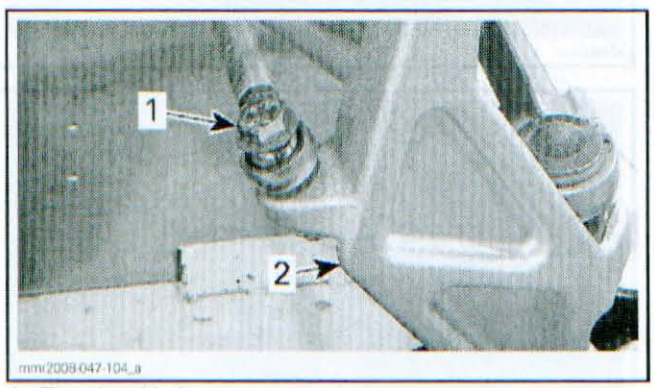
1. Ball joint remover support
2. Ball joint installer
3. Steel plate

2. Reinstall the circlip. If the circlip seems loose, replace it with a new one.
3. Install the *LOWER SUSPENSION ARM* on vehicle, see procedure in this subsection.

SKI LEG

Ski Leg Removal

1. Remove ski from ski leg.
2. Detach tie-rod end from ski leg.



1. Tie-rod end bolt
2. Ski leg

3. Remove upper and lower ball joints from ski leg. Refer to *UPPER BALL JOINT* and *LOWER BALL JOINT* in this subsection.

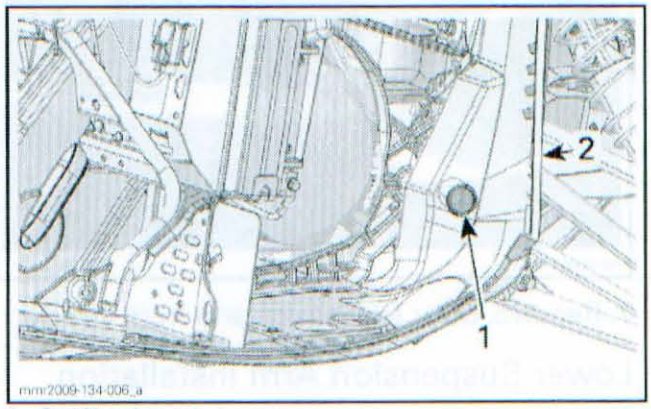
Ski Leg Installation

The installation is the reverse of the removal procedure.

STABILIZER BAR

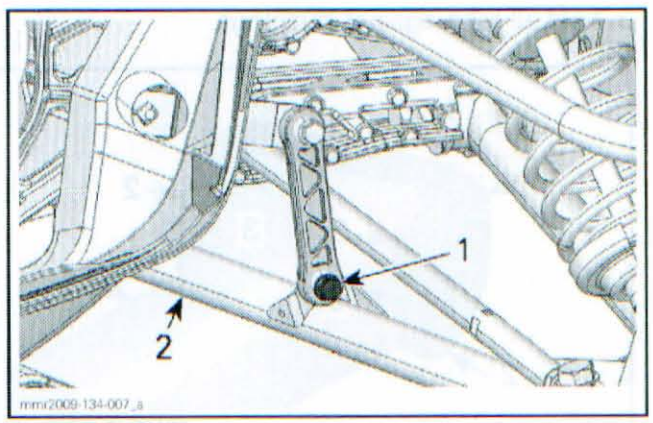
Stabilizer Bar Removal

1. Remove the RH side panel. Refer to *BODY* subsection.
2. Remove the muffler. Refer to *EXHAUST SYSTEM* subsection.
3. Remove the cap at the bottom of the RH side bottom pan.



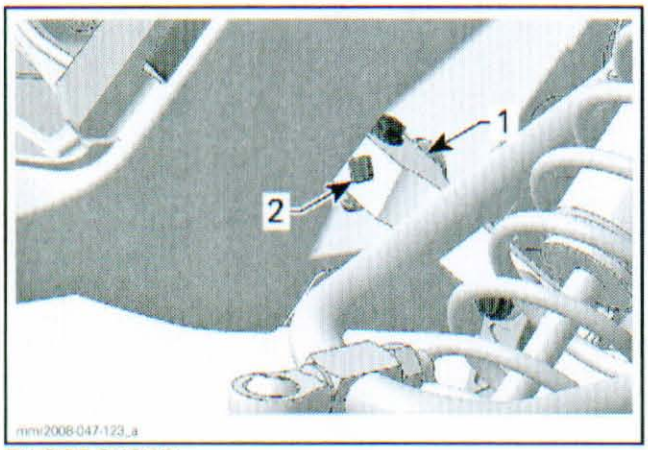
1. Stabilizer bar cap
2. RH side bottom pan

4. Remove bolts securing stabilizer links to lower suspension arms.



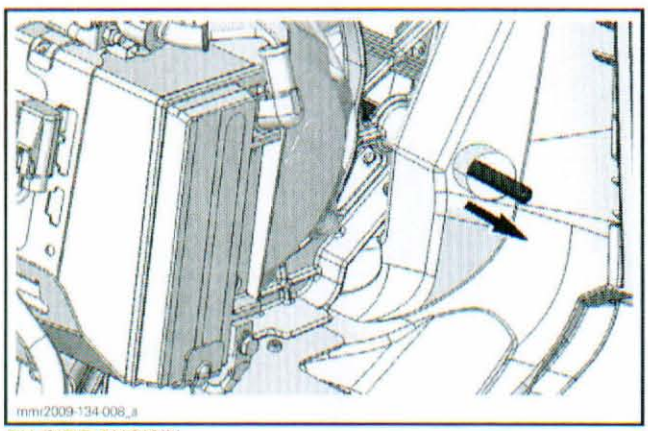
RH SIDE SHOWN
1. Stabilizer link bolt
2. Lower suspension arm

5. Unscrew stabilizer lever bolts.
6. Remove stabilizer levers from stabilizer bar.



RH SIDE SHOWN
1. *Stabilizer lever*
2. *Stabilizer bar*

7. Slide stabilizer bar out of vehicle.



RH SIDE SHOWN

Stabilizer Bar Installation

The installation is the reverse of the removal procedure.

REAR SUSPENSION

SERVICE TOOLS

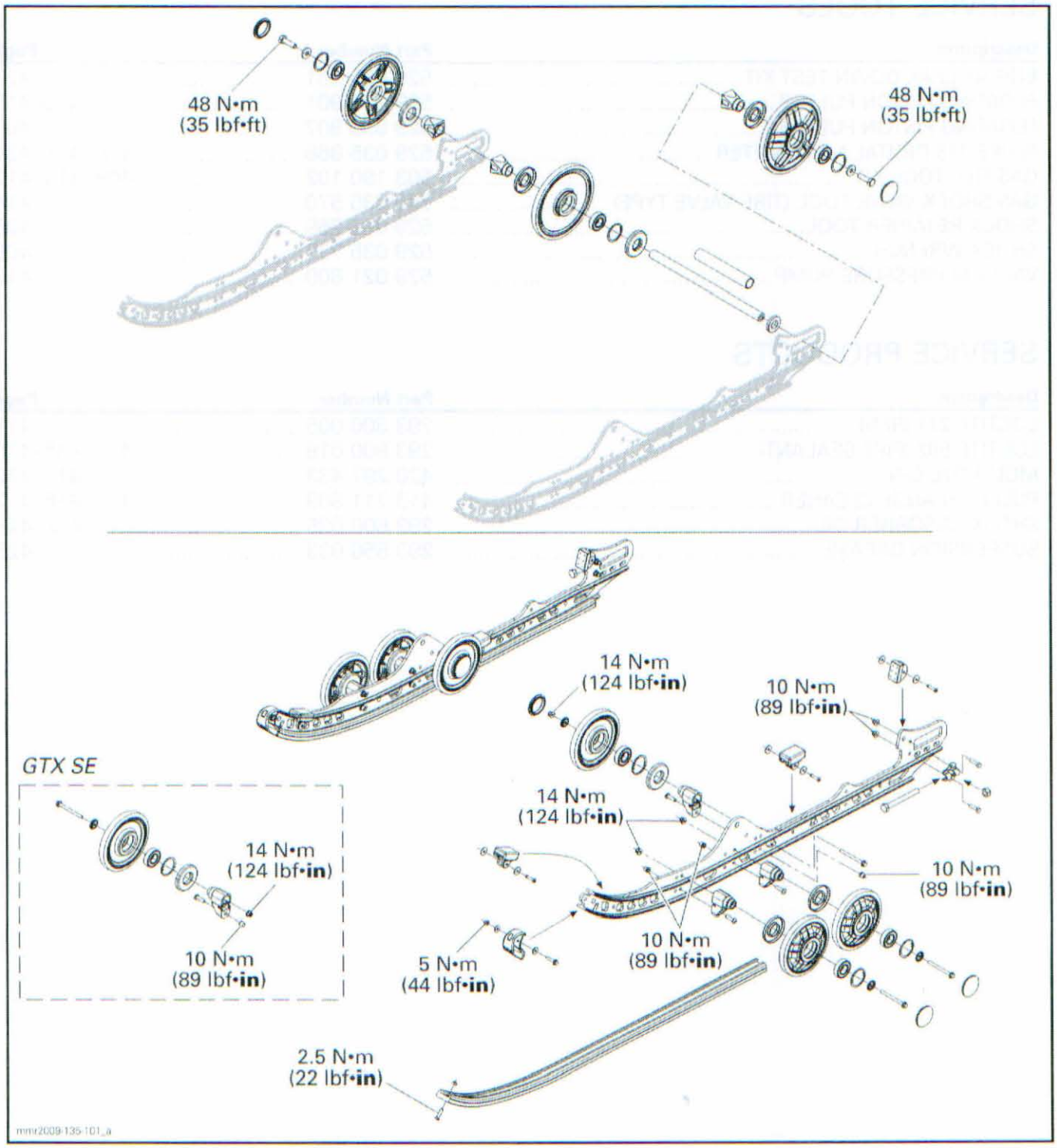
Description	Part Number	Page
ENGINE LEAK DOWN TEST KIT	529 035 661	429
FLOATING PISTON PULLER	529 035 901	415–416
FLOATING PISTON PULLER	529 035 907	409
FLUKE 115 DIGITAL MULTIMETER	529 035 868	428, 431, 434
GAS FILL TOOL KIT	503 190 102	408, 414, 417
GAS SHOCK VALVE TOOL (TIRE VALVE TYPE)	529 035 570	414
SHOCK RETAINER TOOL	529 035 769	408
SHOCK WRENCH	529 035 727	408
VACUUM PRESSURE PUMP	529 021 800	410

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 271 (RED)	293 800 005	411
LOCTITE 592 (PIPE SEALANT)	293 800 018	430, 435–436
MOLYKOTE G-N	420 297 433	411–412
PULLEY FLANGE CLEANER	413 711 809	414, 416–417
SHOCK ABSORBER OIL	293 600 035	412, 416
SUSPENSION GREASE	293 550 033	425

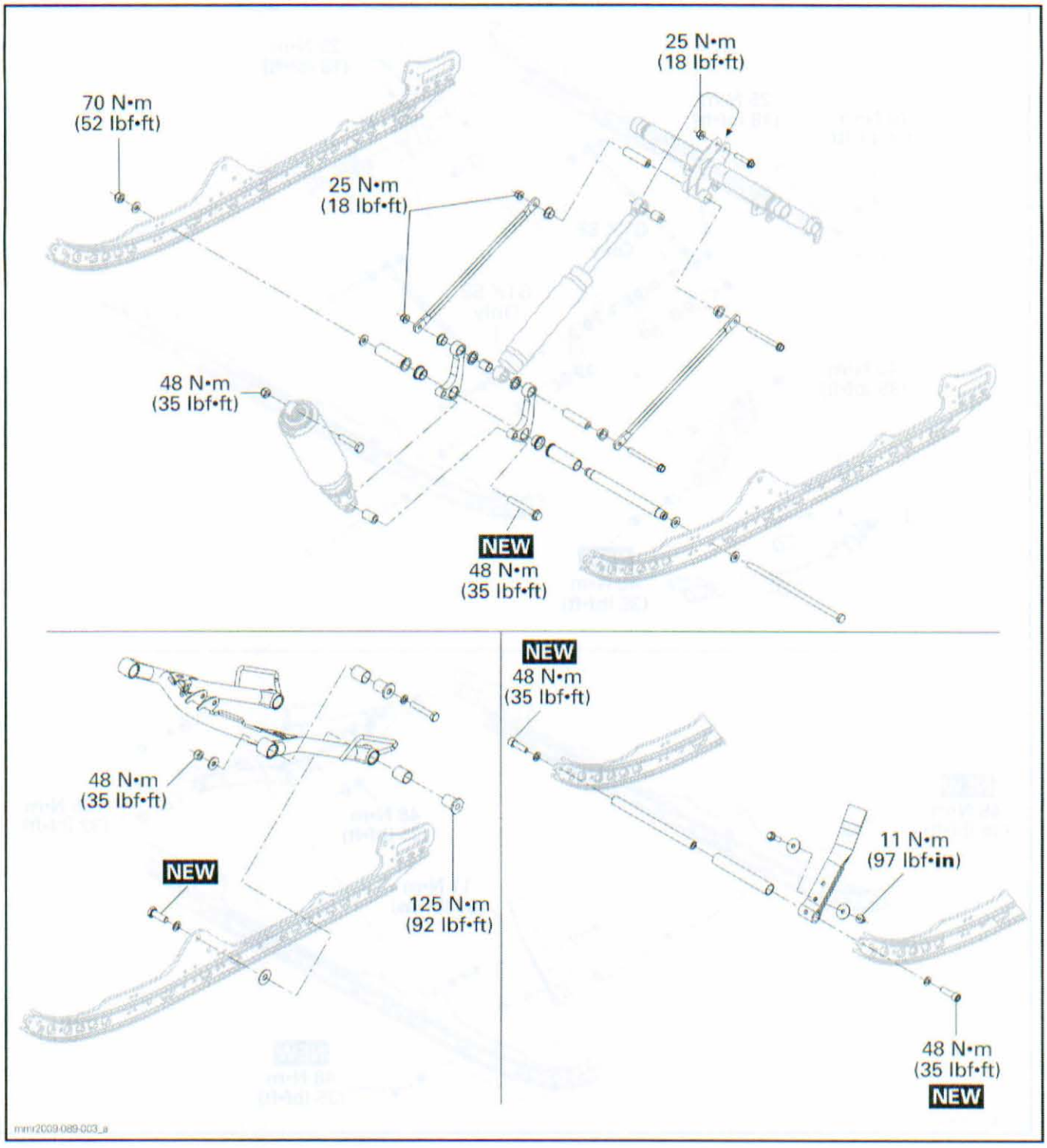
RAILS AND IDLER WHEELS

GSX, GTX and MX Z



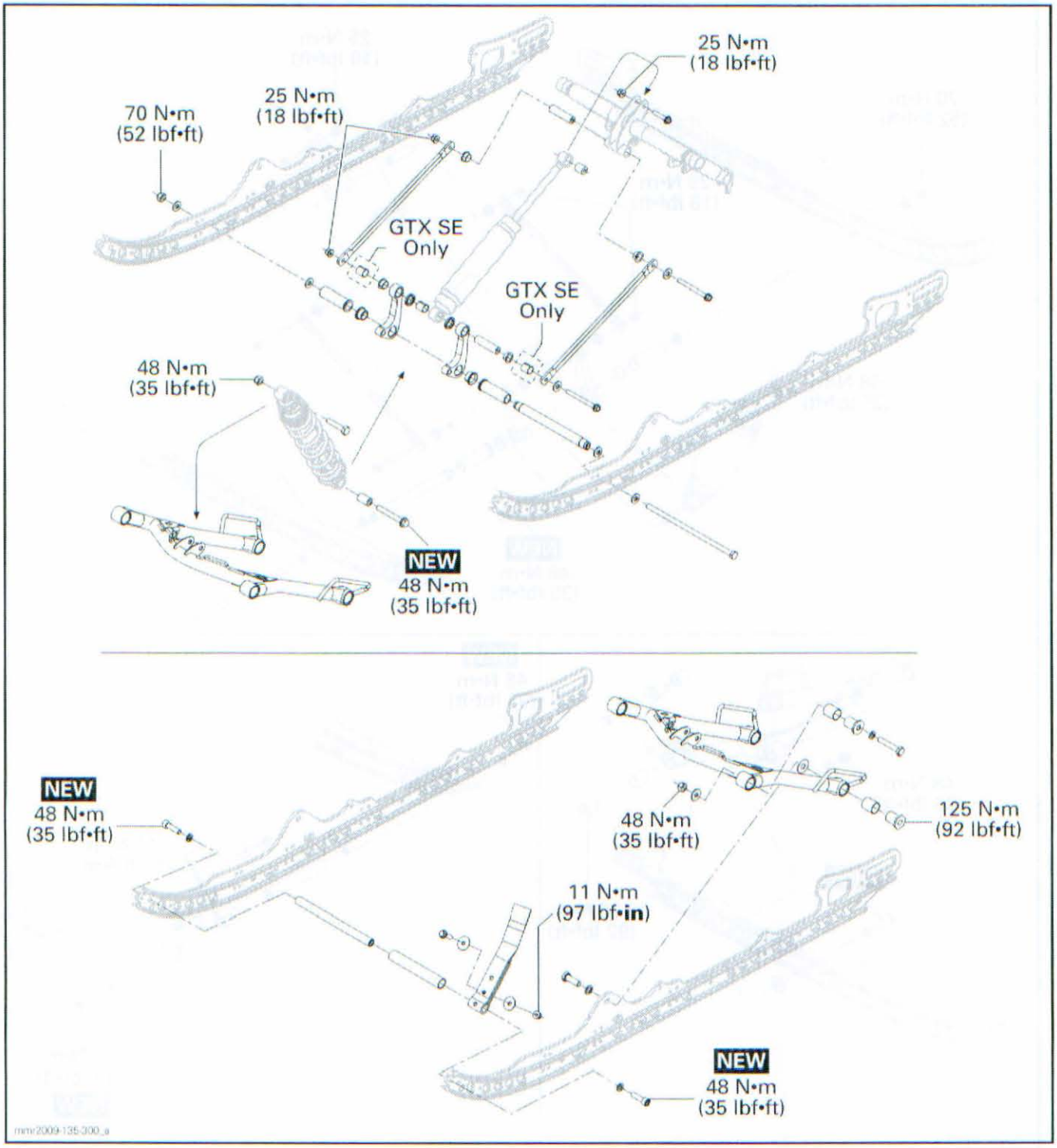
FRONT ARM

GSX and MX Z (X, TNT)



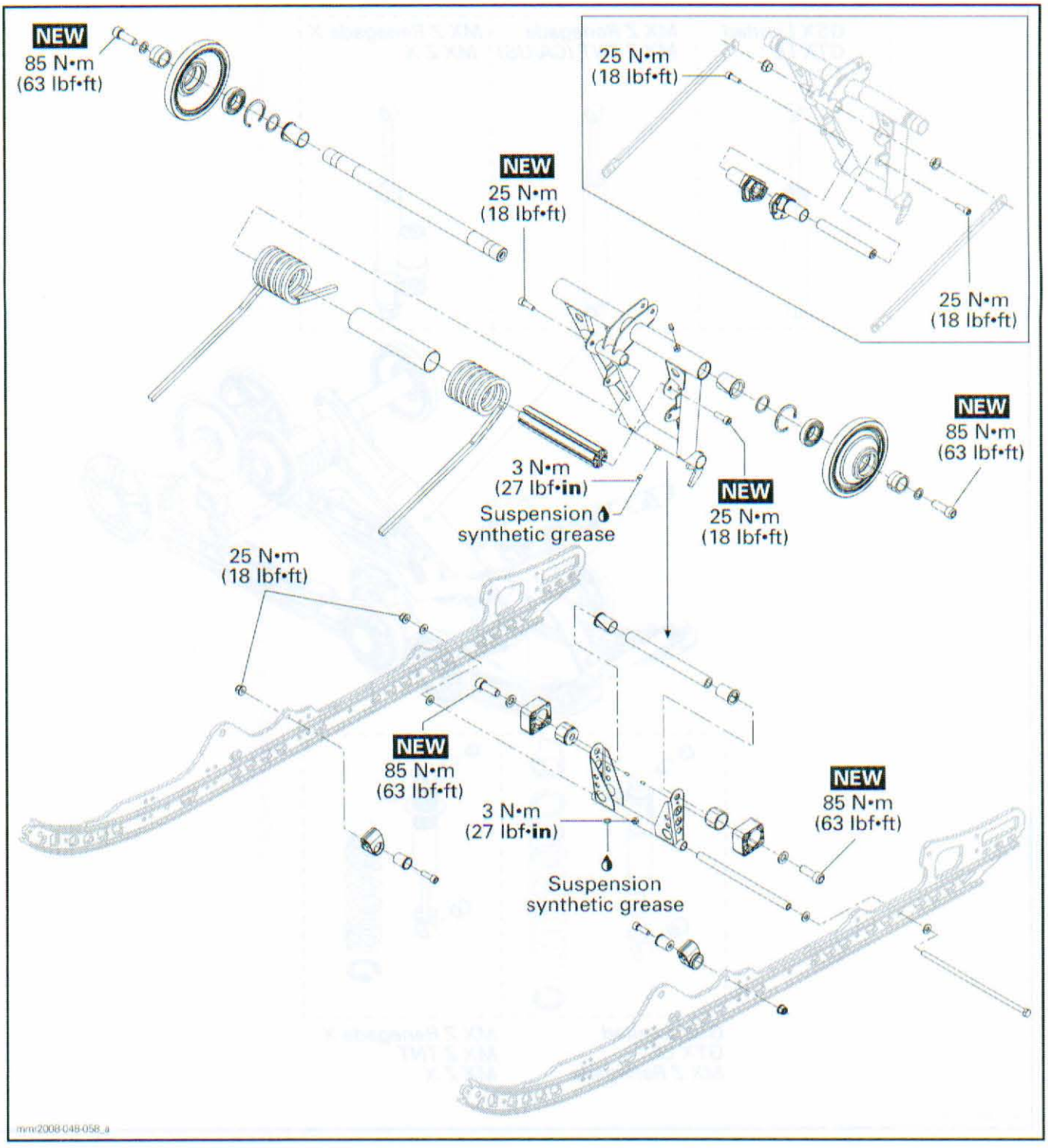
FRONT ARM

GTX and MX Z (Renegade, Renegade X)



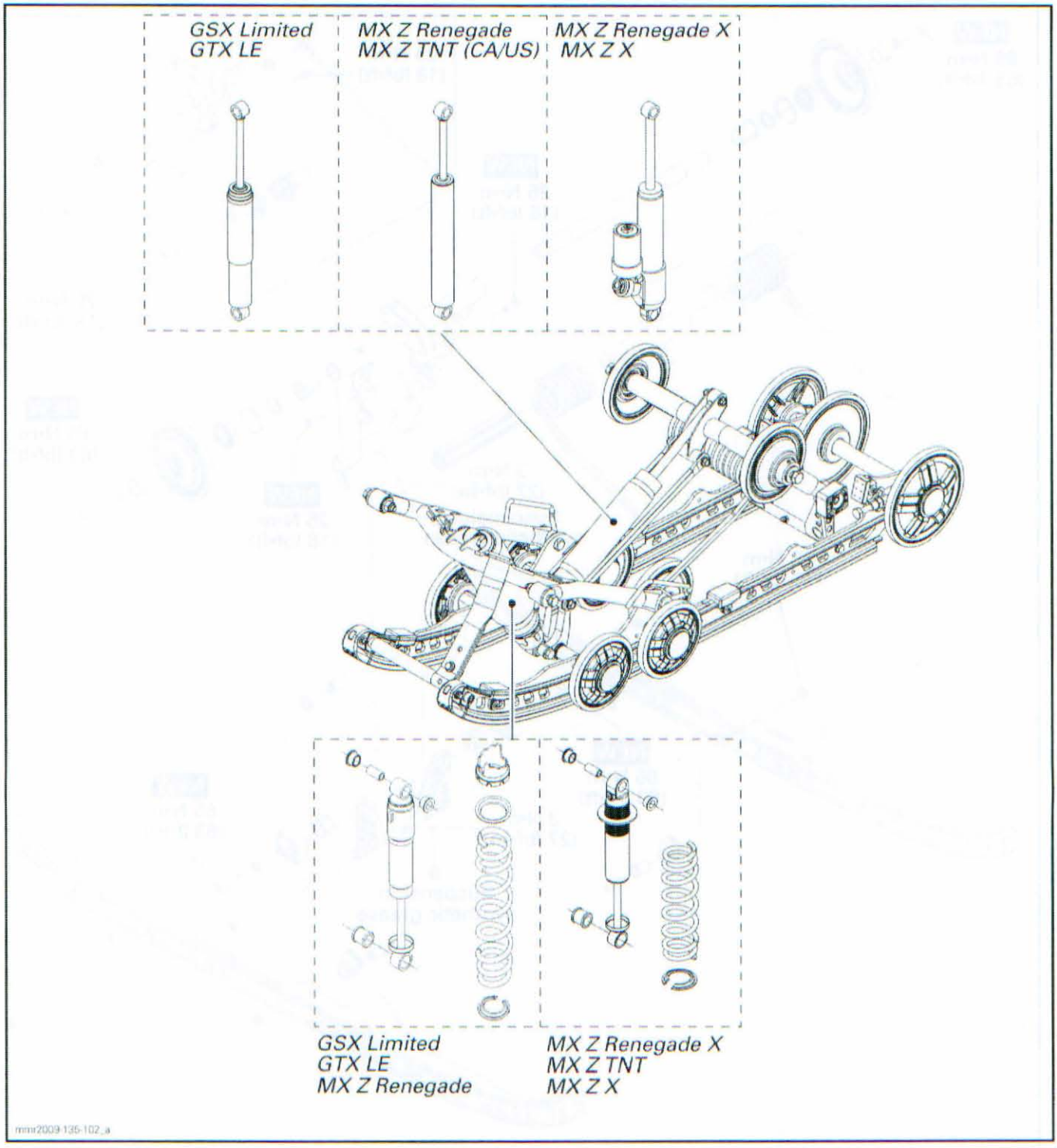
REAR ARM

GSX, GTX and MX Z



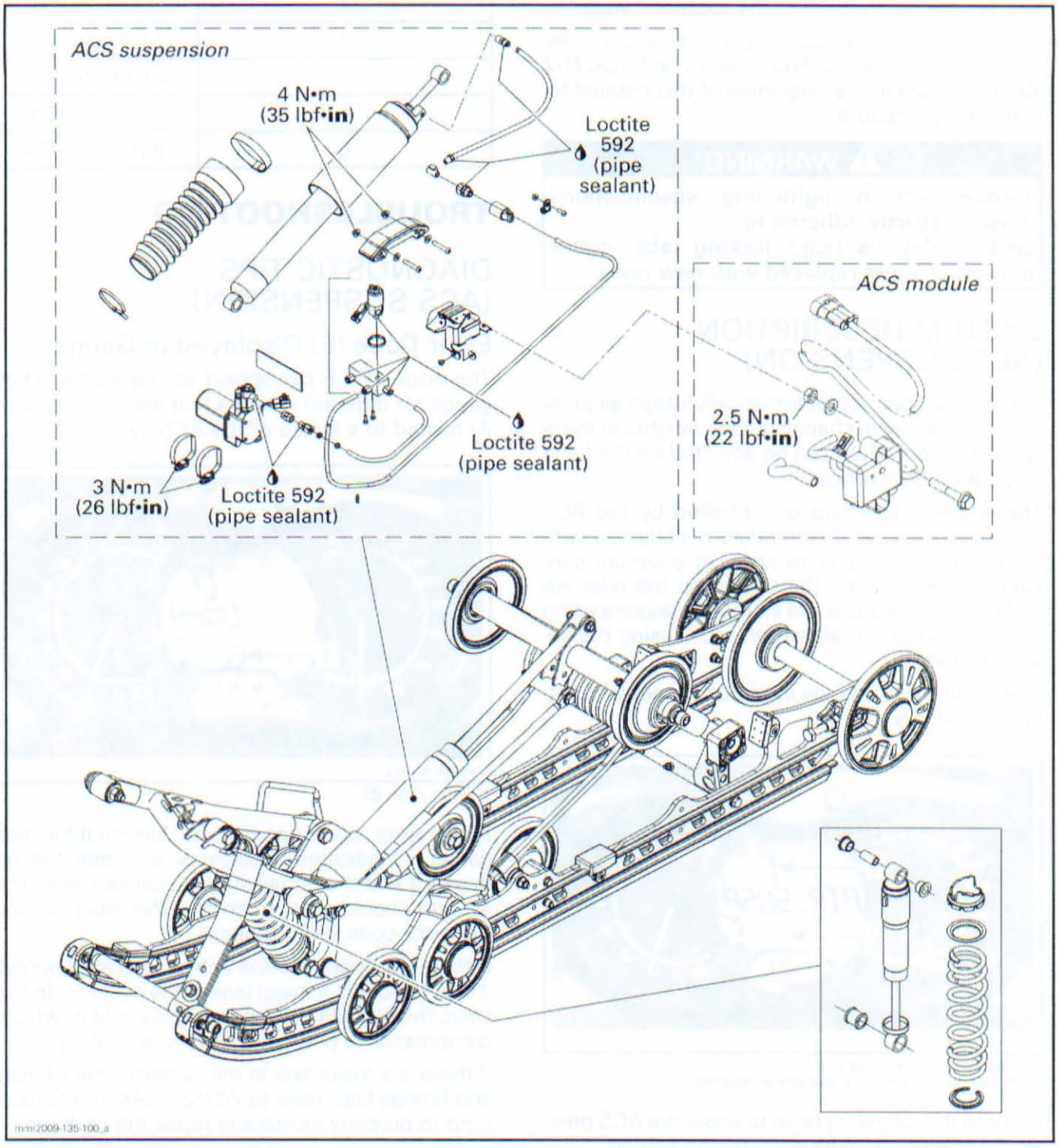
SHOCK ABSORBERS

GSX, GTX LE and MX Z



SHOCK ABSORBERS

GTX SE



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

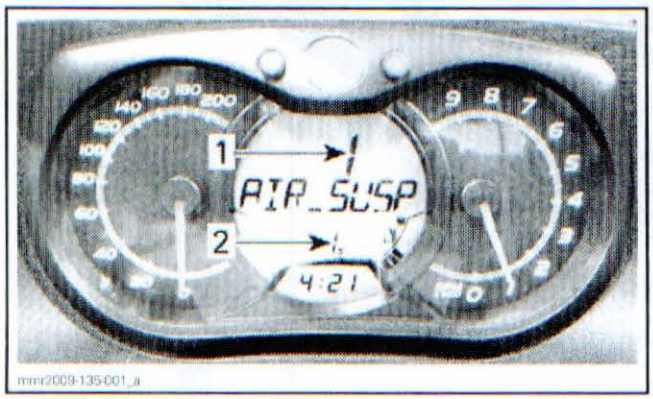
Torque wrench tightening specifications must be strictly adhered to.
Locking devices (e.g.: locking tabs, cotter pins, etc.) must replaced with new ones.

SYSTEM DESCRIPTION (ACS SUSPENSION)

The ACS suspension automatically keeps air pressure constant with changing rider weights or loads applied. The system can be adjusted on the fly to suit rider's preferences.

The requested setting is controlled by the ACS electronic module. The module is equipped with a pressure transducer to keep air pressure constant in the system. Depending on the rider adjustment, the module will increase pressure using the compressor or release pressure using the solenoid valve.

The multifunction gauge indicates suspension setting as follows.



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1. *Requested setting (set point)*
2. *Actual setting (pressure transducer reading)*

Refer to the following table to know the ACS pressure related to multifunction gauge setting.

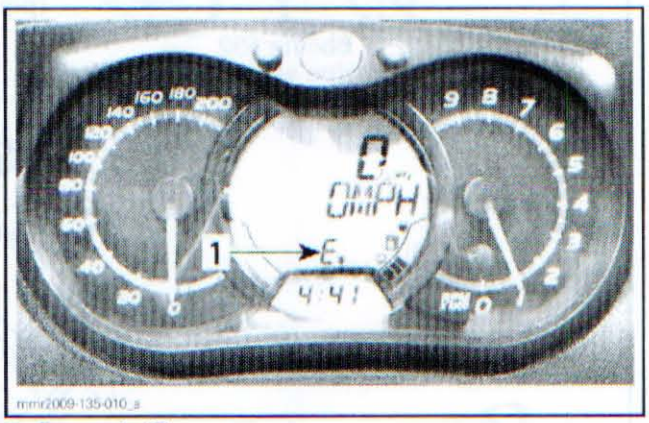
SUSPENSION MODE (MULTIFUNCTION GAUGE)	AIR SUSPENSION PRESSURE
1	1 bar (15 PSI)
2	2.8 bar (40 PSI)
3	4.5 bar (65 PSI)
4	5 bar (90 PSI)
5	8 bar (120 PSI)

TROUBLESHOOTING

DIAGNOSTIC TIPS (ACS SUSPENSION)

Error Code (E) Displayed in Gauge

The error code **E** can appear on the multifunction gauge for different reasons that are not necessarily related to a failure of the ACS system.



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1. *Error code (E)*

If the error code appears on the multifunction gauge, it indicates a disparity between the requested and the actual suspension settings. The system should react to correct this situation and the error code will disappear.

If the error code remains active for a long period, it may indicates a major leak in the system. In this case, the module will automatically shut down the compressor to prevent it from overheating.

If there is a major leak in the system, check hoses and fittings first, refer to *HOSE LEAK TEST* procedure to properly locate and repair the problem.

If no leak is detected from hoses or fittings, inspect the compressor check valve, refer to *COMPRESSOR CHECK VALVE LEAK TEST*.

Error Code (E) Displayed and Suspension Setting Can Not Be Adjusted

If no leak is found, it is probably an electrical problem. In this case, an electrical failure of the compressor or the solenoid valve will result the impossibility to change the actual suspension setting.

After multiple attempts to change suspension setting, the module will activate error code **E**. Refer to *TESTING SEQUENCE* for further troubleshooting procedure.

TESTING SEQUENCE (ACS SUSPENSION)

Suspension Setting Can Not Be Changed

1. Check ACS module signal continuity.
2. Check ACS module input voltage.
3. Check ACS module ground.

Refer to *ACS MODULE* to see the complete testing procedures.

Suspension Setting Can Be Changed to Decrease Pressure Only

1. Check ACS compressor operation.
2. Check ACS compressor input voltage.

Refer to *ACS COMPRESSOR* to see the complete testing procedures.

Suspension Setting Can Be Changed To Increase Pressure Only

1. Check ACS solenoid valve operation.
2. Check ACS solenoid valve input voltage.

Refer to *ACS SOLENOID VALVE* to see the complete testing procedures.

Requested Setting Display Does Not Changed in Gauge

Check the heat selector switch as detailed in *HEATED THROTTLE LEVER* in the *LIGHTS GAUGE AND ACCESSORIES* subsection.

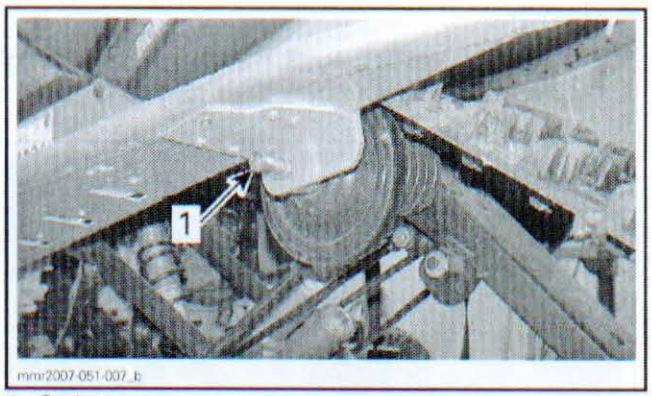
PROCEDURES

NOTE: Many parts can be changed with rear suspension in place. When specified, refer to *SUSPENSION ASSEMBLY* to remove rear suspension from vehicle.

SUSPENSION ASSEMBLY

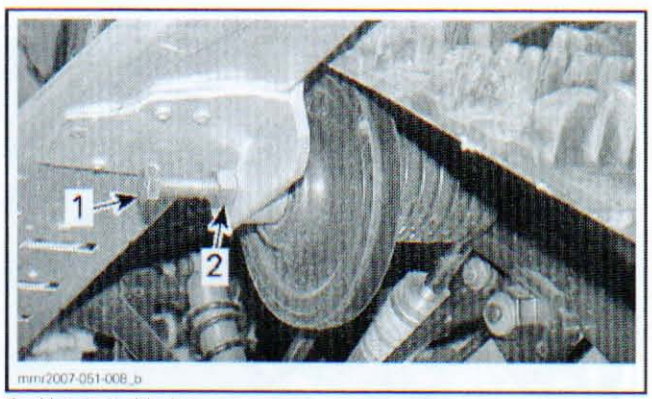
Suspension Assembly Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension.
3. Remove and discard rear arm bolts from chassis. Use the following procedure to remove bolts easily.
   - 3.1 Unscrew one of the socket screws securing the rear arm to frame.



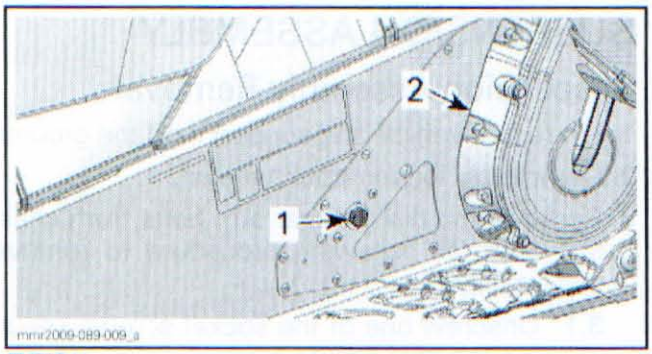
1. Socket screw

   - 3.2 Replace this socket screw with an hexagonal bolt (longer than socket screw) and a nut.
   - 3.3 Screw in the hexagonal bolt by approximately 7 turns.
   - 3.4 Hold the hexagonal bolt and tighten locking nut.



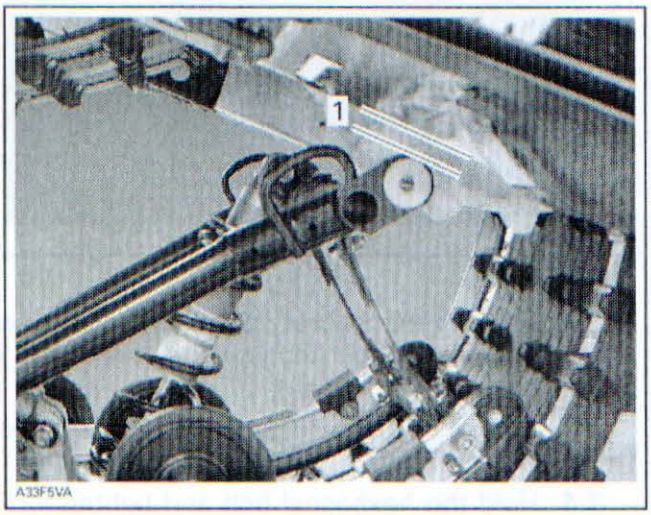
1. Hexagonal bolt
2. Locking nut

   - 3.5 Unscrew the socket screw on the other side then unlock nut and remove the hexagonal bolt.
4. Remove bolts retaining front arm to tunnel.

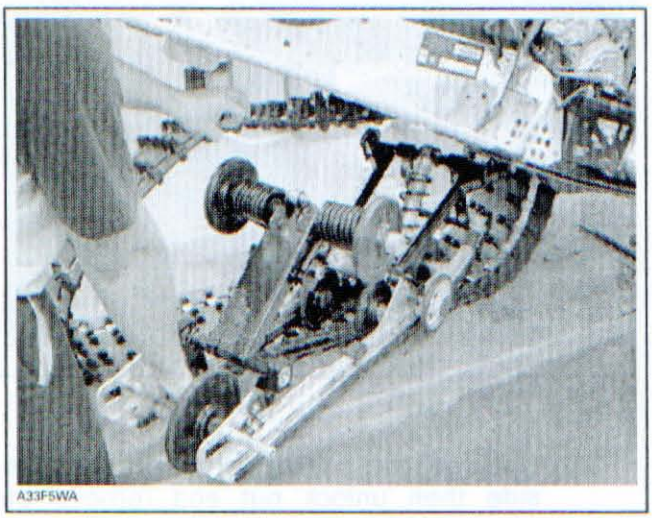


TYPICAL
1. *Front arm bolt*
2. *Chaincase*

5. Lift rear of vehicle until front arm as enough clearance to pass underneath tunnel.



TYPICAL
1. *Enough clearance*



TYPICAL — REMOVE SUSPENSION

Suspension Assembly Installation

Installation is the reverse of removal procedure. Pay attention to the following details.

1. Inspect track thoroughly before reinstalling suspension. Refer to *TRACK* subsection.
2. Install suspension into track with front portion first.
3. Install front arm bolts.
4. Torque them to 48 N•m (35 lbf•ft).
5. Install **NEW** rear arm bolts and tighten them.

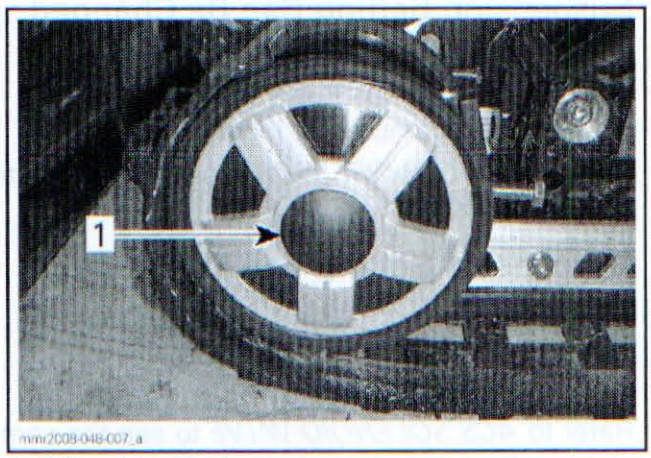
REAR ARM BOLTS TIGHTENING	
GSX, GTX and MX Z	85 N•m (63 lbf•ft)

6. Adjust track tension.

REAR AXLE

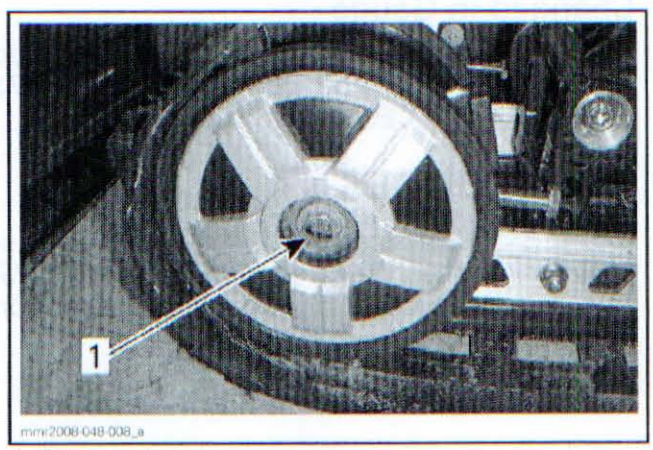
Rear Axle Removal

1. Lift rear of vehicle and support it off the ground.
2. Remove rear idler wheel caps.



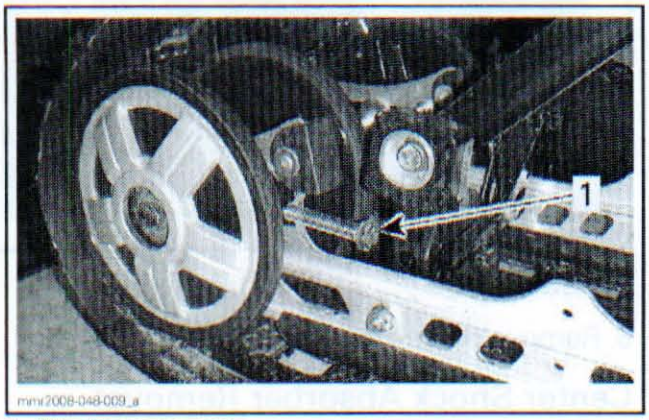
1. RH rear idler wheel cap

3. Loosen rear axle screws (one each side).



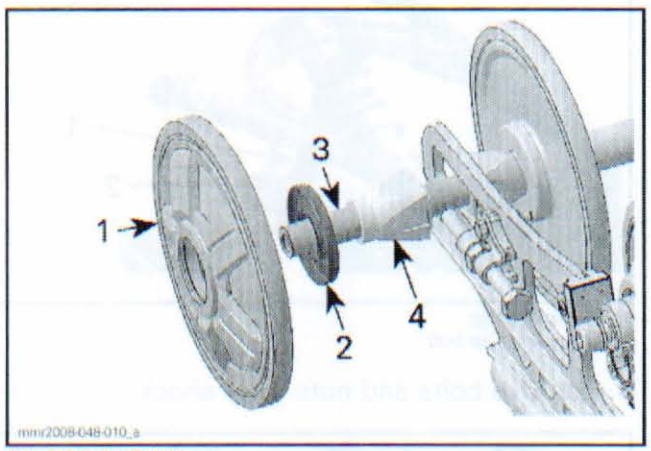
1. RH rear axle screw

4. Completely loosen track tension by unscrewing both adjustment screws.



1. RH adjustment screw

5. Remove both rear axle screws.
6. Remove rear idler wheels, seals and wheel spacers.



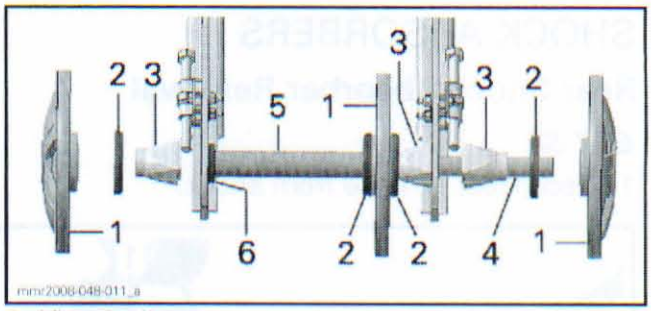
RH SIDE SHOWN
1. Rear idler wheel
2. Seal
3. Rear axle
4. Wheel spacer

7. Pull out the rear axle.

Rear Axle Installation

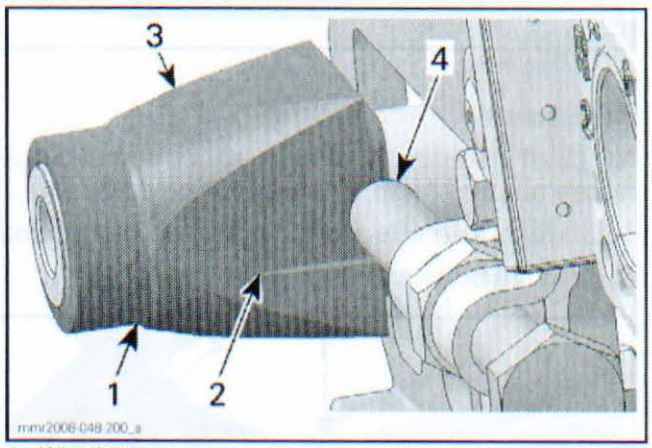
The installation is the reverse of removal procedure. However, pay attention to the following.

1. Make sure to position all parts correctly.



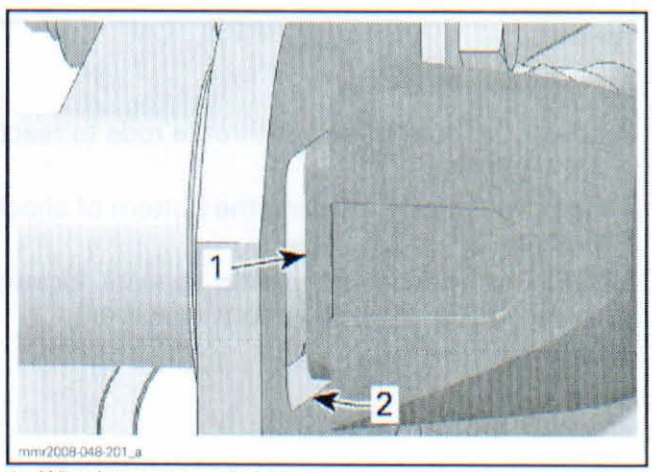
1. Idler wheels
2. Seals
3. Wheel spacers
4. Rear axle
5. Rear axle spacer
6. Washer

2. Position wheel spacers with a flat side up and a groove in front of tensioner screw.



1. Wheel spacer
2. Groove
3. Flat side
4. Tensioner screw

NOTE: When tightening rear axle, make sure each wheel spacer protuberance is engaged into runner slot.



1. Wheel spacer protuberance
2. Runner slot

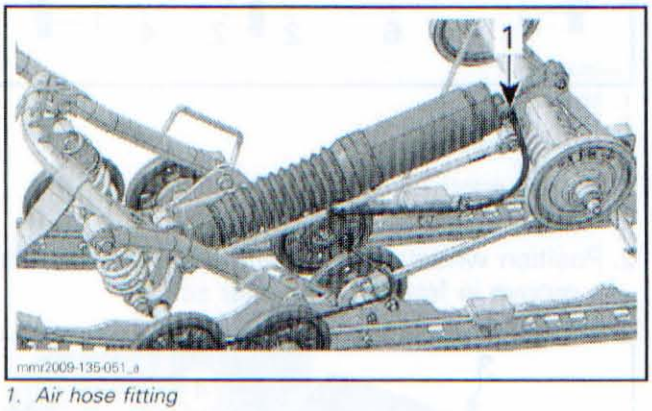
3. Adjust track tension. Refer to *TRACK* subsection.

SHOCK ABSORBERS

Rear Shock Absorber Removal

GTX SE

1. Disconnect air hose from shock.

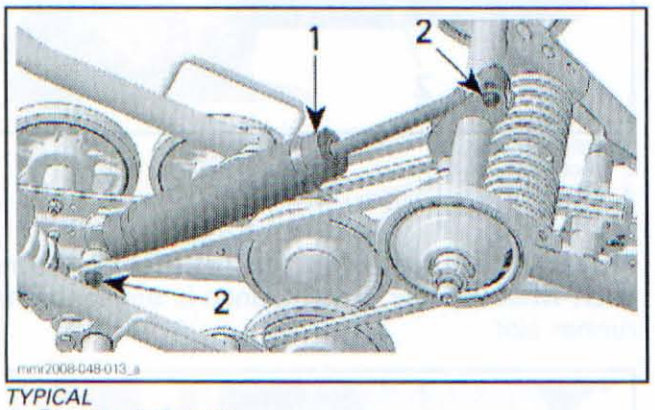


1. Air hose fitting

All Models

NOTE: If necessary, to ease shock removal, unfasten stopper strap to release shock pressure.

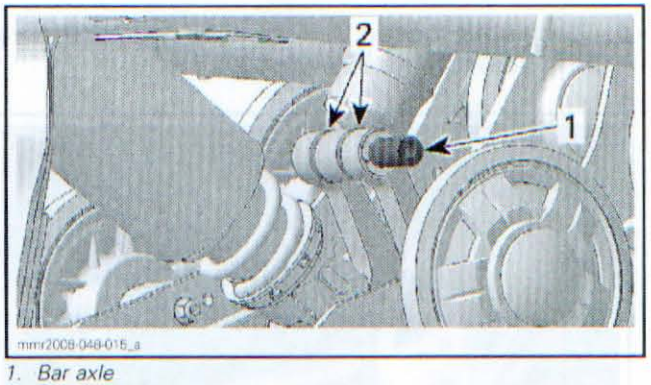
1. Lift rear of vehicle and support it off the ground.
2. Remove bolts and nuts from shock.



TYPICAL
1. Rear shock absorber
2. Remove bolts and nuts

3. Lower the bottom end of throttle rods to reach the bar axle.
4. Remove bar axle retaining the bottom of shock absorber.

NOTE: Pay attention to plastic spacers located between rocker arms and shock absorber.

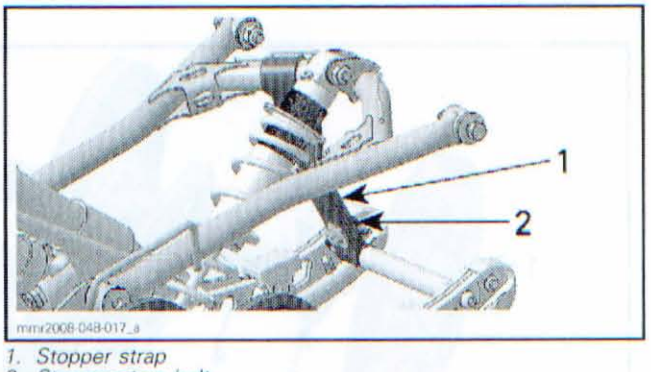


1. Bar axle
2. Plastic spacers

5. Remove rear shock absorber.

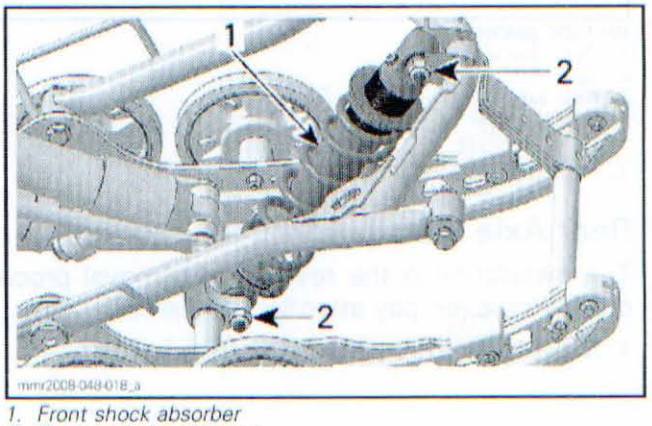
Center Shock Absorber Removal

1. Lift the rear of vehicle and support it off the ground.
2. Unfasten stopper strap.



1. Stopper strap
2. Stopper strap bolt

3. Remove bolts and nuts from shock.



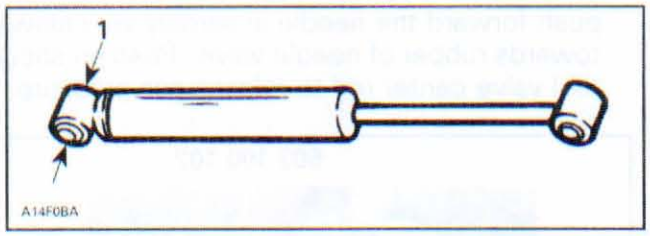
1. Front shock absorber
2. Remove bolts and nuts

Shock Absorber Inspection

Hydraulic Shock

1. Secure the shock body end in a vise with its rod upward.

NOTICE Do not clamp directly on shock body.



1. Clamp

2. Examine shock for leaks. Extend and compress the piston at least 5 complete strokes with its rod upward.
3. After, check that shock moves smoothly and with uniform resistance over its entire stroke.

NOTE: For the first 5 complete strokes, it could be normal to note uneven resistance.

4. Check the following conditions that will denote a defective shock:
   - A skip or a hang back when reversing stroke at mid travel.
   - Seizing or binding condition except at extreme end of either stroke.
   - Oil leakage.
   - A gurgling noise, after completing one full compression and extension strokes.
5. If suspecting a shock is freezing, place shock in a freezer (temperature below 0°C (32°F)) for 4 hours.
6. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
7. Renew if any faults are present.

Gas Shock Except Variable Rate

1. Because of gas pressure, strong resistance is felt when compressing shock.
2. To inspect shock operation, or if suspecting an internal leak between oil chamber and gas chamber, check shock as follows:
3. Install shock in a vise clamping on its bottom eyelet with its rod upward. Verify the compression stroke when the rod is fully extended.
4. Completely push down the shock rod then release.
5. The shock should extend unassisted. Rod must come out at a steady speed. If speed suddenly increases particularly at end of extension, replace shock.
6. If suspecting a shock is freezing, place shock in a freezer (temperature below 0°C (32°F)) for 4 hours.
7. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
8. Renew if any faults are present.

Variable Rate Gas Shock

1. Because of gas pressure, strong resistance is felt when compressing shock.
2. To inspect shock operation, or if suspecting an internal leak between oil chamber and gas chamber, check shock as follows:
3. Install shock in a vise clamping on its bottom eyelet with its rod upward. Verify the compression stroke when the rod is fully extended.
4. Push down the shock rod. The feeling should be stiff for around the first 25 mm (1 in), then softer from 25 mm to 50 mm (1 in to 2 in) and stiffer again after that. This stiff/soft/stiff phenomenon shows the normal operation of shock.
5. When released, the shock should extend unassisted. The rod speed coming out will go slow - faster and slow again due to the VR zone.
6. If suspecting a shock is freezing, place shock in a freezer (temperature below 0°C (32°F)) for 4 hours.
7. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
8. Renew if any faults are present.

HPG T/A Shock

1. Because of gas pressure, strong resistance is felt when compressing shock.
2. To inspect shock operation, or if suspecting an internal leak between oil chamber and gas chamber, check shock as follows:
3. Install shock in a vise clamping on its bottom eyelet with its rod upward. Verify the compression stroke when the rod is fully extended.
4. Completely push down the shock rod then release.
5. The shock should extend unassisted. Rod must come out at a steady speed. If speed suddenly increases particularly at end of extension, replace shock.
6. If suspecting a shock is freezing, place shock in a freezer (temperature below 0°C (32°F)) for 4 hours.

7. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
8. Repair or replace if any faults are present.

Shock Absorber Rebuilt Procedure (HPG T/A)

There are two types of high pressure gas take apart (HPG T/A) shock. One type has a tire valve and the other has a needle valve.

SHOCK TYPE	INFLATION TOOL
Tire valve type	529 035 570
Needle valve type	503 190 102

HPG T/A shocks come in two sizes. C-36 shock is 36 mm (1.417 in) in diameter and C-46 shock is 46 mm (1.811 in).

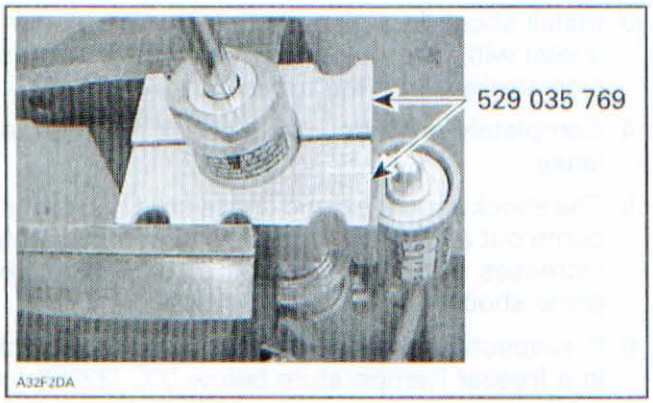
SHOCK SIZE	SERVICING TOOL	P/N
C-36	Piston guide	529 026 600
	Seal guide	529 026 500
	Shock wrench	529 035 727
C-46	Piston guide	529 035 608
	Seal guide	529 035 728
	Shock wrench	529 035 727

1. Release nitrogen (N) pressure on any HPG T/A shock with internal floating piston (IFP).

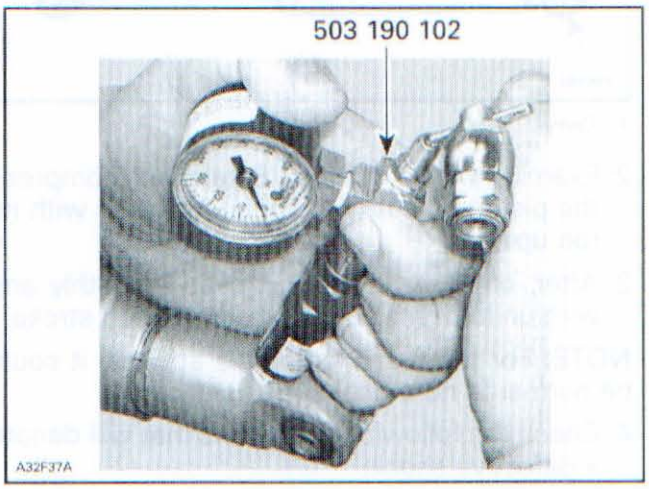
⚠ WARNING

Nitrogen gas is under extreme pressure. Use caution when releasing this gas volume. Protective eye wear should be used.

2. Mount shock in a vise with the SHOCK RETAINER TOOL (P/N 529 035 769).



3. Remove screw on top of valve. Place the needle guide of GAS FILL TOOL KIT (P/N 503 190 102) on the shock valve. Press the detent pin and push forward the needle assembly very slowly towards rubber of needle valve. Push on shock tool valve center rod to release gas pressure.



4. Remove tool from shock.

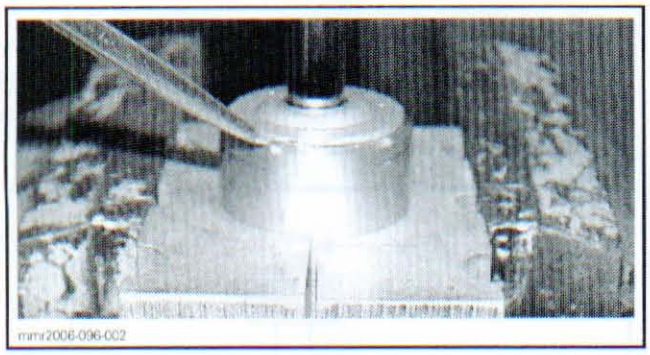
Screw Cap Type HPG T/A Shock

5. Using the SHOCK WRENCH (P/N 529 035 727), unscrew seal carrier.

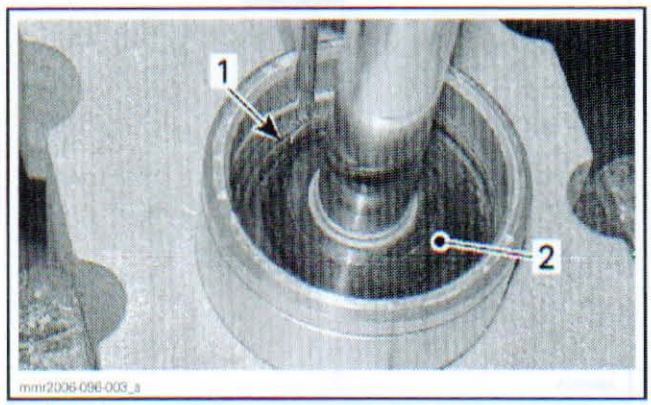
TYPICAL

Snap Ring Cap Type HPG T/A Shock

6. Using a flat tool (small screwdriver or small chisel), pop-out the cap.



7. Compress the carrier to access and using a pick, remove the snap ring.

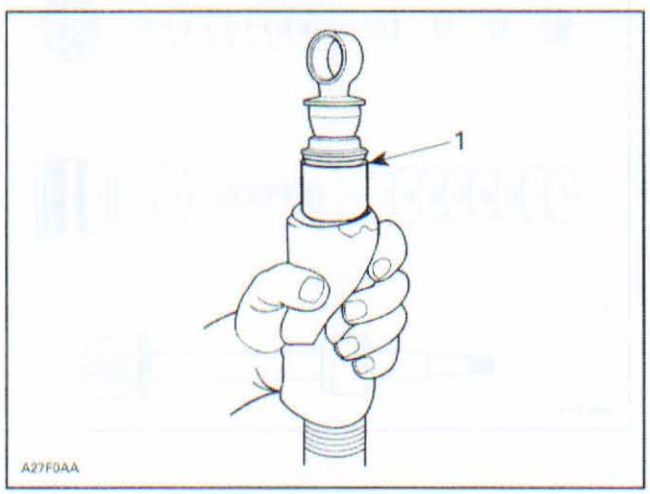


1. Snap ring
2. Carrier

All HPG T/A Shocks

8. With the seal carrier removed, slowly lift and remove damper rod assembly from the damper body.

NOTE: Remove damper rod assembly slowly to reduce oil spillage and prevent piston seal damage by damper body threads. Wrap the damper body with a shop cloth to capture possible overflow oil while removing the damper piston.

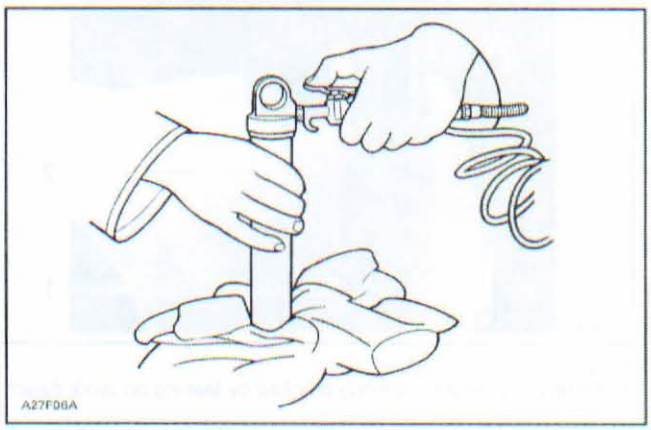


1. Oil flows

9. Discard old oil into storage container. Never reuse damper oil during shock rebuild.

HPG T/A Shock without Remote Reservoir

10. Remove valve core.
11. Place shock absorber in a position where opened extremity is blocked.
12. Using compressed air pressure, carefully remove floating piston from damper body. Hold shop cloth over damper body opening to catch released floating piston. Allow room for floating piston to leave damper body.



