

**can-am**™



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**OUTLANDER™ Series**  
500/650/800

**RENEGADE™ Series**  
500/800

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## SAFETY NOTICE

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# SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2008 Can-Am ATVs as describe in the model list in the *INTRODUCTION*.

This edition was primarily published to be used by mechanical technicians who are already familiar with all service procedures relating to BRP products. Mechanical technicians should attend training courses given by B.R.P.T.I.

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

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

The content depicts parts and/or procedures applicable to the particular product at time of writing. Service and Warranty Bulletins may be published to update the content of this manual. Make sure to read and understand these. It does not include dealer modifications, whether authorized or not by BRP, after manufacturing the product.

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

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

The engines and the corresponding components identified in this document should not be utilized on product(s) other than those for which it was designed.

### **WARNING**

Unless otherwise specified, engine should be turned OFF and cold for all maintenance and repair procedures.

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

### **WARNING**

Identifies an instruction which, if not followed, could cause serious personal injury including possibility of death.

**CAUTION:** Denotes an instruction which, if not followed, could severely damage vehicle components.

**NOTE:** Indicates supplementary information needed to fully complete an instruction.

Although the mere reading of such information does not eliminate the hazard, your understanding of the information will promote its correct use. Always use common shop safety practice.

BRP disclaims liability for all damages and/or injuries resulting from the improper use of the contents. We strongly recommend that any services be carried out and/or verified by a highly skilled professional mechanic. It is understood that certain modifications may render use of the vehicle illegal under existing federal, provincial and state regulations.

# INTRODUCTION

## GENERAL INFORMATION

This shop manual covers the following BRP made 2008 Can-Am ATVs.

MODEL	COLOR	ENGINE	MODEL NUMBER
Outlander 500	Green, Red, Yellow	V490	2T8A, 2T8C, 2T8D, 2T8E, 2T8F
Outlander 500 XT	Camo, Green, Red, Yellow	V490	2U8A, 2U8B, 2U8C, 2U8D
Outlander MAX 500	Red	V490	2W8C
Outlander MAX 500 XT	Green, Red, Yellow	V490	2X8A, 2X8B, 2X8C, 2X8D
Outlander 650	Green, Red, Yellow	V660	2N8A, 2N8C, 2N8E, 2N8F, 2N8H, 2N8J
Outlander 650 XT	Camo, Green, Red, Yellow	V660	2P8A, 2P8B, 2P8C, 2P8D, 2P8E, 2P8F
Outlander MAX 650	Green, Red, Yellow	V660	2R8A, 2R8C, 2R8D, 2R8E, 2R8F, 2R8G, 2R8H
Outlander MAX 650 XT	Camo, Green, Red, Yellow	V660	2S8A, 2S8B, 2S8C, 2S8D, 2S8E, 2S8F
Outlander 800	Green, Red, Yellow	V810	2H8A, 2H8C, 2H8E, 2H8F, 2H8H, 2H8J
Outlander 800 XT	Camo, Green, Red, Yellow	V810	2J8A, 2J8B, 2J8C, 2J8D, 2J8E, 2J8F
Outlander Max 800	Green, Red, Yellow Steel Gray Metallic	V810	2K8A, 2K8C, 2K8D, 2K8E, 2K8F, 2K8G, 2K8H
Outlander MAX 800 XT	Camo, Green, Red, Yellow	V810	2L8A, 2L8B, 2L8C, 2L8D, 2L7E, 2L8F, 2L8G
Outlander MAX 800 Ltd	Steel Gray Metallic	V810	2M8A, 2M8B, 2M8C
Renegade 500	Yellow	V490	4E8A, 4E8B, 4E8C
Renegade 800	Yellow	V810	4B8A, 4B8B, 4B8C

# INTRODUCTION

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

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

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

## VEHICLE INFORMATION

### Model Number



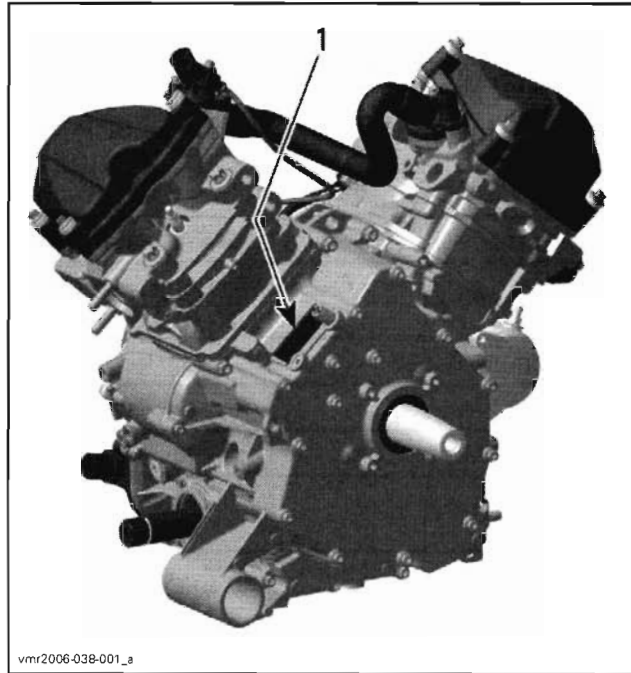
TYPICAL — VEHICLE IDENTIFICATION NUMBER LABEL  
1. Model number

### Vehicle Identification Number (V.I.N.)



TYPICAL  
1. V.I.N. (Vehicle Identification Number)

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



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

## ENGINE EMISSIONS INFORMATION

### Manufacturer's Responsibility

Manufacturers of ATVs 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 ATVs 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 ATVs manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new ATV 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 ATVs 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](mailto:otaqpublicweb@epa.gov)

**SELF-LOCKING FASTENERS PROCEDURE**

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

Use a metal brush or a screw 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.

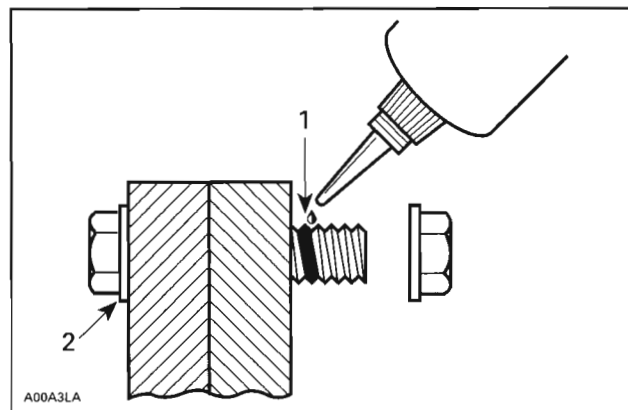
**LOCTITE® APPLICATION PROCEDURE**

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

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

**Threadlocker**

**Uncovered Holes (bolts and nuts)**



- 1. Apply here
- 2. Do not apply

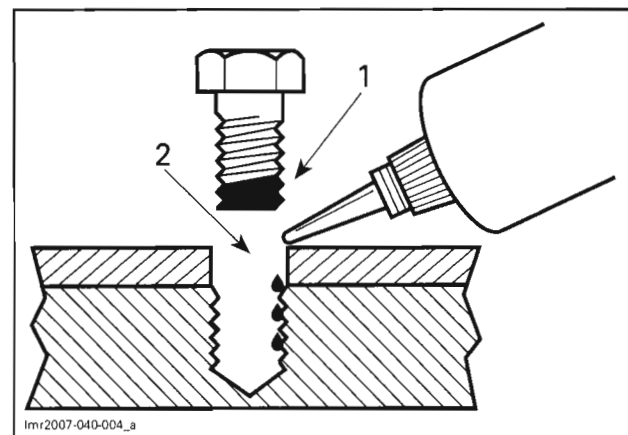
Clean threads (bolt and nut) with solvent. Apply Loctite Primer N (P/N 293 800 041) on threads and allow to dry.

Choose proper strength Loctite threadlocker. Fit bolt in the hole.

Apply a few drops of threadlocker at proposed tightened nut engagement area.

Position nut and tighten as required.

**Blind Holes**



- 1. On screw threads
- 2. On hole threads

# INTRODUCTION

Clean threads (screw and hole) with solvent.

Apply Loctite Primer N (P/N 293 800 041) on threads (screw and nut) and allow to dry for 30 seconds.

Choose proper strength Loctite threadlocker.

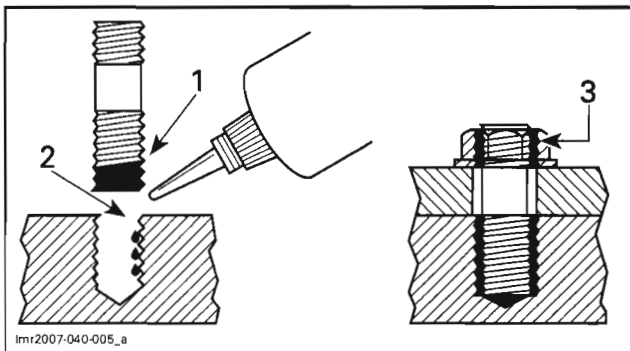
Apply 2 or 3 drops along the threaded hole.

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

Apply several drops on screw threads.

Tighten as required.

## Stud in Blind Holes



1. On stud threads
2. On hole threads
3. Onto nut threads

Clean threads (stud and hole) with solvent.

Apply Loctite Primer N (P/N 293 800 041) on threads and allow to dry.

Put 2 or 3 drops of proper strength Loctite threadlocker along the threaded hole.

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

Apply several drops of proper strength Loctite on stud threads.

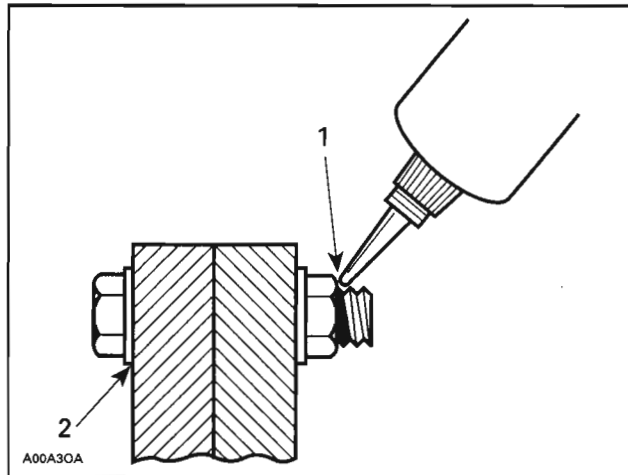
Install stud.

Install cover, etc.

Apply drops of proper strength Loctite on uncovered threads.

Tighten nuts as required.

## Preassembled Parts



1. Apply here
2. Do not apply

Clean bolts and nuts with solvent.

Assemble components.

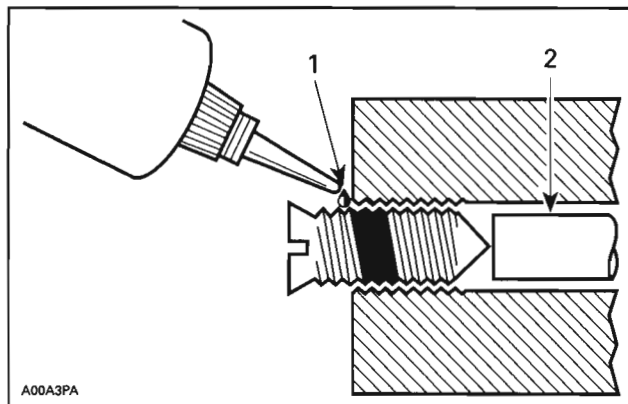
Tighten nuts.

Apply drops of proper strength Loctite on bolt/nut contact surfaces.

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

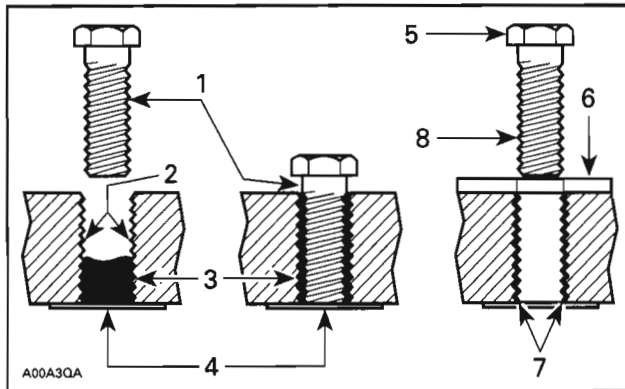
Adjust screw to proper setting.

Apply drops of proper strength Loctite threadlocker on screw/body contact surfaces.

Avoid touching metal with tip of flask.

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

**Stripped Thread Repair**



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

**Standard Thread Repair**

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

If a plate is used to align bolt:

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

Twist bolt when inserting it to improve thread conformation.

**NOTE:** NOT intended for engine stud repairs.

**Repair of Small Holes/Fine Threads**

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

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

**Permanent Stud Installation (light duty)**

Use a stud or thread on desired length.

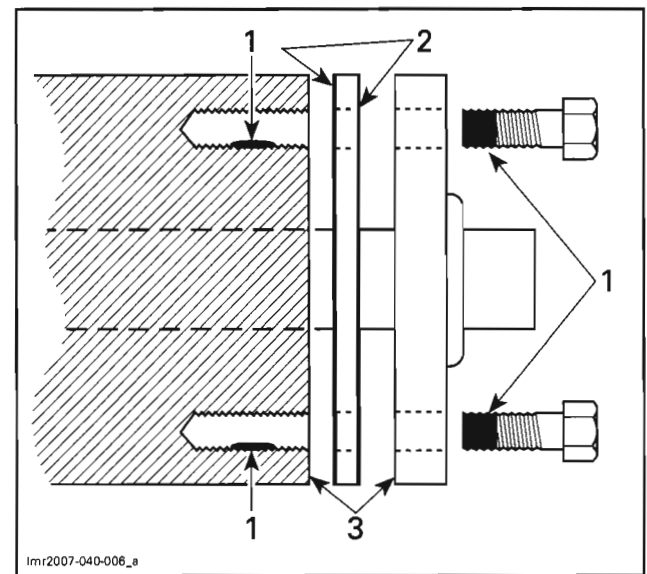
DO NOT apply release agent on stud.

Do a *STANDARD THREAD REPAIR*.

Allow to cure for 30 minutes.

Assemble.

**Gasket Compound**



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

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

**NOTE:** Avoid grinding.

Clean both mating surfaces with solvent.

Spray Loctite Primer N on both mating surfaces and on both sides of gasket. Allow to dry 1 or 2 minutes.

Apply Loctite 518 (P/N 293 800 038) on both sides of gasket, using a clean applicator.

Place gasket on mating surfaces and assemble immediately.

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

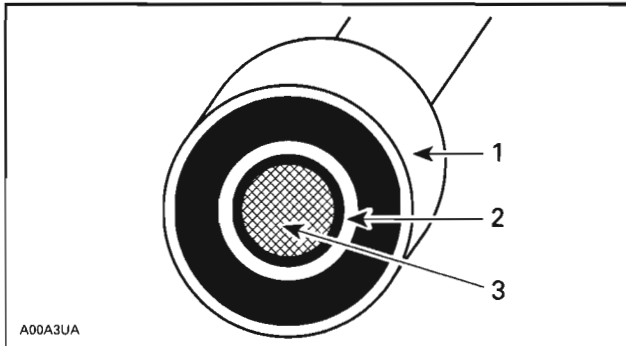
If holes are sunken, apply proper strength Loctite on bolt threads.

Tighten as usual.

# INTRODUCTION

## Mounting on Shaft

### Mounting with a Press



1. Bearing
2. Proper strength Loctite
3. Shaft

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

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

DO NOT use antiseize Loctite or any similar product.

No curing period is required.

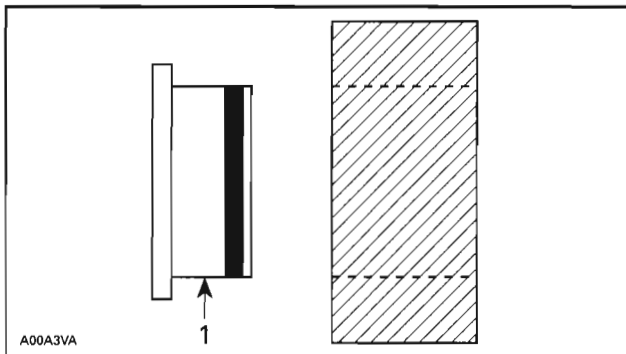
### Mounting in Tandem

Apply retaining compound on internal element bore.

Continue to assemble as shown above.

## Case-In Components

### Metallic Gaskets



1. Proper strength Loctite

Clean inner housing diameter and outer gasket diameter.

Spray housing and gasket with Loctite Primer N (P/N 293 800 041).

Apply a strip of proper strength Loctite on leading edge of outer metallic gasket diameter.

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

Install according to standard procedure.

Wipe off surplus.

Allow it to cure for 30 minutes.

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

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

## TIGHTENING TORQUES

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

### **⚠ WARNING**

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

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

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

Manually screw all screws, bolts and/or nuts.

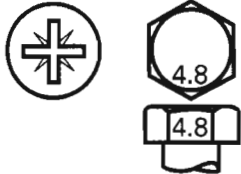



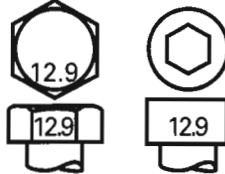




Apply the half of the recommended torque value.

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

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

Torque to the recommended torque value.

**NOTE:** Always torque screws, bolts and/or nuts in a criss-cross sequence.

Property class and head markings	<p>4.8</p> 	<p>8.8</p> 	<p>9.8</p> 	<p>10.9</p> 	<p>12.9</p> 
Property class and nut markings	<p>5</p> 	<p>8</p> 	<p>10</p> 	<p>12</p> 	

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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 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)	25 N•m (18 lbf•ft)	32 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)	73 N•m (53 lbf•ft)
M12	52 N•m (38 lbf•ft)	85 N•m (63 lbf•ft)	105 N•m (77 lbf•ft)	128 N•m (94 lbf•ft)
M14	85 N•m (63 lbf•ft)	135 N•m (100 lbf•ft)	170 N•m (125 lbf•ft)	200 N•m (148 lbf•ft)



# INTRODUCTION

## 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.

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

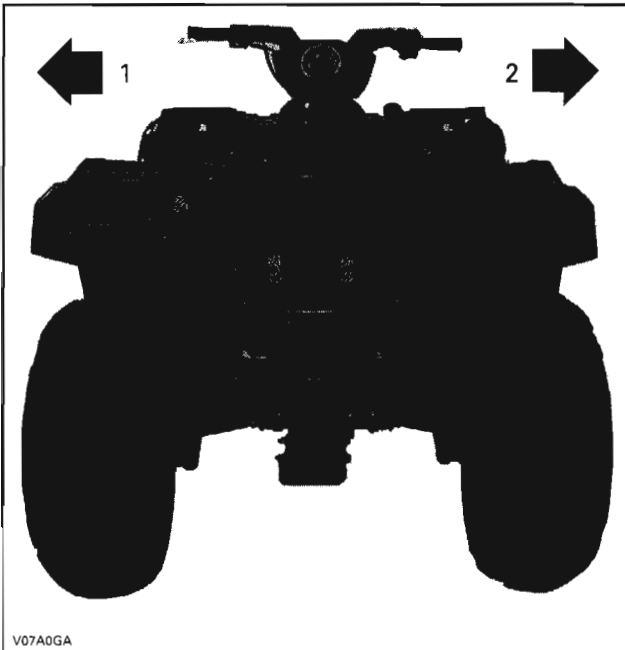
**CAUTION:** Most components in the vehicles are built with parts dimensioned in the metric system. Most fasteners are metric and must not be replaced by customary fasteners or vice-versa. Mismatched or incorrect fasteners could cause damage to the vehicle or possible personal injury.

As many of the procedures in this manual are inter-related, 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 starting any procedure, be sure that you have on hand all required tools, or approved equivalents.

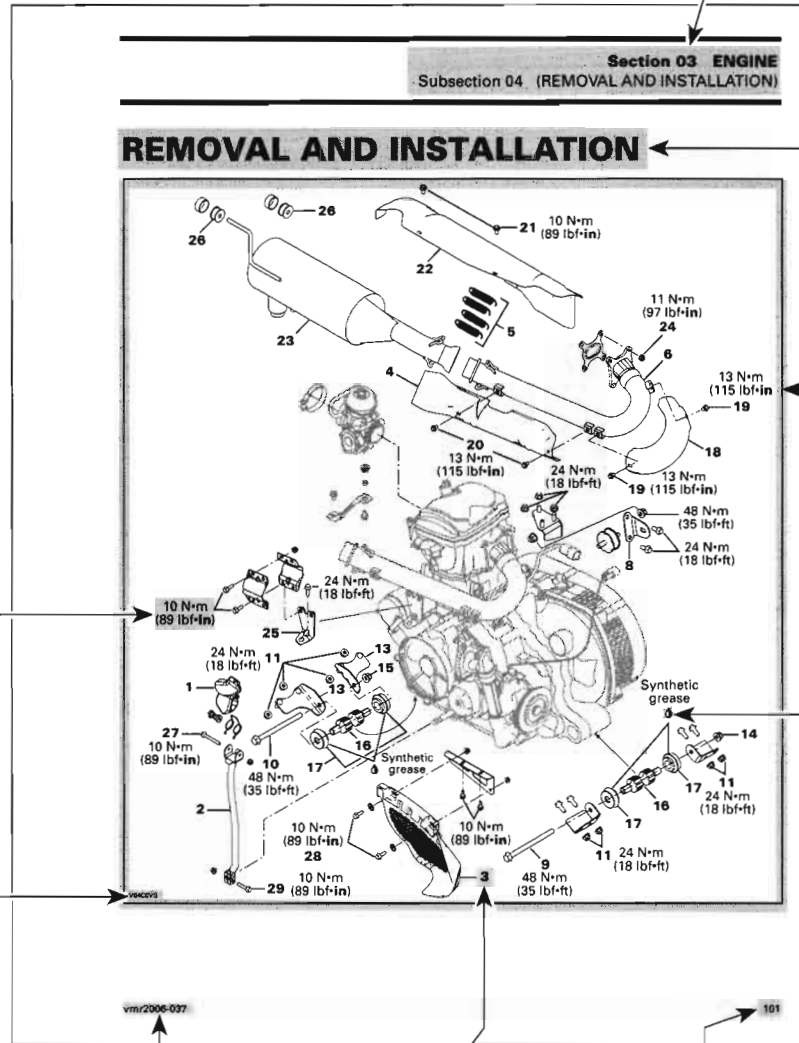
The use of RIGHT and LEFT indications in the text, always refers to the driving position (sitting on the vehicle).

This manual uses technical terms which may be different from the ones of the *PARTS CATALOGS*. When ordering parts always refer to the specific model *PARTS CATALOGS*.



TYPICAL  
1. Left  
2. Right

TYPICAL PAGE



Page heading indicates section and subsection detailed.

Section 03 ENGINE  
Subsection 04 (REMOVAL AND INSTALLATION)

REMOVAL AND INSTALLATION

Subsection title indicates beginning of the subsection.

Exploded view assists you in identifying parts and related positions.

Tightening torque nearby fastener. In this case, nut must be torqued to 10 N·m or 89 lbf·in.  
**CAUTION:** Pay attention to torque specifications. Some of these are in lbf·in instead of lbf·ft. Use appropriate torque wrench.

Drop represents a liquid product to be applied to a surface.

Illustration number for publishing process.

vmr2006-037

Document number for publishing process.

Bold face number indicates special procedure concerning this part.

Page number

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## TYPICAL PAGE

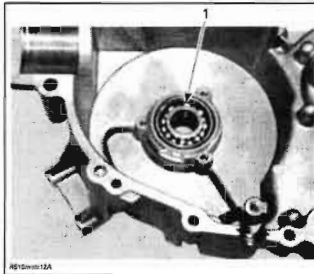
### Section 03 ENGINE Subsection 06 (MAGNETO SYSTEM)

#### **BEARING**

**Inspection**  
Ball bearing no. 10 must rotate freely. Otherwise, replace it.

#### **Removal**

- Heat up the magneto housing cover to about 100°C (212°F) for an easy ball bearing removal.



#### **Installation**

For installation also heat the magneto housing up to about 100°C (212°F) to put ball bearing in place.

Place new ball bearing in freezer for 10 minutes approximately.

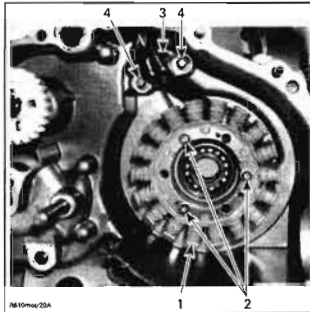
Reinstall other removed parts in the reverse order.

#### **STATOR AND TRIGGER COIL**

#### **Removal**

Remove.

- magneto housing cover no. 7
- screw no. 11 and 12
- stator with trigger coil no. 13.



1. Stator
2. Stator screws
3. Trigger coil
4. Trigger coil screws

#### **Inspection**

Check stator and trigger coil condition. If damaged replace the faulty part.

For electrical inspection, refer to CHARGING SYSTEM for the stator and IGNITION SYSTEM for the trigger coil.

Title indicates main procedure to be carried-out.

Call-outs for above illustration.

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

Reference to look up a certain section and subsection. In this case it concerns IGNITION SYSTEM.

# MAINTENANCE CHART

## MAINTENANCE CHART

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

**NOTE:** The chart gives an equivalence between number of hours and months/year. Perform the maintenance operation to whatever time comes first.

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

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE	10 HOURS OR 300 KM (185 mi)										
	(The initial maintenance is very important and must not be neglected.)										
	EVERY 25 HOURS OR 750 KM (470 mi)										
	EVERY 50 HOURS OR 1500 KM (930 mi)										
	EVERY 100 HOURS OR 3000 KM (1865 mi) OR 1 YEAR										
EVERY 200 HOURS OR 6000 KM (3730 mi) OR 2 YEAR											
PART/TASK											REFER TO
<b>ENGINE</b>											
Engine oil and filter	R				R						<i>LUBRICATION SYSTEM</i>
Valve adjustment	I, A				I, A						<i>INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER</i>
Condition of engine seals	I				I						<i>ENGINE</i>
Engine mounting fasteners	I				I						<i>ENGINE REMOVAL AND INSTALLATION</i>
Air filter <sup>(1)</sup>		C	R								<i>AIR INTAKE SYSTEM</i>
Exhaust system	I				I						<i>EXHAUST SYSTEM</i>
Spark arrester					C						
Coolant	I				I <sup>(2)</sup>	R					<i>COOLING SYSTEM</i>
Radiator cap/cooling system pressure test	I					I					
Radiator condition/cleanliness (radiator fins)	I				I						
<b>ENGINE MANAGEMENT SYSTEM</b>											
Sensors <sup>(4)</sup>	I				I						<i>ENGINE MANAGEMENT</i>
Fault code reading <sup>(4)</sup>	I				I						
<b>FUEL SYSTEM</b>											
Throttle body	I				I, L						<i>ENGINE MANAGEMENT</i>
Throttle cable	I, A				I, A, L						
Fuel lines, fuel rail, connections, check valves and fuel tank pressure test <sup>(4)</sup>	I								I		<i>FUEL TANK AND FUEL PUMP</i>
In-line fuel filter						R					
Fuel pump pressure test									I		

# Section 01 MAINTENANCE

## Subsection 01 (MAINTENANCE CHART)

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE	10 HOURS OR 300 KM (185 mi) (The initial maintenance is very important and must not be neglected.)					REFER TO	
	EVERY 25 HOURS OR 750 KM (470 mi)						
	EVERY 50 HOURS OR 1500 KM (930 mi)						
	EVERY 100 HOURS OR 3000 KM (1865 mi) OR 1 YEAR						
	EVERY 200 HOURS OR 6000 KM (3730 mi) OR 2 YEAR						
PART/TASK							
<b>ELECTRICAL SYSTEM</b>							
Spark plug <sup>(3)</sup> <sup>(4)</sup>	I				R	IGNITION SYSTEM	
Battery connections	I		I			CHARGING SYSTEM	
ECM connectors (visual inspection without disconnecting)				I		ELECTRICAL CONNECTORS	
Electrical connections and fastening (ignition system, starting system, fuel injectors etc.)	I			I			
Digitally Encoded Security System	I			I		DIGITALLY ENCODED SECURITY SYSTEM	
Condition of ignition switch, start button and engine run/stop switch	I			I		LIGHTS, GAUGE AND ACCESSORIES	
Condition of lighting system (HI/LO intensity, brake light, beam aiming, etc.)	I			I			
Winch connections						Refer to <i>BASIC GUIDE TO WINCHING TECHNIQUES</i>	
<b>CONTINUOUSLY VARIABLE TRANSMISSION (CVT)</b>							
Drive belt				I		CVT	
Drive and driven pulleys				I, C			
One-way bearing inside CVT				I, L			
CVT air inlet	I		I, C				
<b>GEARBOX</b>							
Gearbox oil <sup>(1)</sup>	R			I	R	GEARBOX AND 4 X 4 COUPLING UNIT	
Speed sensor	C			C			
4 x 4 coupling unit	I			I			
<b>DRIVE TRAIN</b>							
Drive shaft boots and protectors	I	I				FRONT DRIVE and REAR DRIVE	
Rear propeller shaft joints <sup>(1)</sup>	I		I, L				
Drive shaft joints			I				
Wheel bearings				I			
Wheel nuts/studs	I		I				
Tire wear and pressure		Every ride					
Front and rear differentials oil level, seals and vents	I		I		R		

**Section 01 MAINTENANCE**  
Subsection 01 (MAINTENANCE CHART)

A: ADJUST C: CLEAN I: INSPECT L: LUBRICATE R: REPLACE	10 HOURS OR 300 KM (185 mi) (The initial maintenance is very important and must not be neglected.)					REFER TO
	EVERY 25 HOURS OR 750 KM (470 mi)					
	EVERY 50 HOURS OR 1500 KM (930 mi)					
	EVERY 100 HOURS OR 3000 KM (1865 mi) OR 1 YEAR					
	EVERY 200 HOURS OR 6000 KM (3730 mi) OR 2 YEAR					
PART/TASK						
<b>STEERING SYSTEM</b>						
Handlebar fastener				I		STEERING SYSTEM
Steering system mechanism (column, bearing, etc.) <sup>(2)</sup>	I			I		
Tie rod ends			I			
Front wheel alignment	I			I, A		
<b>SUSPENSION</b>						
Trailing arms				I		REAR SUSPENSION
Trailing arm bearings					I	
Shock absorbers			I			FRONT SUSPENSION and REAR SUSPENSION
A-arms			I, L			FRONT SUSPENSION
Ball joints		I				
<b>BRAKES</b>						
Brake fluid	I	I			R	HYDRAULIC BRAKES
Brake system (discs, hoses, etc.)				I		
Brake pads <sup>(1)</sup>		I				
<b>BODY/FRAME</b>						
Frame fastener			I			BODY/FRAME
Frame				I		
Hitch/trailer ball condition (if installed)	Every ride					
Storage cover latches	Every ride					
Operator's seat and its fasteners	Every ride					
Passenger's seat or storage box and its fasteners (MAX models)	Every ride					
Grab handles (MAX models)	Every ride					
Vehicle cleaning and protection			C			

- (1) More often under severe use such as dusty area, sand, snow, wet or muddy conditions.  
 (2) Every 100 hours, check coolant strength.  
 (3) Make sure that the spark plug gap is correct.  
 (4) Emission-related component.



# PRESEASON PREPARATION

Prior to use vehicle, proper vehicle preparation is required after performing the storage procedure.

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

Using the maintenance chart, performed items in the column indicated: EVERY 100 HOURS OR 3000 km (1865 mi) OR 1 YEAR.

<b>A: ADJUST</b> <b>C: CLEAN</b> <b>I: INSPECT</b> <b>L: LUBRICATE</b> <b>R: REPLACE</b> <b>T: PROCEED WITH TASK</b>	<b>INITIAL INSPECTION 10 HOURS OR 30 DAYS OR 300 KM (186 MI.)</b> <small>(The initial maintenance is very important and must not be skipped)</small>			
	<b>EVERY 25 HOURS OR 750 KM (470 MI.)</b>			
	<b>EVERY 50 HOURS OR 1500 KM (930 MI.)</b>			
	<b>EVERY 100 HOURS OR 3000 KM (1865 MI.) OR 1 YEAR</b>			
	<b>EVERY 200 HOURS OR 6000 KM (3730 MI.) OR 2 YEARS</b>			
PARTS TASK				
Engine				
Engine/transmission oil and filter	R	R	R	L
Engine/transmission oil cooler cleaning			C	Lubricate

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1. Use this column

Furthermore, proceed with the following:

### Vehicles Prepared as per Storage Procedure

Remove rags from: CVT inlet and outlet hoses, engine air intake and muffler.

Test drive vehicle to confirm proper operation.

### Vehicles Not Prepared as per Storage Procedure

Replace engine oil and filter.

Drain fuel tank and fill with fresh fuel.

Test drive vehicle to confirm proper operation.





# STORAGE PROCEDURES

## SERVICE PRODUCTS

Description	Part Number	Page
BRP heavy duty cleaner.....	293 110 001 .....	8
XP-S Lube.....	293 600 016 .....	8
BRP fuel stabilizer.....	413 408 600 .....	7
Vinyl & Plastic Cleaner.....	413 711 200 .....	8
storage oil.....	413 711 600 .....	7
storage oil (US).....	413 711 900 .....	7

If the ATV is not used or is to be stored for an extended period of time, more than 4 months, be sure to perform the storage procedures described below.

## FUEL STABILIZER

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 and fuel system gumming. Follow the manufacturer's instructions for proper use.

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

Pour fuel stabilizer in fuel tank. Fill up fuel tank. Do not drain fuel system.

## ENGINE LUBRICATION

Engine internal parts must be lubricated to protect them from rust formation during the storage period.

**⚠ WARNING**

This procedure must only be performed in a well-ventilated area. Do not run engine during storage period.

Proceed as follows:

- Start the engine and allow it to run at idle speed until the engine reaches its operating temperature.
- Stop the engine.
- Change engine oil and filter. Refer to *LUBRICATION SYSTEM*.
- Remove spark plugs and spray storage oil (P/N 413 711 600) into each cylinder.

**NOTE:** For US citizens, use storage oil (US) (P/N 413 711 900) only.

**CAUTION:** Do not inject storage oil into throttle body bore to avoid blocking idle bypass valve.

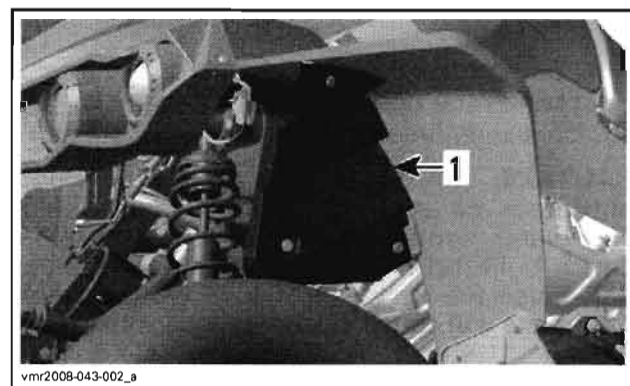
- Press start button, 1 or 2 seconds maximum, to lubricate cylinders.
- Reinstall the spark plugs.
- Remove the battery. Store it in dry and cool place out of the sun, refer to *BATTERY* in *CHARGING SYSTEM*.

## RAGS INSTALLATION

Using cleans rags, block the following locations: CVT inlet and outlet hoses, air intake inlet and muffler. The rags will prevent the intrusion of small animals, leaves or other debris.

**CAUTION:** Do not forget, these rags must be removed during pre-season preparation before starting the vehicle.

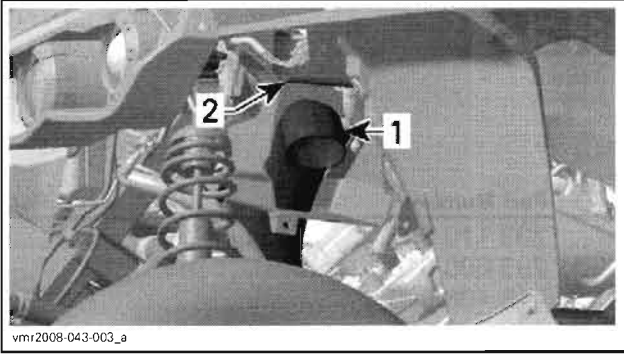
To reach the CVT inlet hose and the air intake inlet, remove the front inner fender on the left side of vehicle.



TYPICAL — RENEGADE SHOWN  
1. Inner fender

## Section 01 MAINTENANCE

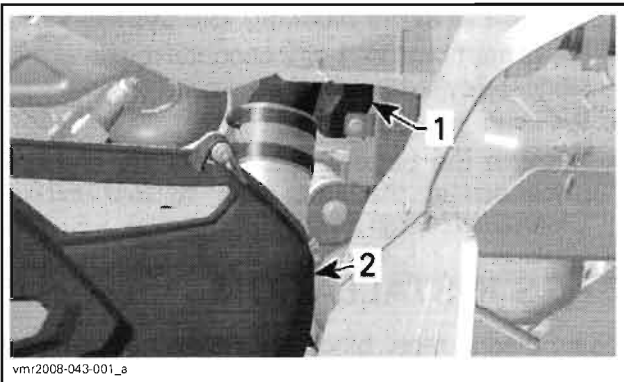
### Subsection 03 (STORAGE PROCEDURES)



TYPICAL — RENEGADE SHOWN

1. CVT inlet hose
2. Air intake inlet

The CVT outlet hose is located at the rear of engine, against vertical frame beam. The removal of the left side panel is necessary to reach the hose.



TYPICAL — RENEGADE SHOWN

1. CVT outlet hose
2. CVT cover

## COOLANT DENSITY

Test coolant density using an antifreeze hydrometer.

**NOTE:** Follow manufacturer's instructions for proper use.

A 50/50 mixture of antifreeze and distilled water will provide the optimum cooling, corrosion protection and antifreeze protection.

**CAUTION:** Do not use tap water, straight antifreeze or straight water in the system. Tap water contains minerals and impurities which build up in the system. Straight water will cause the system to freeze while straight antifreeze will cause system temperature problems.

Change coolant if necessary. Refer to *COOLING SYSTEM*.

## DRIVE AND DRIVEN PULLEYS PROTECTION

Remove drive belt from pulleys.

Inspect and clean pulleys then spray XP-S Lube (P/N 293 600 016) on pulley faces.

Do not reinstall drive belt. Close CVT cover.

## VEHICLE CLEANING

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

Wash and dry the vehicle.

**CAUTION:** Never use a high pressure washer to clean the vehicle. USE LOW PRESSURE ONLY (like a garden hose). The high pressure can cause electrical or mechanical damages.

Remove any dirt or rust.

To clean the vinyl or plastic parts, use only flannel clothes with Vinyl & Plastic Cleaner (P/N 413 711 200).

**CAUTION:** It is necessary to use flannel cloths on plastic parts to avoid damaging surfaces. Never clean plastic parts with strong detergent, degreasing agent, paint thinner, acetone, products containing chlorine, etc.

To clean the entire vehicle, including metallic parts use BRP heavy duty cleaner (P/N 293 110 001).

Inspect the vehicle and repair any damage. Touch up all metal spots where paint has been scratched off. Spray all metal parts with XP-S Lube (P/N 293 600 016).

## VEHICLE PROTECTION

Protect the vehicle with a cover to prevent dust accumulation during storage.

**CAUTION:** The vehicle has to be stored in a cool and dry place and covered with an opaque tarpaulin. This will prevent sun rays and grime from affecting plastic components and vehicle finish.

# SPECIAL PROCEDURES

## SERVICE PRODUCTS

Description	Part Number	Page
XP-S Lube .....	293 600 016 .....	9-10

## TURN OVER

If the check engine indicator light stays ON after starting engine and the engine oil level is good, check the following:

- Oil filter for contamination.
  - Replace oil filter and oil.
- Oil pressure regulator valve stays open in the crankcase due to contamination (metallic particles).
  - Clean and/or replace the valve.
- Valve piston stuck in the oil pump housing.
  - Repair valve piston.
- Oil pressure switch for damages.
  - Replace it if necessary.
- Oil pump cleanliness and working.
  - Clean and/or replace oil pump if necessary.
- Oil strainer cleanliness and damages.
  - Clean and/or replace oil strainer.

## ATV IMMERSION

### ATV Submerged for a Long Time (over one hour)

Disassemble engine and transmission to clean the internal parts and check if there is no rust or corrosion on any internal parts. Refer to *TRANSMISSION* and to the specific *ENGINE* section.

Drain air filter housing then clean and dry air filter.

Remove muffler and empty it. Let muffler dry then reinstall it on the vehicle.

Flush fuel tank and refill with new gas.

Lubricate the throttle body. Refer to *ENGINE MANAGEMENT*.

Look for water in:

- brake system (replace brake fluid)
- differentials (drain oil and check internal parts for rust or corrosion then refill).

Lubricate all cables. Check if the cables operate properly.

Spray all metal parts with XP-S Lube (P/N 293 600 016).

Test drive to confirm all is working well (electrical and mechanical components).

### ATV Submerged for a Short Time (fewer one hour)

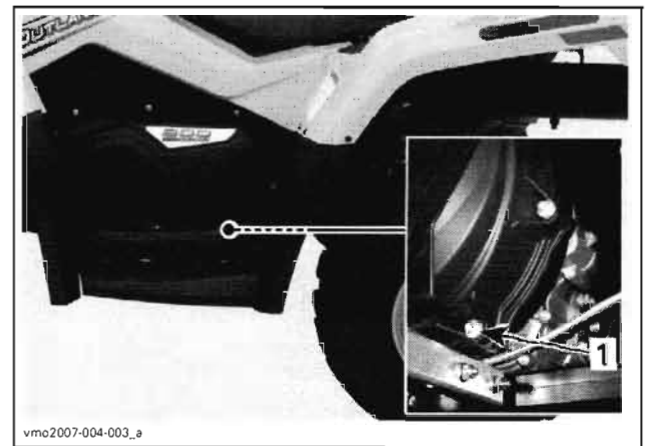
Check if engine oil is contaminated (oil will be milky). If so, perform the following instructions.

Drain engine oil.

Drain air filter housing then clean and dry air filter.

Look for water in fuel tank, in doubt, flush fuel tank and refill with new gas.

Drain the CVT housing by removing the bottom rear screw.



OUTLANDER SHOWN  
1. CVT cover drain plug

Remove the CVT cover then clean and check all parts of CVT. Refer to *CVT*.

Lubricate all cables. Check if the cables operate properly.

Remove spark plugs then crank engine several times.

Add a small quantity of engine oil in cylinders (approximately 2 teaspoonfuls). Do not reinstall spark plugs at this moment.

Refill engine at the proper level with the recommended oil. Crank engine several times.

## **Section 01 MAINTENANCE**

### **Subsection 04 (SPECIAL PROCEDURES)**

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Check condition of spark plugs. If spark plugs appear good reinstall them, if not install new ones.

Start the engine and allow it to run at idle speed until the engine reaches its operating temperature.

Stop the engine.

Change engine oil and filter.

**NOTE:** Change oil as many times as necessary, until there is no white appearance in engine oil.

Spray all metal parts with XP-S Lube (P/N 293 600 016).

Test drive to confirm all is working well (electrical and mechanical components).

# TROUBLESHOOTING CHART

The following charts are provided to help in diagnosing the probable source of troubles. It should be used as a guideline. This section pertains to engine mechanical components only. Some related problems can come from other systems such as ignition system, fuel system etc. and have an impact on the engine. Ensure to check the other systems before concluding that the engine is faulty.

## ELECTRICAL SYSTEM

Symptom: **STARTER DOES NOT TURN**

---

- 1. Ignition switch is in the OFF position.**  
*- Turn switch to the ON position.*
- 2. Engine run/stop switch is in the OFF position.**  
*- Turn switch to the RUN position.*
- 3. DESS key not programmed for the vehicle.**  
*- Refer to DESS SYSTEM.*
- 4. Defective DESS key or switch.**  
*- Check key and switch.*
- 5. Burnt fuse.**  
*- Check main fuse and wiring condition.*
- 6. Transmission is not set to Park or Neutral position or brake switch is not activated.**  
*- Set transmission to PARK or NEUTRAL position or squeeze the brake lever or press on brake pedal.*
- 7. Weak battery.**  
*- Recharge battery.*
- 8. Poor contact of battery terminal(s) or ground cable connections.**  
*- Clean and tighten terminal(s).*
- 9. Poor contact or open circuit of: start button, engine run/stop switch, ignition switch or starting solenoid.**  
*- Check and replace defective part.*
- 10. GBPS switch(es) is (are) defective.**  
*- Check GBPS switch(es) and wiring condition. Refer to GEARBOX.*
- 11. Diode incorrectly installed or failure.**  
*- Check diode installation and condition.*
- 12. Defective ECM.**  
*- Check. Refer to ENGINE MANAGEMENT.*
- 13. Multifunction speedometer replaced but not updated with proper coding.**  
*- Use B.U.D.S. and update ECM. Refer to LIGHTS, GAUGES AND ACCESSORIES.*
- 14. Defective brake switch.**  
*- Check brake switch and its connectors. Replace defective part.*
- 15. Engine mechanical problem (ensure that other electric components are good).**  
*- Check and replace defective part.*

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

---

Symptom: **STARTER TURNS, BUT DOES NOT CRANK THE ENGINE**

---

1. **Worn sprag clutch.**  
- *Replace.*
2. **Worn gears.**  
- *Replace.*

Symptom: **STARTER MOTOR KEEPS RUNNING**

---

1. **Shorted starting solenoid switch winding.**  
- *Replace starter solenoid.*
2. **Melted solenoid contacts.**  
- *Replace starter solenoid.*
3. **Sticking or defective starter clutch.**  
- *Lubricate or replace electric starter.*
4. **Start button stock.**  
- *Fix or remove mud/ice/dirt or replace multifunction switch.*

## COOLING SYSTEM

Symptom: **HIGH ENGINE OPERATING TEMPERATURE**

---

1. **Check coolant level.**  
- *Coolant level lower than recommended. Refill (refer to COOLING SYSTEM).*
2. **Check for air bubbles in cooling system.**  
- *Air in cooling system. Refill and bleed cooling system (refer to COOLING SYSTEM).*
3. **Check temperature sensor for electrical/mechanical failure.**  
- *Temperature sensor defective. Replace.*
4. **Check thermostat.**  
- *Thermostat defective (does not open when engine gets hot). Replace (refer to COOLING SYSTEM).*
5. **Check leak indicator hole (in crankcase MAG side-water pump housing area) if coolant leaks.**  
- *Coolant leaking from indicator hole means a damaged water pump rotary seal. Replace rotary seal (refer to COOLING SYSTEM).*
6. **Check condition of hoses and hose clamps fixation.**  
- *Hoses are brittle and/or hard. Replace.*  
- *Hose clamps are loose. Retighten clamps.*
7. **Check condition of impeller located on the water pump shaft.**  
- *Impeller wings broken and/or impeller threads are damaged. Replace (refer to COOLING SYSTEM).*
8. **Check gasket on water pump housing.**  
- *Gasket on water pump housing leaks. Retighten screws and/or replace gasket.*
9. **Check cylinder head and/or cylinder base gasket.**  
- *Worn out gasket(s) is (are) causing coolant leakage. Replace.*
10. **Check coolant drain screw on water pump housing MAG side (marked "DRAIN").**  
- *Copper ring on drain screw leaks. Retighten screw and/or replace copper ring.*

Symptom: **HIGH ENGINE OPERATING TEMPERATURE** (cont'd)

---

**11. Check intermediate gear(s) behind of PTO cover.**

- Worn out and/or broken gear(s) is/are causing less coolant supply. Replace worn out and/or broken gear(s) (refer to BOTTOM END).

**12. Check if water pump shaft is seized.**

- Water pump shaft does not turn. Replace defective part(s).

**13. Check cooling fan and connection.**

- Fan motor faulty. Replace.

- Wire harness is brittle or hard (no connection). Replace.

**14. Check radiator fan switch and fuse 20 A.**

- Faulty fan switch and/or faulty fuse. Replace defective part(s).

**15. Check radiator condition for leakage.**

- Radiator swelled, cracked or deformed. Replace radiator.

**16. Check mud/dust in radiator fins.**

- Radiator fin obstructed, hard air cooling. Clean radiator fins.

**17. Check radiator cap.**

- Defective radiator cap relief valve. Replace.

**18. Check vent holes in coolant expansion tank cap.**

- Inner cap vent hole of coolant expansion tank is clogged. Replace.

- Cap vent hole of coolant expansion tank is clogged. Replace.

## MAGNETO SYSTEM

Symptom: **BATTERY NOT CHARGING OR CHARGING VOLTAGE INADEQUATE**

---

**1. Check battery.**

- Battery shows less power. Reload battery.

- Battery has electrical failure. Replace.

**2. Check magneto for damage and/or electrical failure.**

- Radial position of rotor wrong due to broken Woodruff key. Replace Woodruff key.

- Coating on stator winding is damaged. Replace stator.

- Resistance value is out of specification (refer to TECHNICAL SPECIFICATIONS). Replace magneto.

- Connector on magneto is damaged and/or has electrical failure. Repair and clean contacts of connector.

**3. Check voltage regulator/rectifier.**

- Refer to CHARGING SYSTEM.

**4. Check wiring harness for cracks or other damages.**

- Harness shows electrical failure and/or other damages. Replace/repair wiring harness.