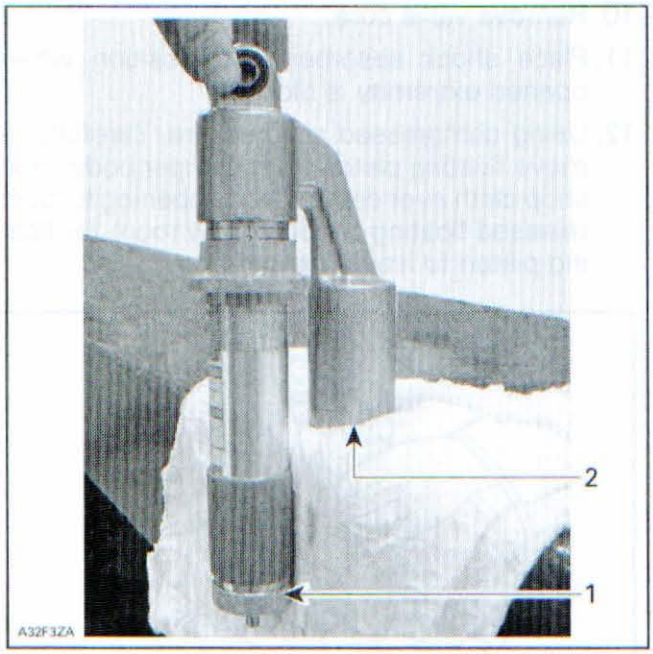
TYPICAL

HPG T/A Shock with Remote Reservoir

13. Install the FLOATING PISTON PULLER (P/N 529 035 907) on shock absorber, as shown below.

1. Floating piston remover tool

14. Place shock absorber in a position where remote gas reservoir opened extremity is blocked. Refer to following photo.



1. Tool
2. Reservoir opened extremity blocked by leaning on work bench

15. With the VACUUM PRESSURE PUMP (P/N 529 021 800), pressurize shock absorber until remote reservoir piston pops-out.

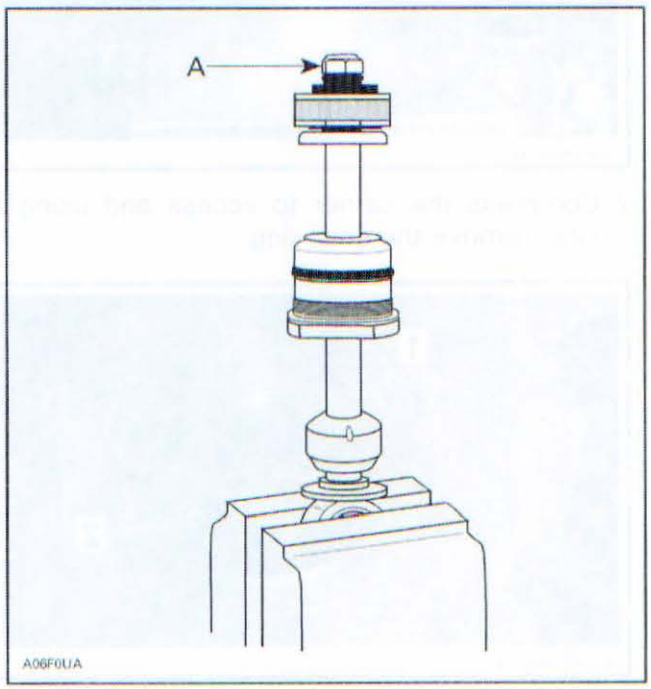
NOTE: Use towels to prevent damaging remote reservoir piston when it pops-out.

16. Thoroughly clean, with a typical cleaning solution, and blow dry using low pressure air. Carefully inspect the damper body for any imperfections or signs of wear in the damper bore.

17. Replace damper body if wear is identified.

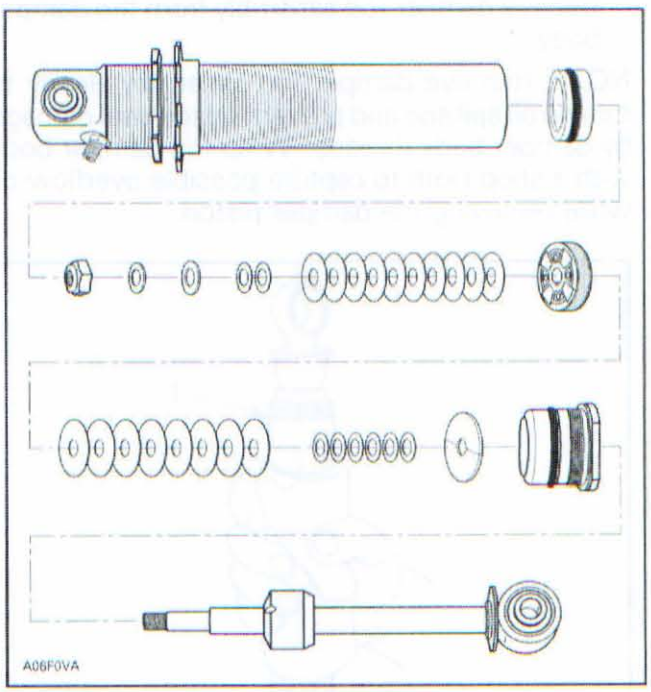
All HPG T/A Shocks

18. Holding the damper rod assembly in a bench vise by the eyelet section, begin piston and valve removal.



A. Remove damper rod nut

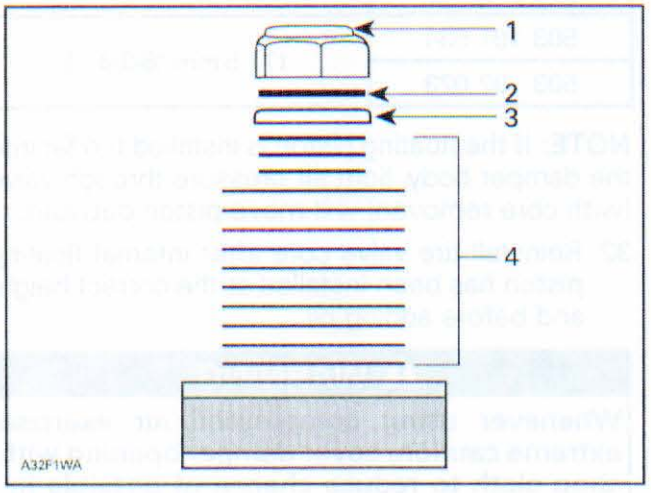
19. Always arrange parts removed in the sequence of disassembly.



20. If revalving is to be done, it is imperative that you identify the original shim pack (size and number of shims). There is no need to remove seal carrier if only revalving is to be done.
21. Shims can be measured by using a vernier caliper or a micrometer.

NOTE: All shims should be carefully inspected and any bent or broken shims must be replaced for the shock to function properly.

22. After the new or replacement shim pack has been selected, reassemble in the reverse order of disassembly. Torque damper rod nut to 18 N•m (159 lbf•**in**).



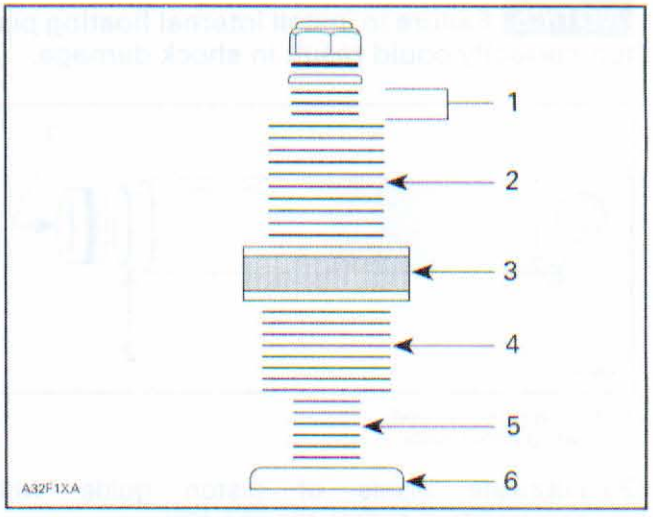
1. Damper rod nut
2. Spacer
3. Stopper with its round edge facing nut
4. Shim pack

23. As a general rule, we suggest replacing the damper rod nut after 4 rebuilds to ensure proper locking friction and the use of LOCTITE 271 (RED) (P/N 293 800 005) each time.

NOTICE Do not substitute the damper rod nut for non - O.E.M.

24. This (these) spacer washer(s) must be used as shown to ensure damper rod nut does not bottom out or contact shaft threads.
25. Rebound valve stopper with round edge facing nut.

NOTE: Rebound shim stack must not reach into threads of damper rod. Spacer under damper rod nut is used to prevent damper rod nut from bottoming on threads.

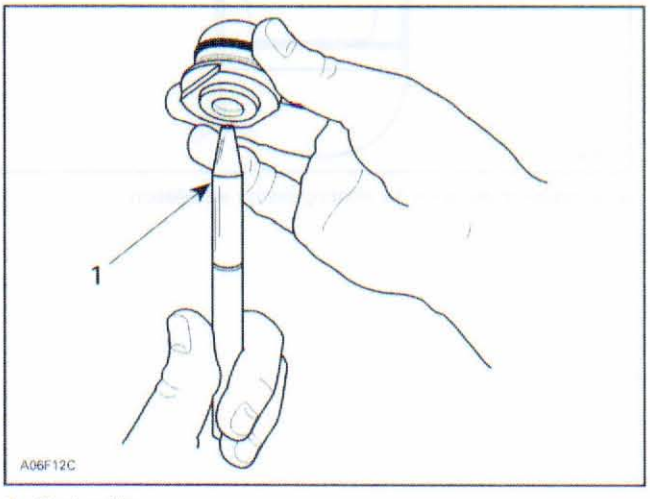


1. Rebound dampening shim pack
2. Rebound dampening shim pack
3. Piston
4. Compression dampening shim pack
5. Compression dampening shim pack
6. Stopper

26. If the seal carrier assembly is replaced, use seal pilot to guide seal over damper rod. Lubricate seal carrier guide pilot before use.

NOTICE Failure to use seal pilot will result in seal damage.

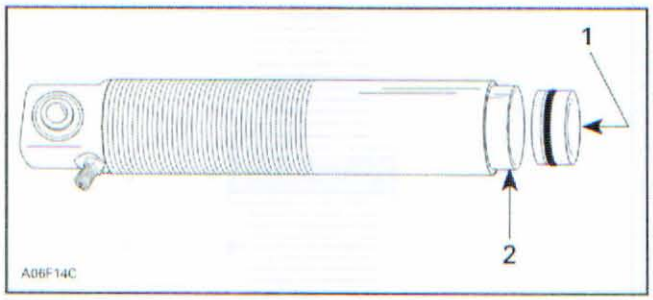
27. Reassemble damper rod assembly, taking care to properly assemble shim packs as required for your dampening needs. Ensure that the shaft piston is installed with the slits/larger intake holes facing the rebound shim stack.



1. Seal guide

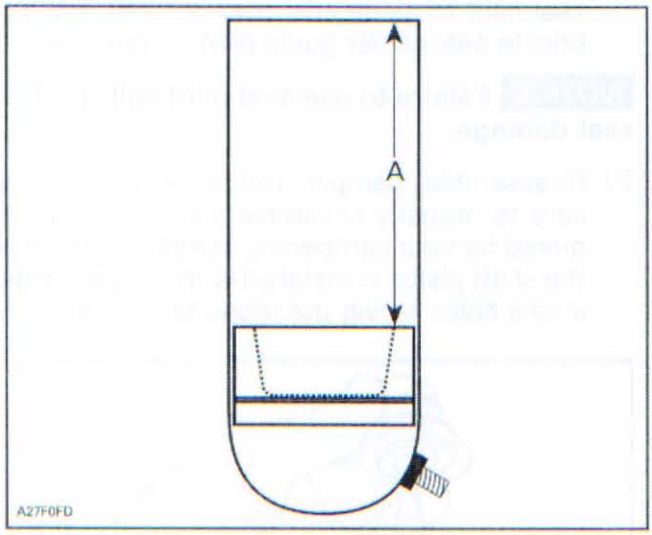
28. If internal floating piston has been removed, reinstall it into damper body (ensure that valve core has been removed). Use MOLYKOTE G-N (P/N 420 297 433) to ease O-ring past damper body threads with floating piston guide.

NOTICE Failure to install internal floating piston correctly could result in shock damage.



1. Push (slowly) by hand
2. Floating piston guide

29. Lubricate inside of piston guide with MOLYKOTE G-N (P/N 420 297 433).
30. Install floating piston to the proper depth refer to following the table.
31. On all HPG T/A shocks, the floating piston is installed hollow side up.



A. Installation distance for floating piston installation

SHOCK P/N	INSTALLATION DISTANCE OF FLOATING PISTON
503 192 024	54.5 mm (2-9/64 in)
503 192 025	
503 191 532	119.5 mm (4-11/16 in)
503 191 791	
503 191 797	
503 192 035	
503 192 678	164 mm (6-15/32 in)
505 071 991	167 mm (6-9/16 in)
505 072 232	
503 191 534	171.5 mm (6-3/4 in)
503 192 023	

NOTE: If the floating piston is installed too far into the damper body, light air pressure through valve (with core removed) will move piston outward.

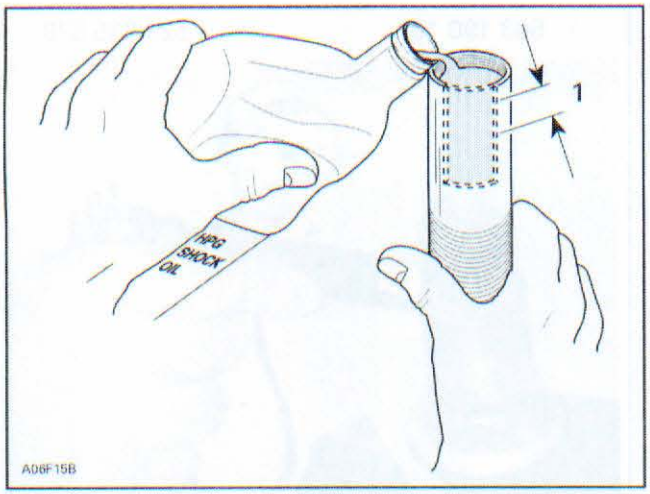
32. Reinstall tire valve core after internal floating piston has been installed at the correct height and before adding oil.

⚠ WARNING

Whenever using compressed air exercise extreme caution, cover damper opening with shop cloth to reduce chance of possible injury.

NOTICE Moisture laden compressed air will contaminate the gas chamber and rust floating piston.

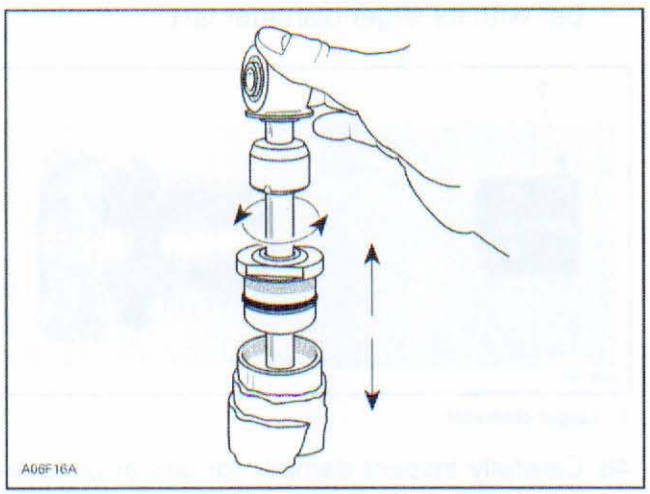
33. Fill the shock with SHOCK ABSORBER OIL (P/N 293 600 035) to approximately 10 mm (3/8 in), from the base of seal carrier threads.



1. Fill to 10 mm (3/8 in)

NOTE: Although we do not measure the exact amount of oil added to the damper, approximately 252 ml (8.52 U.S. oz) will be used.

34. Carefully insert damper rod into the damper body. Lightly oil damper piston seal ring with shock oil to ease installation.



NOTE: Some shock oil will overflow when installing damper. Wrap damper with shop cloth to catch possible overflow oil.

NOTICE Use care when passing piston into damper body at damper body threads.

35. Slight oscillation of damper rod may be required to allow piston to enter damper body bore.
36. Slowly push piston into damper body. Slight up and down movement may be required on short stroke to allow all air to pass through piston assembly. The gentle tapping of a small wrench, on the shock eye, may help dislodge air trapped in the submersed piston. Be careful not to drive the shaft any deeper into the oil than is necessary to just cover the shim stack.

NOTE: Fast installation of the damper rod may displace the floating piston from its original position. This must not occur if the damper is expected to perform as designed.

37. With damper rod piston into oil, TOP OFF damper oil volume. Oil level should be to damper body thread base.

Screw Cap Type HPG T/A Shock

38. Seal carrier assembly can now be threaded into damper body. This should be done slowly to allow weapage of oil and to minimize internal floating piston displacement. Torque seal carrier to 65 N•m (48 lbf•ft).

NOTE: Some oil must overflow when installing the cap.

Snap Ring Cap Type HPG T/A Shock

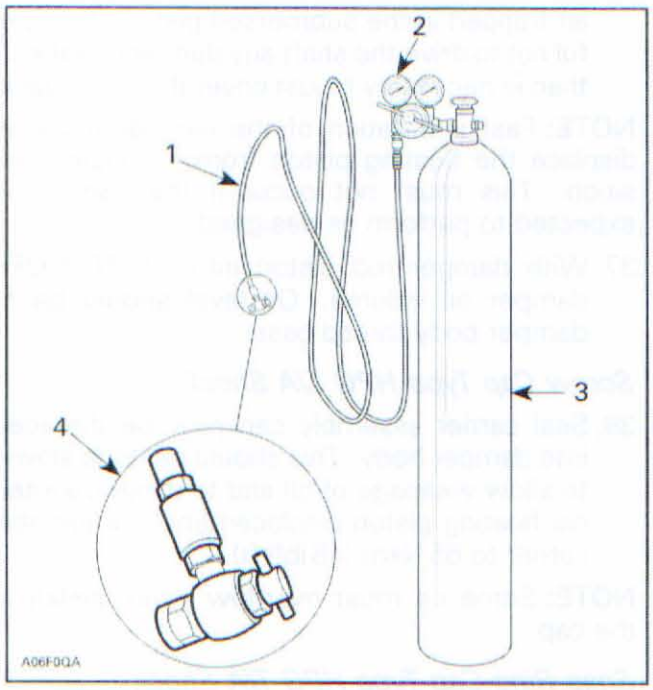
39. Seal carrier assembly can now be pushed into damper body to pass snap ring groove. Install snap ring into groove.

NOTE: Some oil must overflow when the seal carrier is pushed down.

40. Tap the cap on the shock body.

All HPG T/A Shocks

41. After the seal carrier is fully in place avoid pushing the shaft into the body until the nitrogen charge is added.
42. When removing and retightening the tire valve acorn nut use minimal torque. When the cap is over tightened and subsequently removed it may prematurely break the seal of the tire valve to the shock body and cause a loss of nitrogen charge without being noticed. If you suspect this has happened then recharge the shock as a precaution. Inspect the tire valve cap before installation to ensure that the internal rubber gasket is in its proper position.
43. Nitrogen (N) can now be added to damper body.



1. *High pressure hose*
2. *Stage regulator, delivery pressure range 2070 kPa (300 PSI)*
3. *High pressure cylinder filled with industrial grade nitrogen*
4. *Valve tip permanently installed*

NOTE: Never substitute another gas for nitrogen. Nitrogen has been selected for its inert qualities and will not contaminate the gas chamber of the shock.

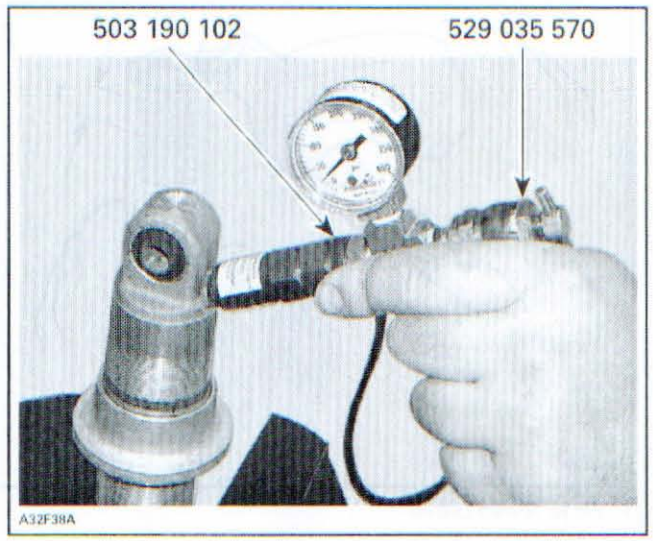
44. Preset your pressure regulator to 2070 kPa (300 PSI) nitrogen (N), this gas pressure will restore the correct pressure for your damper.

NOTICE **Do not exceed the recommended pressure values.**

⚠ WARNING

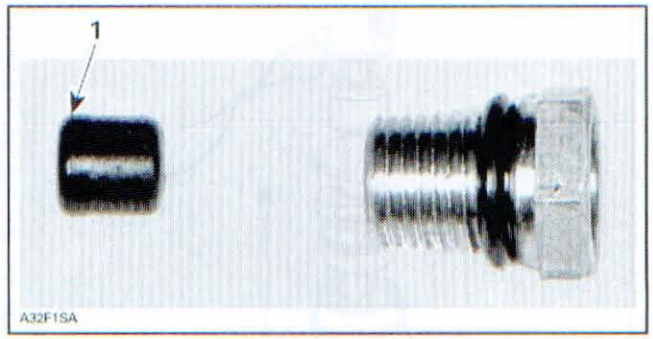
Whenever working with high pressure gas, use eye wear protection. Never direct gas pressure toward anybody.

45. Install the GAS FILL TOOL KIT (P/N 503 190 102) on GAS SHOCK VALVE TOOL (TIRE VALVE TYPE) (P/N 529 035 570). Set the regulator pressure on the nitrogen cylinder as per the shock requirement.
46. Mount the shock on vise. Remove screw on top of valve. Place the needle guide of gas refill tool on the shock valve. While depressing the detent pin of the gas refill tool and pushing forward the needle assembly, insert the needle through the rubber core of the pressure valve assembly of the shock.



NOTE: For replacement of the needle or filling the shock, carefully follow the instructions provided with the GAS FILL TOOL KIT (P/N 503 190 102).

47. On some models, rubber may pop out of needle valve when inserting tool needle. If so, remove valve core and rubber then, reinstall rubber with its larger diameter last.



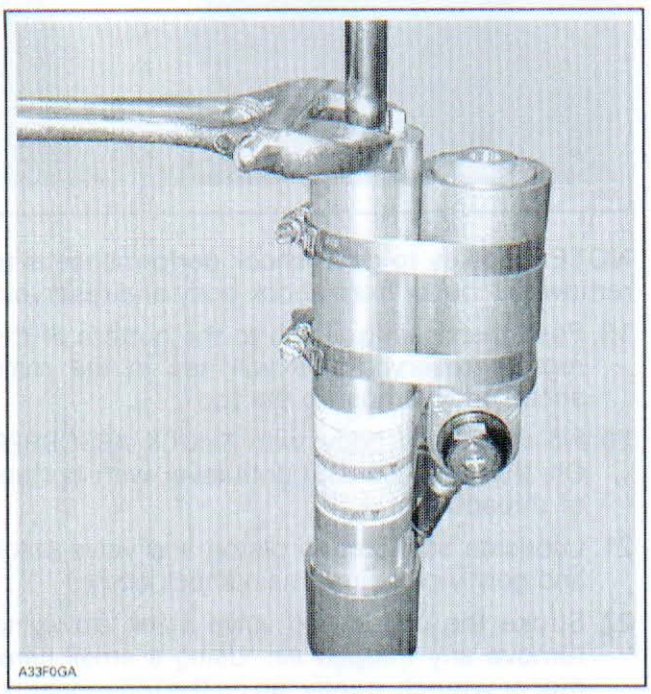
1. *Larger diameter*

48. Carefully inspect damper for gas or oil leaks. Any leaks must be corrected before continuing. If no leak is detected, install the screw on top of the valve and clean the shock with the PULLEY FLANGE CLEANER (P/N 413 711 809).
49. Damper gas pressure cannot be confirmed by using a pressure gauge. The volume of gas in the shock is very small, and the amount lost during gauge installation will lower the pressure too much and require refilling.
50. After recharging is complete the rebuilt shock should be bench-tested. Stroke the shock to ensure full travel and smooth compression and rebound action. If the shaft moves in or out erratically this could indicate too much air is trapped inside. If the shaft will not move or has partial travel then it may be hydraulically locked. In either event the shock must be

rebuilt again. Pay particular attention to the placement of the IFP, quantity of oil and shim stack/piston assembly.

Shock Absorber Rebuilt Procedure (HPG T/A Racing Clicker)

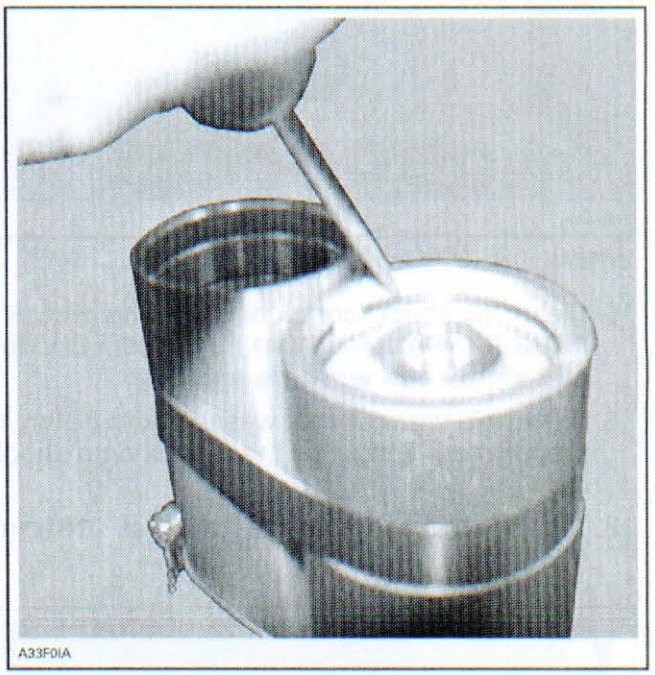
1. Tightly secure the shock base in vise. DO NOT CLAMP ONTO SHOCK BODY.
2. Using a 12 mm wrench, slowly remove air inlet valve, allowing the gas inside the reservoir to escape.
3. Remove top shock cover using a 36 mm wrench.


A33F0GA

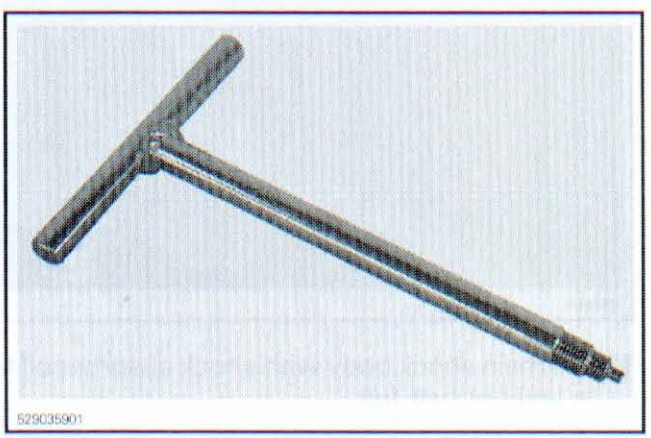
4. Pull shock rod out of main shock body.
5. Drain oil from the shock body. Dispose of used oil properly.

A33F0MA

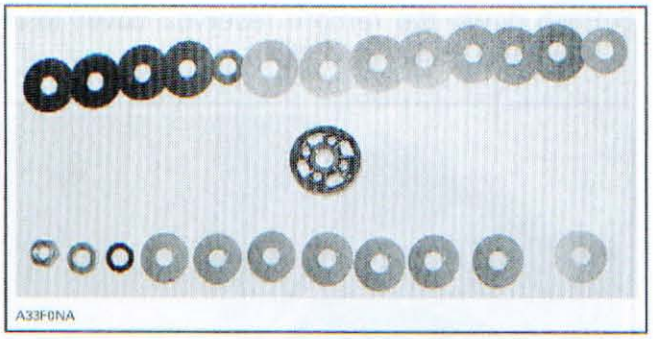
6. Push down the remote reservoir cover to remove the retaining circlip.


A33F0IA

7. Using the FLOATING PISTON PULLER (P/N 529 035 901), remove the remote reservoir cover then the floating piston inside the remote reservoir.

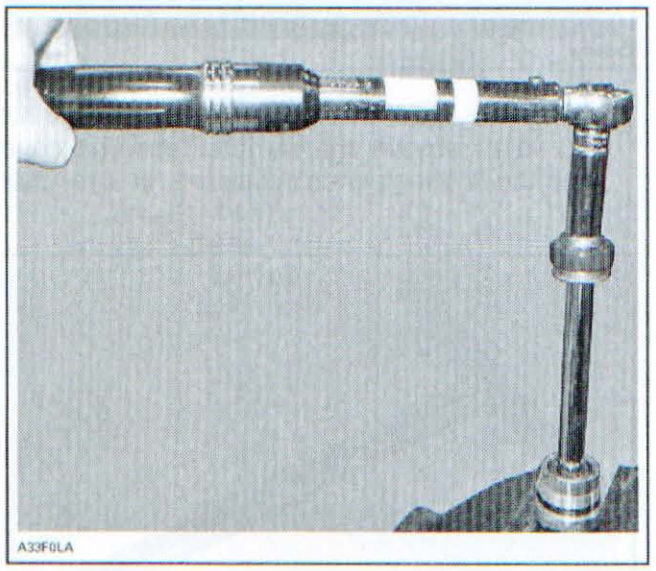

529035901

8. Using a 14 mm wrench, remove the lock nut securing shims, washers and piston to shock rod.
9. Carefully remove and layout shims, washers and piston from shock rod. Play close attention to shims and washers sequence and piston position.



TYPICAL

10. Clean all shock components using PULLEY FLANGE CLEANER (P/N 413 711 809). **Do not mix shims and washers together.**
11. Assemble valve shims, washers and piston in proper order and place them back onto shock rod.
12. Torque the shock rod nut at 18 N•m (159 lbf•**in**).



13. Fill main shock body with shock absorber oil to a level of half full.
14. Fill also remote reservoir with shock absorber oil to within 6.4 mm (1/4 in) from the top.
15. Hold the remote reservoir in a way so the oil level in the shock and the remote reservoir are at the same height.
16. Cup your hand and place it over the remote reservoir. Pump with your hand to circulate oil through the shock and reservoir to remove any trapped air. Low speed adjuster must be open 1 turn minimum.
17. Fill the remote reservoir with shock absorber oil.
18. Lubricate the O-ring on floating piston with shock oil and install it.

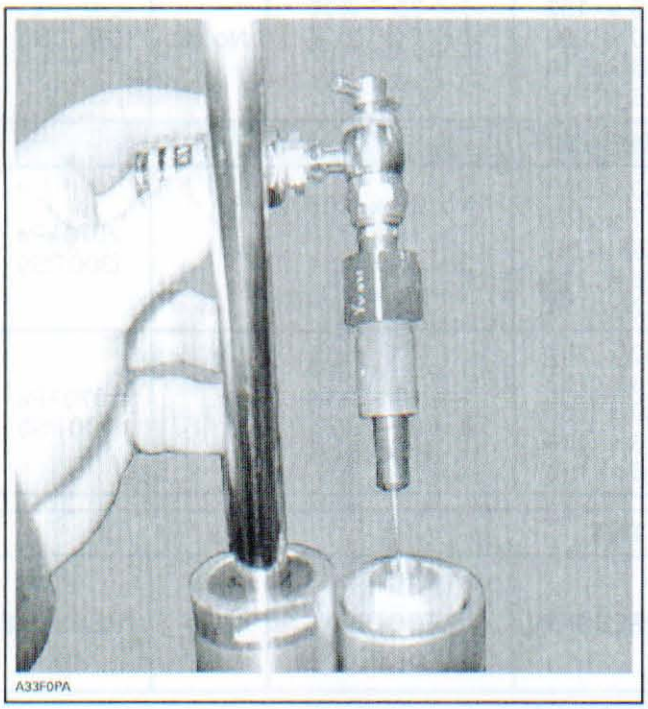
NOTE: The key to good shock performance is to remove all the air from shock body and reservoir.

19. Push the floating piston to the bottom of the remote reservoir. Oil will rise in the main shock body almost to the top.
20. Fill the shock body with SHOCK ABSORBER OIL (P/N 293 600 035) until level with bottom of threads.
21. Lubricate seal around piston and valve stack and gently push into main shock body.
22. Stroke the piston and valve stack slowly to remove any trapped air. Using a small hammer or wrench, gently tap on the rod mounting eyelet to help remove air.
23. Again, push the floating piston to the bottom of the remote reservoir.
24. Pull shock rod as far out as possible and replace the shock cover and torque to 65 N•m (48 lbf•ft). Oil must spill from the shock body before the seal cover O-ring seals the shock.
25. Lubricate the O-ring on remote reservoir cover with shock oil and install the remote reservoir cover.
26. Push down the cover and install the retaining circlip.
27. Using the FLOATING PISTON PULLER (P/N 529 035 901), pull the cover to seat it against the retaining circlip.

⚠ WARNING

Make sure the cover is firmly seated against the retaining circlip before filling with gas.

28. Install the air inlet valve.
29. Pressurize the shock at 2070 kPa (300 PSI) with nitrogen (N). Use the correct GAS FILL TOOL KIT (P/N 503 190 102).



A33F0PA

30. Carefully inspect damper for gas or oil leaks. Any leaks must be corrected before continuing. If no leak is detected, install the safety screw into the air inlet valve and clean the shock with the PULLEY FLANGE CLEANER (P/N 413 711 809).
31. After recharging is complete, the rebuilt shock should be bench-tested. Stroke the shock to ensure full travel, smooth compression and rebound action. If the damper rod moves in or out erratically this could indicate air is trapped inside. If the damper rod will not move or has partial travel then it may be hydraulically locked. In either event the shock must be taken apart.

Shock Absorber Calibration Charts (HPG T/A)

MX Z RENEGADE X						
	BRP P/N	**INSTALLATION DISTANCE OF FLOATING PISTON (IFP)**	**COMPRESSION**	**REBOUND**	**SLIT**	**PRESSURE**
FRONT SUSPENSION						
FRONT	505 072 491 (Kayaba shock)	164 mm (6-15/32 in)	3 x 30 x .203 1 x 15 x .152 3 x 30 x .203 1 x 26 x .114 1 x 16 x .152	1 x 26 x .203 1 x 15 x .114 4 x 26 x .152 1 x 16 x .203	No slit	2070 kPa (300 PSI)
REAR SUSPENSION						
CENTER	503 192 797 (C-36 Kayaba shock)	119.5 mm (4-11/16 in)	2 x 30 x .203 1 x 17 x .152 10 x 30 x .152 1 x 26 x .114 1 x 22 x .114	1 x 26 x .203 1 x 15 x .114 3 x 26 x .254 1 x 16 x .203	1	2070 kPa (300 PSI)
REAR	503 192 025 (C-46 Kayaba shock)	54.5 mm (2-9/64 in)	5 x 30 x .254 1 x 15 x .152 4 x 30 x .254 1 x 26 x .114 1 x 16 x .152	1 x 26 x .203 1 x 16 x .114 4 x 26 x .254 1 x 16 x .203	1	2070 kPa (300 PSI)

MX Z TNT						
	BRP P/N	**INSTALLATION DISTANCE OF FLOATING PISTON (IFP)**	**COMPRESSION**	**REBOUND**	**SLIT**	**PRESSURE**
FRONT SUSPENSION						
FRONT	505 071 639 (Kayaba shock)	167 mm (6-9/16 in)	3 x 30 x .203 1 x 15 x .152 3 x 30 x .203 1 x 26 x .114 1 x 16 x .152	1 x 26 x .203 1 x 15 x .114 4 x 26 x .152 1 x 16 x .203	1	2070 kPa (300 PSI)
REAR SUSPENSION						
CENTER	503 191 791 (C-36 Kayaba shock)	119.5 mm (4-11/16 in)	2 x 30 x .203 1 x 14 x .152 6 x 30 x .152 1 x 26 x .114 1 x 18 x .114	1 x 26 x .203 1 x 15 x .114 3 x 26 x .254 1 x 16 x .203	1	2070 kPa (300 PSI)
REAR	503 192 023 (C-36 Kayaba shock)	171.5 mm (6-3/4 in)	7 x 30 x .203 1 x 17 x .152 4 x 30 x .203 1 x 26 x .114 1 x 16 x .152	1 x 26 x .203 1 x 16 x .114 4 x 26 x .254 1 x 16 x .203	1	2070 kPa (300 PSI)

MX Z X						
	BRP P/N	**INSTALLATION DISTANCE OF FLOATING PISTON (IFP)**	**COMPRESSION**	**REBOUND**	**SLIT**	**PRESSURE**
FRONT SUSPENSION						
FRONT	505 072 491 (Kayaba shock)	164 mm (6-15/32 in)	3 x 30 x .203 1 x 15 x .152 3 x 30 x .203 1 x 26 x .114 1 x 16 x .152	1 x 26 x .203 1 x 15 x .114 4 x 26 x .152 1 x 16 x .203	No slit	2070 kPa (300 PSI)
REAR SUSPENSION						
CENTER	503 191 791 (C-36 Kayaba shock)	119.5 mm (4-11/16 in)	2 x 30 x .203 1 x 14 x .152 6 x 30 x .152 1 x 26 x .114 1 x 18 x .114	1 x 26 x .203 1 x 15 x .114 3 x 26 x .254 1 x 16 x .203	1	2070 kPa (300 PSI)
REAR	503 192 024 (C-46 Kayaba shock)	54.5 mm (2-9/64 in)	3 x 30 x .203 1 x 30 x .152 1 x 15 x .152 2 x 30 x .203 1 x 30 x .152 1 x 26 x .114 1 x 16 x .152	1 x 26 x .203 1 x 16 x .114 5 x 26 x .254 1 x 16 x .203	1	2070 kPa (300 PSI)

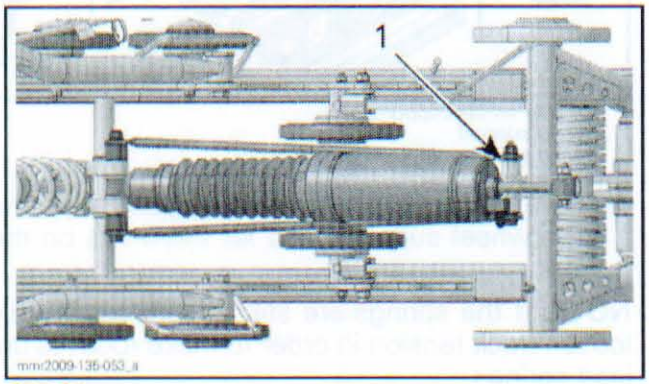
Rear Shock Absorber Installation

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

To ease shock installation, secure upper side of shock first.

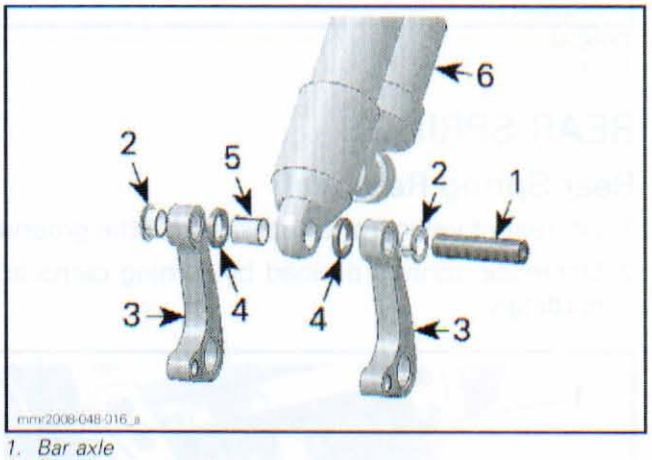
For GTX SE models:

- Connect air hose on shock.
- Do not install shims between rear arm and throttle rods (upper shock fixation).
- Install shims on lower throttle rods fixation.



GTX SE
1. No shims here

NOTE: If the shock absorber has a remote reservoir, make sure to install the shock so that reservoir is facing down.

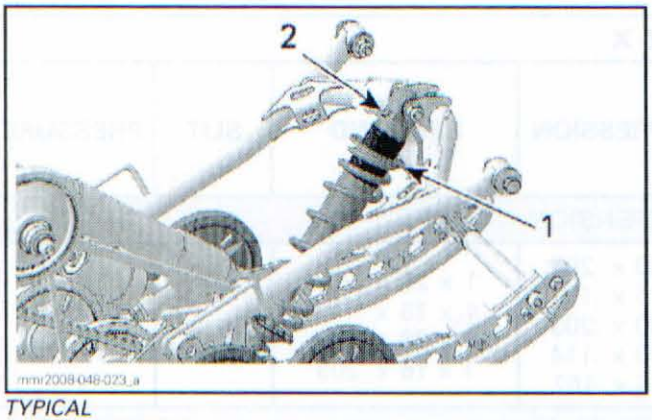


1. Bar axle
2. Bushings
3. Rocker arms
4. Plastic spacers
5. Inner sleeve
6. Reservoir position

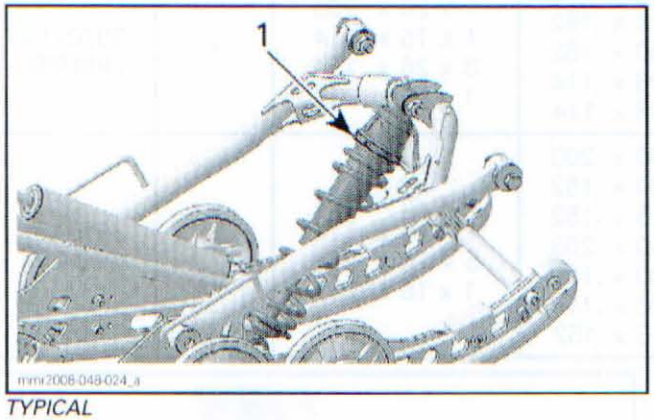
Center Shock Absorber Installation

Installation is reverse of removal procedure. Pay attention to the following details.

1. Position the adjustment ring or the cam upwards and the valve towards the tunnel.



TYPICAL
1. *Adjustment ring*
2. *Valve*

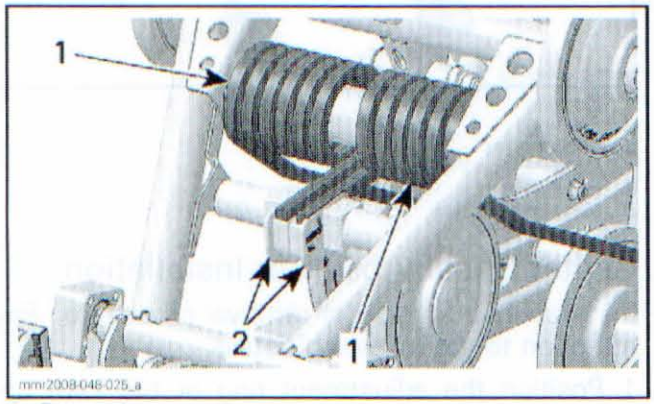


TYPICAL
1. *Cam*

REAR SPRINGS

Rear Spring Removal

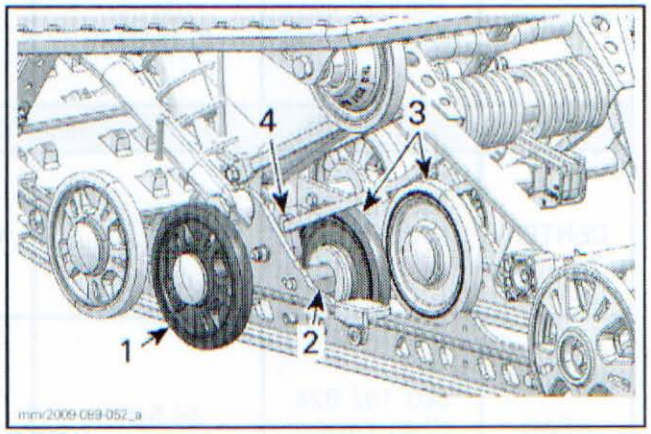
1. Lift rear of vehicle and support it off the ground.
2. Decrease springs preload by turning cams accordingly.



1. *Rear springs*
2. *Cams*

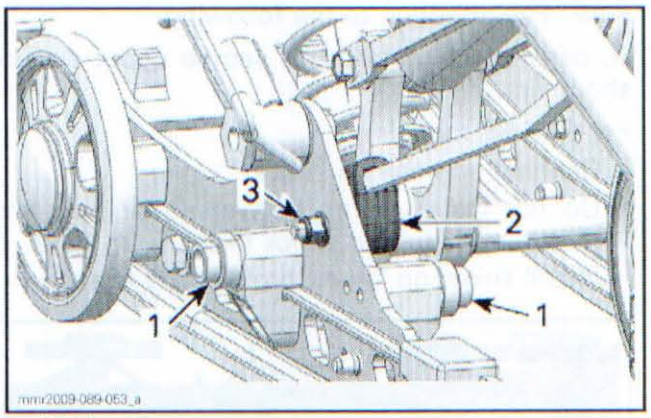
3. Remove idler wheels to have access to spring support screws.

IDLER WHEELS	
GSX AND MX Z (EXCEPT RENEGADE AND RENEGADE X)	External and internal idler wheels
GTX AND MX Z (RENEGADE AND RENEGADE X)	Internal idler wheels



TYPICAL
1. *LH external idler wheel*
2. *Idler wheel support*
3. *Internal idler wheels*
4. *LH spring support*

4. Hold the spring supports firmly and remove spring support nuts.

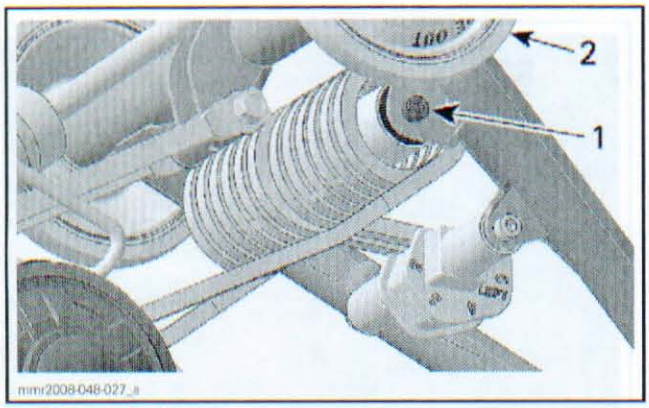


1. *LH idler wheel supports*
2. *Spring support*
3. *Spring support nut*

5. Move spring supports with spring ends over the idler wheel supports and let them sits on the track.

NOTE: If the springs are still loaded, completely loosen track tension in order to make room to unload springs.

6. Remove spring axle screws (one each side).



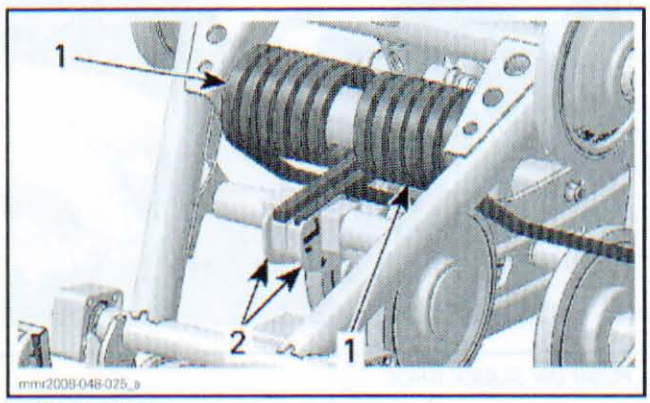
1. *Spring axle screw*
2. *Upper idler wheel*

7. Remove springs and spring axle.

Rear Spring Installation

Installation is reverse of removal procedure. Pay attention to the following.

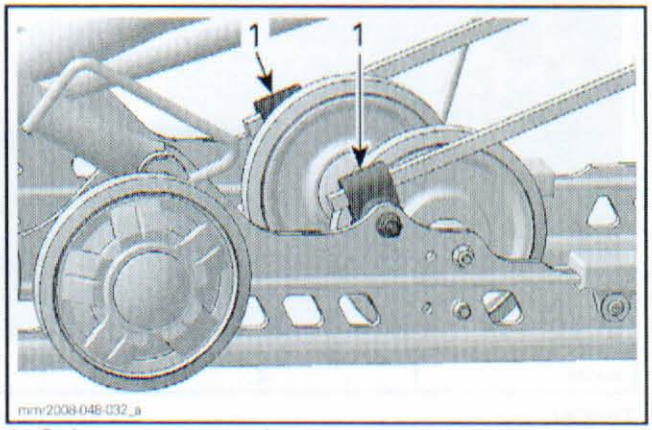
1. Respect THIS SIDE OUT inscription on top idler wheels.
2. Make sure that spring end is in cam adjuster.



1. *Rear springs*
2. *Cams*

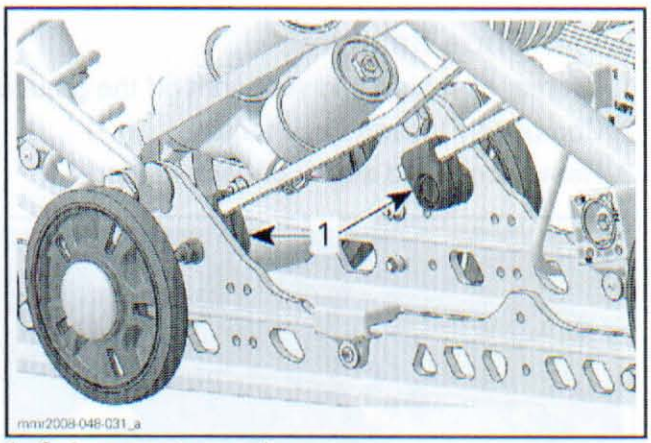
3. Install spring supports upwards.

GTX Series and MX Z (Renegade and Renegade X)



1. *Spring supports upwards*

GSX Series and All MX Z except Renegade and Renegade X

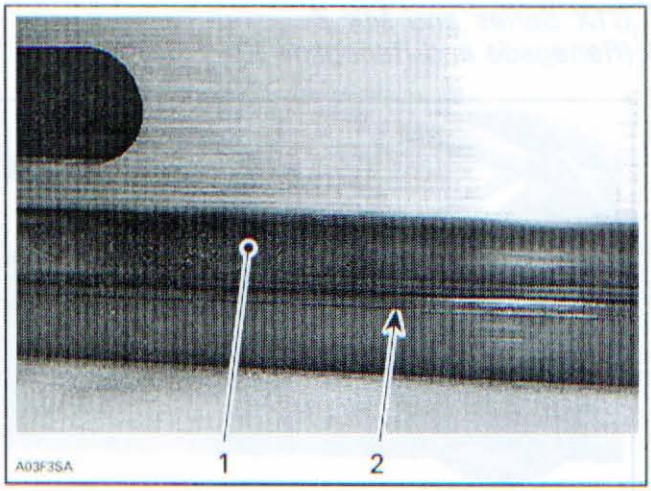


1. *Spring supports upwards*

SLIDER SHOES

Slider Shoe Inspection

Replace slider shoes when the wear reach 1 mm to 2 mm (.04 in to .08 in) beyond the moulding line.

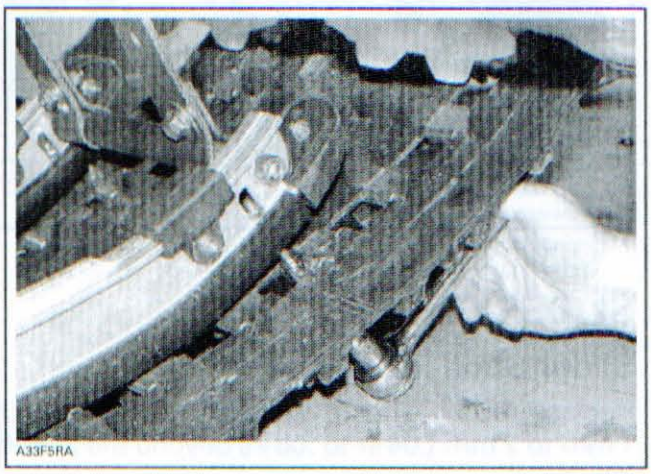


TYPICAL
1. Slider shoe
2. Molding line

NOTICE Slider shoes must always be replaced in pairs.

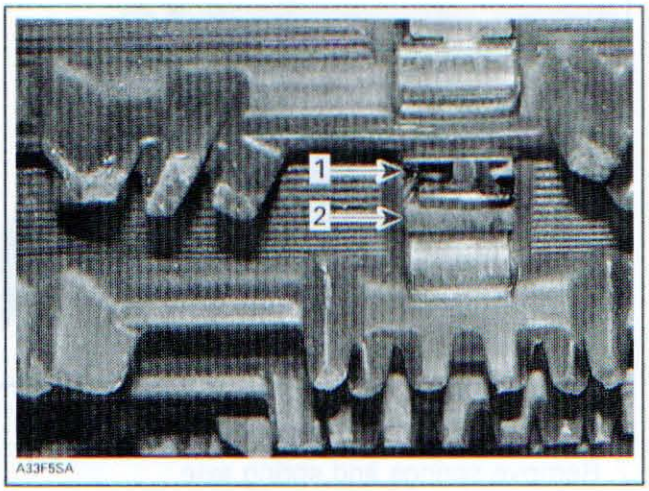
Slider Shoe Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension.
3. Remove nut and screw of each runner.



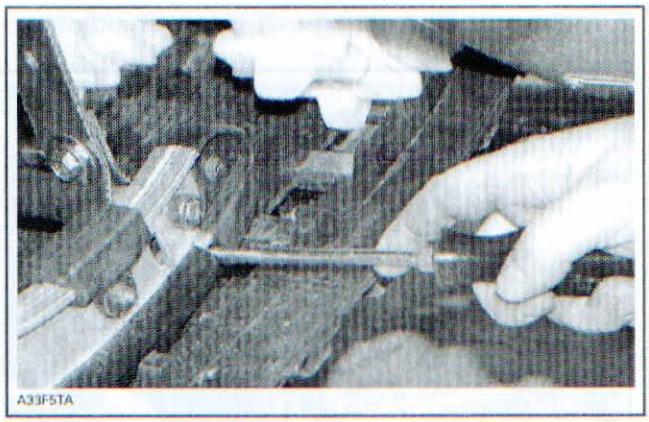
REMOVE NUT AND SCREW OF EACH RUNNER

4. At the rear of vehicle, align a track window with slider shoe.



TYPICAL
1. Track window
2. Slider shoe

5. Using a pry bar or a screwdriver, push slider shoe rearward until it comes in contact with track.



PUSH ON SLIDER SHOE

6. Using locking pliers, pull slider shoe through track window to remove.

NOTE: If necessary, lubricate track window to facilitate slider shoe removal.

PULL ON SLIDER SHOE TO REMOVE

Slider Shoe Installation

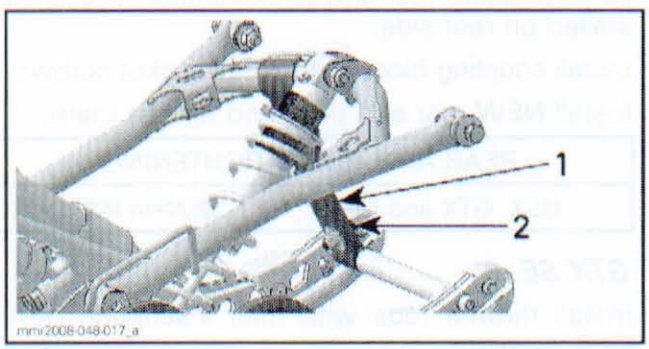
Installation is reverse of removal procedure. Pay attention to the following detail.

Make sure to insert slider shoe end with hole first.

FRONT ARM

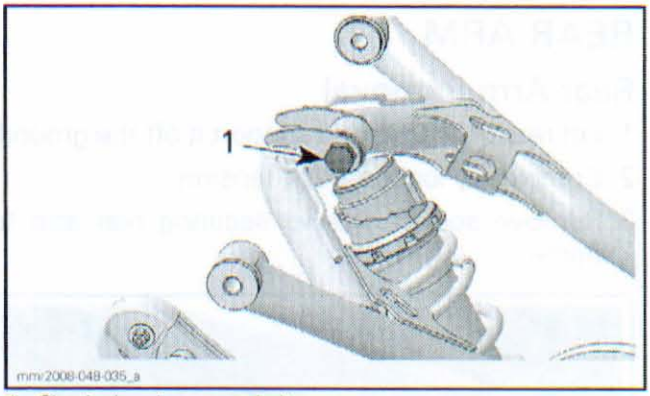
Front Arm Removal

1. Remove *SUSPENSION ASSEMBLY*, see procedure in this subsection.
2. Unfasten stopper strap.



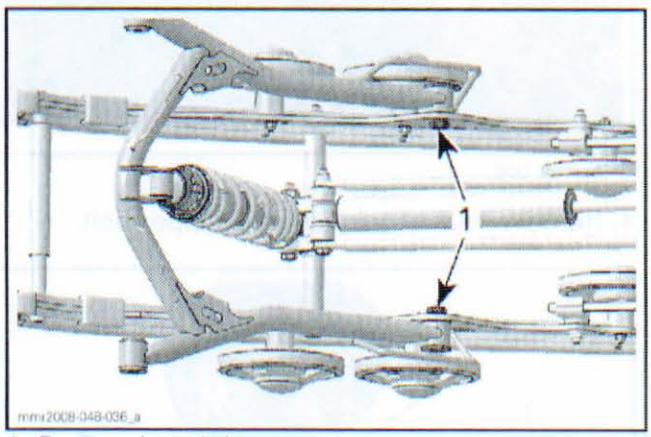
1. *Stopper strap*
2. *Stopper strap bolt*

3. Remove upper bolt securing the front shock absorber.



1. *Shock absorber upper bolt*

4. Unscrew bolts securing the bottom ends of front arm.

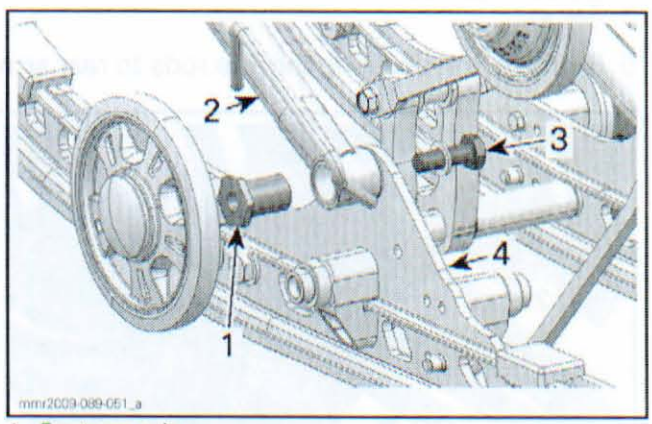


1. *Front arm lower bolts*

Front Arm Installation

Installation is reverse of removal procedure. Pay attention to the following details.

1. Install the lower bolts and tighten axles to 125 N•m (92 lbf•ft).



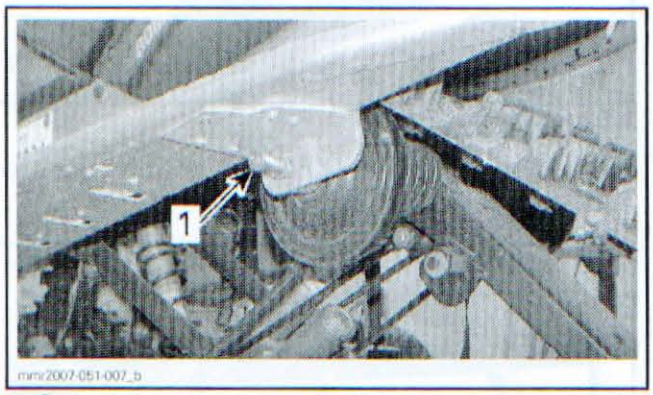
1. *Front arm axle*
2. *Front arm*
3. *Front arm lower bolt*
4. *LH runner*

2. Install all other removed parts accordingly with their installation procedures.

REAR ARM

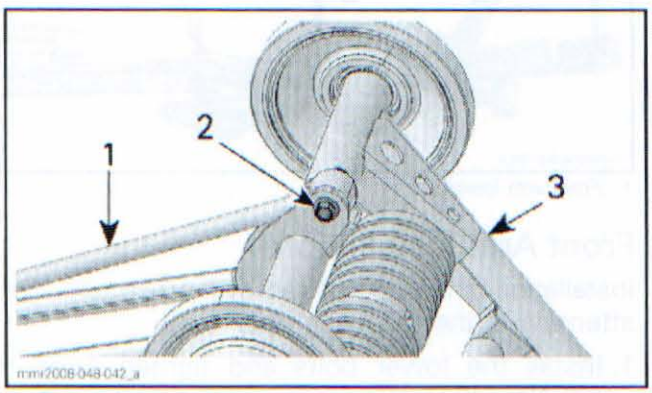
Rear Arm Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension.
3. Remove socket screws securing rear arm to frame.



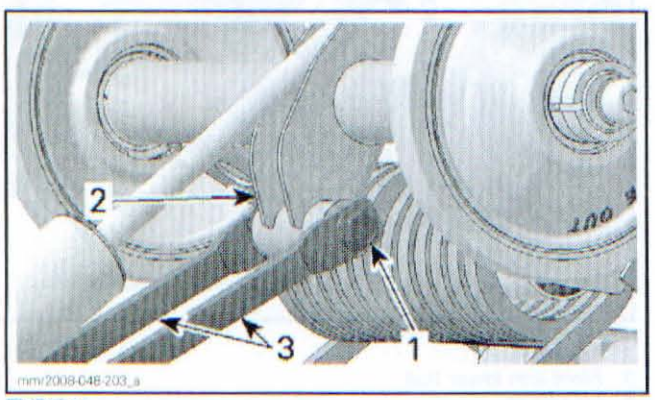
1. Socket bolt

4. Remove rear shock absorber upper bolt.



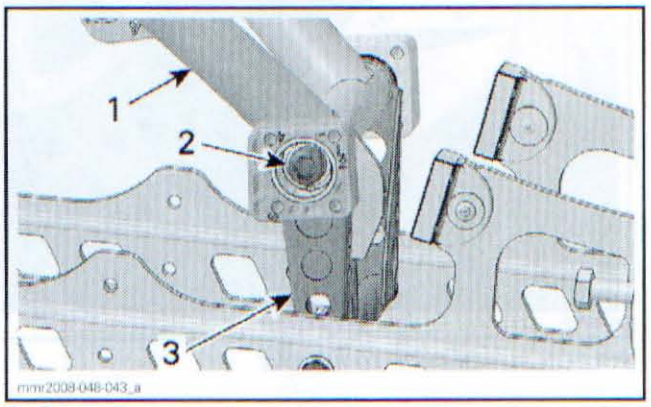
1. Rear shock absorber
2. Shock absorber bolt
3. Rear arm

5. Remove bolt securing throttle rods to rear arm.



TYPICAL
1. Throttle rod bolt
2. Rear arm
3. Throttle rods

6. Remove *REAR SPRING*, see procedure in this subsection.
7. Remove and discard coupling block screws securing rear arm to pivot arm.



1. Rear arm
2. LH coupling block bolt
3. Pivot arm

8. Remove rear arm.

Rear Arm Installation

All Models

Installation is the reverse of removal procedure. Pay attention to the following details.

Pivot arm grease fitting must be installed towards the front of the vehicle.

At installation, rear arm stroke limiter must be installed on rear side.

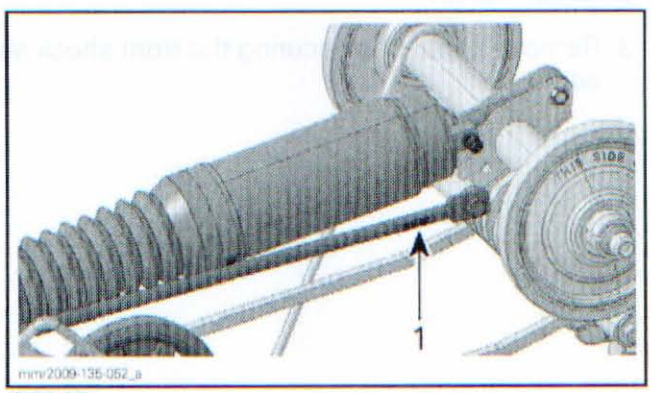
Install coupling block with **NEW** socket screws.