## LUBRICATION

Symptom: **LOW OR NO OIL PRESSURE/HIGH OIL CONSUMPTION**

---

- 1. Check oil level and search for leakage on crankcase and/or sealing parts.**
  - Crankcase is leaking due to damage. Rebuild engine with new crankcase and gasket parts. Use recommended oil (refer to TECHNICAL SPECIFICATIONS).
  - Crankcase is leaking due to loose screws. Retighten screws with recommended torque.
  - Sealing rings, O-rings and/or gaskets are brittle, hard or damaged. Replace damaged parts.
  - Piston rings worn out (blue colored engine exhaust emission). Replace piston rings (refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).
  - Piston rings are broken (low compression). Replace piston rings (refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).
  - Valve stem seal damaged and/or sealing lip is hard and/or brittle. Replace all valve stem seals.
- 2. Check oil filter for contamination.**
  - Oil filter clogged. Replace oil and oil filter at the same time. Use recommended oil (refer to TECHNICAL SPECIFICATIONS).
- 3. Check oil drain plug on engine bottom.**
  - Plug is loose and/or gasket ring is missing. Retighten the plug and/or place gasket ring.
- 4. Check leak indicator hole if oil leaks (in crankcase MAG side-water pump housing area).**
  - Oil leaking from leak indicator hole means a damaged oil seal on water pump shaft. Replace oil seal (refer to COOLING SYSTEM).
- 5. Check oil pressure switch function.**
  - Oil pressure switch damaged. Replace oil pressure switch.
- 6. Check oil orifice(s) on the oil pump suction side.**
  - Oil orifice(s) is (are) clogged. Clean from contamination. Replace oil and oil filter if necessary (refer to LUBRICATION SYSTEM).
- 7. Check oil pump function.**
  - Oil pump rotor is out of wear limit. Replace oil pump (refer to LUBRICATION SYSTEM).
  - Oil pump seized due to oil leakage and/or air inclusion. Replace oil pump (refer to LUBRICATION SYSTEM).
  - Gears driving oil pump are broken or otherwise damaged. Replace gears.
  - Incorrect oil being used. Use recommended oil (refer to TECHNICAL SPECIFICATIONS).
- 8. Check oil pressure regulator valve (spring) function.**
  - Valve spring damaged (valve always open). Replace spring.
  - Valve piston is worn or broken. Replace valve piston (refer to LUBRICATION SYSTEM).
  - Valve piston stays open due to contamination. Clean or repair valve piston.
- 9. Check plain bearings in crankcase for heavy wear.**
  - Plain bearings out of specification (increased clearance). Replace plain bearings (refer to BOTTOM END).
- 10. Check engine oil strainer in crankcase.**
  - Oil strainer is clogged due to contamination. Clean or replace strainer and diagnose causes. Replace possible damaged parts (refer to BOTTOM END).

Symptom: **OIL CONTAMINATION (white appearance)**

---

- 1. Check leak indicator hole (in crankcase MAG side-water pump housing area) if coolant and oil leaks.**
  - Leakage of oil/colant mixture from indicator bore means damaged water pump seal ring and rotary seal. Replace sealing ring, rotary seal and change oil, oil filter and/or coolant (refer to LUBRICATION SYSTEM, COOLING SYSTEM and BOTTOM END).

Symptom: **OIL CONTAMINATION (white appearance)** (cont'd)

---

**2. Check cylinder head and/or cylinder base gasket.**

- Gasket damaged or leaking. Retighten cylinder head with recommended torque and/or replace gasket.

**3. Check tightening torque of cylinder head screws.**

- Screws not properly tightened. Retighten screws to recommended torque and replace oil.

**4. Check oil for particles (may indicate possible engine internal damages).**

- Oil contamination due to metal or plastic particles. Replace possibly damaged part(s) including oil and oil filter. Use recommended oil (refer to TECHNICAL SPECIFICATIONS).

## CYLINDER AND HEAD

Symptom: **UNUSUAL ENGINE NOISE AND/OR VIBRATION**

---

**1. Check noise coming from cylinder head area.**

- Improper valve clearance adjustment. Readjust valve clearance and/or replace defective part(s).

- Faulty chain tensioner. Replace spring and/or mechanism.

- Chain guide worn out. Replace chain guide.

- Stretched chain and/or worn out sprockets. Replace chain and sprockets.

- Sprocket screws got loose. Retighten screws with recommended torque.

- Rocker arm(s) is (are) worn out (valve adjustment). Readjust valve clearance and/or replace rocker arm(s).

- Incorrect camshaft timing adjustment. Replace damaged components and readjust camshaft timing (refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).

Symptom: **OIL CONTAMINATION ON CYLINDER AND/OR HEAD**

---

**1. Check screws for torque.**

- Loose screws. Retighten screws with recommended torque.

- Gaskets are brittle, hard, worn out or otherwise damaged. Replace damaged gaskets, O-rings or the V-ring on breather.

## CRANKSHAFT

Symptom: **UNUSUAL ENGINE NOISE AND/OR VIBRATIONS**

---

**1. Check noise coming from crankshaft area.**

- Crankshaft plain bearings are damaged. Replace crankshaft plain bearings (refer to BOTTOM END).

- Connecting rod plain bearings are damaged. Replace connecting rod plain bearings (refer to BOTTOM END).

- Magneto rotor got loose. Replace damaged components and retighten rotor retaining screw with recommended torque (refer to MAGNETO SYSTEM).

## GEARBOX

Symptom: **UNUSUAL GEARBOX NOISE AND/OR VIBRATIONS**

---

**1. Check oil level in gearbox.**

- Oil leakage from gearbox. Replace damaged gasket(s) and/or oil seal(s), torque screws and refill with oil up to specified level (refer to TECHNICAL SPECIFICATIONS and GEARBOX).

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

---

Symptom: **UNUSUAL GEARBOX NOISE AND/OR VIBRATIONS** (cont'd)

---

- 2. Check bearings in the gearbox for free movement.**
  - Bearing(s) do(es) not move freely. Replace bearing(s).
- 3. Check for knocking noise.**
  - Tooth of gears are damaged and/or worn. Replace respective gears.

Symptom: **GEAR INDICATION FAILS**

---

- 1. Check contact screws on gear housing center.**
  - Check contact screw outside for contamination and wetness. Clean contact screw and screw for wiring harness.
  - Contact(s) is (are) corroded and/or contact screw for wiring harness got loose. Clean contact surface and retighten contact screw(s) with recommended torque.
  - Wiring harness has broken cables. Replace wiring harness.
  - Shifting indicator switch(es) pin(s) is (are) worn and/or damaged. Replace shifting indicator switch(es).

Symptom: **GEAR(S) IS (ARE) HARD TO SHIFT**

---

- 1. Check shift shaft spline and/or shift forks for wear and/or damages.**
  - Shift shaft is worn out and/or shows damaged splines. Replace shift shaft.
  - Shift drum track(s) and/or splines is (are) worn out or damaged. Replace shift drum and damaged part(s).
  - Shift fork(s) is (are) worn out and/or engagement pins are damaged. Replace shift fork(s).
  - Shift fork(s) is (are) worn out and/or fork(s) is (are) damaged. Replace shift fork(s).
  - Shift gear(s) is (are) worn out. Replace shift gear(s).
  - Shifting indicator switch(es) pin(s) is (are) worn out (no roundings on top of pin). Replace shifting indicator switch(es).
- 2. Check engine idle speed.**
  - Check throttle cable and throttle adjustment.
  - Check bypass idle valve and connectors.
- 3. Check CVT one way clutch on drive pulley.**
  - CVT one way clutch was not lubricated correctly. Lubricate CVT one way clutch (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
  - CVT one way clutch is worn out or damaged. Replace defective part(s) (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
  - Check if friction washer at one way clutch is worn. Replace friction washer (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
- 4. Check transmission lever and connecting rod.**
  - Ball joint and/or ball joint nut is (are) loose. Retighten or replace the ball joint.
- 5. Check spring on shift shaft in gearbox.**
  - Broken spring. Replace the spring (refer to GEARBOX).
- 6. Check for any mud intrusions.**
  - CVT parts dirty. Clean all CVT parts.

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

---

Symptom: **UNUSUAL GEARBOX NOISE AND/OR VIBRATIONS** (cont'd)

---

- 2. Check bearings in the gearbox for free movement.**
  - Bearing(s) do(es) not move freely. Replace bearing(s).
- 3. Check for knocking noise.**
  - Tooth of gears are damaged and/or worn. Replace respective gears.

Symptom: **GEAR INDICATION FAILS**

---

- 1. Check contact screws on gear housing center.**
  - Check contact screw outside for contamination and wetness. Clean contact screw and screw for wiring harness.
  - Contact(s) is (are) corroded and/or contact screw for wiring harness got loose. Clean contact surface and retighten contact screw(s) with recommended torque.
  - Wiring harness has broken cables. Replace wiring harness.
  - Shifting indicator switch(es) pin(s) is (are) worn and/or damaged. Replace shifting indicator switch(es).

Symptom: **GEAR(S) IS (ARE) HARD TO SHIFT**

---

- 1. Check shift shaft spline and/or shift forks for wear and/or damages.**
  - Shift shaft is worn out and/or shows damaged splines. Replace shift shaft.
  - Shift drum track(s) and/or splines is (are) worn out or damaged. Replace shift drum and damaged part(s).
  - Shift fork(s) is (are) worn out and/or engagement pins are damaged. Replace shift fork(s).
  - Shift fork(s) is (are) worn out and/or fork(s) is (are) damaged. Replace shift fork(s).
  - Shift gear(s) is (are) worn out. Replace shift gear(s).
  - Shifting indicator switch(es) pin(s) is (are) worn out (no roundings on top of pin). Replace shifting indicator switch(es).
- 2. Check engine idle speed.**
  - Check throttle cable and throttle adjustment.
  - Check bypass idle valve and connectors.
- 3. Check CVT one way clutch on drive pulley.**
  - CVT one way clutch was not lubricated correctly. Lubricate CVT one way clutch (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
  - CVT one way clutch is worn out or damaged. Replace defective part(s) (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
  - Check if friction washer at one way clutch is worn. Replace friction washer (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
- 4. Check transmission lever and connecting rod.**
  - Ball joint and/or ball joint nut is (are) loose. Retighten or replace the ball joint.
- 5. Check spring on shift shaft in gearbox.**
  - Broken spring. Replace the spring (refer to GEARBOX).
- 6. Check for any mud intrusions.**
  - CVT parts dirty. Clean all CVT parts.

## COUPLING UNIT

Symptom: **4 WHEEL DRIVE INDICATION FAILS**

---

**1. Check contact screw on gear housing right side for damage and/or wear.**

- Shifting indicator switch pin is worn and/or damaged. Replace shifting indicator switch (refer to GEARBOX).
- Contact is corroded and/or contact screw for wiring harness got loose. Clean contact surface and retighten contact screw with recommended torque.
- Wiring harness has broken cable. Replace wiring harness.

Symptom: **4 WHEEL DRIVE DOES NOT ENGAGE OR DISENGAGE**

---

**1. Check actuator and/or actuator shifting fork for wear and/or damages.**

- Check if selector works properly. If so, check actuator.
- If selector is out of specifications, check wires, connectors and/or replace selector.
- Actuator shifting fork is worn out and/or damaged. Replace shifting fork of actuator.
- Check function of actuator. Replace if actuator is not turning, refer to GEARBOX.

**2. Check shifting sleeve spline and/or shifting fork for wear and/or damages.**

- Shifting sleeve shows damaged splines. Replace shifting sleeve (refer to GEARBOX).
- Shifting fork is worn out and/or engagement pin is damaged. Replace shifting fork.

## CVT

Symptom: **UNUSUAL ACCELERATION BEHAVIOR**

---

**1. Check drive belt condition.**

- Belt is too narrow (drive belt engagement is higher in drive pulley). Replace belt if width is less than specified (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) and/or TECHNICAL SPECIFICATIONS).

**2. Check lever condition on drive pulley sliding sheave and/or roller(s) on governor cup.**

- Lever(s) on drive pulley sliding sheave is (are) worn and/or damaged (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace all levers at the same time (lever kit).
- Roller(s) is (are) worn and/or damaged (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace governor cup assembly.

**3. Check drive/driven pulley sliding sheave for free axial movement.**

- Sliding sheave is stuck (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace damaged part(s).

**4. Check condition of drive/driven pulley spring.**

- Drive pulley spring tension is too smooth and/or damaged (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace spring.
- Driven pulley spring tension is too stiff (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace spring.

**5. Check if cam of driven pulley is worn.**

- Replace if out of specifications; refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT).

**6. Check condition of fixed and sliding sheaves (drive and driven pulley).**

- Check surface of fixed and sliding sheaves (drive and driven pulley) for grooves or other damages; refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT).

**7. Check with B.U.D.S. at diagnostic communication port for failure.**

- Repair or replace defective part.

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

---

Symptom: **UNUSUAL ACCELERATION BEHAVIOR** (cont'd)

---

**8. Check valve adjustment.**

- Intake and/or exhaust valves are not adjusted correctly. Adjust valves.

**9. Check engine condition.**

- Low engine compression; refer to LEAK TEST in INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER.

**10. Check ignition condition.**

- Faulty spark plug. Install new spark plug(s).

**11. Check differentials operation.**

- Vehicle on Neutral is hard to move. Repair or replace defective part(s).

Symptom: **ENGINE MAXIMUM RPM IS TOO HIGH AND TOP SPEED IS NOT REACHED**

---

**1. Check drive/driven pulley area for contamination and/or water intrusion.**

- CVT area is contaminated with water, dirt or oil. Clean CVT system and replace damaged part(s).

**2. Check items 1 to 3 of UNUSUAL ACCELERATION BEHAVIOR.**

**3. Check drive/driven pulley spring tension.**

- Drive pulley spring tension is too stiff. Replace spring (recommended BRP spring).

- Driven pulley spring tension is too smooth and/or damaged (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace spring.

Symptom: **DRIVE PULLEY NOISE IN IDLE SPEED**

---

**1. Check slider shoes (drive pulley).**

- Worn slider shoes (increased clearance between governor cup and drive pulley sliding sheave). Replace all slider shoes at the same time (slider shoes kit).

**2. Check driven pulley sliding mechanism (between driven pulley outer and inner sheave).**

- Mechanism is stuck and/or damaged. Replace driven pulley assembly.

**3. Check roller(s) and/or levers for wear (located on sliding sheave of drive pulley).**

- Roller(s) on governor cup is (are) worn out and/or damaged (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace governor cup assembly.

- Lever(s) on drive pulley sliding sheave is (are) worn out and/or damaged (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)). Replace all levers at the same time (lever kit).

**4. Check drive pulley screw for torque.**

- Loose screw. Retighten screw with recommended torque.

**5. Check one-way clutch condition on drive pulley sliding sheave.**

- Bearing(s) do(es) not move freely. Replace damaged part(s) and lubricate inside of one-way clutch (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).

- Spring sleeve(s) inside one-way clutch is (are) worn out. Replace both sleeves and springs and lubricate inside of one-way clutch (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).

- Spring(s) inside one-way clutch is (are) worn out. Replace both pins and springs and lubricate inside of one-way clutch (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).

Symptom: **DRIVE PULLEY NOISE WHEN ACCELERATING/DECELERATING**

---

**1. Check items 1 to 5 of DRIVE PULLEY NOISE IN IDLE SPEED.**

**2. Check if belt runs in dry conditions.**

- Drive pulley area is wet/contaminated due to water/dirt intrusion. Clean driven pulley area and/or drain water out of CVT cover.

Symptom: **DRIVE PULLEY NOISE WHEN ACCELERATING/DECELERATING** (cont'd)

- 3. Check drive/driven pulley screw for torque.**
  - Loose screw on drive and/or driven pulley. Retighten screw with recommended torque.
- 4. Check cam and driven pulley fixed sheave for wear.**
  - Cam and/or drive pulley fixed sheave out of wear limit and/or damaged. Replace damaged part(s).
- 5. Check torque gear fixed in driven pulley sliding sheave for wear.**
  - Torque gear out of wear limit and/or damaged. Replace torque gear (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).
- 6. Check for foreign particles in CVT area (stones, dirt, etc.).**
  - Small particles damaged belt and/or pulley surface(s). Clean system and replace damaged parts (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).

Symptom: **VIBRATIONS ORIGINATING FROM DRIVE PULLEY**

- 1. Check tightening torque of drive pulley screw.**
  - Moving sliding sheave. Retighten screw.
- 2. Check fixed sheave bushings.**
  - Excessive gap between bushings and fixed sheave shaft, thus restraining sliding sheave movements. Replace fixed sheave assembly.
- 3. Check if slider shoes are present and/or placed in correct position.**
  - Slider shoe(s) is (are) missing and/or damaged. Replace all slider shoes at the same time (slider shoes kit).

Symptom: **VIBRATIONS ORIGINATING FROM DRIVEN PULLEY**

- 1. Check fixed and sliding sheave bushings on driven pulley.**
  - Excessive gap between bushings and CVT shaft, thus restraining sliding sheave movements. Replace fixed and/or sliding sheave of driven pulley, polish CVT shaft area with fine emery cloth and wipe clean with a cloth.

Symptom: **PULLEYS DO NOT DOWN/UP SHIFT PROPERLY**

- 1. Check drive pulley bushings (cleanliness, wear, etc.).**
  - Check items 1 and 2 of UNUSUAL ACCELERATION BEHAVIOR.
  - Bushings stick to fixed sheave pulley shaft. Clean or replace.
  - Spring seat sticks to sliding sheave pulley bushing. Clean system and/or replace sliding sheave pulley.
  - One-way clutch does not operate properly. Clean system and/or replace damaged part(s).
- 2. Check driven pulley spring tension.**
  - Driven pulley spring tension is too weak or broken. Replace.
  - Driven pulley cam is worn or damaged. Replace.

Symptom: **BELT GLAZED EXCESSIVELY OR HAVING BAKED APPEARANCE**

- 1. Check if CVT air intake and/or outlet is clogged.**
  - CVT area heats up due to contamination. Clean air intake and/or outlet from contamination.
  - Fans located on drive pulley fixed sheave are clogged. Clean from contamination.
- 2. Check if pulley sheaves are clean.**
  - Oil on pulley surfaces. Clean pulley sheaves and replace belt.
  - Water intrusion in CVT area. Find root cause and repair. Drain water and replace belt.

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

---

#### Symptom: **BELT WORN EXCESSIVELY IN TOP WIDTH**

---

- 1. Check drive belt width.**
  - *Considerable wear. Replace belt if narrower than specified (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) or TECHNICAL SPECIFICATIONS).*
- 2. Check drive belt identification number.**
  - *Wrong type of belt. Replace belt with an appropriate drive belt.*
- 3. Check for localized belt wear caused by belt slippage.**
  - *Localized wear. Replace belt.*

#### Symptom: **BELT DISINTEGRATION**

---

- 1. Check drive belt lifetime is exceeded.**
  - *Clean CVT system and rebuild with a new drive belt.*
- 2. Check drive belt identification number.**
  - *Excessive belt speed. Using unspecified type of belt. Replace belt with proper type of belt (refer to TECHNICAL SPECIFICATIONS).*
- 3. Check if pulley sheaves are clean.**
  - *Oil on pulley surfaces. Clean pulley surfaces with fine emery cloth and wipe clean using Pulley Flange Cleaner (P/N 413 711 809) and a cloth.*
  - *Drive/driven pulley sheaves are damaged through stones inside CVT area. Clean pulley surfaces with fine emery cloth, wipe clean with a cloth or replace drive/driven pulley sheaves and belt.*

#### Symptom: **CRACKS BETWEEN COGS**

---

- 1. Check drive belt condition.**
  - *Considerable use, belt wearing out. Replace.*
  - *Brittle belt condition through aging. Replace belt.*

## ENGINE GENERAL

#### Symptom: **ENGINE CRANKS BUT FAILS TO START**

---

- 1. Check if spark plug connectors fit on spark plugs (refer to IGNITION SYSTEM).**
- 2. Check spark plugs.**
  - *Define spark plugs (no spark) or wrong spark plug gap. Readjust gap and clean spark plugs or replace.*
- 3. Check for fuel on spark plugs.**
  - *Flooded engine (spark plugs wet when removed). Activate engine drowned mode and crank engine with rags over the spark plug holes (refer to OVERVIEW in EMS SYSTEM).*
- 4. Check battery voltage.**
  - *Battery is discharged and starter works not properly. Charge battery.*
- 5. Check fuel level in fuel tank and fuel pressure. Ensure fuel pump was not disabled by B.U.D.S.**
  - *Low or no fuel pressure. Replace defective part(s) (refer to FUEL TANK AND FUEL PUMP).*
- 6. Check fuel injectors.**
  - *Plugged or faulty injector(s). Replace defective part(s) (refer to ENGINE MANAGEMENT).*
- 7. Check idle bypass valve.**
  - *Stuck or defective. Refer to ENGINE MANAGEMENT.*



Symptom: **ENGINE CRANKS BUT FAILS TO START** (cont'd)

---

- 8. Check encoder wheel.**
  - Bent tooth. Refer to MAGNETO SYSTEM.
- 9. Check engine compression.**
  - Insufficient engine compression. Replace defective part(s) (refer to LEAK TEST in INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).
- 10. Check fault codes in B.U.D.S system.**
  - Check if electrical actuator(s) is/are defective. Replace defective part(s) (refer to ENGINE MANAGEMENT).

Symptom: **ENGINE DOES NOT START**

---

- 1. Electrical problem.**
  - Determine if the electrical system works correctly (fuse(s), battery, wiring harness, etc.). Refer to IGNITION SYSTEM.
- 2. Problem with fuel system (carburetor, fuel pump, hoses, etc.).**
  - Clean, inspect, repair or replace defective parts. Refer to FUEL SYSTEM.
- 3. Check engine compression.**
  - Insufficient engine compression. Replace defective parts.
  - Valve seat worn and/or damaged. Repair by performing valve guide procedure (refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER). Readjust valve clearance.
- 4. Internal engine problem.**
  - Overhaul engine to find defective parts. refer to the appropriate section in ENGINE.

Symptom: **ENGINE HARD TO START**

---

- 1. Check idle bypass valve.**
  - Stuck or defective. Refer to ENGINE MANAGEMENT.
- 2. Check closed throttle and idle actuator with B.U.D.S.**
  - Wrong TPS zero setting/idle bypass valve reset. Refer to ENGINE MANAGEMENT.
- 3. Check throttle cable adjustment.**
  - Wrong adjustment (likely too tight). Refer to ENGINE MANAGEMENT.
- 4. Check engine compression.**
  - Insufficient engine compression. Replace defective part(s) (refer to LEAK TEST in INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).
- 5. Verify spark plug condition.**
  - Defective, improperly set, worn out, fouled. Identify source of problem and correct. Replace spark plug.
- 6. Check fuel level in fuel tank and fuel pressure.**
  - Low or no fuel pressure. Replace defective part(s) (refer to FUEL TANK AND FUEL PUMP).
- 7. Check CAPS (camshaft position sensor).**
  - Defective sensor/wiring. Refer to ENGINE MANAGEMENT.

Symptom: **ENGINE SUDDENLY TURNS OFF**

---

- 1. Perform engine leak test. Refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER.**
  - Damaged head gasket and/or seal and/or leaking inlet/exhaust valve(s). Replace and/or repair defective parts.

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

---

Symptom: **ENGINE SUDDENLY TURNS OFF** (cont'd)

---

**2. Check spark plugs condition and/or gap.**

- Fouled spark plugs or wrong spark plug gap. Readjust gap and clean spark plugs or replace.

**3. Piston seizure.**

- Spark plugs heat range is too hot. Install spark plugs with appropriate heat range (refer to TECHNICAL SPECIFICATIONS).

- Compression ratio is too high. Install genuine parts.

- Poor oil quality. Use recommended oil.

- Leaks at air intake manifold (engine gets too lean). Retighten screws or replace air intake manifold gasket.

- Snow/water intrusion through intake system into combustion chamber. Clean intake system and replace defective part(s).

**4. Melted and/or perforated piston dome; melted section at ring end gap.**

- Spark plugs heat range is too hot. Install recommended spark plugs (refer to TECHNICAL SPECIFICATIONS).

- Coolant less than recommended level (engine gets too hot). Repair cooling circuit and/or refill with recommended liquid.

- Poor quality and/or wrong fuel. Clean from contamination and use appropriate fuel (refer to TECHNICAL SPECIFICATIONS).

**5. Piston color is dark due to seizure on intake and exhaust sides.**

- Cooling system leaks and lowers coolant level. Tighten clamps or replace defective parts. Add antifreeze in cooling system until appropriate level is reached. Replace damaged parts.

**6. Cracked or broken piston.**

- Cracked or broken piston due to excessive piston/cylinder clearance or engine overrevving. Replace piston. Check piston/cylinder clearance (refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).

**7. Check piston rings and cylinder surface for grooves.**

- Poor oil quality. Use recommended oil.

- Contamination through engine intake. Replace defective part(s) and use new air filter.

**8. Check crankshaft, rocker arms movement.**

- Oil pump failure due to lack of oil. Repair and replace defective parts and use recommended oil.

- Oil contamination due to clogged oil filter/oil strainer. Replace oil and oil filter at the same time, replace defective part(s) (refer to LUBRICATION SYSTEM).

**9. Check valve springs exhaust/intake.**

- Broken valve spring damages the cylinder head, valve(s), rocker arm(s), piston, piston rings and connecting rod. Replace defective part(s).

**10. Check if fuel supply is sufficient.**

- Low fuel level.

- Clogged fuel filter or fuel injector filter.

- Fuel line is contaminated and/or bent. Clean and/or replace defective part(s).

**11. Check fault codes in B.U.D.S. system.**

- Check if electrical actuator(s) is/are defective. Replace defective part(s) (refer to ENGINE MANAGEMENT).

Symptom: **ENGINE BACKFIRES**

---

**1. Check spark plugs.**

- Carbon accumulation caused by defective spark plugs. Replace spark plugs.

Symptom: **ENGINE BACKFIRES** (cont'd)

---

- 2. Check leakage on intake manifold.**  
*- Air leak on intake system. Retighten screws and/or replace intake manifold gasket.*
- 3. Check exhaust air leaking.**  
*- Exhaust gasket is leaking. Retighten screws and/or replace exhaust gasket.*
- 4. Check intake valve(s) for leaking.**  
*- Intake valve(s) is (are) leaking. Repair or replace valve(s).*
- 5. Check if fuel supply is sufficient.**  
*- Fuel line is contaminated and/or bent (engine gets lean). Clean and/or replace defective part(s).*
- 6. Check engine ground.**  
*- Poor engine ground. Clean.*
- 7. Check fault codes in B.U.D.S. system.**  
*- Check if electrical actuator(s) is/are defective. Replace defective part(s) (refer to ENGINE MANAGEMENT).*

Symptom: **ENGINE DOES NOT OFFER MAXIMUM POWER AND/OR DOES NOT REACH MAXIMUM OPERATING RPM**

---

- 1. Check spark plugs condition and/or gap.**  
*- Fouled spark plugs or wrong spark plug gap. Readjust gap and clean spark plugs or replace.*
- 2. Check spark plugs type.**  
*- Improper spark plugs heat range. Install recommended spark plugs (refer to TECHNICAL SPECIFICATIONS).*
- 3. Perform engine leak test. Refer to LEAK TEST procedure in INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER.**  
*- Damaged head gasket and/or seal and/or leaking intake/exhaust valve(s). Replace and/or repair defective parts.*
- 4. Check for water in fuel (wrong fuel).**  
*- There is water in fuel or wrong fuel. Drain fuel system, search for leakage and refill it with appropriate fuel.*
- 5. Check engine compression.**  
*- Worn piston(s) and/or piston ring(s). Replace defective part(s) (refer to INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER).*
- 6. Check fuel pressure.**  
*- Low fuel pressure. Perform fuel pressure test (refer to FUEL SYSTEM).*
- 7. Check air intake system.**  
*- Air filter is clogged due to contamination. Replace air filter.*
- 8. Check if EMS (engine management system) is in limp home mode. Check fault codes in B.U.D.S system.**  
*- Check if electrical actuator(s) is/are defective. Replace defective part(s) (refer to ENGINE MANAGEMENT).*
- 9. Check drive belt.**  
*- Worn. Replace belt if its width is less than specified (refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT)).*

Symptom: **HIGH ENGINE OPERATING TEMPERATURE**

---

- 1. Check if cooling system shows any failure (see COOLING SYSTEM).**  
*- System is leaking. Repair and/or replace damaged part(s).*

---

## Section 02 TROUBLESHOOTING

### Subsection 01 (TROUBLESHOOTING CHART)

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Symptom: **HIGH ENGINE OPERATING TEMPERATURE** (cont'd)

---

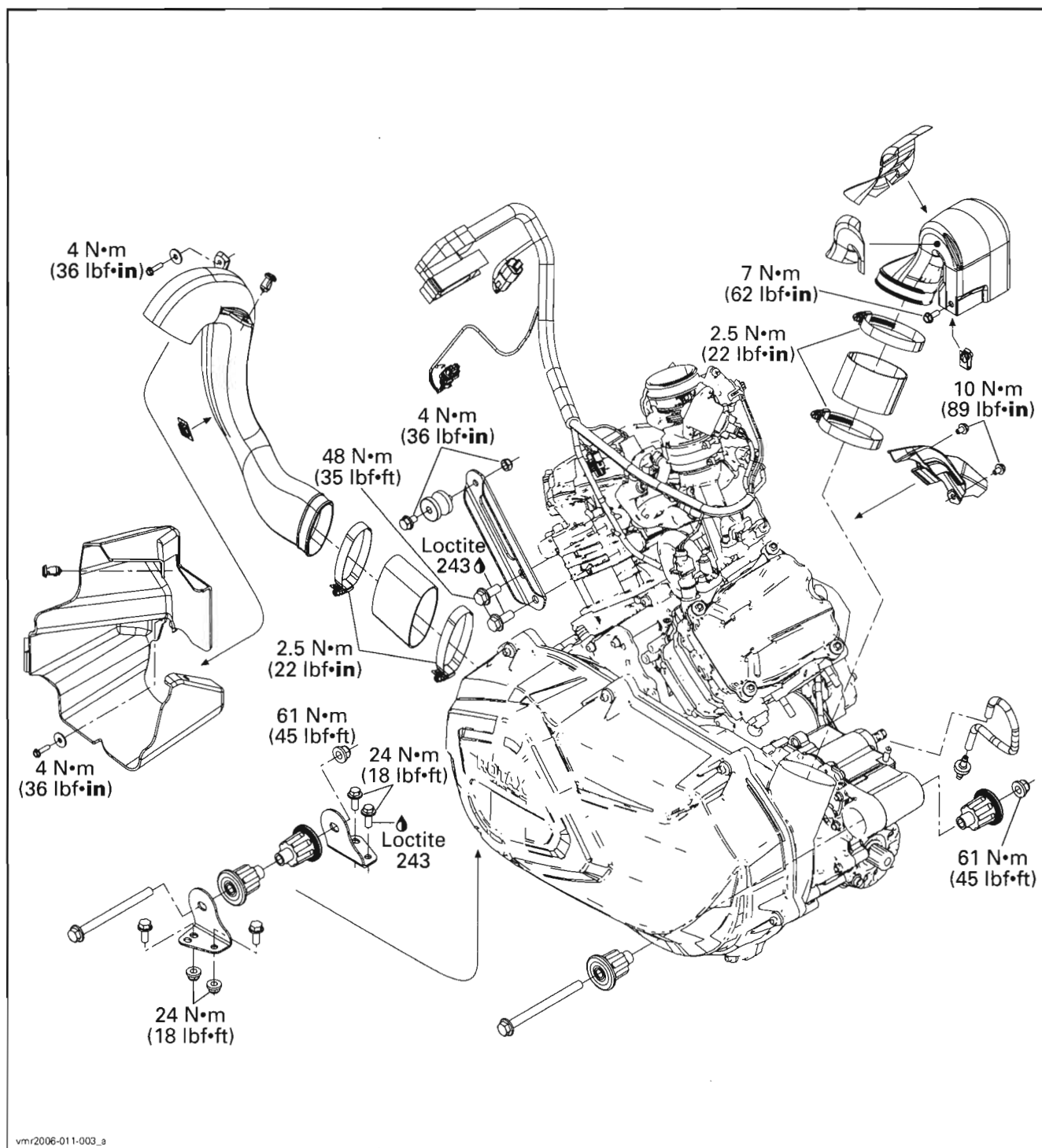
- 2. Check function of lubrication system (see LUBRICATION SYSTEM).**
  - Lubrication is not working properly. Repair and/or replace damaged part(s).
- 3. Check condition and heat range of spark plugs.**
  - Melted spark plug tip or inadequate heat range. Replace.
- 4. Check air leakage on engine intake.**
  - Leakage causes overheating. Replace/repair damaged part(s).
- 5. Check air inlet and outlet of the CVT cover.**
  - Air circulation is clogged (overheating). Clean air circulation from contamination.
  - Drive belt worn and/or damaged. Replace belt with an appropriate drive belt (refer to TECHNICAL SPECIFICATIONS).



# ENGINE REMOVAL AND INSTALLATION

## SERVICE TOOLS

Description	Part Number	Page
engine lifting tool .....	529 036 022 .....	31



## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

## GENERAL

### **⚠ WARNING**

To avoid potential burns, let engine and exhaust system cool down before servicing.

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

## PROCEDURES

### ENGINE REMOVAL

#### Vehicle and Engine Preparation

Place vehicle on a workstation that will have access to an engine-lifting hoist. Then start with initial preparation of vehicle by doing the following.

Select 4WD position then place transmission lever to PARK.

Using B.U.D.S., remove fuel pressure in the fuel system. Refer to *ENGINE MANAGEMENT*.

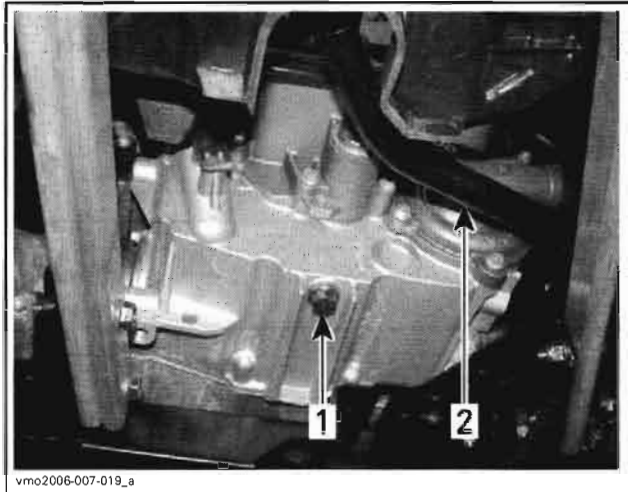
Disconnect the BLACK (-) cable from battery, then the RED (+) cable.

### **⚠ WARNING**

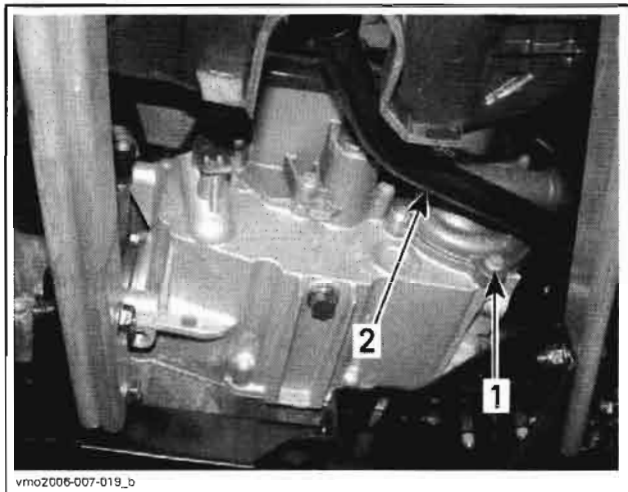
Always disconnect battery cables exactly in the specified order, the BLACK (-) cable first. It is recommended to disconnect electrical connections prior to disconnecting fuel lines.

Drain oil and coolant from engine.

**NOTE:** Drain engine oil only if engine overhaul is necessary. To work on gearbox the engine removal is necessary but not engine oil drain.



1. Oil drain plug  
2. Brake pedal



1. Cooling drain plug  
2. Brake pedal

Remove:

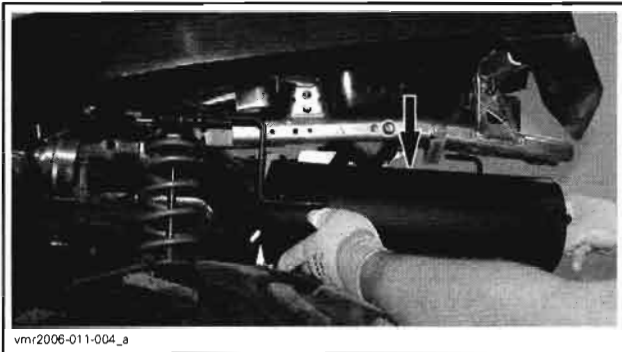
- seat
- both side panels. Refer to *BODY*.
- both footrests. Refer to *BODY*.
- central panel. Refer to *BODY*.
- air filter housing cover. Refer to *AIR INTAKE SYSTEM*.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

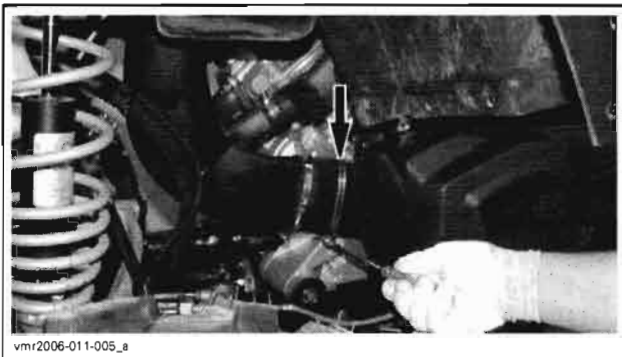
### Subsection 01 (ENGINE REMOVAL AND INSTALLATION)



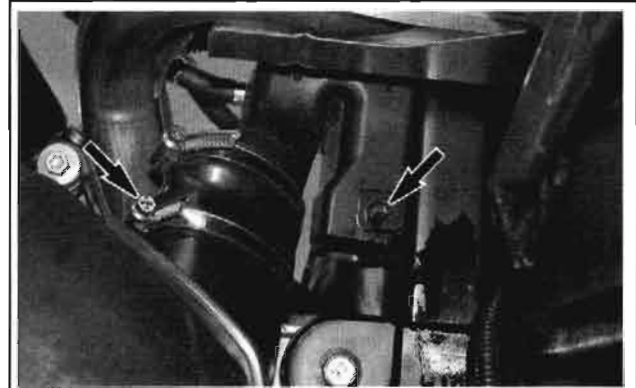
On Left Side of Vehicle, Remove the Following Parts:



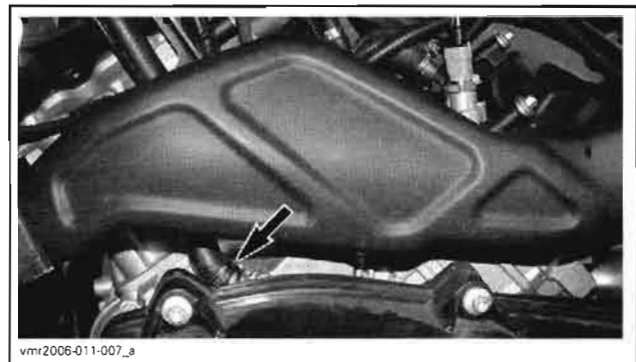
MUFFLER — OUTLANDER SHOWN



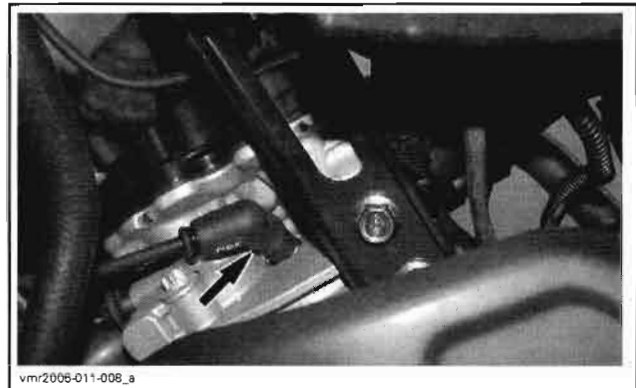
CVT INLET HOSE CLAMP



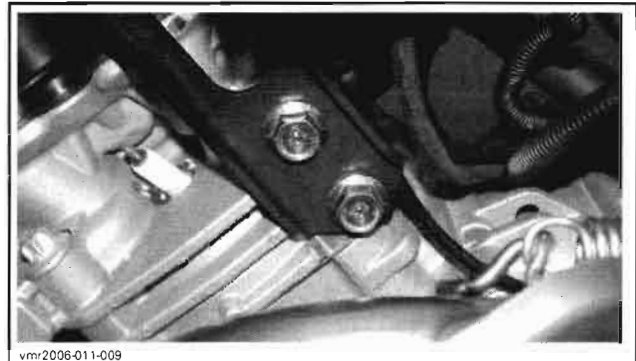
CVT OUTLET HOSE (UNSCREW BOTTOM CLAMP AND BOLT)



CRANKCASE VENT TUBE FROM ENGINE



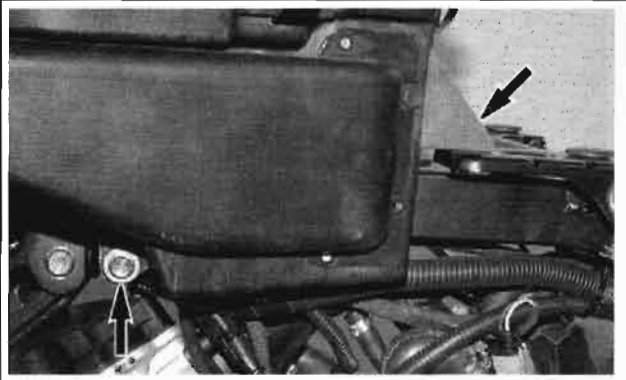
FRONT SPARK PLUG CABLE



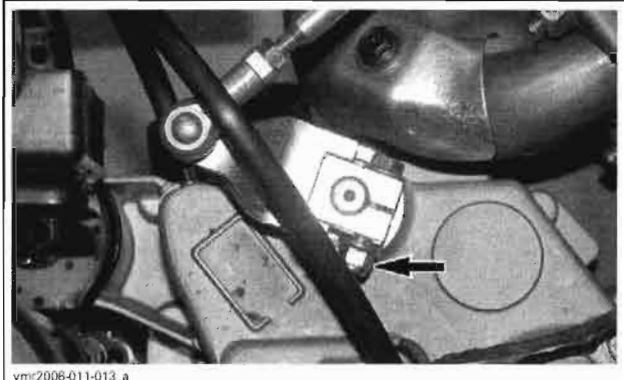
LOWER BOLTS FROM UPPER ENGINE SUPPORT

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

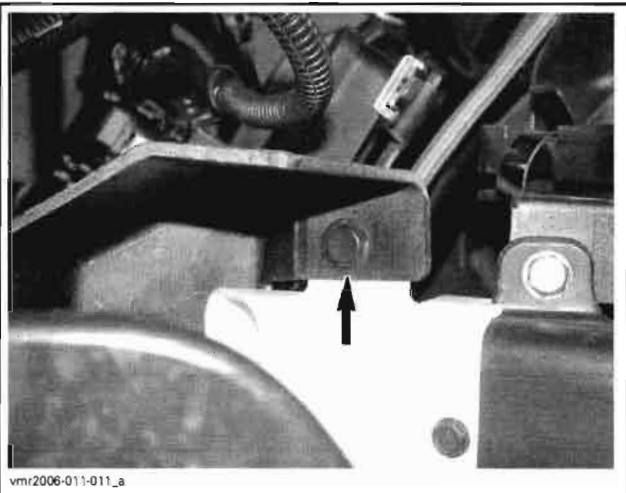
### Subsection 01 (ENGINE REMOVAL AND INSTALLATION)



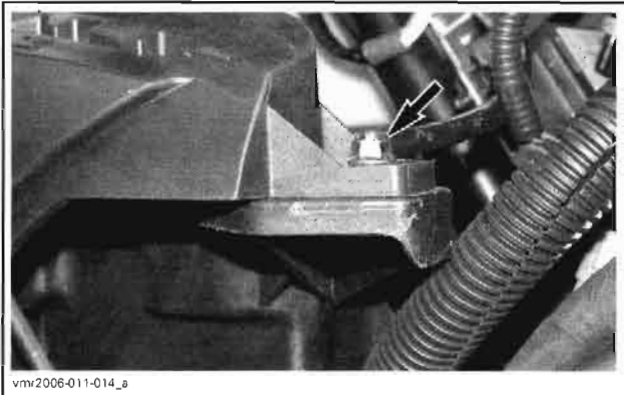
**BOLTS RETAINING AIR FILTER HOUSING**



**SHIFTING PLATE (UNSCREW BOLT TO REMOVE SHIFTING PLATE)**

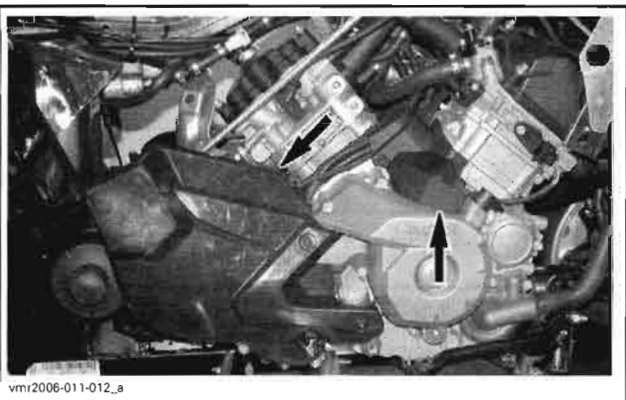


**DART HOLDING AIR INTAKE INLET**



**AIR FILTER HOUSING BOLT**

On right side of vehicle, remove or disconnect the following:



**FRONT AND REAR ENGINE COVERS**

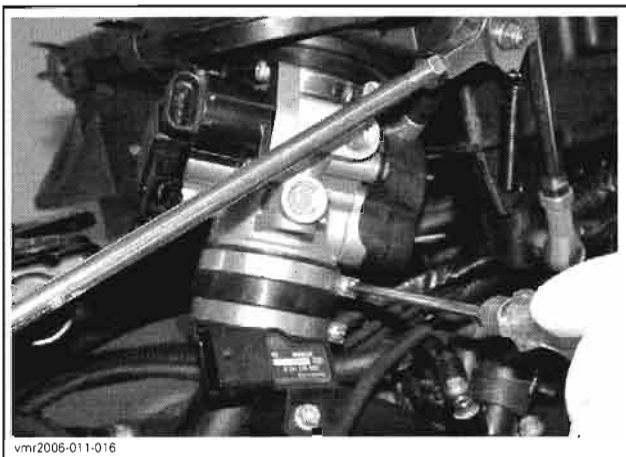


**CONNECTORS FROM THROTTLE BODY AND INTAKE MANIFOLD**

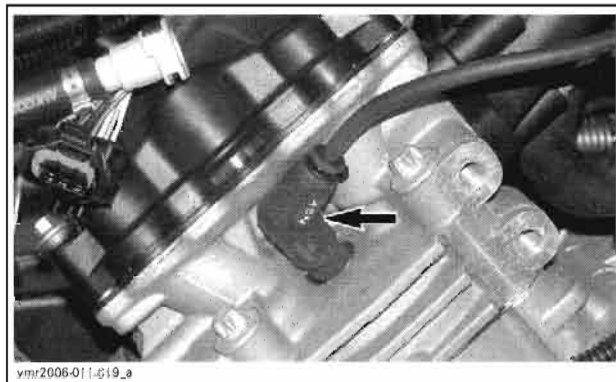


**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**

**Subsection 01 (ENGINE REMOVAL AND INSTALLATION)**



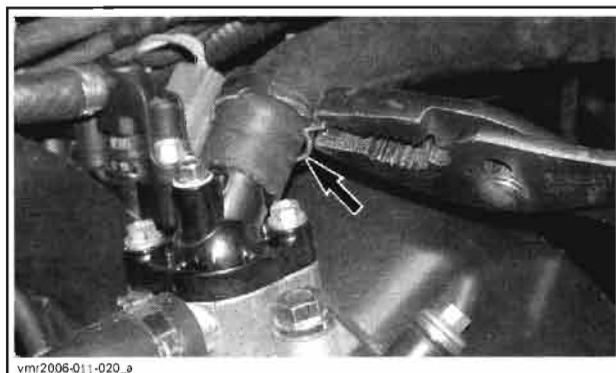
**UPPER THROTTLE BODY CLAMP**



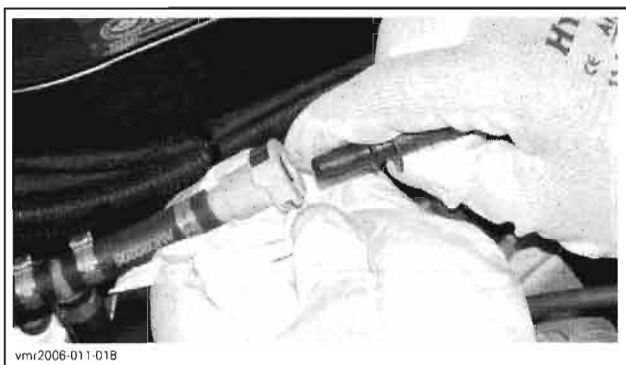
**THE OTHER SPARK PLUG CABLE**



**AIR FILTER HOUSING AND PLACE IT ON FRONT RACK (ON RENEGADE MODELS, REMOVE IT COMPLETELY)**



**OUTLET ENGINE COOLANT HOSE**



**FUEL SUPPLY LINE**



**FUEL INJECTOR CONNECTORS**



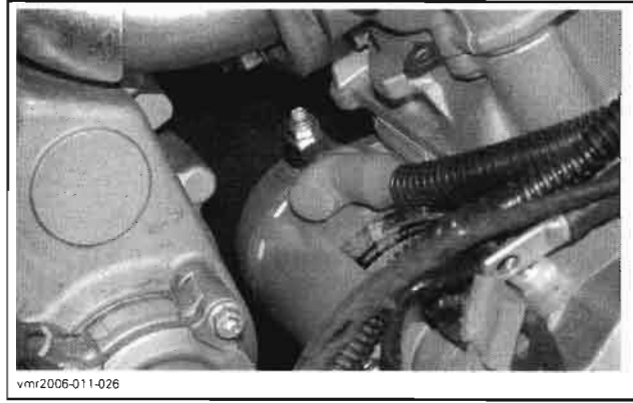
**INTAKE MANIFOLD**

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**

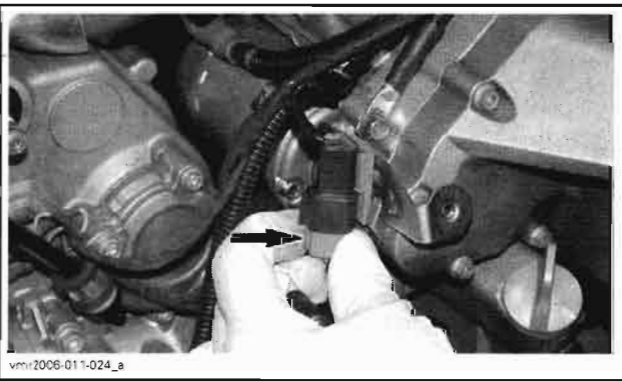
**Subsection 01 (ENGINE REMOVAL AND INSTALLATION)**



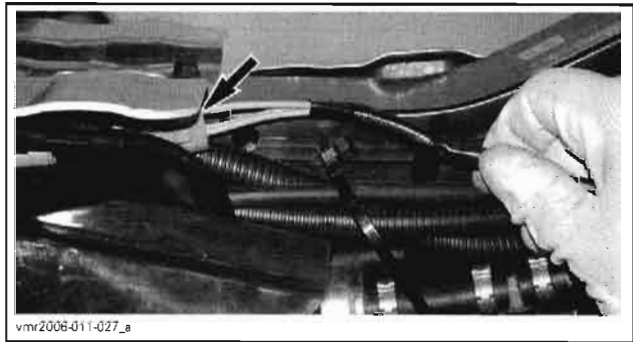
*COUPLING UNIT CONNECTOR*



*STARTER CABLE*



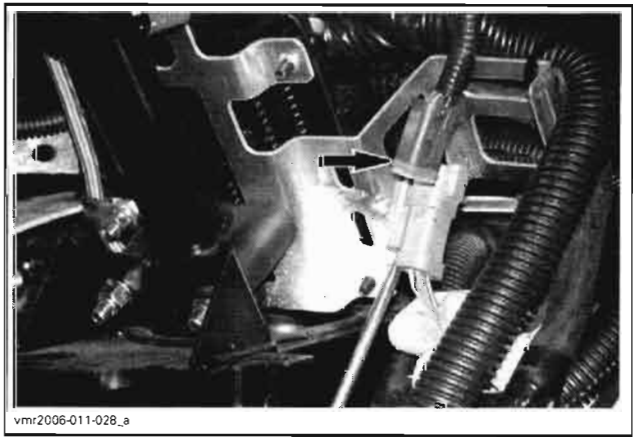
*2WD/4WD SWITCH CONNECTOR THEN REMOVE HOUSING FROM BRACKET*



*MAGNETO CONNECTOR*



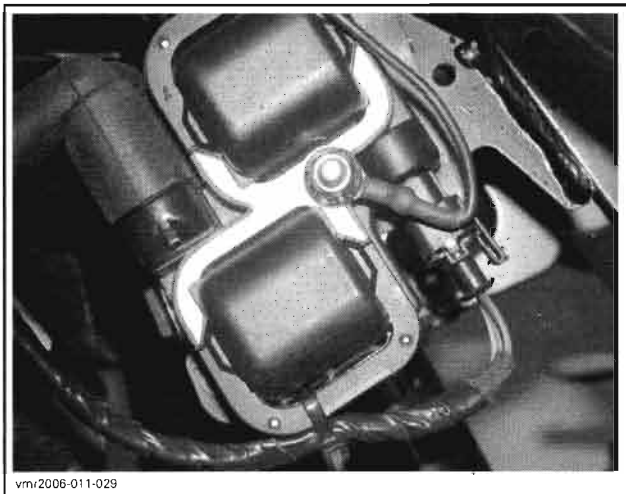
*ENGINE GROUND*



*B.U.D.S. CONNECTOR THEN REMOVE HOUSING FROM BRACKET*

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**

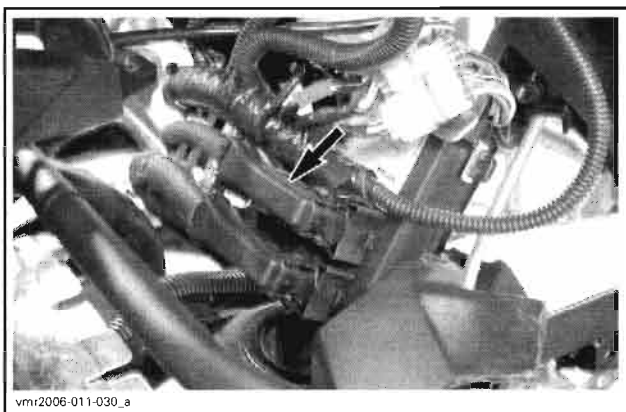
**Subsection 01 (ENGINE REMOVAL AND INSTALLATION)**



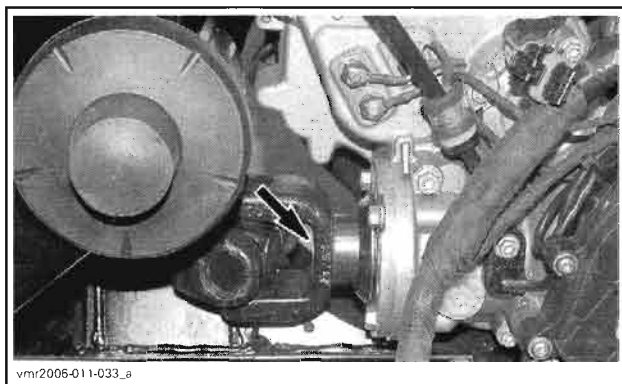
*IGNITION COIL CONNECTOR THEN CUT THE LOCKING TIE*



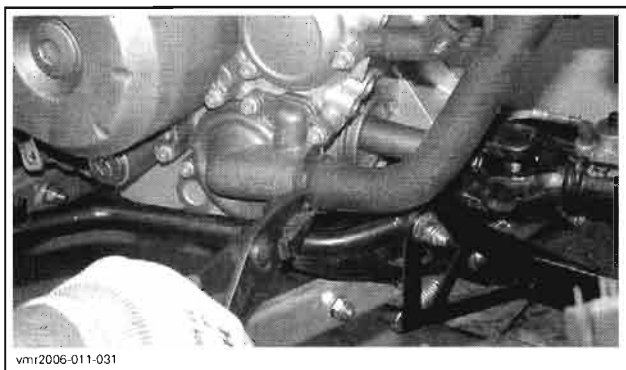
*FRONT PROPELLER BOLT*



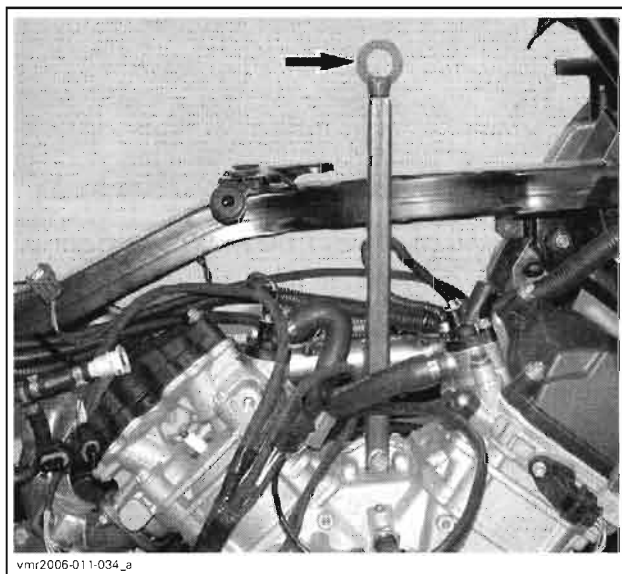
*CONNECTOR "A" FROM ECM*



*REAR PROPELLER BOLT*



*INLET ENGINE COOLANT HOSE*

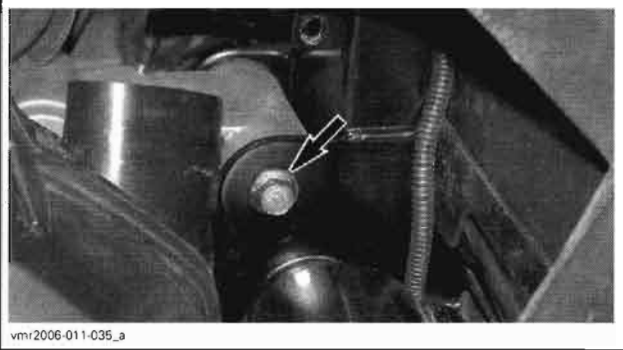


*INSTALL THE ENGINE LIFTING TOOL (P/N 529 036 022)*

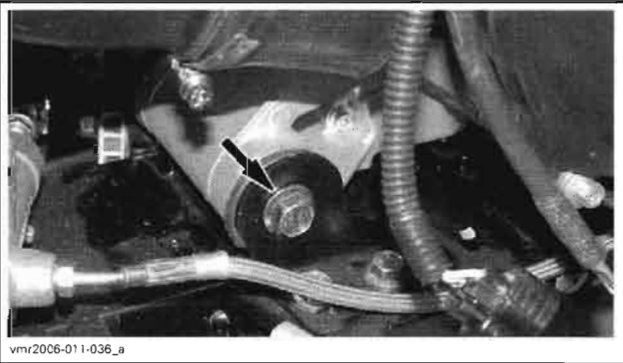
**Lifting Engine**

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

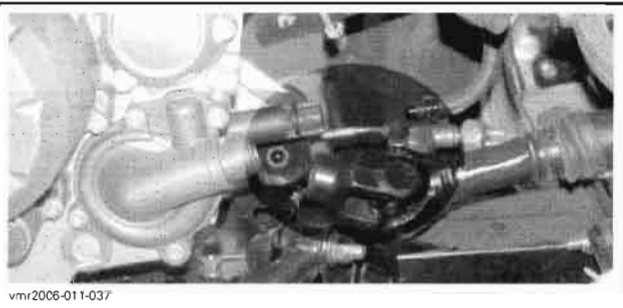
### Subsection 01 (ENGINE REMOVAL AND INSTALLATION)



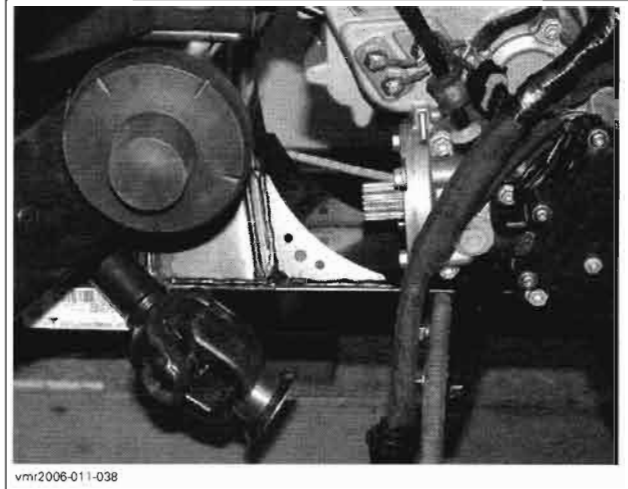
REMOVE THE REAR ENGINE MOUNTING BOLT



THEN THE FRONT ENGINE MOUNTING BOLT



LIFT ENGINE AND DISCONNECT THE FRONT PROPELLER SHAFT FROM ENGINE



MOVE ENGINE FORWARD AND DISCONNECT REAR PROPELLER SHAFT

Lift engine to clear mounting brackets.

Turn engine 90°, cylinder head towards right side of vehicle.

Remove engine from vehicle.

## ENGINE INSTALLATION

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

**NOTE:** Prior to install engine, inspect condition of engine mounts.

Install the rear engine mounting bolt. Do not torque yet.

Install the rear propeller shaft onto engine output shaft.

Connect the front propeller shaft to engine output shaft while lowering engine.

Install front engine mounting bolt then torque all mounting bolts.

Install and connect all other removed parts.

### Final Assembly Procedure

Make sure coolant and oil drain plugs are reinstalled and tight.

Fill cooling system. Refer to *COOLING SYSTEM*.

Fill engine with the recommended oil and quantity. Refer to *LUBRICATION*.

Reconnect battery.

### **⚠ WARNING**

Connect RED (+) cable then BLACK (-) cable. Always connect RED (+) cable in first.

Start engine and let it reach its operating temperature.

Stop engine and check coolant and oil levels. Re-fill as necessary.

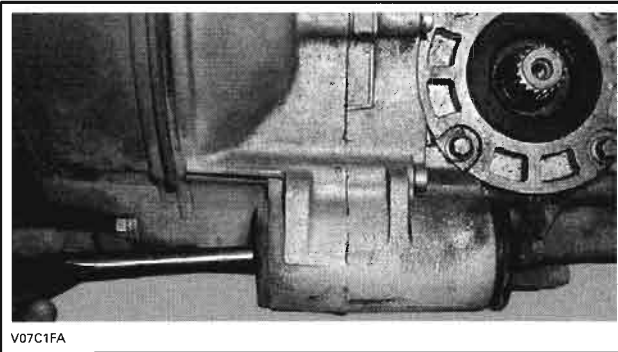
Test drive vehicle to confirm proper operation.

## ENGINE MOUNT REPLACEMENT

**NOTE:** Use the same procedure for the front and rear engine mounts.

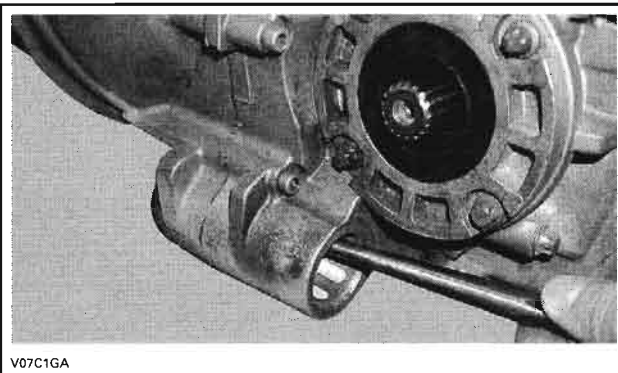
### Removal

Insert a punch in any engine mount bushing and push the other bushing out.



*TYPICAL*

Use punch from the other side to remove the remaining bushing.



*TYPICAL*

### Installation

The installation is the reverse of the removal procedure.



*Midwest Manuals*

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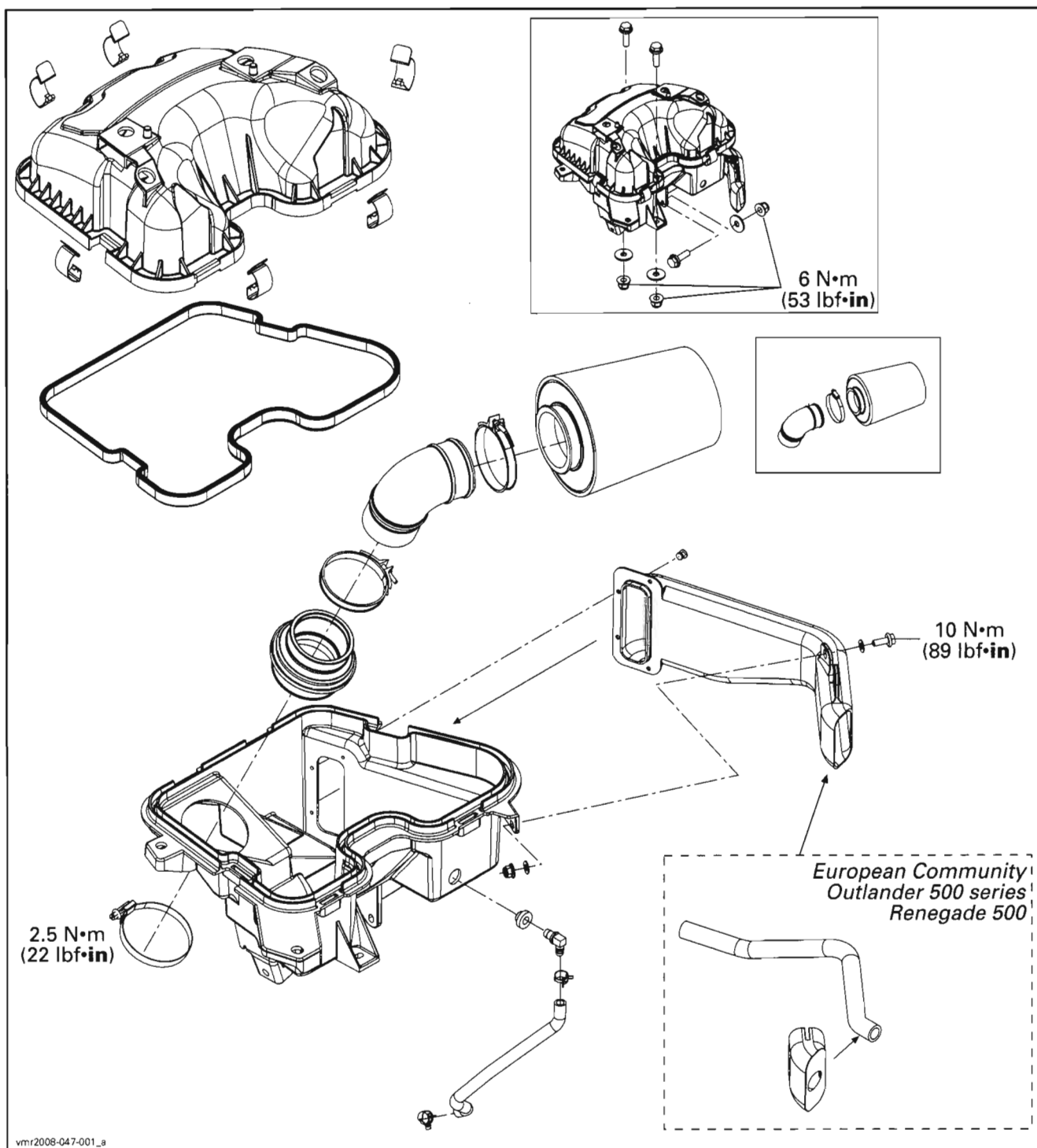
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# AIR INTAKE SYSTEM

## SERVICE PRODUCTS

<u>Description</u>	<u>Part Number</u>	<u>Page</u>
air filter cleaning solution.....	219 700 341 .....	37
Loctite 5910.....	293 800 081 .....	39

### AIR FILTER HOUSING





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

## PROCEDURES

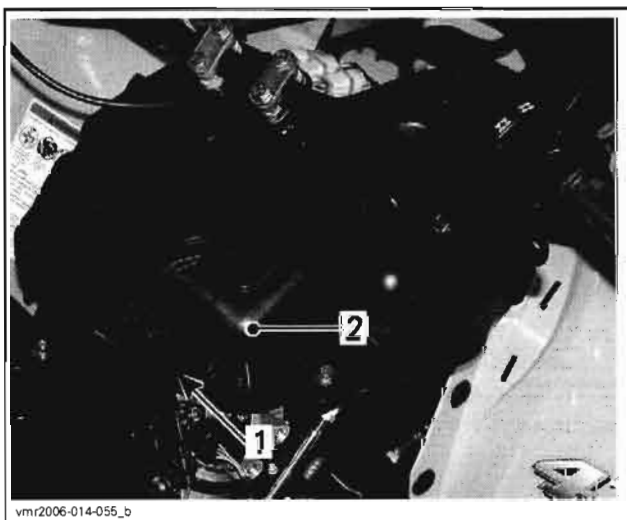
### AIR FILTER

#### Air Filter Removal

**CAUTION:** Never remove or modify any component in the air filter housing. The engine management system is calibrated to operate specifically with these components. Otherwise, engine performance degradation or damage can occur.

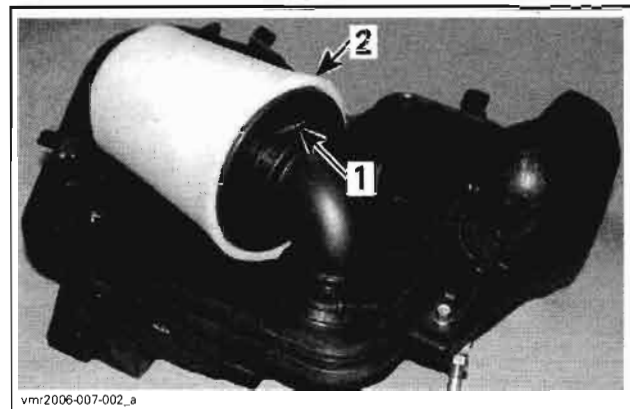
Remove seat, side panels, central panel and dashboard. Refer to *BODY*.

Release clamps and remove air filter housing cover.



1. Clamps
2. Cover

Loosen clamp and remove air filter.



1. Clamp
2. Air filter

**NOTE:** If vehicle is used in dusty area, inspect more frequently than specified in *MAINTENANCE CHART*.

If liquid/deposits are found, squeeze and dry the foam filter. Replace filter element if damaged.

**CAUTION:** Do not start engine if liquid or deposit are found. If there is oil in the air filter housing, check engine oil level. Oil level may be too high.

Pour air filter cleaning solution (P/N 219 700 341) or an equivalent into a bucket. Put the foam filter in to soak. Do not wash filter element.

While filter soaks, clean inside of air filter housing.

Rinse foam filter with warm water and let it dry completely.

Blow low pressure compressed air on filter element to clean it.

#### Air Filter Installation

Properly reinstall removed parts in the reverse order of their removal.

### AIR FILTER HOUSING

#### Air Filter Housing Removal

Remove seat, side panels, central panel and dashboard. Refer to *BODY*.

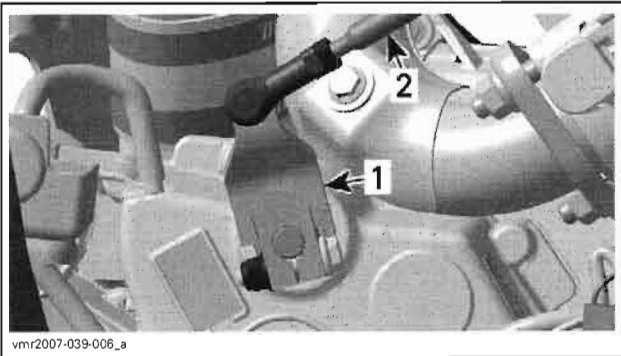
Set shifter lever to PARK.

Disconnect ball joint from shifting plate.

**NOTE:** If you prefer to remove the shifting plate from transmission shaft, refer to *SHIFTER* section for the procedure.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 02 (AIR INTAKE SYSTEM)

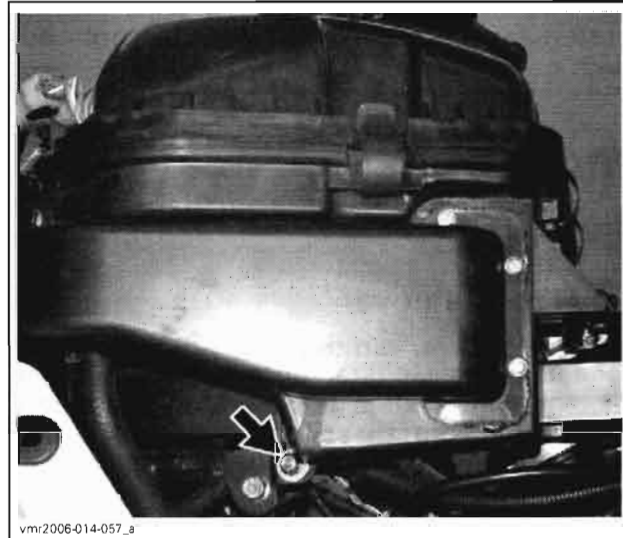
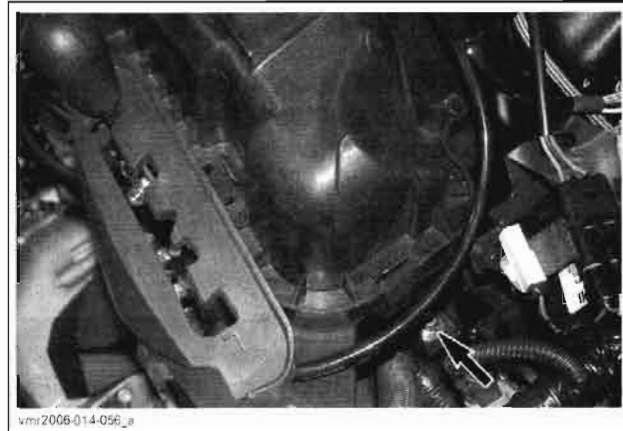
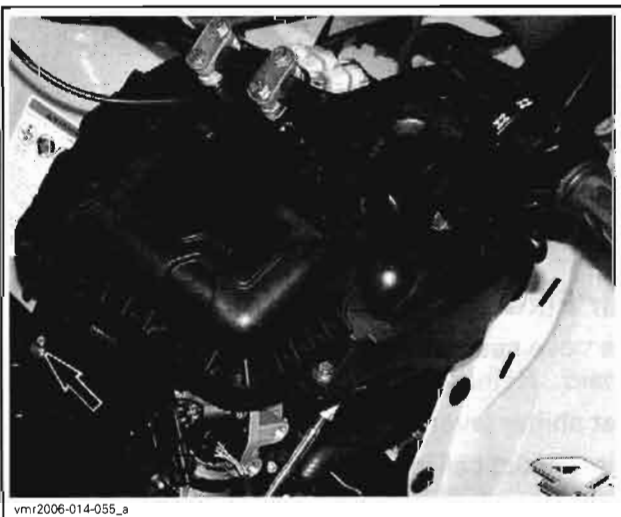


1. Shifting plate
2. Shifter link rod

Detach throttle cable from shifter panel.



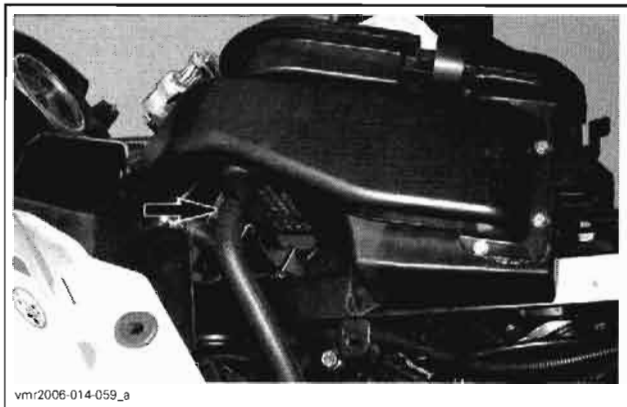
Remove retaining fasteners.



Remove dart.



Disconnect vent tube.



Pull air filter housing out.

### Air Filter Housing Installation

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

If the baffle is removed, reseal it with Loctite 5910 (P/N 293 800 081) and replace rivets by screws (M4 x 12 mm) and elastic stop nuts.

Set shifter lever to PARK then reinstall shifter to transmission shaft. Check its operation and adjust as necessary. Refer to *GEARBOX*.

Secure throttle cable to shifter panel.

Gently pull throttle cable toward rear to have a gap between cable and shifter mechanism.



GAP HERE

### WARNING

Ensure shifter mechanism does not touch throttle cable. Depress throttle lever several times to ensure it properly returns.

## RESTRICTOR

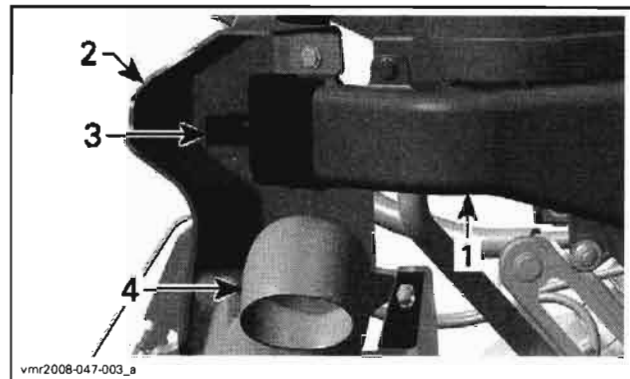
***Outlander 500 and Renegade 500 (European Community Models)***

### Restrictor Removal

The restrictor is installed on the inlet tube of the air filter housing.

Remove the water deflector.

Pull the restrictor.



1. Inlet tube of air filter housing
2. Water deflector
3. Restrictor
4. CVT air inlet

### Restrictor Installation

The installation is the reverse of the removal procedure.



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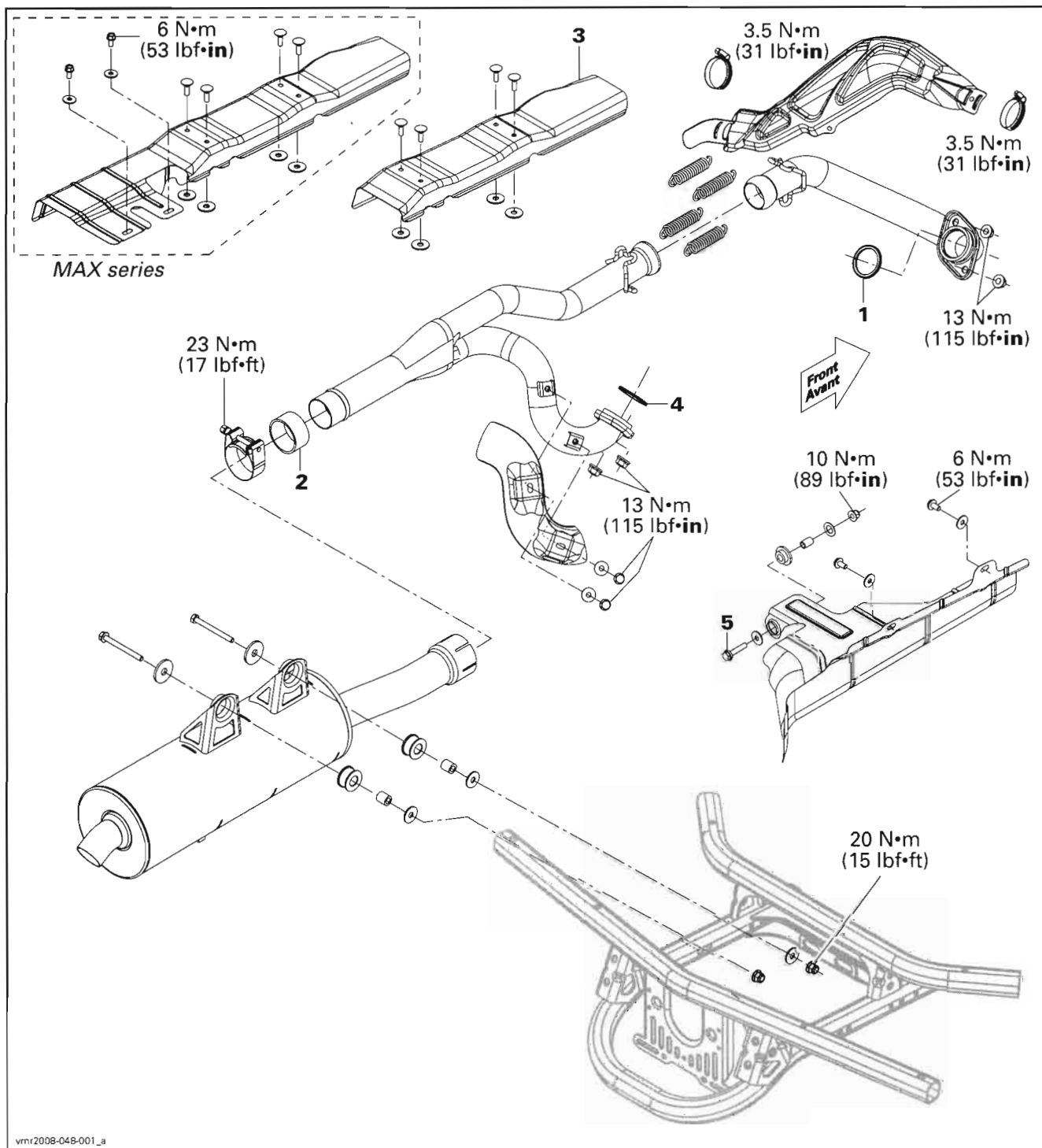
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# EXHAUST SYSTEM

## SERVICE TOOLS

Description	Part Number	Page
exhaust spring tool .....	529 035 983 .....	42



## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 03 (EXHAUST SYSTEM)

## GENERAL

### **⚠ WARNING**

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

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, self-locking fasteners, cotter pin, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

## PROCEDURES

### FRONT EXHAUST PIPE

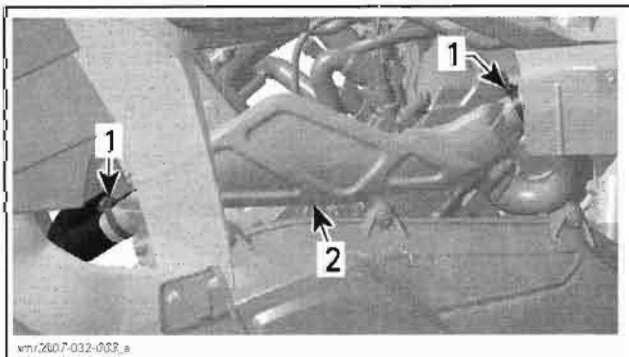
#### Inspection

Check for cracks, bending or other damages. Replace if necessary.

#### Removal

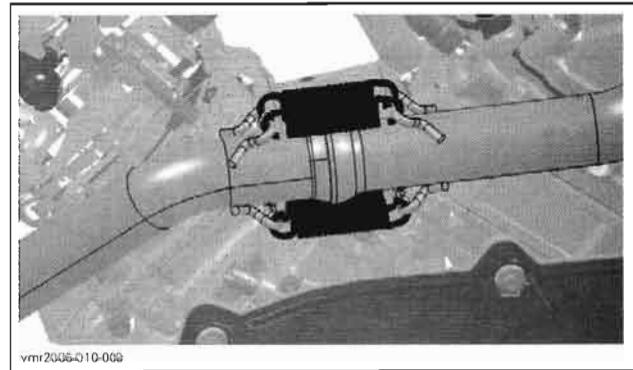
Remove LH side panel.

Unscrew heat shield clamps.

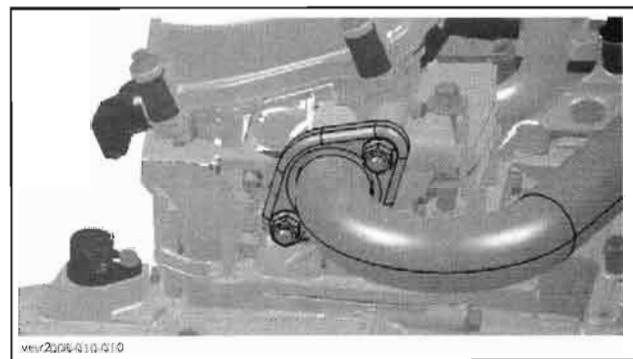


1. Heat shield clamps
2. Heat shield of front exhaust pipe

Using the exhaust spring tool (P/N 529 035 983), remove exhaust springs.



Unscrew exhaust pipe nuts.



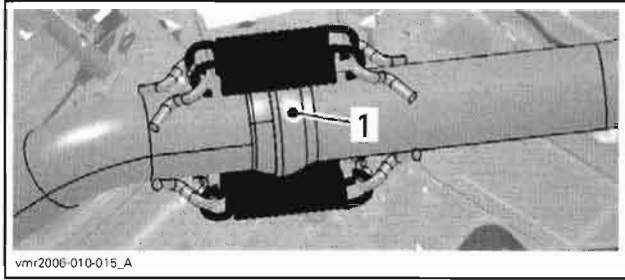
Move front exhaust pipe forward then remove it. Remove exhaust gasket no. 1 from engine exhaust port.

#### Installation

Install a new exhaust gasket on front exhaust pipe end.

Loosely install front exhaust pipe on cylinder head with exhaust nuts.

Make sure front exhaust pipe end is properly aligned inside ball socket of "Y" exhaust pipe. Install exhaust springs.



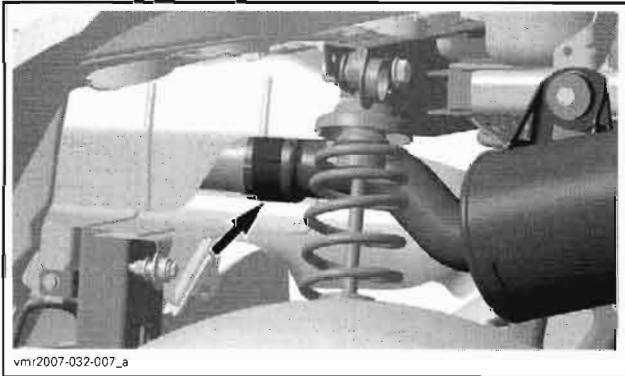
1. "Y" exhaust pipe ball socket

Torque exhaust pipe nuts.  
Reinstall all other removed parts.

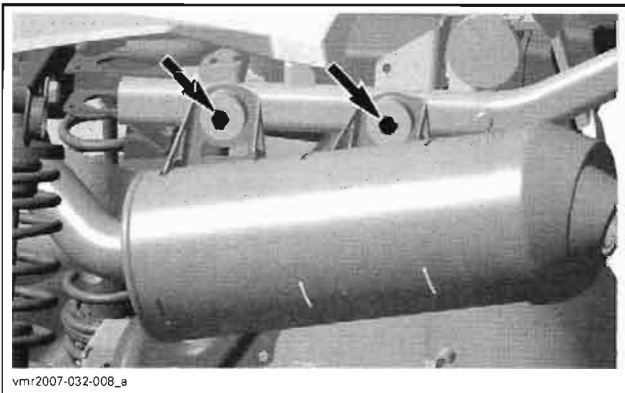
## MUFFLER

### Removal

Unscrew muffler clamp.



Remove muffler screws then pull muffler to remove it.



Discard the gasket no. 2 at the end of "Y" exhaust pipe.

### Inspection

Check muffler for cracks or other damages. Replace if necessary.

### Installation

For the installation, reverse the removal procedure.

vmr2008-048

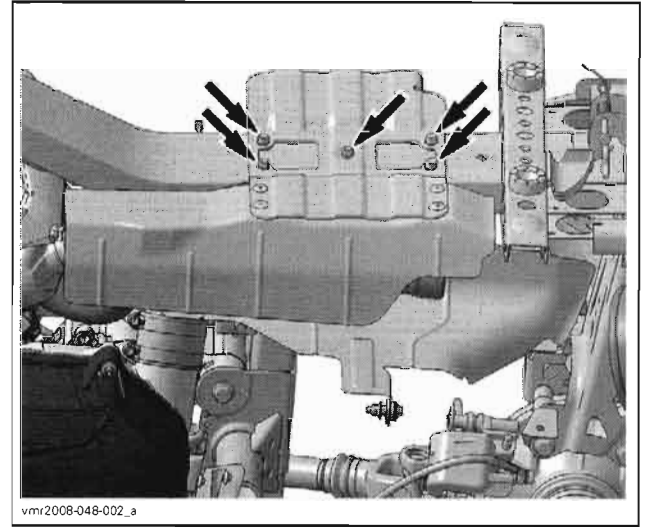
## "Y" EXHAUST PIPE

### Inspection

Check for cracks, bending or other damages. Replace if necessary.

### Removal

Remove heat shield no. 3.

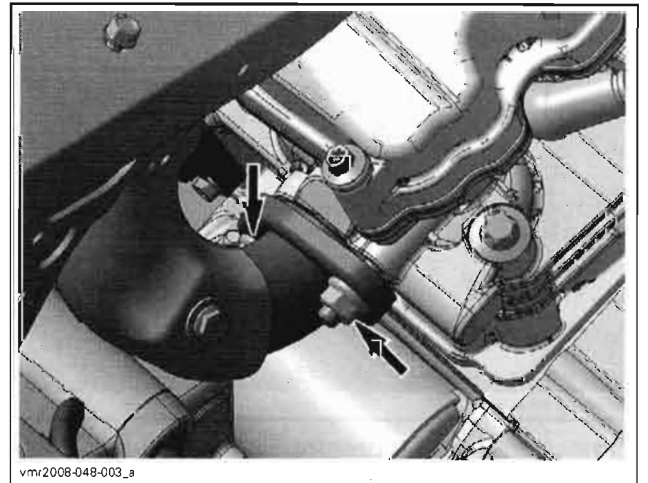


Remove muffler.

Remove front exhaust pipe.

Discard the gasket no. 2.

Unscrew exhaust pipe nuts then remove "Y" exhaust pipe.



Remove exhaust gasket no. 4 from engine exhaust port.

### Installation

Install a new gasket on each end of Y-exhaust pipe end and another on the end of "Y" exhaust pipe (cylinder side).

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 03 (EXHAUST SYSTEM)

---

While sliding the "Y" exhaust pipe end over the front exhaust pipe end, align its other end with the studs on cylinder head.

Secure the front exhaust pipe on cylinder with exhaust nuts.

Torque exhaust nuts and exhaust clamp.

Reinstall all other removed parts.

## FUEL TANK PROTECTOR

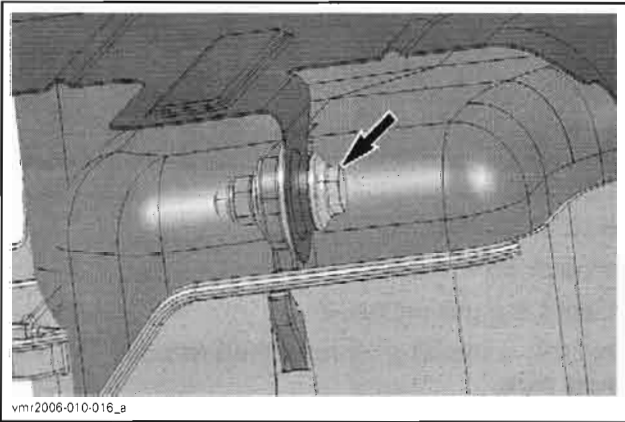
### Inspection

Check for wear, cracks or other damages. Replace if necessary.

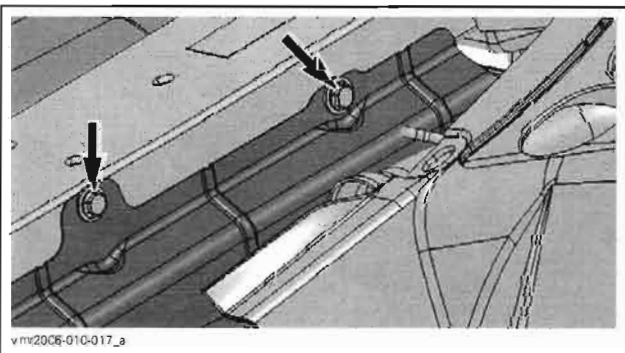
### Removal

Remove muffler.

Unscrew front bolt.



Unscrew upper bolts.



Remove fuel tank protector.

### Installation

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

First, loosely install front bolt then install remaining bolts. Torque all bolts as per installation sequence.



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# LUBRICATION SYSTEM

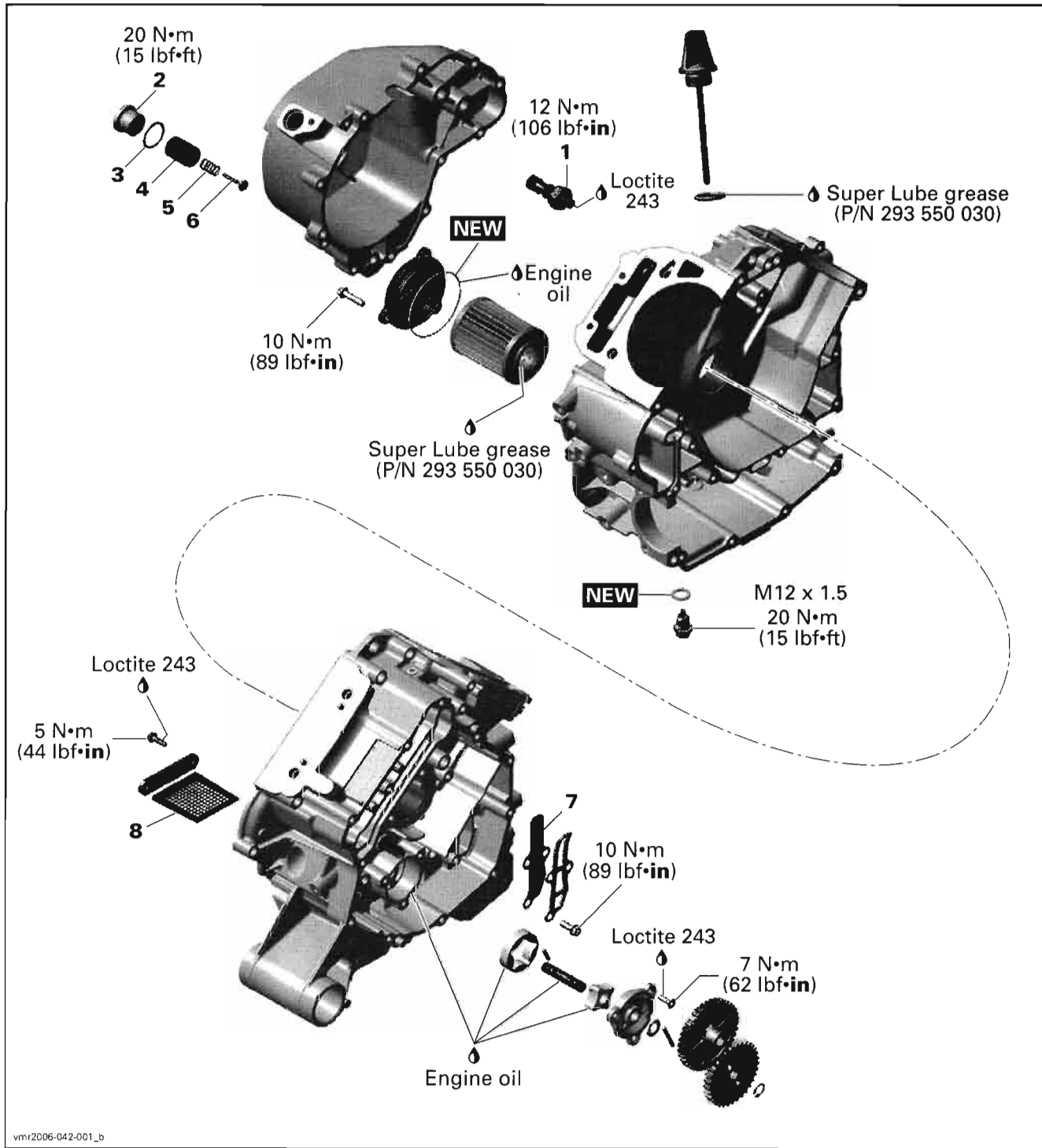
## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
adapter hose.....	529 035 652 .....	49
oil pressure gauge.....	529 035 709 .....	49
disconnect tool.....	529 035 714 .....	49

## SERVICE PRODUCTS

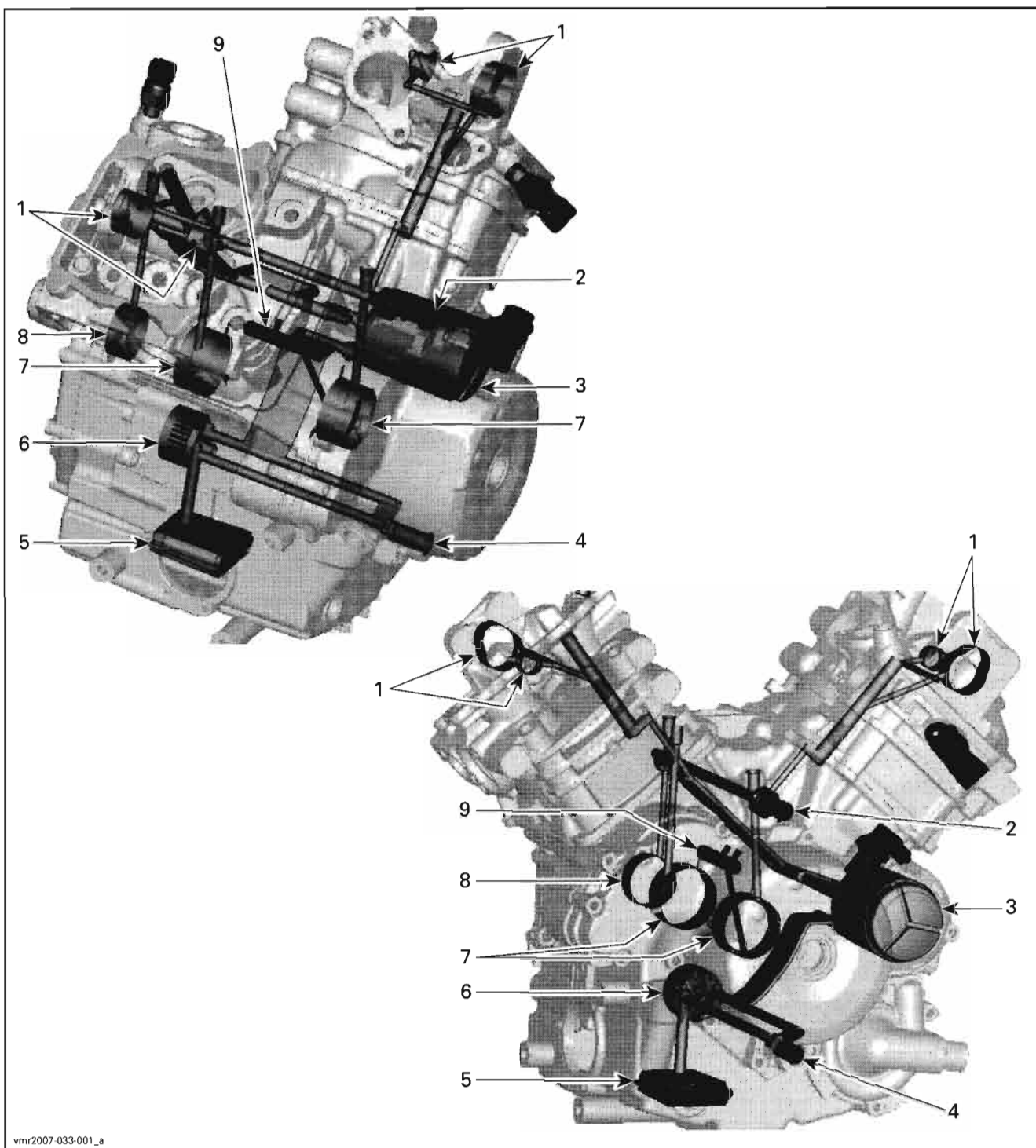
<b>Description</b>	<b>Part Number</b>	<b>Page</b>
XP-S 5W30 mineral oil.....	219 700 706 .....	48
Loctite 243 (blue).....	293 800 060 .....	51

### COMPONENTS



vmr2006-042-001\_b

## ENGINE LUBRICATION



vmr2007-033-001\_a

1. Camshaft bearings
2. Oil pressure switch
3. Oil filter
4. Oil pressure regulator valve
5. Oil strainer
6. Oil pump
7. Crankshaft main bearings
8. Crankshaft support bearing
9. Connecting rod bearings

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 04 (LUBRICATION SYSTEM)

## 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 strictly be adhered to.

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

## MAINTENANCE

### ENGINE OIL

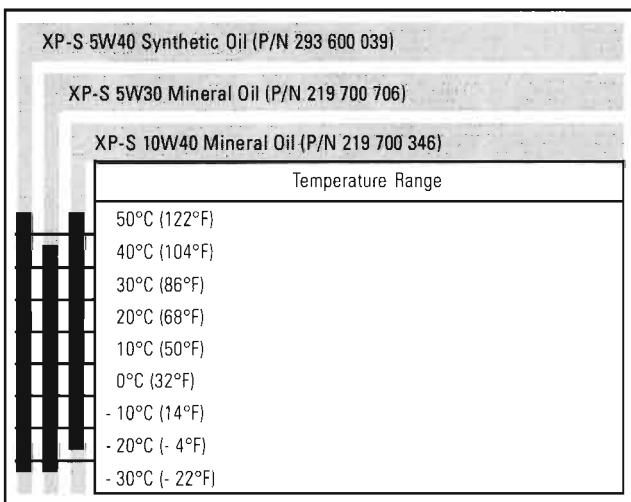
#### Recommended Oil

Use 4-stroke engine oil that meets or exceeds the requirements for API service classification SM, SL or SJ. Always check the API service label certification on the oil container, it must contain at least one of the above standards.