Install **NEW** rear arm bolts and tighten them.

REAR ARM BOLTS TIGHTENING	
GSX, GTX and MX Z	85 N•m (63 lbf•ft)

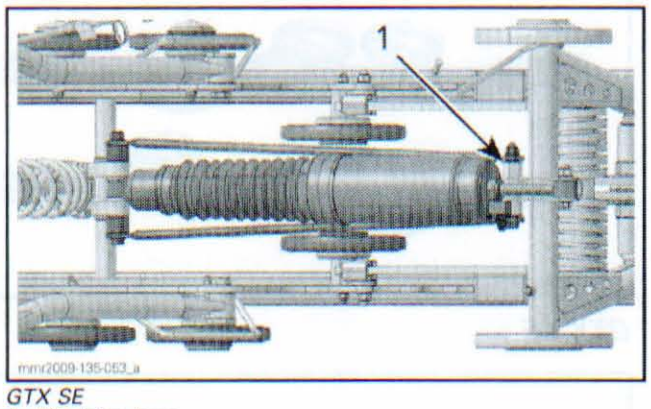
GTX SE

Install throttle rods with their inscription REAR OUT properly.



GTX SE
1. REAR OUT inscription

Do not install shims between rear arm and throttle rods (upper shock fixation).

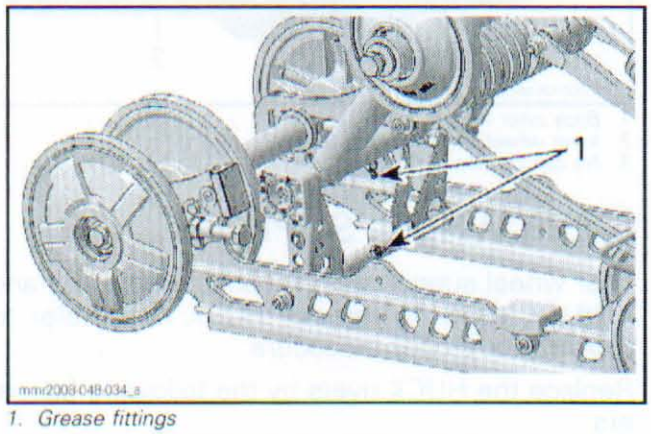


GTX SE
1. No shims here

Rear Arm Lubrication

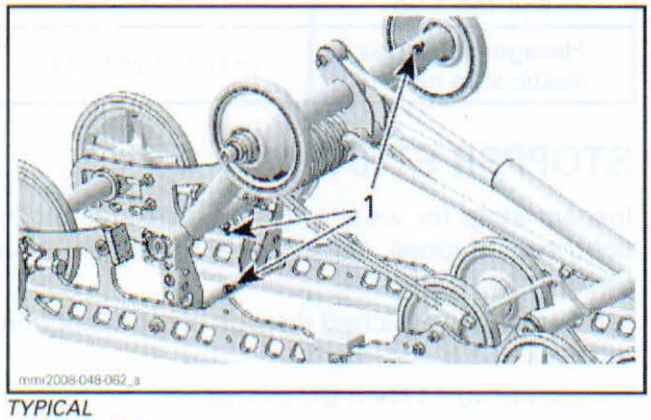
Lubricate pivot arm and rear arm at grease fittings using SUSPENSION GREASE (P/N 293 550 033).

GSX Series and MX Z (TNT, X)



1. Grease fittings

GTX Series and MX Z (Renegade, Renegade X)

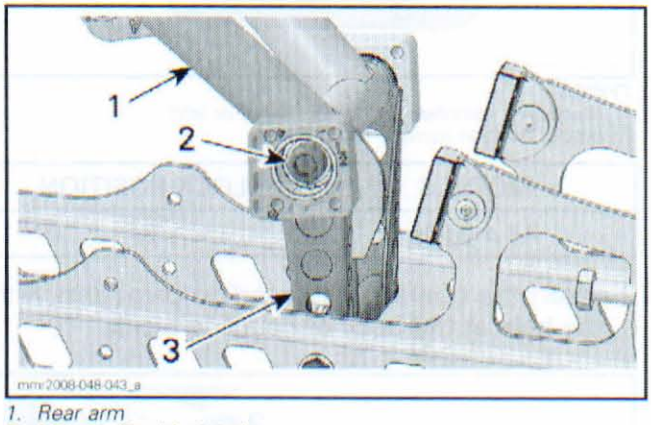


TYPICAL
1. Grease fittings

PIVOT ARM

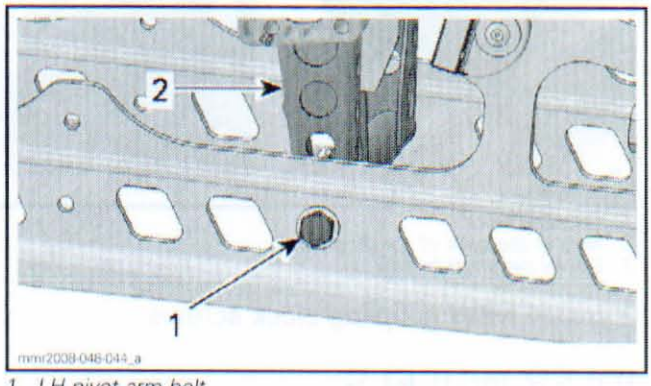
Pivot Arm Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension.
3. Remove and discard coupling block screws securing rear arm to pivot arm.



1. Rear arm
2. LH coupling block bolt
3. Pivot arm

4. Remove bolts and washers holding pivot arm to runners.



1. LH pivot arm bolt
2. Pivot arm

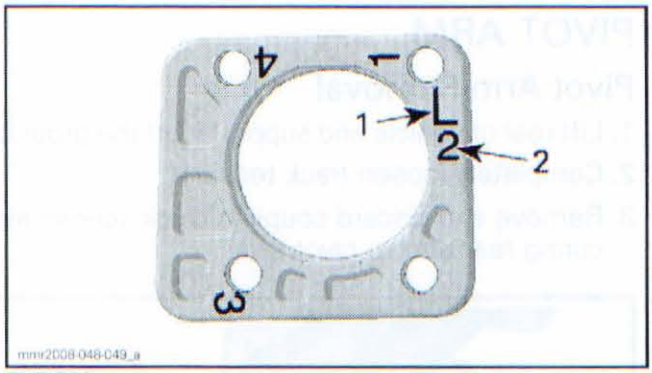
5. Separate pivot arm from rear arm.

Pivot Arm Installation

The installation is the reverse of the removal procedure.

COUPLING BLOCKS

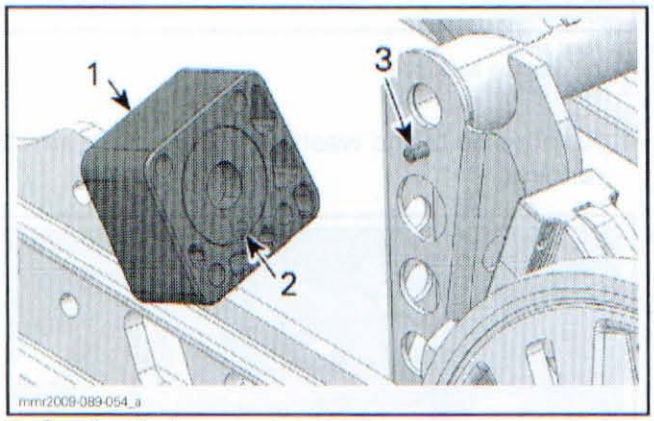
1. Both coupling blocks are identified "R" or "L" (right or left) and have position number (from 1 to 4). At installation make sure to install proper block on proper side with the same adjustment position on both sides.



TYPICAL
1. *Blocks are identified "R" or "L" (right or left)*
2. *Blocks position number (from 1 to 4)*

MODELS	BLOCK POSITION
All models	2

2. Insert the dowel pin located on pivot arm with the hole at the back of coupling block.



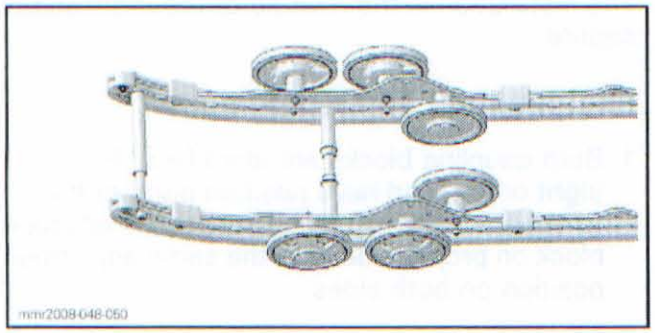
1. *Coupling block*
2. *Hole at the back of coupling block*
3. *Dowel pin on pivot arm*

3. Install **NEW** coupling block screws.

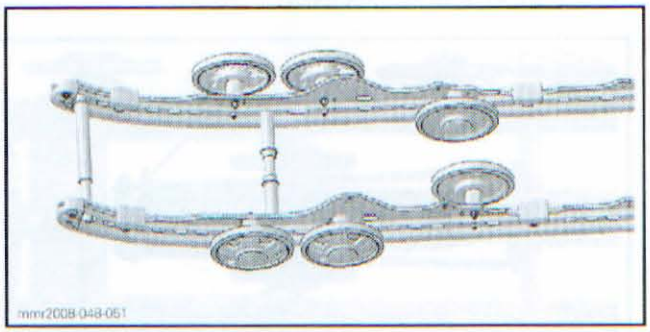
IDLER WHEELS

Refer to illustration for idler wheels position at installation.

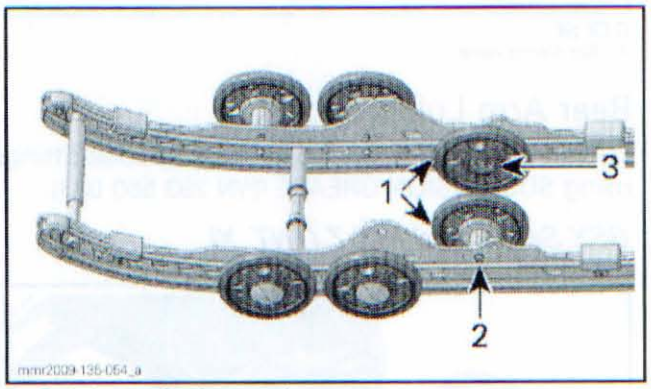
GSX Series and MX Z (TNT, X)



GTX LE and MX Z (Renegade, Renegade X)



GTX SE



1. *Both inner wheels toward rear*
2. *Inner wheel bolt toward outside*
3. *No cap on inner wheel*

IDLER WHEEL SUPPORT

Idler wheel supports are retained with a bolt and a HUCK rivet. To remove HUCK rivet, refer to *FRAME* for proper procedure.

Replace the HUCK rivets by the following fasteners.

NEW FASTENERS	
Hexagonal flanged bolt M6 x 25	(P/N 207 662 544)
Hexagonal flanged elastic stop nut M6	(P/N 233 261 414)

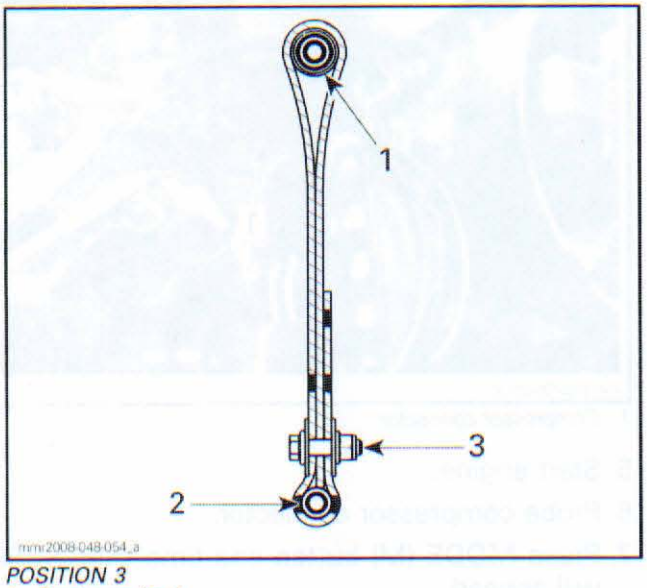
STOPPER STRAP

Inspect strap for wear or cracks, bolt and nut for tightness. If loose, inspect hole for deformation. Replace as required.

Make sure it is attached through proper hole from the end.

Torque nut to 11 N•m (97 lbf•**in**).

GSX, GTX and MX Z



POSITION 3
1. *Front arm (top)*
2. *Front axle*
3. *Towards the rear of vehicle*

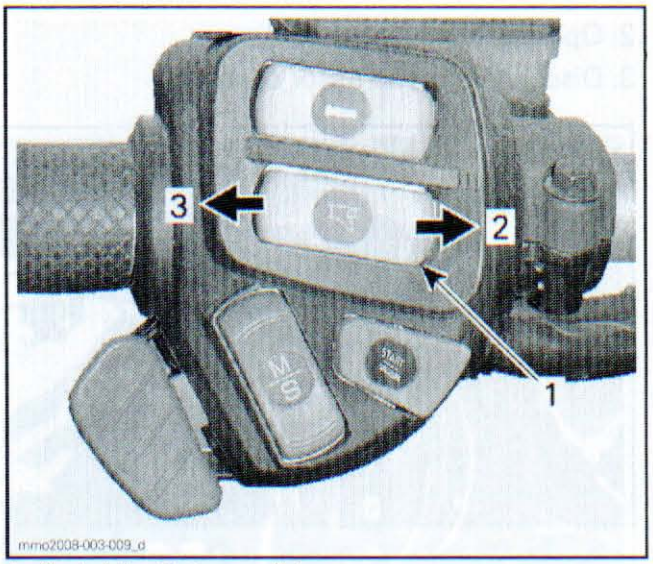
ACS COMPRESSOR

⚠ WARNING

The ACS suspension system may be under high pressure (up to 8 bar (120 PSI)). Release air pressure prior to working on the system. Refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.

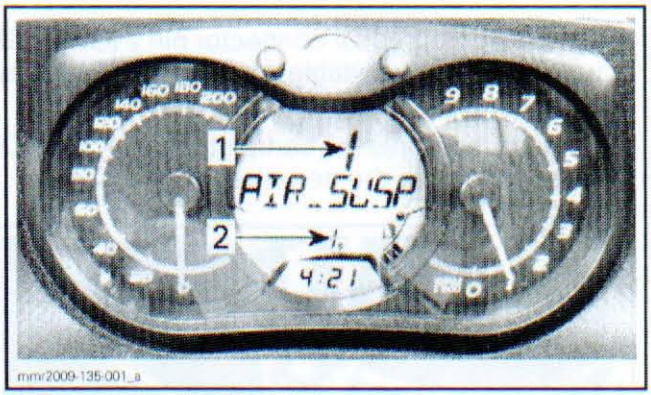
ACS System Air Pressure Release

1. Start vehicle.
2. Press MODE (M) button one time (AIR_SUSP will appear).
3. Set suspension mode to 1 using the heated throttle lever switch.



1. *Heated throttle lever switch*
2. *Increase pressure*
3. *Decrease pressure*

4. Wait until the actual setting shows 1 (lower display).



1. *Requested setting (set point)*
2. *Actual setting (pressure transducer reading)*

NOTE: Make sure to wait enough time in order to let the system expel the air. If the actual setting (lower display) never show 1, the system will still be pressurized. In this case, apply 12 Vdc on ACS solenoid valve connector in order to activate it and let the pressure drop.

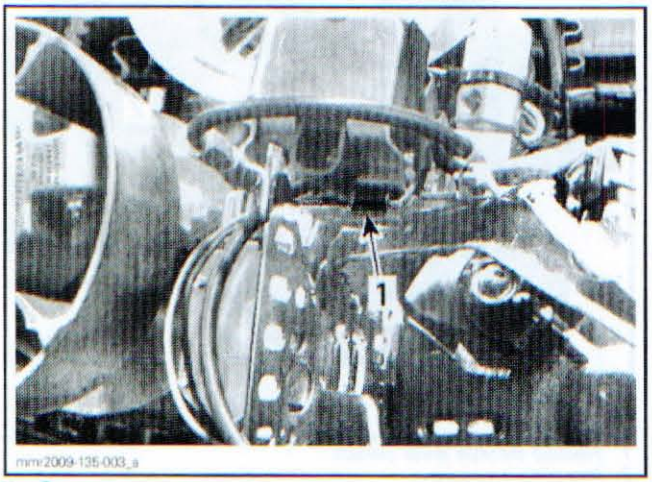
5. Stop vehicle.

ACS Compressor Operation Test

NOTICE Do not power the compressor directly with the battery for more than 10 seconds. Apply voltage quickly to ensure that the compressor will not over pressurized the ACS system. Respect 1 minute cool down between tests.

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.

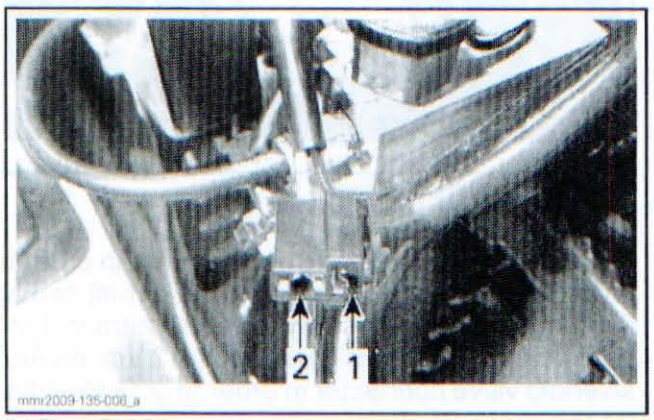
2. Open LH side panel.
3. Disconnect compressor connector.



1. Compressor connector

NOTICE **Be careful not to power the module by the compressor connector in order to avoid to damage it permanently.**

4. Connect compressor connector pin 2 (ORANGE wire) to a 20 A suitable fuse jumper and then directly to the positive battery post.
5. Connect compressor connector pin 1 (BLACK wire) directly to the negative battery post.

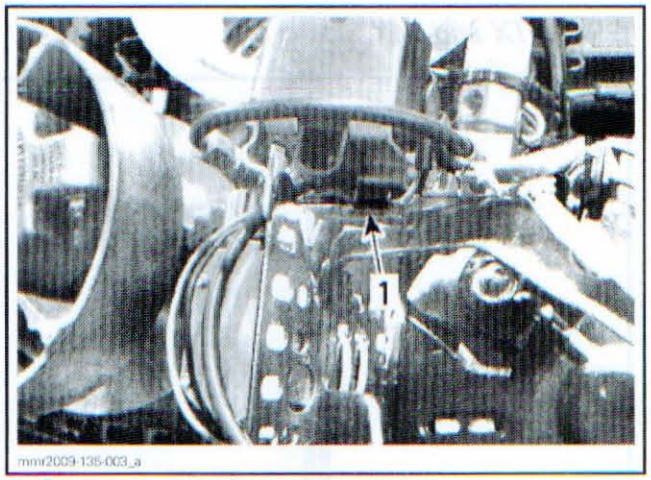


1. Pin 1 (BLACK wire)
2. Pin 2 (ORANGE wire)

6. Verify if compressor works properly.

ACS Compressor Input Voltage Test

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
3. Open LH side panel.
4. Disconnect compressor connector.



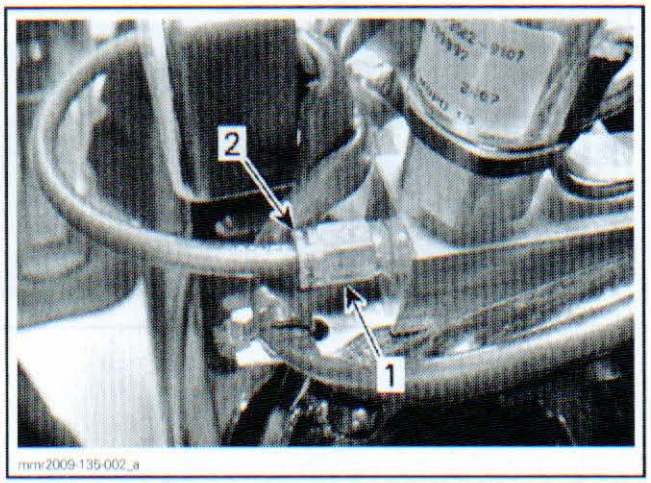
1. Compressor connector

5. Start engine.
6. Probe compressor connector.
7. Press MODE (M) button one time (AIR_SUSP will appear).
8. Set suspension mode to 2 using the heated throttle lever switch.
9. Measure voltage between compressor connector terminals as per the following table.

TEST PROBES	VOLTAGE
Pin 2 (OR)	Battery voltage (± 12 Vdc)
Pin 1 (BK)	

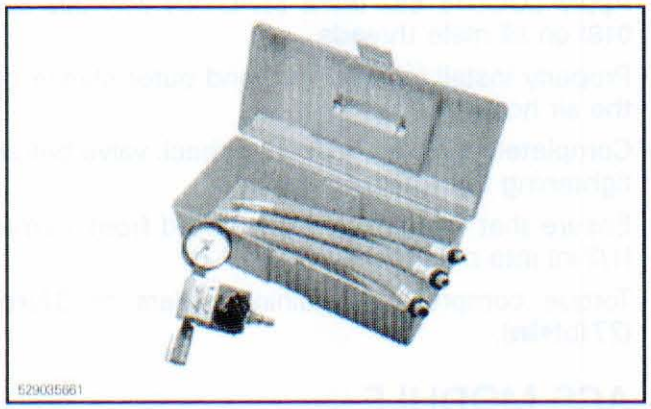
Check Valve Leak Test (ACS Compressor)

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Remove LH side panel.
3. Disconnect inlet hose from manifold air fitting as follows:
   - 3.1 Push fitting ring toward manifold.
   - 3.2 Hold ring in place.
   - 3.3 Pull air hose.

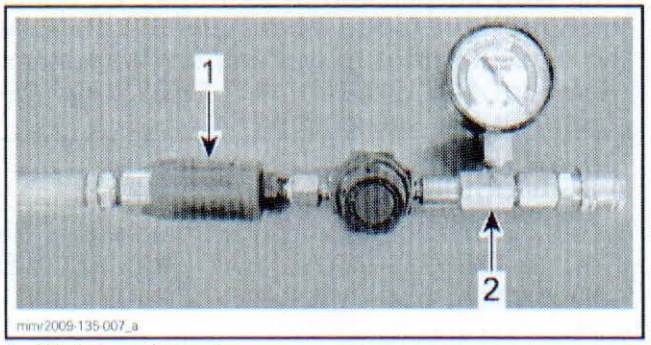


1. *Inlet hose fitting*
2. *Ring*

4. Use the ENGINE LEAK DOWN TEST KIT (P/N 529 035 661).

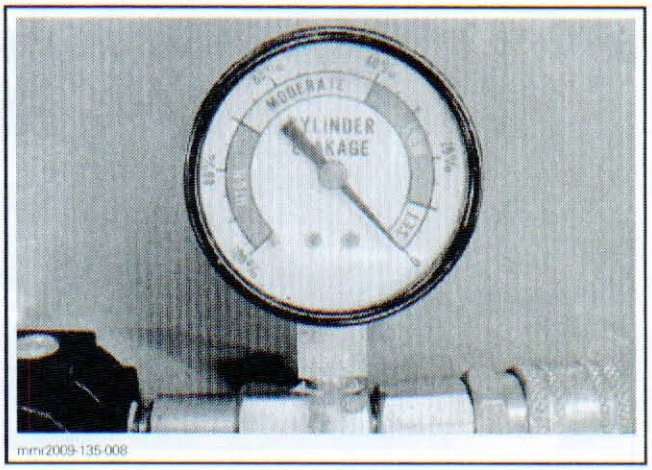


5. Connect workshop air supply into engine leak down test kit.

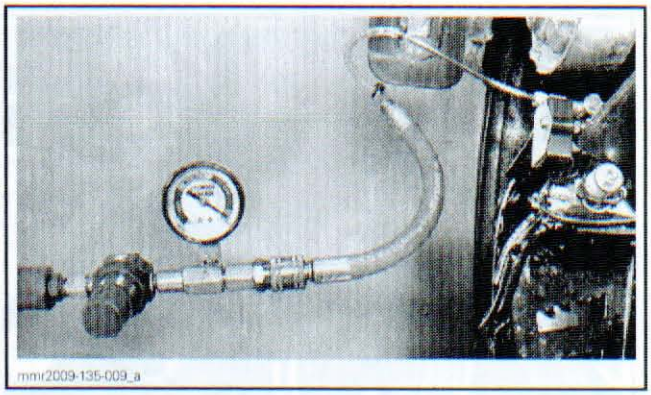


1. *Workshop air supply*
2. *Engine leak down test kit*

6. Adjust engine leak down test kit reading to 0 using knob.



7. Connect a suitable adapter between compressor hose and engine leak down test kit output hose.

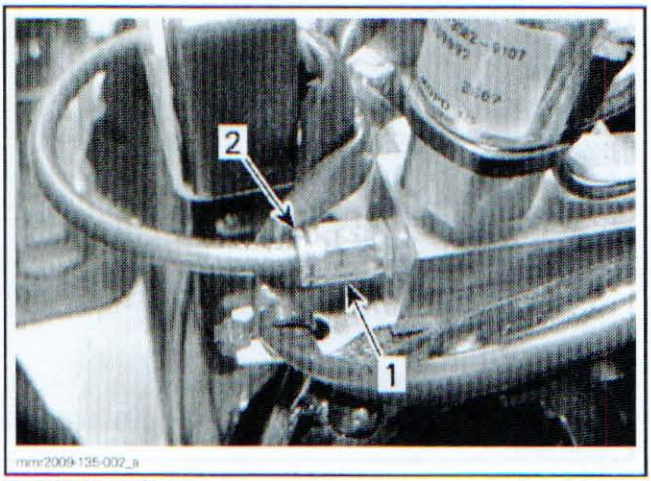


8. Check for a check valve leak, refer to the following table.

LEAK PERCENTAGE	CHECK VALVE
Below 10%	Good (do not replace)
Above 10%	Faulty (replace it)

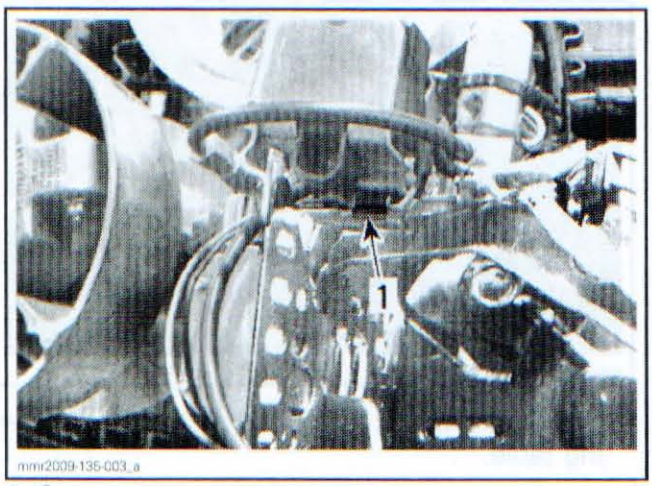
ACS Compressor Removal

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Remove LH side panel.
3. Disconnect inlet hose from manifold air fitting as follows:
   - 3.1 Push fitting ring toward manifold.
   - 3.2 Hold ring in place.
   - 3.3 Pull air hose.



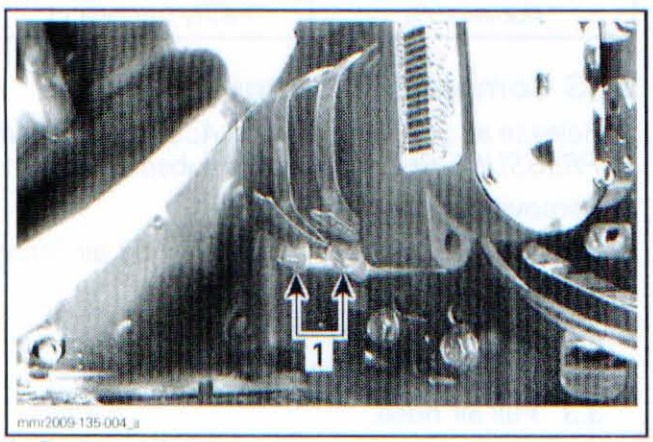
1. *Inlet hose fitting*
2. *Ring*

4. Disconnect compressor connector.



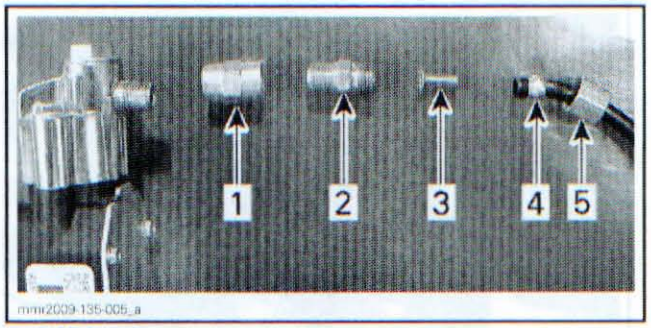
1. *Compressor connector*

5. Unscrew compressor retaining collars.



1. *Retaining collars*

6. Remove compressor from vehicle.
7. Disassemble compressor hose as per the following illustration.



1. *NPT Nipple*
2. *Check valve*
3. *Inner sleeve*
4. *Outer sleeve*
5. *Retaining sleeve*

ACS Compressor Installation

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

Apply LOCTITE 592 (PIPE SEALANT) (P/N 293 800 018) on all male threads.

Properly install inner sleeve and outer sleeve on the air hose.

Completely push air hose into check valve before tightening the retaining sleeve.

Ensure that the air hose is inserted from 13 mm (1/2 in) into manifold air fitting.

Torque compressor retaining collars to 3 N•m (27 lbf•**in**).

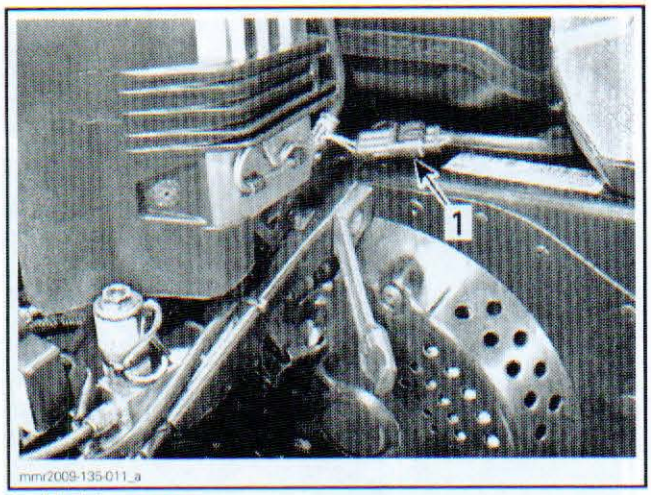
ACS MODULE

⚠ WARNING

The ACS suspension system may be under high pressure (up to 8 bar (120 PSI)). Release air pressure prior to working on the system. Refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.

ACS Module Signal Continuity Test

1. Remove multifunction gauge from vehicle. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
2. Open LH side panel.
3. Disconnect module connector.



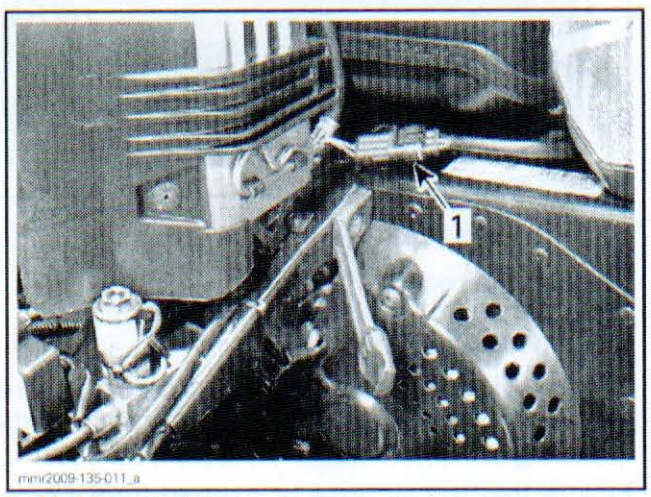
1. Module connector

4. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Ω.
5. Measure resistance as per the following table.

TEST PROBES	RESISTANCE
Gauge pin 14 (WH/OR)	Close to 0 Ω
Module pin 2 (WH/OR)	

ACS Module Input Voltage Test

1. Open LH side panel.
2. Disconnect module connector.



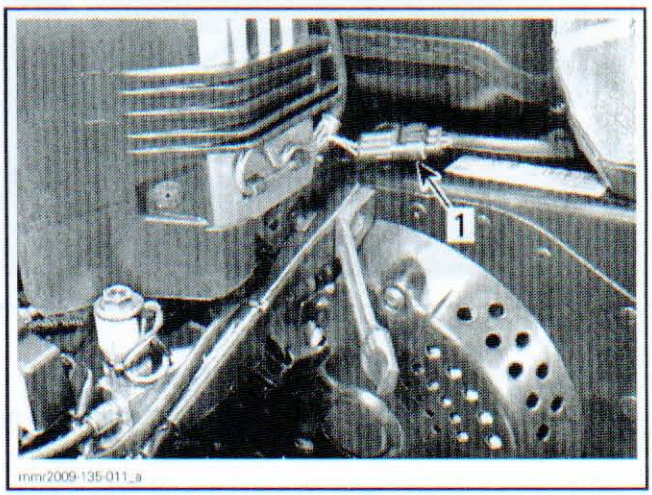
1. Module connector

3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
4. Start engine.
5. Measure voltage as per the following table.

TEST PROBES	VOLTAGE
Pin 1 (RD/YL)	Battery voltage (± 12 Vdc)
Battery negative (-) post	

ACS Module Ground Test

1. Open LH side panel.
2. Disconnect module connector.



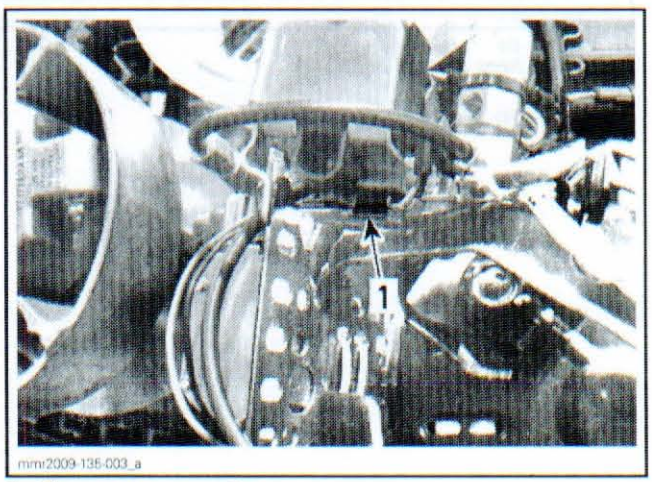
1. Module connector

3. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
4. Start engine.
5. Measure voltage as per the following table.

TEST PROBES	VOLTAGE
Pin 3 (BK)	Battery voltage (± 12 Vdc)
Battery positive (+) post	

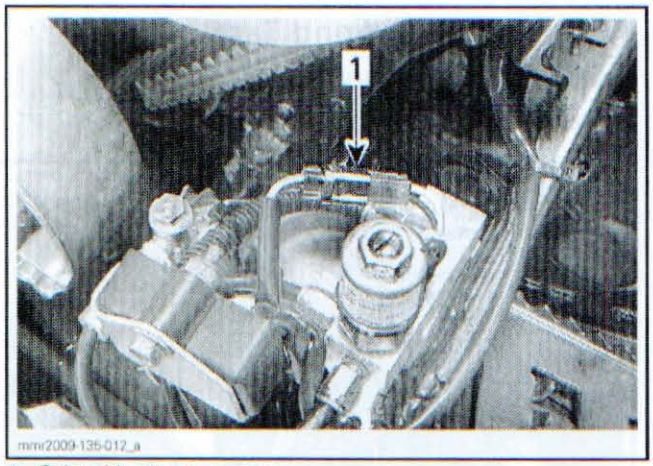
ACS Module Removal

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Remove LH side panel.
3. Disconnect compressor connector.



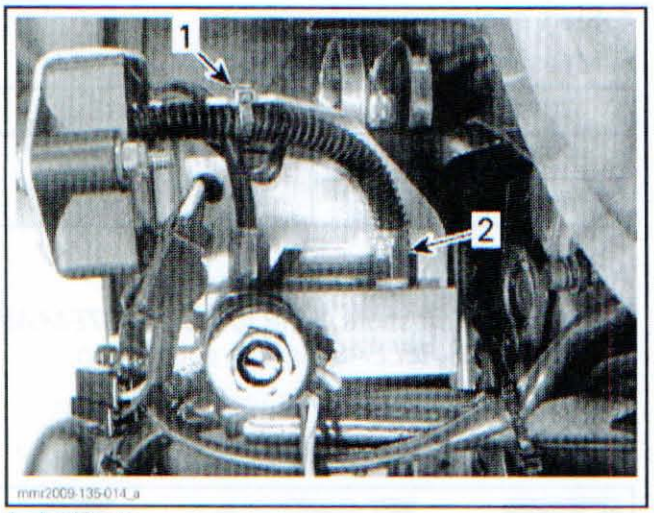
1. Compressor connector

4. Disconnect solenoid valve connector.



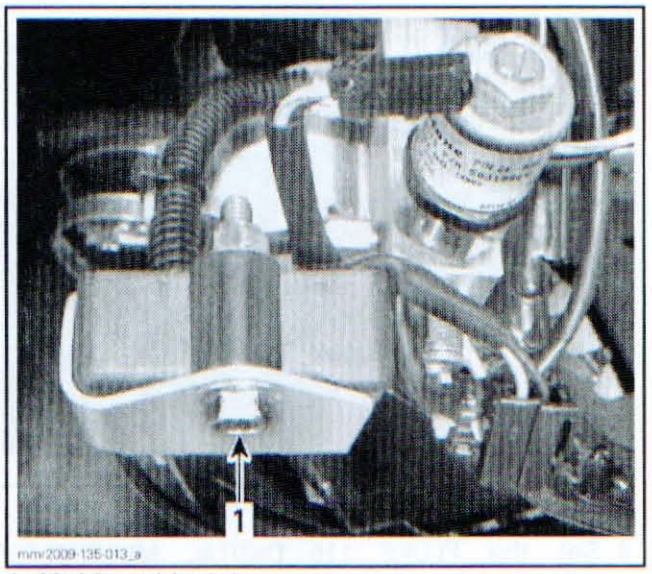
1. Solenoid valve connector

5. Cut locking tie from module hose.
6. Disconnect ACS module hose from manifold air fitting as follows:
   - 6.1 Push fitting ring toward manifold.
   - 6.2 Hold ring in place.
   - 6.3 Pull air hose.



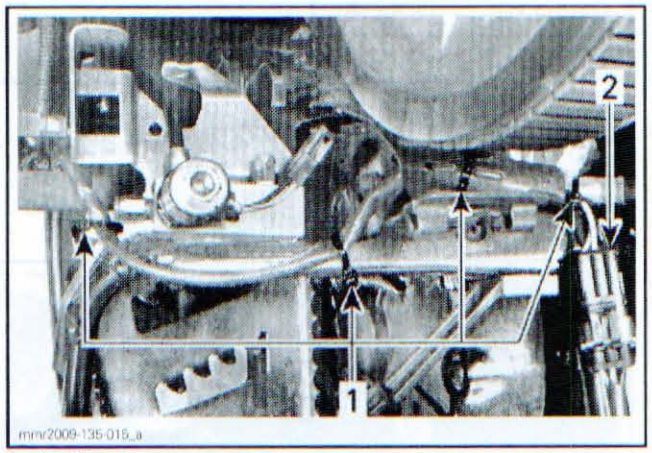
1. Locking tie
2. Module hose fitting

7. Remove module retaining bolt.



1. Module retaining bolt

8. Cut locking ties from module harness.
9. Disconnect module connector.



1. Locking ties
2. Module connector

10. Remove module from vehicle.

ACS Module Installation

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

Ensure that the air hose is inserted from 13 mm (1/2 in) into manifold air fitting.

Torque module retaining nut to 2.5 N•m (22 lbf•**in**).

ACS SOLENOID VALVE

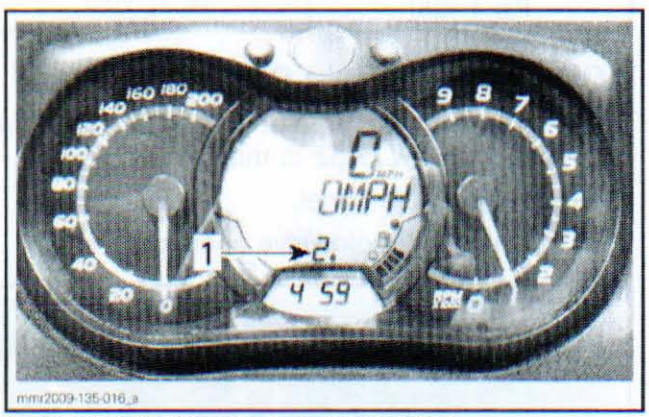
⚠ WARNING

The ACS suspension system may be under high pressure (up to 8 bar (120 PSI)). Release air pressure prior to working on the system. Refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.

ACS Solenoid Valve Operation Test

NOTICE **Do not power the solenoid valve directly with the battery for a long period. Apply voltage quickly to ensure that the valve will not completely empty the ACS system.**

1. Start vehicle.
2. Press MODE (M) button one time (AIR_SUSP will appear).
3. Set suspension mode to **2** using the heated throttle lever switch.
4. Wait until the actual setting shows 2 (lower display).



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1. Actual setting (pressure transducer reading)

NOTE: Make sure to wait enough time in order to let the system adjust the air pressure.

5. Stop vehicle.
6. Open LH side panel.
7. Disconnect solenoid valve connector.

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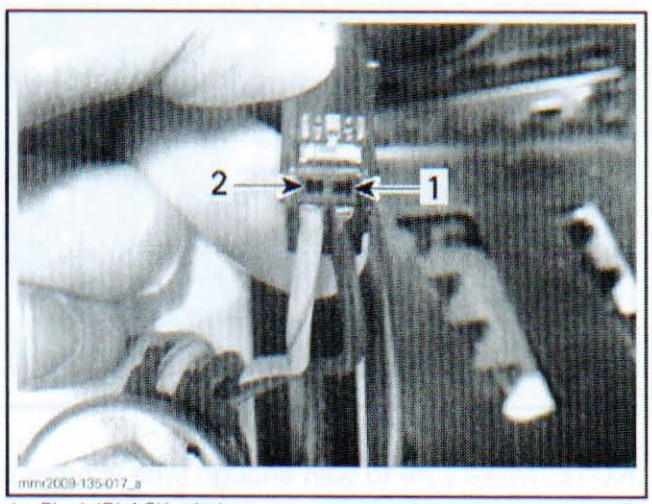
1. Solenoid valve connector

NOTICE **Be careful not to power the module by the solenoid valve connector in order to avoid to damage it permanently.**

8. Connect solenoid valve connector pin 2 (YELLOW/GREEN wire) to a 20 A suitable fuse jumper and then directly to the positive battery post.
9. Connect solenoid valve connector pin 1 (BLACK wire) directly to the negative battery post.



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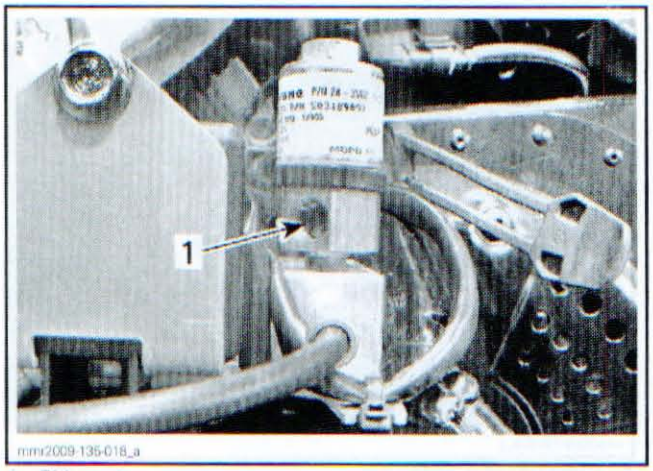
1. Pin 1 (BLACK wire)
2. Pin 2 (YELLOW/GREEN wire)

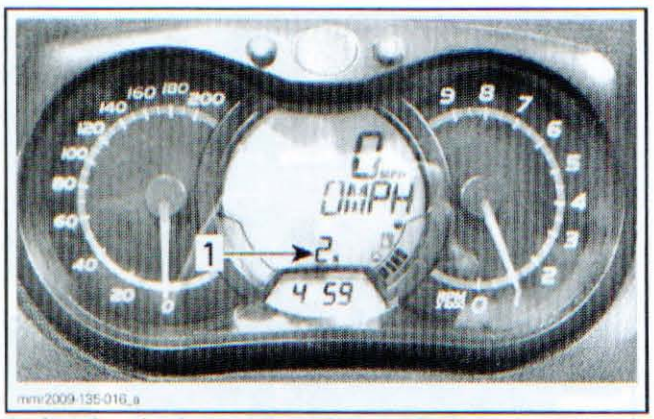
10. Verify that air exits from side port to confirm proper solenoid operation.



1. Side port

ACS Solenoid Valve Input Voltage Test

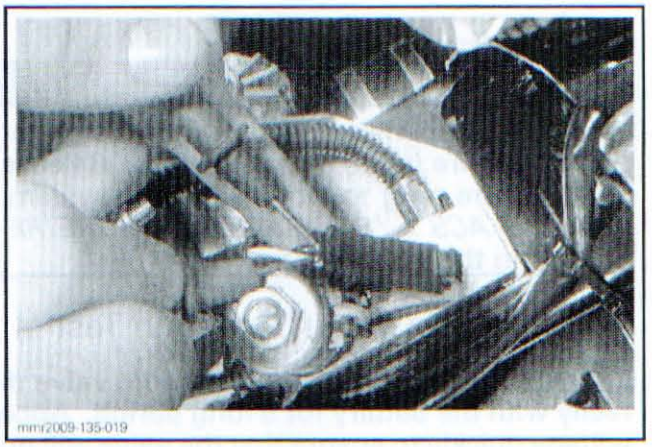
1. Start vehicle.
2. Press MODE (M) button one time (AIR_SUSP will appear).
3. Set suspension mode to **2** using the heated throttle lever switch.
4. Wait until the actual setting shows 2 (lower display).



1. Actual setting (pressure transducer reading)

NOTE: Make sure to wait enough time in order to let the system adjust the air pressure.

5. Set the FLUKE 115 DIGITAL MULTIMETER (P/N 529 035 868) to Vdc.
6. Open LH side panel.
7. Back probe solenoid connector (without disconnecting).

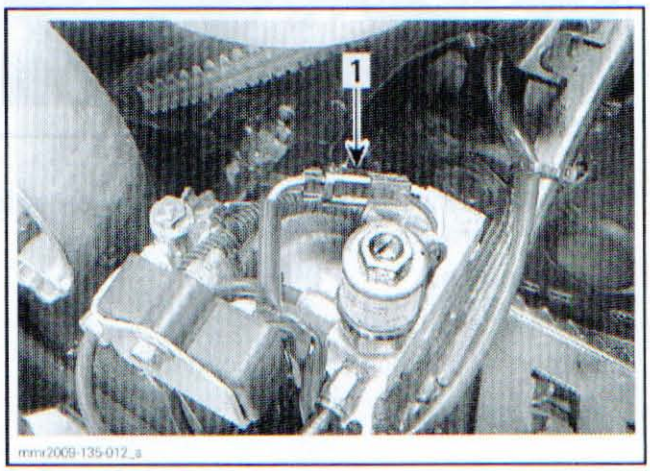


8. Press MODE (M) button one time (AIR_SUSP will appear).
9. Set suspension mode to 1 using the heated throttle lever switch.
10. Measure voltage between solenoid connector terminals as per the following table.

TEST PROBES	VOLTAGE
Pin 2 (YL/GN)	Battery voltage (± 12 Vdc)
Pin 1 (BK)	

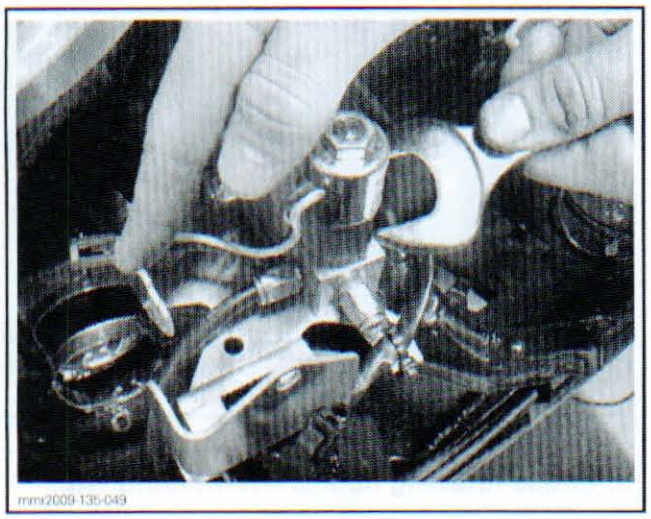
ACS Solenoid Valve Removal

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Remove LH side panel.
3. Disconnect solenoid valve connector.



1. Solenoid valve connector

4. Unscrew solenoid valve from manifold.



ACS Solenoid Valve Installation

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

Apply LOCTITE 592 (PIPE SEALANT) (P/N 293 800 018) on male threads.

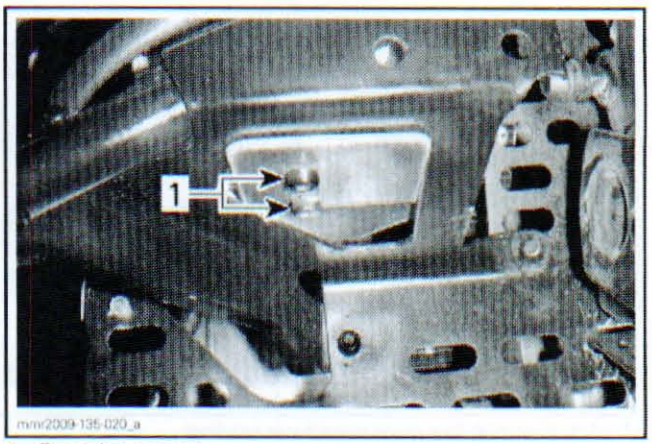
ACS MANIFOLD

⚠ WARNING

The ACS suspension system may be under high pressure (up to 8 bar (120 PSI)). Release air pressure prior to working on the system. Refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.

ACS Manifold Removal

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Remove LH side panel.
3. Disconnect the following hoses from manifold air fittings.
   - Compressor inlet hose
   - Module hose
   - Shock hose.
4. Disconnect solenoid valve connector.
5. Unscrew solenoid valve from manifold.
6. Remove manifold retaining screws.



1. Retaining screws

NOTE: To remove support, drill out the front rivet.

ACS Manifold Installation

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

Apply LOCTITE 592 (PIPE SEALANT) (P/N 293 800 018) on all male threads.

Ensure that air hoses are inserted from 13 mm (1/2 in) into manifold air fittings.

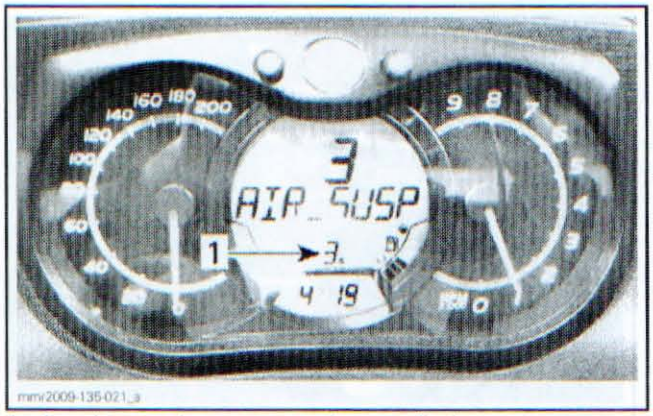
ACS HOSES

⚠ WARNING

The ACS suspension system may be under high pressure (up to 8 bar (120 PSI)). Release air pressure prior to working on the system. Refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.

ACS Hose Leak Test

1. Start vehicle.
2. Press MODE (M) button one time (AIR_SUSP will appear).
3. Set suspension mode to **3** using the heated throttle lever switch.
4. Wait until the actual setting shows 3 (lower display).



1. Actual setting (pressure transducer reading)

NOTE: Make sure to wait enough time in order to let the system adjust the air pressure.

5. Inspect all hoses and fittings with soapy water to detect leaks.

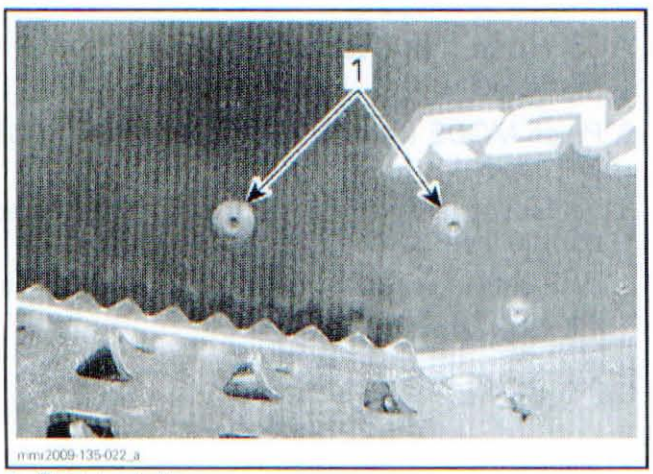
ACS Hose and Fitting Replacement

1. Release air pressure, refer to *ACS SYSTEM AIR PRESSURE RELEASE* in this subsection.
2. Locate hose or fitting to be replaced.
3. Remove it from vehicle.
4. Install the new hose or fitting.
5. Perform a *HOSE LEAK TEST.*

NOTE: Apply LOCTITE 592 (PIPE SEALANT) (P/N 293 800 018) on all male threads.

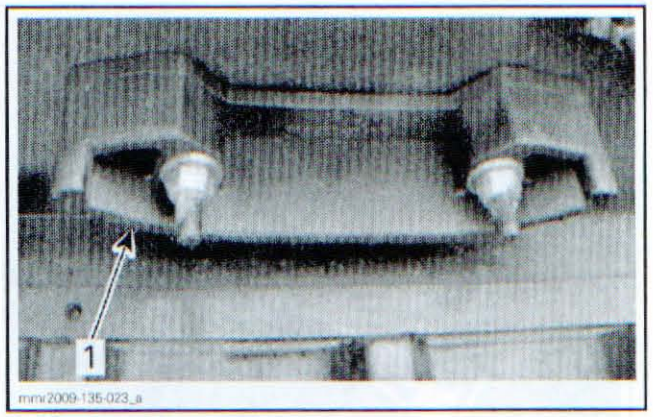
ACS Hose Protector Replacement

1. Remove hose protector retaining bolts and nuts located on LH side of tunnel.



1. Retaining bolts

2. Replace hose protector that is located from underneath tunnel.



1. Hose protector

3. Torque retaining nuts to 4 N•m (35 lbf•**in**).

STEERING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
HEATED GRIP INSTALLER	529 035 897	445

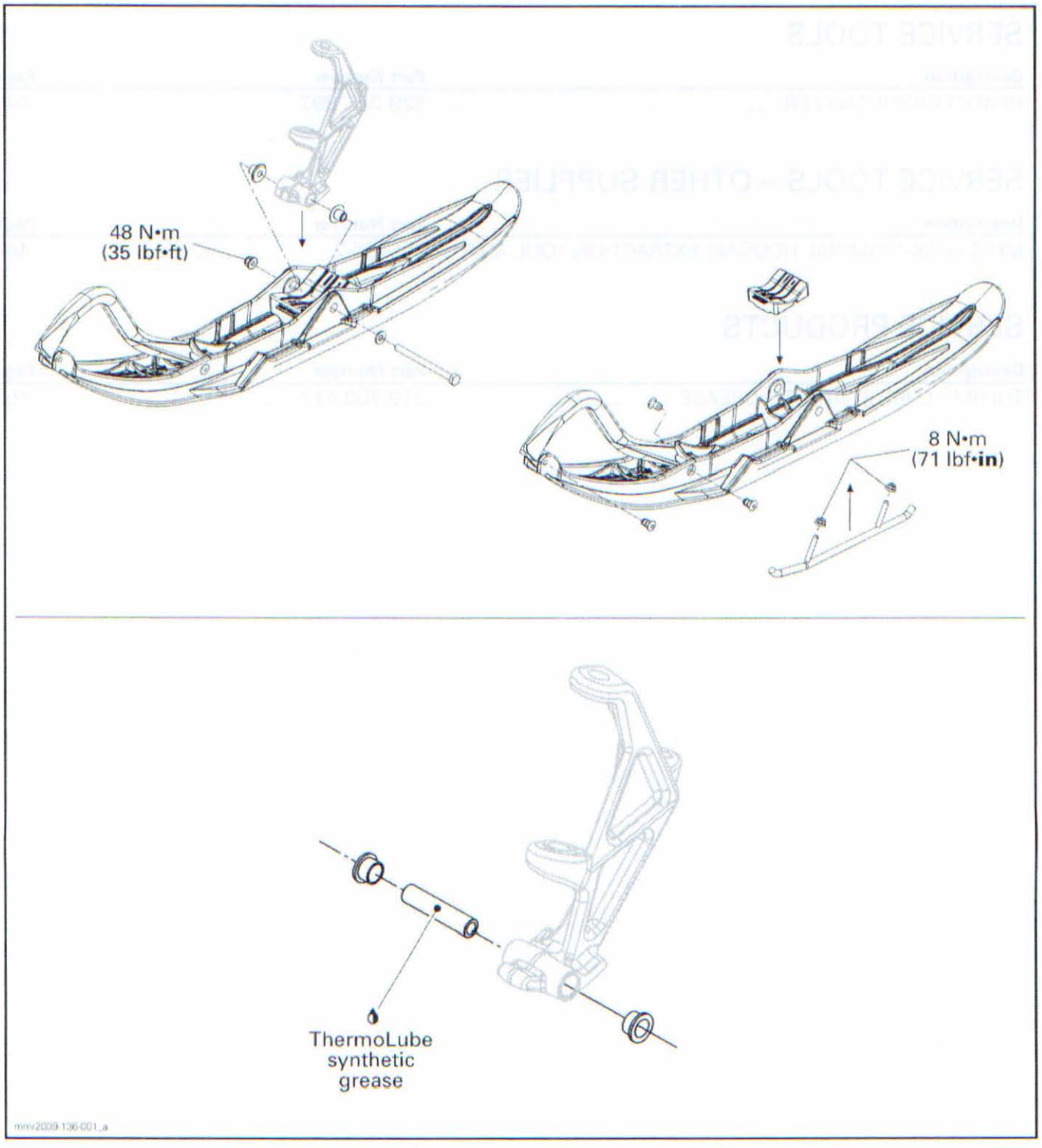
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
MULTILOCK-TERMINAL HOUSING EXTRACTION TOOL AMP	755430-2	444

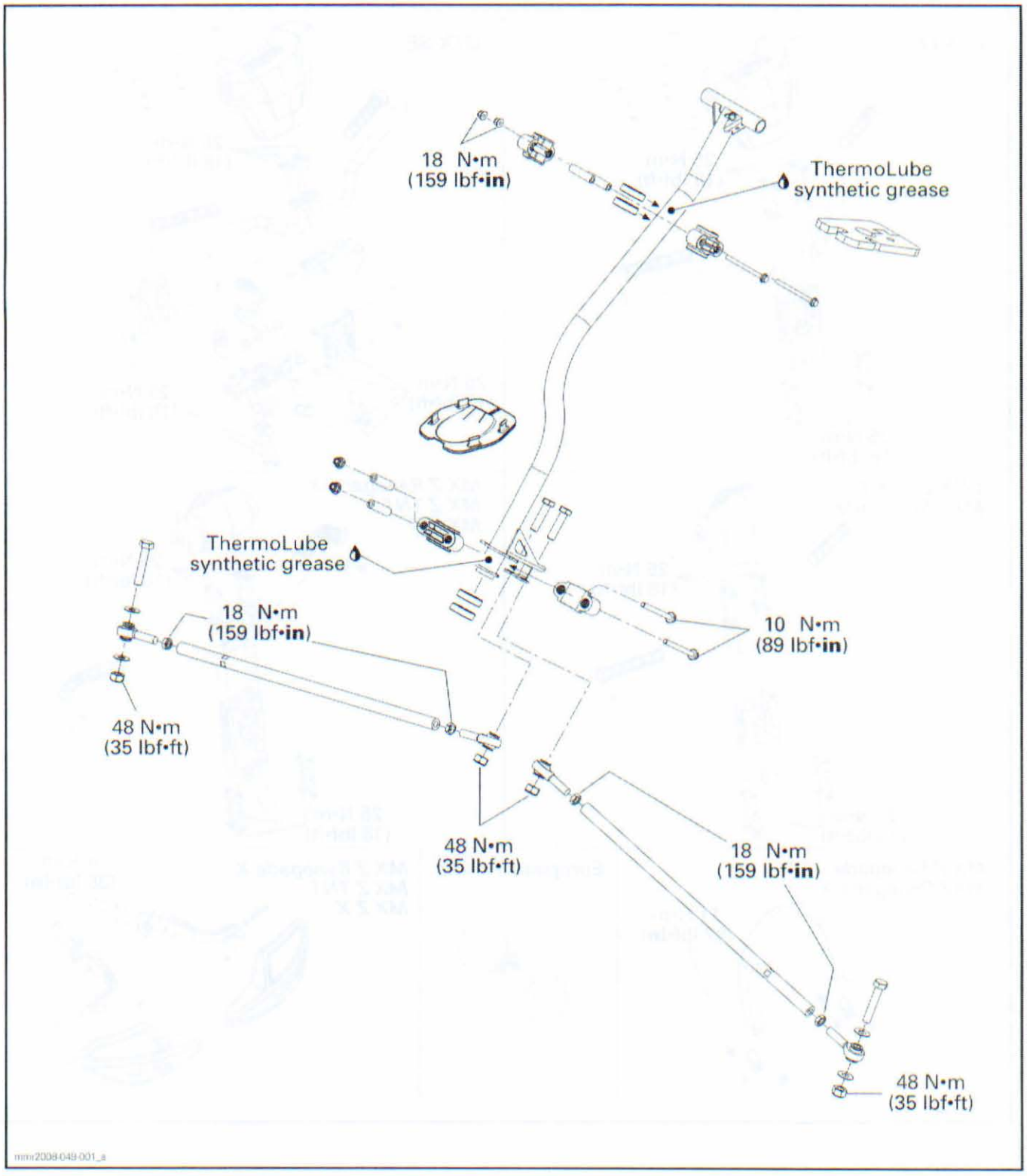
SERVICE PRODUCTS

Description	Part Number	Page
THERMO LUBE SYNTHETIC GREASE	219 700 417	450

SKIS

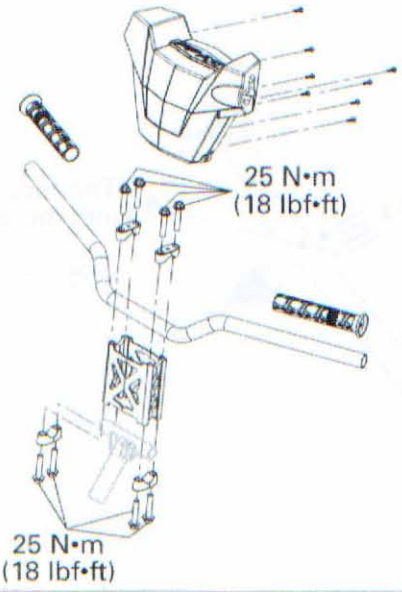

48 N•m
(35 lbf•ft)
8 N•m
(71 lbf•in)
ThermoLube
synthetic
grease
mmr2009-136-001_a

STEERING COLUMN AND TIE-RODS

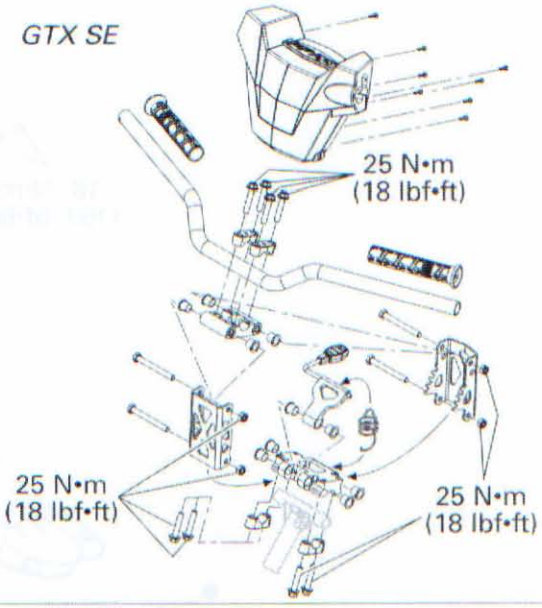


HANDLEBAR

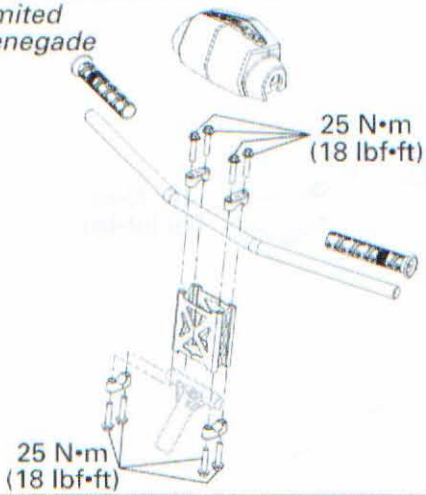
GTX LE



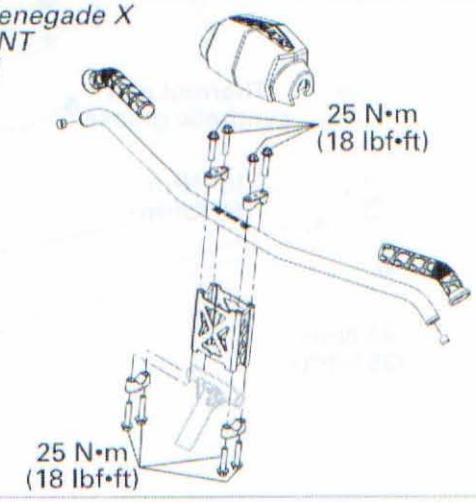
GTX SE



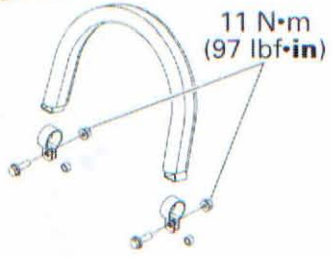
GSX Limited
MXZ Renegade



MX Z Renegade X
MX Z TNT
MX Z X

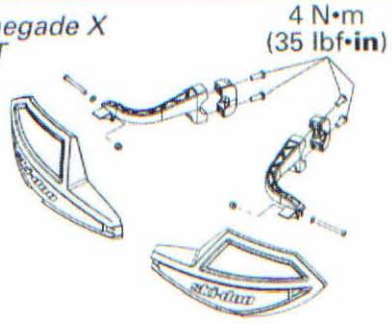


MX Z Renegade
MXZ Renegade X



European models

MX Z Renegade X
MX Z TNT
MX Z X



mmr2009-136-002_a

GENERAL

When removing or replacing a part of steering system (except handle grips and handlebar), perform the steering alignment, refer to *STEERING ALIGNMENT* in this subsection.

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

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

⚠ WARNING

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

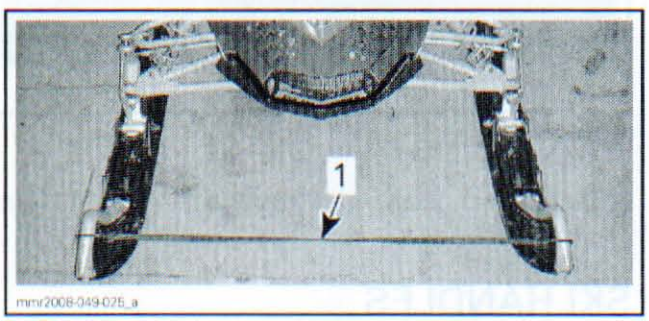
Hoses, cables and locking ties removed during a procedure must be reinstalled as factory standards.

ADJUSTMENT

STEERING ALIGNMENT

Ski alignment is performed by adjusting length of left and right tie-rods. To do this, use the following procedure:

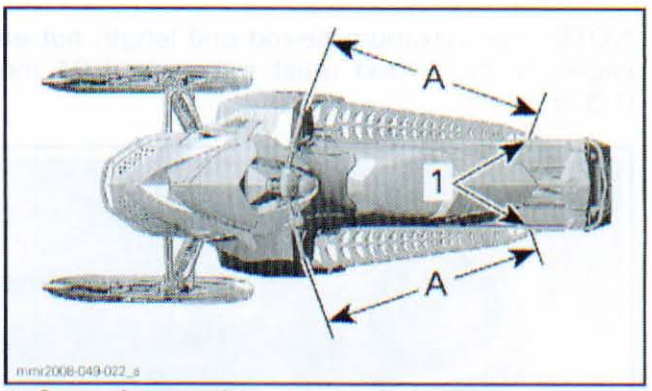
1. Leave the vehicle on the ground on its own weight.
2. Attach ski handles together with a bungee cord.



1. Bungee cord

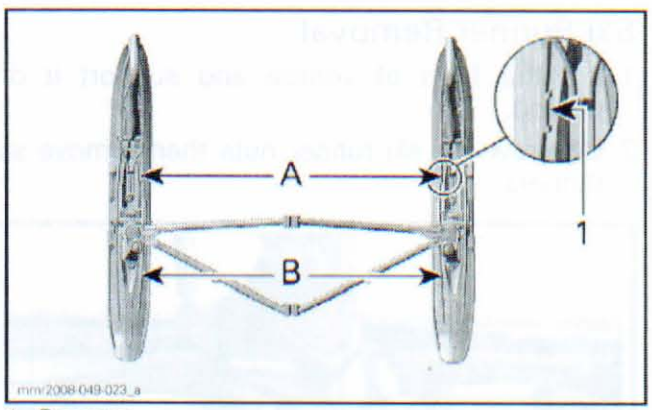
3. Position handlebar so that it is straight ahead position by measuring from the extremities of the grips to the rear most edge of the tunnel, as shown.

NOTE: The reference point must be the same to each side.



1. Same reference point
A. Equal distance on each side

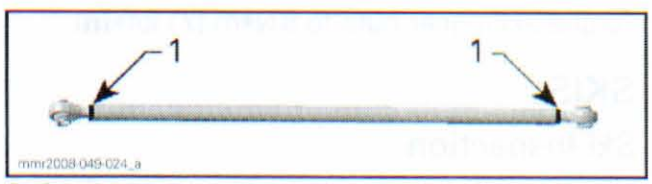
4. Verify if skis are in straight-ahead position by placing a straight edge against adjusted track and measuring distance between front and rear ski recesses and straight edge.
5. When skis are in straight ahead position, adjust the toe-out.
6. Measure the distance between front and rear ski recesses.
7. Use the following illustration and this equation to determine the perfect steering adjustment.



1. Recesses
A – B = 5 MM (.197 IN)

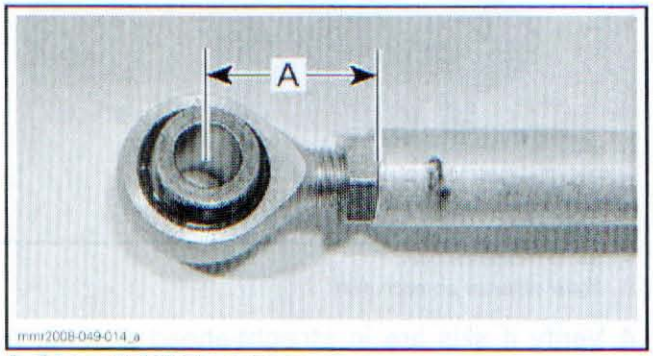
STEERING ALIGNMENT	
Toe-out	5 mm (.197 in)

8. If adjustment is needed, loosen tie-rod jam nuts then turn tie-rods to change their length.
9. Tighten jam nuts and torque them to 18 N•m (159 lbf•**in**).



1. Jam nut

NOTE: The maximum tie-rod end length not engaged in the tie rod must not exceed 34 mm (1.339 in).



A. 34 mm (1.339 in) maximum

PROCEDURES

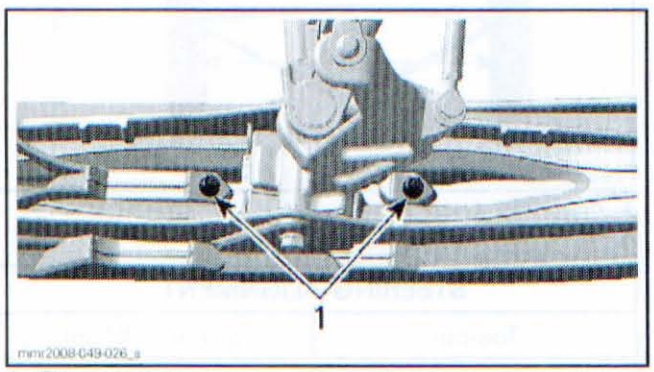
SKI RUNNERS

Ski Runner Inspection

Lift the front of vehicle and check ski runners for wear or damages (missing or broken carbide). Replace if necessary.

Ski Runner Removal

1. Lift the front of vehicle and support it off ground.
2. Unscrew the ski runner nuts then remove ski runners.



1. Ski runner nuts

Ski Runner Installation

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

Torque ski runner nuts to 8 N•m (71 lbf•**in**).

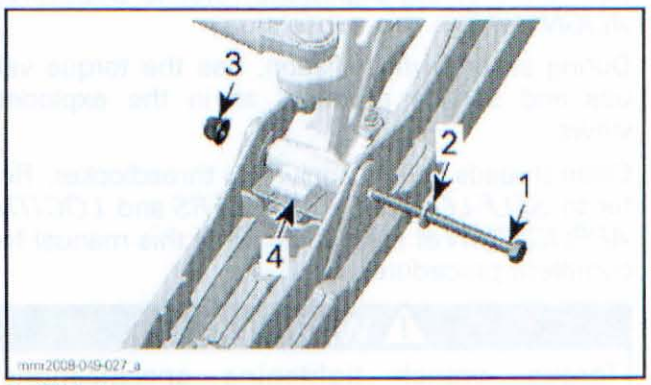
SKIS

Ski Inspection

Inspect ski for excessive wear or other damage. Replace if necessary.

Ski Removal

1. Lift front of vehicle and support it off ground.
2. Unscrew nut then pull ski bolt out.

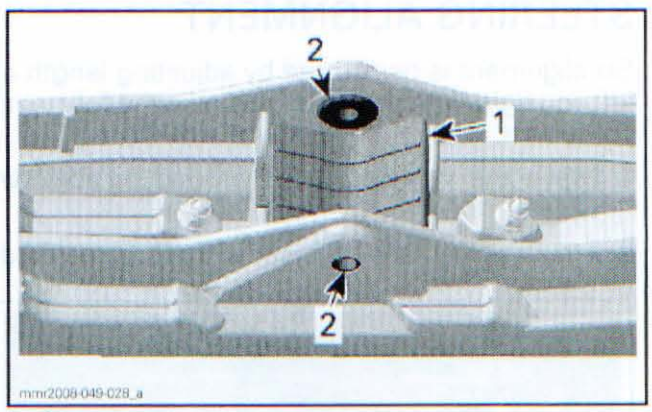


1. Ski bolt
2. Washer
3. Nut
4. Ski leg

3. Remove ski from vehicle.

Ski Installation

1. Make sure bushings are installed in ski holes.
2. Install the ski stopper. Position indicator in front and make sure the bump in the ski is in the groove of the ski stopper.



1. Ski stopper
2. Bushings

3. Install ski bolt and torque it to 48 N•m (35 lbf•ft).

SKI HANDLES

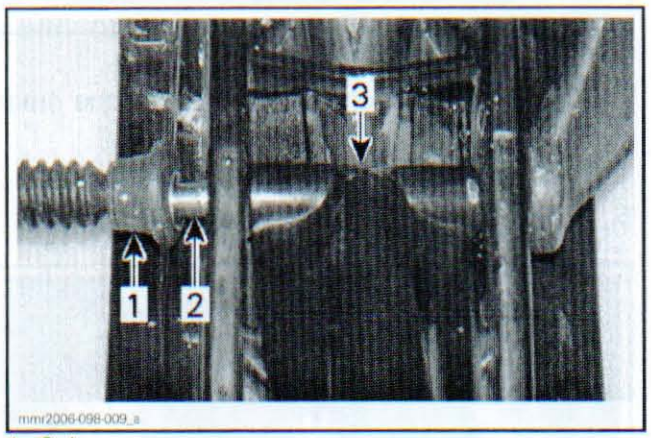
Ski Handle Removal

1. Remove ski from vehicle.
2. Using a 9 mm (3/8 in) drill bit, remove ski handle rivets. Only drill the head of rivet. Do not try to drill all the way through the rivet. Angle the drill bit to reduce the chance of spinning the rivet in the ski.

3. Remove handle from ski.
4. Place handle in hot water for 10 minutes then using a punch, drive the inner part of rivet out of handle.

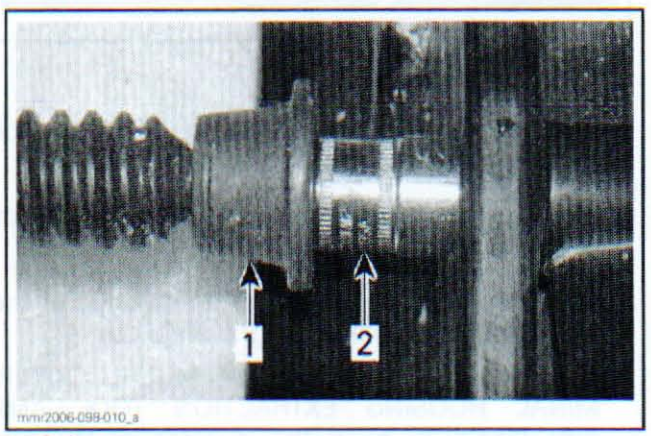
Ski Handle Installation

1. To install rivets, use a C-clamp and a short 10 mm socket.
2. Place a rivet in position and insert it into ski and ski handle. Repeat the procedure for the other side.



1. C-clamp
2. Rivet
3. Handle

3. When both rivets are installed, use the short 10 mm socket to push rivet heads against ski.



1. C-clamp
2. 10 mm socket

SKI LEGS

To replace a ski leg, refer to *FRONT SUSPENSION* subsection.

HANDLEBAR GRIPS

Two handlebar grip types are available, with or without integrated elements.

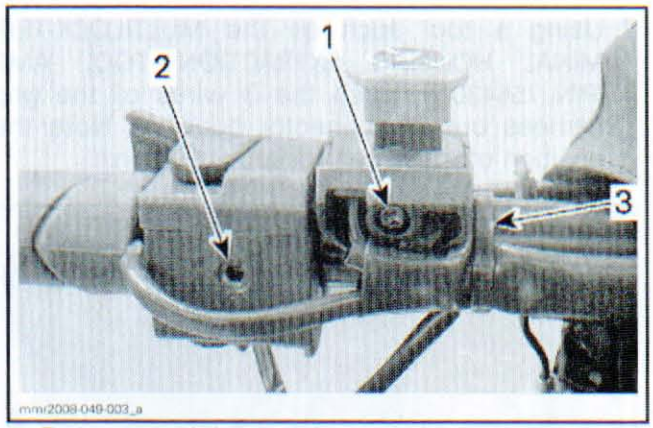
NOTE: To verify heating elements, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

Handlebar Grip Removal (Integrated Heating Element)

NOTICE **Removing grip from handlebar might damage the heating element. Do not remove needlessly.**

Throttle Side:

1. Loosen engine stop switch and throttle lever.



1. Engine stop switch screw
2. Throttle lever screw
3. Cut this locking tie

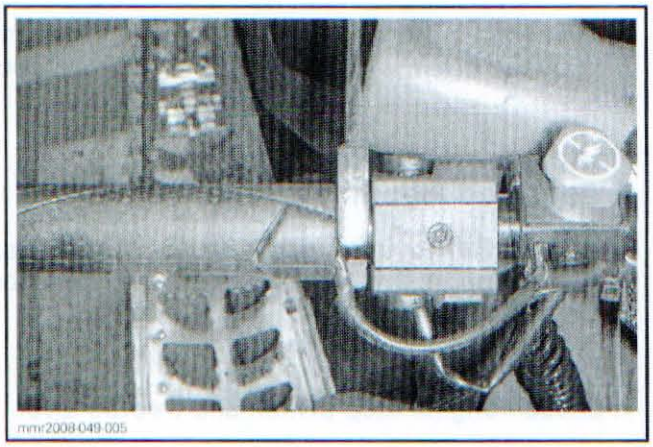
2. Move them towards the steering column.
3. Remove the steering cover.
4. Unplug the heating element connector.

GSX LIMITED SHOWN
1. Heating element connector

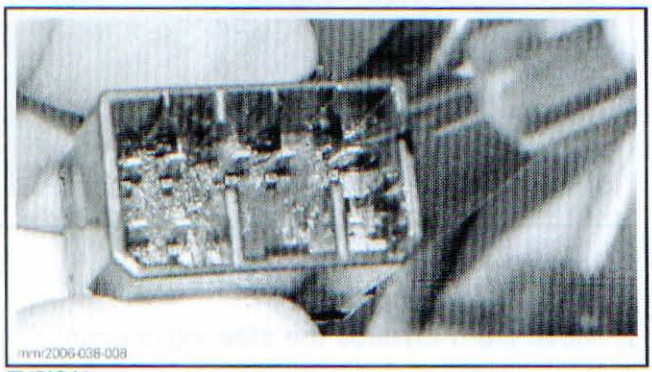
5. Insert the open side of a 23 mm (7/8 in) wrench against the inner end of grip.

NOTICE **Pay attention not to damage wires with the wrench.**

6. Using a plastic hammer, tap on the side of the wrench end to make the grip slide out.



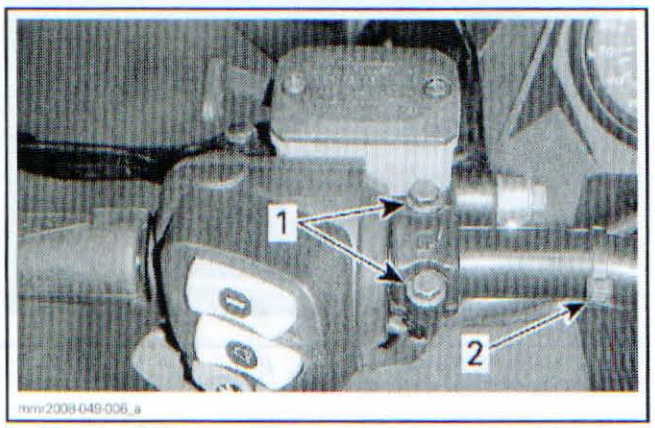
7. Using a tool such as the MULTILOCK-TERMINAL HOUSING EXTRACTION TOOL AMP (P/N 755430-2), push the 3 wires of the grip harness out of connector housing. Note the position of the wires for reinstallation.



TYPICAL

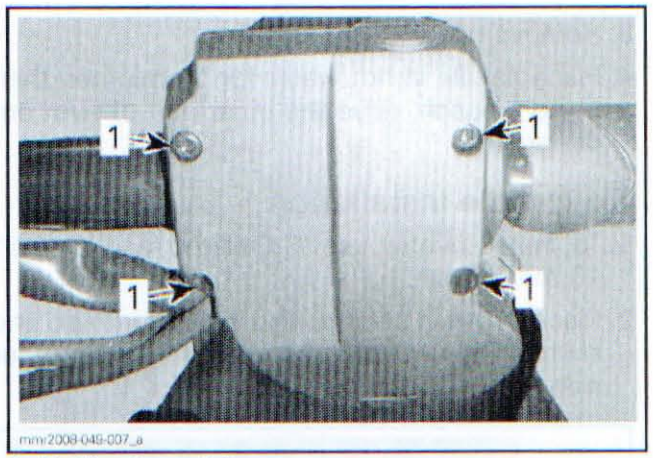
Brake Side:

1. Unscrew master cylinder from handlebar.



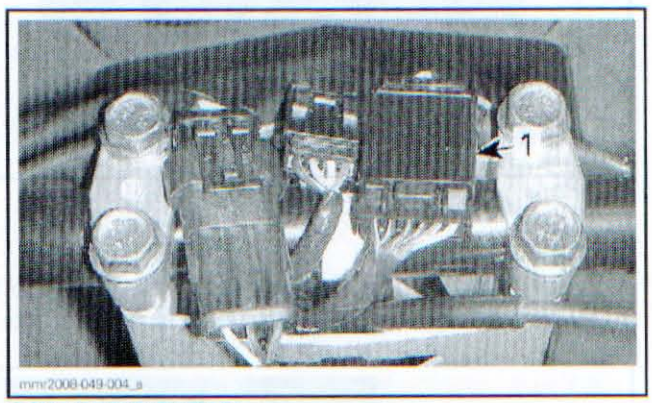
1. Master cylinder screws
2. Cut this locking tie

2. Loosen multifunction switch screws.



1. Multifunction switch screws

3. Move multifunction switch towards the steering column.
4. Remove the steering cover.
5. Unplug the heating element connector.

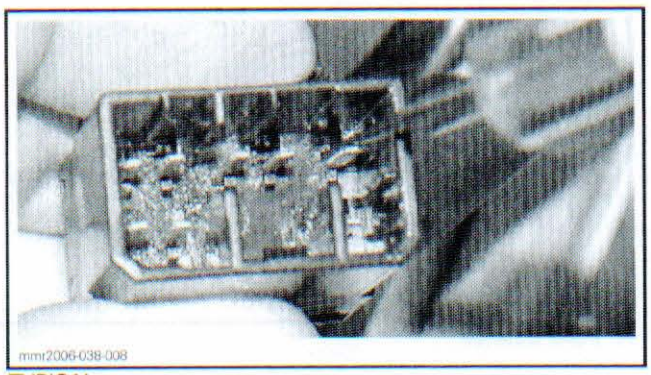


GSX LIMITED SHOWN
1. Heating element connector

6. Insert the open side of a 23 mm (7/8 in) wrench against the inner end of grip.

NOTICE Pay attention not to damage wires with the wrench.

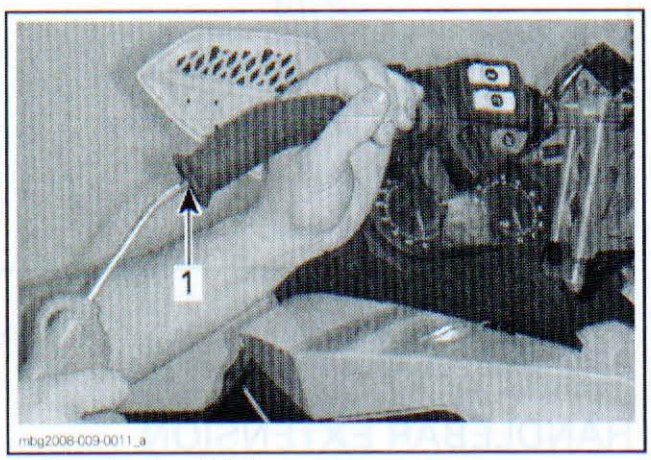
7. Using a plastic hammer, tap on the side of the wrench end to make the grip slide out.
8. Using a tool such as the MULTILOCK-TERMINAL HOUSING EXTRACTION TOOL AMP (P/N 755430-2), push the 3 wires of the grip harness out of connector housing. Note the position of the wires for reinstallation.



TYPICAL

Handlebar Grip Removal (Without Integrated Heating Element)

Remove grips by pulling while using compressed air, which will inflate or loosen the fit between the grip and handlebar, as shown on picture.



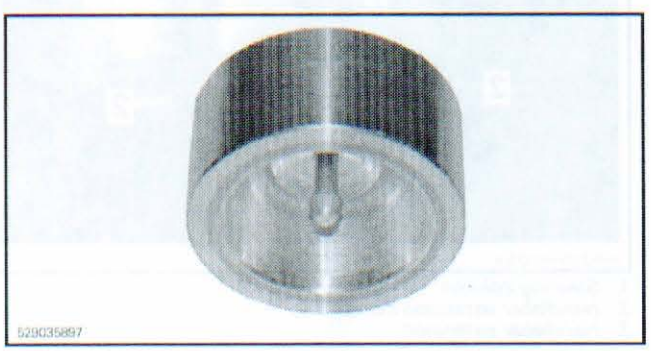
1. Blow air in the grip hole

Handlebar Grip Installation (With Integrated Heating Element)

1. Clean handlebar ends and inside of grip with isopropyl alcohol. Let dry before installation.

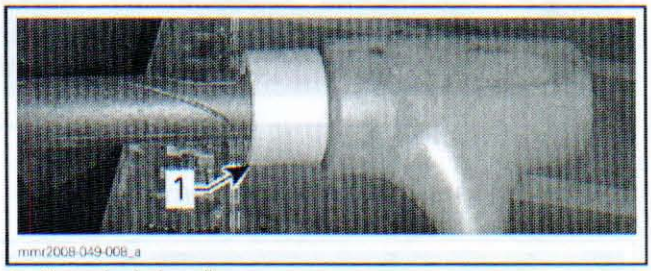
NOTICE **Handlebar end and inside of heating grip must be clean and dry before installing heating grip to ensure proper adhesion.**

2. Use the HEATED GRIP INSTALLER (P/N 529 035 897) to properly install grip.



NOTICE **Installing grip without the insertion tool is likely to damage its heating element.**

3. Position the insertion tool at the outside end of grip.
4. Using a plastic hammer, tap on tool to push grip on. Continue to tap until grip bottoms.



1. Heated grip installer

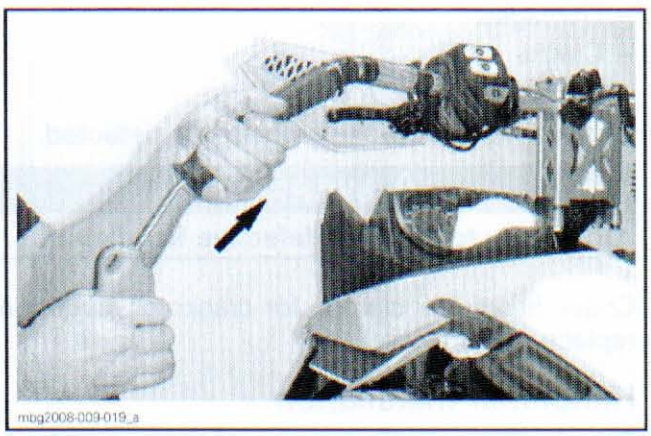
5. Properly route harness at the front of steering.
6. Reinstall terminals and re-plug connectors. Test grips to ensure they heat properly.

NOTE: Note that grips will not work if the engine is at idle speed. Electricity is supplied to grips only if engine is over 2000 RPM.

7. Install all other removed parts.

Handlebar Grip Installation (Without Integrated Heating Element)

Insert the handlebar grip on handlebar while blowing compressed air to inflate or loosen the fit between grip and handlebar.

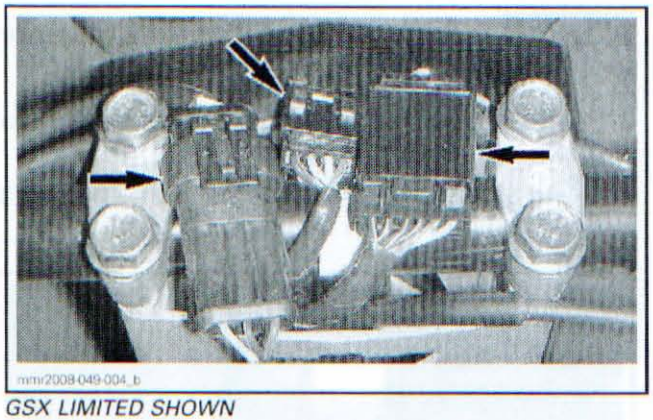


HANDLEBAR

Handlebar Removal

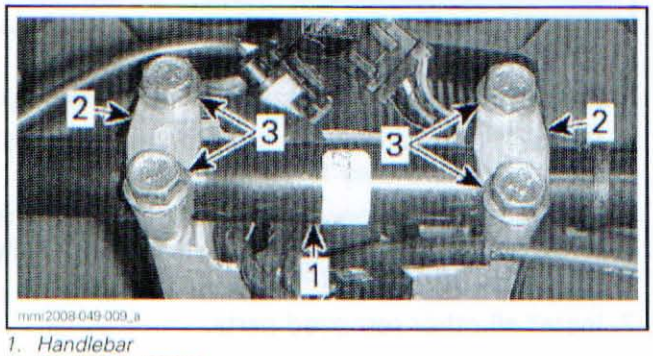
NOTE: If the handlebar must be changed, remove all components (handle grip, throttle lever housing, etc.) before removing it from vehicle.

1. Remove steering cover.
2. Unplug all connectors.



GSX LIMITED SHOWN

3. Remove handlebar retaining clamp screws.



1. *Handlebar*
2. *Retaining clamps*
3. *Screws*

4. Remove handlebar from handlebar extension.

Handlebar Inspection

Inspect the handlebar for:
- Damages
- Cracks
- Bending.

Replace if any of these problems is detected.

⚠ WARNING

Do not try to repair a defective handlebar.

Check handlebar clamps for cracks or distortion, replace if necessary.

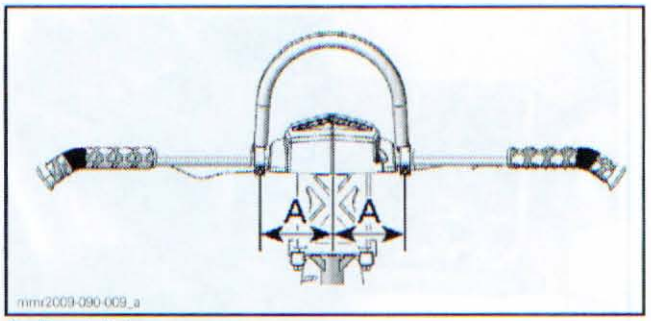
Handlebar Installation

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

Handlebar Strap

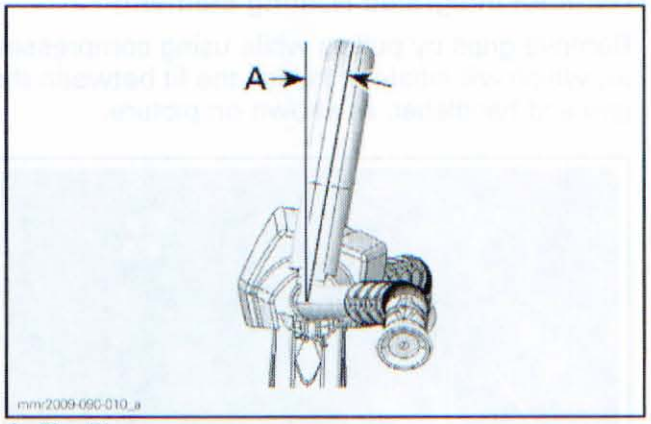
MX Z (Renegade, Renegade X)

1. Ensure to position strap symmetrically each side of handlebar retaining clamps.



A. Equal distance

2. Tilt strap 5° ± 5° towards driver relative to handlebar extension.



A. 5° ± 5°

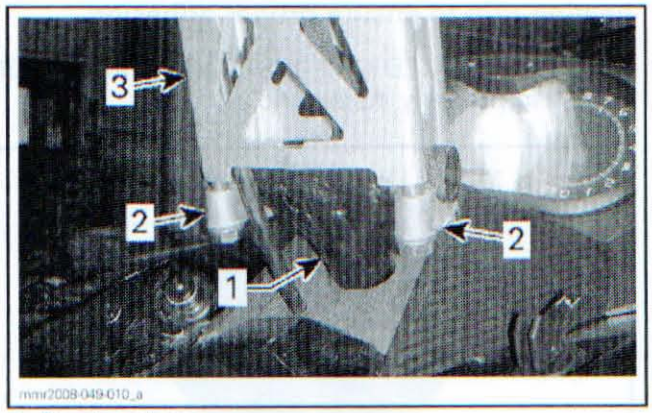
3. Retaining clip and hardware must be installed in the same position on both strap ends.

HANDLEBAR EXTENSION

All Models except GTX SE

Handlebar Extension Removal

1. Remove *HANDLEBAR* from handlebar extension, see procedure in this subsection.
2. Unscrew bolts retaining the extension to steering column.



1. *Steering column*
2. *Handlebar extension clamps*
3. *Handlebar extension*

3. Remove handlebar extension from vehicle.

Handlebar Extension Inspection

Check handlebar extension for:
- Cracks
- Bending
- Other damages.

Replace if any of these problems is detected.

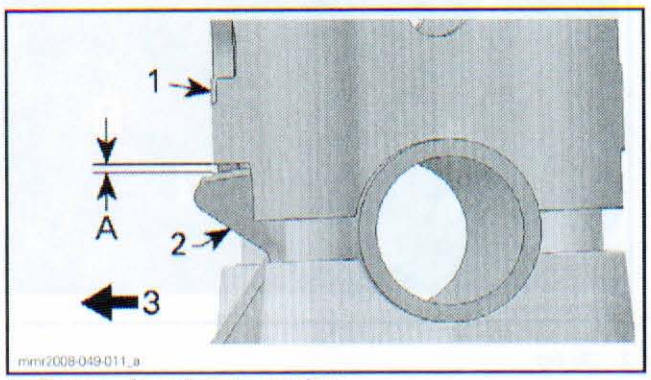
⚠ WARNING

Do not try to repair a defective handlebar extension.

Handlebar Extension Installation

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

When installing handlebar extension, ensure to leave a gap between handlebar extension and stop block on steering column.



1. *Bottom of handlebar extension*
2. *Steering column stop block*
3. *Front of vehicle*

A. 1 mm (.039 in) minimum

⚠ WARNING

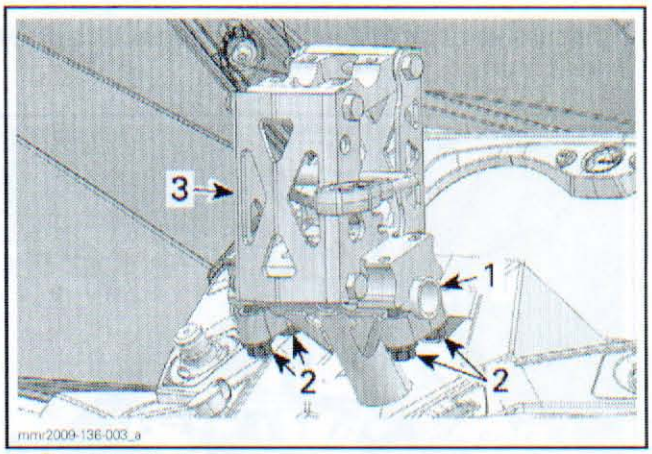
Handlebar and it's components must not get in contact with anything (windshield, fuel tank cap, etc.) when steering is turned.

ADJUSTABLE HANDLEBAR EXTENSION

GTX SE Only

Adjustable Handlebar Extension Removal

1. Remove *HANDLEBAR* from handlebar extension, see procedure in this subsection.
2. Remove screws retaining the adjustable extension to steering column.



1. *Steering column*
2. *Retaining screws*
3. *Adjustable handlebar extension*

3. Remove the adjustable handlebar extension from vehicle.

Adjustable Handlebar Extension Inspection

Check adjustable handlebar extension for:
- Cracks
- Bending
- Other damages.

Check the proper operation of the locking mechanism.

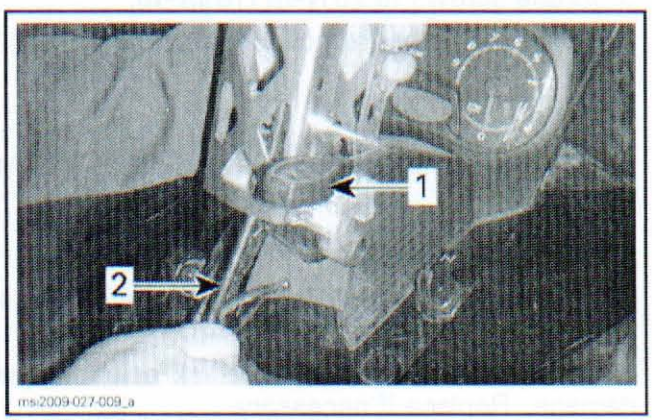
Replace if any of these problems is detected.

⚠ WARNING

Do not try to repair a defective adjustable handlebar extension.

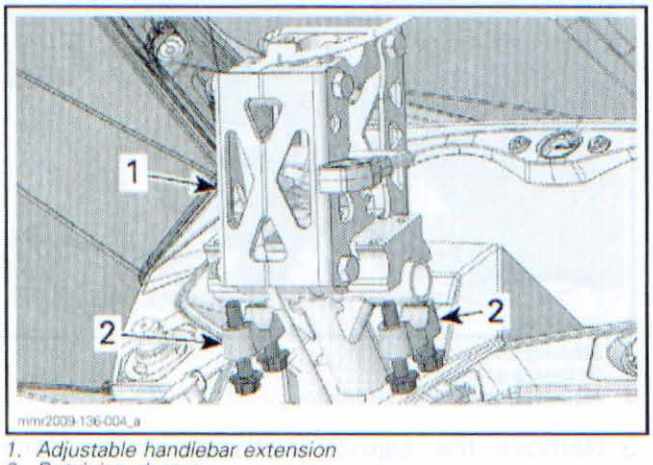
Adjustable Handlebar Extension Installation

1. Insert throttle cable in the adjustable handlebar extension.



1. *Adjustable handlebar extension*
2. *Throttle cable*

2. Secure adjustable handlebar extension to steering column.

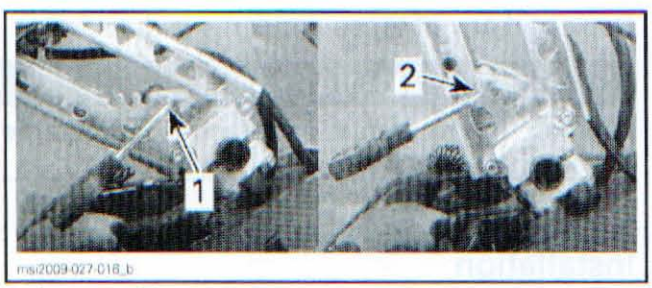


1. Adjustable handlebar extension
2. Retaining clamps

NOTE: Make sure adjustable extension is well centered on steering column.

⚠ WARNING

Handlebar and it's components, settled in any position, must not get in contact with anything (windshield, fuel tank cap, etc.) when steering is turned.



1. Lower position
2. Higher position

3. Torque screws to 25 N•m (18 lbf•ft).
4. Reinstall all other removed parts.

TIE-RODS

NOTE: The same procedure is applied on RH and LH side.

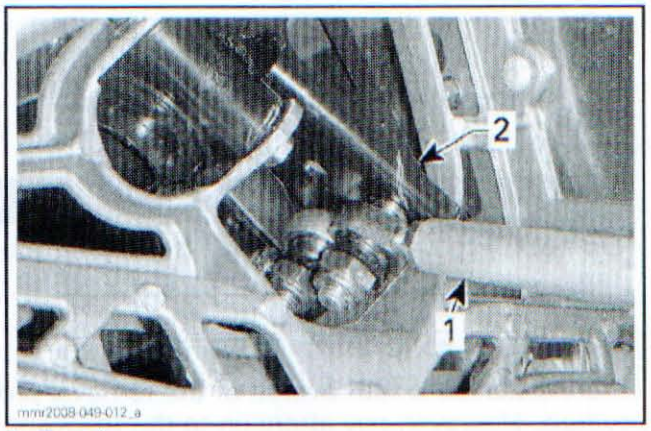
Tie-Rod Inspection

Check tie-rod ends for looseness. If play is excessive, replace tie-rod.

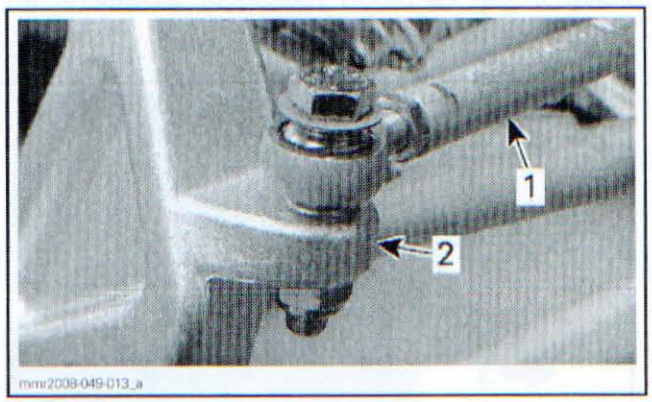
Check if the tie-rod is bend, crack or otherwise damage. Replace if necessary.

Tie-Rod Removal

1. Remove the tie-rod ends from the steering column and ski leg.



1. Tie-rod
2. Steering column



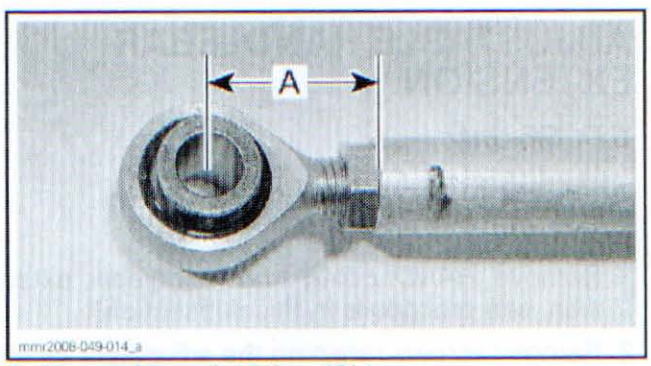
1. Tie-rod
2. Ski leg

2. Remove tie-rod from vehicle.

Tie-Rod Installation

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

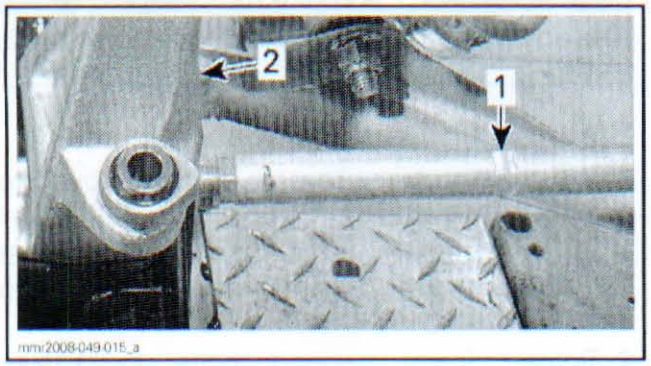
Adjust each tie-rod end length of both tie-rod ends to 30 mm ± 0.5 mm (1.181 in ± .02 in).



A. 30 mm ± 0.5 mm (1.181 in ± .02 in)

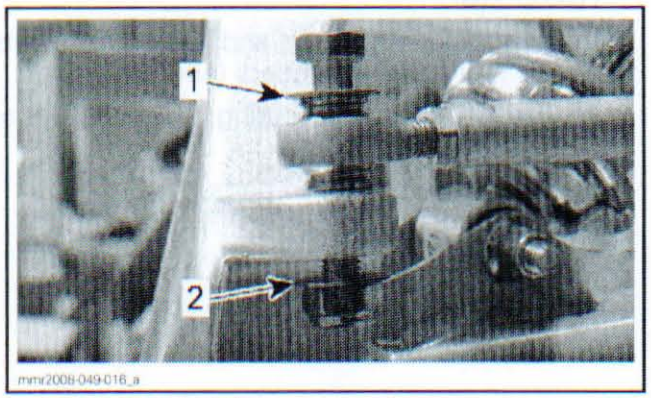
NOTE: The maximum tie-rod end length not engaged in the tie rod must not exceed 34 mm (1.339 in).

Install tie-rod with the groove on ski leg side.



1. *Tie-rod groove*
2. *Ski leg*

On ski leg side, install hardened washers as shown.



1. *Large hardened washer*
2. *Small hardened washer*

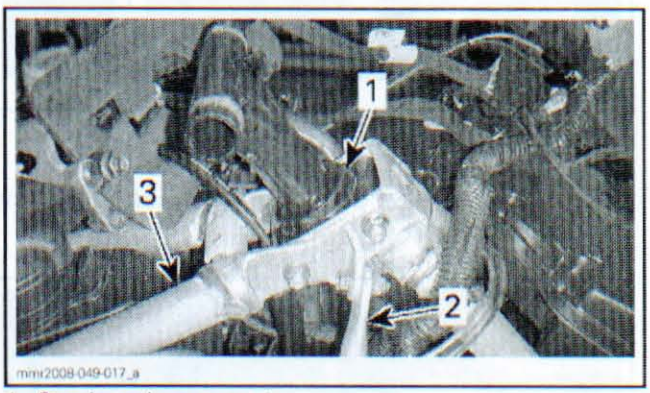
Install nuts retaining tie-rod ends. Torque them to 48 N•m (35 lbf•ft).

Perform the steering alignment, refer to *STEERING ALIGNMENT* in this subsection.

STEERING COLUMN

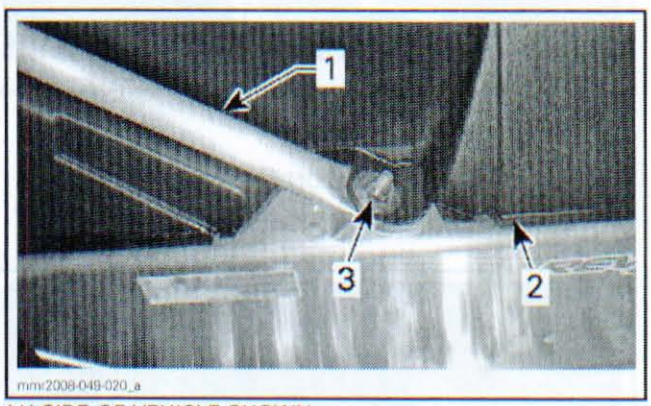
Steering Column Removal

1. Refer to *BODY* subsection to remove the following parts:
   - Seat(s)
   - RH side panel
   - Hood
   - Console.
2. Remove gauge support and console. Refer to *BODY* subsection.
3. Remove *HANDLEBAR EXTENSION* or *ADJUSTABLE HANDLEBAR EXTENSION* from steering column, see procedure in this subsection.
4. Remove screws securing steering column upper support.
5. Remove screws securing side frame members to rear frame member.



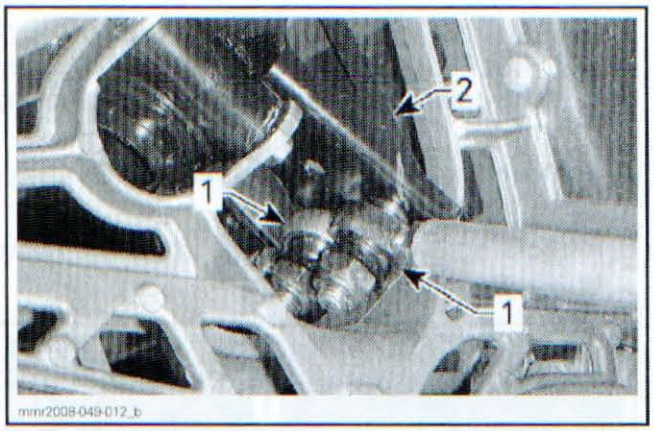
1. *Steering column support*
2. *RH side frame member*
3. *Rear frame member*

6. Remove seat.
7. Unscrew nuts retaining rear frame member and fuel tank to frame.



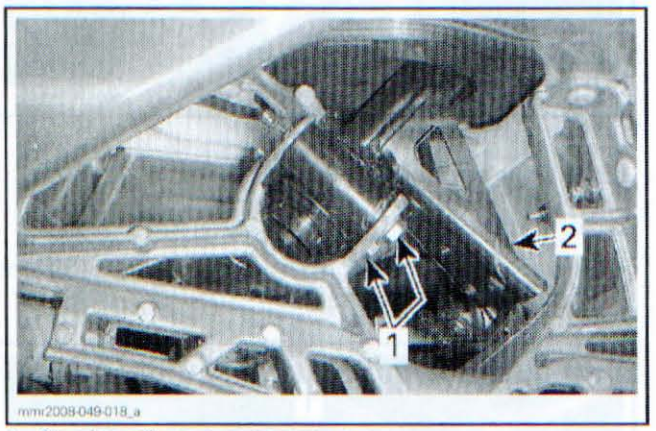
LH SIDE OF VEHICLE SHOWN
1. *Rear frame member*
2. *Fuel tank*
3. *Nut to remove*

8. Remove exhaust pipe. Refer to *EXHAUST SYSTEM* subsection.
9. Remove the tie-rod ends from the steering column.



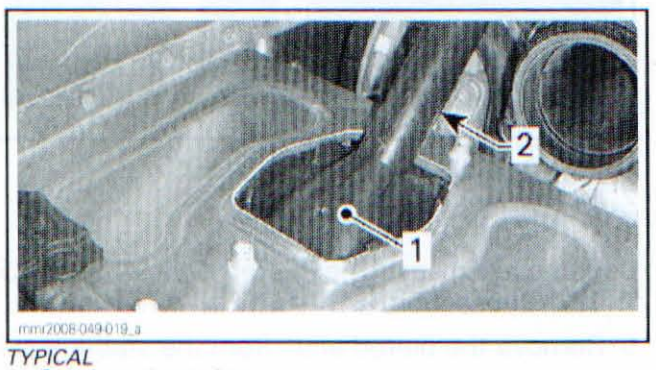
1. *Tie-rod ends*
2. *Steering column*

10. Remove screws securing the steering column lower support.



1. *Steering column support screws*
2. *Steering column*

11. Remove lower support.
12. Remove the steering column plate.



TYPICAL
1. *Steering column plate*
2. *Steering column*

13. Pull steering column from top.

Steering Column Inspection

Check if steering column is:
- Cracked
- Bent
- Twist
- Otherwise damaged.

Replace steering column if necessary.

⚠ WARNING

Do not try to repair a defective steering column.

Steering Column Installation

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

1. Apply THERMO LUBE SYNTHETIC GREASE (P/N 219 700 417) on vibration dampers before installing upper and lower supports.
2. Tighten lower support bolts to 10 N•m (89 lbf•**in**).
3. Install rear frame members.
4. Tighten the upper support bolts to 18 N•m (159 lbf•**in**).
5. Install shoulder bushings and **NEW** elastic nuts on the rear frame members (one each side).
6. Torque elastic nuts securing the fuel tank to 33 N•m (24 lbf•ft).
7. Install all other removed parts.

BODY

SERVICE TOOLS

Description	Part Number	Page
FUEL TANK NUT WRENCH	529 035 891	458
SUPERTITANIUM DRILL BIT 3/16"	529 031 800	456

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
ARROW ELECTRIC TACKER GUN	ETFX50	461
ARROW HEAVY DUTY TACKER GUN	T50	461

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	463

GENERAL

CLEANING

Seat Cleaning

It is recommended to clean the seat with a solution of warm soapy water, using a soft clean cloth.

NOTICE Avoid use of harsh detergents such as strong soaps, degreasing solvents, abrasive cleaners, paint thinners, etc. that may cause damage to the seat cover.

Plastic Cleaning

Clean the vehicle thoroughly, removing all dirt and grease accumulation.

To clean use a soft clean cloth and either soapy water or isopropyl alcohol.

To remove grease, oil or glue use isopropyl alcohol.

NOTICE Do not apply isopropyl alcohol or acetone directly on decals.

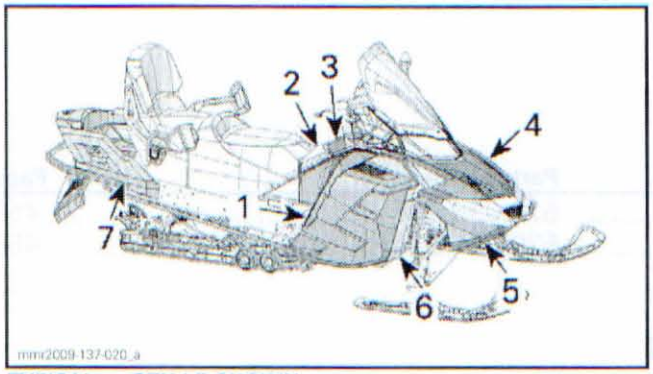
NOTICE The following products must not be applied on the plastic components used on the vehicles:

- Gasoline
- Brake fluid
- Kerosene
- Diesel fuel
- Lighter fluid
- Varsol
- Naphtha
- Acetone
- Strong detergents
- Abrasive cleaners
- Waxes containing an abrasive or a cleaning agent in their formula.

Apply a non abrasive wax on glossy finish only.

BODY PARTS REPAIR

The very first step before repairing plastic materials is to find out exactly which type of material is involved.



TYPICAL — GTX LE SHOWN

PLASTIC PARTS		
PARTS		MATERIAL
1	Side panel	Surlyn/popypropylene
2	Console	Surlyn
3	Gauge support	Polypropylene
4	Hood	Surlyn
5	Front bottom pan	Polypropylene
6	Side bottom pan	Polypropylene
7	Trunk	Polypropylene

NOTICE Some repair products are not compatible with certain plastics.

⚠ WARNING

Polycarbonate windshields must never be repaired by welding or otherwise.

The following company provides a complete line of products to repair plastic materials:

CREST INDUSTRIES, INC.
Trenton, MI 48183
Phone: 734 479-4141
Toll Free: 1 800 822-4100
Fax: 734 479-4040
E-Mail: info@crestauto.com
www.crestauto.com

PROCEDURES

DECAL

Decal Replacement

1. To remove a decal; heat old decal with a heat gun and peel off slowly.
2. Using isopropyl alcohol, clean the surface and dry thoroughly.
3. Apply liquid soap to new decal and carefully position the decal. Using a sponge or a squeegee, remove the air bubbles and surplus water working from the center toward the edges. Allow to air dry.

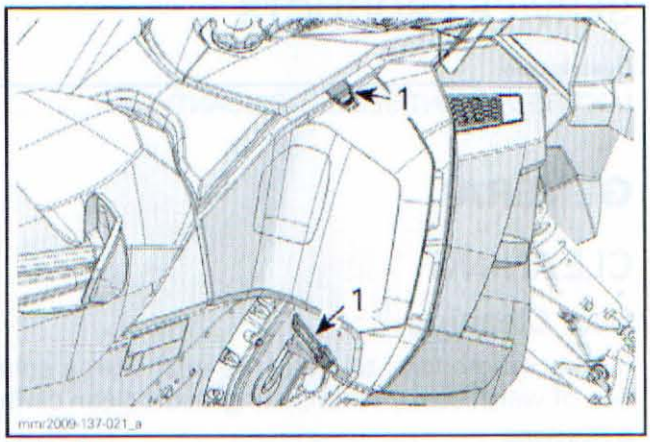
NOTICE Do not apply isopropyl alcohol or solvent directly on decals. Use only in a well ventilated area.

SIDE PANEL

Side Panel Removal

NOTE: The same procedure applies for RH or LH side.

1. Stretch and unhook the latches.

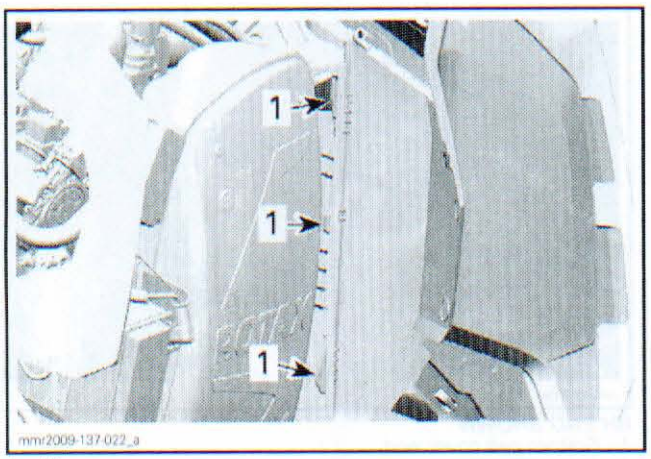


1. Latches

2. Open side panel.
3. Lift up the side panel and move the lower and center hinges out of its slots.
4. Free the upper hinge from its slot by lowering the side panel.

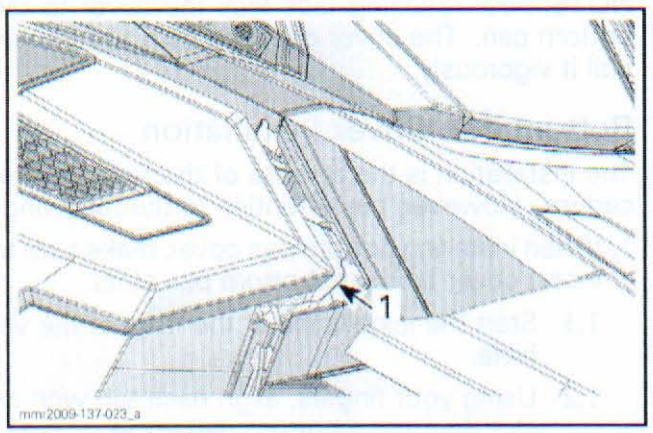
Side Panel Installation

Insert the 3 hinges in side bottom pan holes.



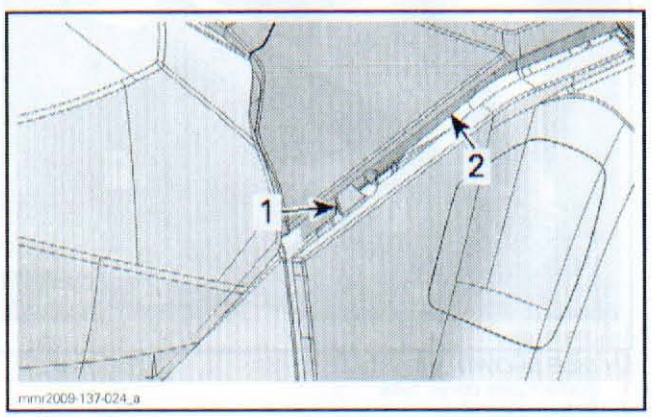
1. Hinges

Make sure the front top triangle is inserted correctly under side bottom pan.



1. Front top triangle

Insert the rear tab under console.



1. Rear tab
2. Console

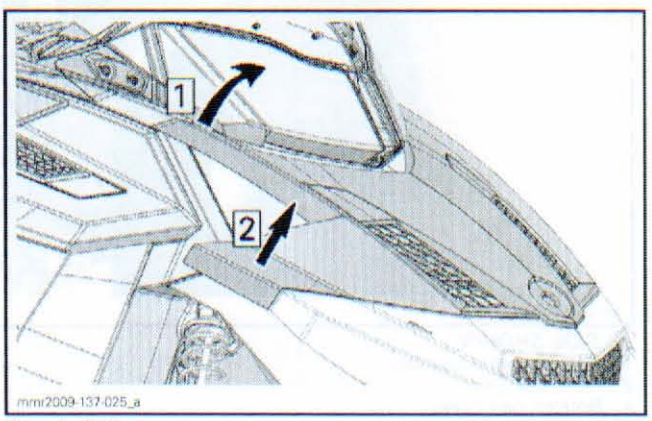
Attach both latches.

HOOD

Hood Removal

1. Hood

1. Pull up the rear end of the hood on both sides until it is disengaged from the console.
2. Lift the rear end of the hood until it disengages from the bottom pan.



Step 1: Pull up
Step 2: Lift

3. Lift the hood to disengage it from the bottom pan cover.

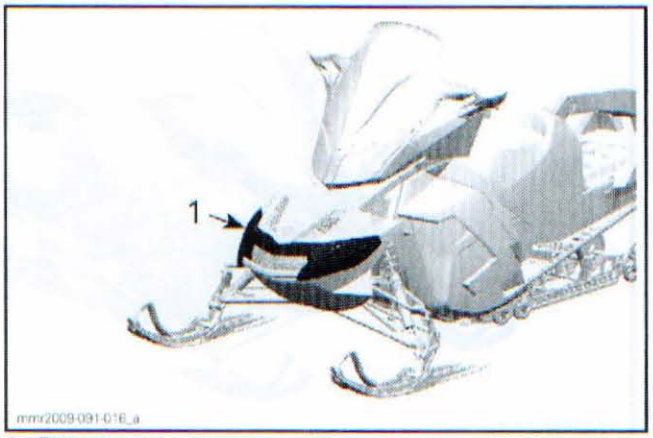
Hood Installation

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

Position the hood hook in bottom pan cover hole then flip the hood in place.

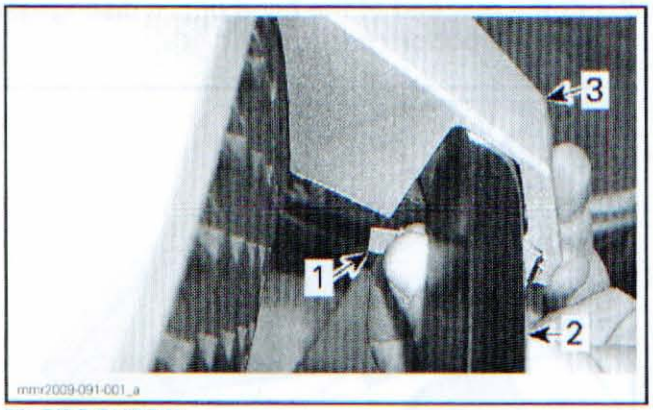
BOTTOM PAN COVER

Bottom Pan Cover Removal



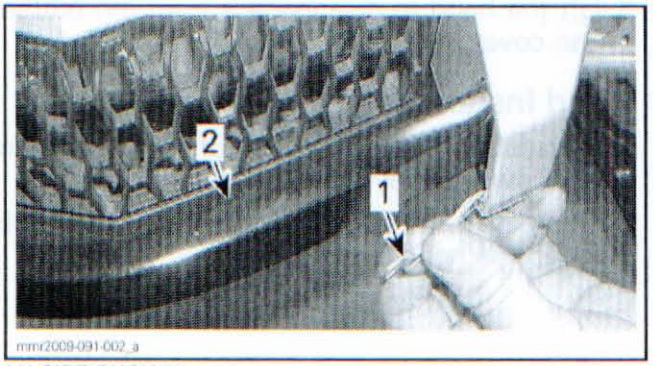
1. Bottom pan cover

1. Lower both locks located under the front bumper.



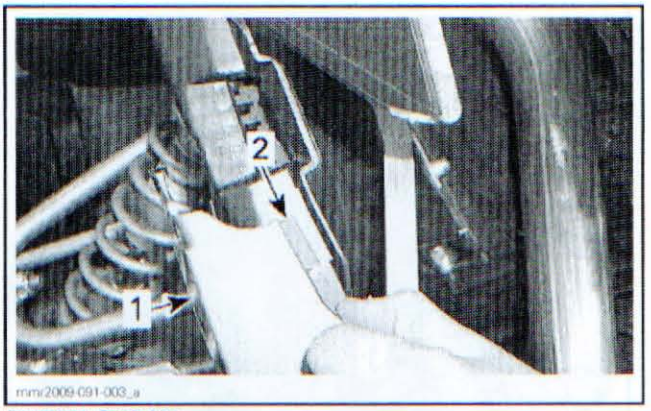
LH SIDE SHOWN
1. Bottom pan cover lock
2. Front bumper
3. Bottom pan cover

2. Pull locks toward the front of vehicle.



LH SIDE SHOWN
1. Bottom pan cover lock
2. Front bumper

3. Move the ends of cover away to release cover tabs.



RH END SHOWN
1. Bottom pan cover end
2. Cover tab

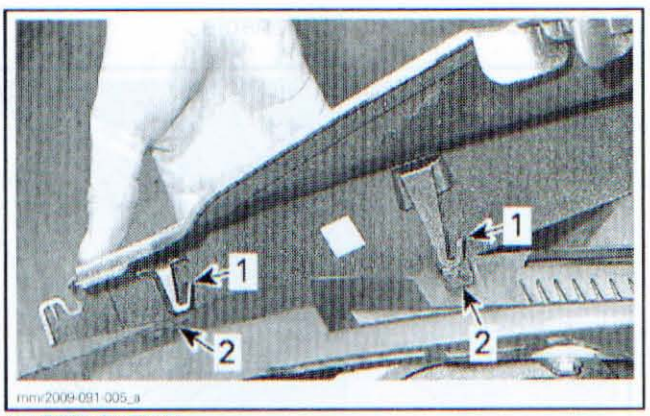
4. Hold both ends of the cover and pull the cover in your direction.

NOTE: Four retaining tabs lock the cover to the bottom pan. The cover could be hard to remove, pull it vigorously.

Bottom Pan Cover Installation

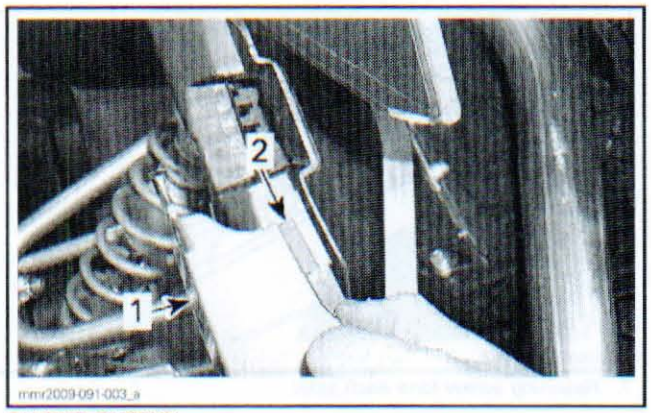
The installation is the reverse of the removal procedure. However, pay attention to the following.