#### Oil Viscosity

XP-S 5W30 mineral oil (P/N 219 700 706) is recommended for all seasons.

Refer to the following chart for other viscosity grades.



#### Oil Level Verification

**NOTE:** Strictly follow this procedure, otherwise wrong oil level may be indicated.

Ensure vehicle is on a level surface.

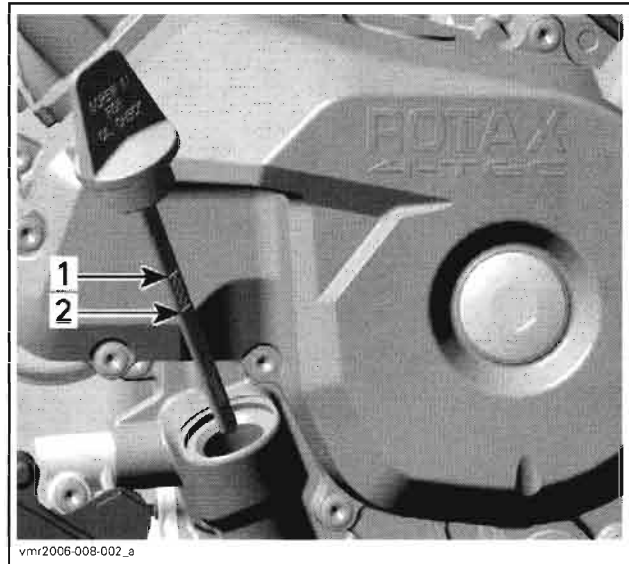
Start engine and let idle for a few minutes.

Stop engine. Wait a few minutes to allow oil to flow down to crankcase then check oil level.

Fully screw in dipstick to check oil level.

Remove dipstick and read oil level.

Oil level must be between minimum and maximum marks on dipstick.



TYPICAL — FULLY SCREW DIPSTICK TO CHECK OIL LEVEL

1. Maximum
2. Minimum

There is a capacity of 300 mL (10 U.S. oz) between the two marks.

Refill oil as necessary. Do not overfill.

Reinstall dipstick.

#### Oil and Filter Change

Prior to change the oil, ensure vehicle is on a level surface.

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

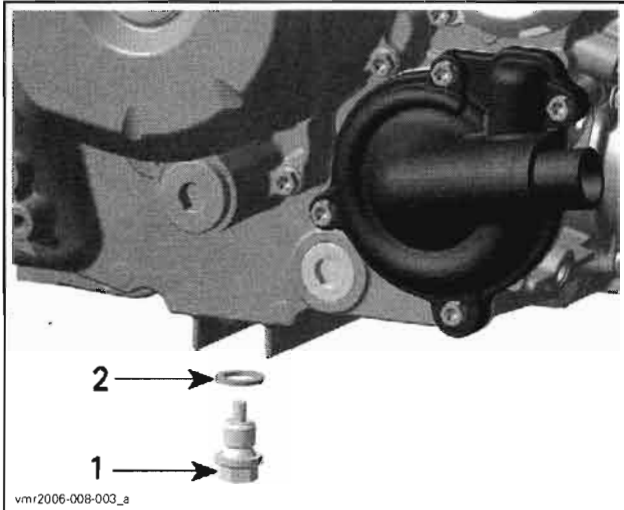
### **⚠ WARNING**

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

Place a drain pan under the engine drain plug area.

Clean the drain plug area.

Unscrew drain plug and discard the gasket ring.



1. Drain plug  
2. Gasket ring

Remove dipstick.

Allow oil to drain completely from crankcase.

**NOTE:** Oil condition gives information about the engine condition. See *TROUBLESHOOTING* section.

Clean the magnetic drain plug from metal shavings and residue. Presence of debris gives an indication of failure inside the engine. Check engine to correct the problem.

Install a **NEW** gasket ring on drain plug. Torque drain plug to 20 N•m (15 lbf•ft).

**CAUTION:** Never use the gasket ring a second time. Always replace by a new one.

Replace oil filter. Refer to *OIL FILTER* further in this section.

Refill engine with recommended engine oil. See *RECOMMENDED OIL* and *OIL VISCOSITY CHART* above.

Oil change capacity with filter: 2 L (2.11 qt).

After filling, check the oil level with the dipstick. Refer to *OIL LEVEL CHECK* above.

Run engine to ensure oil filter and drain plug areas are not leaking.

Dispose oil and filter as per your local environmental regulations.

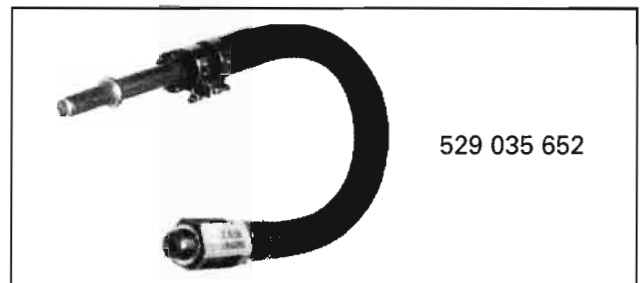
## INSPECTION

### ENGINE OIL PRESSURE

**NOTE:** The engine oil pressure test should be done with a **warm engine** 90°C (194°F) and the recommended oil.

Remove the oil pressure switch. See procedure below.

Install oil pressure gauge (P/N 529 035 709) and adapter hose (P/N 529 035 652).



The engine oil pressure should be within the following values.

OIL PRESSURE	1250 RPM	6000 RPM
MINIMAL	70 kPa (10 PSI)	350 kPa (51 PSI)
NOMINAL	180 kPa (26 PSI)	420 kPa (61 PSI)
MAXIMAL	300 kPa (43 PSI)	550 KPa (80 PSI)

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

Remove oil pressure gauge and adapter hose.

**NOTE:** To remove adapter hose from oil pressure gauge, use the disconnect tool (P/N 529 035 714).

Reinstall the oil pressure switch.

## PROCEDURES

### OIL FILTER

#### Oil Filter Removal

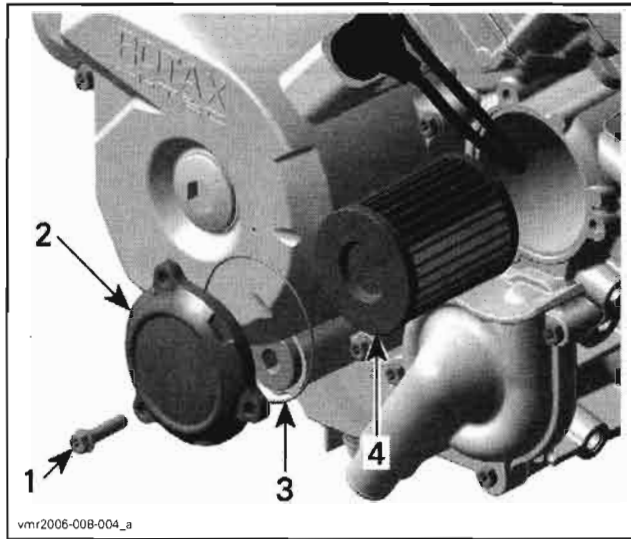
Remove oil filter screws.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 04 (LUBRICATION SYSTEM)

Remove oil filter cover.

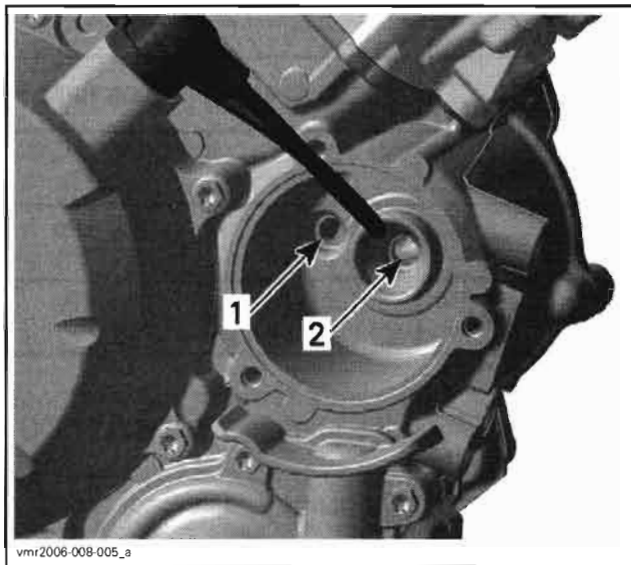
Remove oil filter.



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

### Oil Filter Inspection

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



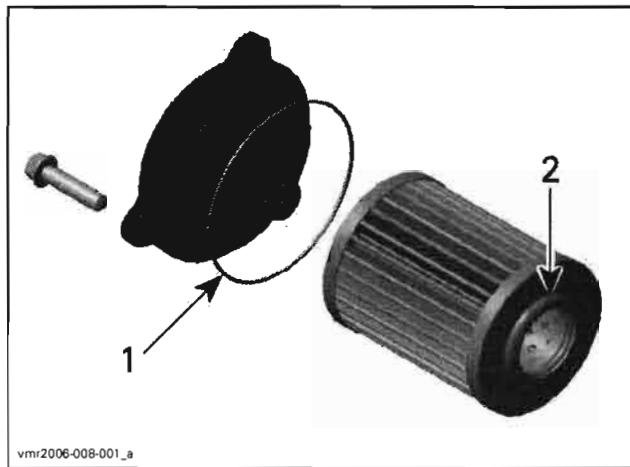
1. Inlet bore from the oil pump to the oil filter
2. Outlet bore to the engine oil providing system

### Oil Filter Installation

Install a **NEW** O-ring on oil filter cover.

Install the filter into the cover.

Apply engine oil on O-ring and grease on the end of filter.

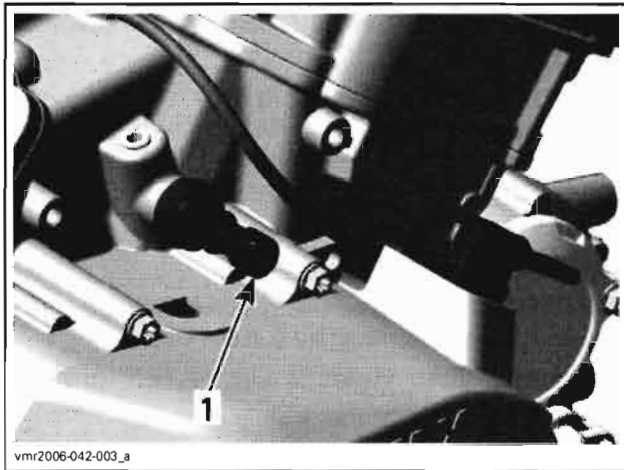


1. Slightly oil
2. Slightly grease

Install the cover on the engine.

Torque screws to 10 N•m (89 lbf•in).

### OIL PRESSURE SWITCH (OPS)



1. Oil pressure switch

### Oil Pressure Switch Activation

Oil pressure switch works when engine oil pressure is between 20 and 40 kPa (2.9 and 5.8 PSI).

To check the function of the oil pressure switch, an oil pressure test has to be performed. Refer to **ENGINE OIL PRESSURE**.

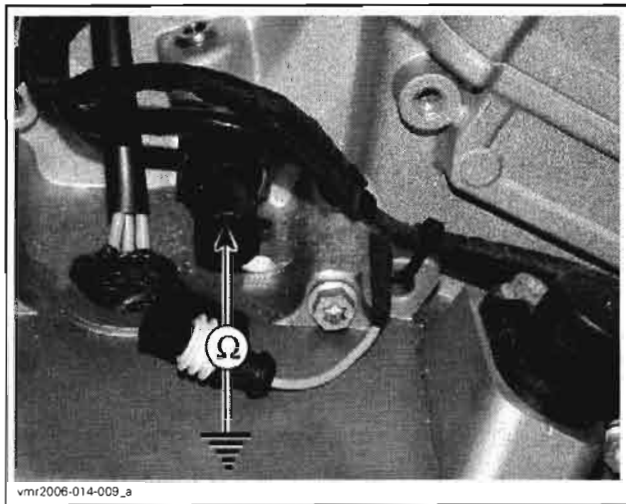
If the engine oil pressure is good, check the resistance of the oil pressure switch while engine is off and while engine is running.

### Oil Pressure Switch Resistance Test

Disconnect the connector from the oil pressure switch.

Use a multimeter to check the resistance between as shown.

OPS CONNECTOR		ENGINE NOT RUNNING	ENGINE RUNNING
PIN		RESISTANCE ( $\Omega$ )	
1	Engine ground	Close to 0 $\Omega$ (normally closed switch)	Infinitely high when pressure reaches 20 - 40 kPa (2.9 - 5.8 PSI)



If resistance values are incorrect, replace the oil pressure switch.

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

Disconnect the connector "A" from the ECM and check continuity of circuit 10.

### Oil Pressure Switch Removal

Unplug then unscrew the oil pressure switch no. 1, mounted on the crankcase.

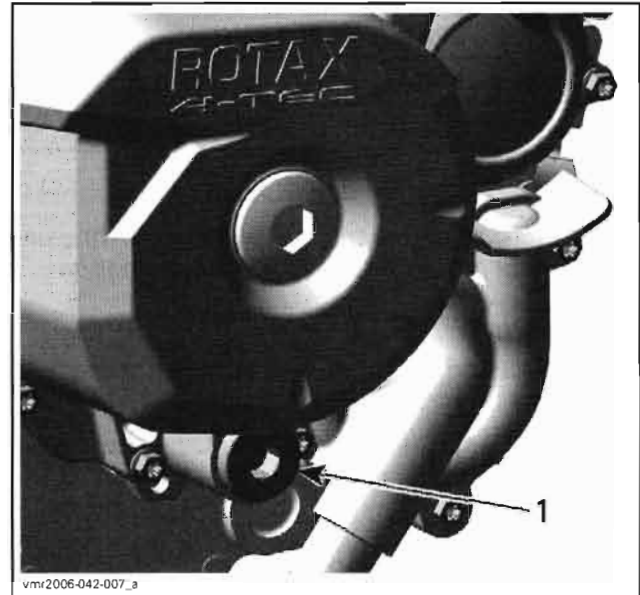
### Oil Pressure Switch Installation

Torque switch to 12 N•m (106 lbf•in).

**NOTE:** Install oil pressure switch with Loctite 243 (blue) (P/N 293 800 060).

## ENGINE OIL PRESSURE REGULATOR

The oil pressure regulator is located on the engine magneto side (inside magneto cover).

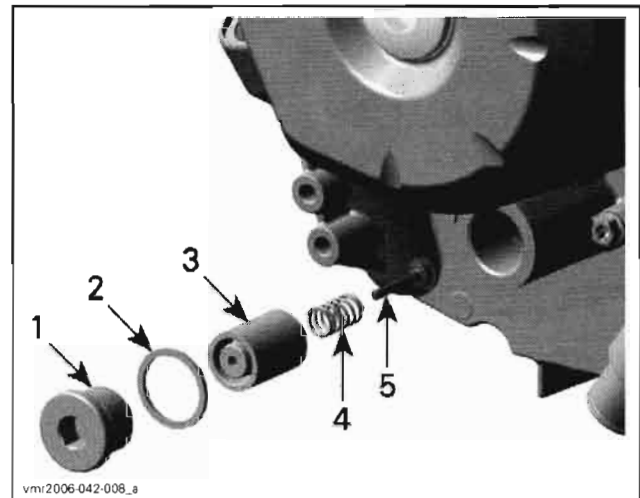


1. Engine oil pressure regulator

**NOTE:** The oil pressure regulator system works when the oil pressure exceeds 450 kPa (65 PSI).

### Removal

Remove plug screw no. 2 and pull oil pressure regulator out.



- 1. Plug screw
- 2. Gasket ring
- 3. Pressure regulator housing
- 4. Spring
- 5. Pressure regulator valve

### Inspection

Inspect pressure regulator housing no. 4 and valve no. 6 for scoring or other damages.

Check spring no. 5 for free length.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 04 (LUBRICATION SYSTEM)

#### SPRING FREE LENGTH

SPRING FREE LENGTH	
NEW NOMINAL	39 mm (1.535 in)
SERVICE LIMIT	37 mm (1.457 in)

**NOTE:** Replace worn or damaged components.  
Clean bore and thread in the magneto housing from metal shavings and other contaminations.

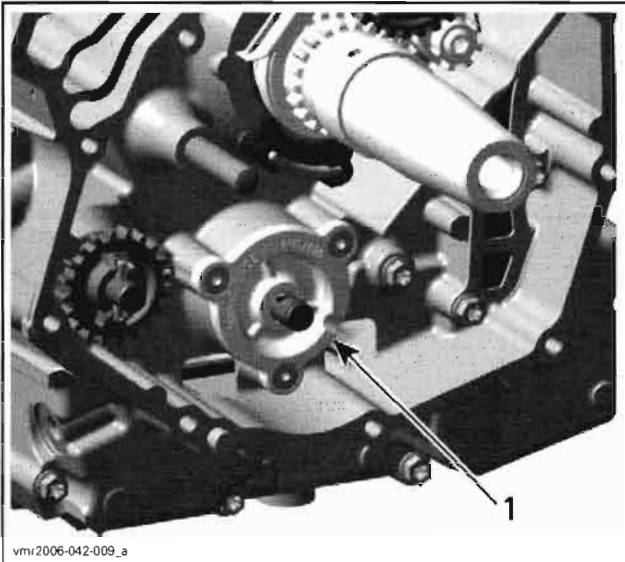
#### Installation

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

**NOTE:** At installation, always replace the gasket ring no. 3 of the plug screw.

## OIL PUMP

The oil pump is located on the engine PTO side (behind cover).



1. Oil pump

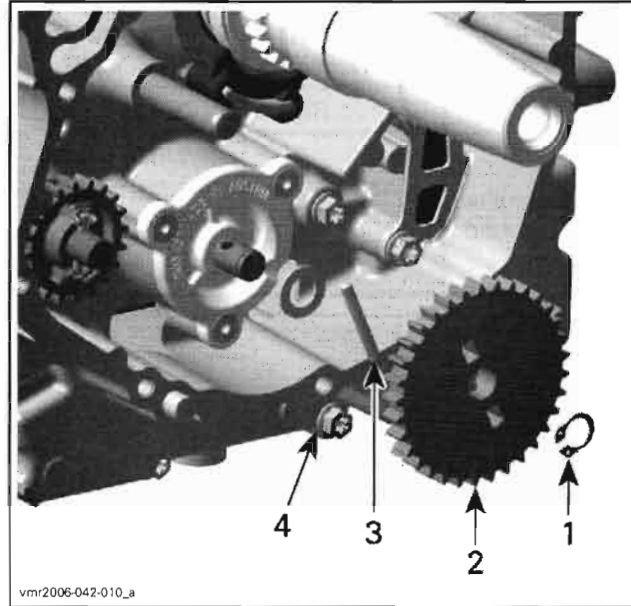
#### Removal

Remove parts to access the engine crankcase PTO cover.

Remove the engine crankcase PTO cover. Refer to *BOTTOM END* section.

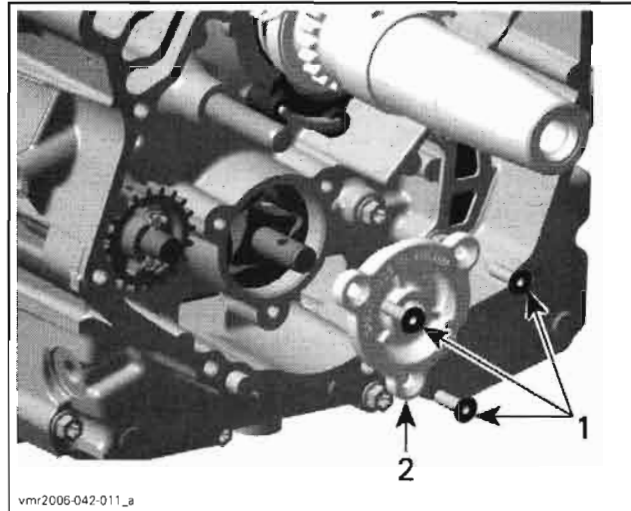
Remove:

- retaining ring
- oil pump gear
- needle pin
- thrust washer



1. Retaining ring  
2. Oil pump gear  
3. Needle pin  
4. Thrust washer

- oil pump cover screws and pull oil pump cover
- oil pump shaft with inner rotor and outer rotor.

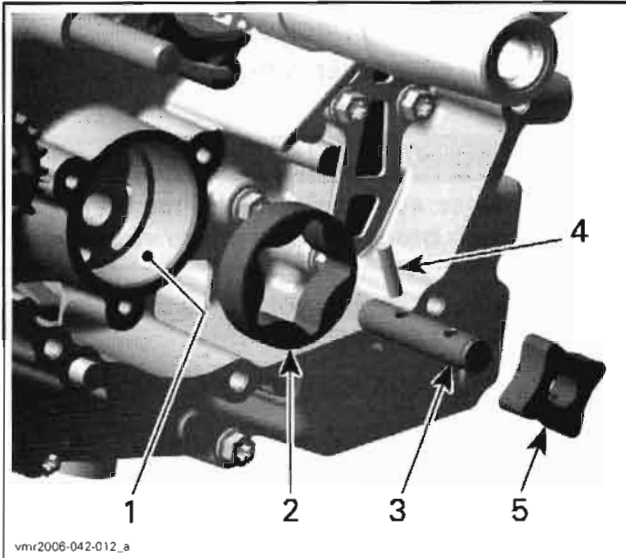


1. Retaining screws  
2. Oil pump cover

#### Inspection

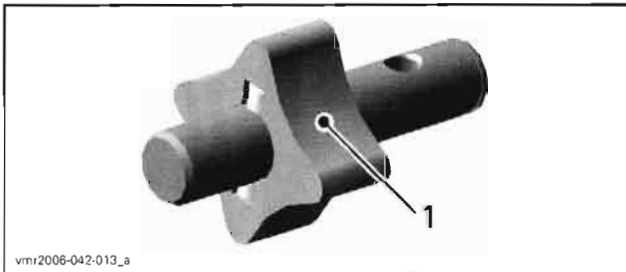
Inspect oil pump for marks or other damages. Check for scratches in crankcase between outer rotor and oil pump bore. If so, replace damaged parts.





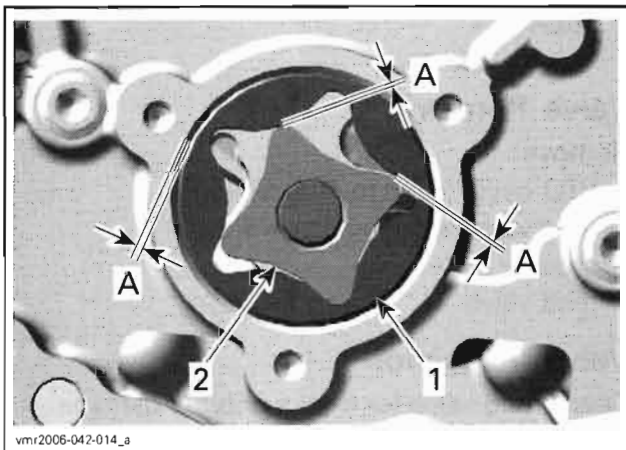
1. Oil pump bore
2. Outer rotor
3. Oil pump shaft
4. Needle pin
5. Inner rotor

Check inner rotor for corrosion pin holes or other damages. If so, replace oil pump shaft assembly.



1. Pittings on the teeth

Using a feeler gauge, measure the clearance of inner and outer rotors as shown.

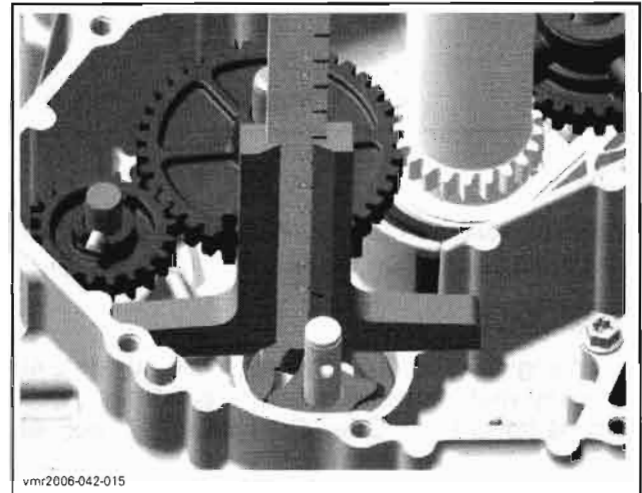


1. Outer rotor
2. Inner rotor
- A. Service limit: 0.25 mm (.009 in)

If clearance of inner and outer rotors exceeds the tolerance, replace oil pump shaft assembly. Ensure to also check oil pump cover. If damaged, replace the complete oil pump assembly.

If clearance between outer rotor and its bore in crankcase exceeds the tolerance, replace the complete oil pump assembly and/or the crankcase.

Using a depth gauge, measure the axial clearance of the oil pump as shown.



OIL PUMP — MEASUREMENT "A"



OIL PUMP COVER — MEASUREMENT "B"

Difference between measurements should not exceed 0.2 mm (.008 in). If so, replace the complete oil pump assembly.

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

### Installation

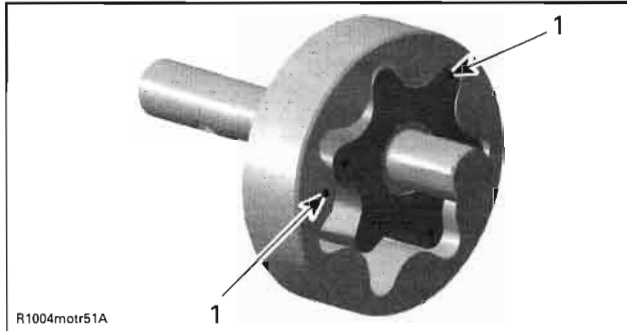
For installation, reverse the removal procedure.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 04 (LUBRICATION SYSTEM)

Pay attention to the following details:

**NOTE:** The outer rotor and inner rotor are marked. When installing, make sure both markings are on the upper side.



R1004motr51A

**TYPICAL**  
1. Markings

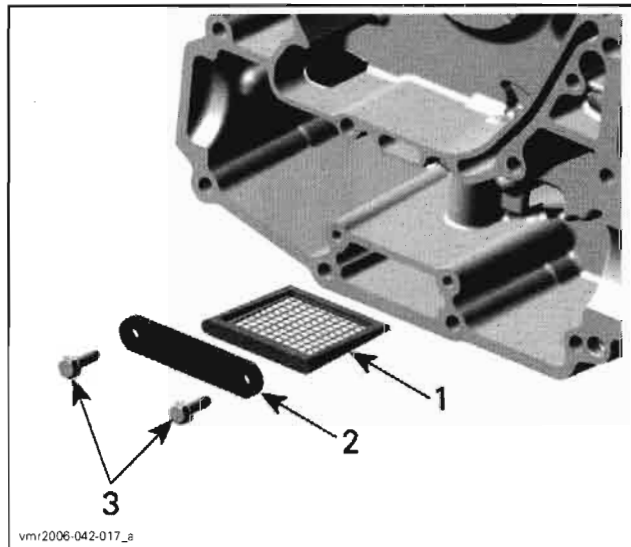
After reinstallation of the remaining parts, check for smooth operation of the oil pump assembly.

### Final Test

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

## ENGINE OIL STRAINER

The engine oil strainer no. 7 is located between both crankcase halves.



1. Engine oil strainer  
2. Retaining plate  
3. Screws

### Removal

Refer to *BOTTOM END* section.

## Cleaning and Inspection

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

### **⚠ WARNING**

Always wear eye protector. Chemicals can cause a rash break out and injure your eyes.

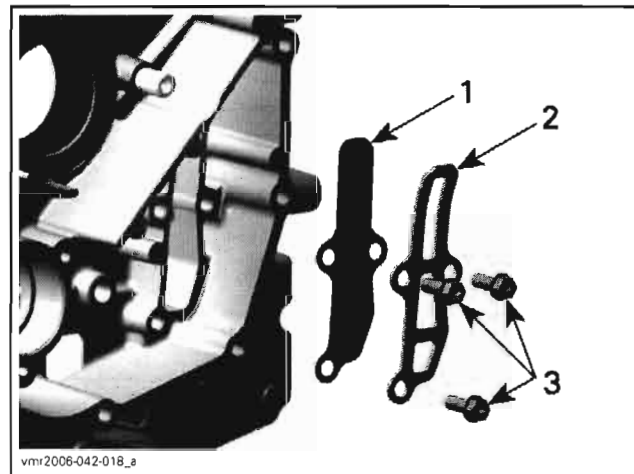
Check engine oil strainer for cracks or other damage. Replace if damaged.

### Installation

Refer to *BOTTOM END* section.

## REED VALVE

The engine is equipped with a reed valve no. 8 which prevents accumulation of larger oil quantities in the crankcase. The reed valve is fitted into the crankcase.



1. Reed valve  
2. Stopper  
3. Screws

### Valve Removal

Remove:

- PTO cover (refer to *PTO COVER*)
- reed valve retaining screws
- stopper plate
- reed valve.

### Valve Inspection

Check reed valve for cracks or other damage.

**NOTE:** Replace reed valve if damaged.

### Valve Installation

The installation is the reverse of the removal procedure.

# COOLING SYSTEM

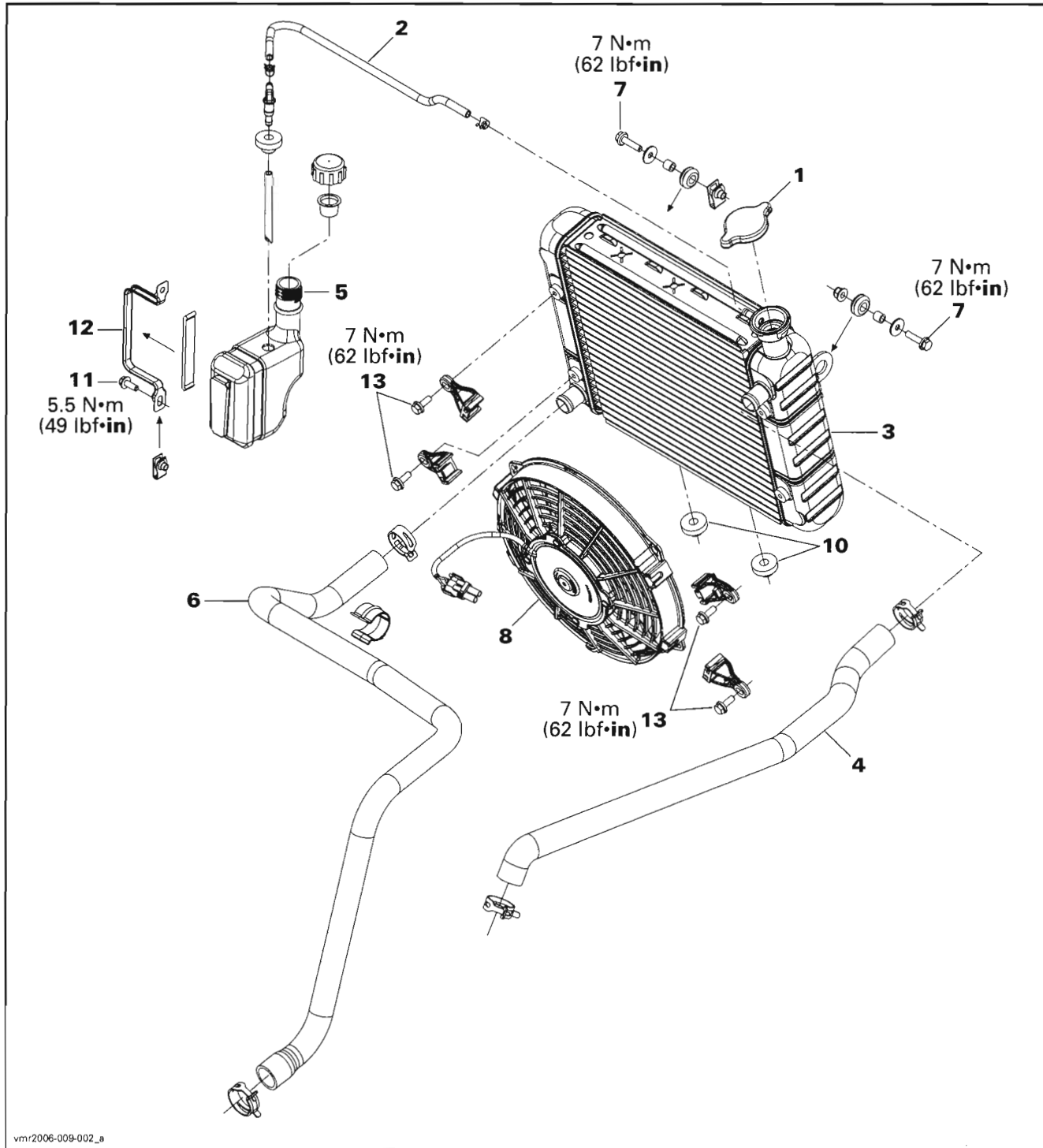
## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
installer handle.....	420 877 650 .....	68
pressure/vacuum pump.....	529 021 800 .....	58
large hose pincher .....	529 032 500 .....	59
oil seal pusher.....	529 035 757 .....	68
rotary seal installer.....	529 035 766 .....	69
Fluke 111 multimeter .....	529 035 868 .....	62
test cap.....	529 035 991 .....	58
puller kit .....	529 036 056 .....	68

## SERVICE PRODUCTS

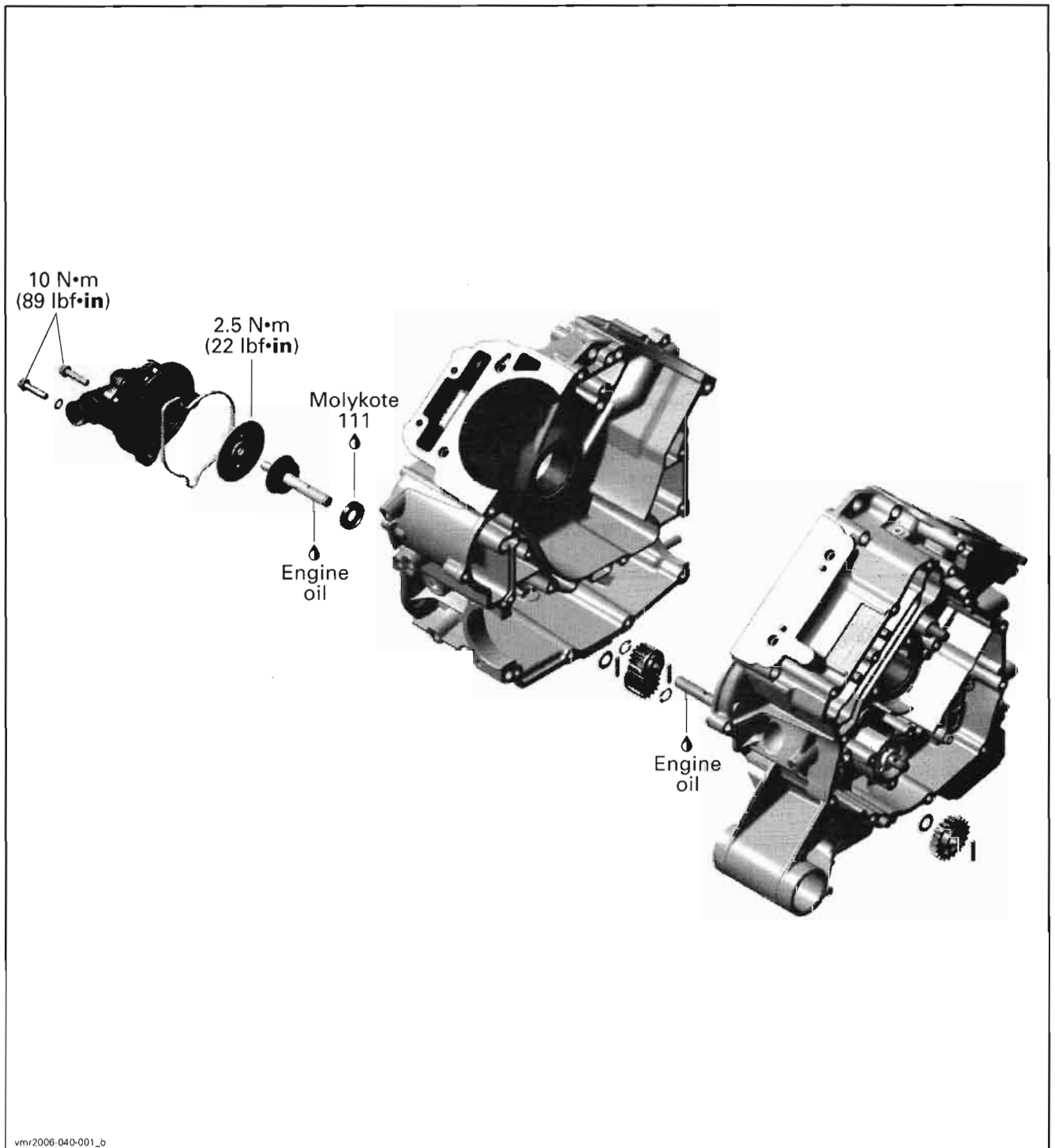
<b>Description</b>	<b>Part Number</b>	<b>Page</b>
BRP premixed coolant.....	219 700 362 .....	59
Molykote 111.....	413 707 000 .....	69

# RADIATOR



vnr2006-009-002\_a

## WATER PUMP



vmr2006-040-001\_b

**GENERAL**

**⚠ WARNING**

Never start engine without coolant. Some engine parts such as the rotary seal on water pump shaft can be damaged.

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, self-locking fasteners, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

**INSPECTION**

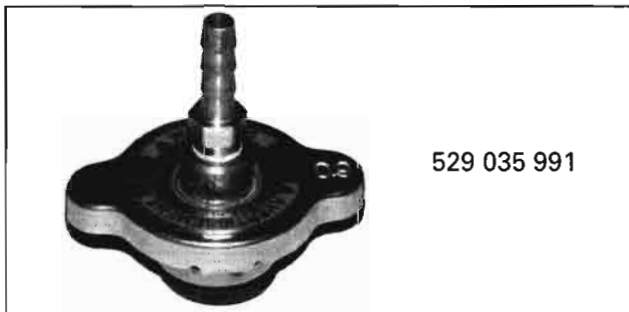
**COOLING SYSTEM LEAK TEST**

**⚠ WARNING**

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

Open the access panel and remove the radiator cap no. 1.

Install the test cap (P/N 529 035 991) on filler neck.



Using pressure/vacuum pump (P/N 529 021 800), pressurize system to 103 kPa (15 PSI).



*TYPICAL*  
1. Special radiator cap

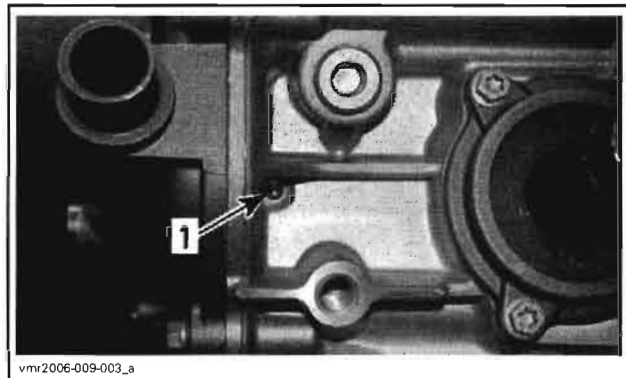
Check all hoses, radiator no. 3 and cylinder(s)/base for coolant leaks or air bubbles.

**Inspection**

Check general condition of hoses and clamps tightness.

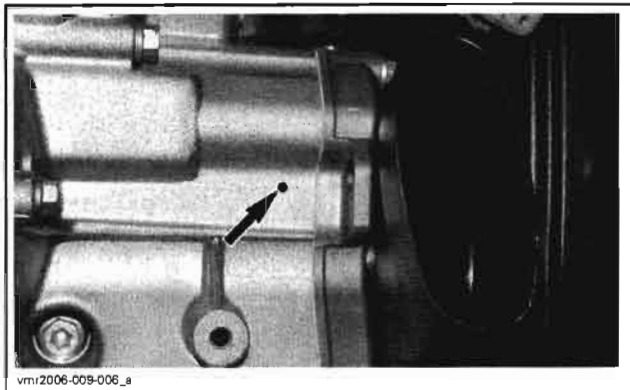
Check the leak indicator hole if there is oil or coolant.

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



1. Leak indicator hole

Another leak indicator hole is visible on the PTO side. It indicate if the PTO gasket is in good condition. If a liquid leaks by this hole, the PTO gasket replacement is necessary.



## MAINTENANCE

### COOLANT REPLACEMENT

#### **⚠ WARNING**

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

#### Recommended Coolant

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

To prevent antifreeze deterioration, always use the same brand. Never mix different brands unless cooling system is completely flushed and refilled.

**CAUTION:** To prevent rust formation or freezing condition, always replenish the system with the BRP premixed coolant or with 50% antifreeze and 50% water. Do not use tap water, straight antifreeze or straight water in the system. Tap water contains minerals and impurities which build up in the system. During cold weather, straight water causes the system to freeze while straight antifreeze thickens and does not have the same efficiency. Always use ethylene glycol antifreeze containing corrosion inhibitors specifically recommended for aluminum engines.

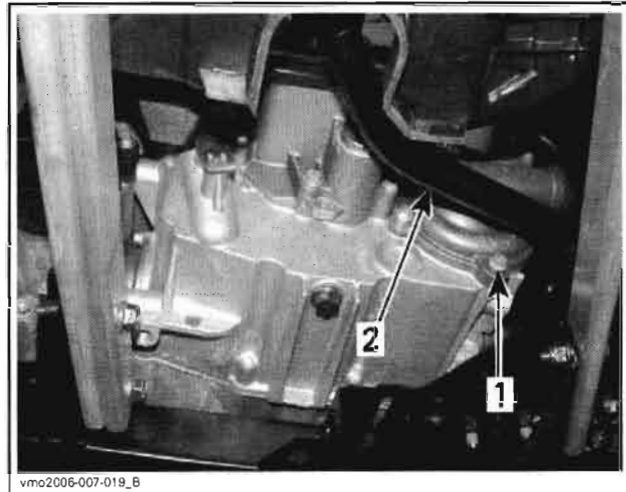
#### Draining the System

#### **⚠ WARNING**

Never drain or refill cooling system when engine is hot.

Remove radiator cap no. 1.

Partially unscrew cooling drain plug located below water pump housing.



UNDER RH FOOTREST

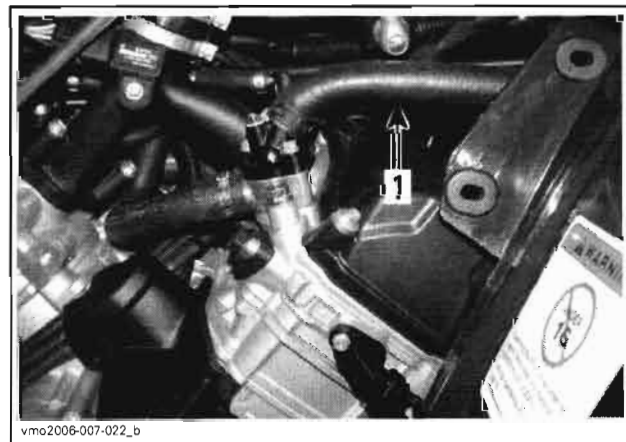
1. Cooling drain plug
2. Brake pedal

When cooling system is drained completely, remove cooling drain plug completely and install a new gasket ring. Screw the cooling drain plug and torque it to 10 N•m (89 lbf•in).

#### Refilling the System

Remove the RH side panel.

Pinch radiator inlet hose no. 4 between radiator and thermostat housing with a large hose pincher (P/N 529 032 500).

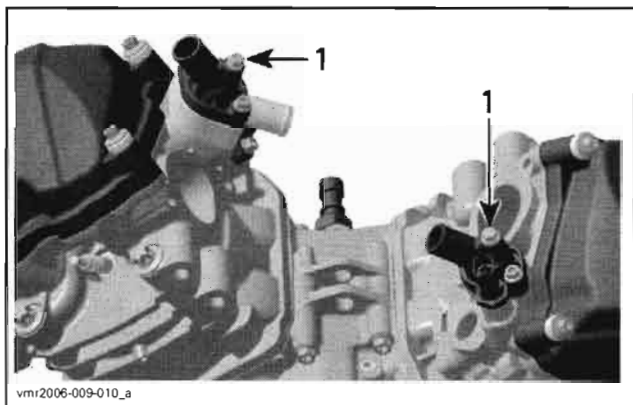


1. Place hose pincher here

Unscrew bleeding screws on top of thermostat housing.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

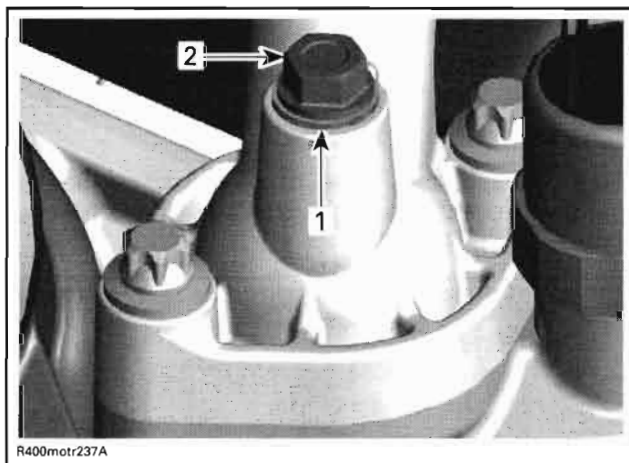
### Subsection 05 (COOLING SYSTEM)



1. Bleeding screws

**NOTE:** Both cylinders must be bled.

With vehicle on a flat surface, engine cold, refill radiator **no. 3**. When the coolant comes out by the thermostat housing hole, install the bleeding screw with its gasket ring and torque to 5 N•m (44 lbf•in).



#### TYPICAL

1. Gasket ring
2. Bleeding screw

Remove hose pincher, fill up the radiator then install radiator cap.

Refill coolant tank **no. 5** up to cold level mark. Install the coolant tank cap. Run engine until thermostat opens then stop engine.

When engine has completely cooled down, recheck coolant level in radiator and coolant tank and top up if necessary. The level in the coolant tank should be between MIN. and MAX. marks.

**NOTE:** Each year or every 100 hours or when vehicle reaches 3000 km (1865 mi), check coolant concentration (freezing point) with proper tester.