1. When installing bottom pan cover, make sure to insert cover tabs into bottom pan slots.
   1.1 Start the installation at the front of the vehicle.
   1.2 Using your fingers, align each tab with its slot then push bottom pan cover.



LH SIDE SHOWN
1. Bottom pan cover tabs
2. Bottom pan slots

2. Replace front locks in their original position.
3. Insert both cover tabs in their slots.

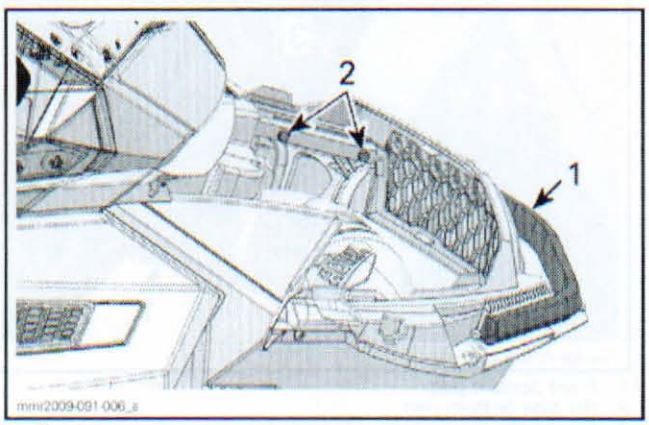


RH END SHOWN
1. *Bottom pan cover end*
2. *Cover tab*

FRONT BUMPER

Front Bumper Removal

1. Remove *HOOD* and *BOTTOM PAN COVER*, see procedures in this subsection.
2. Remove screws securing front bumper to frame.

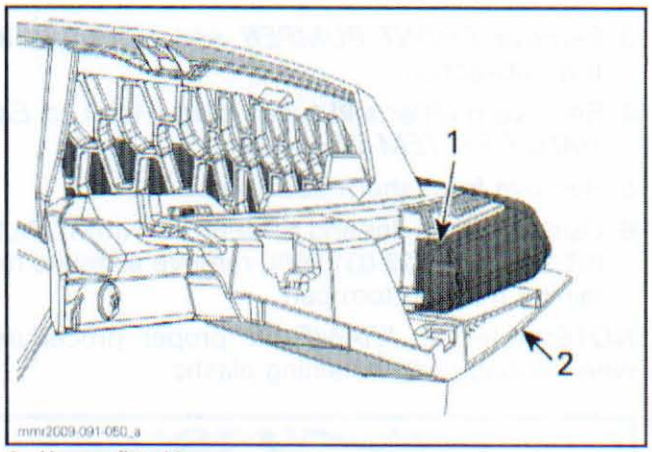


1. *Front bumper*
2. *Front bumper screws*

3. Remove bumper from vehicle by pulling it toward the front of vehicle.

Front Bumper Installation

1. Install bumper on vehicle. Position the narrow flat side on top.

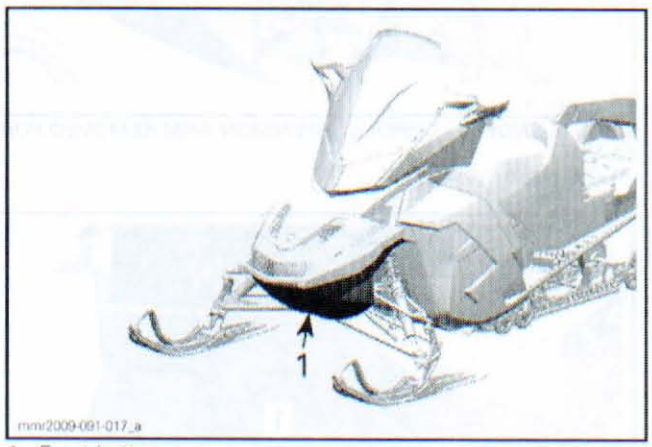


1. *Narrow flat side*
2. *Bottom pan*

2. Tighten bumper screws to 10 N•m (89 lbf•**in**).
3. Install bottom pan cover and hood.

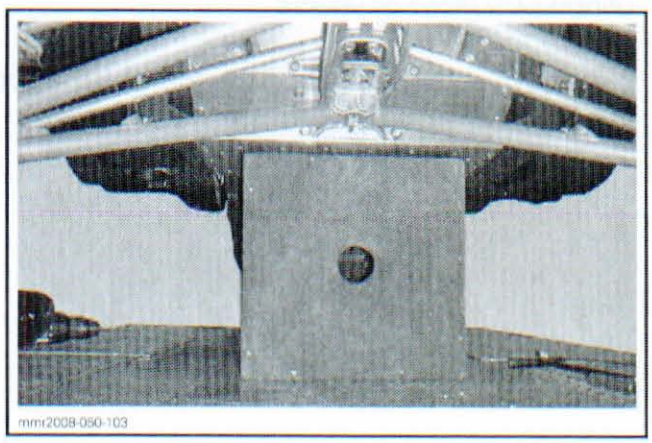
FRONT BOTTOM PAN

Front Bottom Pan Removal



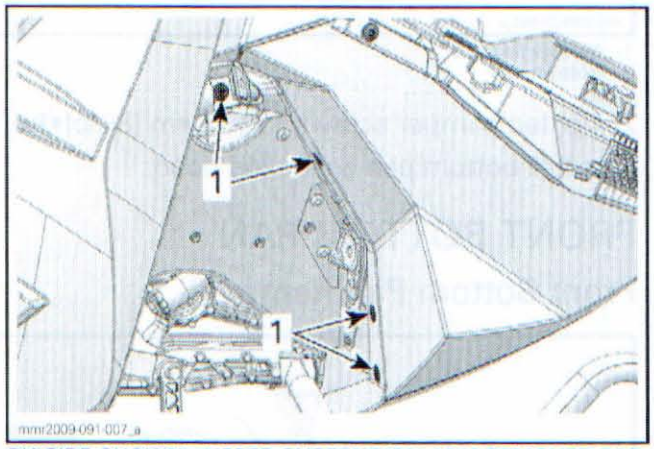
1. *Front bottom pan*

1. Lift front of vehicle until skis are off the ground.
2. Place the front portion of frame on a wooden box to support it securely.

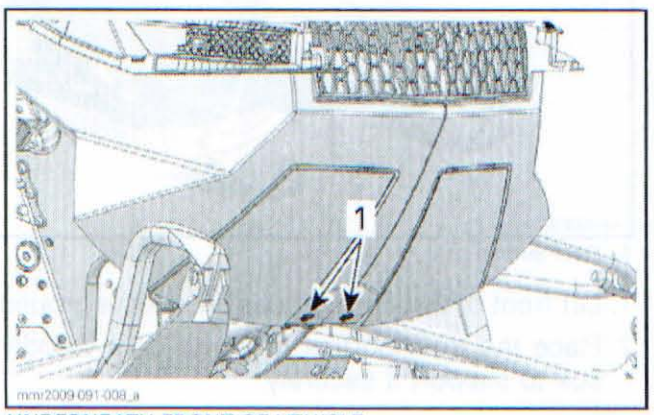


3. Remove *FRONT BUMPER*, see procedure in this subsection.
4. Remove muffler and tuned pipe. Refer to *EXHAUST SYSTEM* subsection.
5. Remove front shock absorbers.
6. Using an angle drill and a SUPERTITANIUM DRILL BIT 3/16" (P/N 529 031 800), remove all rivets retaining front bottom pan.

NOTE: Refer to *FRAME* for proper procedure when drilling rivets retaining plastic.



RH SIDE SHOWN - UPPER SUSPENSION ARM REMOVED FOR CLARITY
1. Drill these rivets



UNDERNEATH FRONT OF VEHICLE
1. Drill these rivets

7. Remove screws securing the top of front bottom pan.

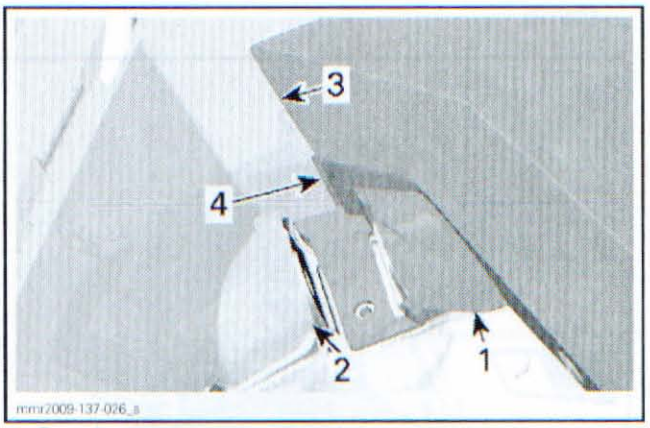
1. Retaining screw (one each side)

8. Remove bottom pan.

Front Bottom Pan Installation

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

Above shock absorber upper bracket, install the front bottom pan behind the side bottom pan to have a good fit.



1. Front bottom pan
2. RH side bottom pan
3. Front bottom pan over side bottom pan
4. Front bottom pan behind side bottom pan

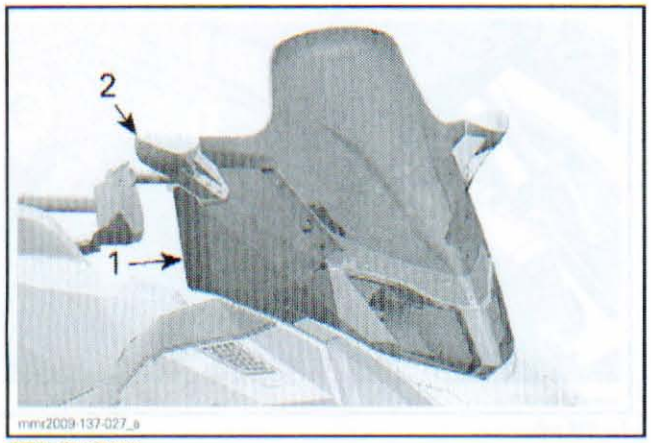
WINDSHIELD

Windshield Removal

Place your hands on each side of windshield.

Pull the windshield until its pins come out of rubber grommets.

NOTE: On GSX and GTX LE, free both deflectors first by pulling them vertically outside of vehicle.



GTX SHOWN
1. *Windshield deflector*
2. *Mirror*

Under headlights, disengage the tab inserted in the gauge support slot.

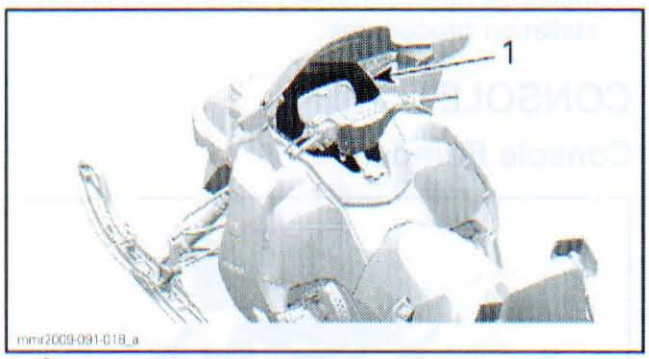
Windshield Installation

The installation is the reverse of removal procedure.

NOTE: Make sure not to push grommets through gauge support holes.

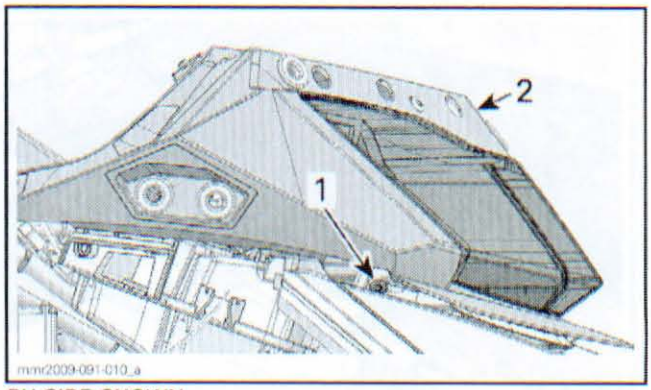
GAUGE SUPPORT

Gauge Support Removal

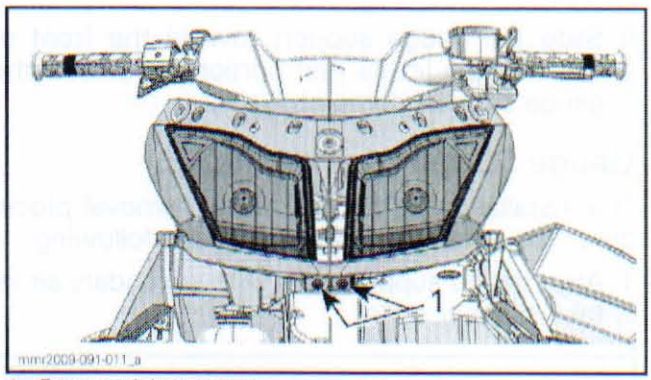


1. *Gauge support*

1. Remove *WINDSHIELD*, see procedure in this subsection.
2. Remove *CONSOLE*, see procedure in this subsection.
3. Remove the multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
4. Unplug headlight connectors.
5. Remove screws securing the gauge support.

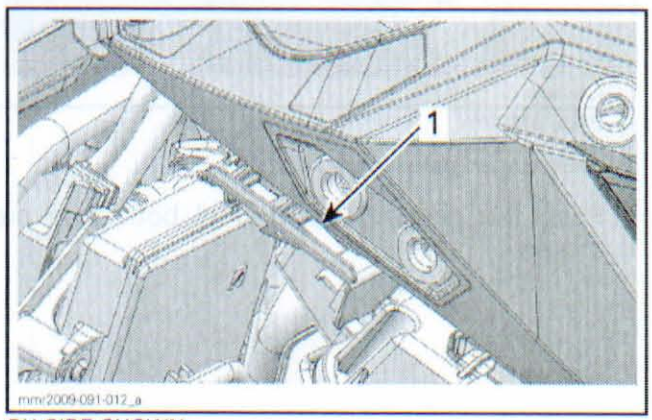


RH SIDE SHOWN
1. *Retaining screw*
2. *Gauge support*

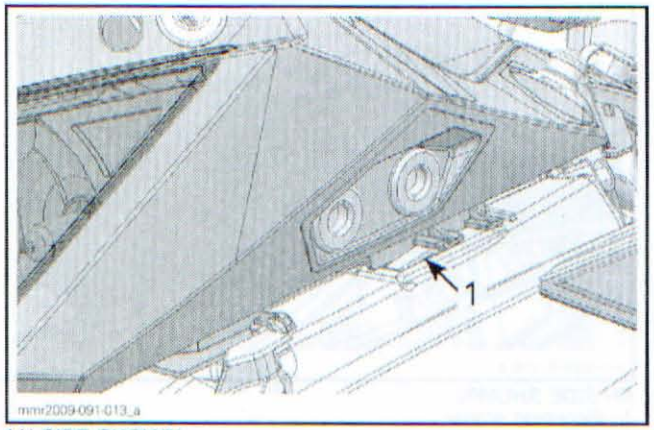


1. *Front retaining screws*

6. On so equipped models, unplug the 12-volt power outlet, the D.E.S.S. post and the visor outlet.
7. On LH and RH sides, press and hold the tabs securing gauge support to secondary air intake silencer.



RH SIDE SHOWN
1. *Press this tab*



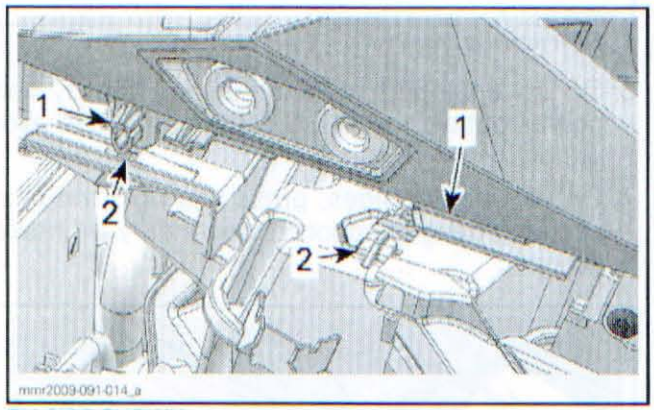
LH SIDE SHOWN
1. Press this tab

8. Slide the gauge support toward the front of vehicle then lift its rear portion to remove the gauge support completely.

Gauge Support Installation

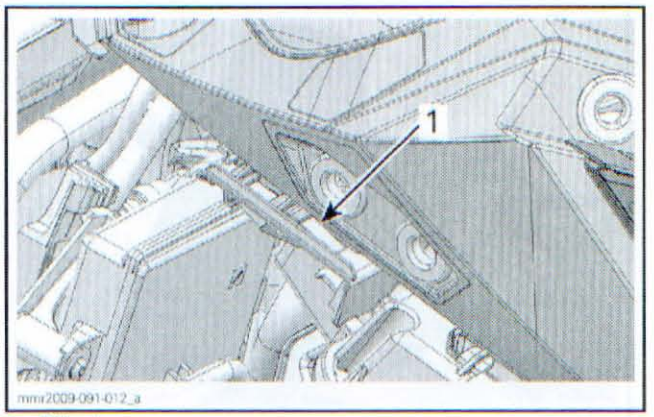
The installation is the reverse of removal procedure. However, pay attention to the following.

1. Align gauge support tabs with secondary air intake silencer slots.

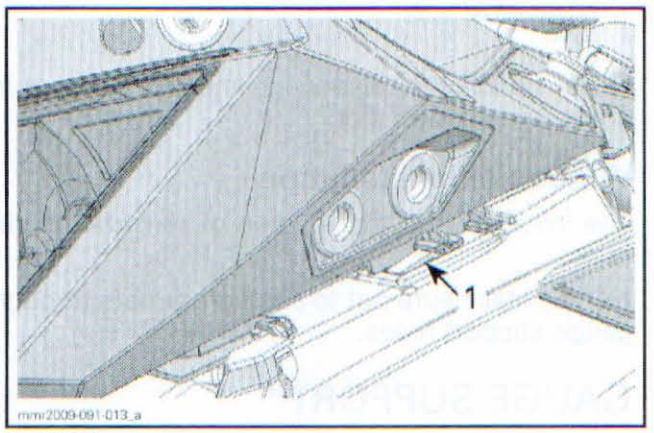


RH SIDE SHOWN
1. Gauge support tabs
2. Secondary air intake silencer slots

2. Push the gauge support until both tabs are locked.



1. RH tab



1. LH tab

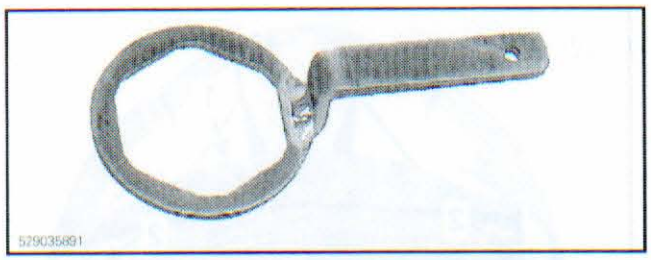
3. Install all other removed parts using proper installation procedures.

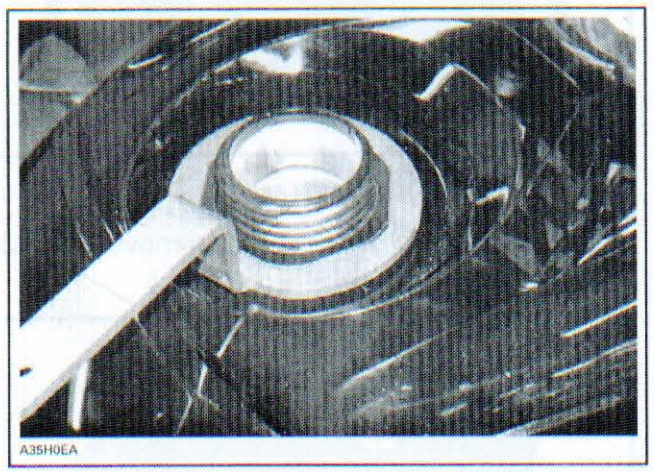
CONSOLE

Console Removal

1. Console

1. Remove LH and RH side panels.
2. Remove seat.
3. Remove fuel tank cap.
4. Using the FUEL TANK NUT WRENCH (P/N 529 035 891), unscrew the fuel tank nut.





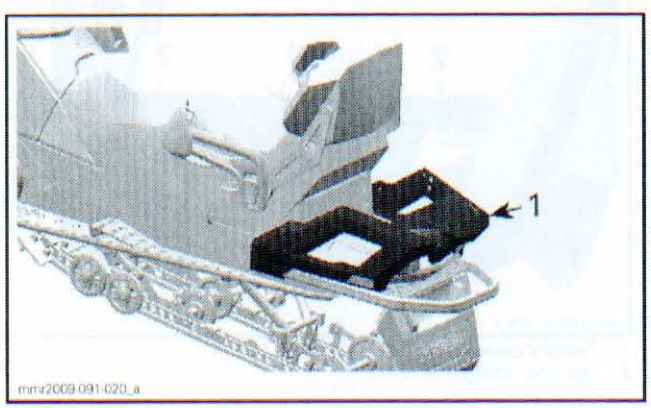
5. Unclip the front ends of console from the air intake silencer.
6. Lift up the rear of console and slide it toward the rear of the vehicle.
7. Install fuel tank cap.

Console Installation

The installation is the reverse of removal procedure.

REAR RACK

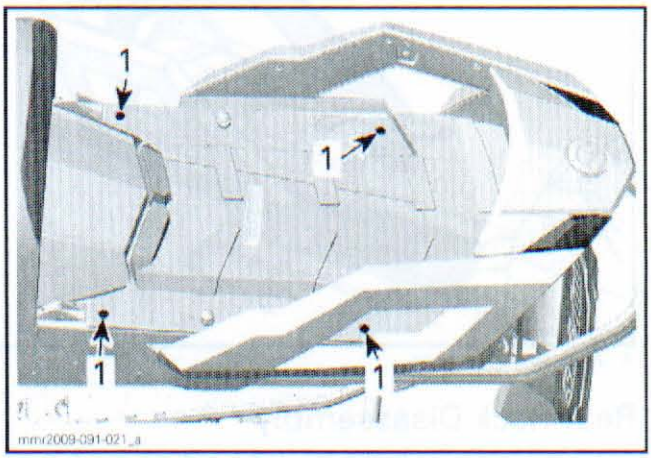
GSX Limited and GTX LE/SE



1. Rear rack

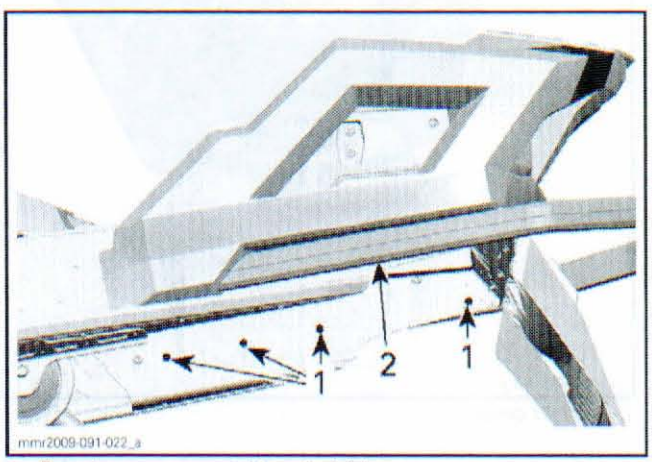
Rear Rack Removal

1. Remove saddlebags and tunnel bag (**GTX SE only**).
2. Remove passenger's seat.
3. Drill rivets (4) securing the radiator cover.



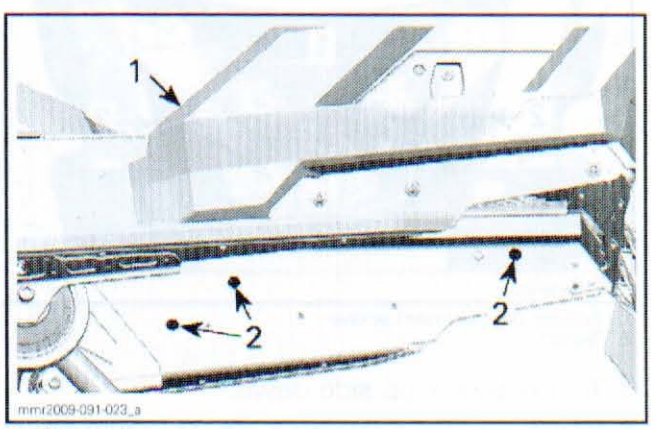
1. Radiator cover rivets

4. Remove the rear bumper.



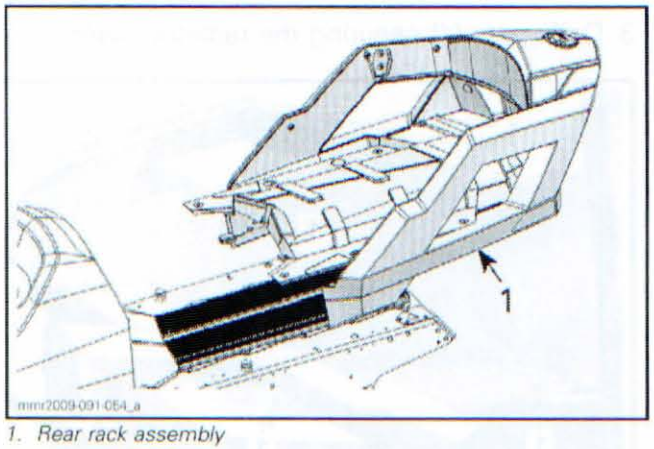
1. Rear bumper screws (4 each side)
2. Rear bumper

5. Remove screws (6) securing the rear rack assembly to tunnel.



1. Rear rack
2. Rear rack screws (3 each side)

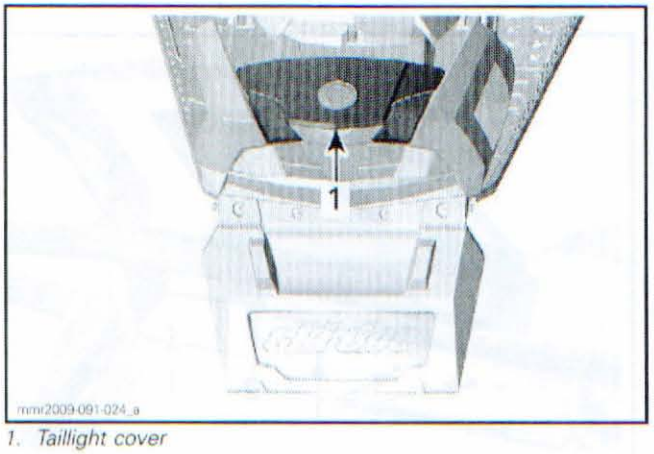
6. Remove rear rack.



1. Rear rack assembly

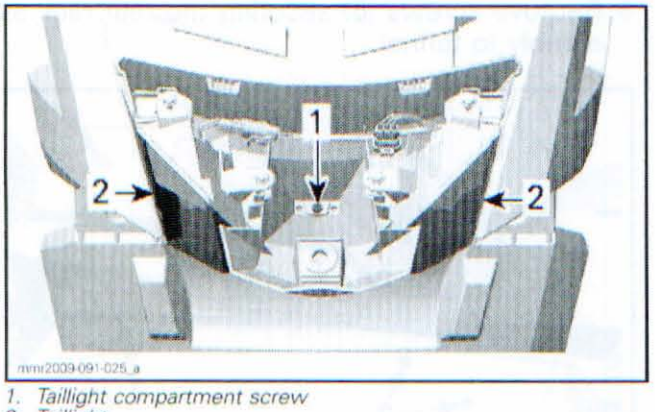
Rear Rack Disassembly

1. Remove the taillight cover by pulling up the rear end of cover.



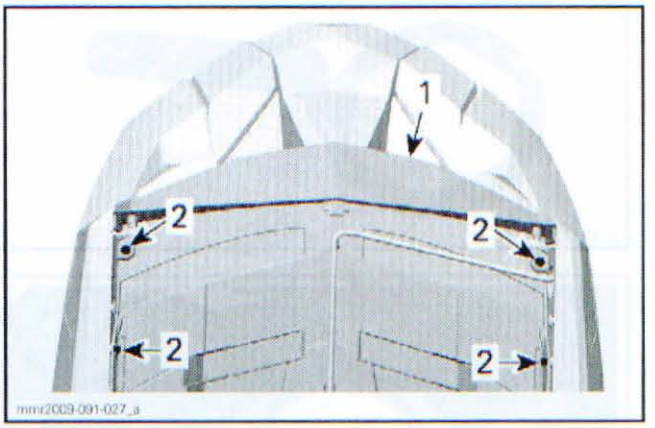
1. Taillight cover

2. Remove screw securing taillight compartment to radiator cover.



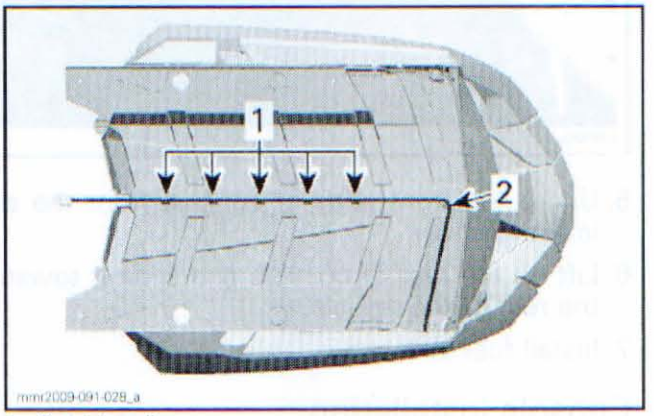
1. Taillight compartment screw
2. Taillight

3. Turn rear rack up side down.
4. Remove screws retaining radiator cover to rear rack arms.



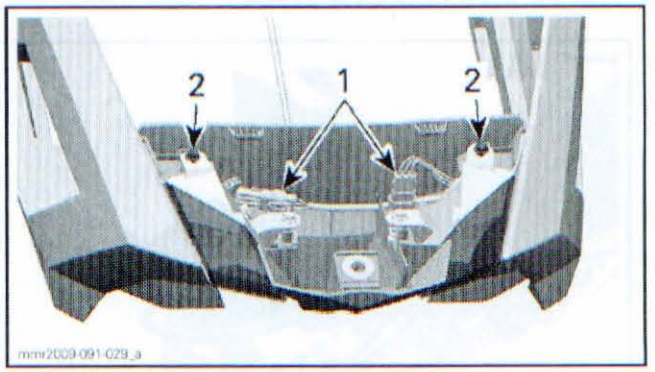
1. Radiator cover
2. Retaining screws

5. Detach taillight harness to remove radiator cover.



1. Retaining clips
2. Taillight harness

6. Unplug taillight connectors.
7. Remove screws securing taillight, rack arms and taillight compartment together.



1. Taillight connectors
2. Remove taillight screws

8. Pull harness inside taillight compartment and separate parts.

Rear Rack Assembly and Installation

The assembly/installation is the reverse of the disassembly and removal procedures.

SEAT COVER

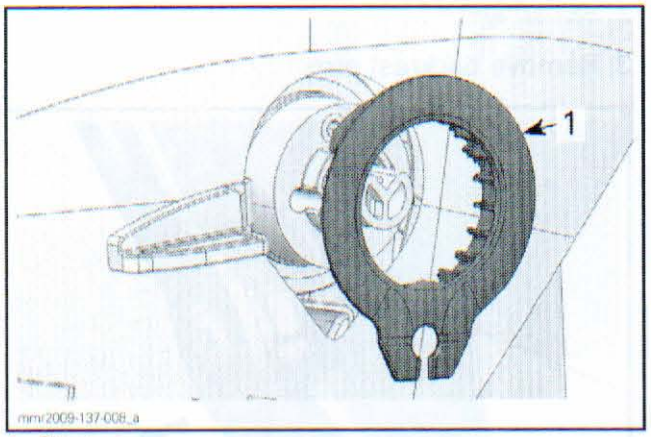
Seat Cover Removal

Operator's Seat

1. Remove seat.
2. Turn seat upside down.
3. Remove seat cover staples.
4. Remove seat cover and foam.

Passenger's Seat

1. Remove *BACKREST ARMS*, see procedure in this subsection.
2. Unplug the 4-pin connector (heating seat).
3. Remove plastic spacer.



1. Plastic ring

4. Remove seat cover staples.
5. Remove seat cover and foam.

Seat Cover Installation

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

Install 1/4" staples with an electric tacker such as the ARROW ELECTRIC TACKER GUN (P/N ETFX50) or with a manual tacker such as the ARROW HEAVY DUTY TACKER GUN (P/N T50).

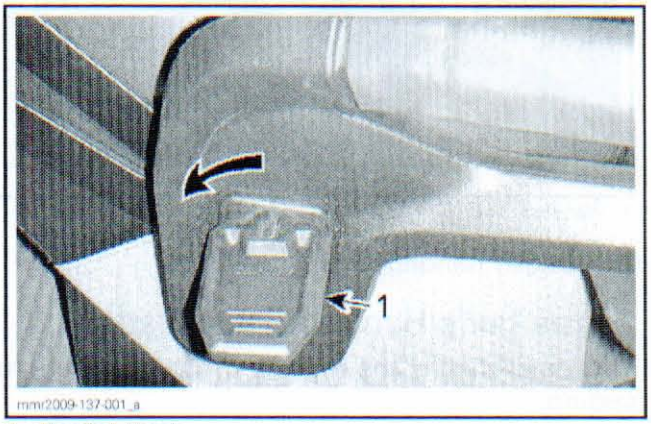
NOTE: For an easier installation, it is highly recommended to use an electric tacker gun.

After seat cover installation, cut all around the excess of material.

PASSENGER'S HANDHOLDS

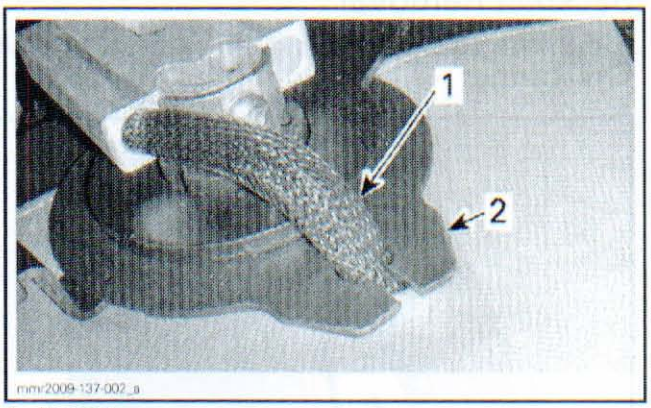
Passenger's Handhold Removal

1. Remove passenger's seat.
2. Under seat unplug connectors.
   - For LH handhold the 14-pin connector.
   - For the RH handhold the 3-pin connector (heating grip).
3. Unscrew the appropriate handhold knob.



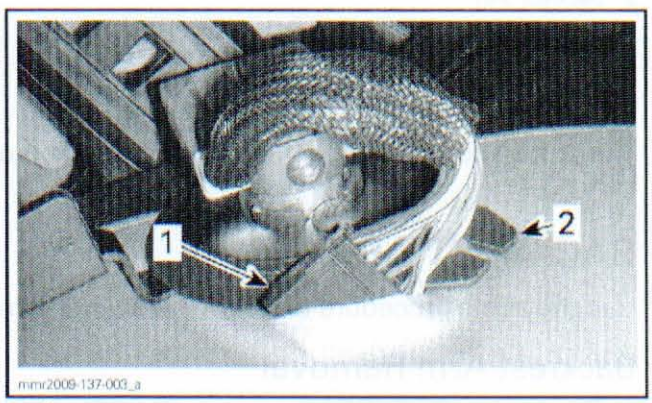
1. Handhold knob

4. Move harness out of plastic ring.



1. Harness
2. Plastic ring

5. Turn plastic ring and remove connector from seat.



1. Connector
2. Plastic ring

6. Unscrew the handhold link retaining screw.

1. Handhold link

7. Remove handhold.

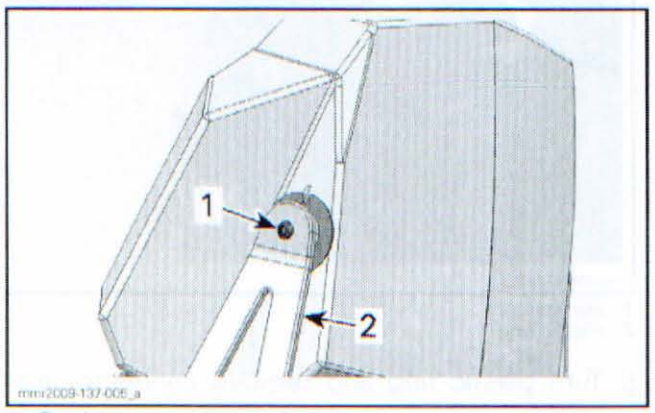
Passenger's Handhold Installation

The installation is the reverse of the removal procedure.

BACKREST

Backrest Removal

1. Remove screws securing the backrest to backrest arms.



1. Retaining screw (one each side)
2. Backrest arm

2. Remove the backrest.

Backrest Installation

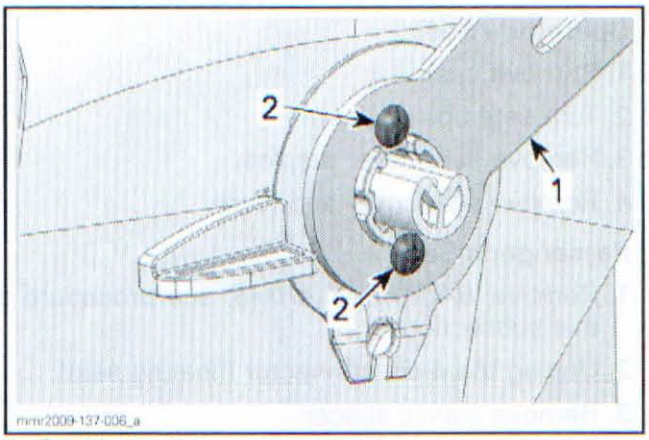
The installation is the reverse of the removal procedure.

BACKREST ARMS

Use the same procedure to remove the other arm.

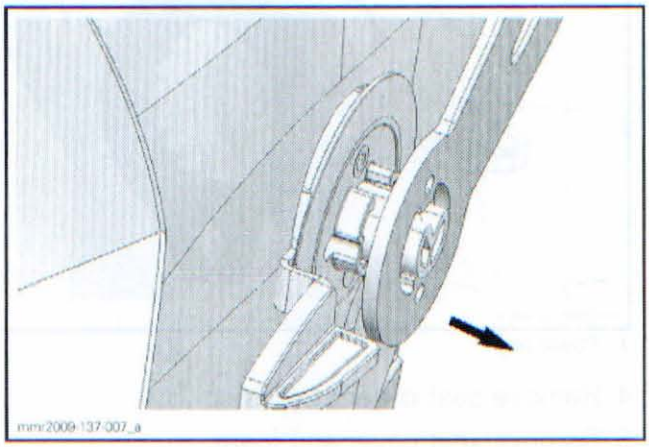
Backrest Arm Removal

1. Remove *BACKREST* and *PASSENGER'S HANDHOLDS*, see procedure in this subsection.
2. Remove both screws that attach backrest arm to backrest support.



1. Retaining screws
2. Backrest arm

3. Remove backrest arm.



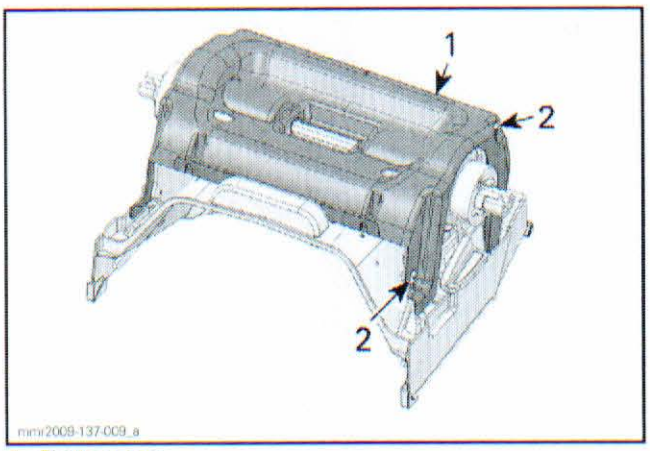
Installation

The installation is the reverse of the removal procedure.

BACKREST MECHANISM

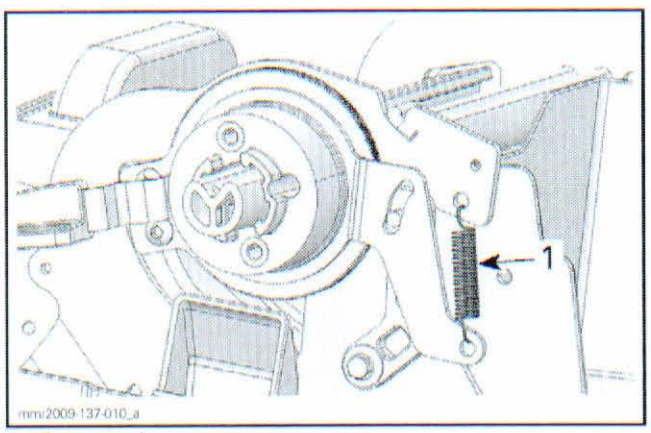
Backrest Mechanism Removal

1. Drill rivets retaining plastic cover to backrest support. Remove plastic cover.



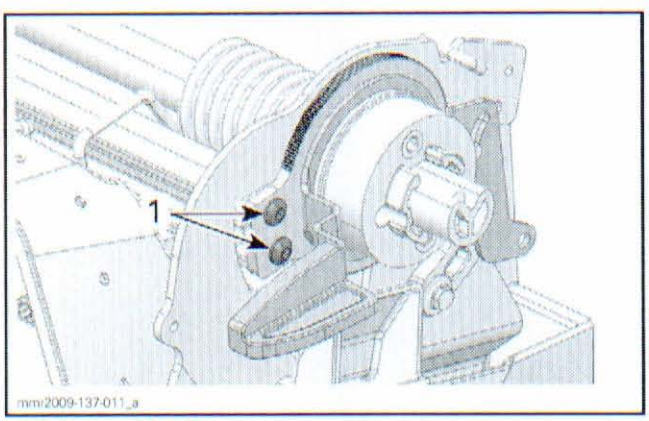
1. Plastic cover
2. Rivets (two each side)

2. Remove return spring.



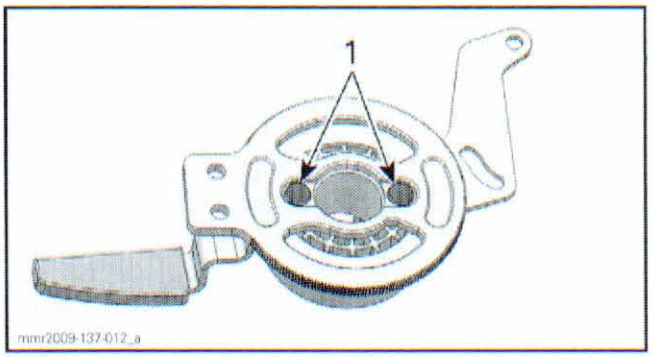
1. Return spring

3. To replace backrest handle or its gear, remove screws retaining handle assembly to support.



1. Retaining screws

4. Remove handle assembly.
5. Drill rivets retaining parts.



1. Rivets

Backrest Mechanism Installation

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) between moving parts of backrest mechanism.

Use a press and a punch to flatten rivet ends.

Reinstall all removed parts by reversing the removal procedure.

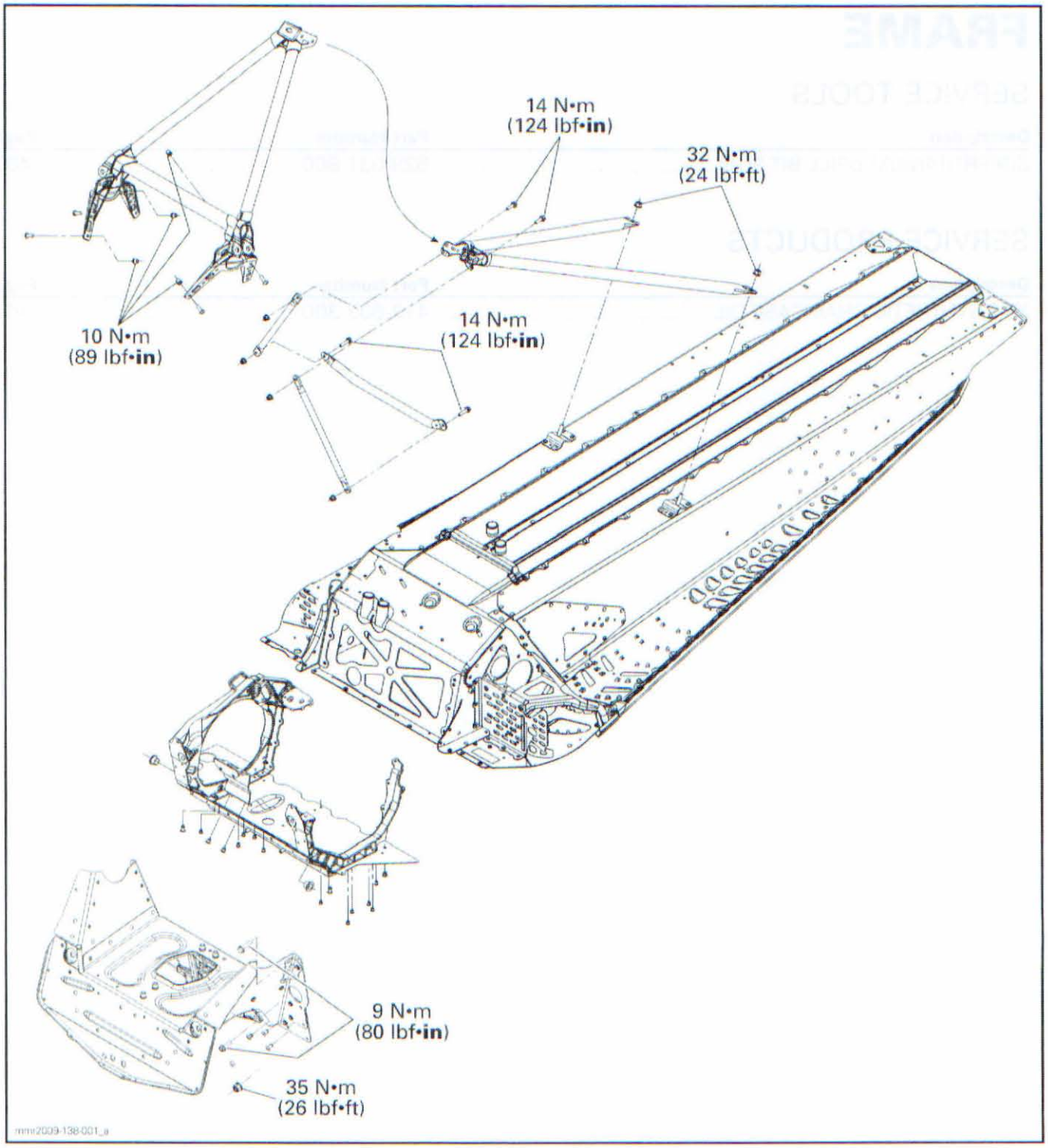
FRAME

SERVICE TOOLS

Description	Part Number	Page
SUPERTITANIUM DRILL BIT 3/16"	529 031 800	467

SERVICE PRODUCTS

Description	Part Number	Page
XP-S SYNTHETIC CHAINCASE OIL	413 803 300	467


14 N•m
(124 lbf•in)
32 N•m
(24 lbf•ft)
14 N•m
(124 lbf•in)
10 N•m
(89 lbf•in)
9 N•m
(80 lbf•in)
35 N•m
(26 lbf•ft)
mmr2009-138-001_a

GENERAL

During assembly/installation, use the torque values and the 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, cotter pins, etc.) must be replaced with new ones.

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

RIVET DRILLING PROCEDURE

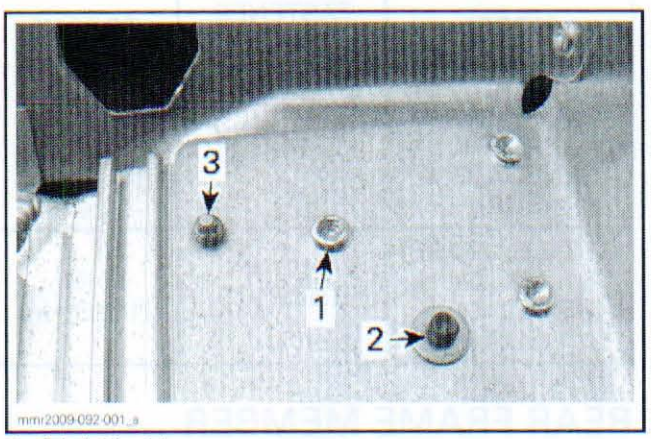
For proper drilling instructions and to prevent premature wear, follow the procedure below.

NOTICE When removing rivets, make sure do not enlarge or deform the holes.

Self-Percing Rivet

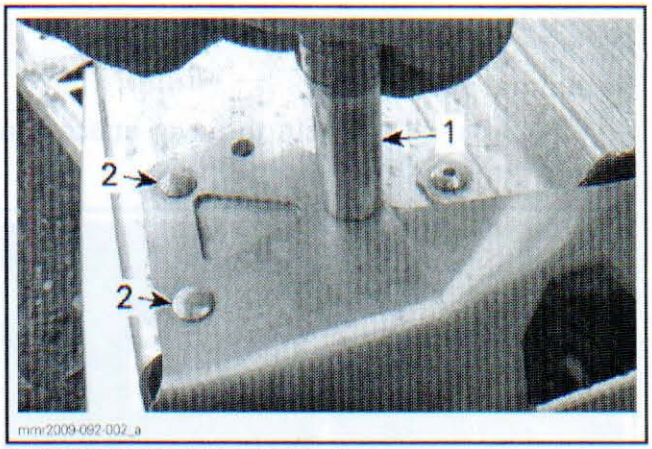
Recommended Method

1. Using a grinding disk, grind the rivet end.



1. *Grind this side*
2. *Pop rivet*
3. *STAVEX rivet*

2. Support the frame around the rivet head with a socket on the opposite side to avoid warpage.



1. *11 mm socket over a rivet head*
2. *Rivet heads*

3. Drive out remaining rivet using a punch.

Alternative Method

1. Use the SUPERTITANIUM DRILL BIT 3/16" (P/N 529 031 800), shipped in packs of 2.
2. Partially drill **rivet end — not the rivet head**.
3. Always use a variable speed drill.

NOTICE High speed drilling will cause excessive heat which may destroy the cutting edge of the bit; therefore, avoid using pneumatic drills.

4. Maintain a slow to medium speed at all times when drilling. The proper speed is attained when a constant chip is ejected.

NOTE: To increase bit life, use XP-S SYNTHETIC CHAINCASE OIL (P/N 413 803 300) as a cutting oil.

5. Cut rivet using a chisel.
6. Remove riveted part.
7. Drive out remaining rivet head using a punch.

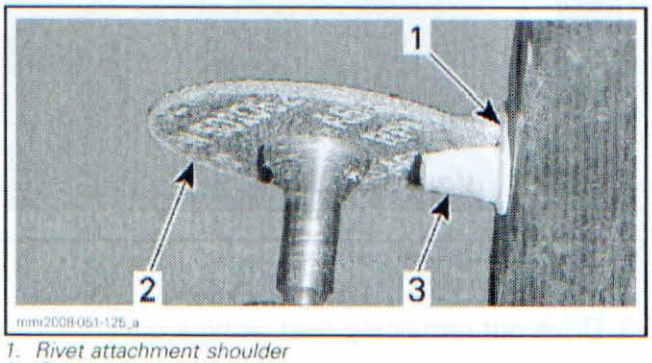
Pop Rivets

1. Use the SUPERTITANIUM DRILL BIT 3/16" (P/N 529 031 800), shipped in packs of 2.
2. Always use a variable speed drill.
3. Always drill **rivet head**.
4. Maintain a slow to medium speed at all times when drilling. The proper speed is attained when a constant chip is ejected.
5. When rivet is located on plastic part, use pliers to avoid rivet turning and heating plastic.
6. Use a small punch to push the rivet end.

HUCK Rivets

Recommended Method

1. Using a cut-off tool, cut the rivet attachment without touching the shoulder.



1. Rivet attachment shoulder
2. Cutter wheel
3. Rivet attachment

NOTE: Apply a thin layer of grease on cutter wheel to increase its durability.

2. Break the rivet attachment shoulder using a chisel.
3. Use a small punch to push the rivet stem.

Alternative Method

1. Measure outside diameter of rivet stem and select appropriate drill bit.
2. Drill the **rivet stem — not the rivet head** until rivet attachment is freed.
3. Always use a variable speed drill.
4. Maintain a slow to medium speed at all times when drilling. The proper speed is attained when a constant chip is ejected.

NOTE: When possible, use an angle grinder to grind rivet head or use an air hammer to cut the rivet attachment.

PROCEDURES

FRAME

Frame Cleaning

Clean frame and tunnel with appropriate cleaners and rinse with high pressure hose.

NOTE: For bare aluminum frames use only aluminum cleaner and follow instructions on container.

NOTICE Never direct high-pressure water jet towards decals. They will peel off.

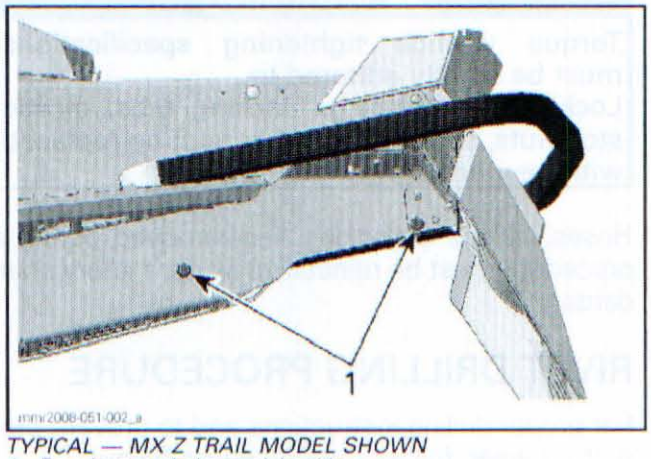
Frame Welding

No welds should be done on aluminum frame except if mentioned or required on a BRP Bulletin.

REAR BUMPER

Rear Bumper Removal

1. Underneath tunnel, remove bolts retaining rear bumper to tunnel.



TYPICAL — MX Z TRAIL MODEL SHOWN
1. Rear bumper bolts on right side

2. Pull rear bumper to remove it from vehicle.

Rear Bumper Installation

The installation is the reverse of the removal procedure.

NOTE: Install all bolts before torquing them.

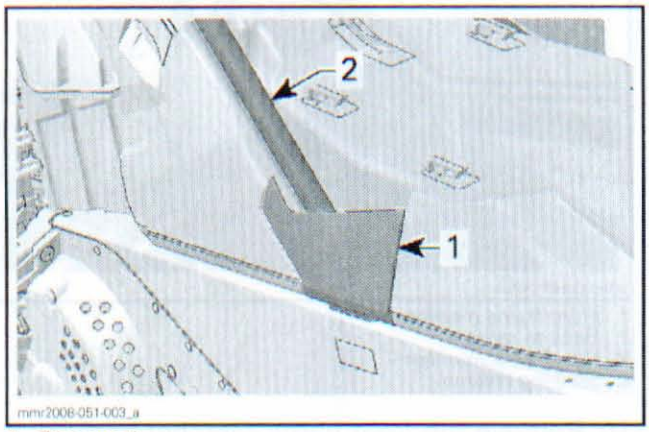
MODEL	FASTENER GRADE	TORQUE
GSX (LIMITED) MX Z (ALL EXCEPT RENEGADE X (EUR))	Grade 8.8	10 N•m (89 lbf•in)
GTX (LE AND SE) MX Z (RENEGADE X (EUR))	Grade 10.9	16 N•m (142 lbf•in)

REAR FRAME MEMBER

Rear Frame Member Removal

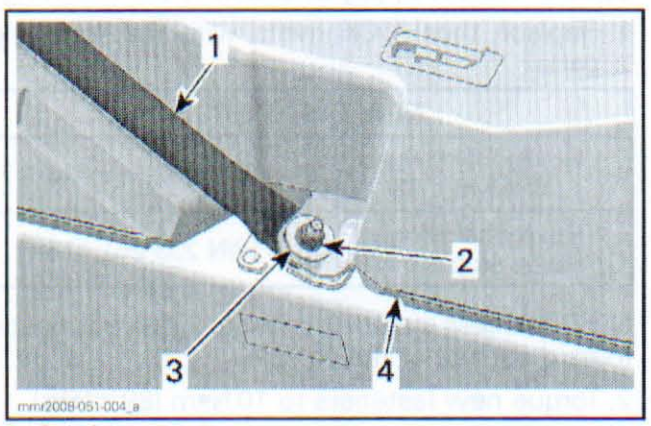
1. Refer to *BODY* subsection to remove the following:
   - Seat
   - Gauge support
   - Console.

2. Remove trim panel at the bottom of rear frame member (one each side).



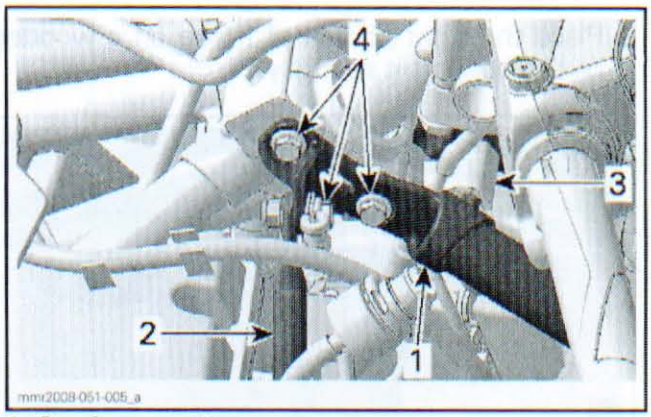
1. *Trim panel*
2. *Rear frame member*

3. Remove nut and shouldered washer securing rear frame member (one each side).



1. *Rear frame member*
2. *Nut to remove*
3. *Shouldered washer*
4. *Fuel tank*

4. Remove screws securing the rear frame member to steering column support and side frame members.



1. *Rear frame member*
2. *LH side frame member*
3. *Steering column support*
4. *Bolts to remove*

5. Remove rear frame member.

Rear Frame Member Installation

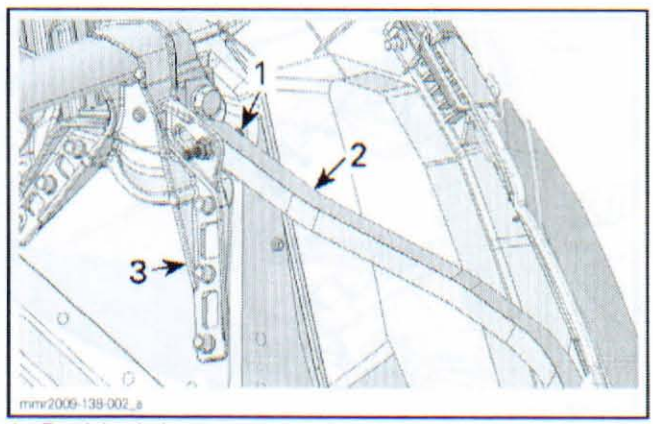
The installation is the reverse of the removal procedure.

NOTE: Install all bolts and nuts before tightening them.

FRONT FRAME MEMBER

Front Frame Member Removal

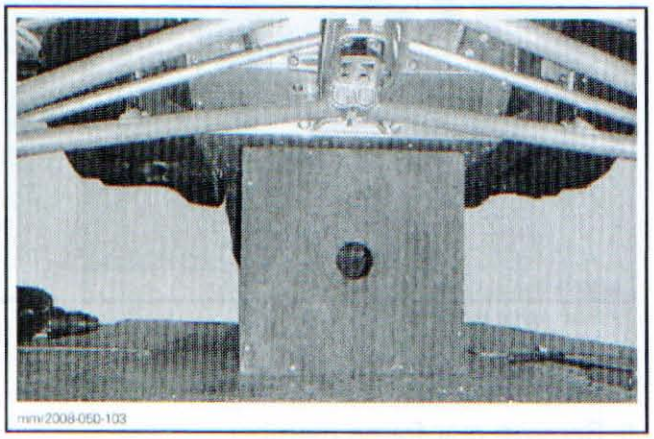
1. Refer to *BODY* subsection to remove the following:
   - Hood
   - Console
   - Gauge support.
2. Remove the exhaust pipe. Refer to *EXHAUST SYSTEM* subsection.
3. Remove bolts securing both bumper supports to front frame member.



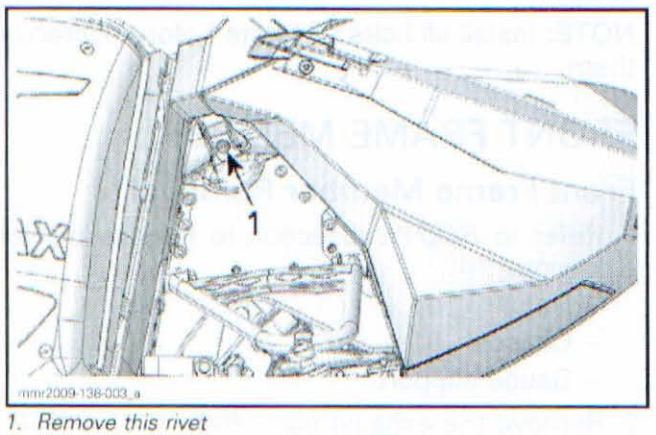
1. *Retaining bolt*
2. *LH bumper support*
3. *Front frame member*

4. Lift front of vehicle until skis are off the ground.

5. Place the front portion of frame on a wooden box to support it securely.

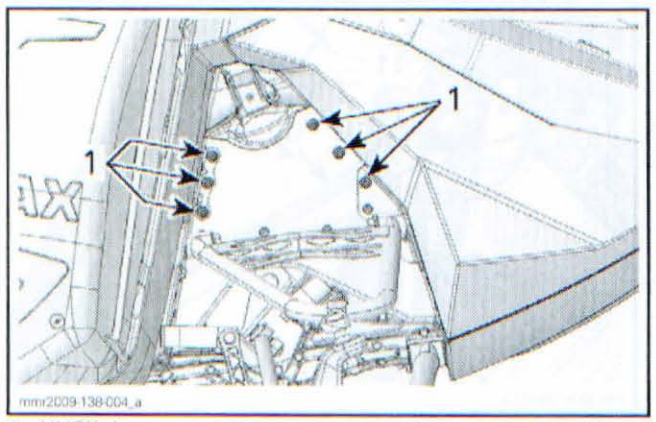


6. Remove front shock absorbers.
7. Drill the rivet retaining the front bottom pan to front frame member (one each side).



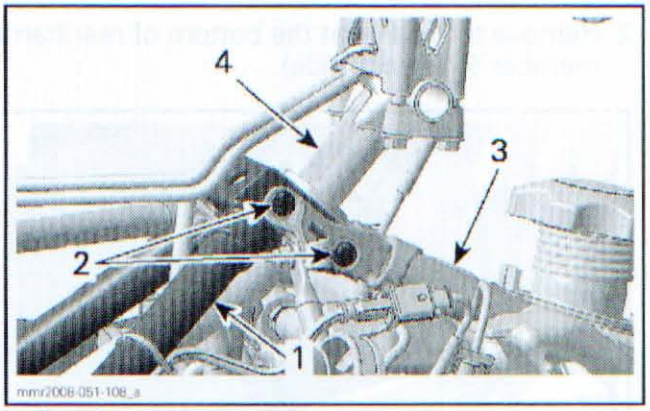
1. Remove this rivet

8. Remove HUCK rivets (six each side), see removal procedure at the beginning of this section.



1. HUCK rivets

9. Remove bolts securing front frame member, rear frame member and steering column support.



1. Front frame member
2. Bolts to remove
3. Rear frame member
4. Steering column

10. Remove the front frame member.

Front Frame Member Installation

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

1. Replace the HUCK rivets with the following parts.

NEW FASTENERS	
Hexagonal flanged bolt M6 x 20	(P/N 207 662 044)
Hexagonal flanged elastic stop nut M6	(P/N 233 261 414)

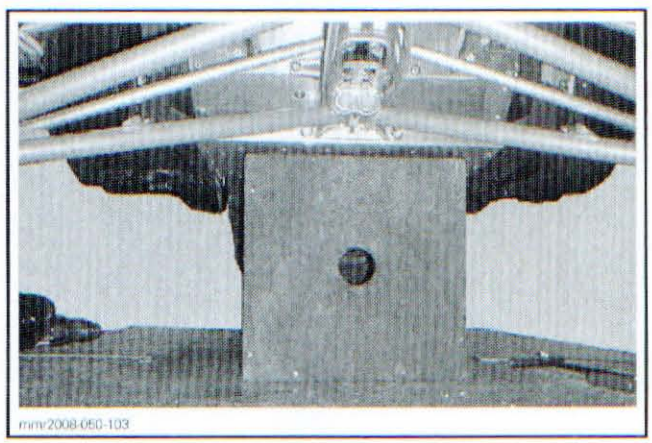
NOTE: Unless stated otherwise, install bolt heads toward outside of the vehicle.

2. Torque new fasteners to 10 N•m (89 lbf•**in**).

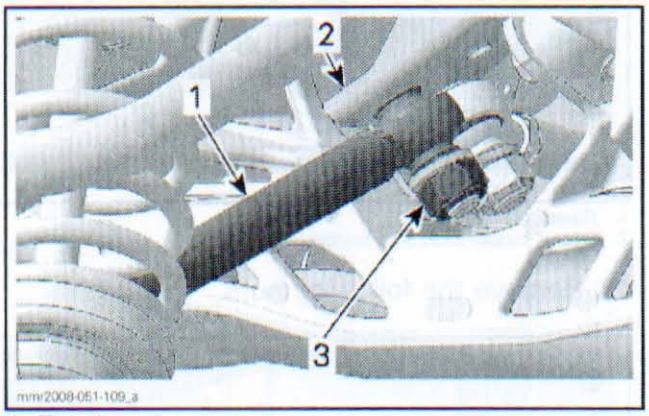
FRONT CROSS MEMBER

Front Cross Member Removal

1. Lift front of vehicle until skis are off the ground.
2. Place the front portion of frame on a wooden box to support it securely.

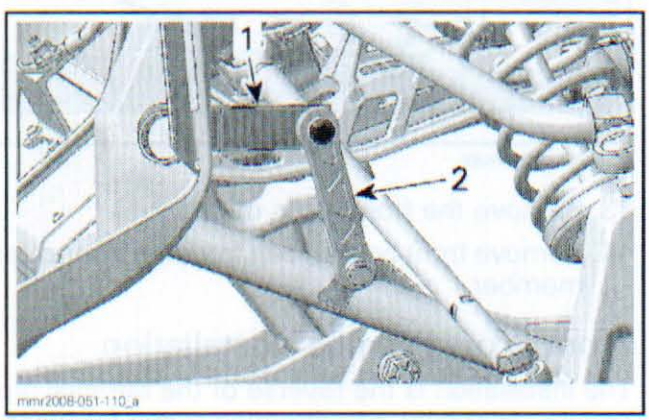


3. Remove the muffler and the tuned pipe. Refer to *EXHAUST SYSTEM* subsection.
4. Remove the RH front suspension assembly by doing the following:
   4.1 Detach tie-rod end from steering column.



1. *Tie-rod*
2. *Steering column*
3. *Tie-rod end nut*

   4.2 Remove shock absorber upper bolt.
   4.3 Remove bolt linking stabilizer link and stabilizer lever.

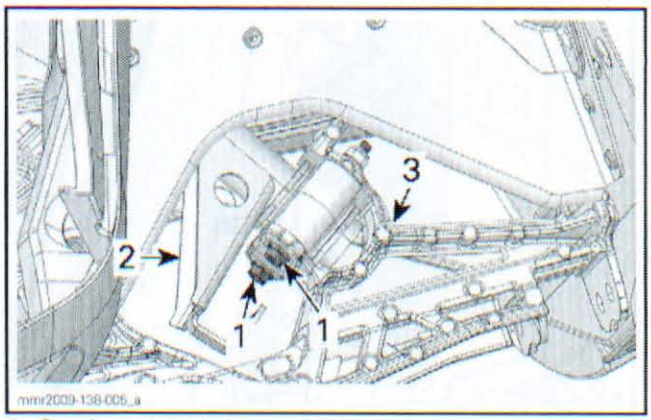


1. *Stabilizer lever*
2. *Stabilizer link*

   4.4 Remove upper and lower suspension arms bolts. Refer to *FRONT SUSPENSION* subsection.
   4.5 Pull suspension arms to remove the RH front suspension assembly.

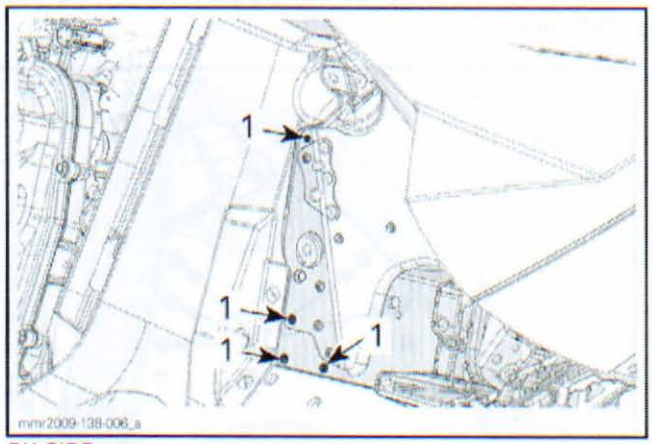
   NOTE: Repeat same procedure for the LH front suspension.

5. Remove the stabilizer bar. Refer to *FRONT SUSPENSION* subsection.
6. Remove bolts securing the bottom of steering column.

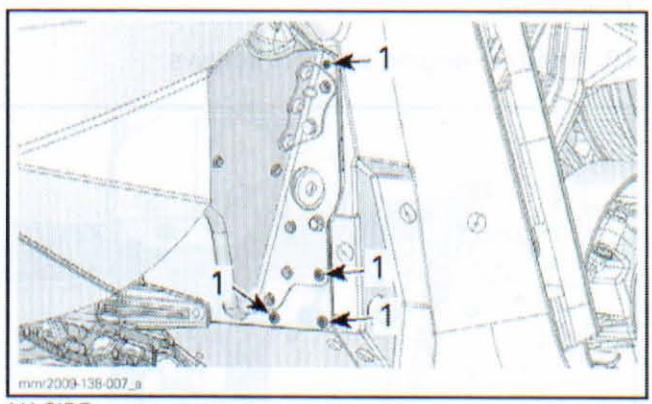


1. *Steering column bolts*
2. *Steering column*
3. *Lower suspension arm support*

7. Drill the following rivets.

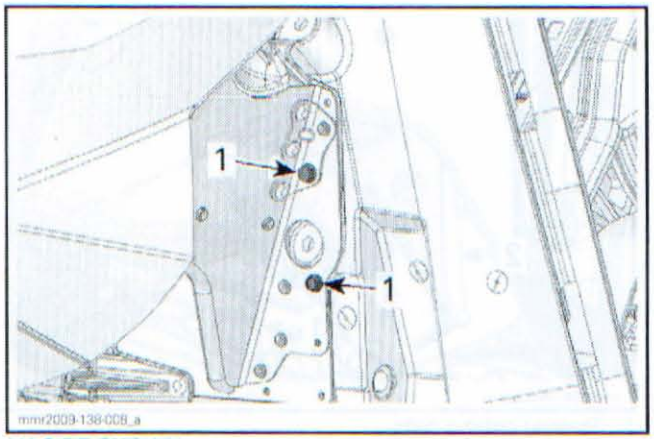


RH SIDE
1. *Remove these rivets*



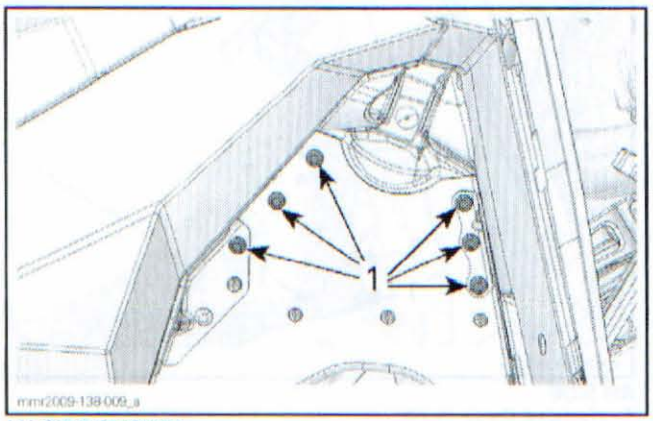
LH SIDE
1. *Remove these rivets*

8. Remove screws securing front cross member to frame (2 each side).



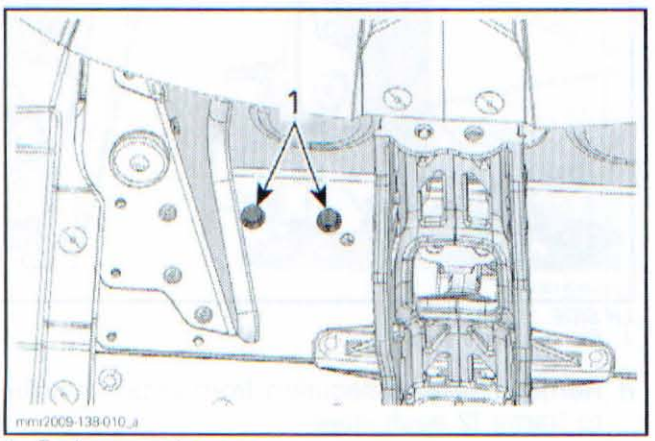
LH SIDE SHOWN
1. Hexagonal flanged bolt

9. Remove HUCK rivets (six each side), see removal procedure at the beginning of this subsection.



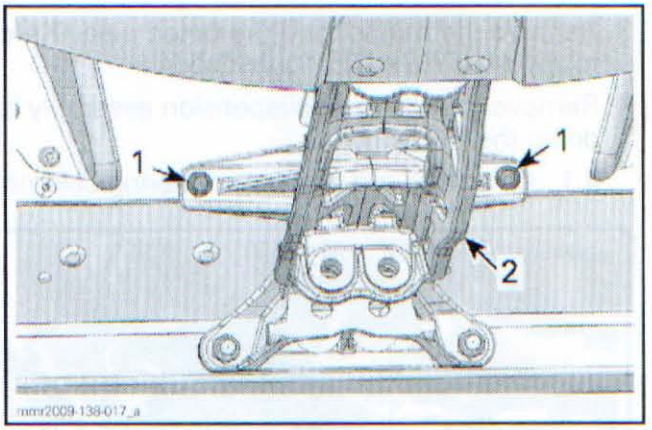
LH SIDE SHOWN
1. HUCK rivets

10. Remove engine support screws.



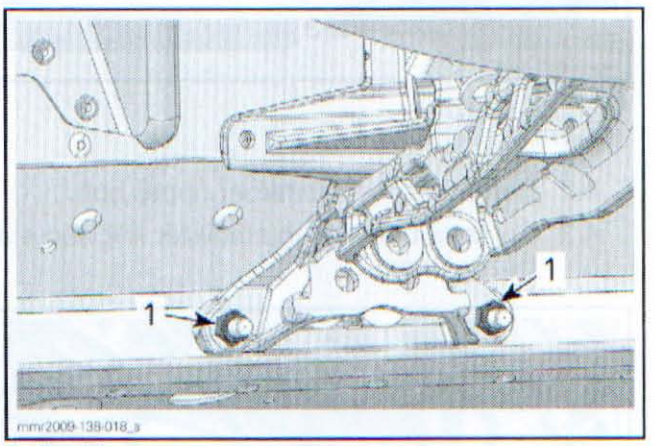
1. Engine support screws

11. Grind rivets securing the lower suspension arm support to engine member.



1. Rivets
2. Lower suspension arm support

12. Remove the following nuts.



1. Retaining nuts

13. Remove the front cross member.
14. Remove front bottom pan from the front cross member.

Front Cross Member Installation

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

1. Replace the HUCK rivets with the following parts.

NEW FASTENERS	
Hexagonal flanged bolt M6 x 20	(P/N 207 662 044)
Hexagonal flanged elastic stop nut M6	(P/N 233 261 414)

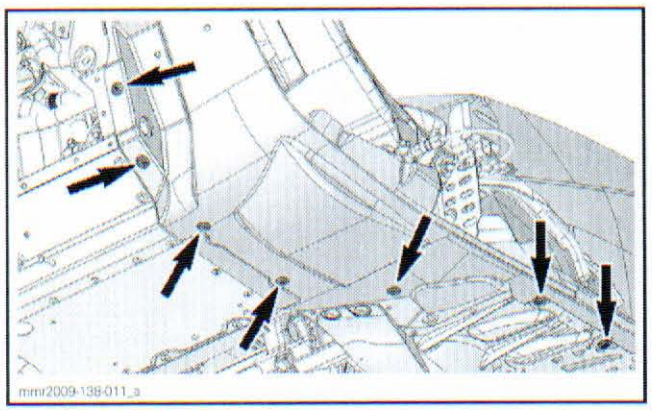
NOTE: Unless stated otherwise, install bolt heads toward outside of the vehicle.

2. Torque new fasteners to 10 N•m (89 lbf•**in**).
3. Reinstall all removed parts by using the appropriate installation procedure.

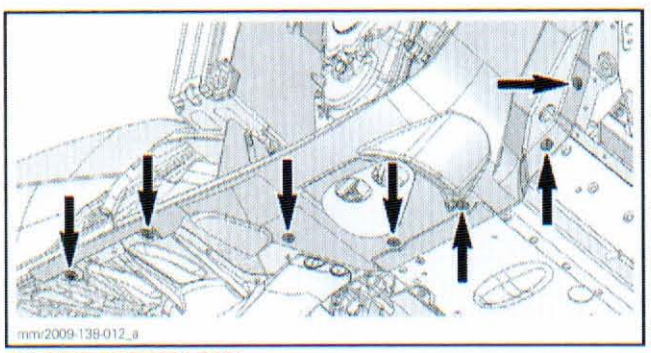
ENGINE MEMBER

Engine Member Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove rear suspension. Refer to *REAR SUSPENSION* subsection.
3. Remove the *FRONT CROSS MEMBER*, see procedure in this subsection.
4. Remove both side bottom pans by drilling the following rivets.

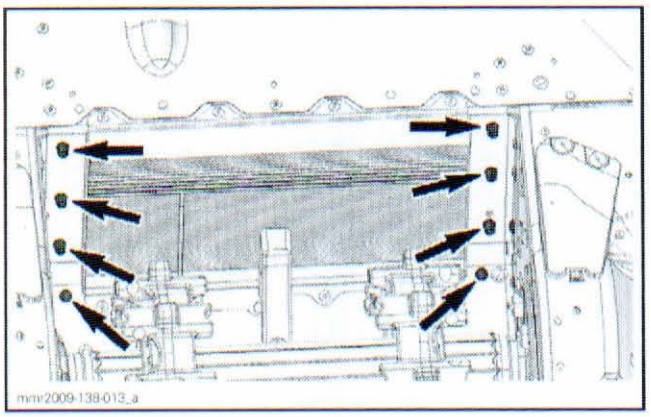


LH SIDE BOTTOM PAN

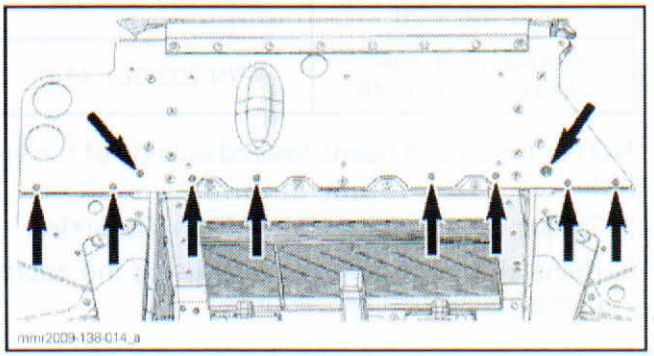


RH SIDE BOTTOM PAN

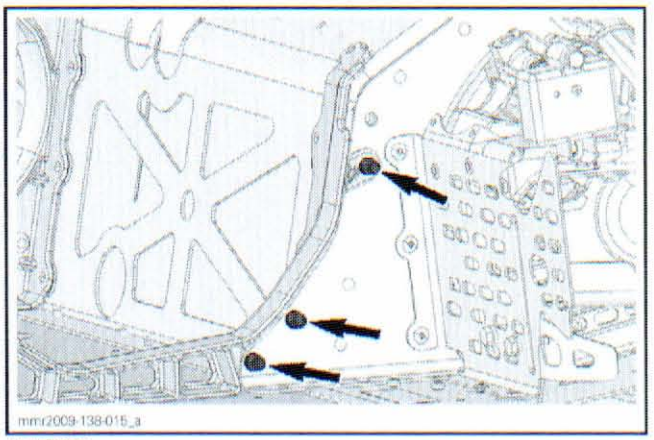
5. From underneath of tunnel, remove HUCK rivets, see removal procedure at the beginning of this subsection.



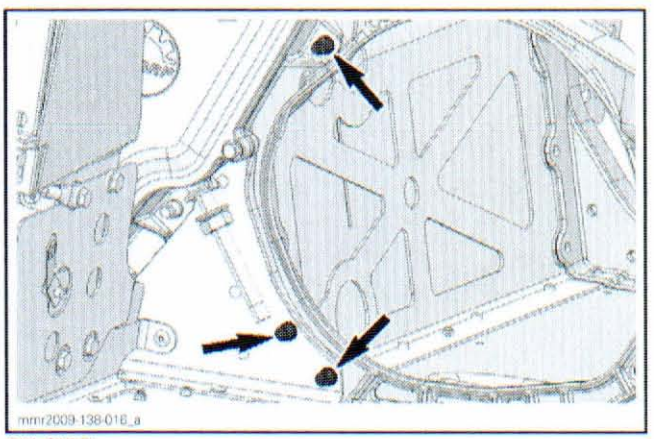
6. Drill or grind rivets securing engine member to frame.



7. Remove HUCK rivets located on both sides of frame, see removal procedure at the beginning of this subsection.



LH SIDE



RH SIDE

8. Remove the engine member.

Engine Member Installation

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

1. Replace the HUCK rivets with the following parts.

NEW FASTENERS	
Hexagonal flanged bolt M6 x 20	(P/N 207 662 044)
Hexagonal flanged elastic stop nut M6	(P/N 233 261 414)

NOTE: Install bolt heads toward outside of the vehicle.

2. Torque new fasteners to 10 N•m (89 lbf•**in**).
3. Reinstall all removed parts by using the appropriate installation procedure.

1200 4-TEC

ENGINE			ALL MODELS
Engine type			ROTAX® 1203
			4-stroke, Double Over Head Camshaft (DOHC), liquid cooled
Number of cylinders			3
Number of valves			12 valves (mechanical adjustment)
Bore			91 mm (3.58 in)
Stroke			60 mm (2.36 in)
Displacement			1 171 cm^3 (71.46 in^3)
Compression ratio			11.0:1
Decompressor type			N.A.
Maximum HP RPM			7800 RPM
Intake valve opening			0° BTDC
Intake valve closing			40° ABDC
Exhaust valve opening			60° BBDC
Exhaust valve closing			5° BTDC
Valve clearance	Intake		0.10 mm to 0.20 mm (.0039 in to .0079 in)
	Exhaust		0.30 mm to 0.40 mm (.0118 in to .0157 in)
Valve stem diameter	Intake	New	5.471 mm to 5.486 mm (.2154 in to .216 in)
		Service limit	5.450 mm (.2146 in)
	Exhaust	New	5.461 mm to 5.476 mm (.215 in to .2156 in)
		Service limit	5.440 mm (.2142 in)
Valve guide diameter		New	5.506 mm to 5.518 mm (.2168 in to .2172 in)
		Service limit	5.568 mm (.2192 in)
Valve spring free length		New	36.70 mm (1.445 in)
		Service limit	35.50 mm (1.398 in)
Valve seat contact width	Intake	New	1.6 mm to 1.8 mm (.063 in to .0709 in)
		Service limit	2.2 mm (.0866 in)
	Exhaust	New	1.4 mm to 1.8 mm (.0551 in to .0709 in)
		Service limit	2.4 mm (.0945 in)
Cam follower bore diameter		New	8.013 mm to 8.049 mm (.3155 in to .3169 in)
		Service limit	8.060 mm (.3173 in)
Cam follower shaft diameter		New	7.972 mm to 7.980 mm (.3139 in to .3142 in)
		Service limit	7.960 mm (.3134 in)
Piston measurement		New	90.950 mm to 90.966 mm (3.5807 in to 3.5813 in)
Piston/cylinder wall clearance		New	0.027 mm to 0.057 mm (.0011 in to .0022 in)
		Service limit	0.100 mm (.0039 in)

ENGINE (cont'd)			ALL MODELS
Piston ring type		1st	Upper compression ring, rectangular
		2nd	Lower compression ring, tapered face
		3rd	Oil scraper ring
Ring end gap	Rectangular	New	0.25 mm to 0.40 mm (.0098 in to .0157 in)
		Service limit	0.60 mm (.0236 in)
	Taper-face	New	0.20 mm to 0.40 mm (.0079 in to .0157 in)
		Service limit	0.70 mm (.0276 in)
	Oil scraper ring	New	0.20 mm to 0.70 mm (.0079 in to .0276 in)
		Service limit	1.0 mm (.0394 in)
Ring/piston groove clearance	Rectangular	New	0.30 mm to 0.70 mm (.0118 in to .0276 in)
		Service limit	0.150 mm (.0059 in)
	Taper-face	New	0.020 mm to 0.060 mm (.0008 in to .0024 in)
		Service limit	0.150 mm (.0059 in)
	Oil scraper ring	New	0.010 mm to 0.180 mm (.0004 in to .0071 in)
		Service limit	0.250 mm (.0098 in)
Cylinder bore		New	90.993 mm to 91.007 mm (3.5824 in to 3.583 in)
Cylinder taper		Maximum New	0.030 mm (.0012 in)
		Service limit	0.090 mm (.0035 in)
Cylinder out of round		Maximum New	0.008 mm (.0003 in)
		Service limit	0.050 mm (.002 in)
Camshaft bearing journal diameter	PTO/MAG	New	23.967 mm to 23.980 mm (.9436 in to .9441 in)
		Service limit	23.950 mm (.9429 in)
	Center	New	32.959 mm to 32.975 mm (1.2976 in to 1.2982 in)
		Service limit	32.942 mm (1.2969 in)
Camshaft bracket bore diameter	PTO/MAG	New	24.007 mm to 24.020 mm (.9452 in to .9457 in)
		Service limit	24.070 mm (.948 in)
Camshaft lobe height	Intake	New	38.12 mm to 38.32 mm (1.5008 in to 1.5087 in)
		Service limit	38.09 mm (1.4996 in)
	Exhaust	New	37.86 mm to 38.06 mm (1.4906 in to 1.4984 in)
		Service limit	37.83 mm (1.4894 in)
Crankshaft bearing journal diameter		New	35.984 mm to 36.000 mm (1.4167 in to 1.4173 in)
		Service limit	35.970 mm (1.4161 in)
Crankshaft radial play		Service limit	0.10 mm (.0039 in)
Crankshaft axial play		New	0.080 mm to 0.313 mm (.0031 in to .0123 in)
		Service limit	0.350 mm (.0138 in)
Balancer shaft bearing journal diameter		New	35.984 mm to 36.000 mm (1.4167 in to 1.4173 in)
		Service limit	35.970 mm (1.4161 in)
Balancer shaft radial play		Service limit	0.10 mm (.0039 in)
Balancer shaft axial play		New	0.10 mm to 0.23 mm (.0039 in to .0091 in)
		Service limit	0.350 mm (.0138 in)
Crankshaft pin diameter		New	37.984 mm to 38.000 mm (1.4954 in to 1.4961 in)
		Service limit	37.970 mm (1.4949 in)

ENGINE (cont'd)			ALL MODELS
Crankshaft deflection	MAG	Maximum	0.050 mm (.002 in)
	Center	Maximum	0.050 mm (.002 in)
	PTO	Maximum	0.030 mm (.0012 in)
Crankshaft/balancer shaft plain bearing inside diameter		Service limit	36.100 mm (1.4213 in)
Connecting rod big end diameter		Service limit	38.060 mm (1.4984 in)
Connecting rod big end radial play		Service limit	0.08 mm (.0031 in)
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.0039 in to .0139 in)
		Service limit	0.400 mm (.0157 in)
Connecting rod small end diameter		New	22.010 mm to 22.020 mm (.8665 in to .8669 in)
		Service limit	22.040 mm (.8677 in)
Piston pin diameter		New	21.991 mm to 21.996 mm (.8658 in to .866 in)
		Service limit	21.985 mm (.8656 in)
Connecting rod small end radial play		Service limit	0.045 mm (.0018 in)
COOLING SYSTEM			**ALL MODELS**
Coolant		Type	Ethyl glycol and distilled water (50%/50%). Use BRP premixed coolant (P/N 219 700 362) or coolant specifically formulated for aluminum engines
		Quantity	MX Z TNT/MX Z X/GTX: 4.0 L (1.1 U.S. gal.) MX Z RENEGADE/RENEGADE X/GTX: 5.8 L (1.5 U.S. gal.)
Thermostat opening temperature			75°C (167°F)
Radiator cap opening pressure			110 kPa (16 PSI)
LUBRICATION SYSTEM			**ALL MODELS**
Lubrication	Type		Dry sump. Replaceable oil filter
	Oil filter		BRP Rotax paper type, replaceable
	Engine oil pressure	Minimum	100 kPa (15 PSI) @ 1100 RPM
			400 kPa (58 PSI) @ 7700 RPM
	Engine oil	Capacity (oil change with filter)	3.5 L (3.7 qt (U.S. liq.))
		Recommended	XP-S 0W40 synthetic oil or an equivalent
FUEL SYSTEM			**ALL MODELS**
Throttle body type			Dell'Orto
Idle speed		Normal idle	1100 RPM
		Fast idle	1500 RPM
Gas type			Unleaded
Minimum octane rating		Inside North America ((R+M)/2)	87
		Outside North America (RON)	92
Fuel tank capacity			40 L (10.57 U.S. gal.)

ELECTRICAL SYSTEM		ALL MODELS	
Magneto generator output		490 W @ 5000 RPM @ 14 V	
Ignition type		IDI (Inductive Digital Ignition)	
Spark plug	Make and type	NGK CR8EKB	
	Gap	0.75 mm (.03 in) (not adjustable)	
Ignition timing		Not adjustable	
Battery		12 volt 18 A.h. YTX20HL-BS	
Headlamp		2 X 55/60 W	
Taillight and stoplight		5/21 W	
Fuses (fuse box)	F 1	15 A	
	F 2	10 A	
	F 3	5 A	
	F 4	5 A	
	F 5	5 A	
	F 6	20 A	
	F 7	15 A	
	F 8	20 A	
	F 9	5 A	
	F 10	10 A	
	F 11	15 A	
Fuse	Main fuse	30 A	
DRIVE SYSTEM		**GSX**	**GTX**
Chaincase oil	Type	XP-S synthetic chaincase oil	
	Quantity	250 ml (8.5 U.S. oz)	
Chain drive ratio		24/43	24/45
Chain	Pitch	9.53 mm (3/8 in)	
	Type/links qty/plate qty	Silent 104/13	
Drive pulley type		TRA IV	
Drive pulley calibration	Clutch engagement	2500	
	Spring color	Yellow-blue	
	Spring length	90.70 mm (3.571 in)	
	Pin	Solid (P/N 417 222 594)	
	Ramp	617	
	Screw position	3	
Driven pulley type	Type	QRS	
	Spring preload – New	8.3 kgf ± 0.7 kgf (18.3 lbf ± 1.5 lbf)	
	Spring preload – After break-in	7.5 kgf ± 0.7 kgf (16.5 lbf ± 1.5 lbf)	
	Spring color	Beige	
	Cam angle	50/44°	
Pulley distance Offset	Z	21.40 mm (.843 in)	
	X	36.90 mm ± 0.5 mm (1.453 in ± .02 in)	

DRIVE SYSTEM (cont'd)			GSX	GTX
Drive belt part number			417 300 383	
Drive belt		Width	38.3 mm (1.508 in)	
		Wear limit	35.90 mm (1.413 in)	
Track		Width	381 mm (15 in)	
		Length	3.05 m (120 in)	3.49 m (137 in)
		Profile height	25.4 mm (1 in)	
Track adjustment		Deflection	30 mm to 35 mm (1.18 in to 1.38 in)	
		Force	7.3 kgf (16 lbf)	
DRIVE SYSTEM			**MX Z RENEGADE**	**MX Z RENEGADE X**
Chaincase oil		Type	XP-S synthetic chaincase oil	
		Quantity	250 ml (8.5 U.S. oz)	
Chain drive ratio			24/45	
Chain		Pitch	9.53 mm (3/8 in)	
		Type/links qty/plate qty	Silent 104/13	
Drive pulley type			TRA IV	
Drive pulley calibration		Clutch engagement	2800	
		Spring color	Blue-blue	
		Spring length	99.80 mm (3.929 in)	
		Pin	Solid (P/N 417 222 594)	
		Ramp	617	
		Screw position	3	
Driven pulley type	Type		QRS	
	Spring preload	New	8.3 kgf ± 0.7 kgf (18.3 lbf ± 1.5 lbf)	
		After break-in	7.5 kgf ± 0.7 kgf (16.5 lbf ± 1.5 lbf)	
	Spring color		Beige	
	Cam angle		47/44°	
Pulley distance Offset		Z	21.40 mm (.843 in)	
		X	36.90 mm ± 0.5 mm (1.453 in ± .02 in)	
Drive belt part number			417 300 383	
Drive belt		Width	38.3 mm (1.508 in)	
		Wear limit	35.90 mm (1.413 in)	
Track		Width	406 mm (16 in)	
		Length	3.49 m (137 in)	
		Profile height	31.75 mm (1.25 in)	
Track adjustment		Deflection	30 mm to 35 mm (1.18 in to 1.38 in)	
		Force	7.3 kgf (16 lbf)	

DRIVE SYSTEM			MX Z TNT	MX Z X
Chaincase oil		Type	XP-S synthetic chaincase oil	
		Quantity	250 ml (8.5 U.S. oz)	
Chain drive ratio			24/43	
Chain		Pitch	9.53 mm (3/8 in)	
		Type/links qty/plate qty	Silent 104/13	
Drive pulley type			TRA IV	
Drive pulley calibration		Clutch engagement	2800	
		Spring color	Blue-blue	
		Spring length	99.80 mm (3.929 in)	
		Pin	Solid (P/N 417 222 594)	
		Ramp	617	
		Screw position	3	
Driven pulley type	Type		QRS	
	Spring preload	New	8.3 kgf ± 0.7 kgf (18.3 lbf ± 1.5 lbf)	
		After break-in	7.5 kgf ± 0.7 kgf (16.5 lbf ± 1.5 lbf)	
	Spring color		Beige	
	Cam angle		50/44°	
Pulley distance Offset		Z	21.40 mm (.843 in)	
		X	36.90 mm ± 0.5 mm (1.453 in ± .02 in)	
Drive belt part number			417 300 383	
Drive belt		Width	38.3 mm (1.508 in)	
		Wear limit	35.90 mm (1.413 in)	
Track		Width	381 mm (15 in)	
		Length	3.05 m (120 in)	
		Profile height	25.4 mm (1 in)	31.75 mm (1.25 in)
Track adjustment		Deflection	30 mm to 35 mm (1.18 in to 1.38 in)	
		Force	7.3 kgf (16 lbf)	
BRAKE SYSTEM			**ALL MODELS**	
Brake lining minimum thickness			1 mm (.039 in)	
Brake disk minimum thickness			4.5 mm (.177 in)	
Brake fluid		Type	DOT 4	
		Quantity	65 ml (2.2 U.S. oz)	
FRONT SUSPENSION			**GSX**	**GTX**
Suspension type			REV-XP	
Suspension maximum travel			229 mm (9 in)	
Shock absorber type			H.P.G.	
Stabilizer bar type			Link	

FRONT SUSPENSION		MX Z RENEGADE	MX Z RENEGADE X
Suspension type		REV-XP	
Suspension maximum travel		229 mm (9 in)	
Shock absorber type		H.P.G	H.P.G. rebound clicker (aluminum)
Stabilizer bar type		Link	
FRONT SUSPENSION		**MX Z TNT**	**MX Z X**
Suspension type		REV-XP	
Suspension maximum travel		229 mm (9 in)	
Shock absorber type		H.P.G. T/A (aluminum)	H.P.G. rebound clicker (aluminum)
Stabilizer bar type		Link	
REAR SUSPENSION		**GSX**	**GTX**
Suspension type		SC-5	
Suspension maximum travel		381 mm (15 in)	330 mm (13 in)
Shock absorber type	Center	H.P.G.	H.P.G.
	Rear	H.P.G. VR	LE: H.P.G. VR SE: Motion control air spring
Stroke limiter standard position		3	
Coupling blocks standard position		2	
REAR SUSPENSION		**MX Z RENEGADE**	**MX Z RENEGADE X**
Suspension type		SC-5	
Suspension maximum travel		330 mm (13 in)	
Shock absorber type	Center	H.P.G.	H.P.G. T/A (aluminum)
	Rear	H.P.G.	H.P.G. racing clicker (aluminum)
Stroke limiter standard position		3	
Coupling blocks standard position		2	
REAR SUSPENSION		**MX Z TNT**	**MX Z X**
Suspension type		SC-5	
Suspension maximum travel		381 mm (15 in)	
Shock absorber type	Center	H.P.G. T/A (aluminum)	
	Rear	HPG T/A (aluminum)	H.P.G. racing clicker (aluminum)
Stroke limiter standard position		3	
Coupling blocks standard position		2	
STEERING SYSTEM		**ALL MODELS**	
Ski type		GTX: Pilot SL All others: Pilot 5.7	
Toe-out		5 mm (.197 in)	
Camber		0°	

WEIGHT AND DIMENSIONS	GSX	GTX
Dry weight	234 kg (516 lb)	LE: 265 kg (584 lb) SE: 271 kg (597 lb)
Length	289 cm (113.8 in)	323 cm (127.2 in)
Width	122 cm (48 in)	
Height	127 cm (50 in)	136 cm (54 in)
Ski stance (carbide to carbide)	119.5 cm (47 in)	
WEIGHT AND DIMENSIONS	**MX Z RENEGADE**	**MX Z RENEGADE X**
Dry weight	242 kg (534 lb)	236 kg (520 lb)
Length	311 cm (122.4 in)	
Width	122 cm (48 in)	
Height	133 cm (52 in)	118 cm (46 in)
Ski stance (carbide to carbide)	119.5 cm (47 in)	
WEIGHT AND DIMENSIONS	**MX Z TNT**	**MX Z X**
Dry weight	231 kg (509 lb)	
Length	289 cm (113.8 in)	
Width	122 cm (48 in)	
Height	119 cm (47 in)	
Ski stance (carbide to carbide)	119.5 cm (47 in)	

WIRING DIAGRAM INFORMATION

SERVICE TOOLS

Description	Part Number	Page
CRIMPING PLIER FOR HEAVY GAGE WIRE	529 035 730	490
CRIMPING TOOL	529 035 909	488
KOSTAL DIE	529 035 906	488

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON SCREWDRIVER	TT600-5	484
TOOL	AMP-755430-2	485–486

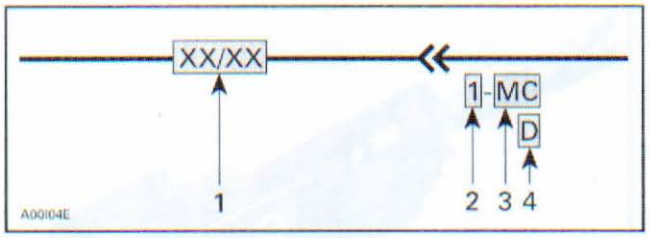
GENERAL

WIRING DIAGRAM LOCATION

The wiring diagrams are in the manual back cover pocket.

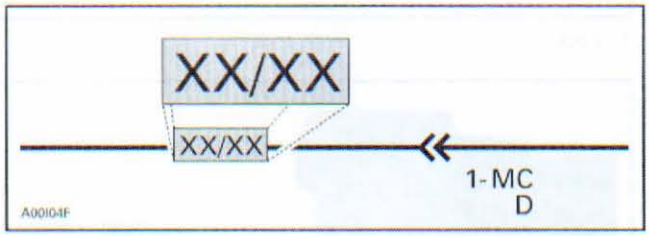
WIRING DIAGRAM CODES

The wiring diagrams use the following codes.



1. *Wire colors*
2. *Connector location*
3. *Connector code*
4. *Terminal position in connector*

Wire Colors



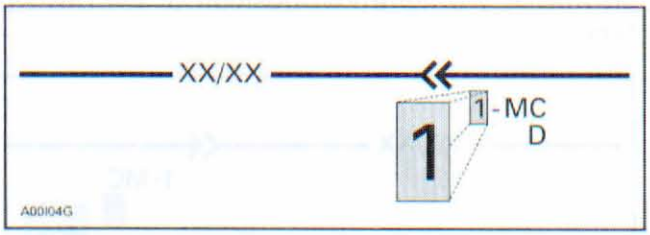
The first color of a wire is the main color, second color is the stripe.

Example: YL / BK is a YELLOW wire with a BLACK stripe.

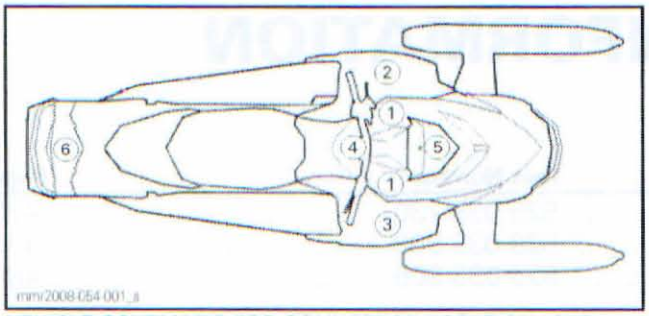
COLOR CODE					
BE	—	BEIGE	OR	—	ORANGE
BK	—	BLACK	RD	—	RED
BU	—	BLUE	VI	—	VIOLET
BR	—	BROWN	WH	—	WHITE
GN	—	GREEN	YL	—	YELLOW
GY	—	GRAY			

Connector Location

The first digit of the connector identification number presents the location of the connector on the vehicle. It may also describe the part removal that is required to reach the connector.



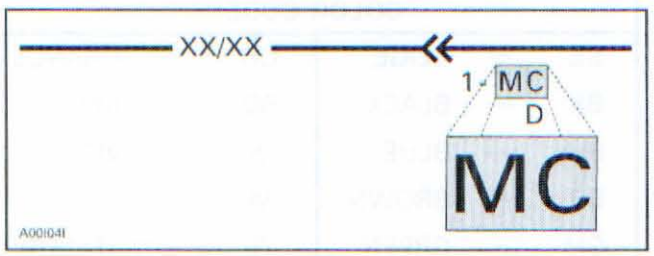
The location of the connectors are shown on the wiring diagram with a vehicle schematic as shown below.



VEHICLE SCHEMATIC FOR CONNECTOR LOCATION (SEE WIRING DIAGRAM)

Connector Code

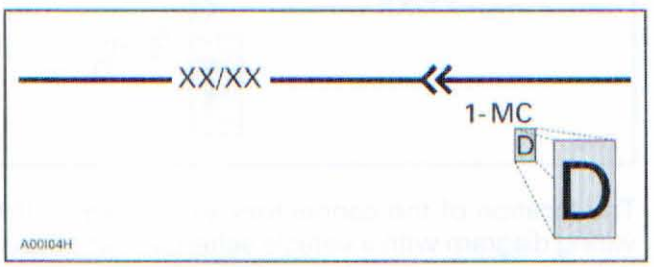
The next two letters (may be up to 8 letters) of the connector identification number represents a connector reference. If there are many connectors in the same area this helps identify which wire is in which connector.



Terminal Position in Connector

The third portion of the connector identification number represents the location of the terminal in the connector. This could be identified by either a number or by a letter depending on the type of connector used.

NOTE: The terminal position identification may also be at the rightmost position of the description.

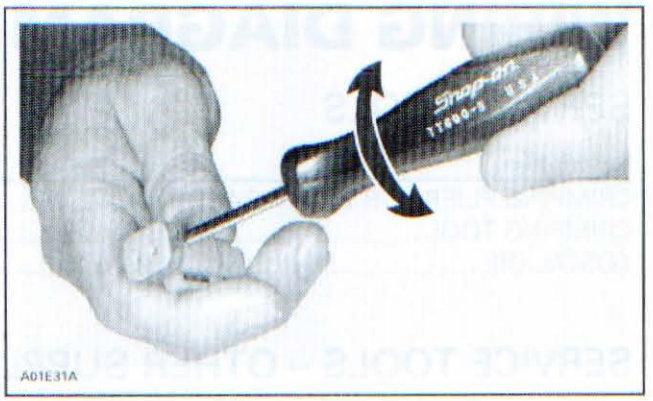


DEUTSCH CONNECTOR INFORMATION

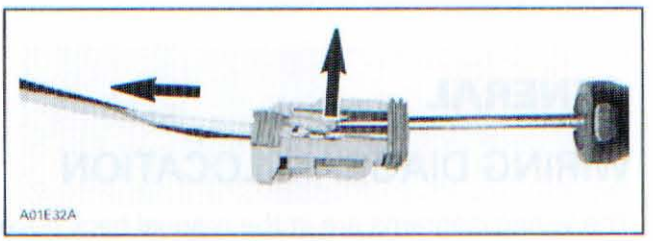
Connector Disassembly

Male Housing

Insert SNAP-ON SCREWDRIVER (P/N TT600-5) under lock and twist to lift it.



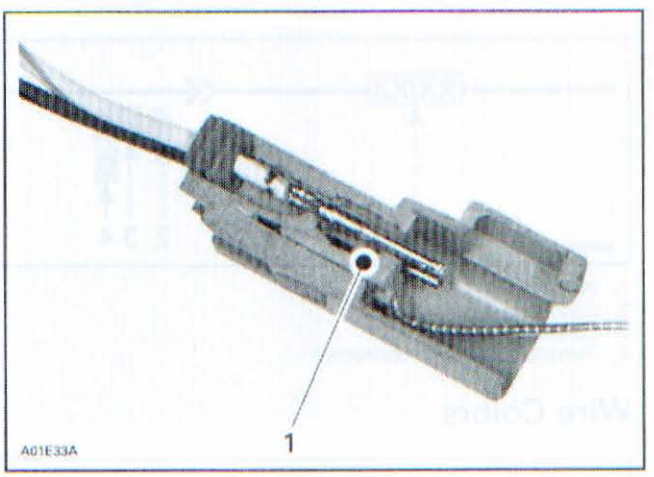
Pry tab to free connector then pull wire out of housing.



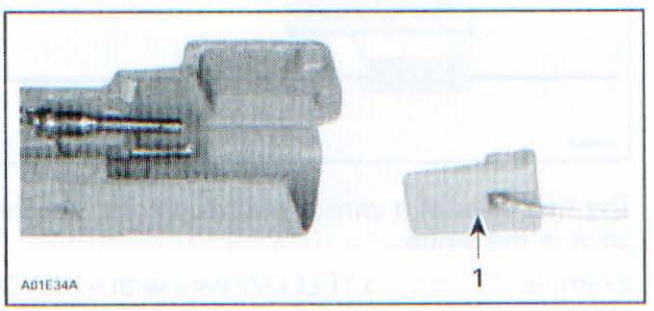
FEMALE CONNECTOR HOUSING — CUT-AWAY

Female Housing

Using a small hook, pull out the lock.

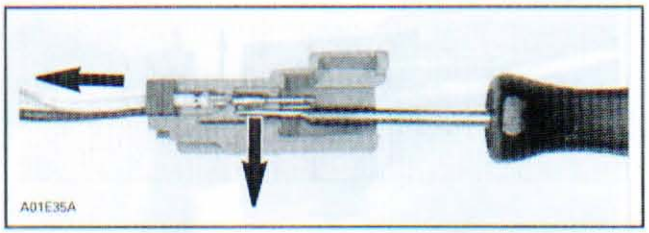


1. Lock



1. Lock

Pry tab to free connector then pull wire out of housing.

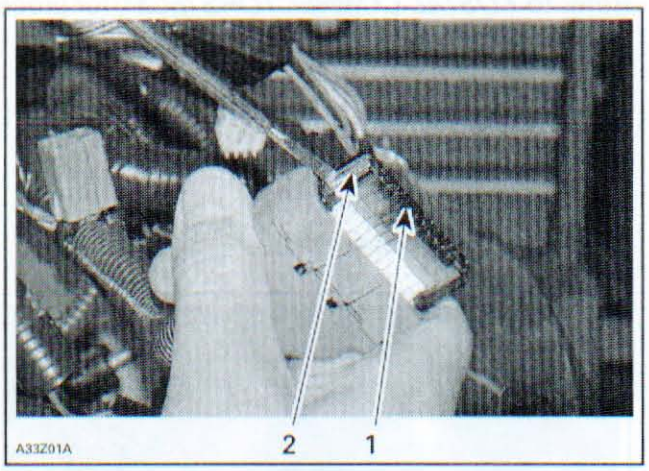


FEMALE HOUSING — CUT-AWAY

PACKARD CONNECTOR INFORMATION (GAUGE)

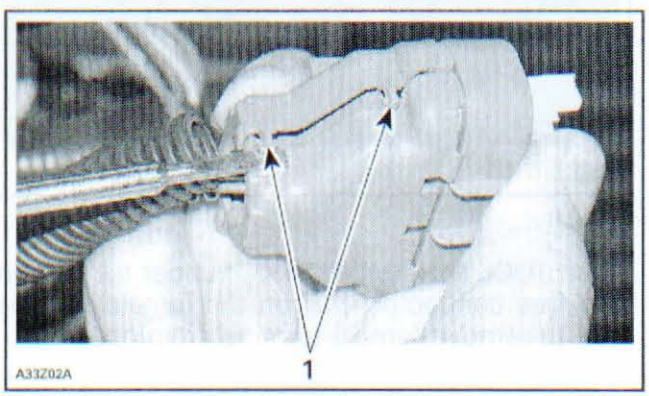
Connector Disassembly

Push on both tabs to remove retainer.



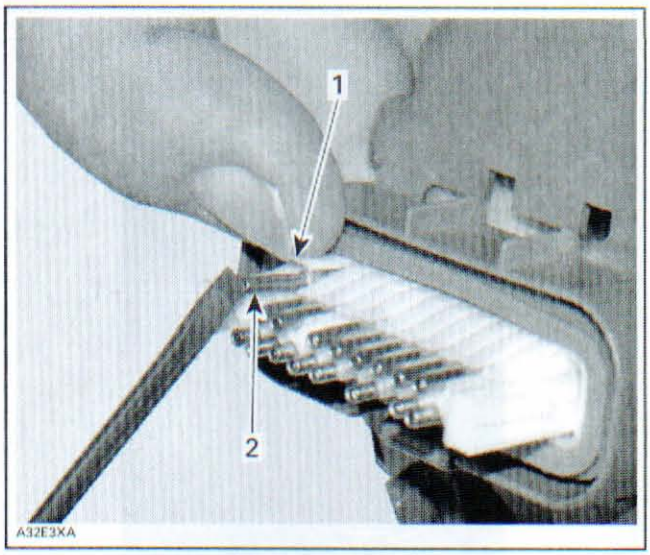
TYPICAL
1. *Retainer*
2. *Tab (one on each side)*

Open housing by lifting 4 tabs.



TYPICAL
1. *Tabs (2 on each side)*

Lift the top plastic lock of the female terminal to be removed and hold in position. Lift the female terminal to unlock from the housing and push out of housing.

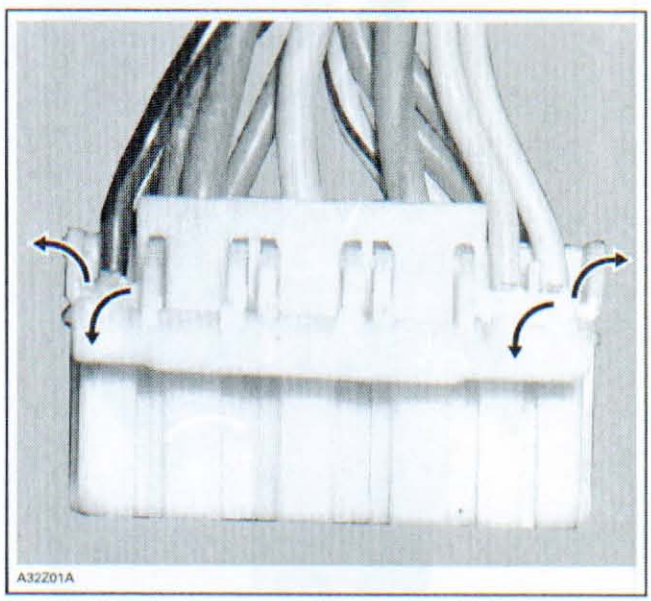


1. *Lift and hold plastic lock*
2. *Lift to unlock and push out*

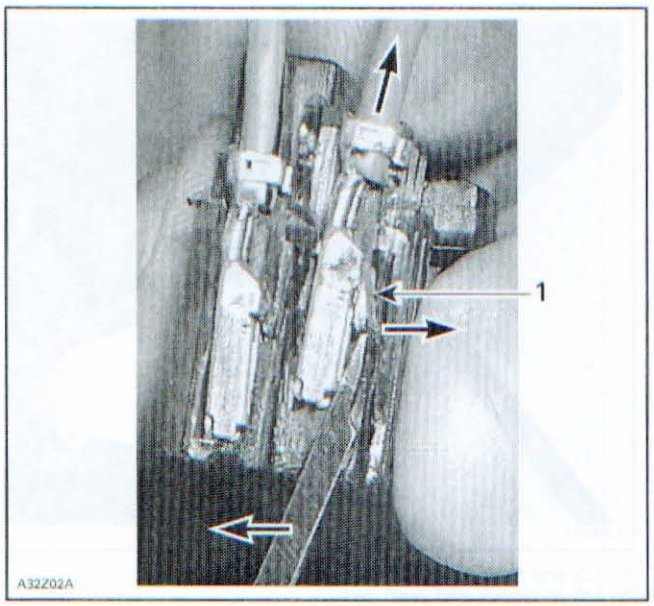
AMP MULTILOCK CONNECTOR INFORMATION

Connector Disassembly

Male Housing



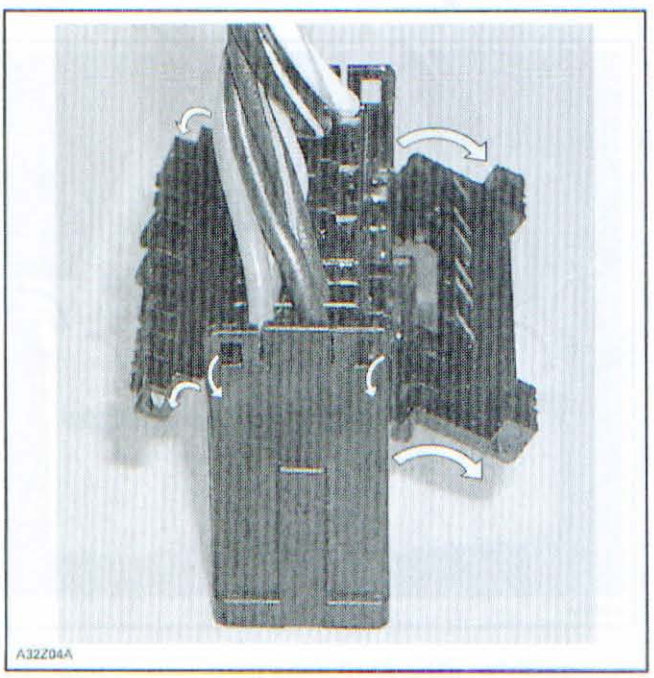
Insert TOOL (P/N AMP-755430-2) under lock and twist to lift it.



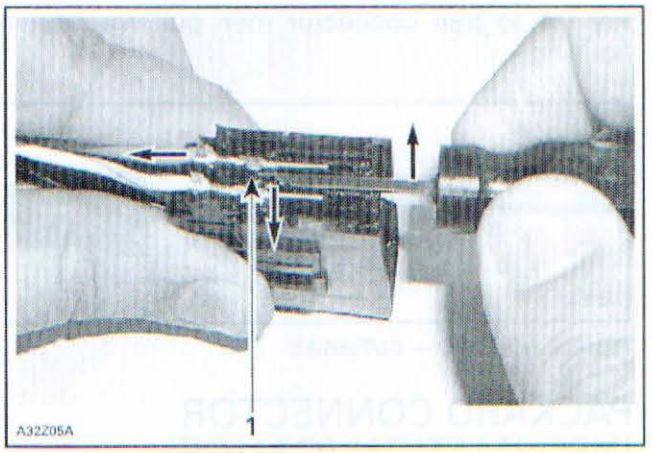
MALE HOUSING — CUT-AWAY
1. Lock

Female terminals can be removed from housing with sharp head pin.

Female Housing



Insert TOOL (P/N AMP-755430-2) under lock and twist to lift it.



FEMALE HOUSING — CUT-AWAY
1. Lock

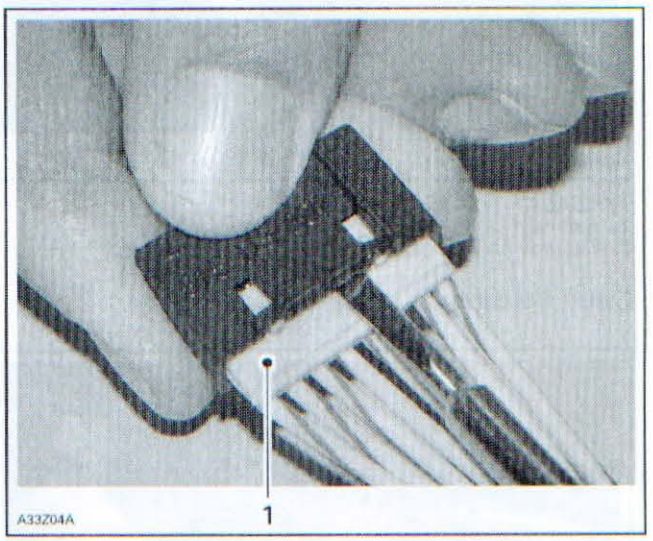
Terminal Crimping

Refer to *KOSTAL CONNECTORS (ECM)* for procedure.

AMP CONNECTOR (8-CIRCUIT) INFORMATION

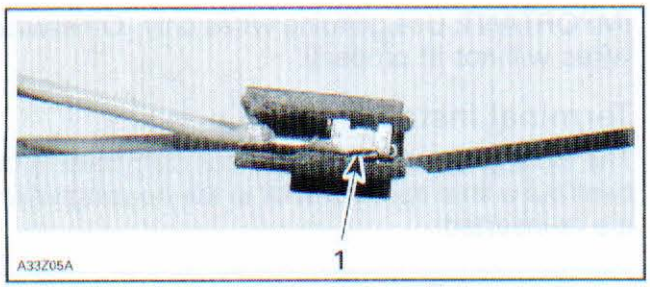
Connector Disassembly

Pry housing to release lock.



1. Lock

Insert TOOL (P/N AMP-755430-2) under tab and pry it to free connector. Pull on the female terminal wire to remove female terminal from housing.



AMP 8-CIRCUIT CONNECTOR — CUT-AWAY
1. Tab

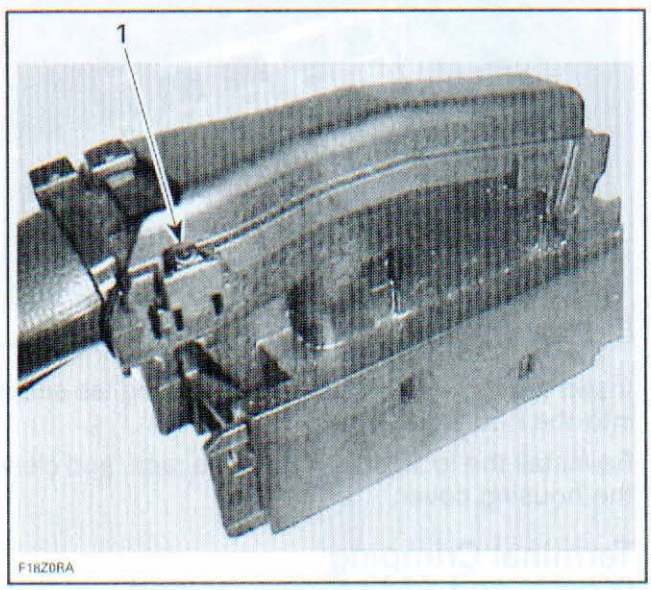
Terminal Crimping

Refer to *KOSTAL CONNECTORS (ECM)* for procedure.

KOSTAL CONNECTOR INFORMATION (ECM)

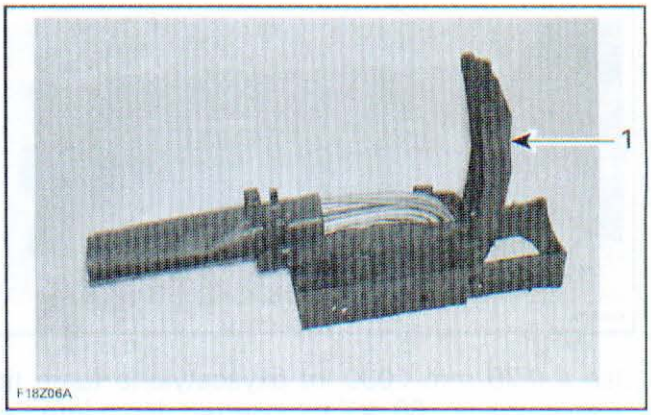
Terminal Removal

Unlock the connector housing cover by pushing in the tabs on top of the housing with a flat screwdriver to be able to flip the top cover up.



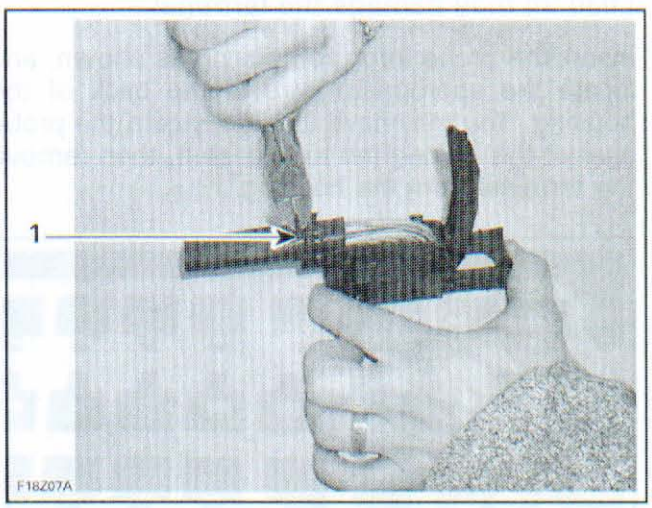
1. Push in tab

Lift the cover by pushing it forward.



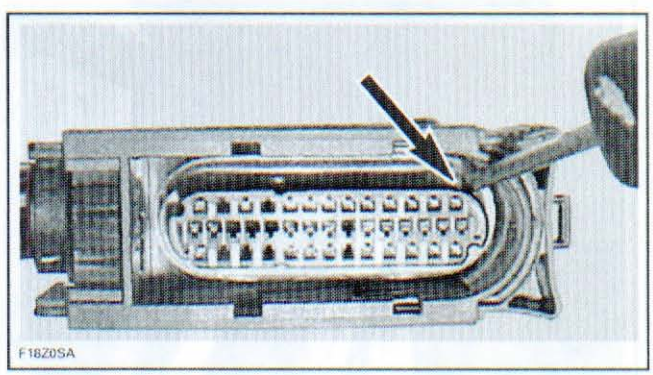
1. Cover

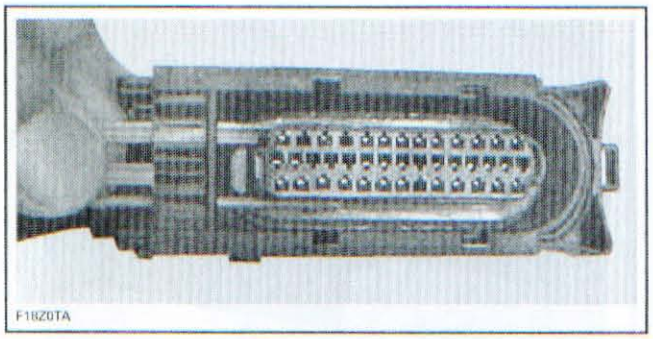
Cut both locking ties that secure the harness to the housing.



1. Locking ties

Turn the housing over and remove the lock by pushing and then pulling toward the wire harness.

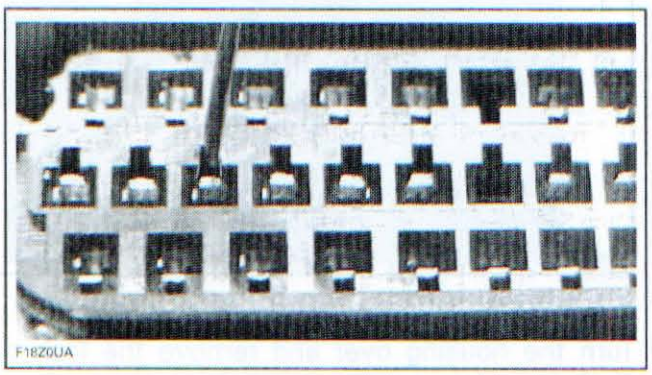


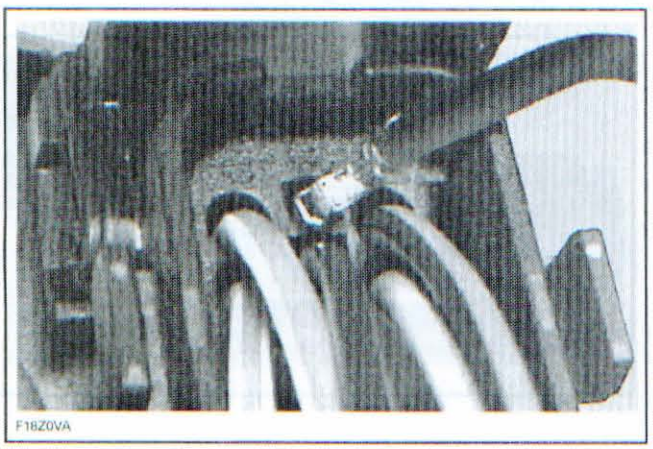

F18Z0TA

Use a 0.76 mm (.030 in) oxyacetylene torch tip cleaner or a no. 68 drill bit inserted down into the housing to release the locking tab on the connector.

NOTICE Using a probe larger than 0.76 mm (.030 in) may damage the terminal.

Insert the probe into the housing as shown, and locate the appropriate wire in the back of the housing. You may have to slightly cam the probe against the locking tab to release it, then remove the terminal from the housing.


F18Z0UA

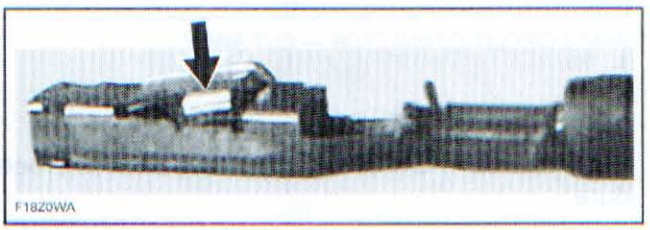

F18Z0VA

If the wire is in good condition but the terminal is rusted or corroded, remove defective terminal and crimp a new one. If wire and terminal are defective, acquire a new genuine wire and new terminal and crimp them together as explained below.

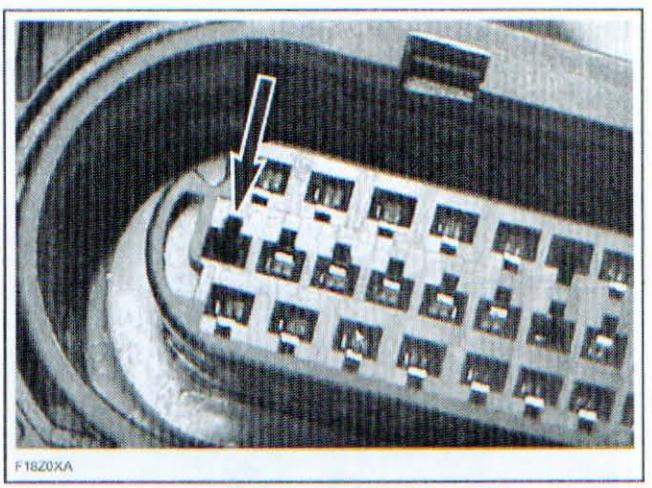
IMPORTANT: Use genuine wires only. Otherwise wires will not fit properly.

Terminal Installation

The locking tab on the connector may have to be bent out a little so it will lock in the housing when it's re-inserted.


F18Z0WA

When re-inserting the connector, the locking tab must be installed facing the smaller cutout of the connector cavity.

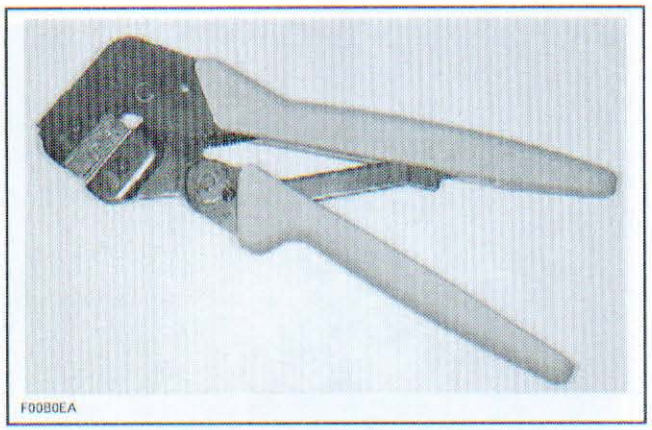

F18Z0XA

Insert the terminal, ensuring the locking tab snaps into the housing.