## PROCEDURES

### THERMOSTAT

The thermostat is a single action type.

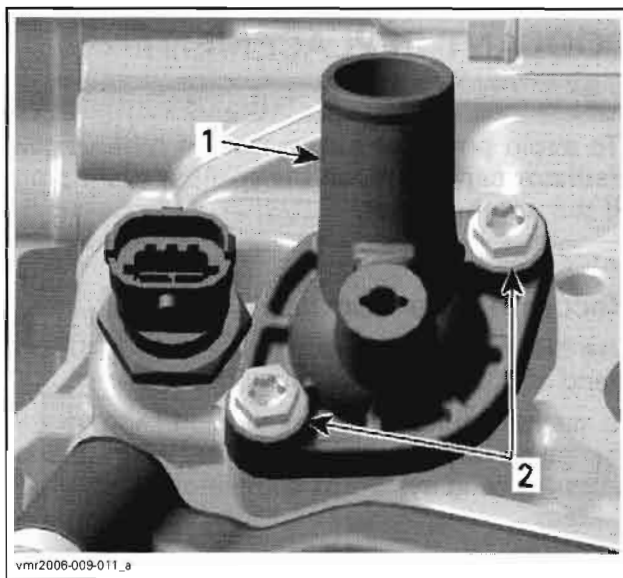
#### Thermostat Removal

**NOTE:** The thermostat is located on the top of cylinder head, on intake side (front cylinder).

Install a hose pincher on both radiator hoses.

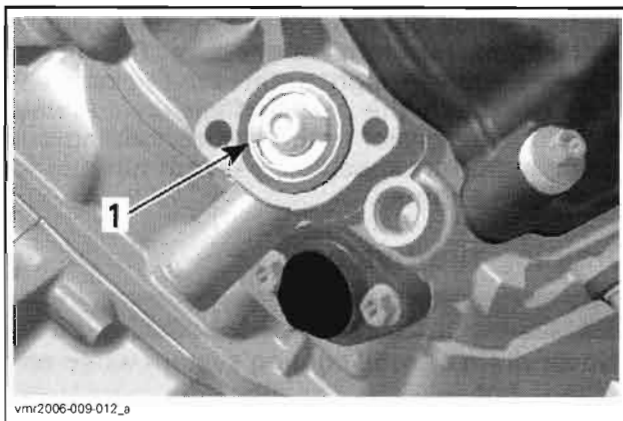
Remove:

- thermostat housing screws and pull thermostat cover



1. Thermostat cover
2. Screws

- thermostat with gasket out of the hole.



1. Thermostat with gasket



### Thermostat Test

To check thermostat, put in water and heat water. Thermostat should open when water temperature reaches 65°C (149°F).

Check if the gasket is brittle, hard or damaged. If so, replace gasket.

### Thermostat Installation

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

Install the thermostat cover then torque screws to 6 N•m (53 lbf•in).

Check coolant level in radiator and coolant tank and top up if necessary.

**CAUTION:** Do not forget to bleed the cooling system. Refer to *COOLANT REPLACEMENT*.

### RADIATOR CAP

Using a pressure cap tester, check the efficiency of radiator cap no. 1. If the efficiency is feeble, install a new 110 kPa (16 PSI) cap (do not exceed this pressure).

### RADIATOR

#### Radiator Inspection

Check radiating fins for clogging or damage.

Remove insects, mud or other obstructions with compressed air or low pressure water.

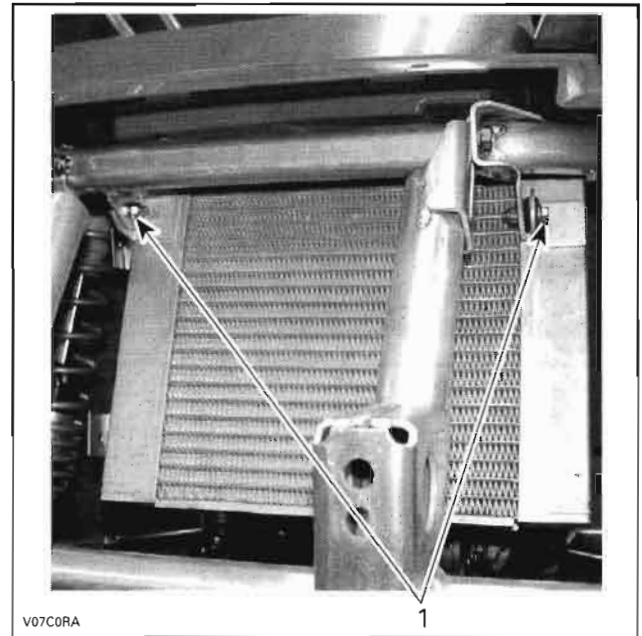
#### Radiator Removal

Drain cooling system.

Remove front fascia and radiator shroud, refer to *BODY*.

Remove:

- radiator inlet no. 4 and radiator outlet no. 6 hoses
- overflow hose no. 2
- mounting bolts no. 7.



V07C0RA

**TYPICAL**

1. Radiator mounting bolts

Unplug radiator fan no. 8.

Remove radiator no. 3.

#### Radiator Installation

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

Install rubber bushings no. 10 between the bottom of radiator and radiator supports.

Fill up the radiator. Refer to *COOLANT REPLACEMENT*, in this section.

Check for any coolant leakage from radiator and hoses.

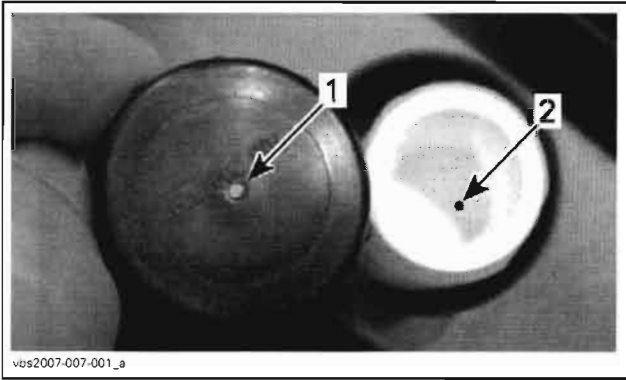
### COOLANT TANK

The coolant expands as the temperature (up to 100 - 110°C (212 - 230°F)) and pressure rise in the system. If the limiting system working pressure cap is reached 110 kPa (16 PSI), the pressure relief valve in the pressure cap is lifted from its seat and allows coolant to flow through the overflow hose into the overflow coolant tank no. 5.

Ensure ventilation holes are not obstructed.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 05 (COOLING SYSTEM)

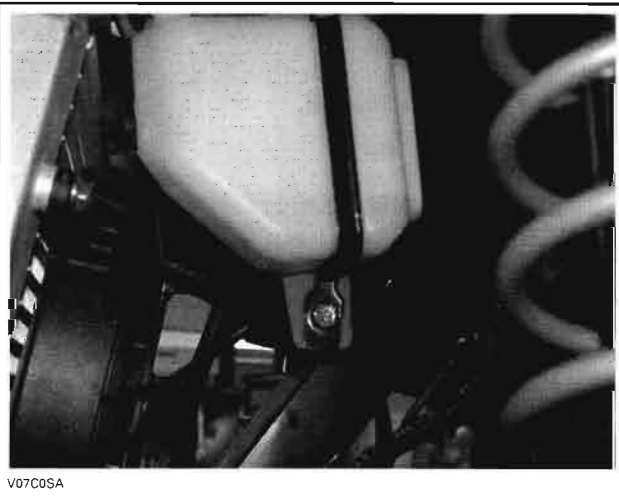


1. Outer cap vent
2. Inner cap vent

### Tank Removal

Remove:

- LH inner fender (refer to *BODY*)
- coolant tank support bolt no. 11



TYPICAL

- overflow hose no. 2
- support no. 12 and coolant tank no. 5.

Empty coolant tank.

### Tank Installation

The installation is the reverse of the removal procedure.

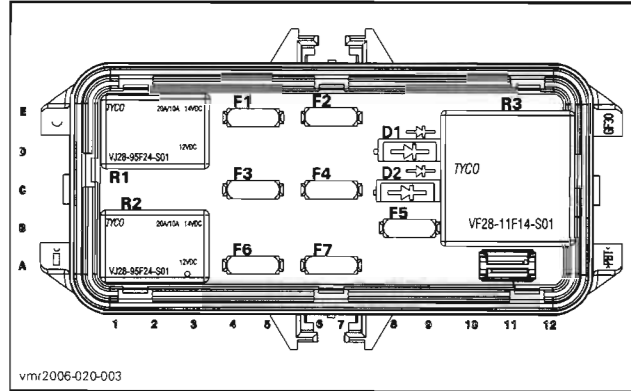
### COOLANT TEMPERATURE SENSOR (CTS)

Refer to *ENGINE MANAGEMENT* section for testing and replacement procedures of the coolant temperature sensor (CTS).

### RADIATOR FAN RELAY (R1)

#### Relay Installation

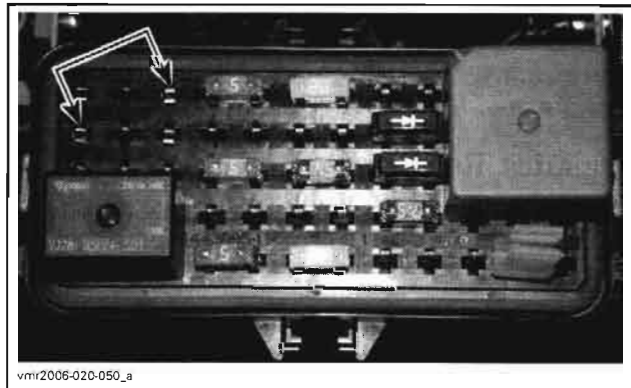
NOTE: Relay may be inverted by 180° at installation and it will work correctly. Ensure to align tabs of relay with terminals of fuse holder at installation.



R1: Radiator fan relay

#### Relay Operation Test

The easiest way to check the relay is to remove it and bypass it with a jumper. If the radiator fan is activated, replace the relay. See illustration to find where to bypass the relay.



RELAY R1 (RADIATOR FAN)

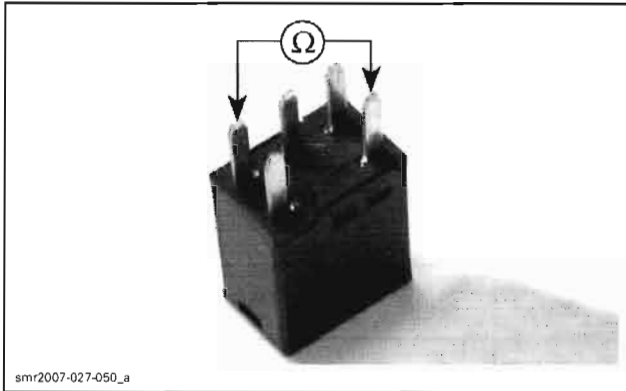
#### Relay Continuity Test

Remove relay.

Use the Fluke 111 multimeter (P/N 529 035 868), and select the  $\Omega$  position.

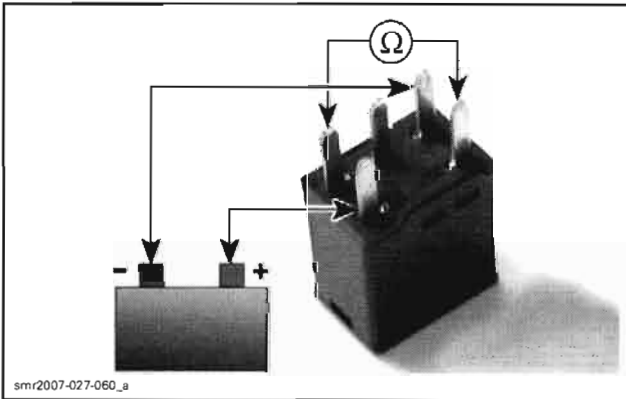
Probe relay as follows.

TERMINAL		RESISTANCE
30	87	Open circuit (OL)



Connect battery as shown and probe relay again as follows.

TERMINAL		RESISTANCE
30	87	0.5 $\Omega$ max. (continuity)



If relay failed any test, replace it.

## RADIATOR FAN

### Radiator Fan Operation

The ECM controls the radiator fan via the input of the coolant temperature sensor (CTS) and the manifold air pressure and temperature sensor (MAPTS).

The radiator fan should turn on when coolant temperature reaches 98°C (208°F) and should turn off when the coolant cools down at 95°C (203°F).

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 05 (COOLING SYSTEM)

ENGINE TEMPERATURE	INTAKE TEMPERATURE	COOLING FAN	CHECK ENGINE LIGHT	MESSAGE IN MULTIFUNCTION GAUGE	LIMP HOME MODE
	88°C (190°F)	Turns ON			
	85°C (185°F)	Turns OFF			
98°C (208°F)		Turns ON			
95°C (203°F)		Turn OFF			
115°C (239°F)		ON	Turns ON	- Check engine - Hi Temp	
118°C (244°F)		ON	Flashes	Limp Home	Engine RPM limited to 4000

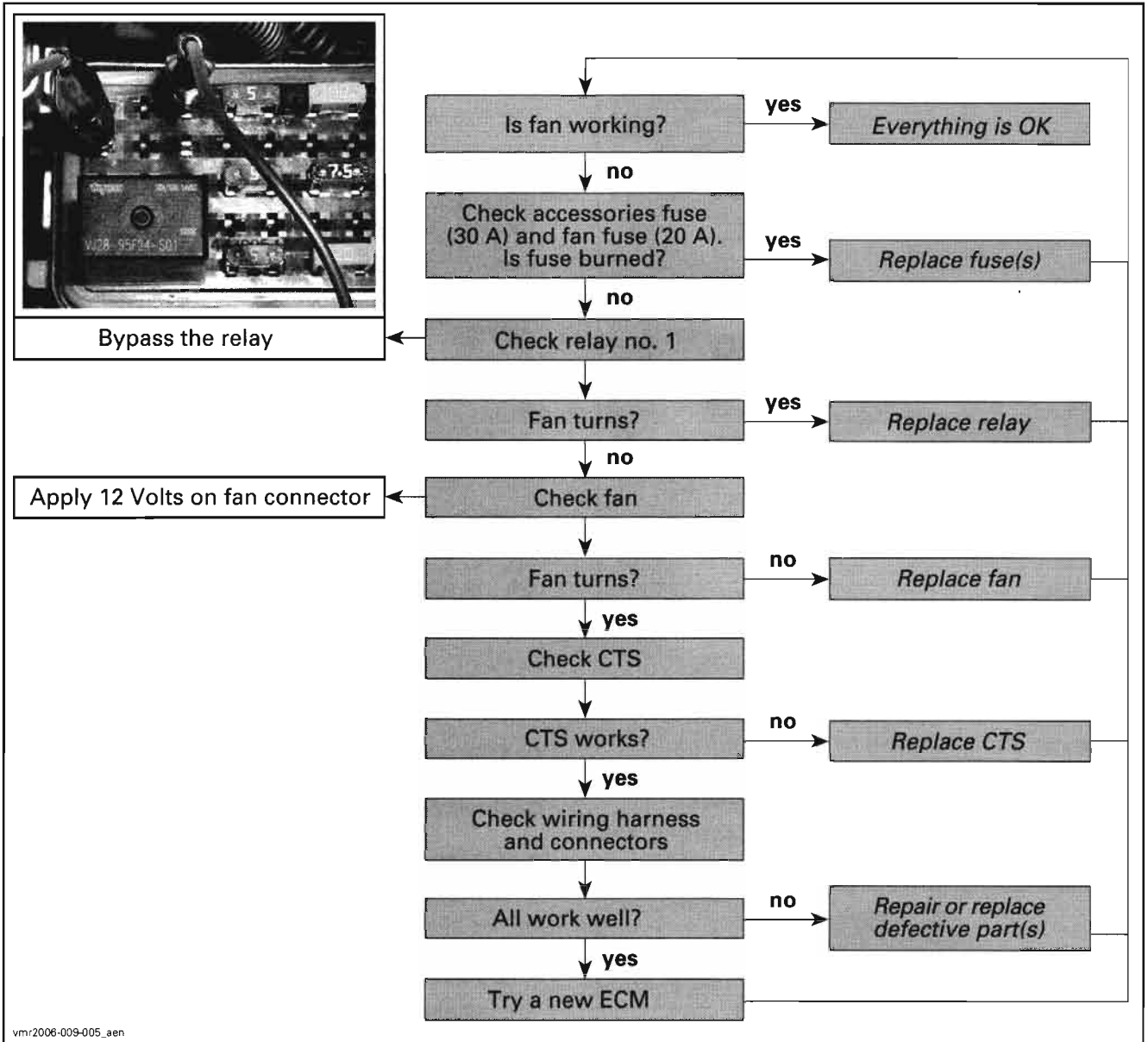
### Radiator Fan Test

Connect the vehicle to B.U.D.S. Refer to *ENGINE MANAGEMENT* for procedure and connector location.

In ACTIVATION folder, press COOLANT FAN button.

If fan turns, check CTS, wiring harness and connectors. If all parts are good, replace the ECM.

If fan does not turn when COOLANT FAN button is pressed, use the following troubleshooting chart to resolve the problem.



**Radiator Fan Removal**

Remove radiator shroud.  
 Remove bolts no. 13.  
 Remove the radiator fan.

**Radiator Fan Installation**

For the installation, reverse the removal procedure.

**WATER PUMP HOUSING**

It is located on the engine MAG side.

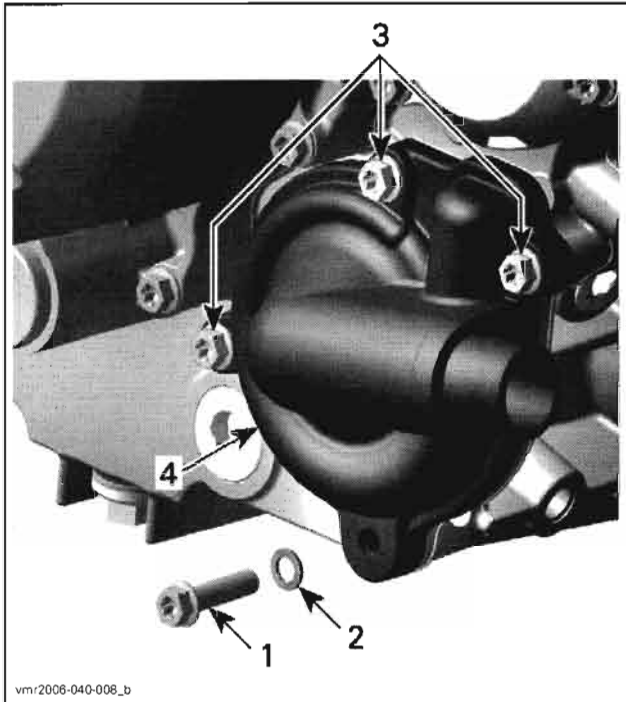
**Water Pump Housing Removal**

**⚠ WARNING**  
 To avoid potential burns, do not remove the radiator cap or loosen the cooling drain plug if the engine is hot.

Drain cooling system.  
 Remove radiator outlet hose from water pump housing.  
 Remove screws retaining water pump housing.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 05 (COOLING SYSTEM)



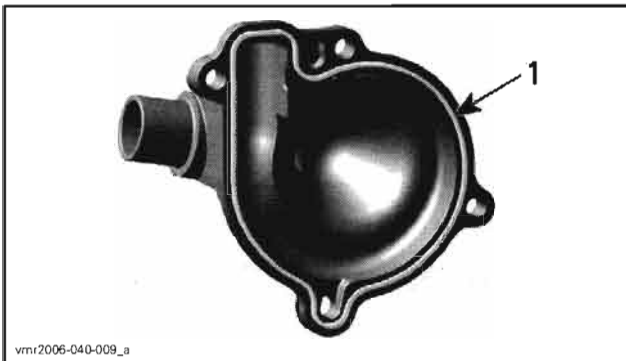
#### TYPICAL

1. Cooling drain plug
2. Sealing ring
3. Screws
4. Water pump housing

Pull water pump housing to remove it.

### Water Pump Housing Inspection

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



#### TYPICAL

1. Gasket

### Water Pump Housing Installation

The installation is the opposite of the removal procedure.

**CAUTION:** To prevent leaking, take care that the gasket is exactly in groove when you reinstall the water pump housing.

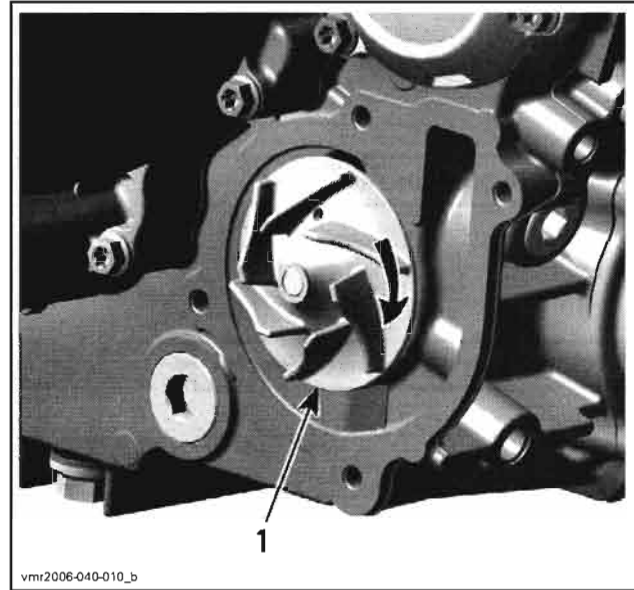
Tighten screws of water pump housing in a criss cross sequence.

## WATER PUMP IMPELLER

### Impeller Removal

Remove water pump housing.

Unscrew impeller.



1. Turn clockwise to unscrew

**CAUTION:** Water pump shaft and impeller have right-hand threads. Remove by turning counterclockwise and install by turning clockwise.

### Impeller Inspection

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

### Impeller Installation

The installation is the opposite of the removal procedure.

**CAUTION:** Be careful not to damage impeller wings during installation.

## WATER PUMP SHAFT AND SEALS

### Shaft/Seal Removal

**NOTE:** It is not required to split crankcase to replace the water pump shaft and seals, but engine removal is necessary.

Drain engine oil. Refer to *LUBRICATION SYSTEM*.

Drain gearbox oil. Refer to *GEARBOX AND 4X4 COUPLING UNIT*.

Remove CVT and inner cover. Refer to *TRANSMISSION* section.

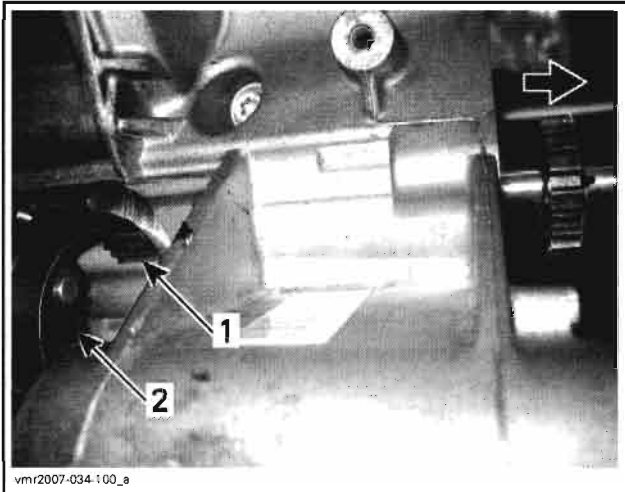
Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* section.

Detach gearbox from engine. Refer to *GEARBOX AND 4X4 COUPLING UNIT*.

Remove engine drive shaft and engine PTO cover. Refer to *BOTTOM END*.

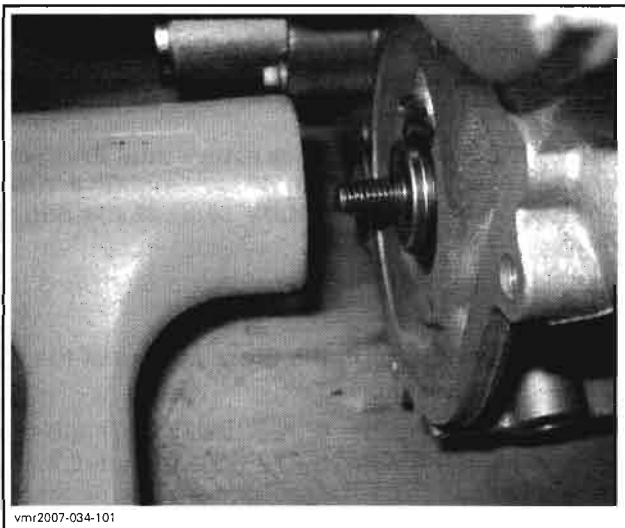
Remove water pump housing and impeller. See procedures in this section.

Pull out water pump gear to disengage the inner drive gear.



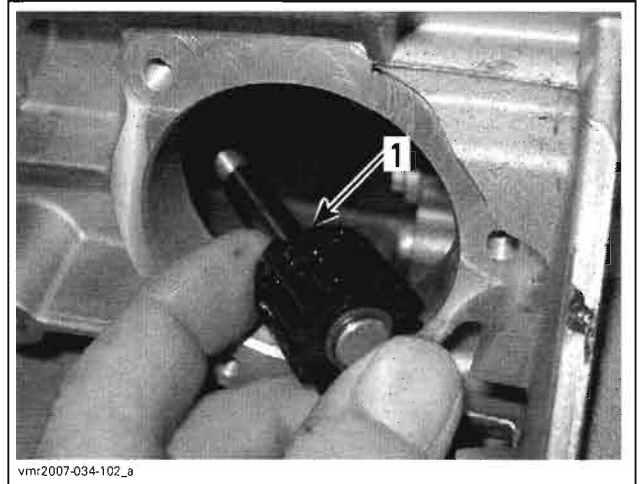
- 1. Water pump gear
- 2. Inner drive gear

Sharply strike water pump shaft out with a plastic hammer.



Pull out water pump shaft through the engine drive shaft opening.

**NOTE:** Pay attention to hold thrust washer to prevent it from falling in crankcase.



- 1. Thrust washer here

**CAUTION:** If thrust washer is not on water pump shaft, use a magnet to retrieve it inside crankcase.

Using appropriate pliers, remove and discard the retaining ring securing water pump gear on water pump shaft.

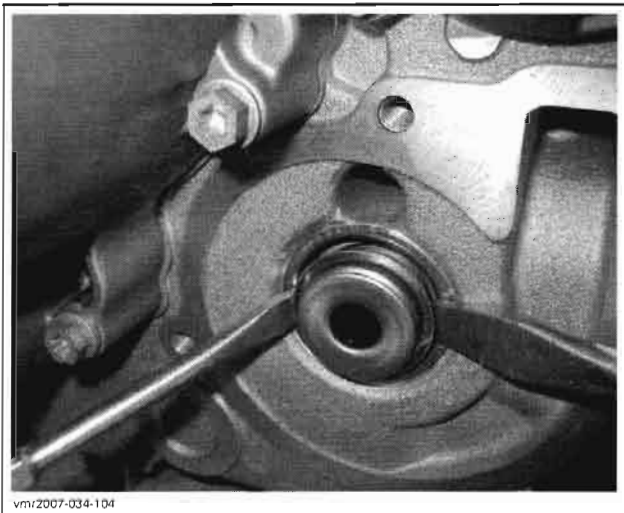
To remove plastic gear from water pump shaft, place gear between your fingers and briskly tap shaft end.



Using 2 screwdrivers, pry out inner part of the rotary seal.

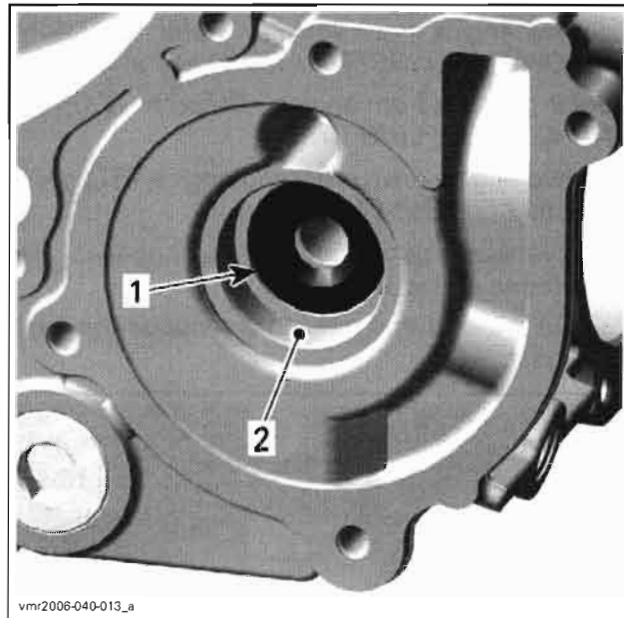
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 05 (COOLING SYSTEM)



To remove outer part of rotary seal, use an expander from puller kit (P/N 529 036 056).

Install expander snugly against outer part and pull rotary seal out.



1. Inner oil seal
2. Rotary seal surface

**CAUTION:** Be careful not to damage the rotary seal surface in crankcase.

#### Part Inspection

Inspect water pump gear for wear and damage on the snap mechanism to the needle pin. Replace if damaged.

#### Shaft/Seal Installation

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

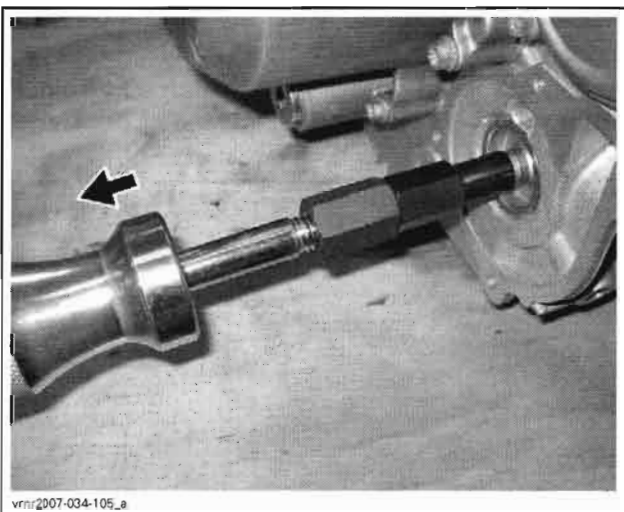
**NOTE:** For installation use the torque values in the exploded view. Ensure to use multipurpose grease for oil seal.

**CAUTION:** Always replace rotary seal and water pump shaft together. Also, install a new inner oil seal (behind rotary seal) at the same time.

Apply engine oil on the water pump shaft and intermediate shaft.

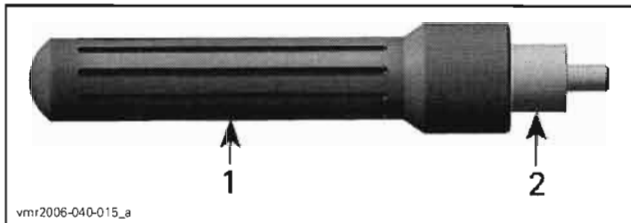
**NOTE:** Never use oil in the press fit area of the oil seal and rotary seal.

Use the oil seal pusher (P/N 529 035 757) and the installer handle (P/N 420 877 650) to install inner oil seal.



Remove inner oil seal.



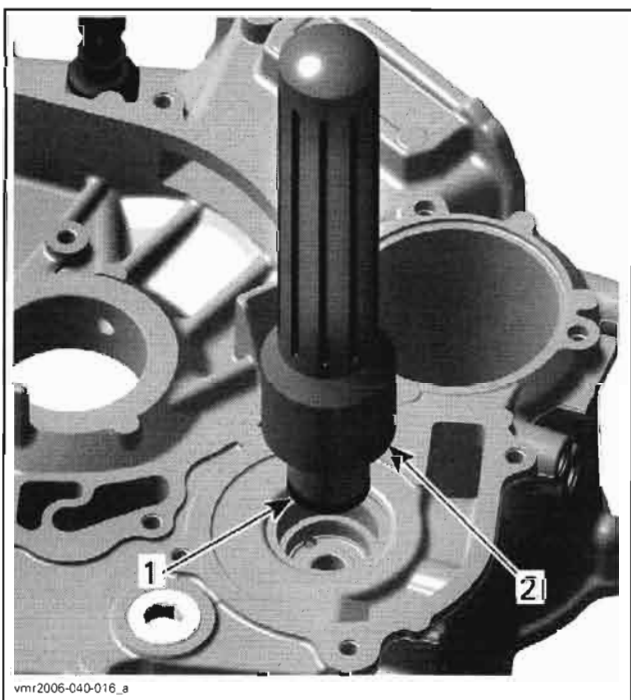


1. Handle
2. Pusher

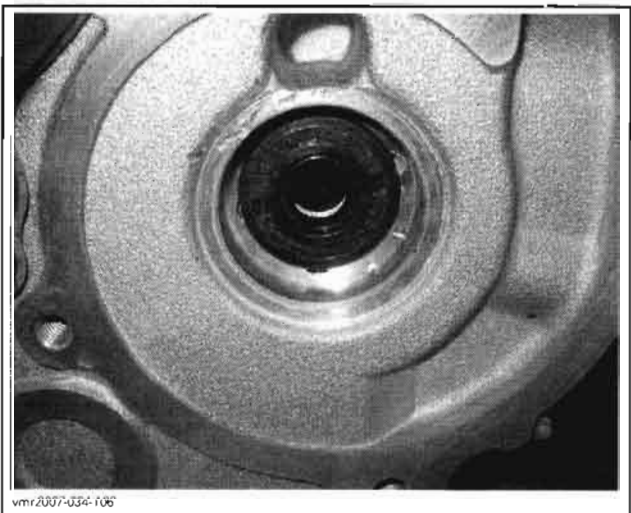
Apply Molykote 111 (P/N 413 707 000) inside lips of oil seal.

When installing the oil seal on the pusher, make sure sealing lip points outside.

Push inner oil seal in place.



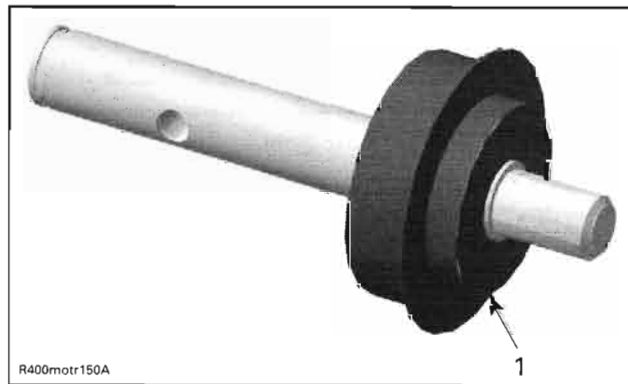
1. Inner oil seal
2. Installer handle with oil seal pusher



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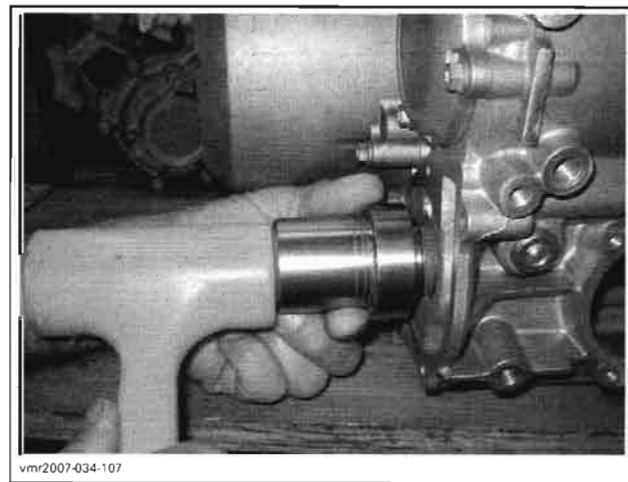
Slide water pump shaft with the new rotary seal into crankcase.

To properly install water pump shaft with rotary seal, use the rotary seal installer (P/N 529 035 766).



1. Surface where rotary seal is pushed by tool

Use a plastic hammer and drive rotary seal into crankcase.



From engine drive shaft opening, insert thrust washer on water pump shaft in crankcase.

Using a flashlight and a mirror, position shaft hole so that pin can be installed.

Position pin between your fingers, push in water pump shaft to fully expose hole then install pin.

Position pin at equal distance out of shaft hole so gear can be installed.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 05 (COOLING SYSTEM)



Install water pump shaft gear.

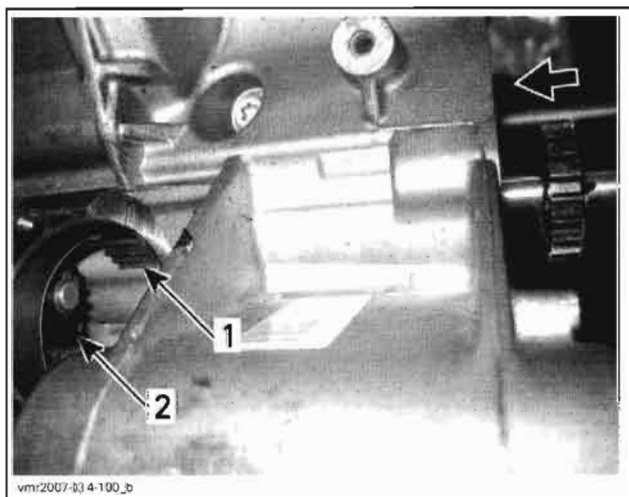
**NOTE:** Ensure gear properly snaps on pin. A screwdriver may have to be used to push gear in place.

Use a 45° snap-ring pliers and install a NEW retaining ring on pump shaft end.

**CAUTION:** Never use the retaining ring a second time. Always install a new one.

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

Carefully push in water pump gear while turning to mesh with the inner drive gear.



1. Water pump gear
2. Inner drive gear

Tighten screws of the water pump housing cross-wise.

Properly reinstall remaining parts. Refer to appropriate sections.

Refill all fluids.

# MAGNETO SYSTEM

## SERVICE TOOLS

Description	Part Number	Page
crankshaft locking bolt.....	529 035 617 .....	75
magneto puller.....	529 035 748 .....	75
crankshaft protector .....	529 036 034 .....	75

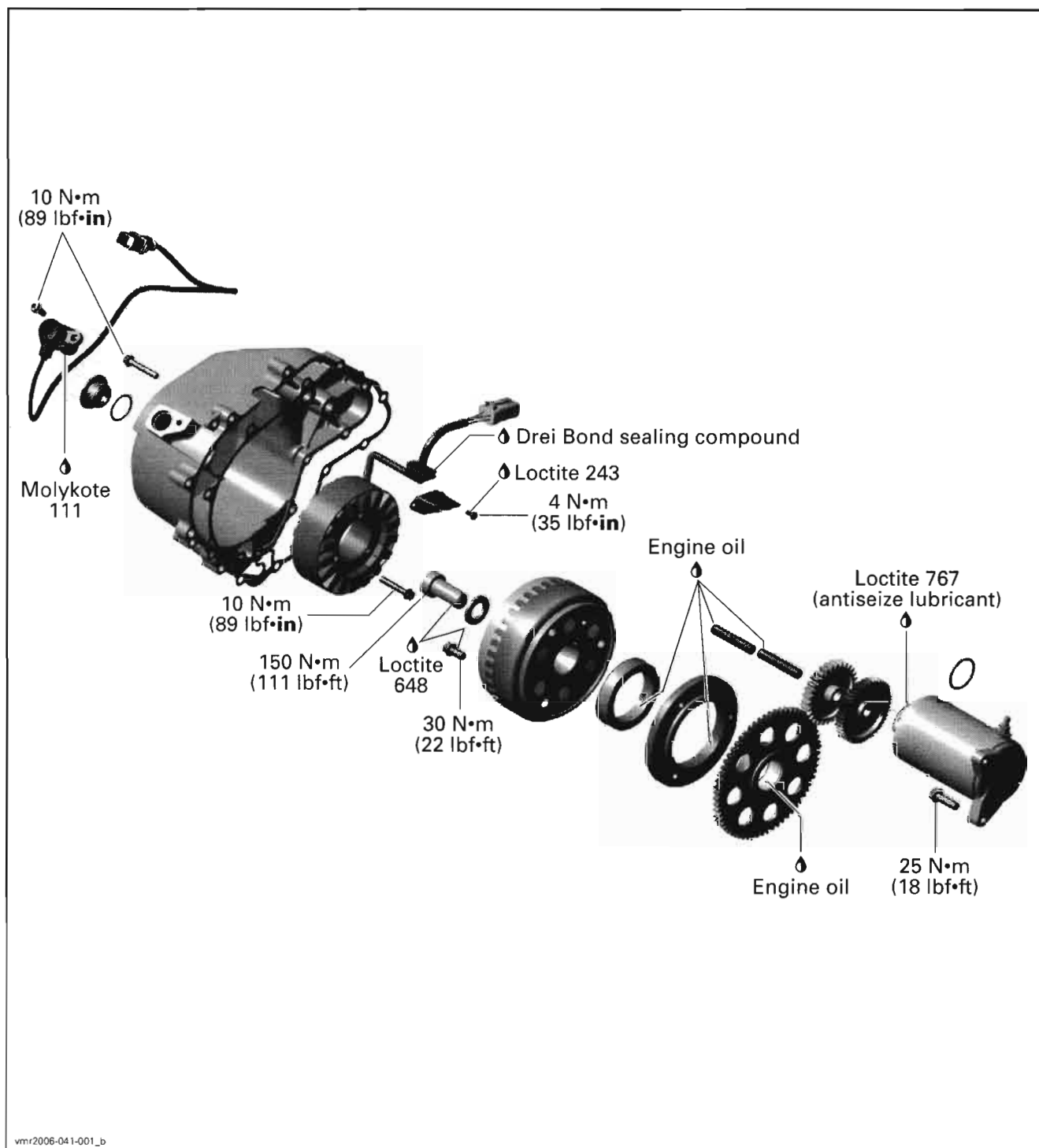
## SERVICE PRODUCTS

Description	Part Number	Page
Loctite 767 (antiseize lubricant) .....	293 800 070 .....	78
pulley flange cleaner.....	413 701 809 .....	75
Loctite Chisel (gasket remover).....	413 708 500 .....	73
Loctite 648 (green) .....	413 711 400 .....	77
Drei Bond sealing compound .....	420 297 906 .....	73



# Section 03 ENGINE AND GEARBOX (V490/V660/V810)

## Subsection 06 (MAGNETO SYSTEM)



## GENERAL

Always perform the electric tests before removing or installing whatever component.

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

Clean threads before applying 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, self-locking fasteners, cotter pins, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

## PROCEDURES

### MAGNETO COVER

#### Magneto Cover Removal

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

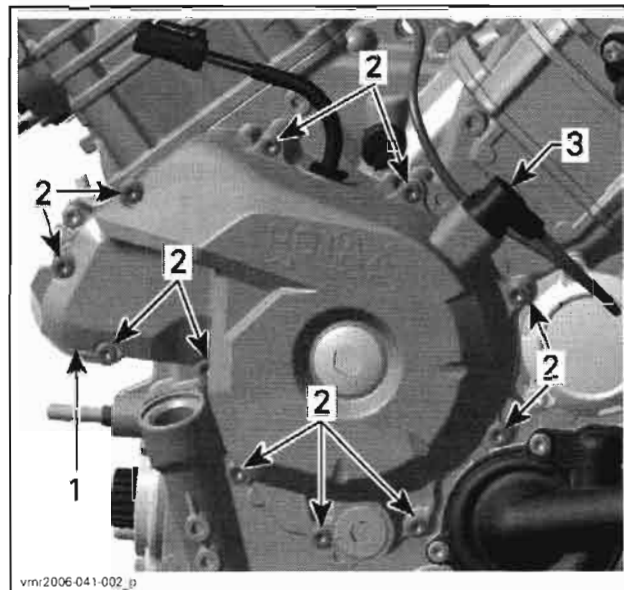
Remove plastic cover.

Remove crankshaft position sensor (CPS) and cut tie raps.

Disconnect magneto connector.

Remove dipstick.

Remove magneto cover retaining screws.



1. Magneto cover  
2. Retaining screws  
3. Crankshaft position sensor

Pull out magneto cover.

#### Magneto Cover Inspection and Cleaning

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

**NOTE:** Clean all metal components in a non-ferrous metal cleaner. Use Loctite Chisel (gasket remover) (P/N 413 708 500), or suitable equivalent.

### WARNING

Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

#### Magneto Cover Installation

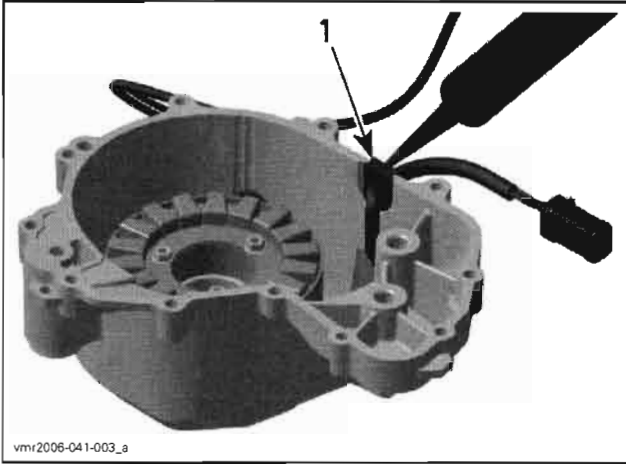
For installation, reverse the removal procedure. However, pay attention to the following.

**NOTE:** At installation replace magneto cover gasket.

Apply Drei Bond sealing compound (P/N 420 297 906) on stator cable grommet as shown in next illustration.

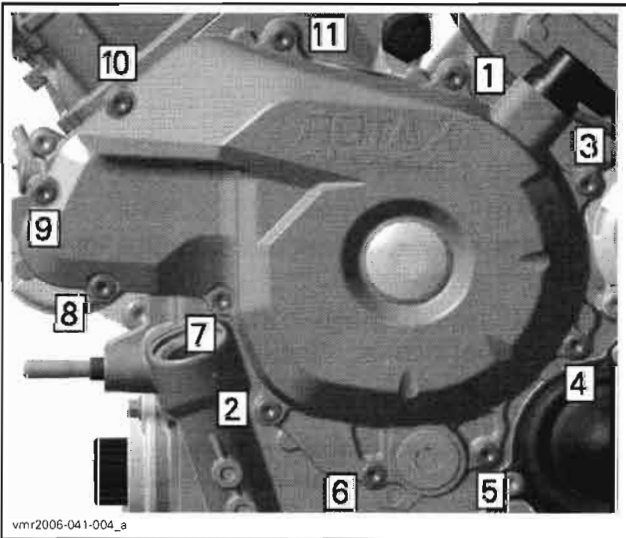
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 06 (MAGNETO SYSTEM)



1. Apply Drei Bond sealing compound

Tightening sequence for screws on magneto cover is as per following illustration.



#### TIGHTENING SEQUENCE

Refill engine with recommended oil.

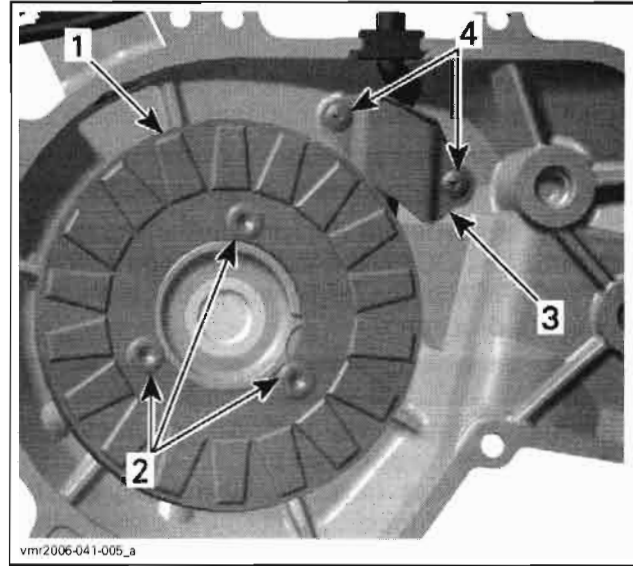
## STATOR

### Stator Removal

Remove magneto cover (refer to *MAGNETO COVER* above).

Remove screws securing holding strip.

Remove stator retaining screws then the stator.



1. Stator
2. Stator retaining screws
3. Holding strip
4. Holding strip screws

### Stator Inspection

Check stator condition. If damaged replace it.

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

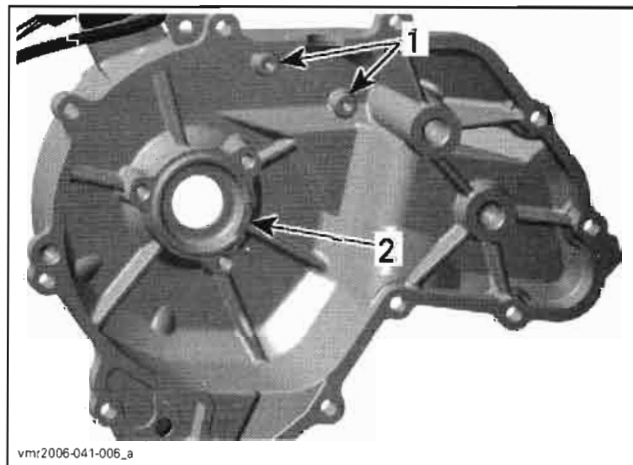
For electrical inspection, refer to *CHARGING SYSTEM*.