Re-install the lock, attach the 2 tie raps, and close the housing cover.

Terminal Crimping (Kostal and AMP 8-circuits and Multilock)

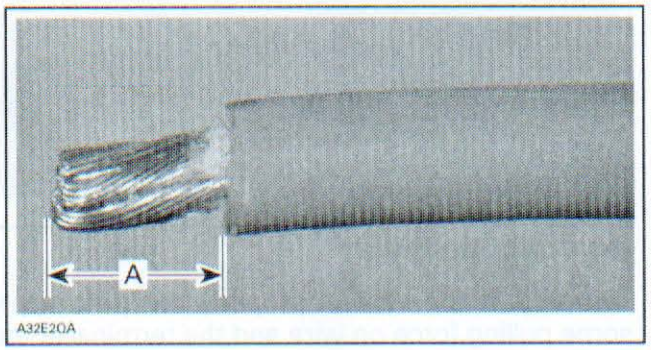
To crimp a new connector terminal, use the CRIMPING TOOL (P/N 529 035 909) and the KOSTAL DIE (P/N 529 035 906).



CRIMPING TOOL

To properly crimp the wires, strictly follow this procedure.

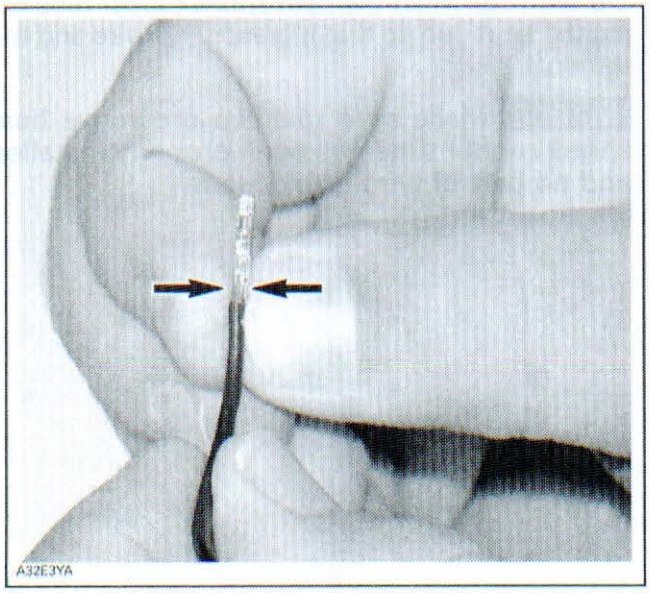
Strip the wire to a maximum of 3 mm (1/8 in).



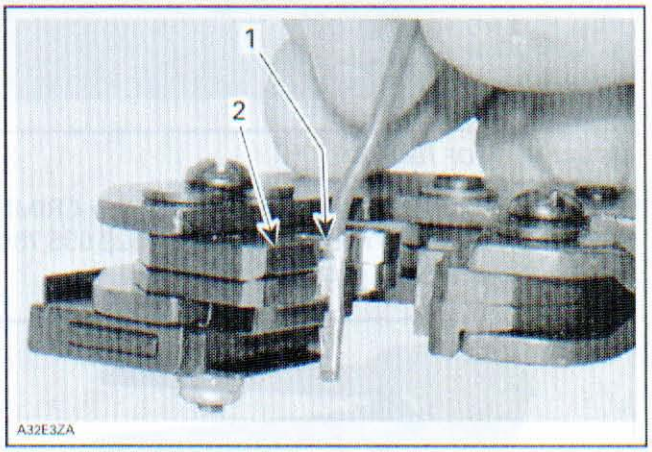
TYPICAL
A. 3 mm (1/8 in) max.

Position wire in terminal.

Squeeze the terminal tabs with your fingers to temporarily retain terminal in place.



Insert terminal with wire in crimping pliers and position so that top of terminal tabs are flush with pliers edge or a little bit lower as shown.



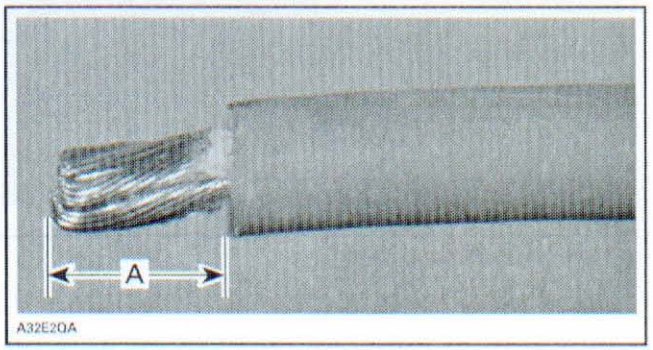
1. Top of terminal tabs
2. Align tabs with pliers edge

Crimp terminal. Ensure no tiny wire goes out of terminal. This might cause strange problems of the electrical system.

BATTERY CABLE TERMINAL INFORMATION

Terminal Installation

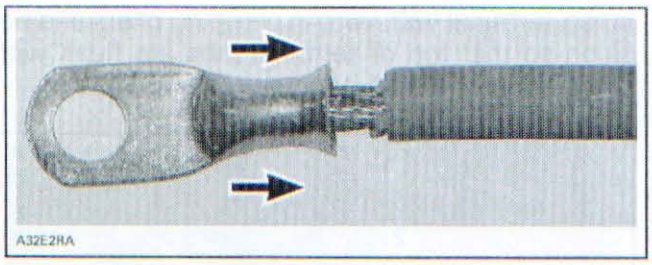
Carefully strip the wire approximately to 10 mm (1/2 in) in length, using a wire stripping tool or sharp blade/knife.



A. 10 mm (1/2 in)

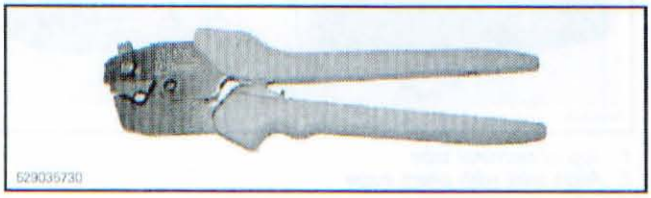
NOTE: Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate *PARTS CATALOG*.

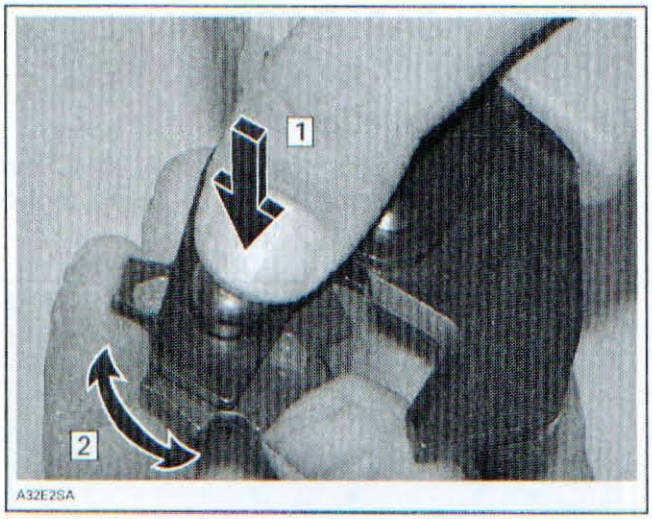


INSTALLATION OF TERMINAL

Follow the instructions provided with the CRIMPING PLIER FOR HEAVY GAGE WIRE (P/N 529 035 730) to select the proper position of the tool.

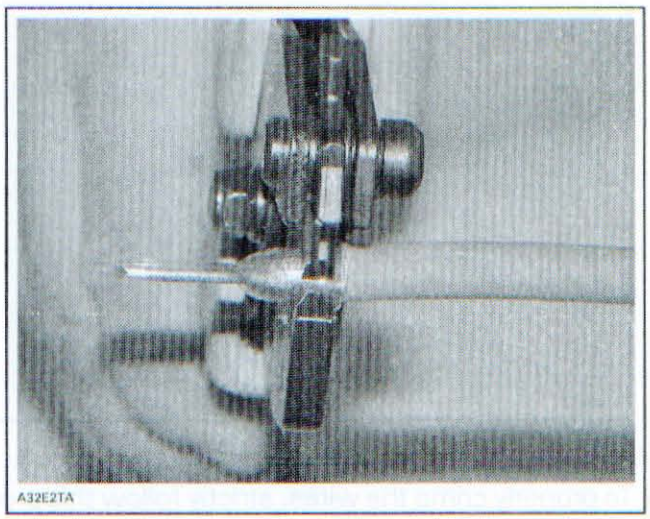


NOTE: Different wires require different crimp pliers settings, so make sure to follow the instruction supplied with the tool.



POSITIONING THE CRIMP PLIERS
Step 1: Press
Step 2: Rotate

After positioning the crimp pliers, crimp the terminal already installed on wire.



CRIMPING OF WIRE

PROPERLY CRIMPED WIRE

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

NOTICE **Never solder the wire to the terminal. Soldering can change the property of the wire and it can become brittle and break.**

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

NOTICE **Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.**

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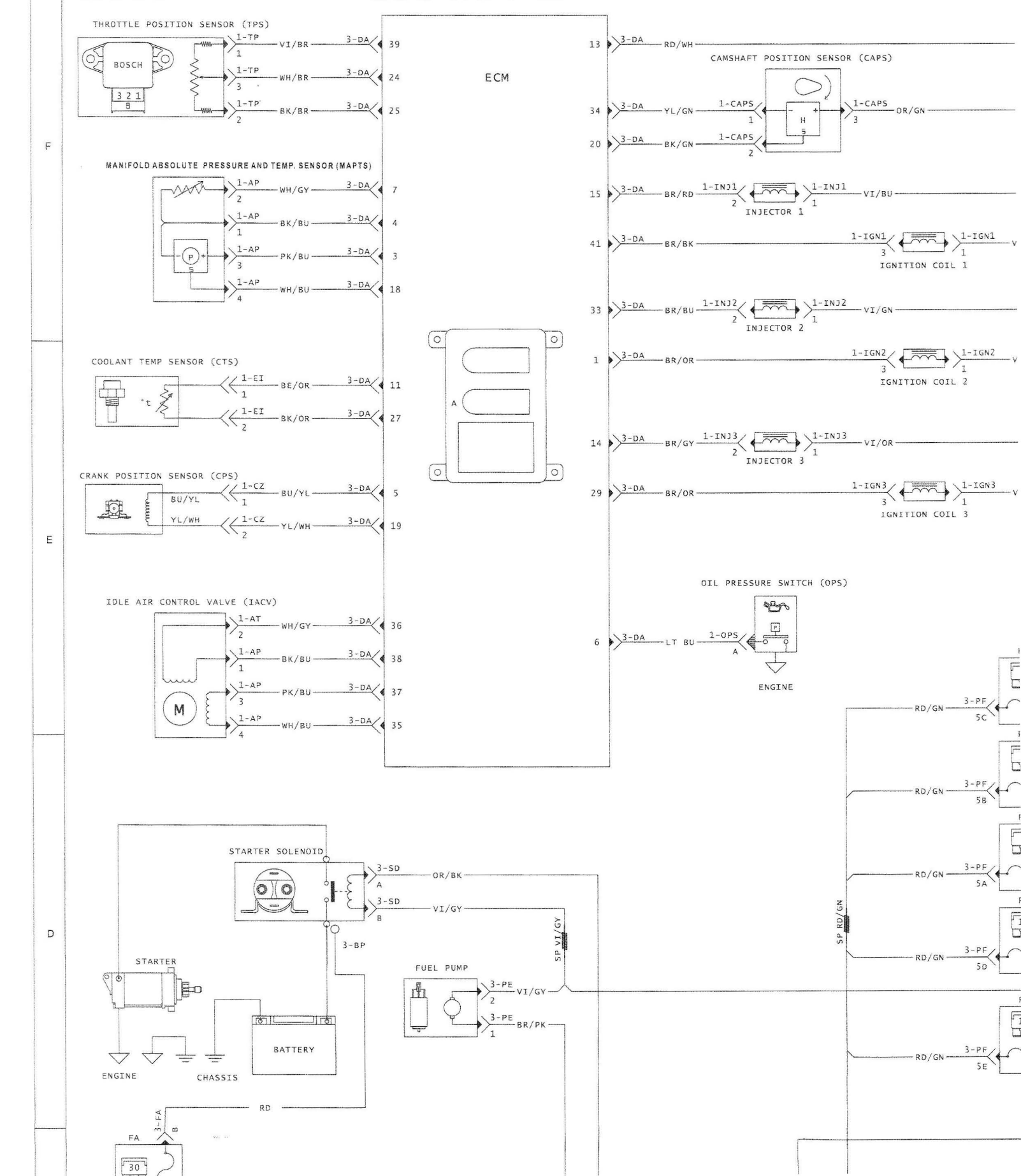
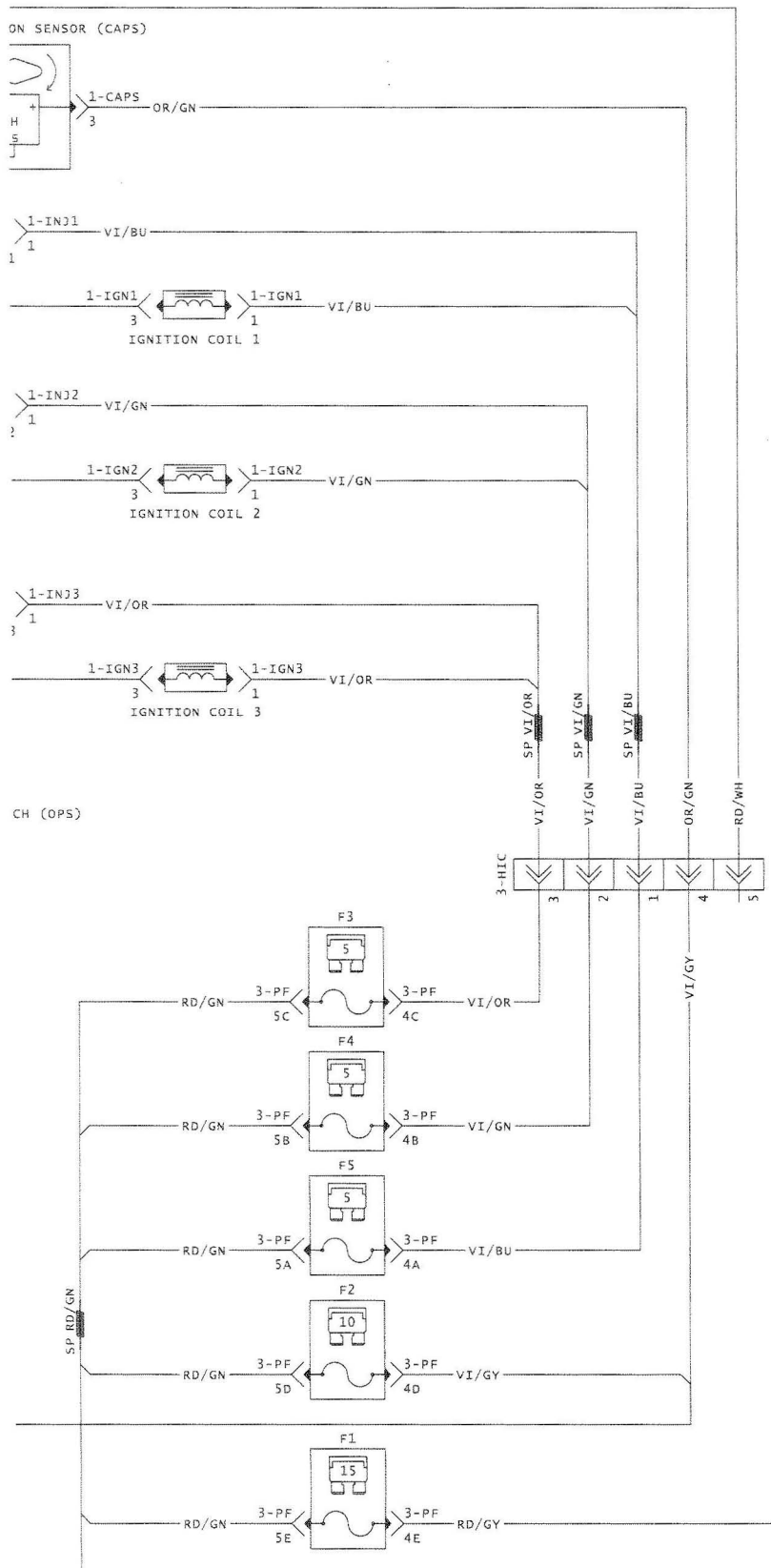
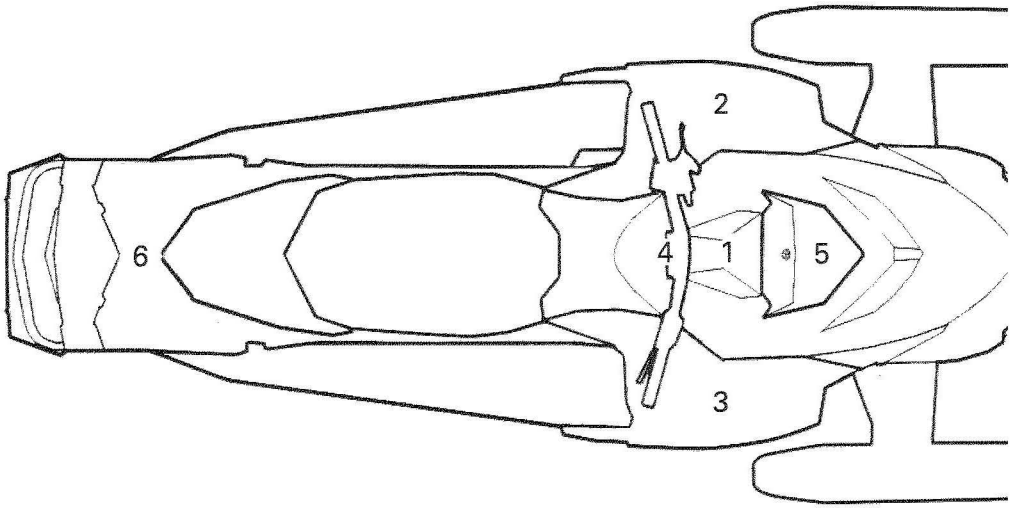
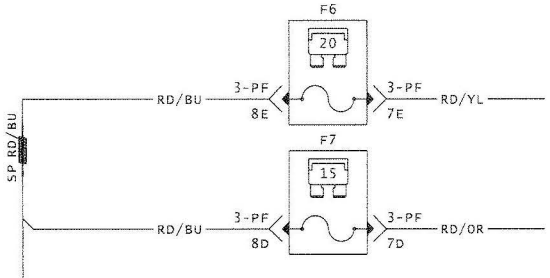
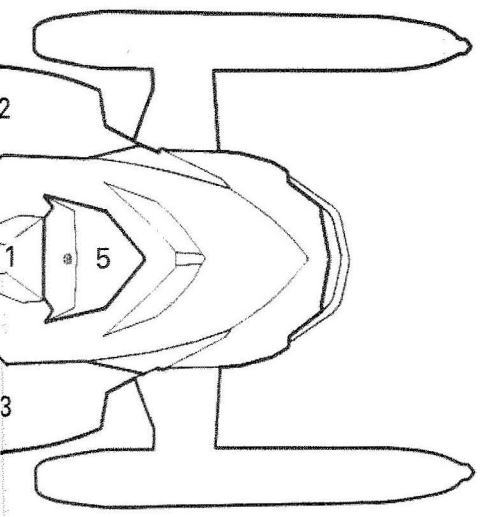



ON SENSOR (CAPS)
1-CAPS
3
OR/GN
1-INJ1
1
VI/BU
1-IGN1
3
1-IGN1
1
VI/BU
IGNITION COIL 1
1-INJ2
1
VI/GN
1-IGN2
3
1-IGN2
1
VI/GN
IGNITION COIL 2
1-INJ3
1
VI/OR
1-IGN3
3
1-IGN3
1
VI/OR
IGNITION COIL 3
SP VI/OR
SP VI/GN
SP VI/BU
CH (OPS)
VI/OR
VI/GN
VI/BU
OR/GN
RD/WH
3-HIC
3
2
1
4
5
F3
5
RD/GN
3-PF
5C
3-PF
4C
VI/OR
F4
5
RD/GN
3-PF
5B
3-PF
4B
VI/GN
F5
5
RD/GN
3-PF
5A
3-PF
4A
VI/BU
VI/GY
SP RD/GN
F2
10
RD/GN
3-PF
5D
3-PF
4D
VI/GY
F1
15
RD/GN
3-PF
5E
3-PF
4E
RD/GY


2
6
4
1
5
3


F6
20
RD/BU
3-PF
8E
3-PF
7E
RD/YL
SP RD/BU
F7
15
RD/BU
3-PF
8D
3-PF
7D
RD/OR



PREM

5-HG2

11
9 RI
3 RI
6 RI
4 BI
2
8
10 G
1 BI
5
7

F6
20
3-PF
7E
RD/YL
SP RD/YL

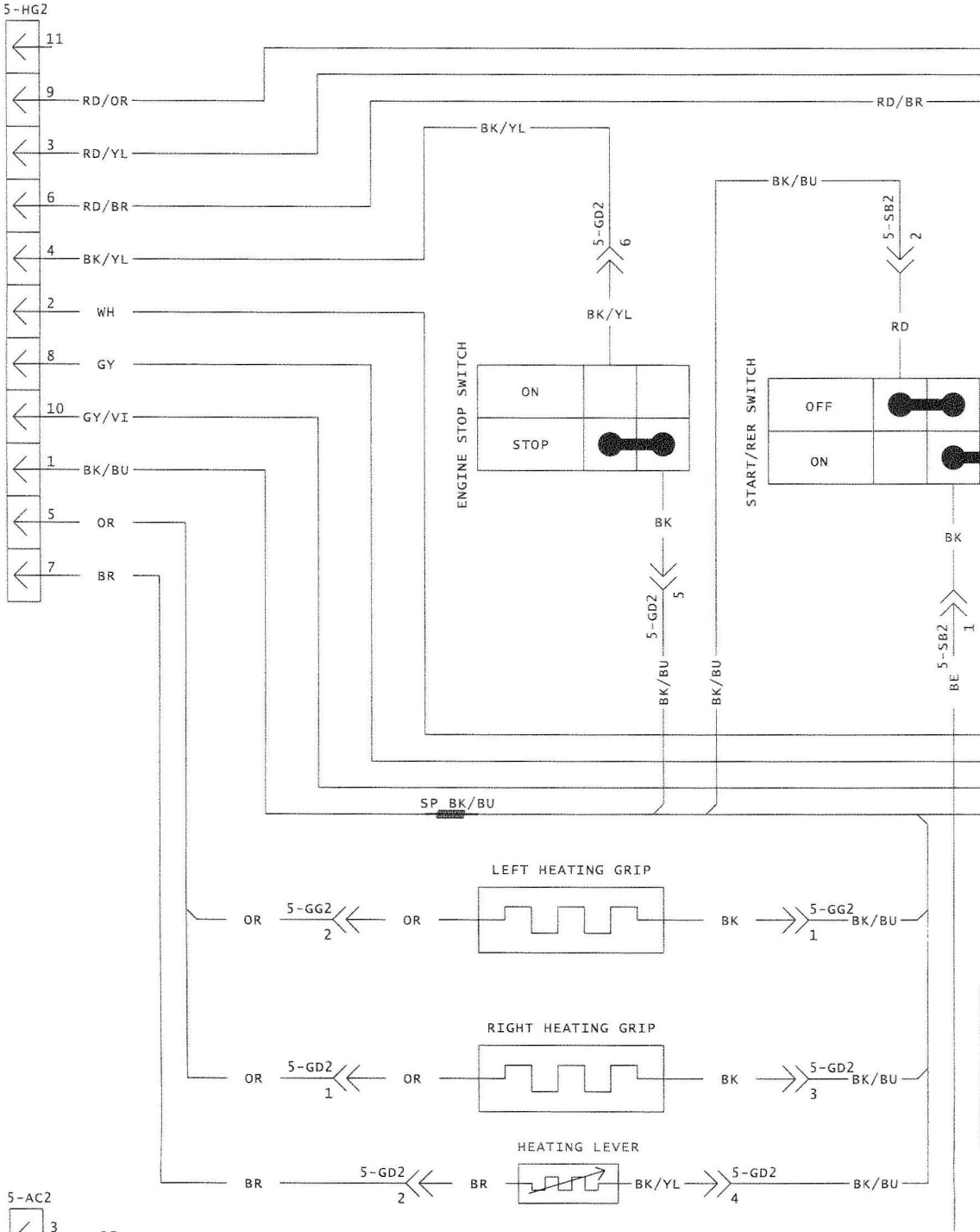
F7
15
3-PF
7D
RD/OR

5-HG

RD/YL 11 HEATING DEVICE POWER
RD/OR 9 HEADLAMP POWER
RD/YL 3 BRAKE SWITCH POWER
RD/BR 6 START/RER SWITCH POWER
BK/YL 4 ENGINE STOP SIGNAL
WH 2 BRAKE LIGHT OUTPUT
GY 8 HEADLAMP HIGH

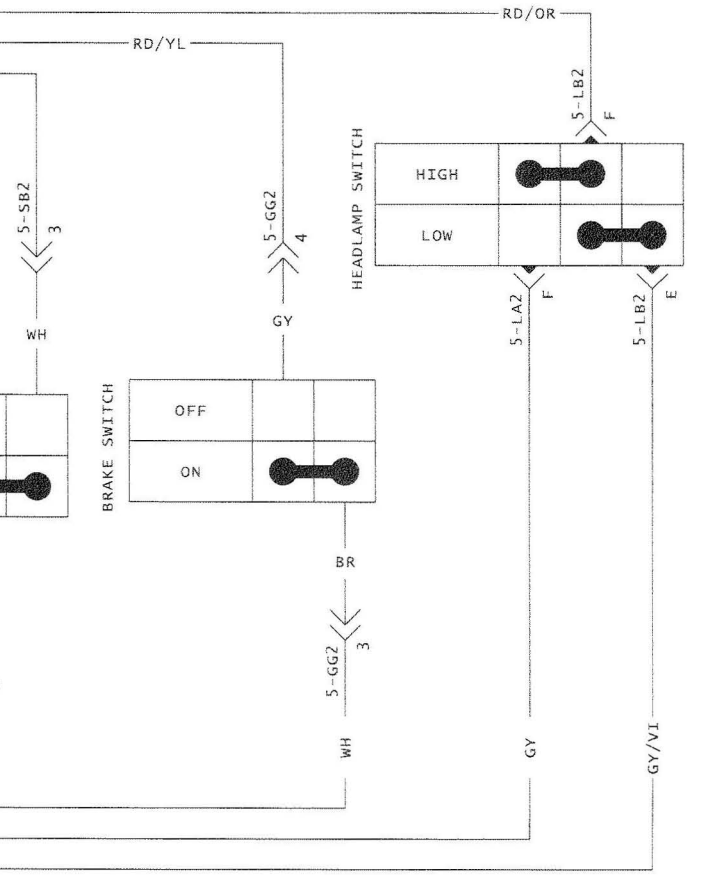
5-AC2

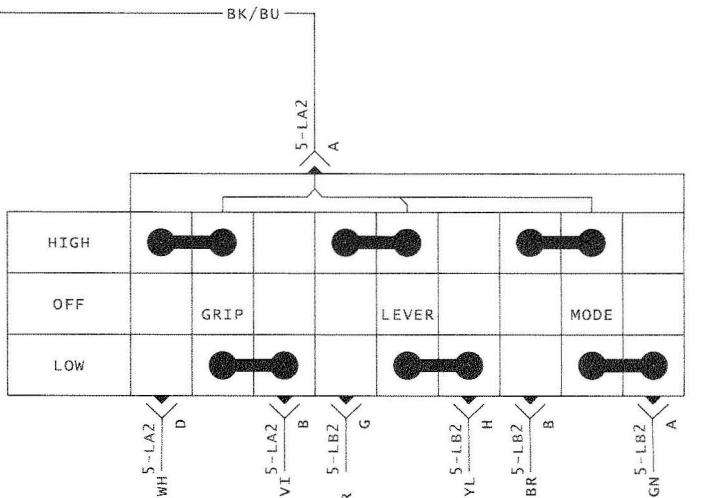
PREMIUM STEERING HARNESS

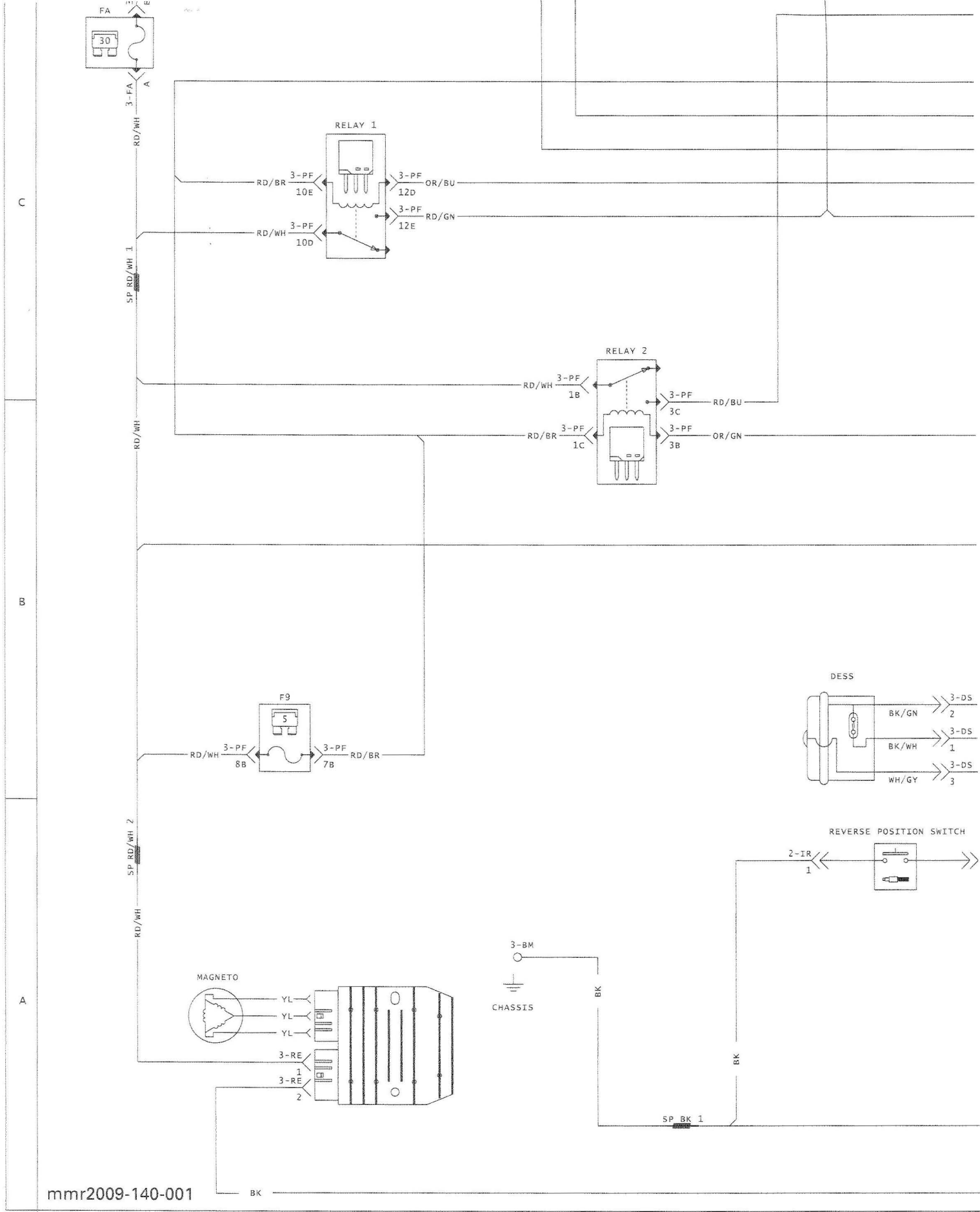


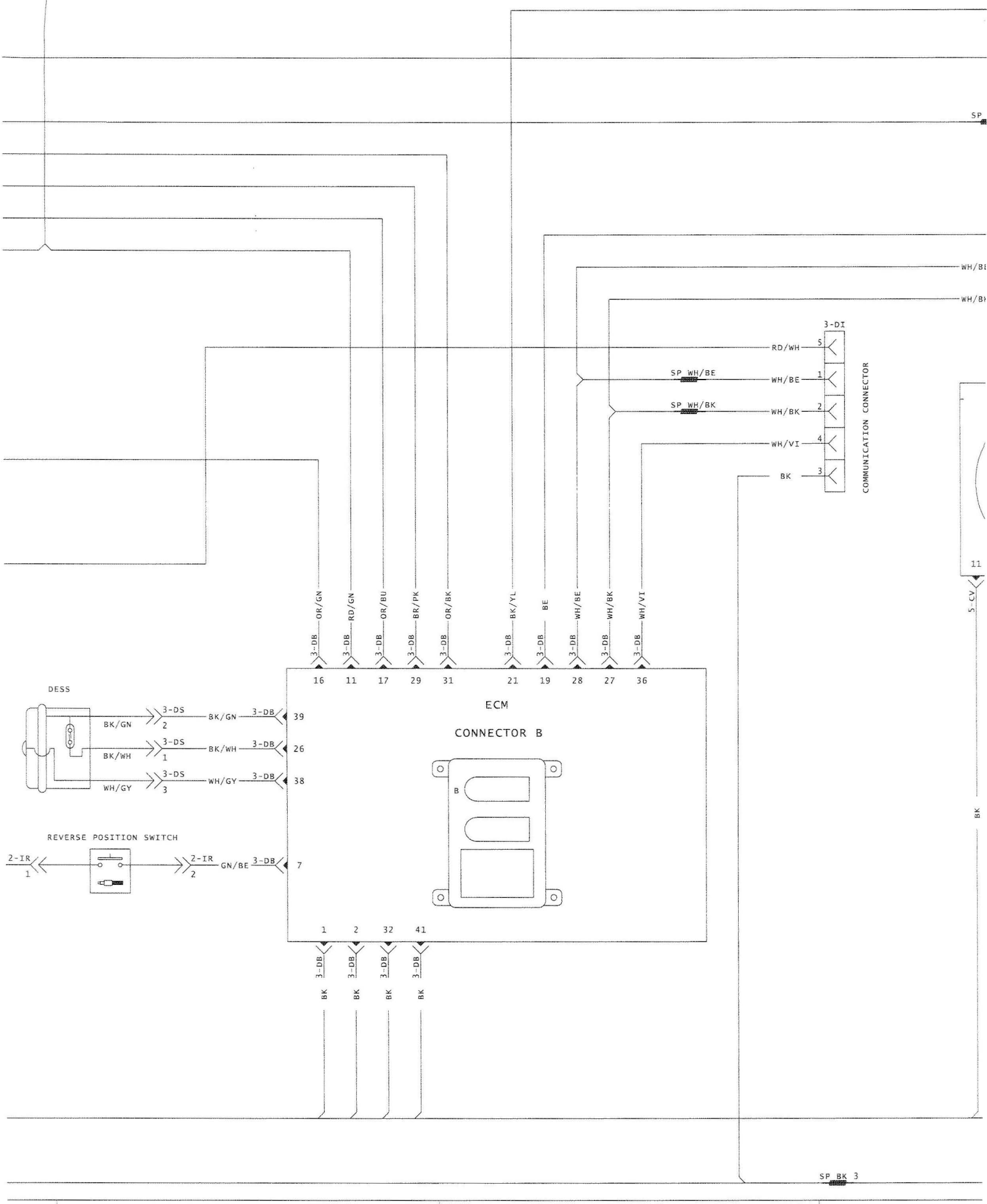
CONNECTOR LOCATION	
1	ENGINE RELATED CONNECTORS
2	LH SIDE PANEL
3	RH SIDE PANEL
4	HANDLEBAR AREA
5	BEHIND MULTI-FUNCTION GAUGE
6	REAR PART OF FRAME

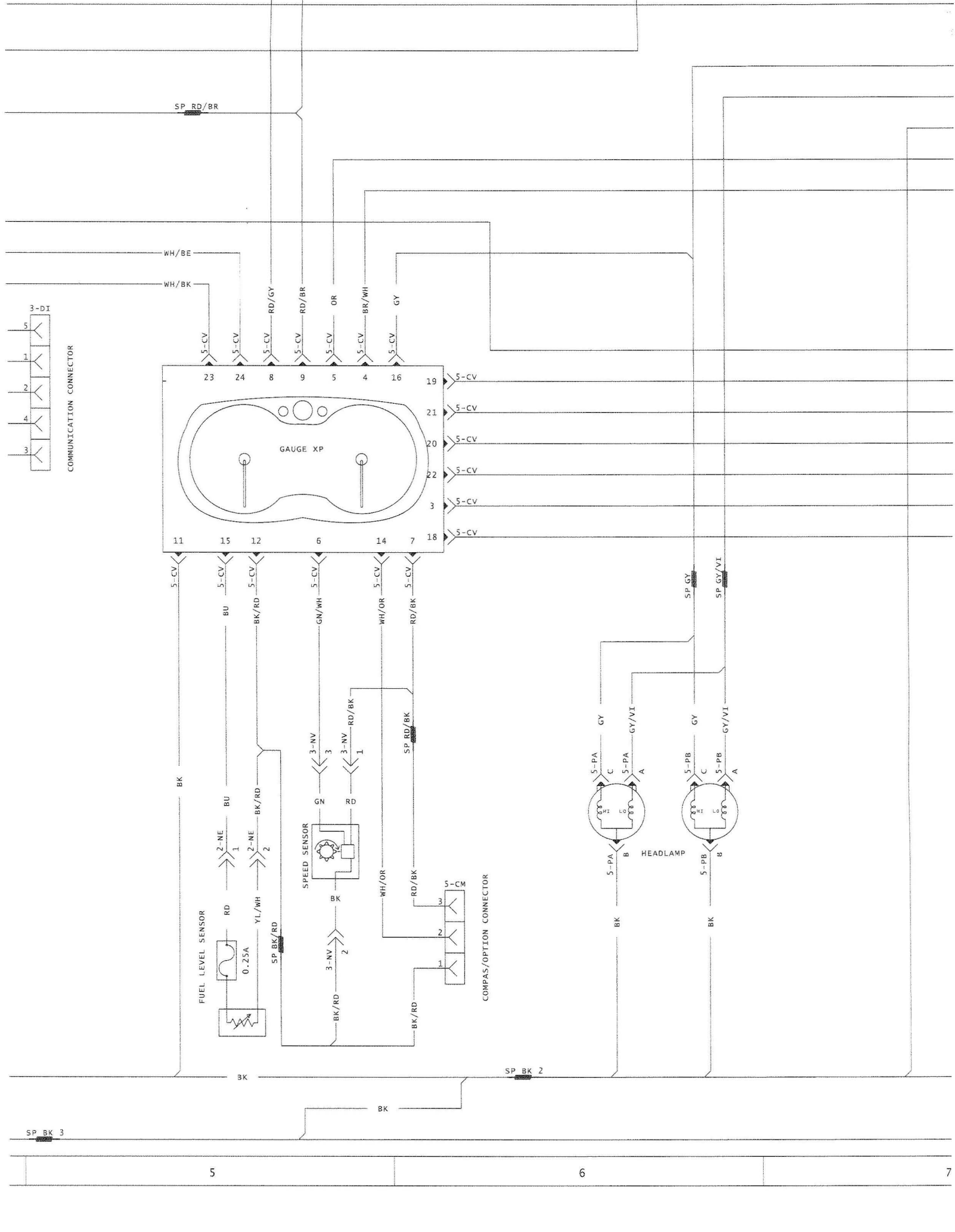
COLOR CODE	
BE	BEIGE
BK	BLACK
BR	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
RD	RED
VI	VIOLET
YL	YELLOW
LT	LIGHT COLOR
SP	SPLICE

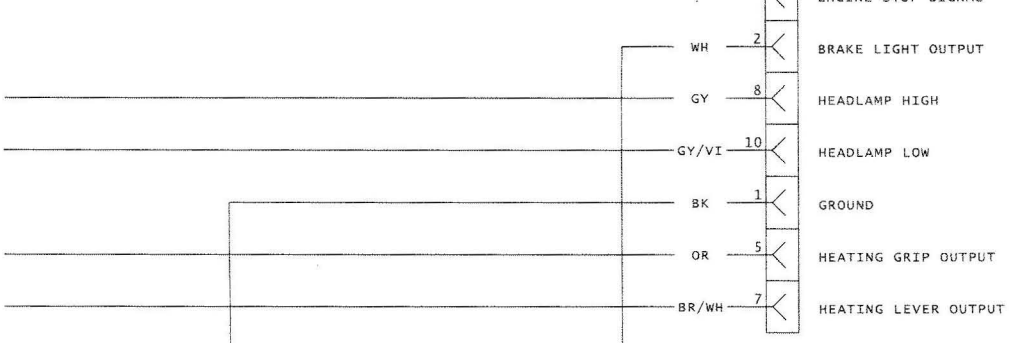




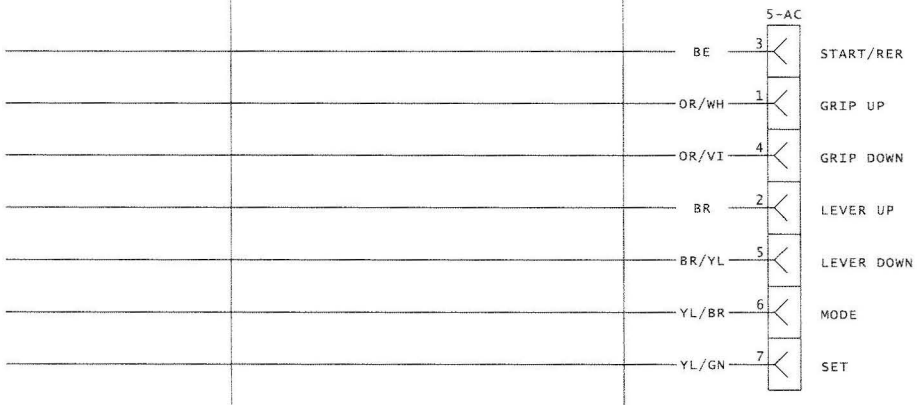

FA
30
3-FA
A
RD/WH
RELAY 1
RD/BR
3-PF
10E
3-PF
12D
OR/BU
3-PF
12E
RD/GN
RD/WH
3-PF
10D
SP RD/WH 1
RELAY 2
RD/WH
3-PF
1B
3-PF
3C
RD/BU
RD/BR
3-PF
1C
3-PF
3B
OR/GN
RD/WH
F9
5
RD/WH
3-PF
8B
3-PF
7B
RD/BR
DESS
BK/GN
3-DS
2
BK/WH
3-DS
1
WH/GY
3-DS
3
REVERSE POSITION SWITCH
2-IR
1
SP RD/WH 2
RD/WH
MAGNETO
YL
YL
YL
3-RE
1
3-RE
2
3-BM
CHASSIS
BK
BK
SP BK 1
BK
mmr2009-140-001
C
B
A
1
2

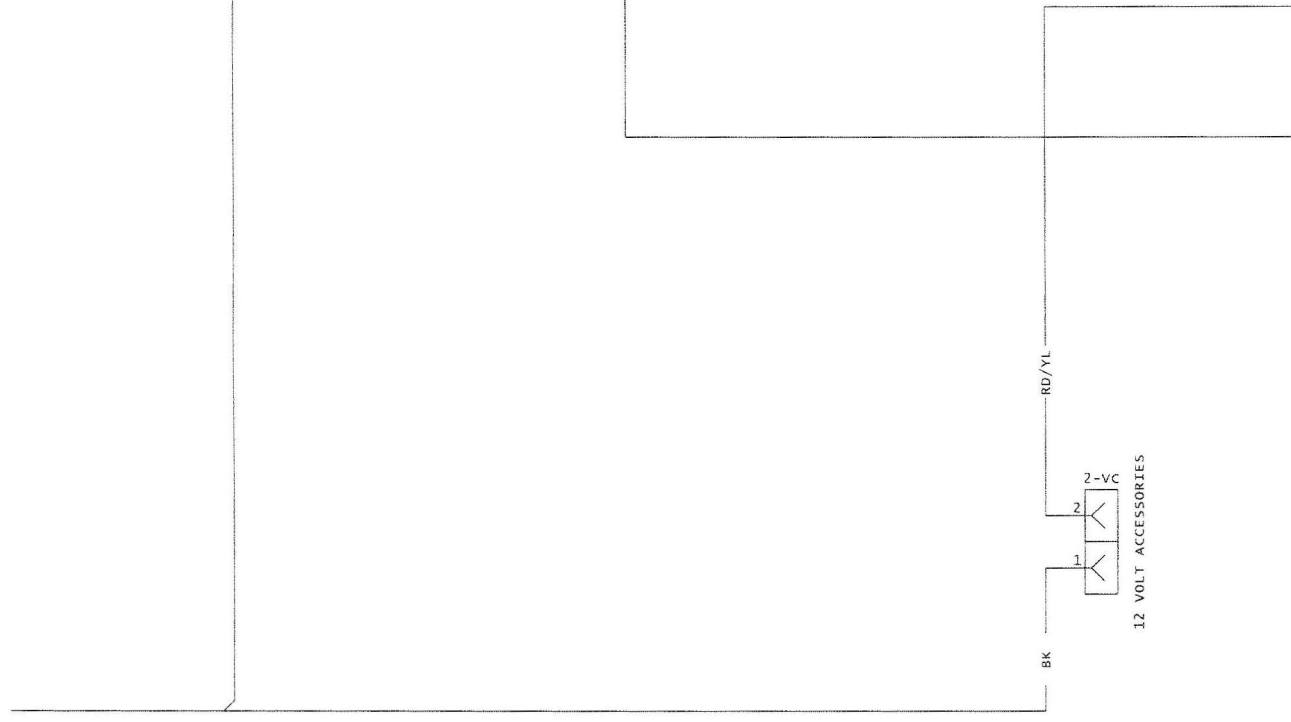

SP
WH/BE
WH/BK
3-DI
RD/WH
5
SP WH/BE
WH/BE
1
SP WH/BK
WH/BK
2
WH/VI
4
BK
3
COMMUNICATION CONNECTOR
11
5-CV
BK
OR/GN
RD/GN
OR/BU
BR/PK
OR/BK
BK/YL
BE
WH/BE
WH/BK
WH/VI
3-DB
16
11
17
29
31
21
19
28
27
36
ECM
CONNECTOR B
B
DESS
BK/GN
BK/WH
WH/GY
3-DS
2
1
3
39
26
38
REVERSE POSITION SWITCH
2-IR
GN/BE
7
1
2
32
41
SP BK 3

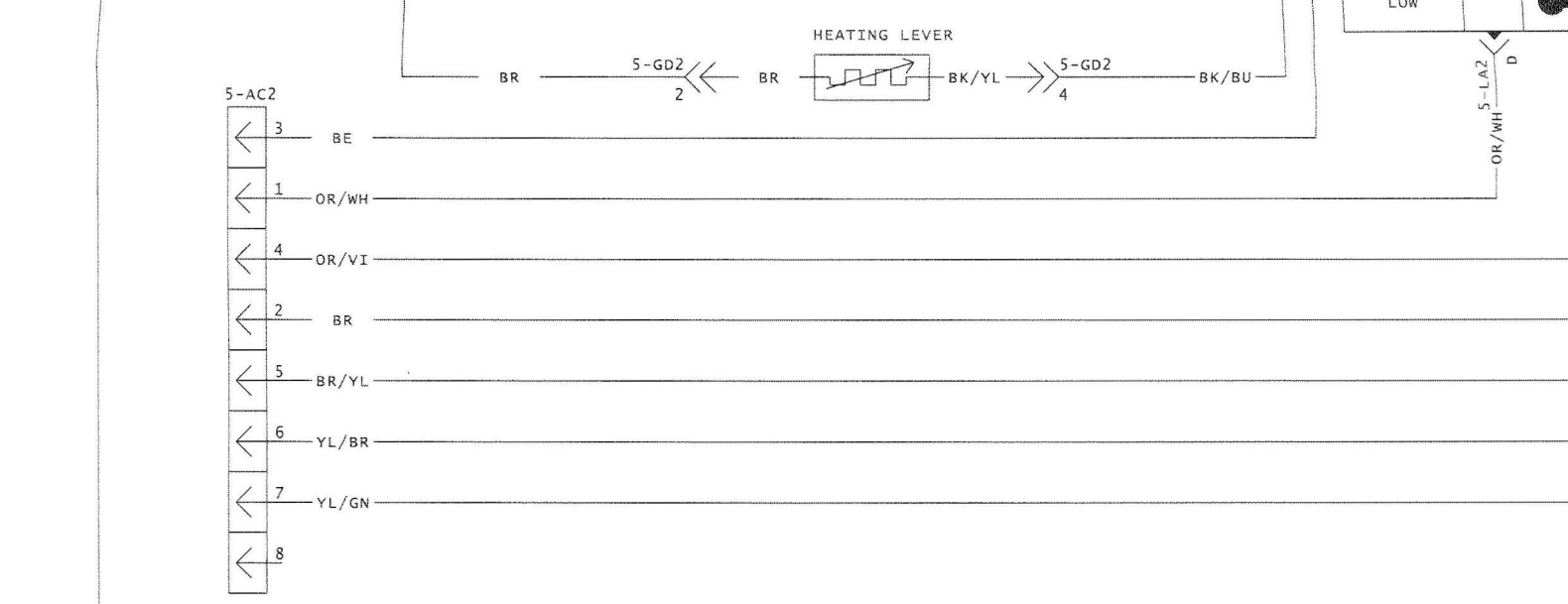

SP RD/BR
WH/BE
WH/BK
3-DI
COMMUNICATION CONNECTOR
RD/GY
RD/BR
OR
BR/WH
GY
GAUGE XP
SP GY
SP GY/VI
BU
BK/RD
GN/WH
WH/OR
RD/BK
SP RD/BK
GN
RD
SPEED SENSOR
FUEL LEVEL SENSOR
YL/WH
SP BK/RD
0.25A
5-CM
COMPAS/OPTION CONNECTOR
HEADLAMP
SP BK 2
SP BK 3
BK



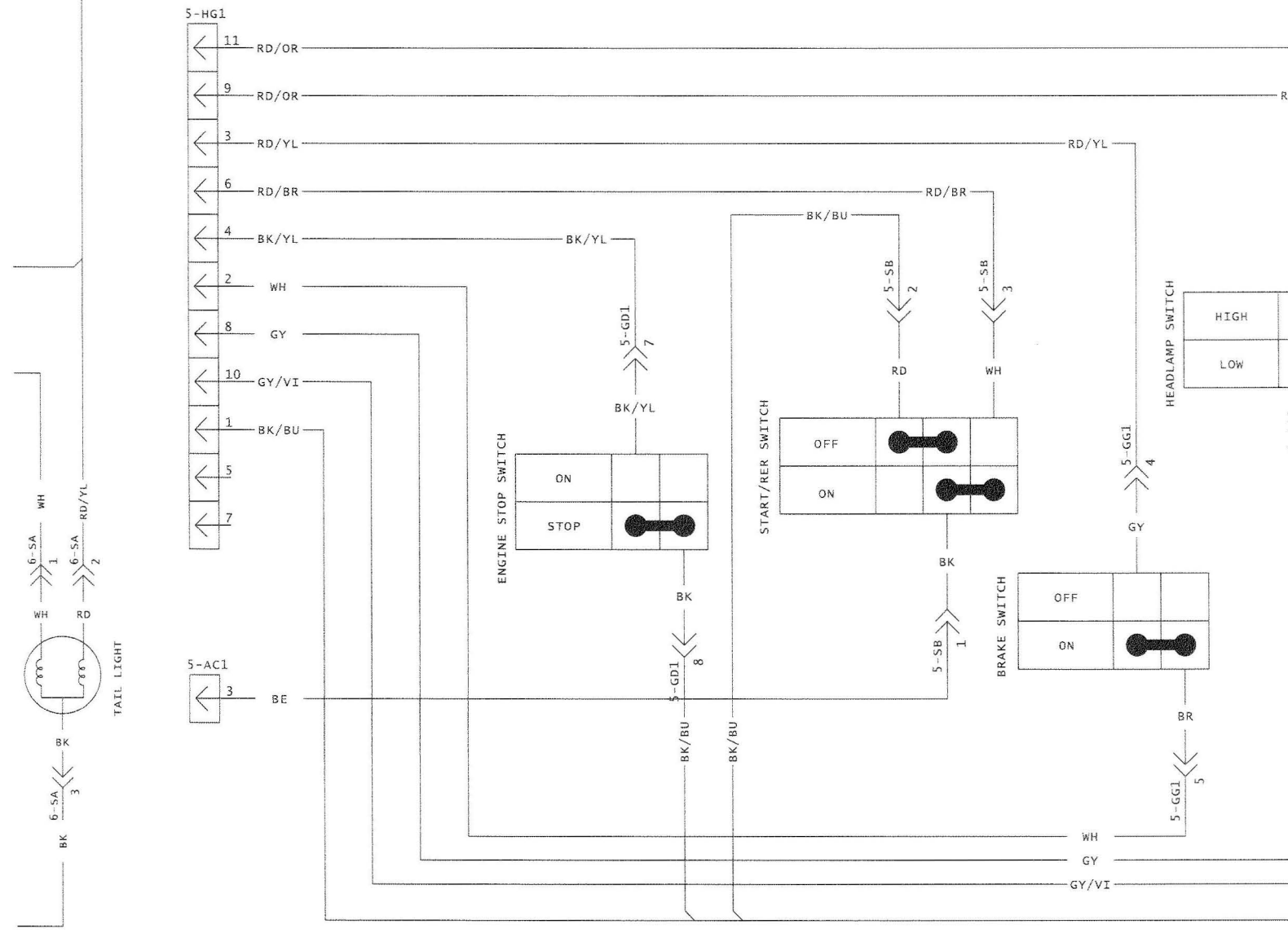
STEERING HARNESS CONNECTORS

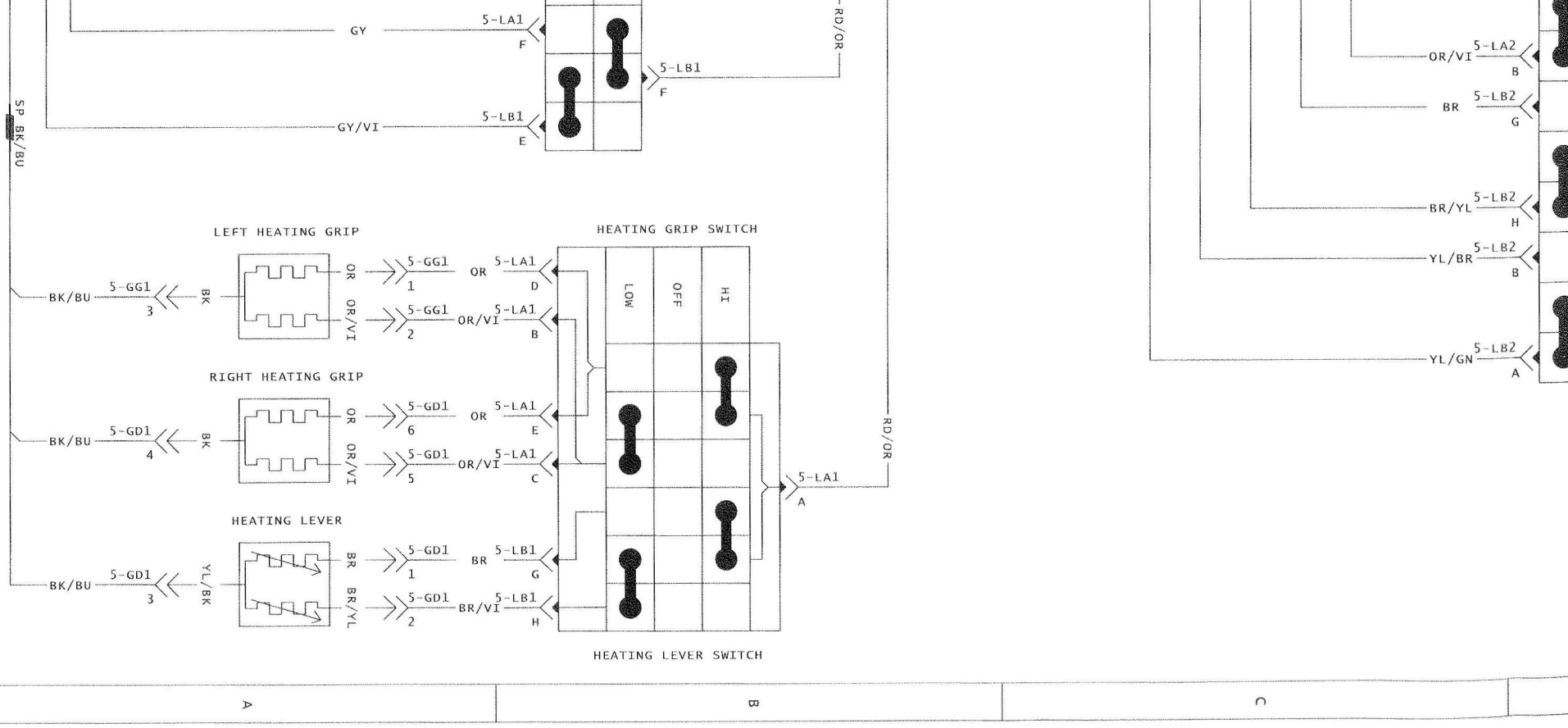






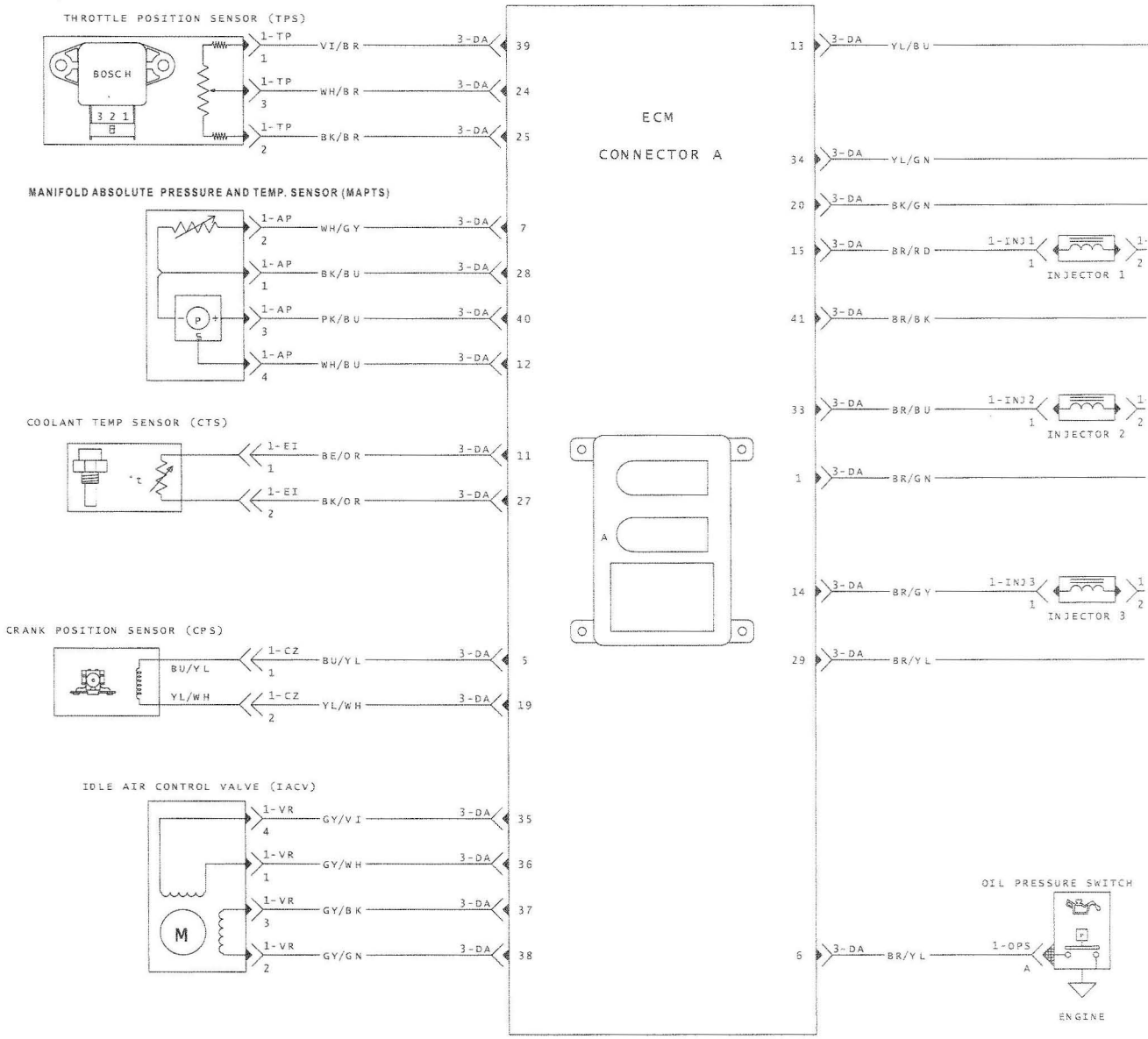
STANDARD STEERING HARNESS

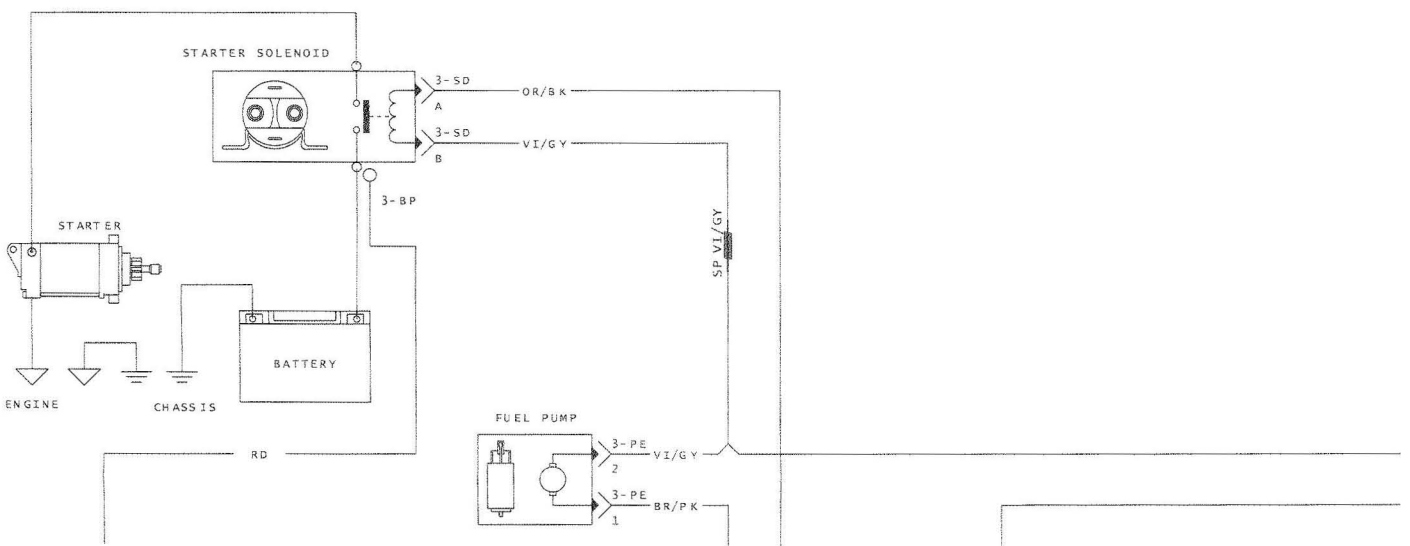


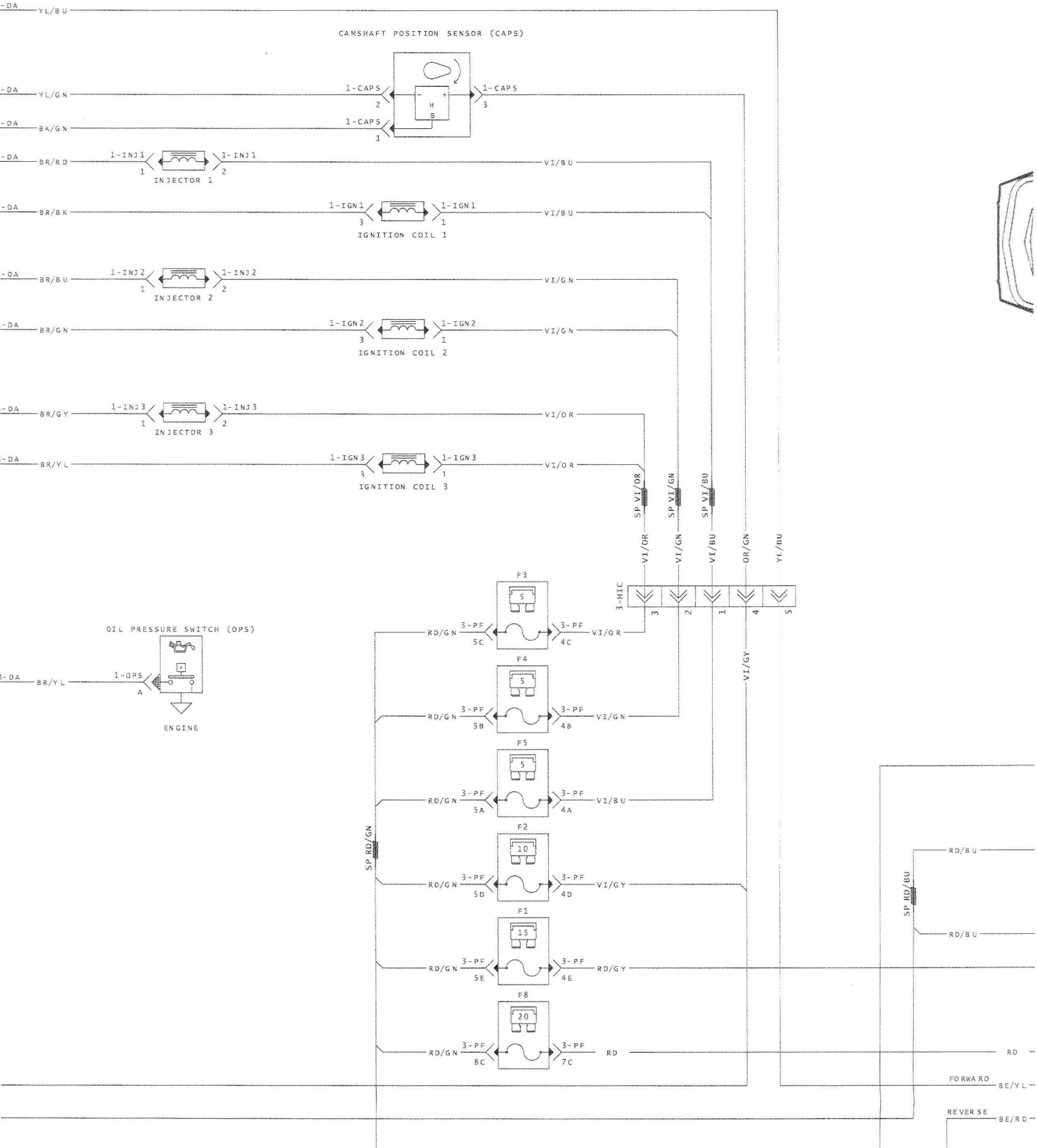

SP BK/BU
GY
5-LA1
F
GY/VI
5-LB1
E
5-LB1
F
RD/OR
OR/VI
5-LA2
B
BR
5-LB2
G
BR/YL
5-LB2
H
YL/BR
5-LB2
B
YL/GN
5-LB2
A
LEFT HEATING GRIP
HEATING GRIP SWITCH
BK/BU
5-GG1
3
BK
OR
OR/VI
5-GG1
1
5-GG1
2
OR
OR/VI
5-LA1
D
5-LA1
B
LOW
OFF
HI
RIGHT HEATING GRIP
BK/BU
5-GD1
4
BK
OR
OR/VI
5-GD1
6
5-GD1
5
OR
OR/VI
5-LA1
E
5-LA1
C
5-LA1
A
RD/OR
HEATING LEVER
BK/BU
5-GD1
3
YL/BK
BR
BR/YL
5-GD1
1
5-GD1
2
BR
BR/VI
5-LB1
G
5-LB1
H
HEATING LEVER SWITCH