### Stator Installation

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

**CAUTION:** When installing the stator take care that the cable is in place (guide for the wire).

**NOTE:** There is only one position for the stator (notch in the magneto housing cover).



1. Threads for cable holding strip
2. Notch for stator

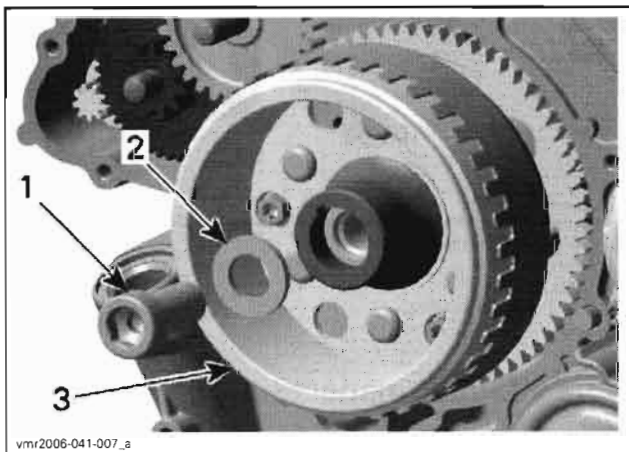
## ROTOR

### Rotor Removal

Lock crankshaft with crankshaft locking bolt (P/N 529 035 617) (refer to *BOTTOM END*).

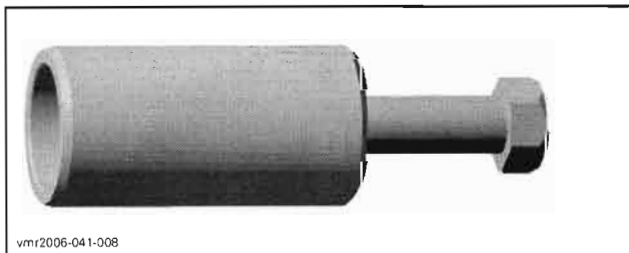
Remove magneto cover. Refer to *MAGNETO COVER* above.

Remove screw and washer securing rotor to crankshaft.

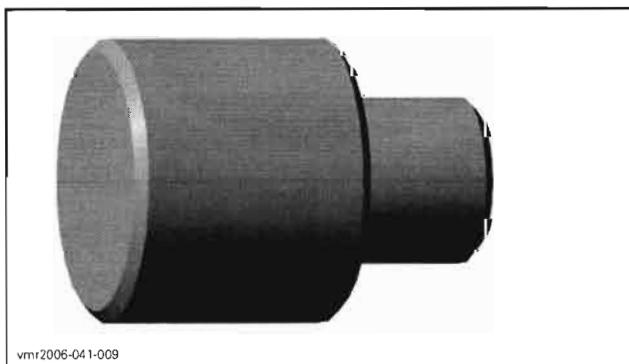


1. Screw M16
2. Washer
3. Rotor

Install magneto puller (P/N 529 035 748) and crankshaft protector (P/N 529 036 034) then remove rotor.



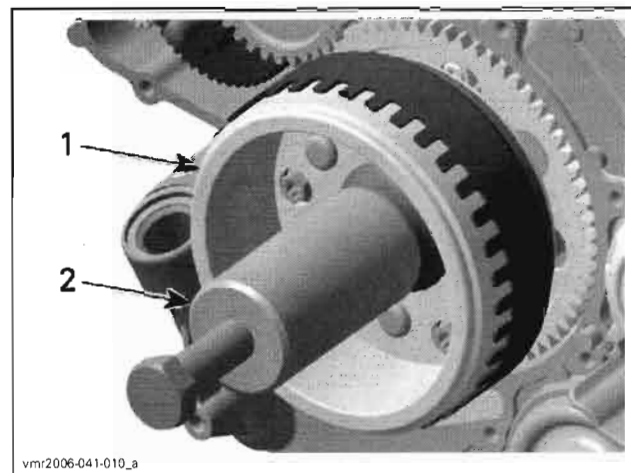
MAGNETO PULLER



CRANKSHAFT PROTECTOR

**NOTE:** Use grease to place protector on crankshaft end prior to screw on the magneto puller.

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1. Rotor
2. Magneto puller

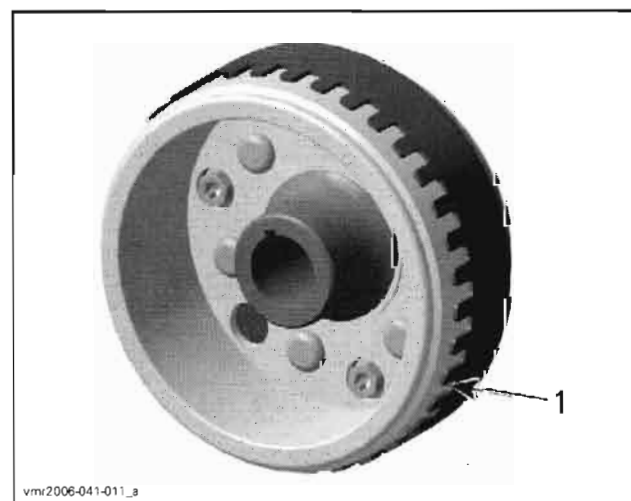
Screw magneto puller bolt to remove rotor.

### Rotor Inspection

Check inner side of rotor for scratches or other damage.

Check keyway of the rotor for wear or damages.

Check if trigger wheel teeth are bent or otherwise damaged.



1. Rotor with trigger wheel

Check woodruff key and keyway on the crankshaft for wear or damages.

Replace parts as necessary.

### Rotor Installation

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

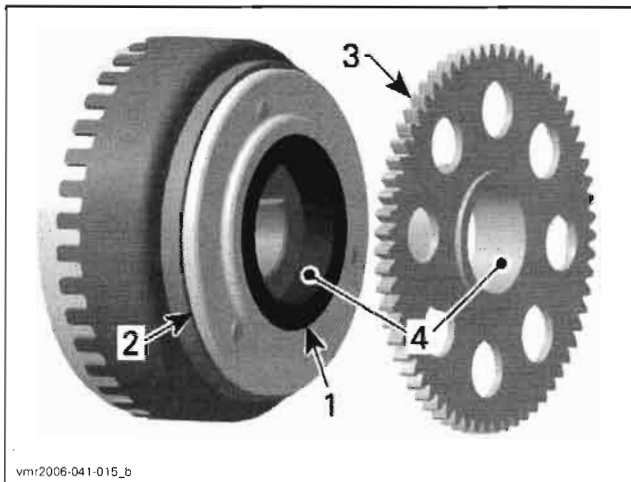
Clean crankshaft taper and rotor with pulley flange cleaner (P/N 413 701 809).

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

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 06 (MAGNETO SYSTEM)

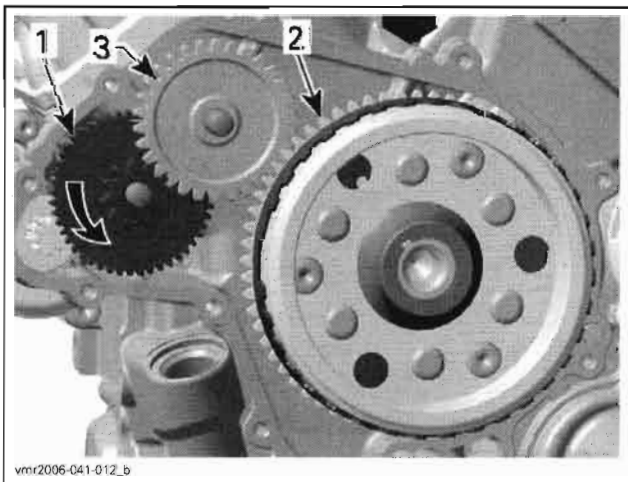
Oil sprag clutch in sprag clutch housing and install sprag clutch gear.



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

Slide rotor onto crankshaft. The woodruff key and the keyway must be aligned.

Rotate starter double gear counterclockwise to align intermediate gear teeth with sprag clutch gear.



1. Starter double gear
2. Sprag clutch gear
3. Intermediate gear

## SPRAG CLUTCH

### Sprag Clutch Removal

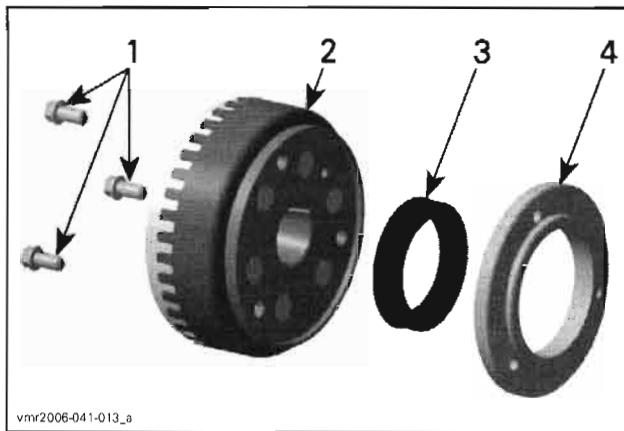
Remove magneto cover (refer to *MAGNETO COVER* above).

Loosen sprag clutch housing screws located inside rotor.

Remove rotor (refer to *ROTOR* above).

Remove sprag clutch gear.

Remove sprag clutch housing screws and sprag clutch housing.



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

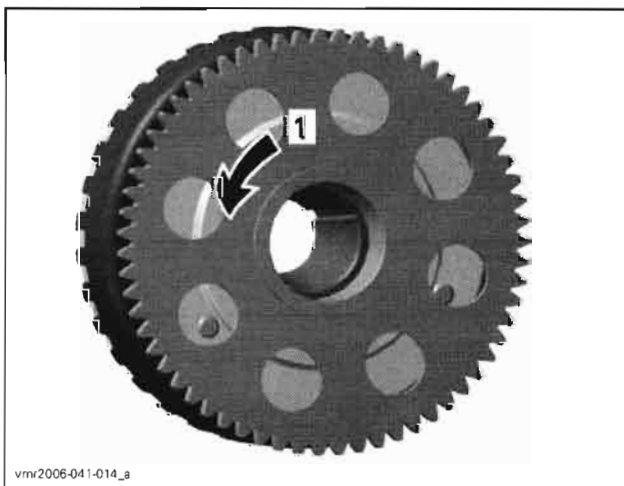
### Sprag Clutch Inspection

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

Also check the collar of the sprag clutch gear.

Perform a functional test of the sprag clutch. To do so, rotate sprag clutch gear in sprag clutch.

**NOTE:** Sprag clutch must lock in counterclockwise direction.



#### SPRAG CLUTCH FUNCTIONAL TEST

1. Lock

**NOTE:** Sprag clutch, housing and gear must be replaced at the same time, if damaged.

### Sprag Clutch Installation

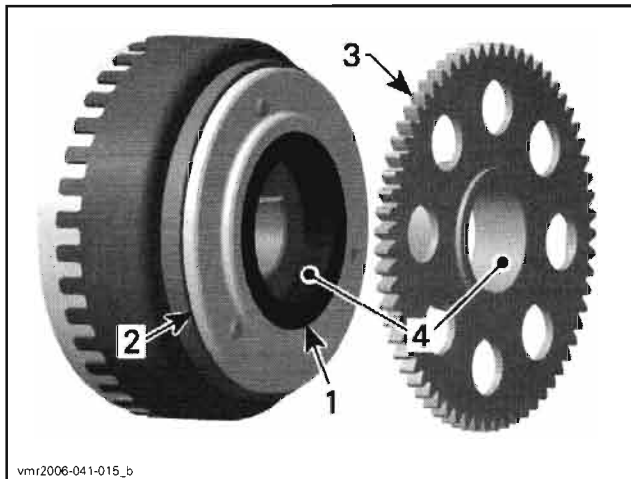
For installation, reverse the removal procedure. Pay attention to the following details.



Apply Loctite 648 (green) (P/N 413 711 400) on threads of sprag clutch housing screws.

Install screws but do not torque yet.

Apply engine oil on sprag clutch and inside sprag clutch gear hole.



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

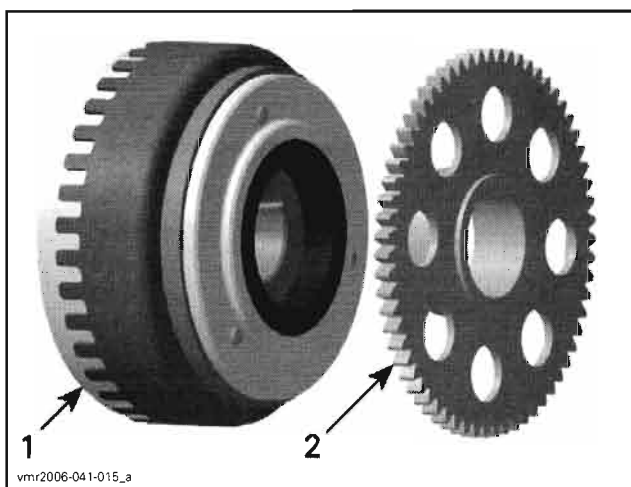
Install rotor then torque sprag clutch housing screws to 30 N•m (22 lbf•ft).

## SPRAG CLUTCH GEAR

### Sprag Clutch Gear Removal

Remove rotor (refer to *ROTOR* above).

Pull sprag clutch gear from the rotor.



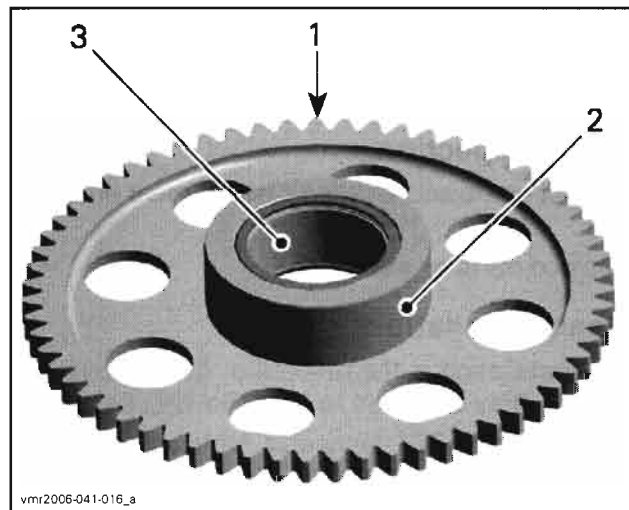
1. Rotor
2. Sprag clutch gear

### Sprag Clutch Gear Inspection

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

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Check needle bearing condition. Replace sprag clutch gear if necessary.



#### INSPECT

1. Teeth
2. Collar
3. Needle bearing

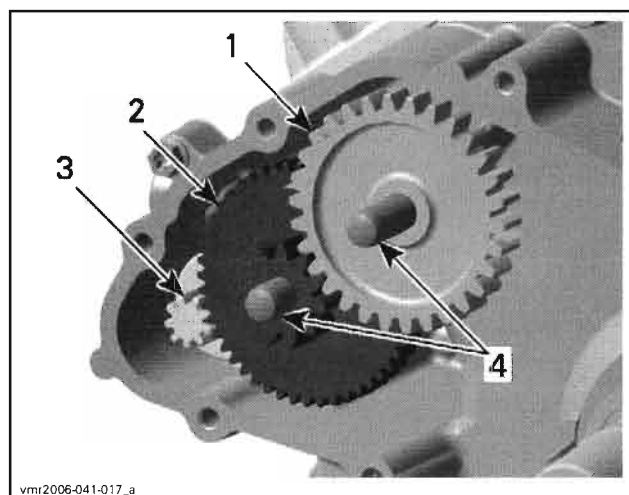
### Sprag Clutch Gear Installation

The installation is the reverse of the removal procedure.

**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

## **Section 03 ENGINE AND GEARBOX (V490/V660/V810)**

### **Subsection 06 (MAGNETO SYSTEM)**

---

#### **Gear Removal**

Remove magneto cover (refer to *MAGNETO COVER* above).

Remove location pins, starter double gear and intermediate gear.

#### **Gear Inspection**

Inspect gears and location pins for wear and damage.

Replace parts as necessary.

#### **Gear Installation**

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

Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) on starter gear before installing the starter double gear.

Apply engine oil on location pins.

# INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER

## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
dial gauge .....	414 104 700 .....	86
crankshaft locking bolt.....	529 035 617 .....	97, 106
valve spring compressor clamp.....	529 035 724 .....	100
valve spring compressor cup.....	529 035 764 .....	100
valve guide installer .....	529 035 853 .....	104
Piston ring compressor.....	529 035 919 .....	106
Circlip installer .....	529 035 921 .....	110
valve guide remover .....	529 035 924 .....	104
camshaft locking tool.....	529 035 926 .....	86, 90
Piston ring compressor.....	529 035 977 .....	106
Circlip installer .....	529 036 058 .....	110

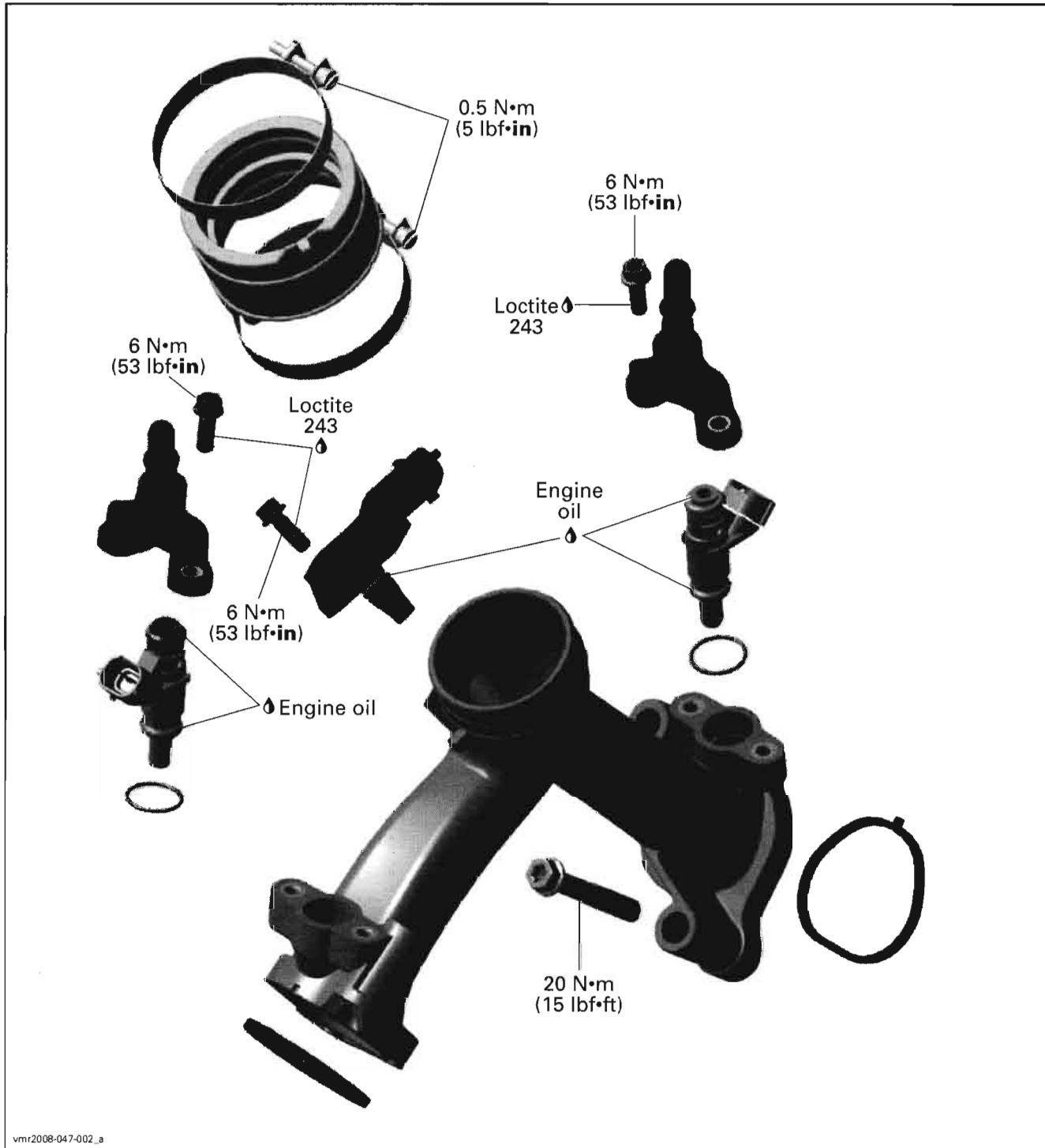
## SERVICE TOOLS – OTHER SUPPLIER

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Snap-on pliers .....	YA 8230 .....	102

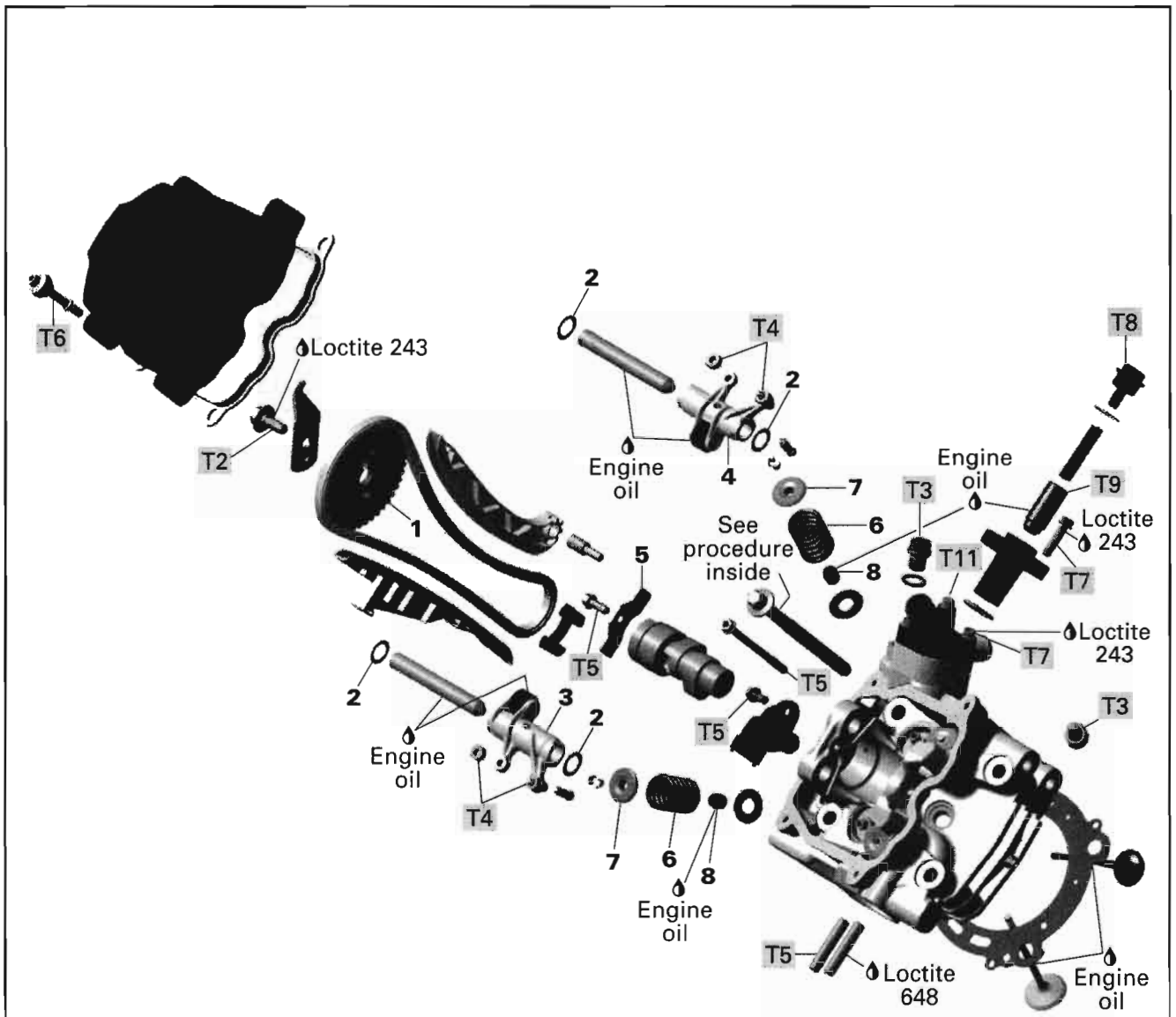
## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Loctite 767 (antiseize lubricant).....	293 800 070 .....	104

**INTAKE MANIFOLD**



## CYLINDER HEAD NO. 1



T1	60 N•m (44 lbf•ft)
T2	30 N•m (22 lbf•ft)
T3	20 N•m (15 lbf•ft)
T4	12 N•m (106 lbf•in)
T5	10 N•m (89 lbf•in)
T6	7 N•m (62 lbf•in)

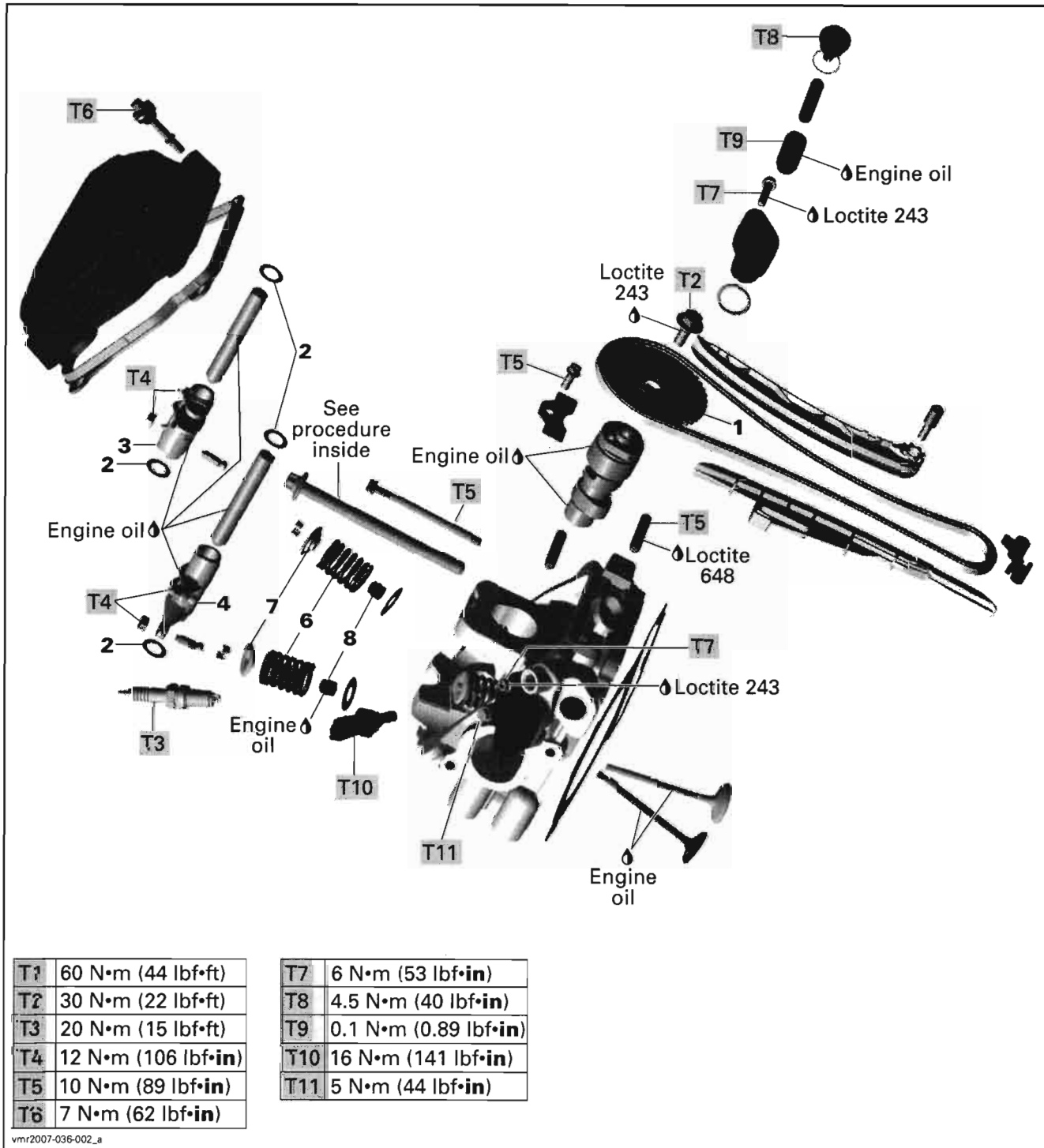
T7	6 N•m (53 lbf•in)
T8	4.5 N•m (40 lbf•in)
T9	0.1 N•m (0.89 lbf•in)
T10	16 N•m (141 lbf•in)
T11	5 N•m (44 lbf•in)

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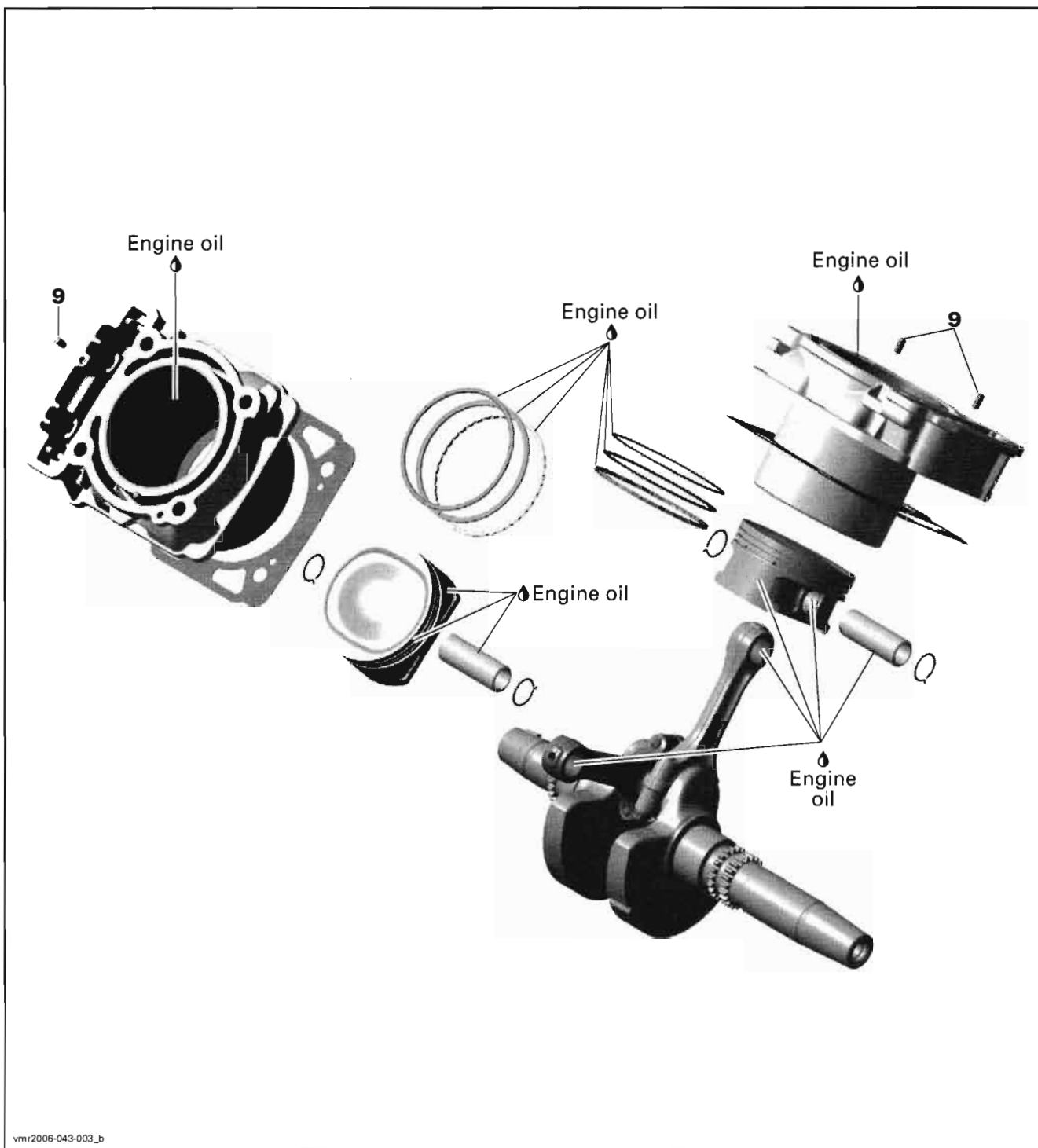
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

## CYLINDER HEAD NO. 2



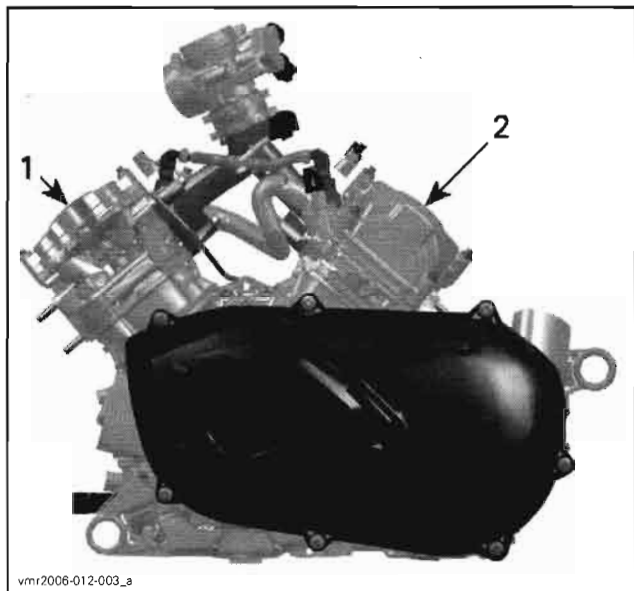
## CYLINDERS AND PISTONS



**GENERAL**

Components which are identical for both cylinders/cylinder heads are identified in the two exploded views by the same number. Components which are different or which are, for instance, present on one of the cylinders/cylinder heads but not on the other, have different numbers. The information given below always relates as a general rule.

Special reference is made in the text to work instructions which are not the same for cylinder no. 1 and cylinder no. 2.



1. Cylinder 1 (front)  
2. Cylinder 2 (rear)

When diagnosing an engine problem, always perform a cylinder leak test.

Always place the vehicle on level surface.

**NOTE:** For a better understanding, the many illustrations are taken with engine out of vehicle. To perform the following instructions, it is not necessary to remove engine from vehicle.

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

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

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.

When disassembling parts that are duplicated in the engine, (e.g.: valves), it is a strongly recommended to note their position (PTO/MAG side, front/rear cylinder) 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 among its group of parts (e.g.: you found a worn valve guide. A bent spring could be the cause and it will be easy to know which one among the springs is the cause to replace it if you grouped them at disassembly). Also, since used parts have matched together during the engine operation, they will keep their matched fit when you reassemble them together within their "group".

**MAINTENANCE****VALVE ADJUSTMENT**

**NOTE:** Check and adjust valve clearance only when engine is cold.

Remove valve covers.

Before checking or adjusting the valve clearance, turn crankshaft to TDC ignition of the respective cylinder, see *CAMSHAFT*.

Using feeler gauge, check the valve clearance.

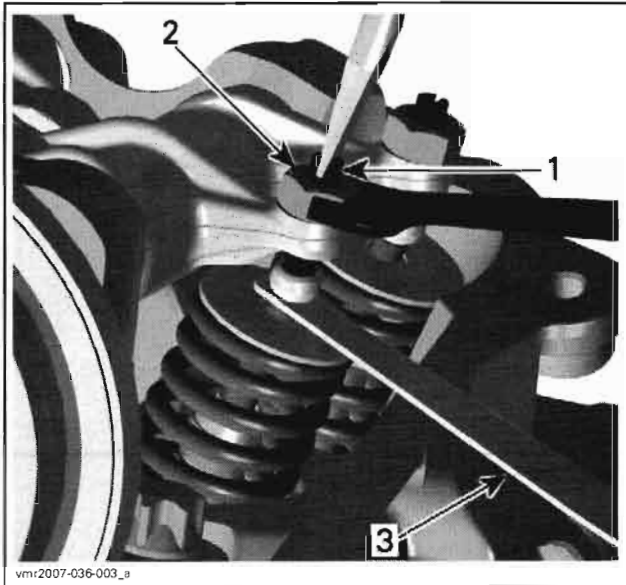
VALVE CLEARANCE	
EXHAUST	0.11 to 0.19 mm (.0043 to .0075 in)
INTAKE	0.06 to 0.14 mm (.0024 to .0055 in)

If the valve clearance is out of specification, adjust valves as follows.

**NOTE:** Use mean value of exhaust/intake to ensure a proper valve adjustment.

Hold the adjustment screw at the proper position and torque the locking nut.





1. Adjustment screw
2. Locking nut
3. Feeler gauge

Repeat the procedure for each valve.  
Before installing valve covers, recheck valve clearance.

## INSPECTION

### LEAK TEST

Before performing the cylinder leak test, verify the following:

- clamp(s) tightness
- radiator and hoses.

**NOTE:** For best accuracy, the leak test should be done with the engine at normal operating temperature.

### WARNING

Prevent burning yourself on hot engine parts.

### Preparation

Disconnect battery.

### WARNING

Always respect this order for disassembly; disconnect BLACK (-) cable first.

Remove radiator cap.

### WARNING

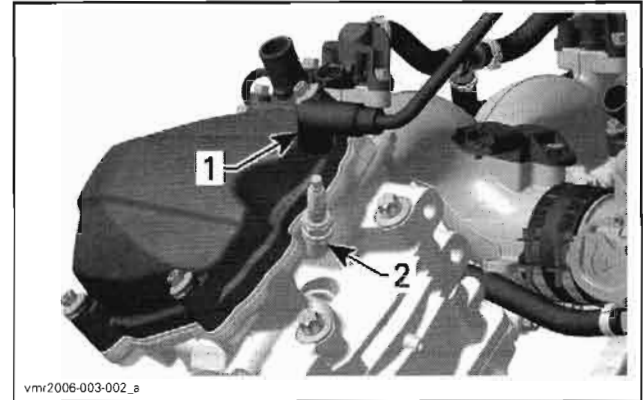
To prevent burning yourself only remove the radiator cap by wearing the appropriate safety equipment.

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Remove any parts to have access to engine cylinder heads.

Unplug spark plug cable.

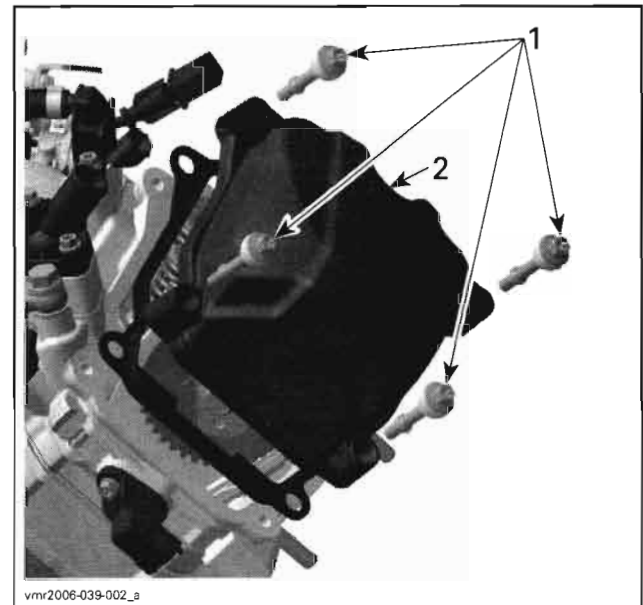
Clean spark plug area and remove spark plug from cylinder head.



### TYPICAL

1. Spark plug cable
2. Spark plug

Remove valve cover.



1. Valve cover screws
2. Valve cover

Rotate crankshaft until piston is at ignition TDC.  
To turn crankshaft, there are two possible procedures.

#### First Procedure

- Turn the drive pulley.

#### Second Procedure

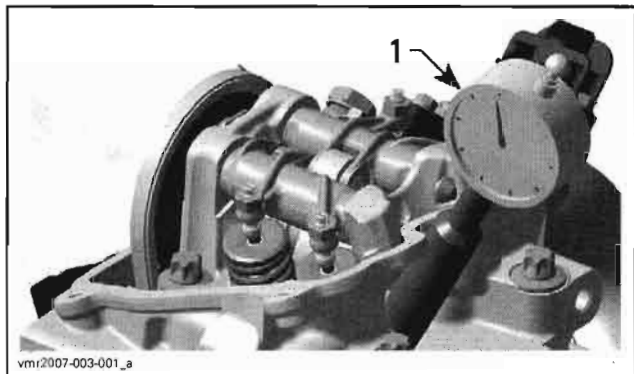
- Remove plug screw with O-ring from magneto cover.
- Use a 14 mm Allen key and turn crankshaft.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

**CAUTION:** Turn only clockwise to avoid loosening of magneto flywheel Allen screw.

Using the dial gauge (P/N 414 104 700), turn the crankshaft and set the piston to precisely ignition TDC.

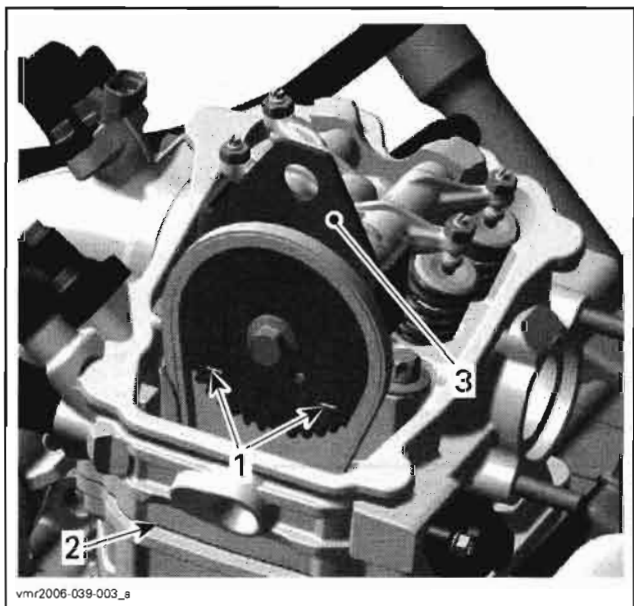


*TYPICAL*  
1. Dial gauge

**NOTE:** If a dial gauge is not available, use a screwdriver or another similarly suitable tool.

**CAUTION:** Do not scratch or damage piston/cylinder surface.

**NOTE:** At ignition TDC the marks on the camshaft timing gear have to be parallel to cylinder head base as per following illustration.



1. Marks on camshaft timing gear  
2. Cylinder head base  
3. Camshaft locking tool

Lock camshaft at TDC by using camshaft locking tool (P/N 529 035 926).



*CAMSHAFT LOCKING TOOL*

### Leak Test

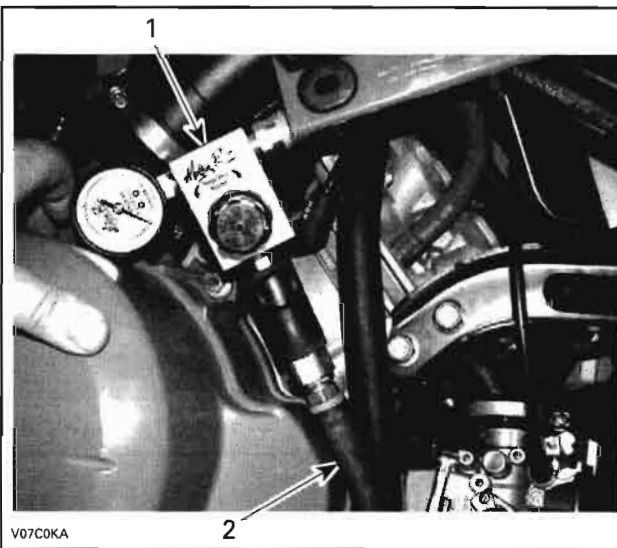
Connect to adequate air supply.

Set needle of measuring gauge to zero.

**NOTE:** All testers have specific instructions on gauge operation and required pressure.

Install gauge adapter into previously cleaned spark plug hole.

Supply combustion chamber with air pressure.



*TYPICAL*  
1. Leak Tester  
2. Air supply hose

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/throttle body means leaking intake valve(s)
- air escaping on exhaust port means leaking exhaust valve(s)
- air bubbles out of radiator means leaking cylinder head gasket
- air/oil escaping from crankcase means damaged gasket and/or loosened screws (refer to *BOTTOM END*)
- air/coolant escaping from cylinder/head means damaged gasket(s) and/or loosened screws (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER*)
- air escaping into crankcase area means excessively worn cylinder and/or broken piston rings (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER*).

**NOTE:** For all the checkpoints mentioned above, see the appropriate engine section to diagnose and repair the engine.

### Reassembly

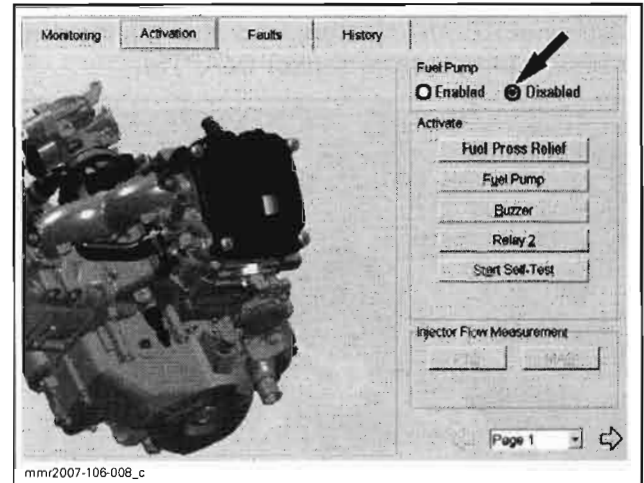
Reverse the preparation procedure. Ensure to respect torque values and use of appropriate products/lubricants. Refer to exploded views in other sections of this manual as required.

## PROCEDURES

### INTAKE MANIFOLD

#### Intake Manifold Removal

Disable fuel pump using B.U.D.S. Look in the Activation tab.



Release fuel pressure by running engine until it runs out of gas.

### **WARNING**

The fuel hose may be under pressure. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the pressure. Wipe off any fuel spillage.

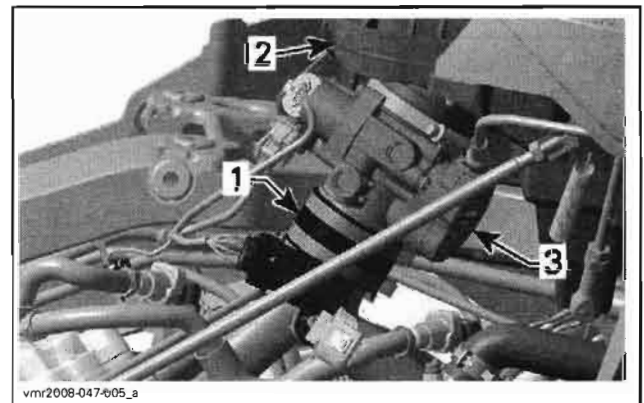
Remove seat, both side panels, central panel and dash board. Refer to *BODY*.

Remove the cover of the air filter housing.

Remove the air filter.

Unscrew bolts securing the air filter housing to frame.

Unscrew the lower clamp retaining the manifold adapter between throttle body and intake manifold.



1. Manifold adapter
2. Throttle body
3. Air filter housing

Remove the manifold adapter.

Unplug fuel lines from injectors.

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**

Disconnect both injectors and the manifold air pressure temperature sensor (MAPTS).



1. MAPTS
2. Fuel lines
3. Injectors connectors

Unscrew intake manifold from cylinders.  
 Remove intake manifold from vehicle.

**NOTE:** To remove fuel injectors from intake manifold, refer to *ENGINE MANAGEMENT*.

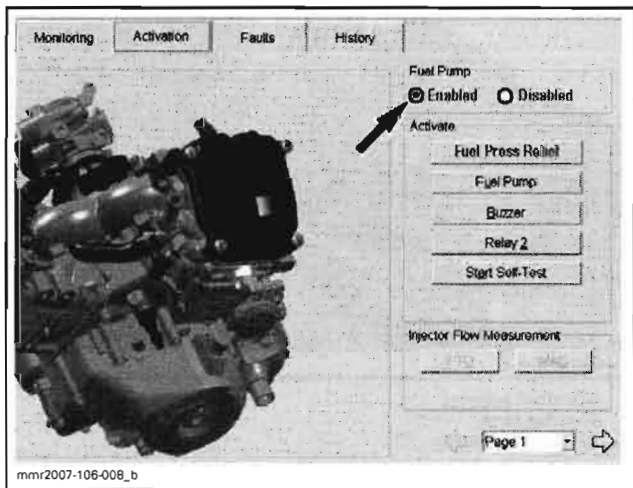
**Intake Manifold Inspection**

Check intake manifold for cracks, warping at flanges or any other damage. Replace if necessary.

**Intake Manifold Installation**

The installation is the reverse of the removal procedure. However, pay attention to the following.  
 Torque manifold screws to 20 N•m (15 lbf•ft) one cylinder at a time.

Re-enable fuel pump using B.U.D.S.

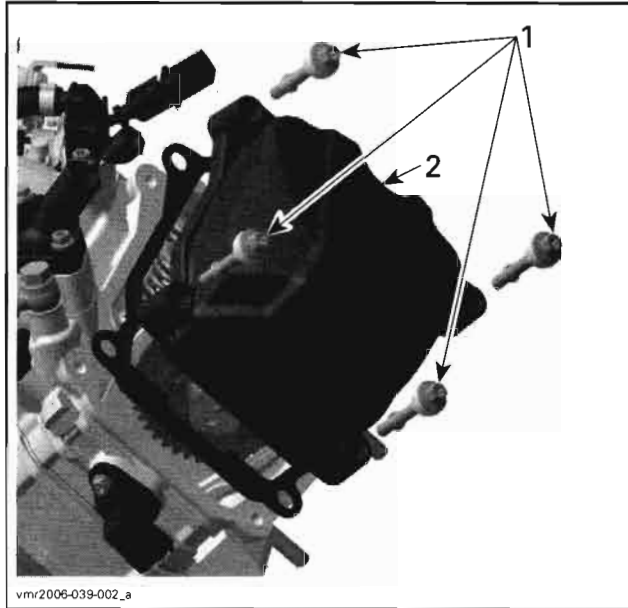


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**VALVE COVER**

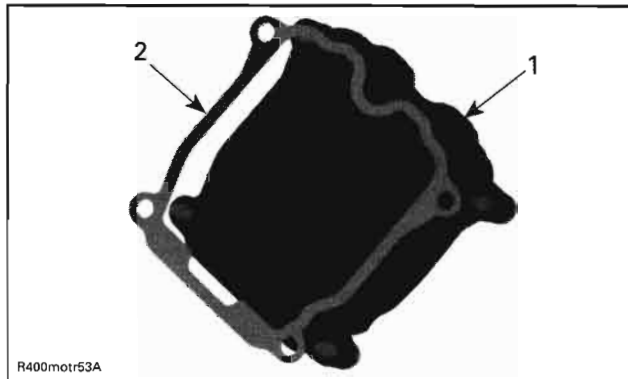
**Cover Removal**

Remove distance screws of valve cover.



1. Distance screws
2. Valve cover

Remove valve cover and gasket.



1. Valve cover
2. Gasket

Repeat the procedure for the other valve cover if required.

**Cover Inspection**

Check the gasket on the valve cover if it is brittle, cracked or hard. If so, replace the gasket.

**Cover Installation**

For installation, reverse the removal procedure.

Torque the valve cover distance screws in a criss-cross sequence.

## TIMING CHAIN TENSIONER

**NOTE:** Before removal and installation, make sure that the respective cylinder is set to TDC ignition. Refer to *CAMSHAFT*.

### Tensioner Removal

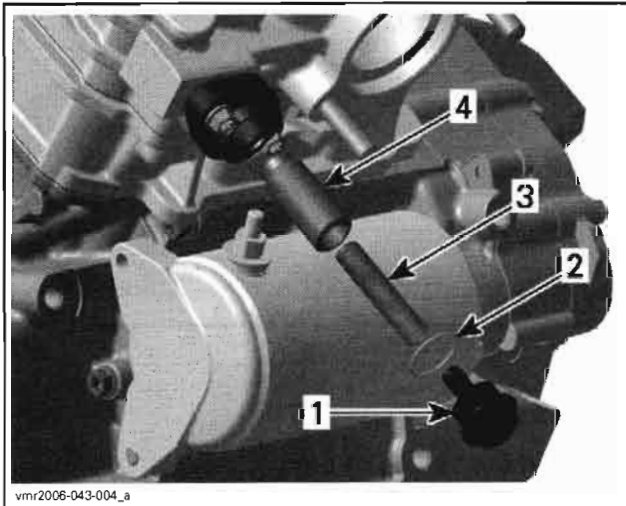
#### **WARNING**

Timing chain tensioner is spring loaded. Never perform this operation immediately after the engine has been run because the exhaust system can be very hot. Wait until exhaust system is warm or cold.

Remove chain tensioner plug.

Unscrew chain tensioner plug.

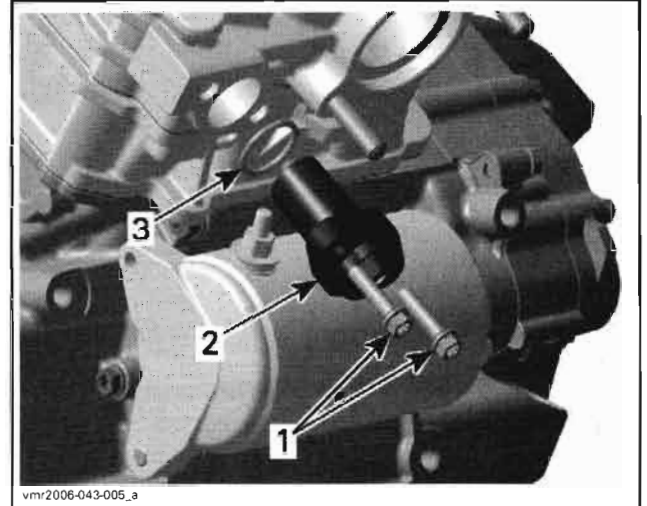
Remove O-ring, spring and chain tensioner plunger.



1. Chain tensioner plug
2. O-ring
3. Spring
4. Chain tensioner plunger

Unscrew screws retaining chain tensioner housing.

Remove chain tensioner housing with O-ring.



1. Chain tensioner screws
2. Chain tensioner housing
3. O-ring

### Tensioner Inspection

Check the housing for cracks or other damages. Replace if necessary.

Check chain tensioner plunger for free movement and/or scoring.

Check if O-rings are brittle, cracked or hard. Replace if necessary.

Check spring condition. Replace if broken or worn.

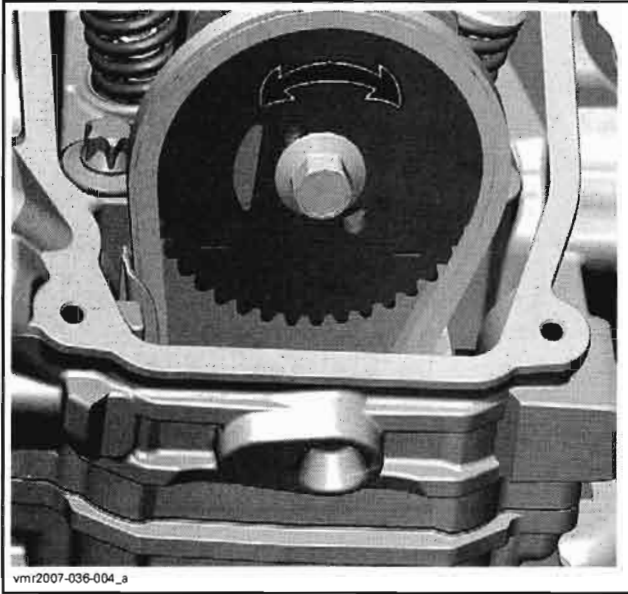
### Tensioner Installation

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

**NOTE:** Before installing the chain tensioner make sure, that the camshaft timing gear can be moved back and forth.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



MOVE GEAR BACK AND FORTH

Apply engine oil on the plunger before installing.

**NOTE:** Slightly screw in the plunger until the timing chain allows no more back and forth movement of the camshaft timing gear. Then screw in the plunger an additional 1/8 turn to reach the required torque of 0.1 N•m (.9 lbf•in).

**CAUTION:** Improper adjustment of the timing chain will lead to severe engine damage.

Fit the spring on one side into the slot of the plug screw and on the other side into the plunger. Turn spring only clockwise in order to fit the spring end into the notch of the plunger and to avoid loosening the plunger during spring installation. Do not preload the spring.

**NOTE:** Do not forget to place the O-ring on chain tensioner plug.

Then compress the spring and screw in the plug screw.

Finally, tighten the plug screw to 4.5 N•m (40 lbf•in).

## CAMSHAFT TIMING GEAR

### Gear Removal

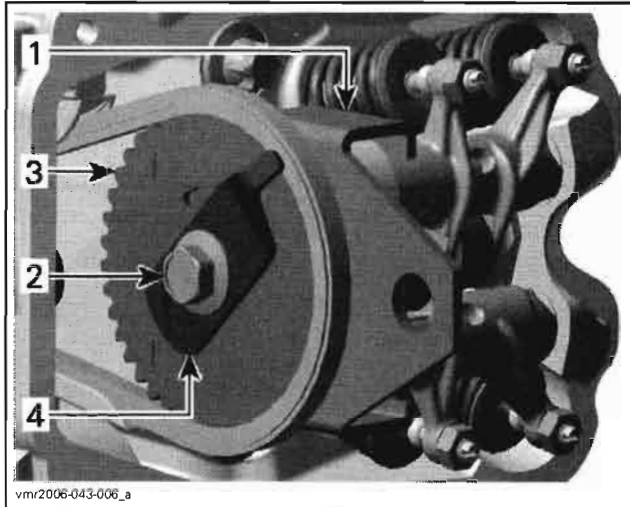
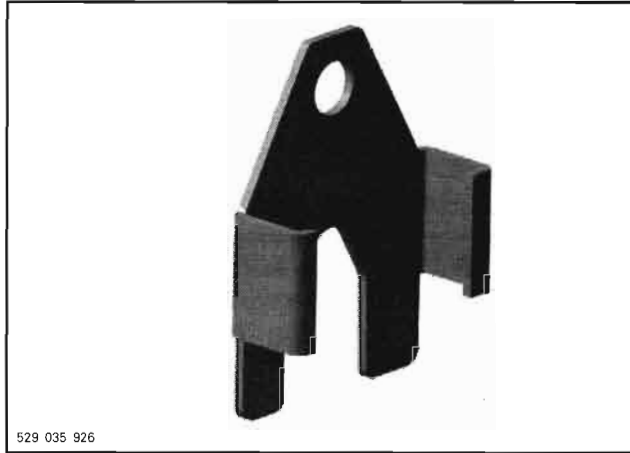
Remove the valve cover.

Turn crankshaft to TDC ignition of the respective cylinder, see *CAMSHAFT*.

Unscrew timing chain tensioner.

Remove camshaft timing gear screw.

To prevent timing chain stretching during removal of camshaft timing gear screw, use the camshaft locking tool (P/N 529 035 926).



1. Camshaft locking tool
2. Camshaft timing gear screw
3. Camshaft timing gear
4. Trigger wheel (cylinder head 1 only)

Remove the camshaft timing gear.

**NOTE:** Secure timing chain with a retaining wire.

### Gear Inspection

Check camshaft timing gear for wear or deterioration.

If gear is worn or damaged, replace it as a set (camshaft timing gear and timing chain).

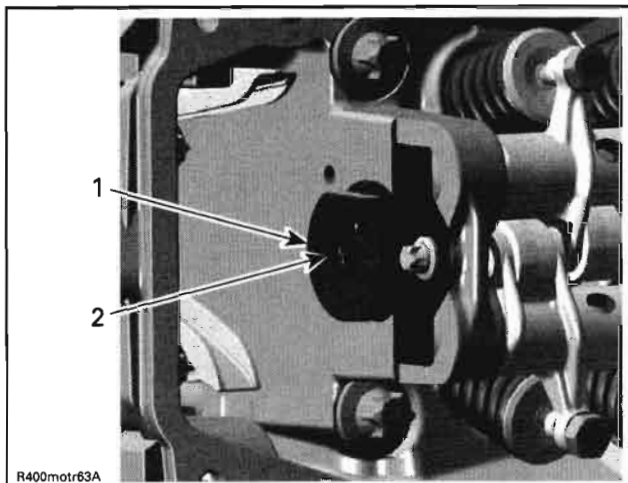
For crankshaft gear, refer to *BOTTOM END* section, see *CRANKSHAFT*.

### Gear Installation

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

Clean mating surface and threads of camshaft prior to assemble camshaft timing gear.

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**



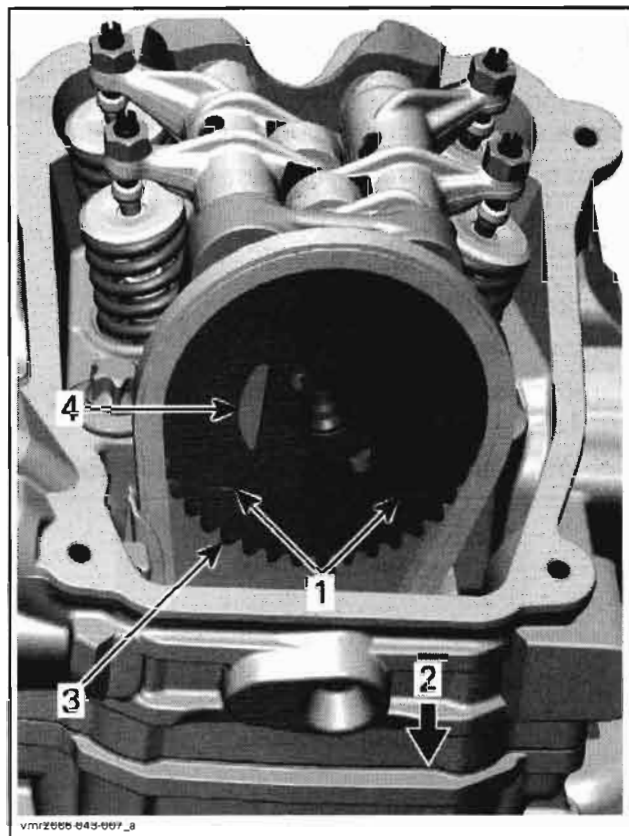
1. Mating surface on camshaft
2. Threads for camshaft screw

Camshaft timing gear and crankshaft must be at TDC ignition position before installing the timing chain.

**CAUTION:** Crankshaft and camshaft must be locked on TDC ignition position to place camshaft timing gear and timing chain in the proper position.

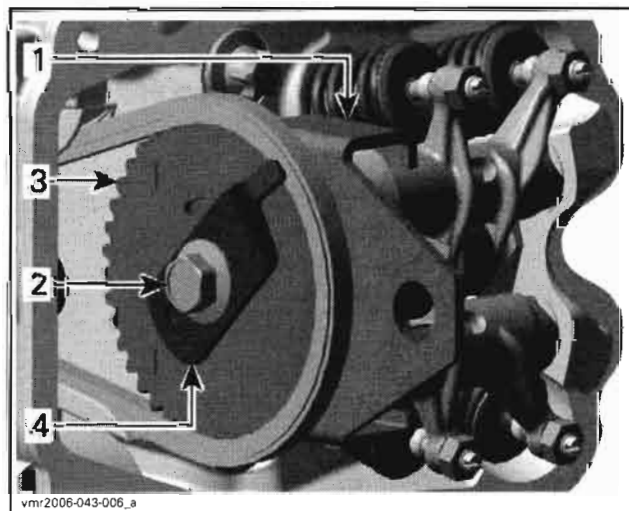
Install camshaft timing gear so that the timing gear tabs are located into the flat zone of the camshaft.

The printed marks on the camshaft timing gear must be parallel to the cylinder head base. See the following illustration for a proper positioning.



1. Printed marks on camshaft timing gear
2. Cylinder head base
3. Camshaft timing gear
4. Timing gear tab

Install trigger wheel on camshaft timing gear of cylinder 1.



1. Camshaft locking tool
2. Camshaft screw
3. Camshaft timing gear
4. Trigger wheel (cylinder head 1 only)

When the camshaft timing gear and the timing chain are installed, remove the crankshaft locking bolt as well as the camshaft locking tool.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

**NOTE:** Before installing the camshaft screw adjust the chain tension (see *CHAIN TENSIONER* below) and check again if marks on the timing gear are parallel to cylinder head base.

Reinstall all other removed parts.

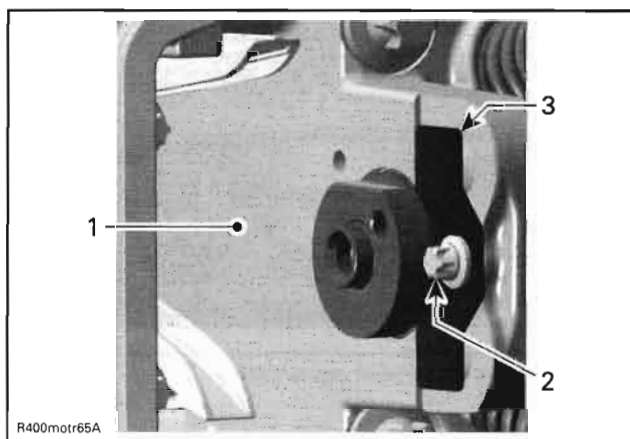
## ROCKER ARM

### Rocker Arm Removal

Remove valve cover.

Remove chain tensioner and camshaft timing gear no. 1.

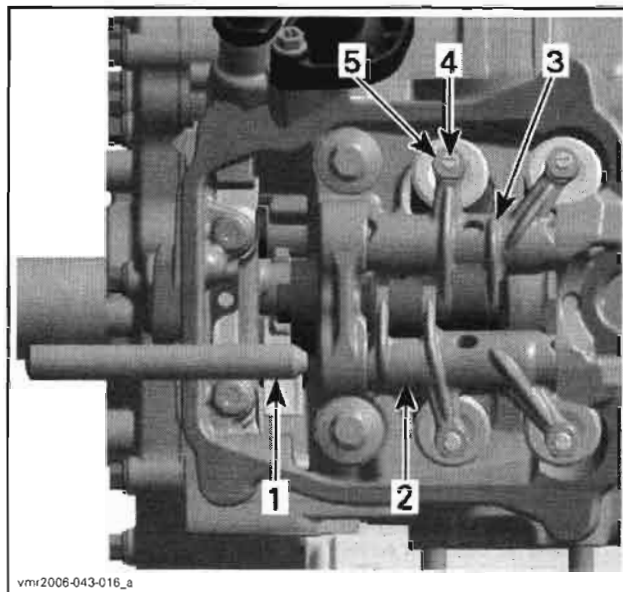
Remove Allen screw and camshaft retaining plate.



1. Cylinder head
2. Allen screw
3. Camshaft retaining plate

Remove rocker arm shafts.

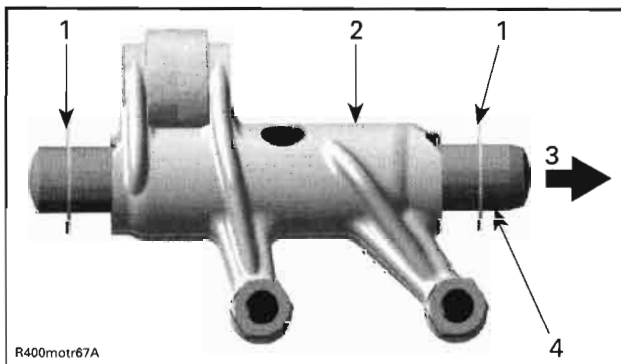
Remove rocker arm assembly (exhaust side and intake side) with adjustment screws and nuts.



1. Rocker arm shaft
2. Rocker arm (exhaust side)
3. Rocker arm (intake side)
4. Adjustment screw
5. Locking nut

Remove thrust washers no. 2.

**CAUTION:** Pay attention not to lose thrust washers or drop them into the timing chain compartment.



1. 2 thrust washers
2. Rocker arm (exhaust side)
3. Cylinder head — spark plug side
4. Big taper to spark plug side

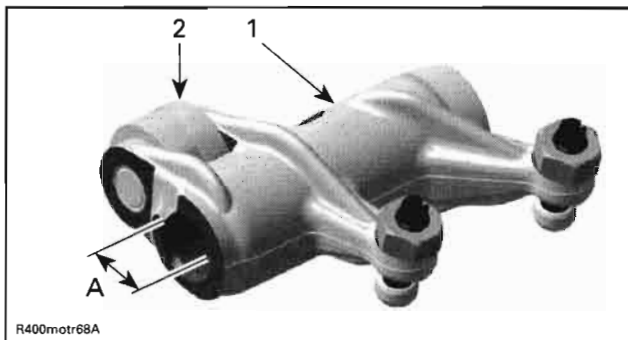
### Rocker Arm Inspection

Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly.

Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly if necessary.



**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**

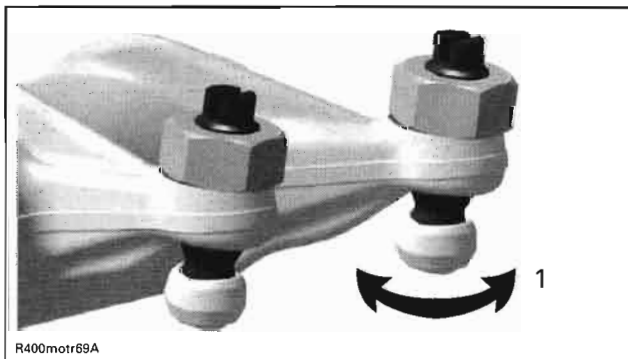


1. Rocker arm (exhaust side)
2. Roller
- A. Bore for rocker arm shaft

Measure rocker arm bore diameter. If diameter is out of specification, change the rocker arm assembly.

ROCKER ARM BORE DIAMETER	
NEW	12.036 to 12.050 mm (.4739 to .4744 in)
SERVICE LIMIT	12.060 mm (.4748 in)

Check adjustment screws for free movement, cracks and/or excessive play.

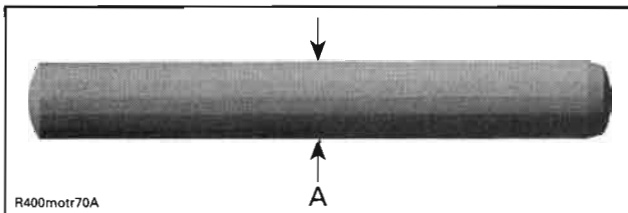


1. Free movement of adjustment screw top

### Rocker Arm Shaft

Check for scored friction surfaces; if so, replace parts.

Measure rocker arm shaft diameter.



- A. Measure rocker arm shaft diameter here

ROCKER ARM SHAFT DIAMETER	
NEW	12.000 to 12.018 mm (.4724 to .4731 in)
SERVICE LIMIT	11.990 mm (.4720 in)

Any area worn excessively will require parts replacement.

### Rocker Arm Installation

**NOTE:** Use the same procedure for exhaust and intake rocker arm.

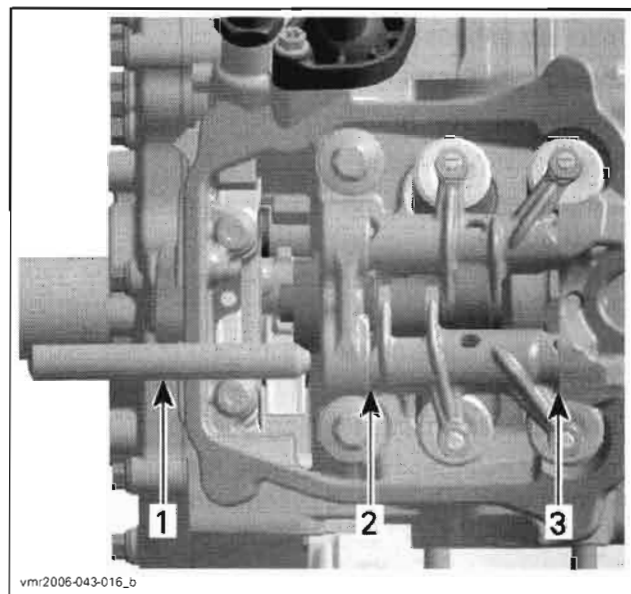
Apply engine oil on rocker arm shaft.

Install the rocker arm shafts with the chamfered edge first and use following procedure.

Insert a rocker arm pin through rocker arm pin bore.

Install a thrust washer no. 2 then the proper rocker arm no. 3 (exhaust side) or no. 4 (intake side).

Push in rocker arm shaft until its chamfer reaches the end of rocker arm bore.



1. Rocker arm shaft
2. Thrust washer (timing chain side)
3. Thrust washer (spark plug side)

Place the other thrust washer and push rocker arm shaft to end position.

Install the camshaft retaining plate no. 5.

### TIMING CHAIN

Refer to *BOTTOM END*, see *TIMING CHAIN*.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

## CYLINDER HEAD

### Cylinder Head Removal

The removal procedure is the same for both cylinder heads.

Drain coolant (refer to *COOLING SYSTEM*).

**NOTE:** Before removing cylinder head, blow out remaining coolant by air pressure. During cylinder head removal, the remaining coolant in cylinder head could overflow into the engine and a little quantity of coolant could drop into the engine. In this case, the engine oil will be contaminated.

Disconnect spark plug wire.

Disconnect temperature sensor connector, located at rear cylinder head.

Disconnect camshaft sensor, located at front cylinder head.

Remove both side panels and both inner fenders (refer to *BODY*).

Remove exhaust pipe springs or exhaust pipe clamp.

Unscrew exhaust pipe nuts.

Unplug radiator inlet hose.

Remove air filter housing.

Remove throttle body.

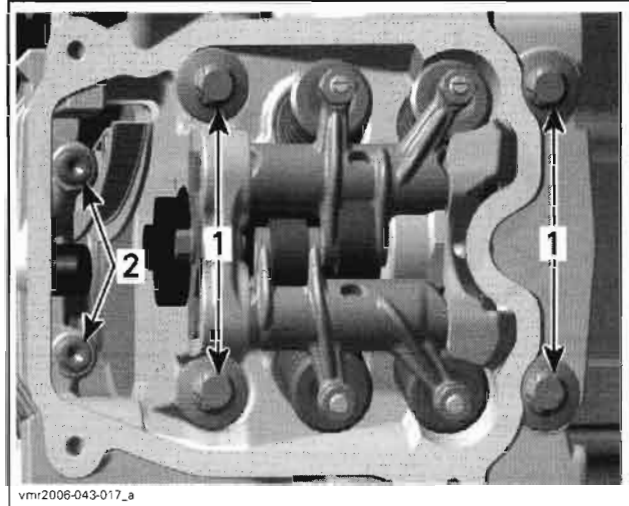
Remove the intake manifold (see *INTAKE MANIFOLD* above).

Remove the chain tensioner (see *CHAIN TENSIONER* above).

Remove the valve cover and its gasket (see *VALVE COVER* above).

Remove the camshaft timing gear.

Unscrew cylinder head screws M6 and M10 retaining cylinder head and cylinder to cylinder base.

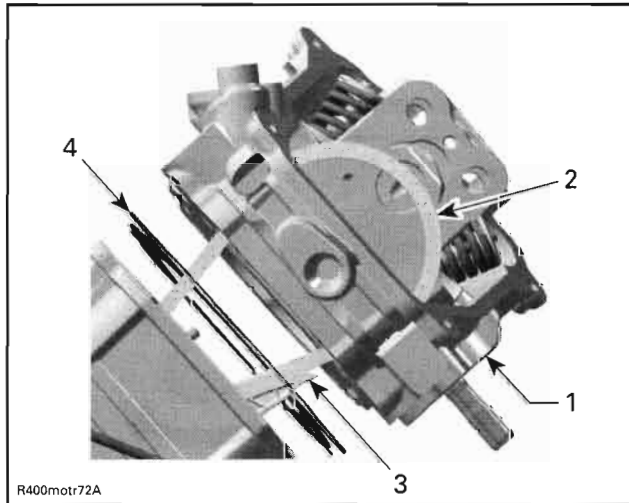


1. Cylinder head screws M10  
2. Cylinder head screws M6

Pull up cylinder head.

Remove chain guide.

Remove the cylinder head gasket and scrap it.



1. Cylinder head  
2. Timing chain  
3. Chain guide  
4. Cylinder head gasket

### Cylinder Head Inspection

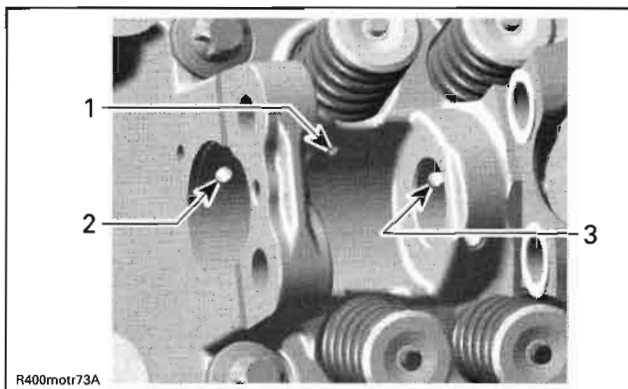
Inspect timing chain guide for wear, cracks or other damages. Replace if necessary.

Check for cracks between valve seats, if so, replace cylinder head.

Check mating surface between cylinder and cylinder head for contamination. If so, clean both surfaces.

Clean oil support through the cylinder head from contamination.

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**



1. Oil port to lubricate camshaft lobes intake/exhaust
2. Oil supply to camshaft bearing journal timing chain side
3. Oil supply to camshaft bearing journal spark plug side

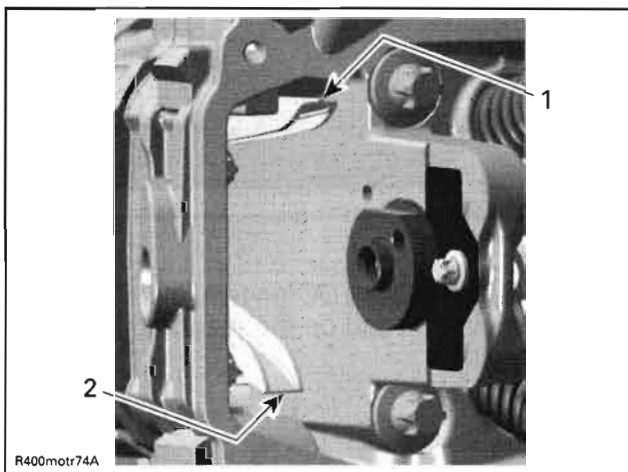
### Cylinder Head Installation

**NOTE:** The cylinder heads are not identical in design. Do not invert the cylinder heads at assembly.

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

Ensure dowel pins no. 9 are in place.

**CAUTION:** Chain guide has to be fixed between cylinder and cylinder head.

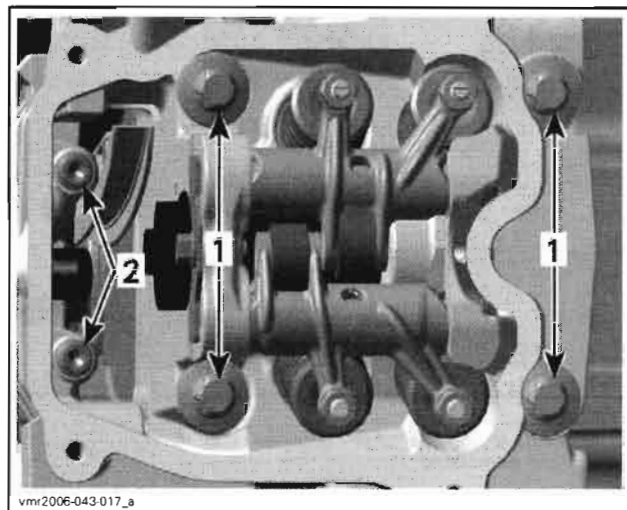


1. Chain guide (fixed between cylinder and cylinder head)
2. Chain tensioner guide (mounted in crankcase)

Install a **NEW** cylinder head gasket.

First, torque cylinder head screws M10 in criss-cross sequence to 20 N•m (15 lbf•ft) then finish by tightening to 60 N•m (44 lbf•ft).

Install cylinder head screws M6.



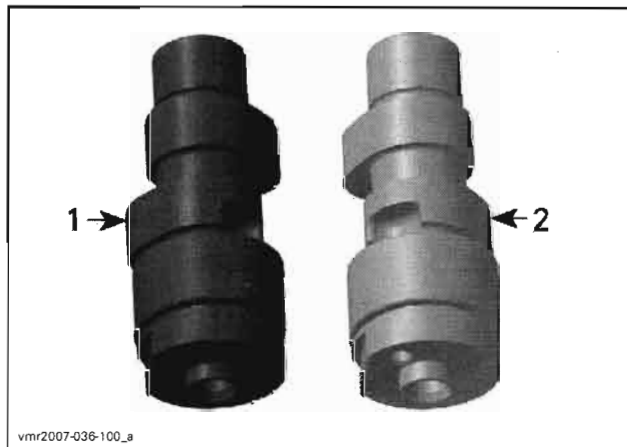
1. Cylinder head screws M10
2. Cylinder head screws M6

Check chain guide for movement.

Remove crankshaft locking bolt and reinstall plug screw with sealing ring.

### CAMSHAFT

**NOTE:** The engine is equipped with two different camshafts.



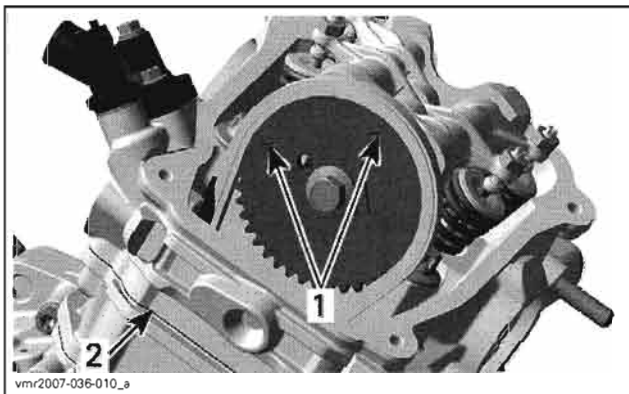
1. Camshaft of cylinder 1
2. Camshaft of cylinder 2

### Camshaft Timing

**NOTE:** If a piston (of cylinder 1 or 2) is set to TDC ignition, the camshaft timing gear of the opposite cylinder must be in the following position.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



#### TYPICAL

1. Marks on timing gear of the opposite cylinder
2. Cylinder head base

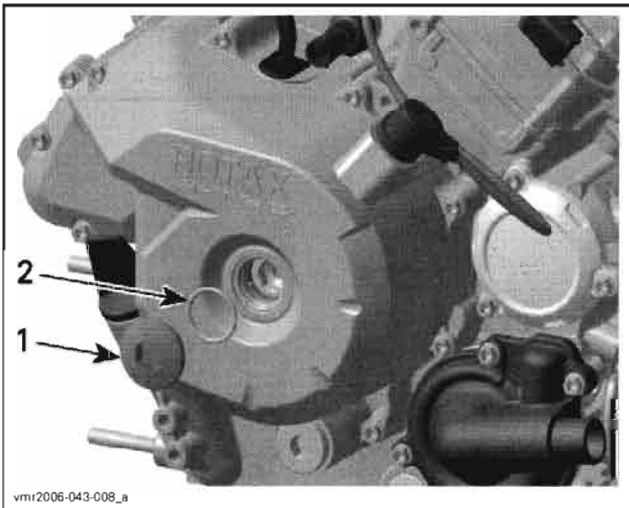
#### Camshaft Timing Cylinder 2

Turn crankshaft until piston is at TDC ignition as follows.

Remove spark plug of both cylinders.

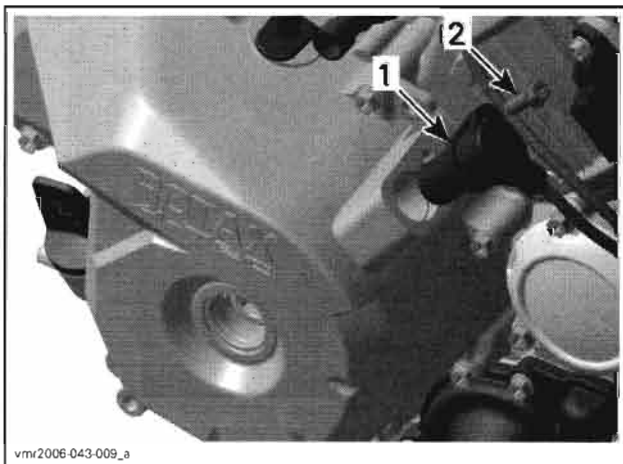
Remove valve covers of both cylinders.

Remove the plug screw and O-ring of magneto cover.



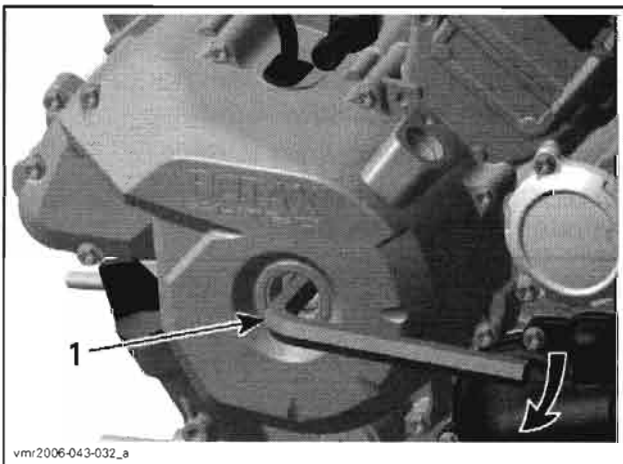
1. Plug screw
2. O-ring

Remove the crankshaft position sensor (CPS).



1. Crankshaft position sensor
2. Screw

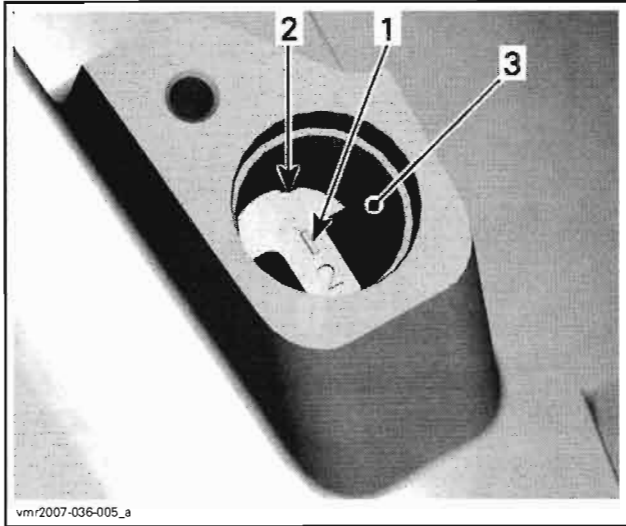
Use a 14 mm Allen key to turn crankshaft until piston 2, rear is at TDC ignition.



1. Allen key 14 mm

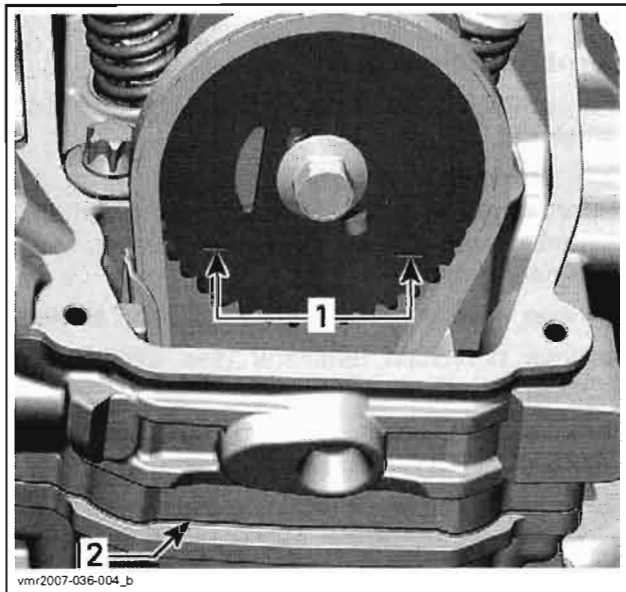
When rear piston is at TDC ignition, marks on magneto flywheel "2" and on the magneto cover are aligned.

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**



1. Mark "2" on magneto flywheel
2. Notch on magneto cover
3. Crankshaft position sensor location

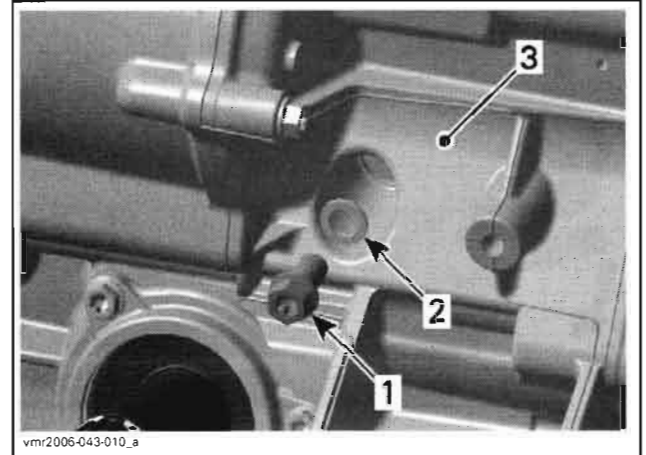
At TDC ignition, the printed marks on the camshaft timing gear have to be parallel to cylinder head base.



1. Printed marks on camshaft timing gear
2. Cylinder head base

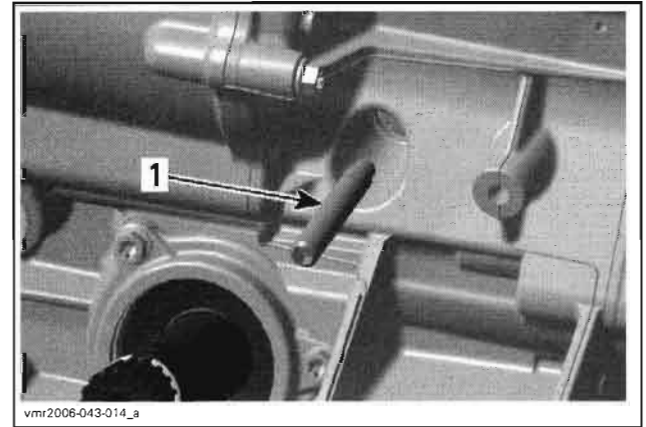
To lock crankshaft at TDC ignition, proceed as follows.

Remove from crankcase plug screw with sealing ring.



1. Plug screw
2. Sealing ring
3. Crankcase PTO side, front side

Lock crankshaft with the crankshaft locking bolt (P/N 529 035 617).



1. Crankshaft locking bolt

**NOTE:** Make sure the locking bolt engages in the groove of the crankshaft.

**Camshaft Timing Cylinder 1**

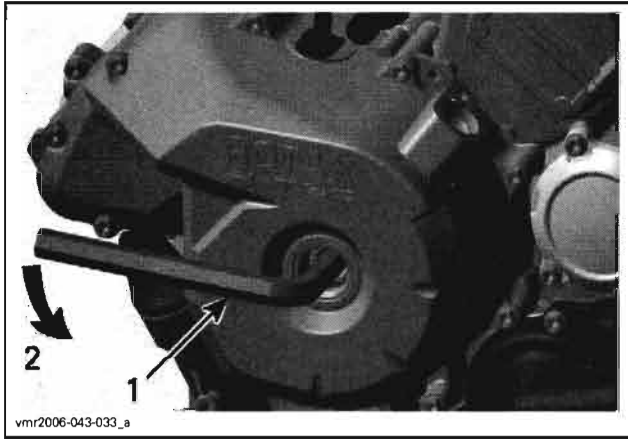
Turn cylinder 2 to TDC ignition, see *CAMSHAFT TIMING CYLINDER 2*.

**NOTE:** Do not lock crankshaft.

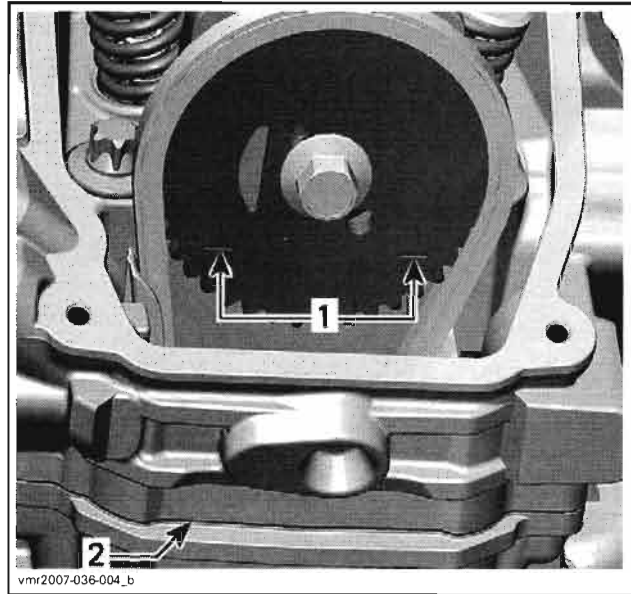
Using a 14 mm Allen key, turn crankshaft 280° counterclockwise, until marks on magneto flywheel "1" and magneto cover are aligned.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



1. Allen key 14 mm
2. Turn crankshaft 280° counterclockwise



#### TYPICAL

1. Printed marks on camshaft timing gear
2. Cylinder head base

**CAUTION:** Crankshaft can not be locked at cylinder 1 TDC ignition.

#### Camshaft Removal

The removal procedure is the same for both camshafts.

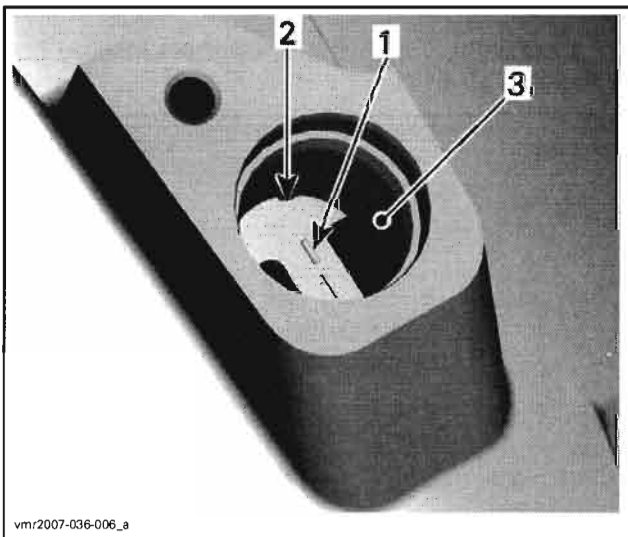
Each camshaft is different in design. Thus, it is important not to mix up any parts of the camshaft assembly with that of the other cylinder. Keep parts as a group.

Remove valve cover (see *VALVE COVER* above).

Remove the chain tensioner (see *CHAIN TENSIONER* above).

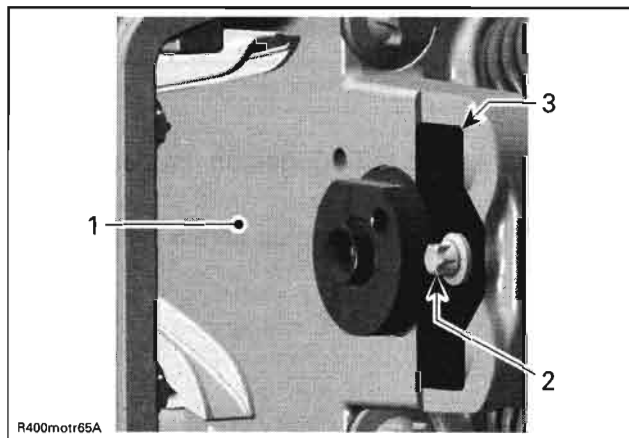
Remove the camshaft timing gear (see *CAMSHAFT TIMING GEAR* above).

Remove the camshaft retaining plate.



1. Mark "1" on magneto flywheel
2. Notch on magneto cover
3. Location of crankshaft position sensor

**NOTE:** At TDC ignition, the printed marks on the camshaft timing gear have to be parallel to cylinder head base as per following illustration.

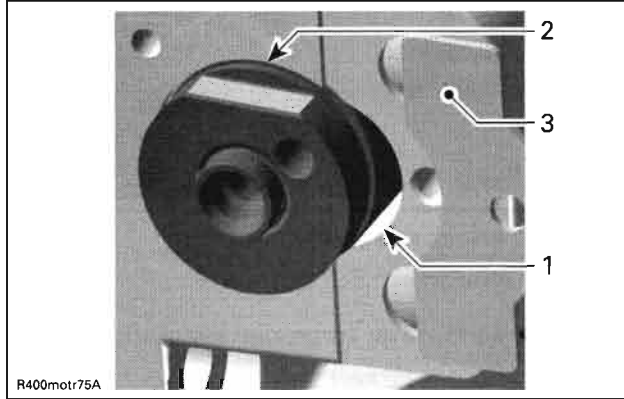


1. Cylinder head
2. Allen screw
3. Camshaft retaining plate

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**

Remove rocker arms (see *ROCKER ARM* above).  
 Remove the camshaft.

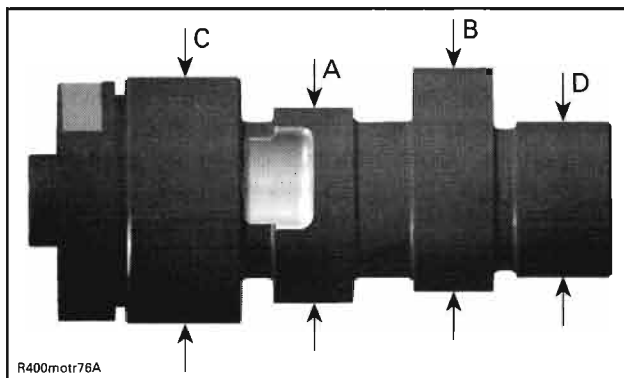
**NOTE:** For removal rotate camshaft so that intake/exhaust lobe shows to upper side of cylinder head.



1. Area for camshaft lobes
2. Camshaft
3. Camshaft retaining plate

### Camshaft Inspection

Check each lobe and bearing journal of camshaft for scoring, scuffing, cracks or other signs of wear. Measure camshaft journal diameter and lobe height using a micrometer.