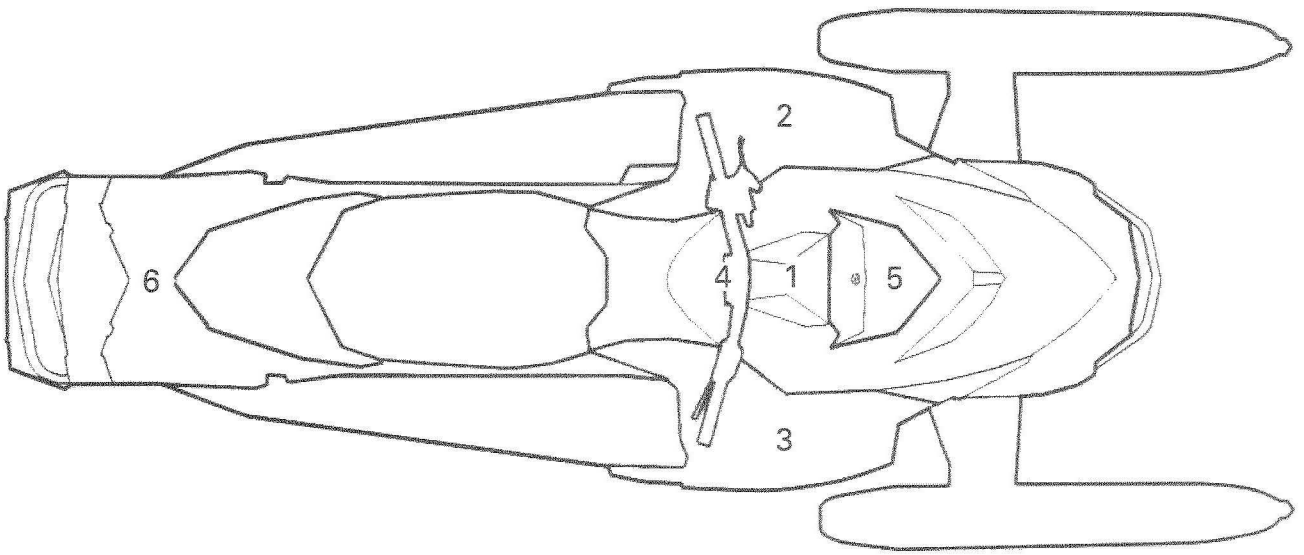
A B C

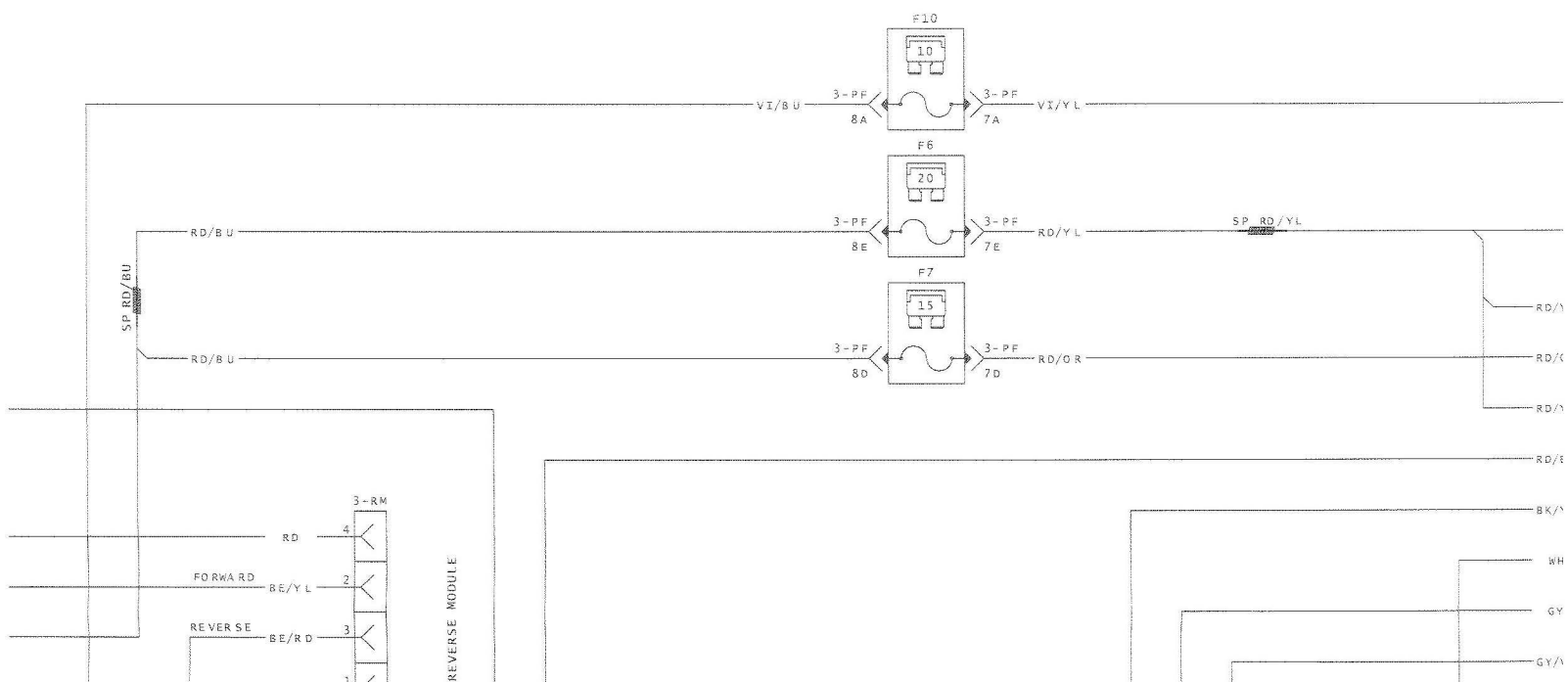
2009 REV-XR 1200 GSX/GTX





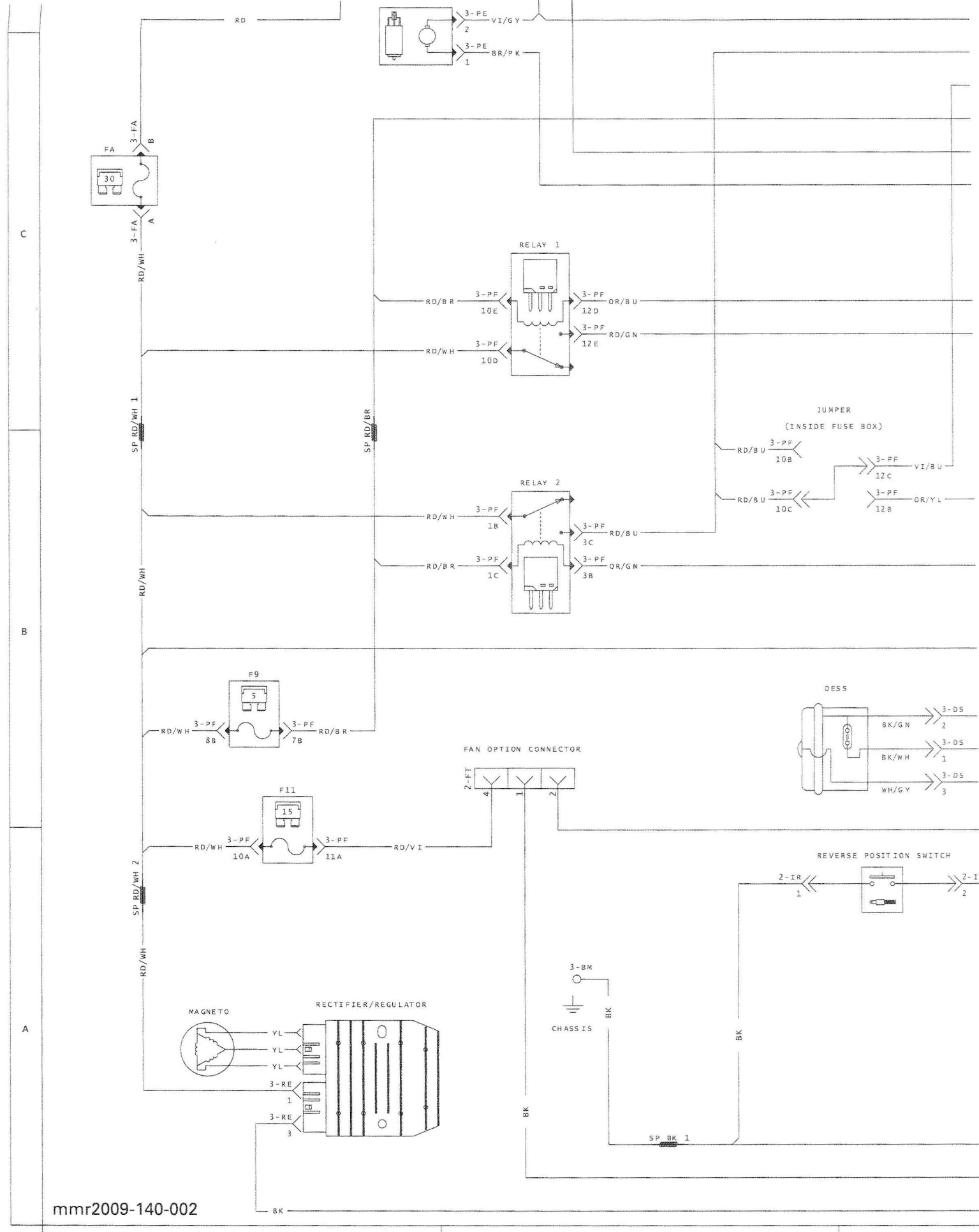

CAMSHAFT POSITION SENSOR (CAPS)
1-CAPS
INJECTOR 1
IGNITION COIL 1
INJECTOR 2
IGNITION COIL 2
INJECTOR 3
IGNITION COIL 3
OIL PRESSURE SWITCH (OPS)
ENGINE
3-HIC
SP VI/OR
SP VI/GN
SP VI/BU
SP RD/GN
SP RD/BU
F1
F2
F3
F4
F5
F8
3-PF
FORWARD
REVERSE


2
6
4
1
5
3


F10
10
VI/BU
3-PF
8A
3-PF
7A
VI/YL
F6
20
RD/BU
3-PF
8E
3-PF
7E
RD/YL
SP RD/YL
F7
15
SP RD/BU
RD/BU
3-PF
8D
3-PF
7D
RD/OR
3-RM
RD
4
FORWARD
BE/YL
2
REVERSE
BE/RD
3
REVERSE MODULE

CONNECTOR LOCATION	
1	ENGINE RELATED CONNECTORS
2	LH SIDE PANEL
3	RH SIDE PANEL
4	HANDLEBAR AREA
5	BEHIND MULTI-FUNCTION GAUGE
6	REAR PART OF FRAME

COLOR CODE	
BE	BEIGE
BK	BLACK
BR	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
RD	RED
VI	VIOLET
YL	YELLOW
LT	LIGHT COLOR
SP	SPLICE



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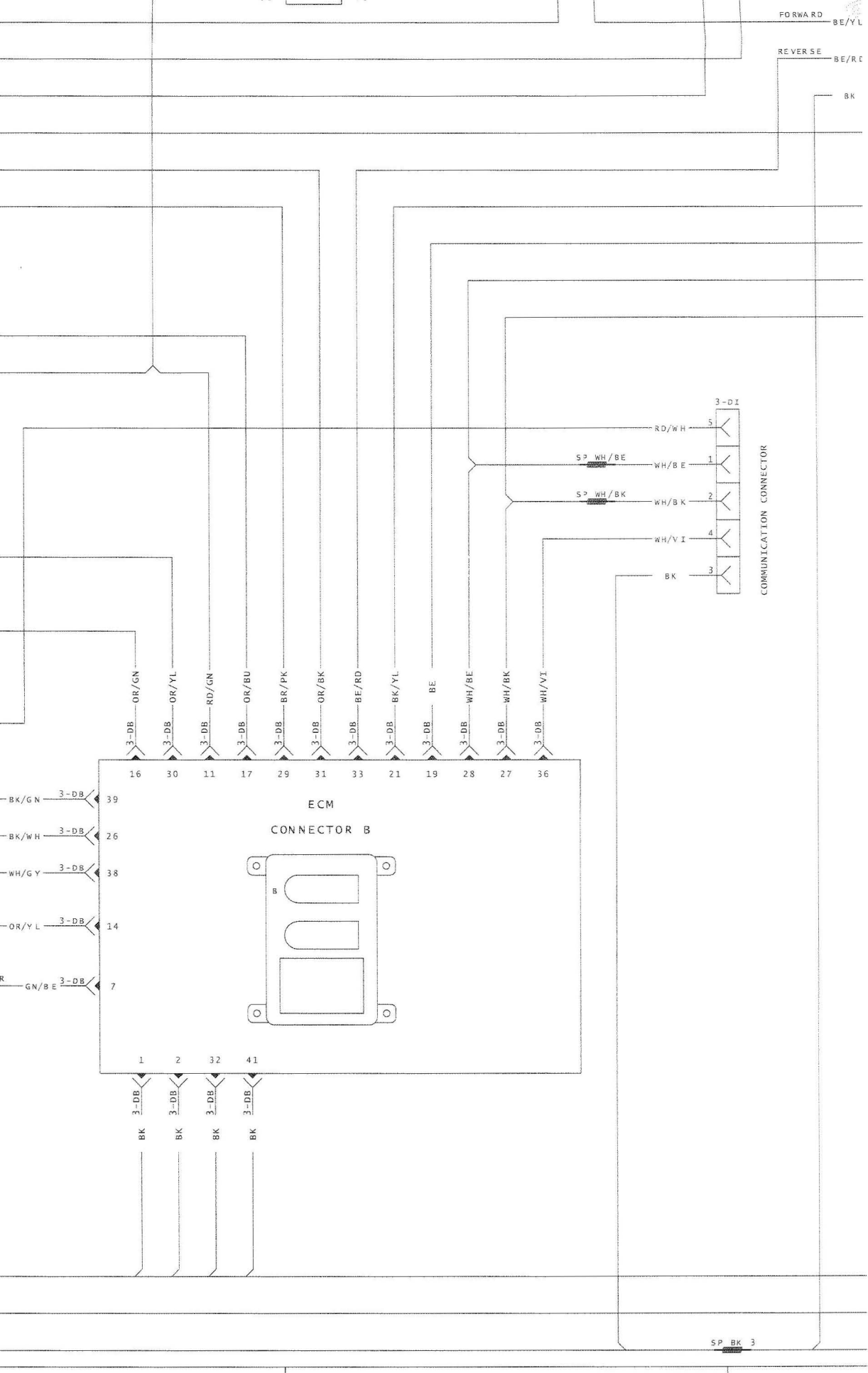
C

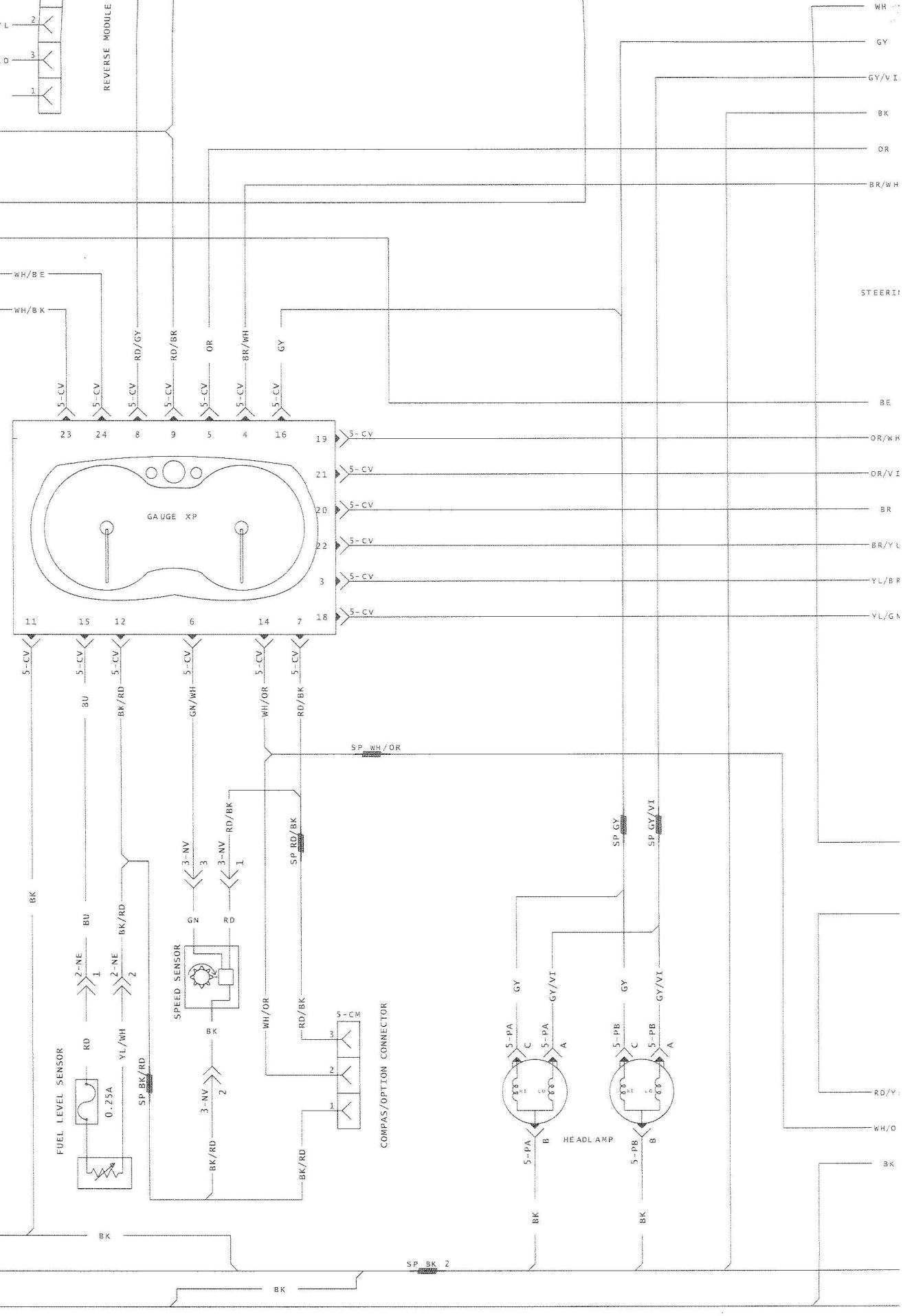
B

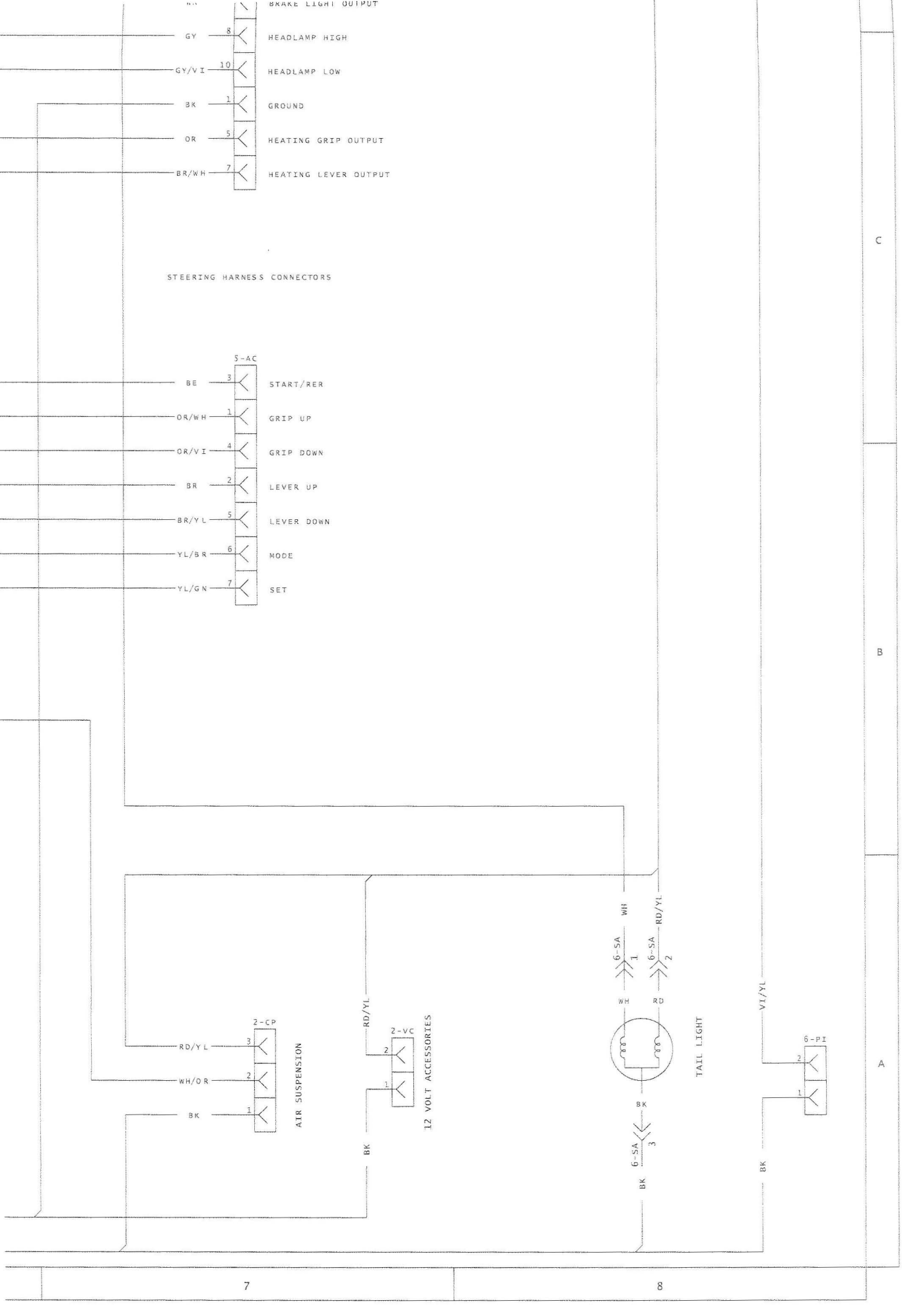
A

1

2

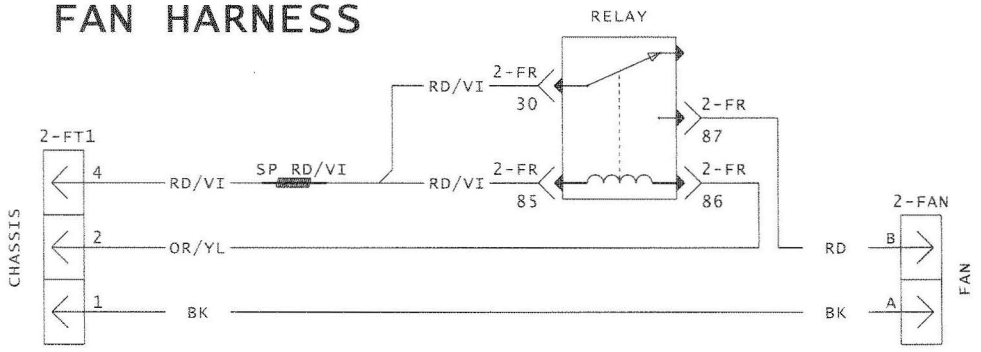

FORWARD
BE/YL
REVERSE
BE/RD
BK
3-DI
RD/WH
5
SP WH/BE
WH/BE
1
SP WH/BK
WH/BK
2
WH/VI
4
BK
3
COMMUNICATION CONNECTOR
OR/GN
OR/YL
RD/GN
OR/BU
BR/PK
OR/BK
BE/RD
BK/YL
BE
WH/BE
WH/BK
WH/VI
3-DB
16
30
11
17
29
31
33
21
19
28
27
36
ECM
CONNECTOR B
B
BK/GN
39
BK/WH
26
WH/GY
38
OR/YL
14
GN/BE
7
1
2
32
41
BK
SP BK 3

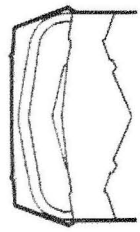

REVERSE MODULE
WH/BE
WH/BK
RD/GY
RD/BR
OR
BR/WH
GY
5-CV
23 24 8 9 5 4 16
GAUGE XP
19 21 20 22 3 18
11 15 12 6 14 7
BU
BK/RD
GN/WH
WH/OR
RD/BK
SP WH/OR
SP RD/BK
3-NV
GN
RD
SPEED SENSOR
2-NE
FUEL LEVEL SENSOR
RD
YL/WH
0.25A
SP BK/RD
5-CM
COMPASS/OPTION CONNECTOR
SP GY
SP GY/VI
GY
GY/VI
5-PA
5-PB
HEADLAMP
BK
SP BK 2
STEERIN
BE
OR/WH
OR/VI
BR
BR/YL
YL/BR
YL/GN
RD/Y
WH/O


BRAKE LIGHT OUTPUT
GY
8
HEADLAMP HIGH
GY/VI
10
HEADLAMP LOW
BK
1
GROUND
OR
5
HEATING GRIP OUTPUT
BR/WH
7
HEATING LEVER OUTPUT
STEERING HARNESS CONNECTORS
5-AC
BE
3
START/RER
OR/WH
1
GRIP UP
OR/VI
4
GRIP DOWN
BR
2
LEVER UP
BR/YL
5
LEVER DOWN
YL/BR
6
MODE
YL/GN
7
SET
2-CP
RD/YL
3
WH/OR
2
BK
1
AIR SUSPENSION
RD/YL
2-VC
2
1
BK
12 VOLT ACCESSORIES
WH
RD/YL
6-SA
1
6-SA
2
WH
RD
BK
6-SA
3
BK
TAIL LIGHT
VI/YL
6-PI
2
1
BK
A
B
C
7
8

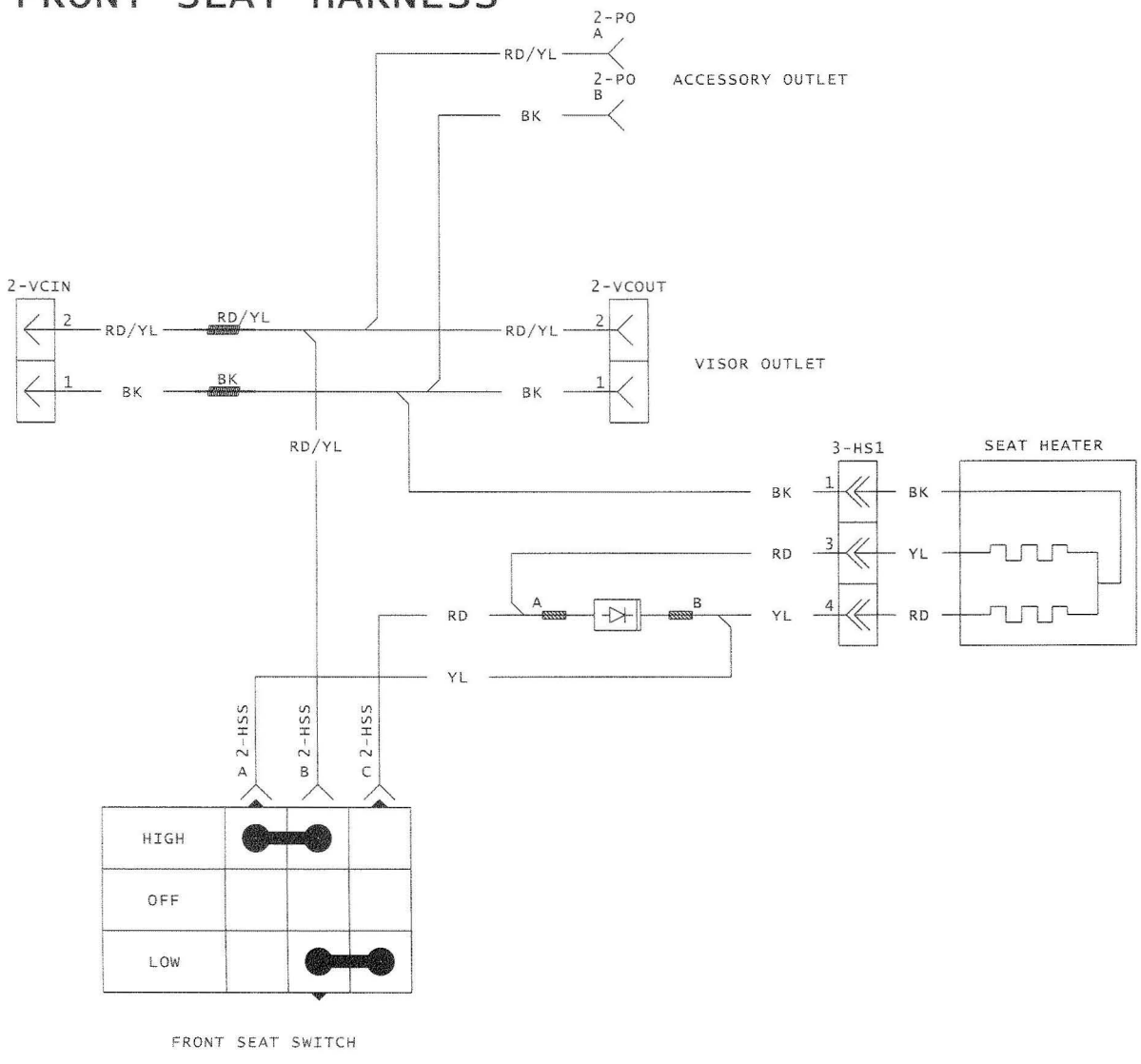
2009 REV-XR 1200 GSX/GTX

FAN HARNESS

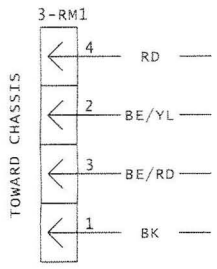


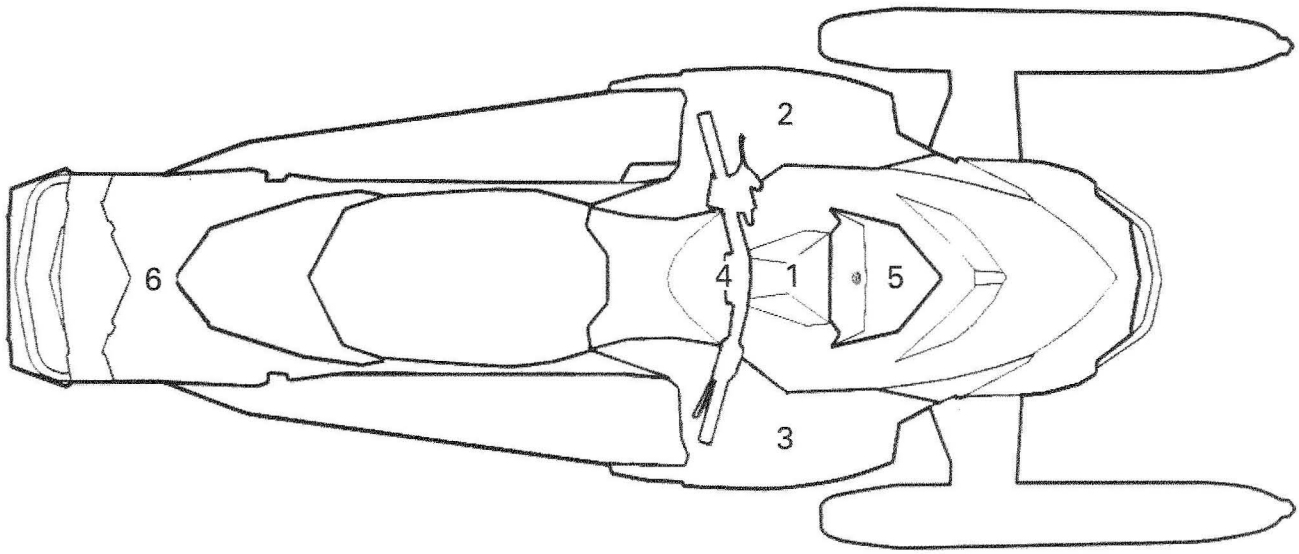


FRONT SEAT HARNESS

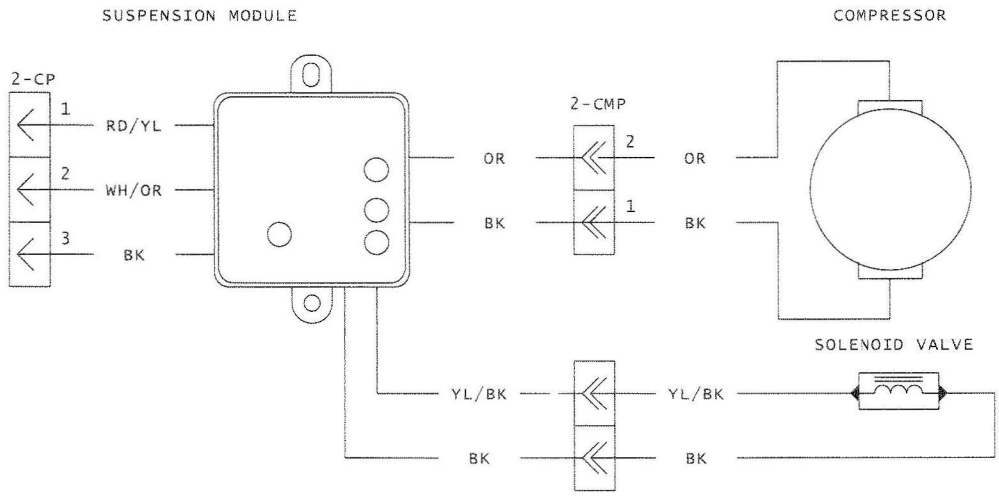


ELECTRO

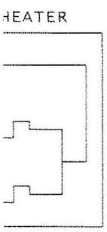




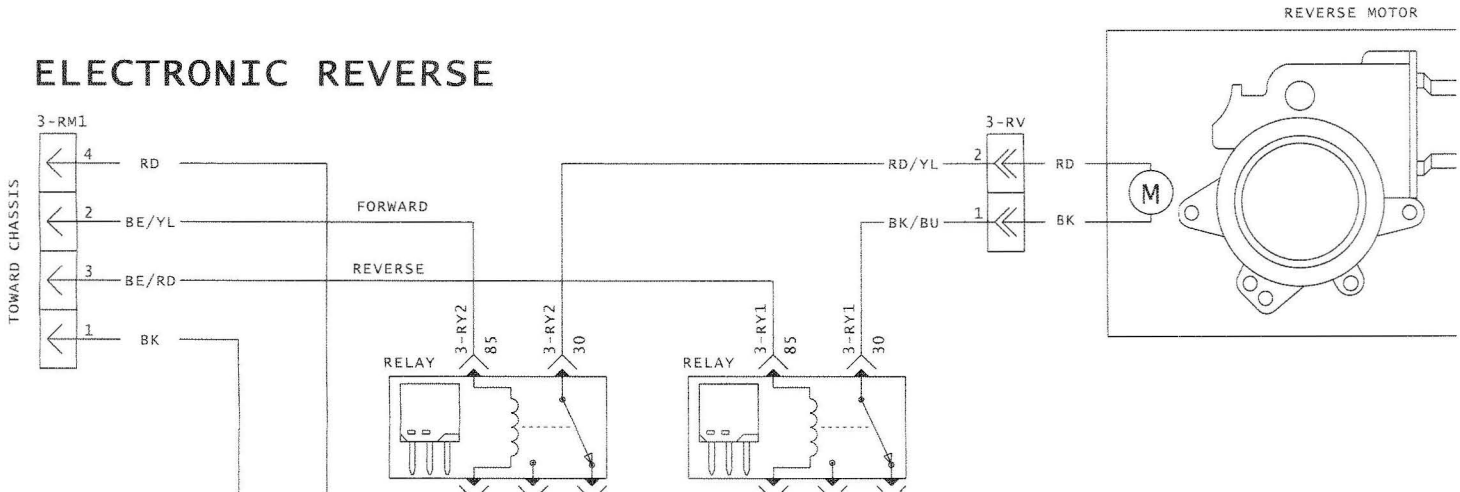
ACS SUSPENSION



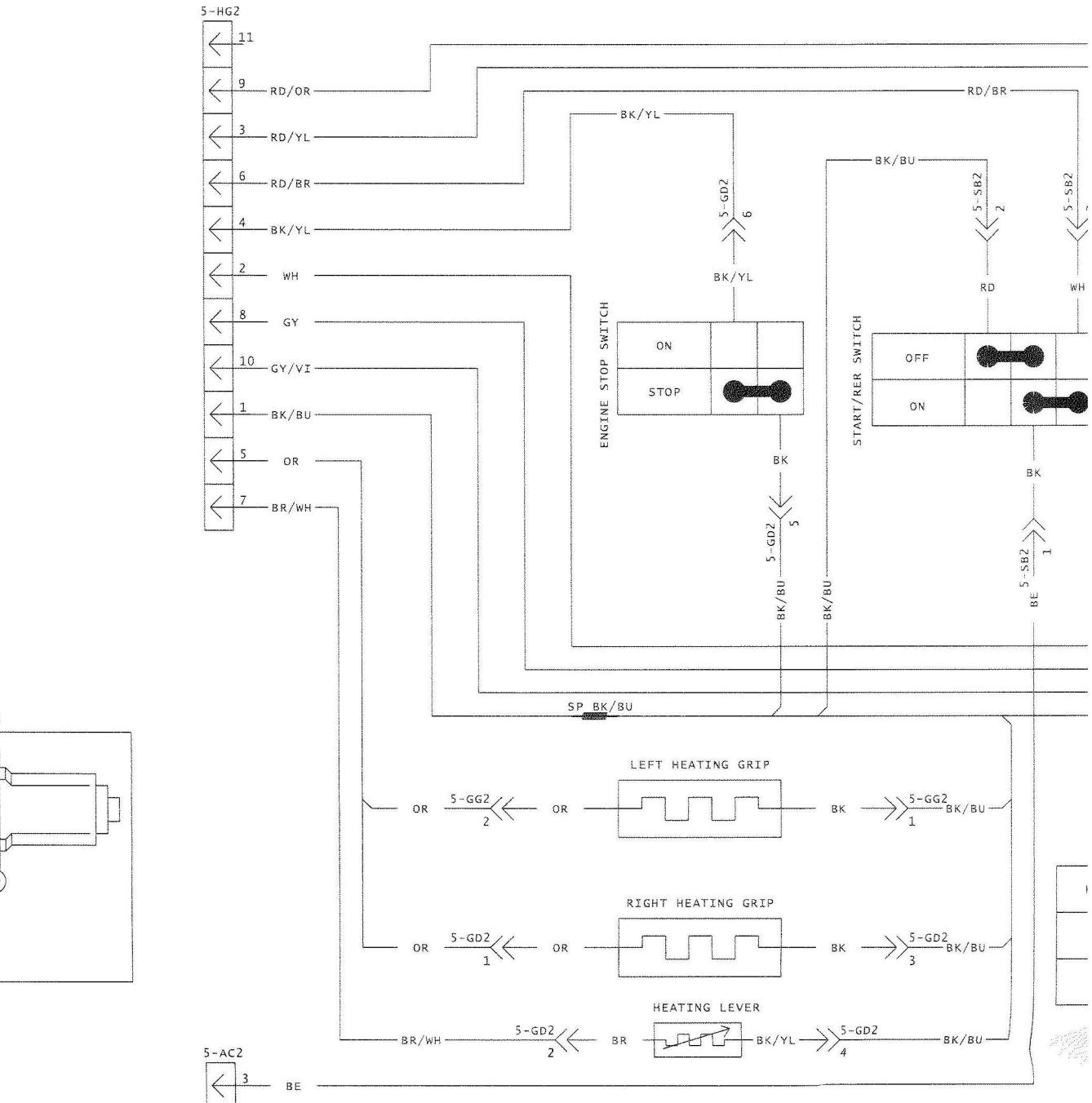
HEATER



ELECTRONIC REVERSE



PREMIUM STEERING HARNESS



CONNECTOR LOCATION	
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3	RH SIDE PANEL
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6	REAR PART OF FRAME

COLOR CODE	
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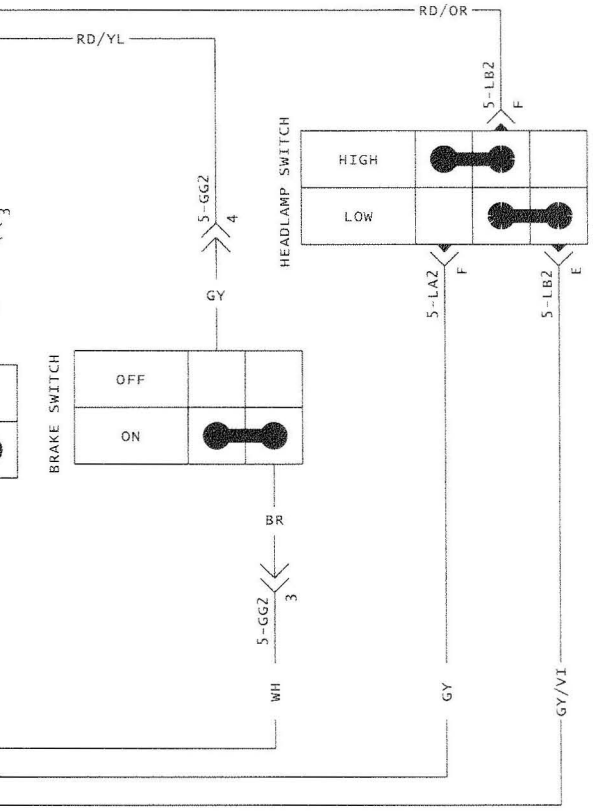
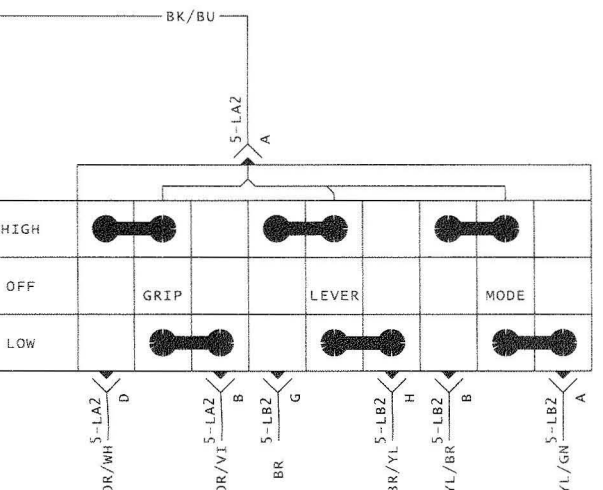
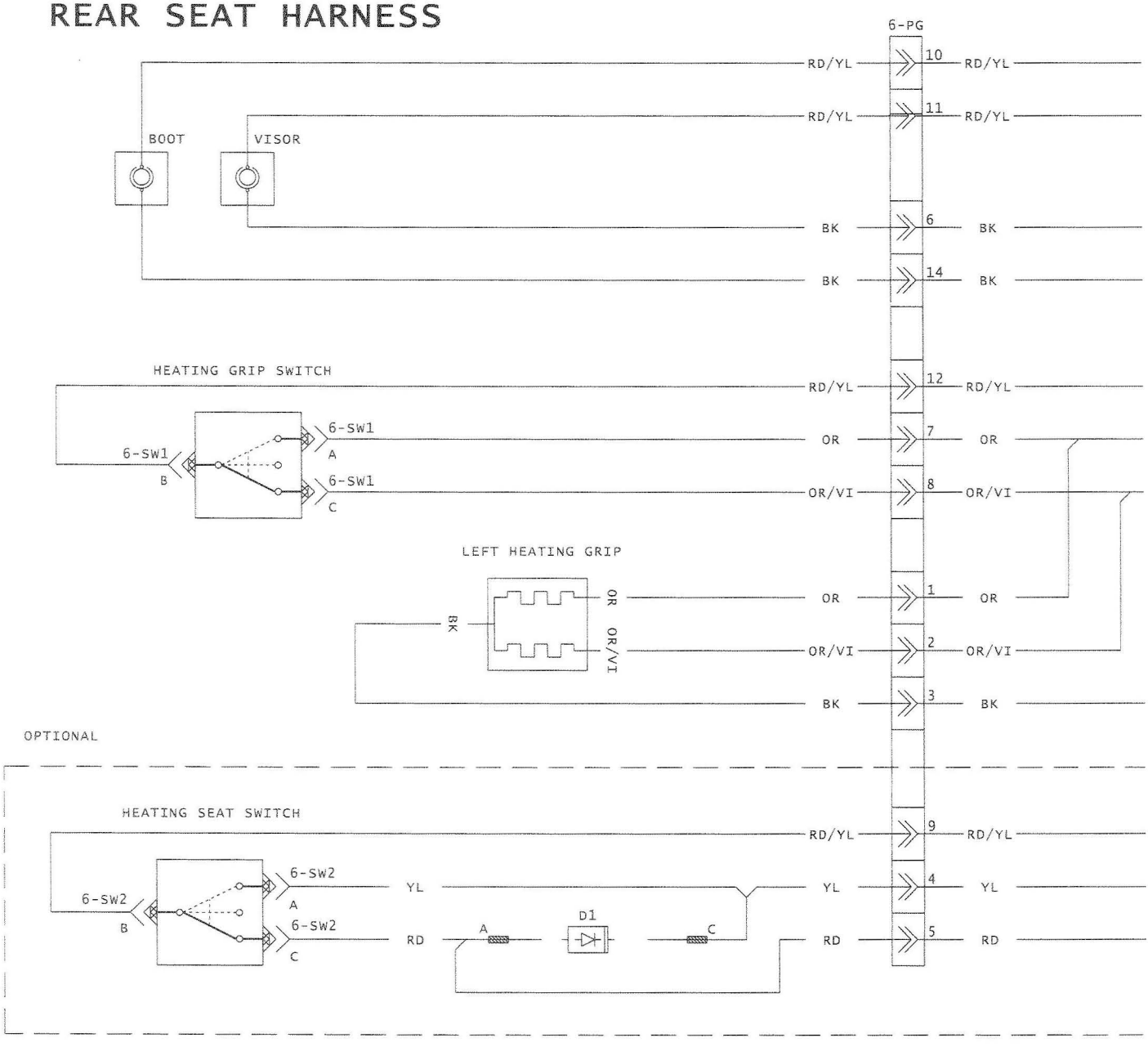
YL	YELLOW
LT	LIGHT COLOR
SP	SPLICE





REAR SEAT HARNESS



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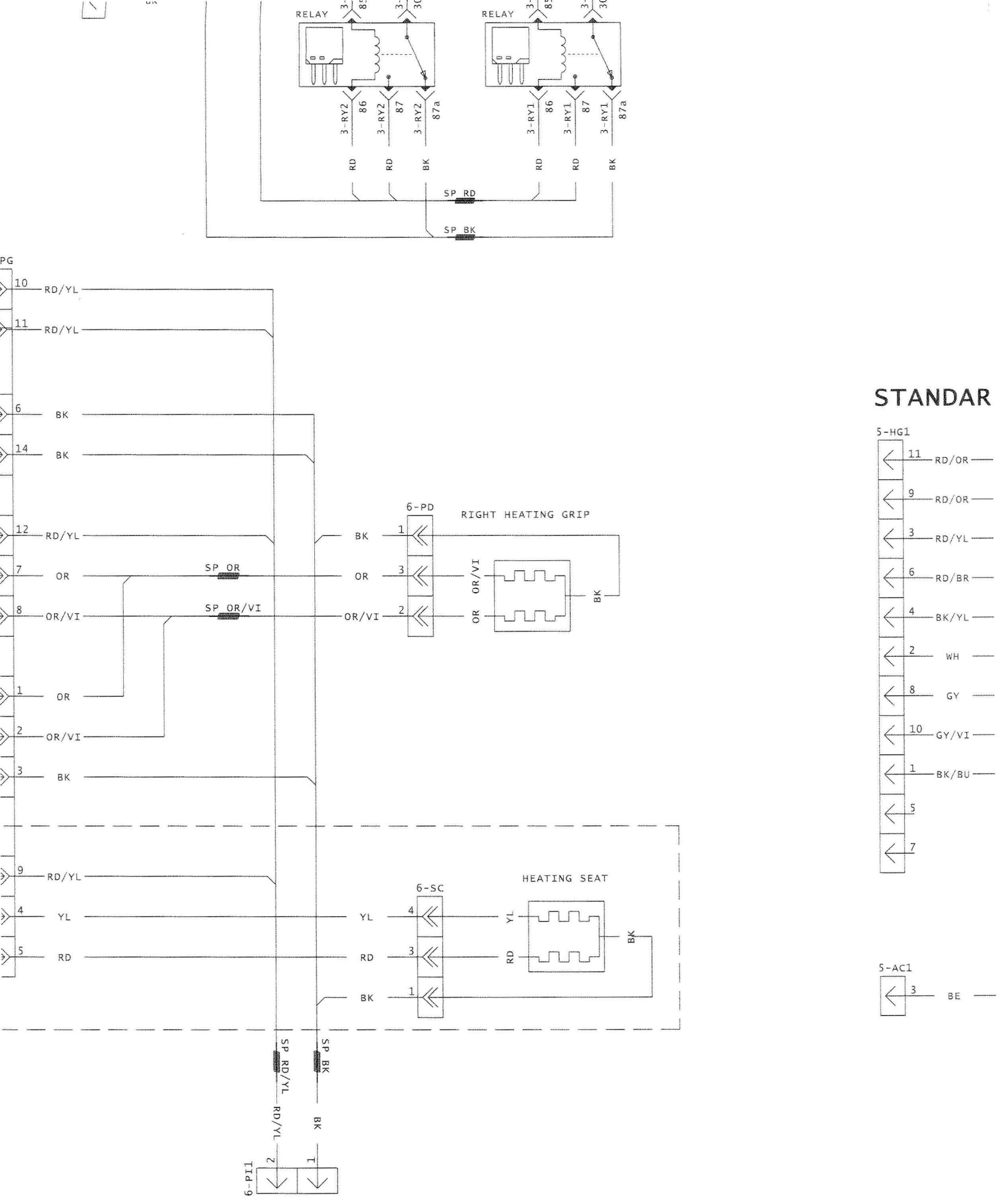
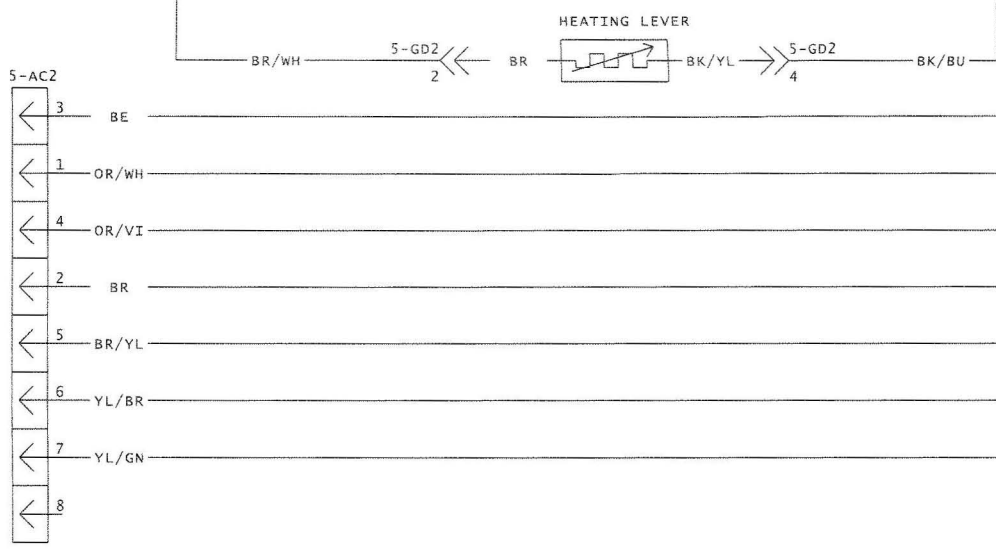
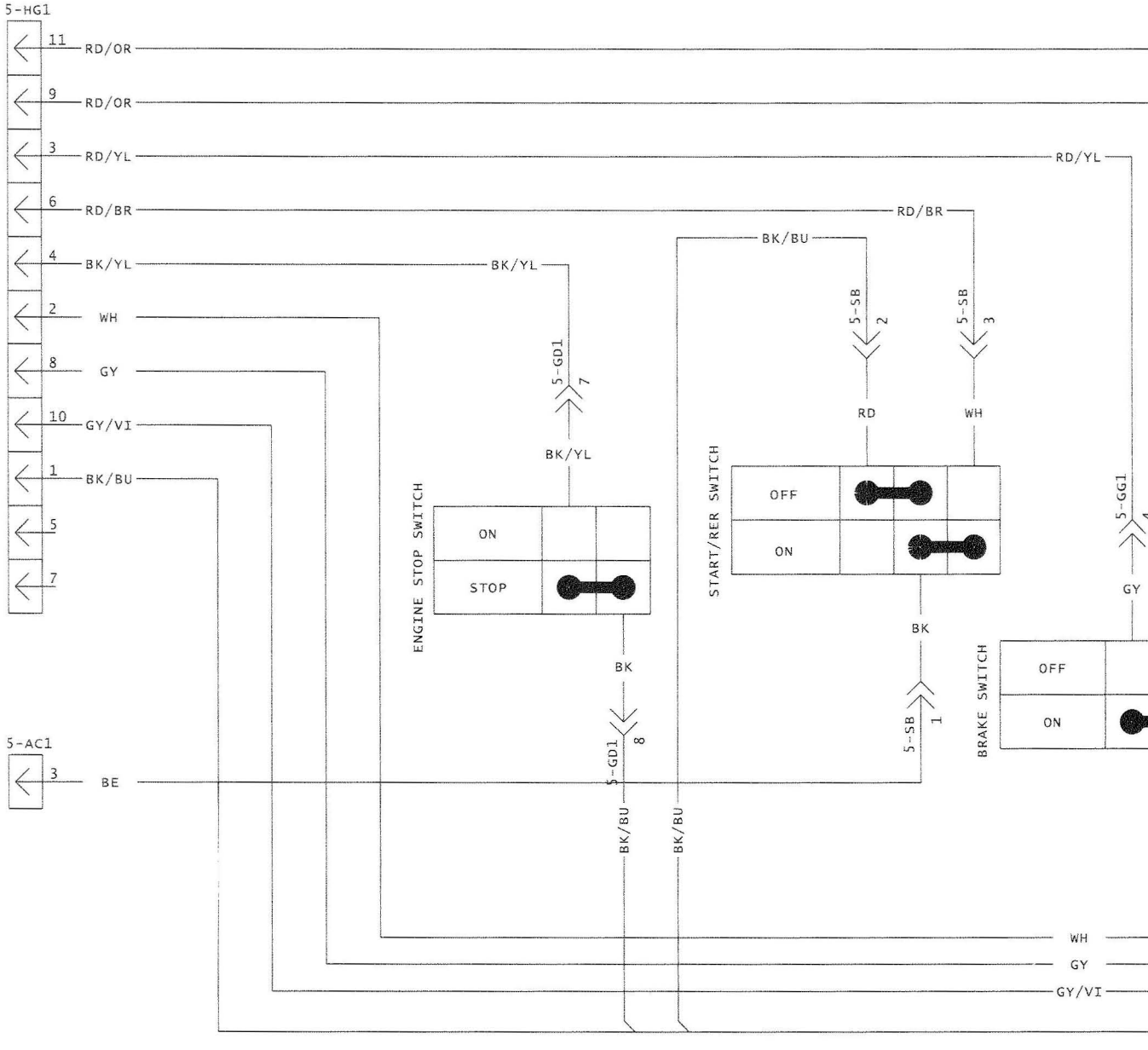
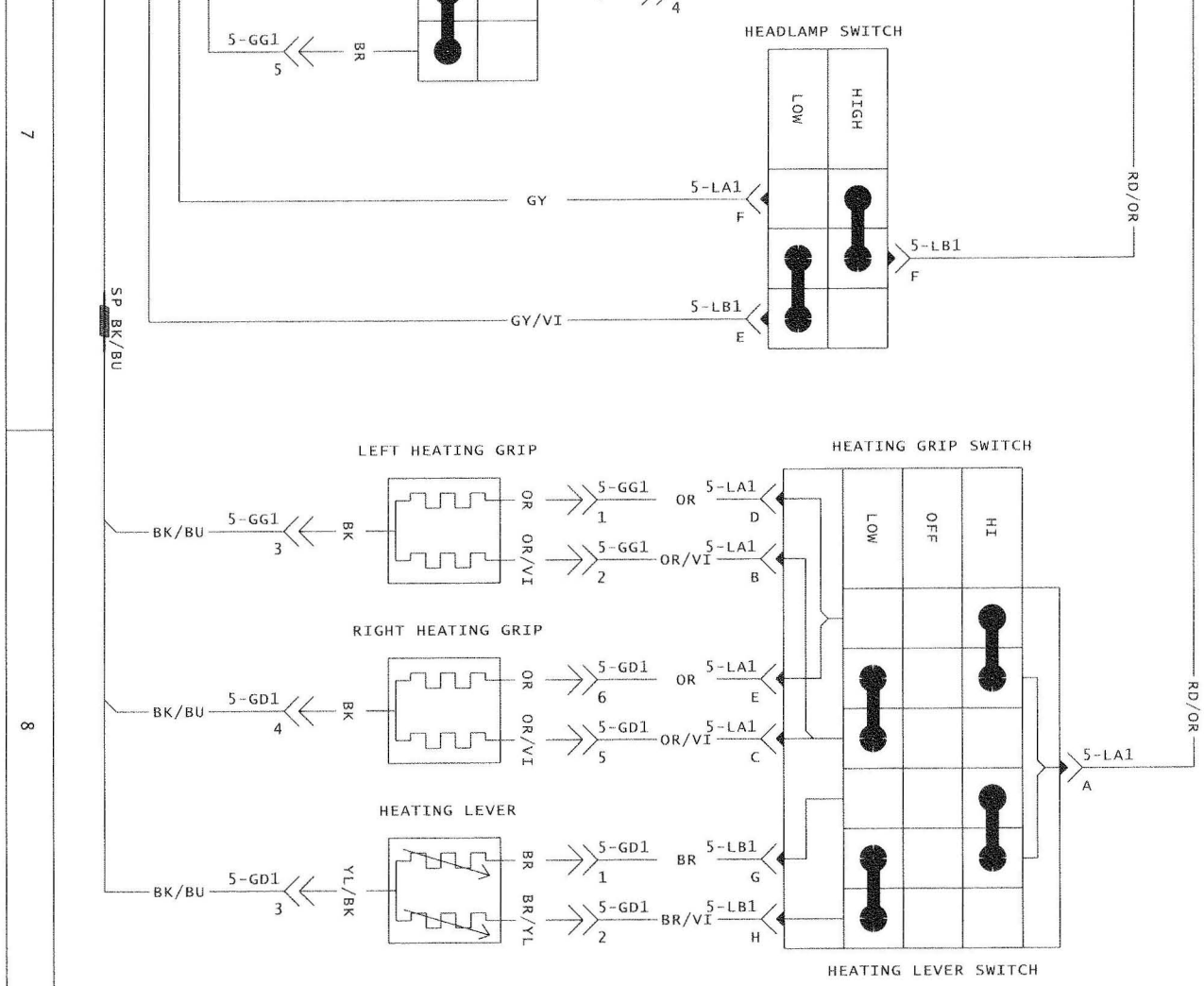

RELAY
RELAY
3-RY2 86
3-RY2 87
3-RY2 87a
3-RY1 86
3-RY1 87
3-RY1 87a
RD
RD
BK
RD
RD
BK
SP RD
SP BK
PG
10 RD/YL
11 RD/YL
6 BK
14 BK
12 RD/YL
7 OR
8 OR/VI
1 OR
2 OR/VI
3 BK
9 RD/YL
4 YL
5 RD
SP OR
SP OR/VI
6-PD
RIGHT HEATING GRIP
BK 1
OR 3
OR/VI 2
OR/VI
OR
BK
6-SC
HEATING SEAT
YL 4
RD 3
BK 1
YL
RD
BK
SP RD/YL
SP BK
RD/YL
BK
6-PI1 2 1
STANDAR
5-HG1
11 RD/OR
9 RD/OR
3 RD/YL
6 RD/BR
4 BK/YL
2 WH
8 GY
10 GY/VI
1 BK/BU
5
7
5-AC1
3 BE



STANDARD STEERING HARNESS




HEADLAMP SWITCH
LOW
HIGH
5-GG1
5
BR
4
GY
5-LA1
F
RD/OR
5-LB1
F
GY/VI
5-LB1
E
SP BK/BU
LEFT HEATING GRIP
HEATING GRIP SWITCH
BK/BU
5-GG1
3
BK
OR
OR/VI
5-GG1
1
2
OR
OR/VI
5-LA1
D
B
LOW
OFF
HI
RIGHT HEATING GRIP
BK/BU
5-GD1
4
BK
OR
OR/VI
5-GD1
6
5
OR
OR/VI
5-LA1
E
C
RD/OR
5-LA1
A
HEATING LEVER
BK/BU
5-GD1
3
YL/BK
BR
BR/YL
5-GD1
1
2
BR
BR/VI
5-LB1
G
H
HEATING LEVER SWITCH
7
8
A
B
C