- A. Camshaft lobe (exhaust valves)
- B. Camshaft lobe (intake valves)
- C. Camshaft journal (timing chain side)
- D. Camshaft journal (spark plug side)

<b>V490</b>	
<b>CAMSHAFT LOBE (exhaust)</b>	
NEW	31.730 to 31.930 mm (1.2492 to 1.2571 in)
SERVICE LIMIT	31.710 mm (1.2484 in)
<b>CAMSHAFT LOBE (intake)</b>	
NEW	31.830 to 32.030 mm (1.2531 to 1.2610 in)
SERVICE LIMIT	31.810 mm (1.2524 in)

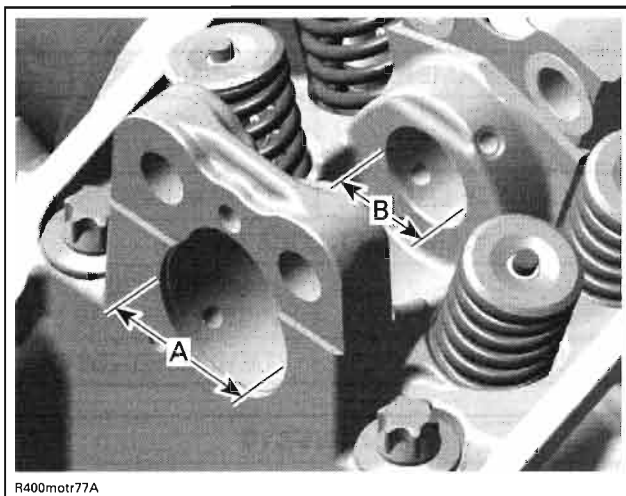
<b>V660/V810</b>	
<b>CAMSHAFT LOBE (exhaust)</b>	
NEW	31.940 to 32.140 mm (1.2575 to 1.2654 in)
SERVICE LIMIT	31.920 mm (1.2567 in)
<b>CAMSHAFT LOBE (intake)</b>	
NEW	32.110 to 32.310 mm (1.2642 to 1.2721 in)
SERVICE LIMIT	32.090 mm (1.2634 in)

<b>ALL ENGINES</b>	
<b>CAMSHAFT JOURNAL (timing chain side)</b>	
NEW	34.959 to 34.975 mm (1.3763 to 1.3770 in)
SERVICE LIMIT	34.950 mm (1.3760 in)
<b>CAMSHAFT JOURNAL (spark plug side)</b>	
NEW	21.959 to 21.980 mm (.8645 to .8654 in)
SERVICE LIMIT	21.950 mm (.8642 in)

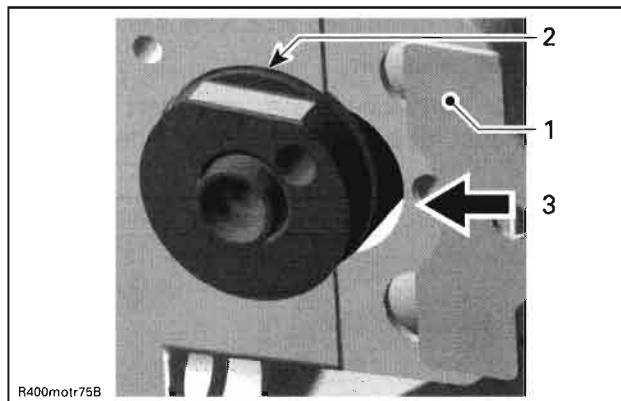
Measure clearance between both ends of camshaft and cylinder head.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



A. Camshaft bearing (timing chain side)  
B. Camshaft bearing (spark plug side)



1. Camshaft retaining plate position  
2. Slot retaining camshaft  
3. Direction of movement

For other parts, refer to proper installation procedure.

ALL ENGINES	
<b>CAMSHAFT BEARING (timing chain side)</b>	
NEW	35.000 to 35.025 mm (1.3780 to 1.3789 in)
SERVICE LIMIT	35.040 mm (1.3795 in)
<b>CAMSHAFT BEARING (spark plug side)</b>	
NEW	22.000 to 22.021 mm (.8661 to .8670 in)
SERVICE LIMIT	22.040 mm (.8677 in)

Replace parts that are not within specifications.

#### Camshaft Installation

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

**CAUTION:** The camshafts are not identical in design. Do not invert the camshafts during assembly. Any mix-up of the components will lead to engine damage.

Place the camshaft retaining plate in the slot of the camshaft.

## VALVE SPRING

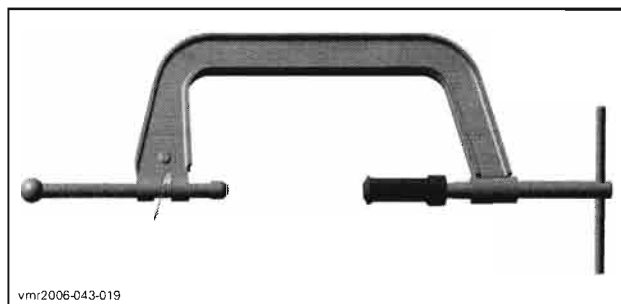
### Valve Spring Removal

Remove rocker arms (see *ROCKER ARM* above). Remove cylinder head (see *CYLINDER HEAD* above).

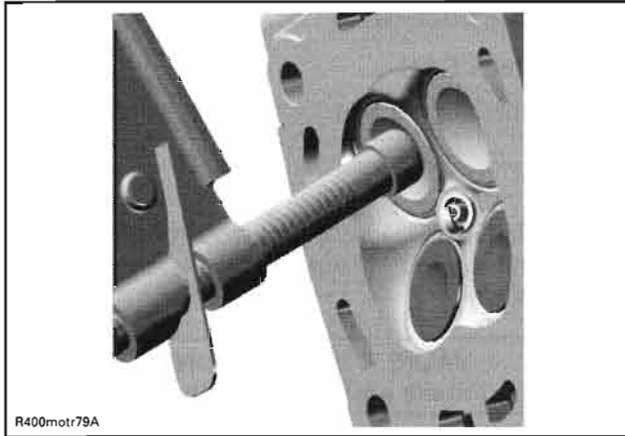
Compress valve spring no. 6; use valve spring compressor clamp (P/N 529 035 724) and valve spring compressor cup (P/N 529 035 764).

**⚠ WARNING**

Always wear safety glasses when disassembling valve springs. Be careful when unlocking valves. Components could fly away because of the strong spring preload.

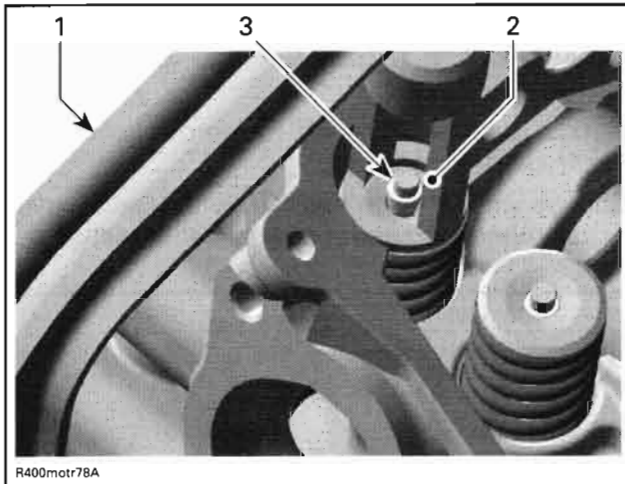






**LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE**

Remove valve cotters.



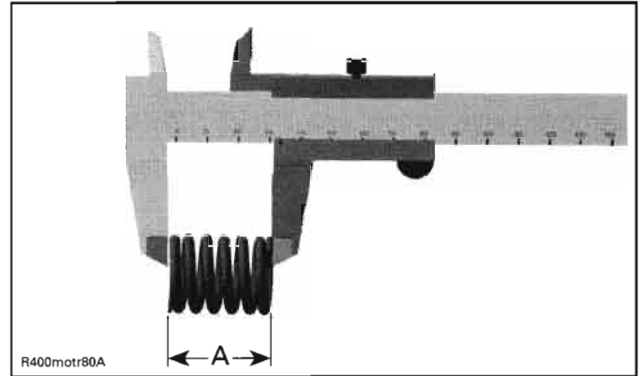
1. Valve spring compressor clamp
2. Valve spring compressor cup
3. Valve cotter

Withdraw valve spring compressor, valve spring retainer no. 7 and valve spring no. 6.

### Valve Spring Inspection

Check valve spring for visible damages. If so, replace valve spring.

Check valve spring for free length and straightness.



A. Valve spring length

VALVE SPRING FREE LENGTH	
NOMINAL NEW	40.81 mm (1.607 in)
SERVICE LIMIT	39.00 mm (1.535 in)

Replace valves springs if not within specifications.

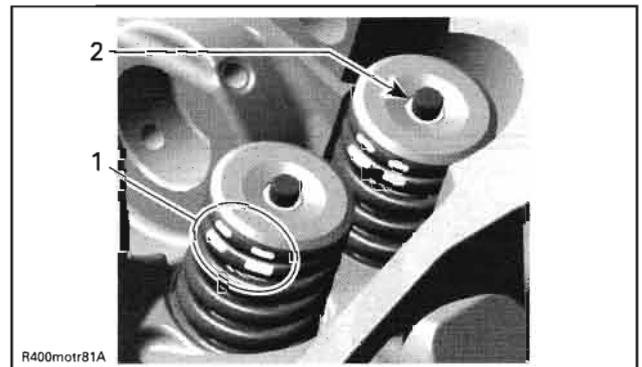
### Valve Spring Installation

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

Colored area of the valve spring must be placed on top.

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

**NOTE:** Valve cotter must be properly engaged in valve stem grooves.



1. Position of the valve spring
2. Valve cotter

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

**CAUTION:** An improperly locked valve spring will cause engine damage.

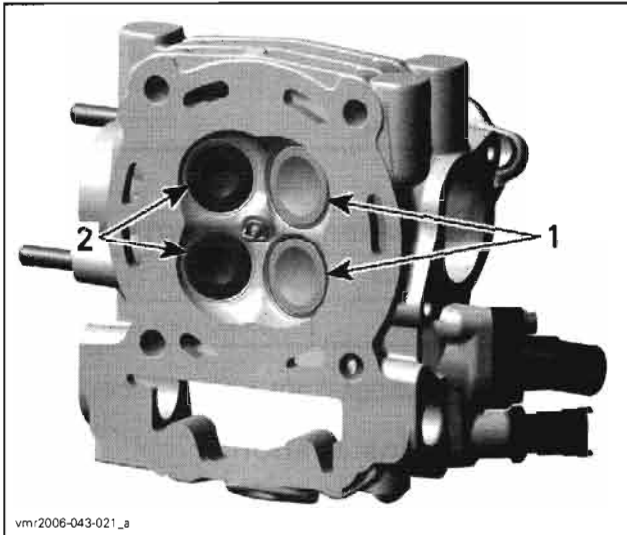
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

## VALVE

### Valve Removal

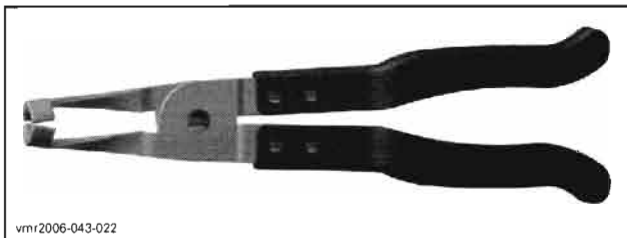
Remove valve spring, see *VALVE SPRING* above.  
Push valve stem, then pull valves (intake and exhaust) out of valve guide.



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1. Intake valves 31 mm
2. Exhaust valves 27 mm

Remove valve stem seal no. 8 with Snap-on pliers (P/N YA 8230) and discard it.



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### Valve Inspection

#### Valve Stem Seal

Always install new seals whenever valves are removed.

#### Valve

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

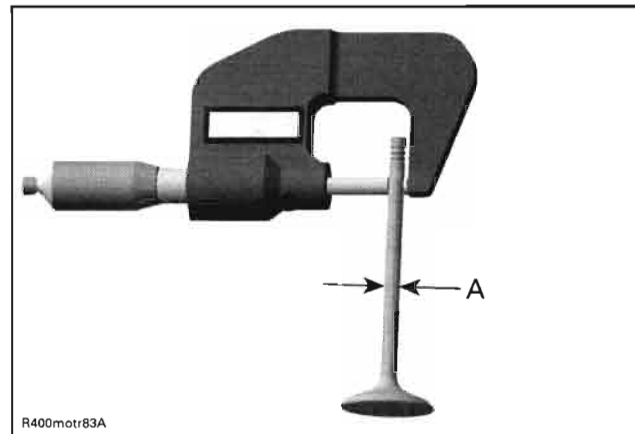
VALVE OUT OF ROUND (intake and exhaust valves)	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

#### Valve Stem and Valve Guide Clearance

Measure valve stem and valve guide in three places using a micrometer and a small bore gauge.

**NOTE:** Clean valve guide to remove carbon deposits before measuring.

Change valve if valve stem is out of specification or has other damages such as wear or friction surface.



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A. Valve stem diameter

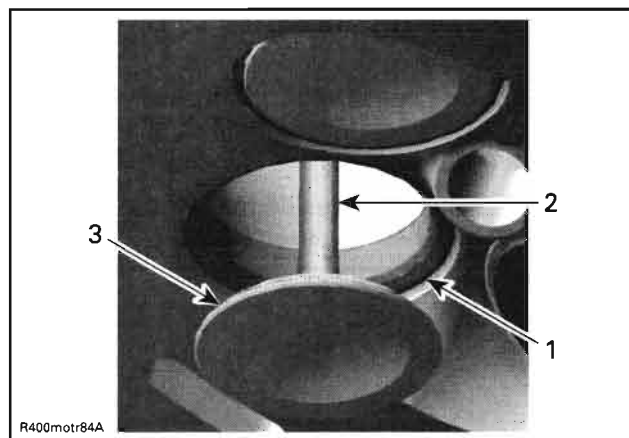
VALVE STEM DIAMETER	
<b>EXHAUST VALVE</b>	
NEW	4.956 to 4.970 mm (.1951 to .1957 in)
SERVICE LIMIT	4.930 mm (.1941 in)
<b>INTAKE VALVE</b>	
NEW	4.966 to 4.980 mm (.1955 to .1960 in)
SERVICE LIMIT	4.930 mm (.1941 in)

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**

Replace valve guide out of cylinder head if valve guide is out of specification or has other damages such as wear or friction surface (see *VALVE GUIDE PROCEDURE* below).

<b>VALVE GUIDE DIAMETER (intake and exhaust valves)</b>	
<b>NEW</b>	4.998 to 5.018 mm (.1968 to .1976 in)
<b>SERVICE LIMIT</b>	5.050 mm (.1988 in)

**Valve Face and Seat**



1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

Check valve face and seat for burning or pittings and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound to valve face and work valve on its seat with a lapping tool (see *VALVE GUIDE PROCEDURE* below).

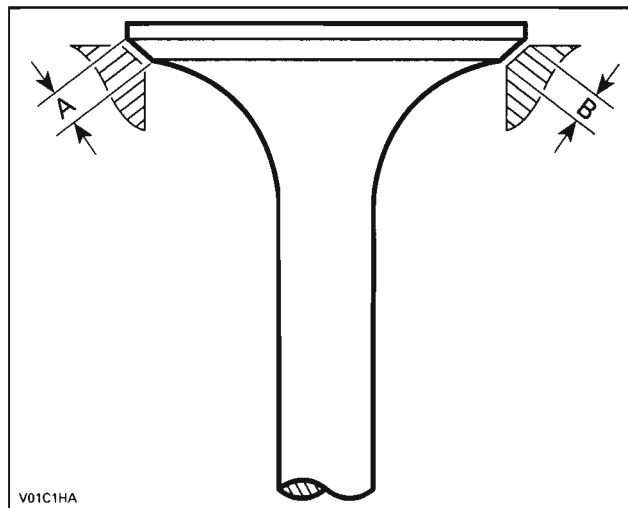
Measure valve face contact width.

**NOTE:** The location of contact area should be in center of valve seat.

Measure valve seat width using a caliper.

<b>VALVE SEAT CONTACT WIDTH</b>	
<b>EXHAUST VALVE</b>	
<b>NEW</b>	1.25 to 1.55 mm (.049 to .061 in)
<b>SERVICE LIMIT</b>	2.00 mm (.078 in)
<b>INTAKE VALVE</b>	
<b>NEW</b>	1.05 to 1.35 mm (.041 to .053 in)
<b>SERVICE LIMIT</b>	1.80 mm (.070 in)

If valve seat contact width is too wide or has dark spots, replace the cylinder head.



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

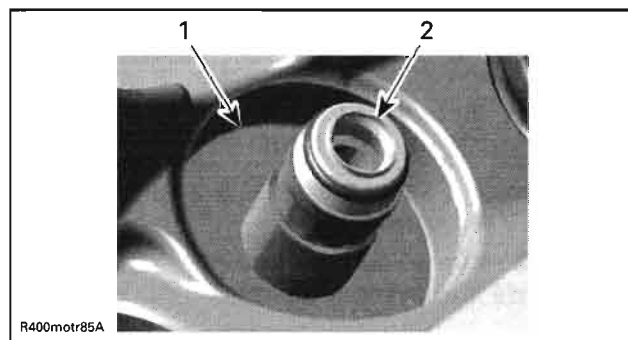
**Valve Installation**

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

Install a **NEW** valve stem seal. Make sure thrust washer is installed before installing seal.

Apply engine oil on valve stem and install it.

**CAUTION:** Be careful when valve stem is passed through sealing lips of valve stem seal.



1. Thrust washer
2. Sealing lips of valve stem seal

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

**CAUTION:** An improperly locked valve spring will cause engine damage.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

## VALVE GUIDE

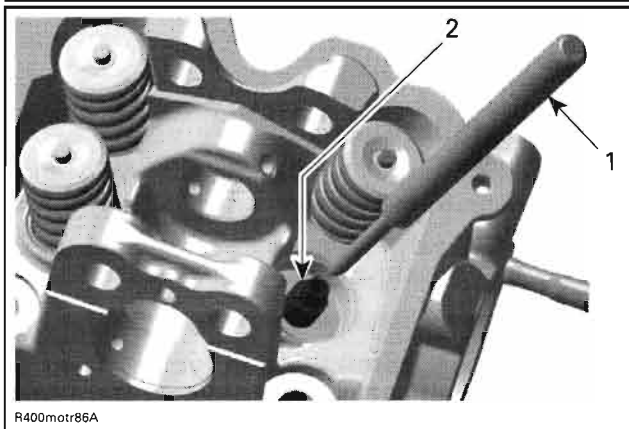
### Valve Guide Removal

Remove cylinder head (see *CYLINDER HEAD* above).

Remove valves (see *VALVE* above).

**NOTE:** Clean valve guide area from contamination before removal.

Using the valve guide remover (P/N 529 035 924) and a hammer, drive the valve guide out of cylinder head.



1. Valve guide remover
2. Valve guide

### Valve Guide Inspection

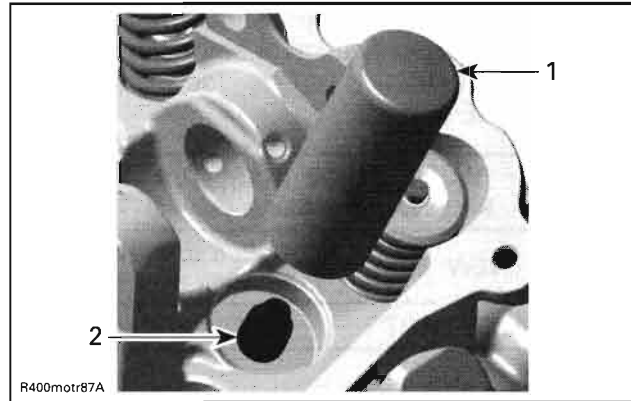
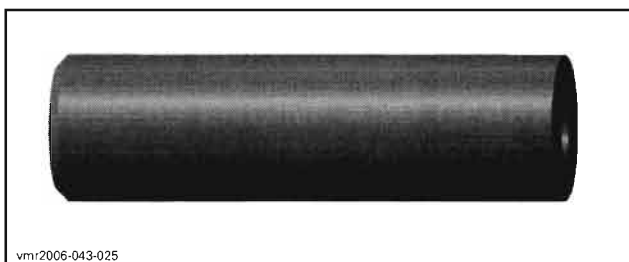
Always replace valve stem seals whenever valve guides are removed.

Clean the valve guide bore before reinstalling the valve guide into cylinder head.

### Valve Guide Installation

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

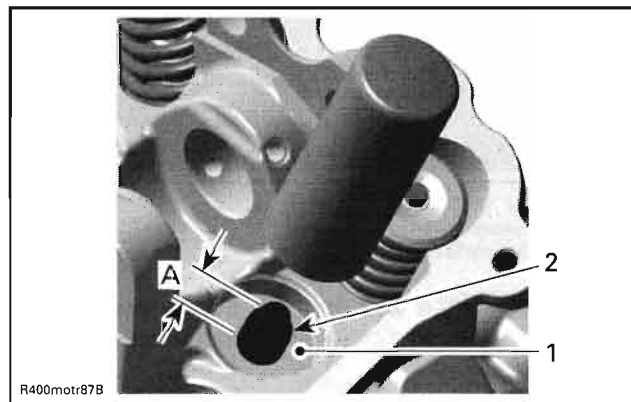
Use the valve guide installer (P/N 529 035 853) to install valve guide.



1. Valve guide installer
2. Valve guide

**NOTE:** Apply Loctite 767 (antiseize lubricant) (P/N 293 800 070) on valve guide prior to install it into the cylinder head.

**CAUTION:** Push valve guide in the cold cylinder head as per following illustration.

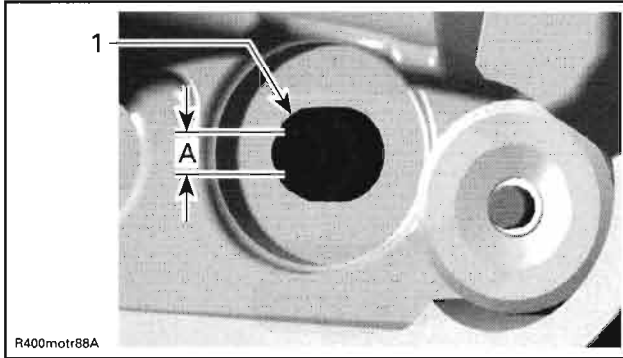


1. Thrust surface of cylinder head
  2. Valve guide
- A. Measurement from thrust surface to valve guide top

VALVE GUIDE (measurement "A")	
NEW	14.00 to 14.40 mm (.5512 to .5669 in)

Valve guide to be adjusted in diameter by using a reamer.

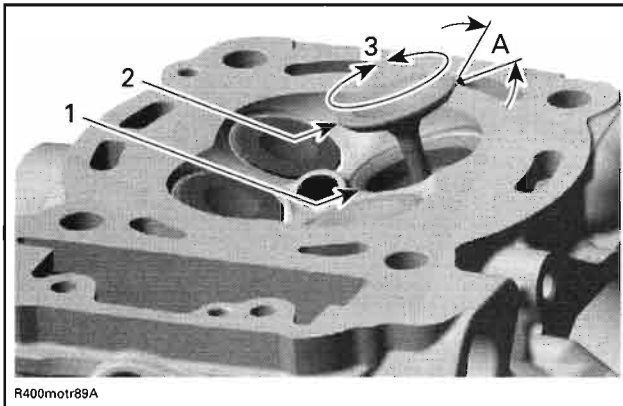
VALVE GUIDE DIAMETER (intake and exhaust valves)	
NEW	4.998 to 5.018 mm (.1968 to .1976 in)



1. Valve guide  
 A. Valve guide diameter

**NOTE:** Ensure to turn reamer in the right direction. Use cutting oil and make brakes to clean reamer/valve guide from metal shavings.

Apply some lapping compound to valve face and work valve on its seat with a lapping tool.



1. Valve seat  
 2. Valve face (contact surface to valve seat)  
 3. Turn valve while pushing against cylinder head  
 A. Valve seat angle 45°

**NOTE:** Ensure to seat valves properly. Apply marking paste to ease checking contact pattern.

Repeat procedure until valve seat/valve face fits together.

## CYLINDER

### Cylinder Removal

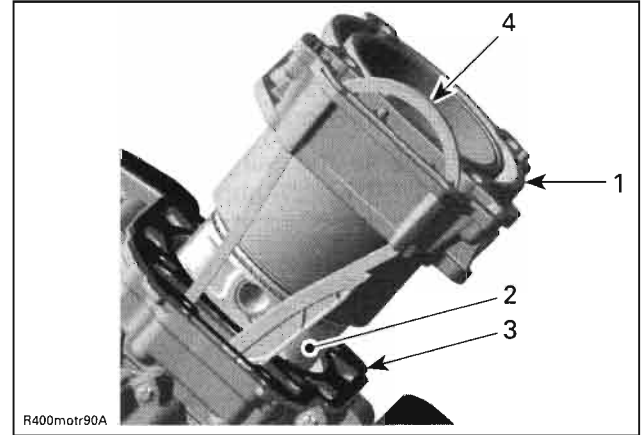
Remove chain tensioner (see *CHAIN TENSIONER*).

Remove the camshaft timing gear (see *CAMSHAFT TIMING GEAR*).

Remove the cylinder head (see *CYLINDER HEAD*).

Pull cylinder.

Discard cylinder base gaskets.



1. Cylinder  
 2. Piston assembly  
 3. Cylinder base gasket  
 4. Camshaft timing chain

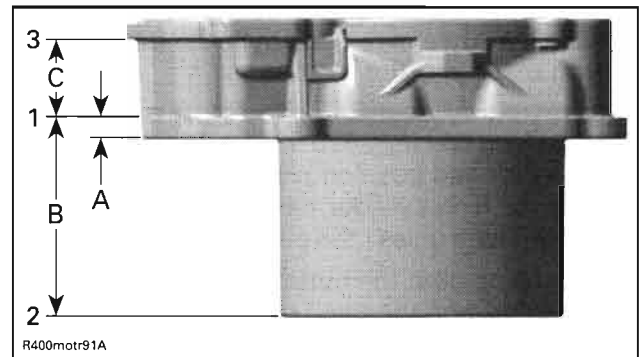
### Cylinder Inspection

Check cylinder for cracks, scoring and wear ridges on the top and bottom of the cylinder. If so, replace cylinder.

### Cylinder Taper

Measure cylinder bore and if it is out of specifications, replace cylinder and piston rings.

Measure cylinder bore at 3 recommended positions. See the following illustration.



1. First measuring of diameter  
 2. Second measuring of diameter  
 3. Third measuring of diameter  
 A. 7 mm (.276 in) from cylinder bottom  
 B. 68 mm (2.68 in)  
 C. 32 mm (1.260 in)

CYLINDER TAPER IN DIAMETER	
NEW (maximum)	0.038 mm (.0015 in)
SERVICE LIMIT	0.090 mm (.0035 in)

Distance between measurements should not exceed the service limit mentioned above.

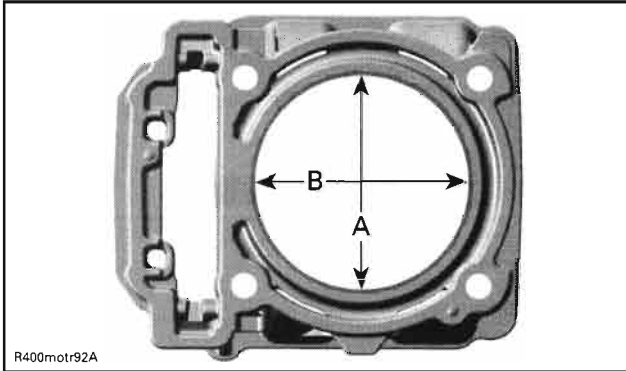
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)

#### Cylinder Out of Round

Measure cylinder diameter in piston axis direction from top of cylinder. Take another measurement 90° from first one and compare.

**NOTE:** Take the same measuring points like described in *CYLINDER TAPER* above.



A. Perpendicular to crankshaft axis  
B. Parallel to crankshaft axis

#### CYLINDER OUT OF ROUND

NEW (maximum)	0.015 mm (.0006 in)
SERVICE LIMIT	0.020 mm (.0008 in)

#### Cylinder Installation

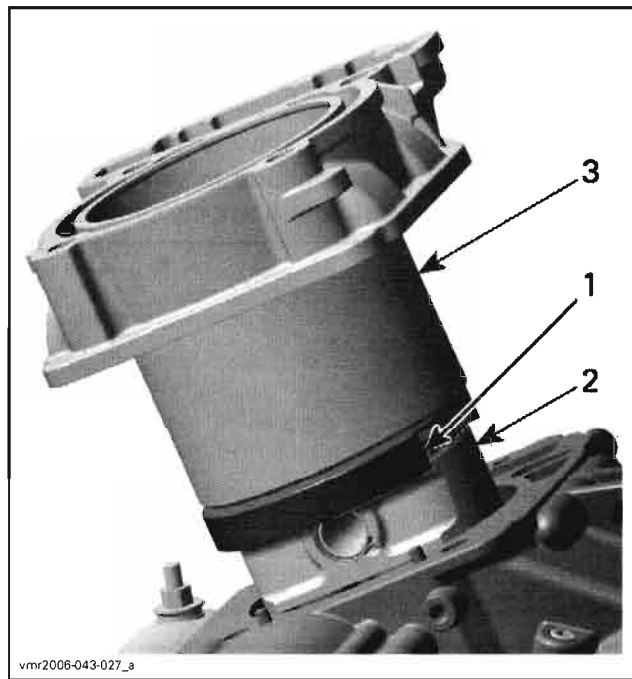
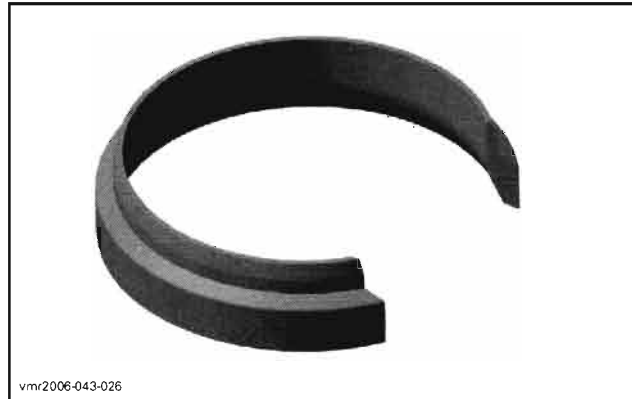
For installation, reverse the removal procedure. Pay attention to the following details.

**CAUTION:** Always replace cylinder base gasket before installing the cylinder.

First mount cylinder 2. Then remove the crankshaft locking bolt (P/N 529 035 617). Crank the engine further and position piston 1 at TDC. Mount cylinder 1. The cylinder can not be pushed fully over the piston unless the piston is located at TDC.

Apply engine oil in the bottom area of the cylinder bore and also on the band of the piston ring compressor tool.

ENGINE	TOOL
V490/V660	Piston ring compressor (P/N 529 035 977)
V810	Piston ring compressor (P/N 529 035 919)



1. Piston ring compressor tool
2. Piston
3. Cylinder

**NOTE:** Put timing chain through the chain pit then put the cylinder in place.

**CAUTION:** Chain guide has to be fixed between cylinder and cylinder head.

**NOTE:** After both cylinders are installed, turn crankshaft until piston of cylinder 2 is at TDC ignition and lock crankshaft. Refer to *CAMSHAFT*.

Install cylinder head and the other parts in accordance with the proper installation procedures.

## PISTON

### Piston Removal

Remove cylinder head (see *CYLINDER HEAD* above).

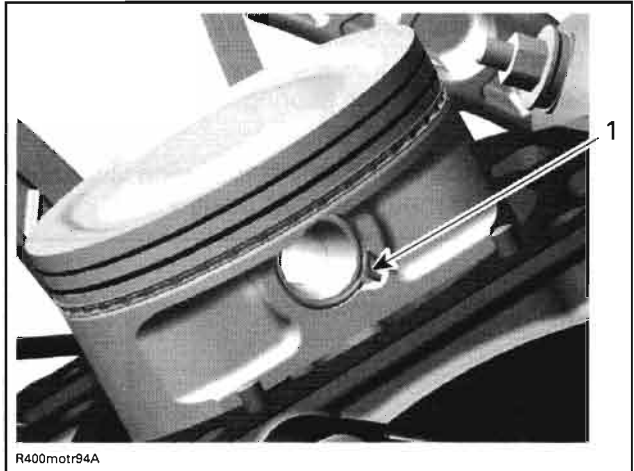
Remove the cylinder (see *CYLINDER* above).

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**

Place a rag under piston and in the area of timing chain compartment.

**⚠ WARNING**  
**Piston circlips are spring loaded.**

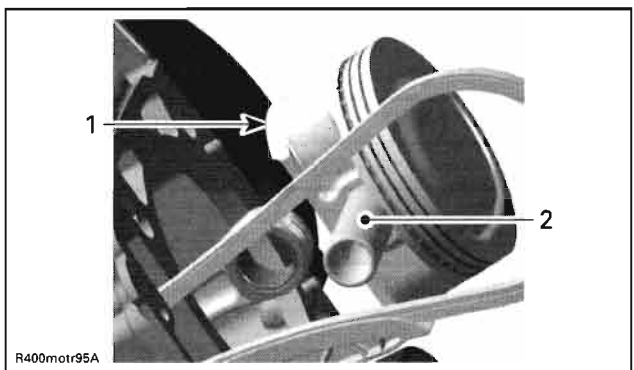
Remove one piston circlip and discard it.



1. Piston circlip

**NOTE:** The removal of both piston circlips is not necessary to remove piston pin.

Push piston pin out of piston.



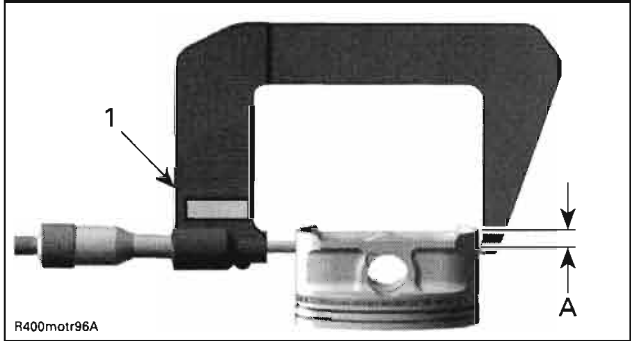
1. Piston  
 2. Piston pin

Detach piston from connecting rod.

**Piston Inspection**

Inspect piston for scoring, 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.



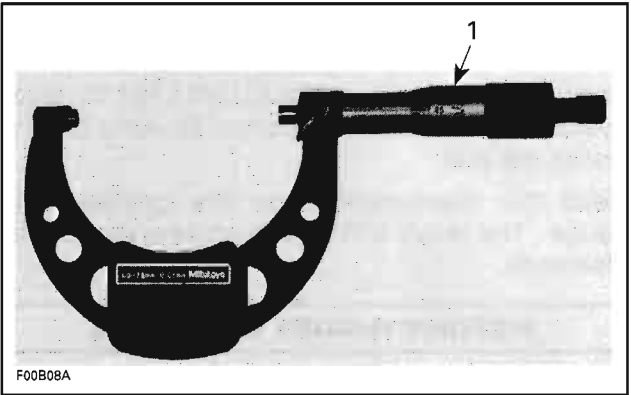
1. Measuring perpendicularly (90°) to piston pin  
 A. 8 mm (.315 in)

The measured dimension should be as described in the following tables. If not, replace piston.

<b>PISTON MEASUREMENT</b>	
<b>V490/V660</b>	
<b>NEW</b>	81.950 to 81.966 mm (3.2264 to 3.2270 in)
<b>SERVICE LIMIT</b>	81.850 mm (3.2224 in)
<b>V810</b>	
<b>NEW</b>	90.950 to 90.966 mm (3.5807 to 3.5813 in)
<b>SERVICE LIMIT</b>	90.850 mm (3.577 in)

**Piston/Cylinder Clearance**

Adjust and lock a micrometer to the piston dimension.

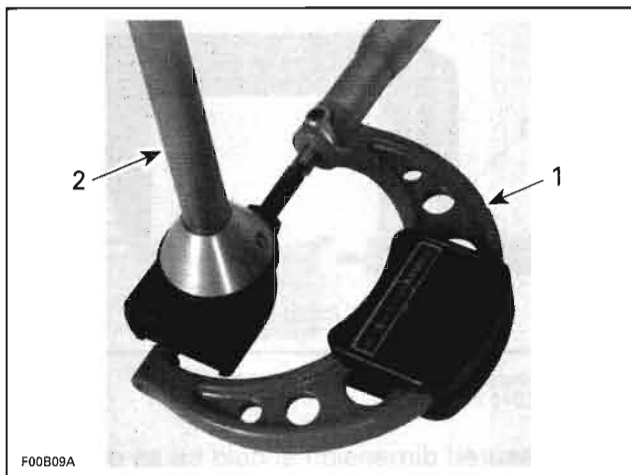


1. Micrometer set to the piston dimension

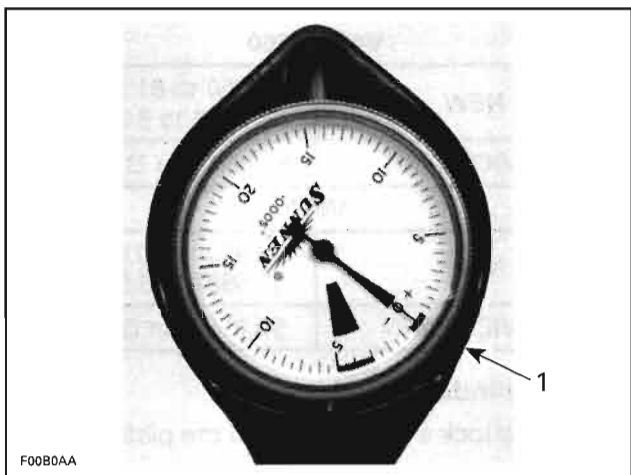
With the micrometer set to the dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



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



- TYPICAL**
1. Indicator set to 0 (zero)

Position the dial bore gauge 20 mm (.787 in) above cylinder base, measuring perpendicularly (90°) to piston pin axis.

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

PISTON/CYLINDER CLEARANCE	
V490/V660	
NEW	0.057 to 0.087 mm (.0022 to .0034 in)
SERVICE LIMIT	0.130 mm (.0051 in)
V810	
NEW	0.027 to 0.057 mm (.0011 to .0022 in)
SERVICE LIMIT	0.100 mm (.0040 in)

If clearance exceeds specified tolerance, replace piston by a new one and measure piston/cylinder clearance again.

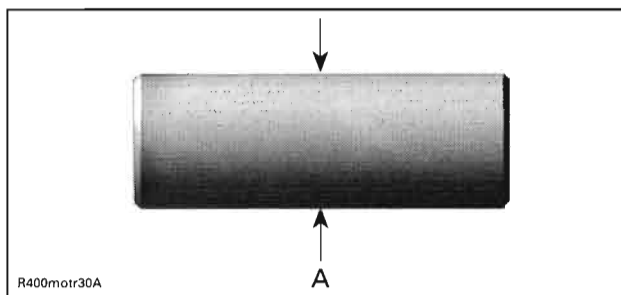
**NOTE:** Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

#### Connecting Rod/Piston Pin Clearance

Using synthetic abrasive woven, clean piston pin from deposits.

Inspect piston pin for scoring, cracking or other damages.

Measure piston pin. See the following illustration for the proper measurement positions.



A. Piston pin diameter

PISTON PIN DIAMETER	
V490	
NEW	17.996 to 18.000 mm (.7085 to .7087 in)
SERVICE LIMIT	17.980 mm (.7079 in)
V660/V810	
NEW	19.996 to 20.000 mm (.7872 to .7874 in)
SERVICE LIMIT	19.980 mm (.7866 in)

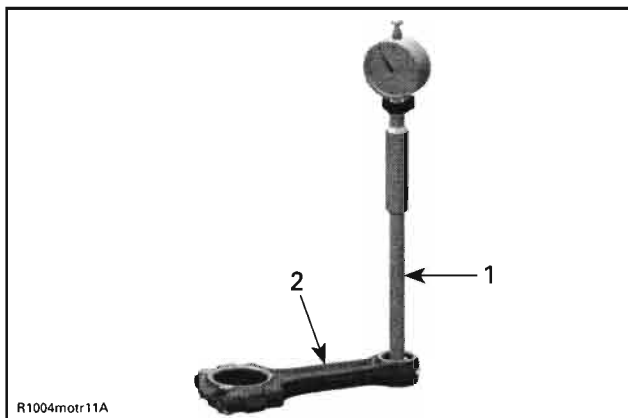
Replace piston pin if diameter is out of specifications.

Measure inside diameter of connecting rod small end bushing.

**NOTE:** Make sure used piston is not worn.



**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)**



1. Bore gauge
2. Connecting rod

<b>CONNECTING ROD SMALL END DIAMETER</b>	
<b>V490</b>	
NEW	18.010 to 18.020 mm (.7091 to .7095 in)
SERVICE LIMIT	18.060 mm (.7110 in)
<b>V660/V810</b>	
NEW	20.010 to 20.020 mm (.7878 to .7882 in)
SERVICE LIMIT	20.060 mm (.7898 in)

Replace connecting rod if diameter of connecting rod small end is out of specifications. Refer to *BOTTOM END* for removal procedure.

Compare measurements to obtain the connecting rod/piston pin clearance.

<b>CONNECTING ROD/ PISTON PIN CLEARANCE</b>	
<b>ALL ENGINES</b>	
SERVICE LIMIT	0.080 mm (.0035 in)

### Piston Installation

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

Apply engine oil on the piston pin.

Insert piston pin into piston and connecting rod.

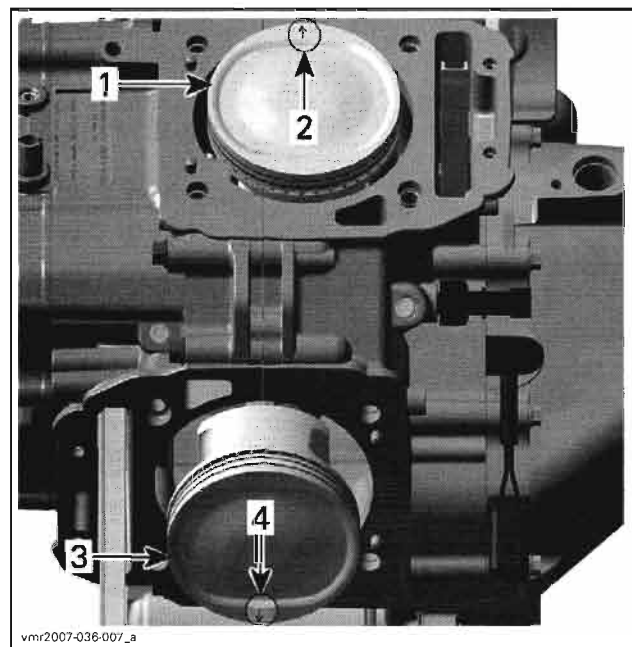
**CAUTION:** The mounting direction of the pistons is different between the V490/V660 and the V810.

#### V490 and V660 Engines

For each cylinder, install piston with the punched arrow on piston dome is pointing toward the exhaust side.

**Front cylinder:** Mark on top of piston must show to exhaust side.

**Rear cylinder:** Mark on top of piston must show to exhaust side.



1. Piston of cylinder 1
2. Mark on piston must show to exhaust side of cylinder 1
3. Piston of cylinder 2
4. Mark on piston must show to exhaust side of cylinder 2

#### V810 Engines

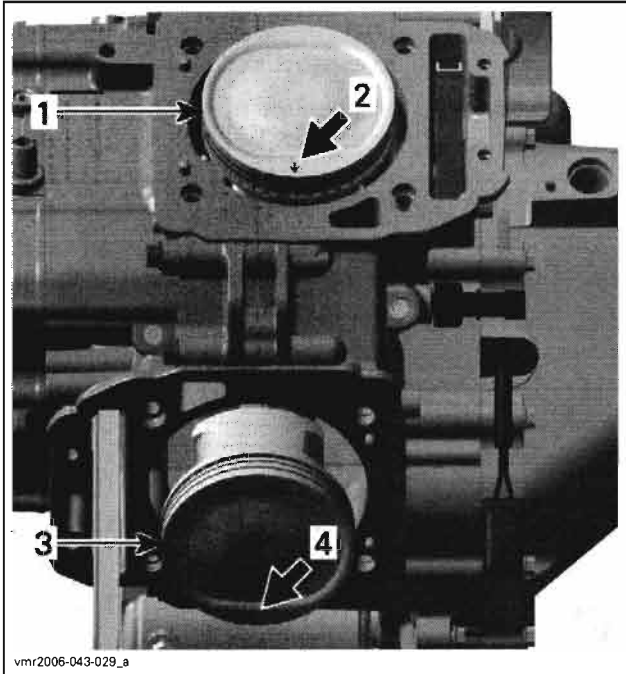
For each cylinder, install piston with the punched arrow on piston dome is pointing toward the rear side of the engine.

**Front cylinder:** Mark on top of piston must show to intake side.

**Rear cylinder:** Mark on top of piston must show to exhaust side.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



1. Piston of cylinder 1
2. Mark on piston must show to intake side of cylinder 1
3. Piston of cylinder 2
4. Mark on piston must show to exhaust side of cylinder 2

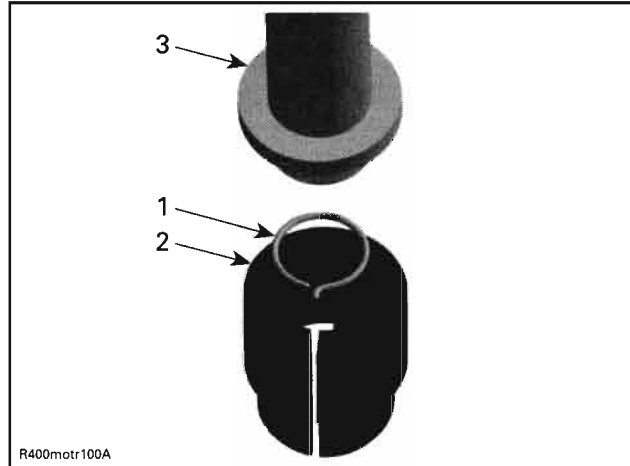
Use the piston appropriate circlip installer to assemble the **NEW** piston circlip as per following procedure:

ENGINE TYPE	TOOL
V490	Circlip installer (P/N 529 036 058)
V660 and V810	Circlip installer (P/N 529 035 921)



**CAUTION:** Always replace disassembled piston circlip(s) by new ones. Place a rag on cylinder base to avoid dropping the circlip inside the engine.

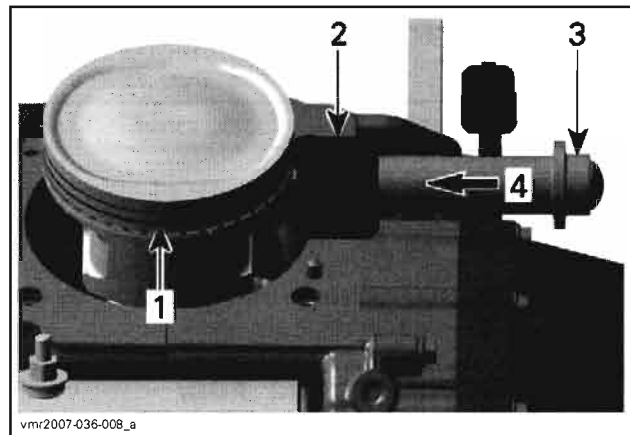
Place circlip in sleeve as per following illustration.



1. Circlip
2. Sleeve
3. Assembly jig from piston clip installer

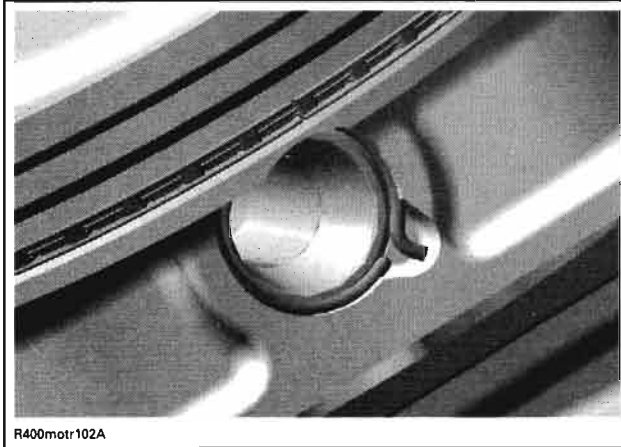
Push taper side of assembly jig until circlip reaches middle of sleeve.

Align sleeve with piston pin axis and push assembly jig until circlip engages in piston.



1. Hold piston while pushing circlip in place
2. Sleeve
3. Assembly jig
4. Direction to push circlip

**NOTE:** Take care that the hook of the piston circlip is positioned properly.



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**CORRECT POSITION OF THE PISTON CIRCLIP**

## PISTON RINGS

### Ring Removal

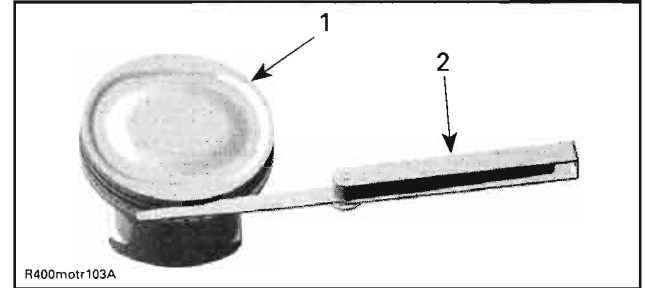
Remove the piston (see *PISTON* above).

### Ring Inspection

#### Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance. If the clearance is too large, the piston and the piston rings should be replaced.

<b>RING/PISTON GROOVE CLEARANCE</b>	
<b>UPPER COMPRESSION RING</b>	
NEW	0.030 to 0.070 mm (.0012 to .0028 in)
SERVICE LIMIT	0.150 mm (.0059 in)
<b>LOWER COMPRESSION RING</b>	
NEW	0.020 to 0.060 mm (.0008 to .0024 in)
SERVICE LIMIT	0.150 mm (.0059 in)
<b>OIL SCRAPER RING</b>	
NEW	0.010 to 0.180 mm (.0004 to .0071 in)
SERVICE LIMIT	0.250 mm (.0098 in)



R400motr103A

1. Piston
2. Feeler gauge

### Ring End Gap

<b>RING END GAP</b>	
<b>UPPER COMPRESSION RING</b>	
NEW	0.20 to 0.40 mm (.008 to .016 in)
SERVICE LIMIT	1.50 mm (.059 in)
<b>LOWER COMPRESSION RING</b>	
NEW	0.20 to 0.40 mm (.008 to .016 in)
SERVICE LIMIT	1.50 mm (.059 in)
<b>OIL SCRAPER RING</b>	
NEW	0.20 to 0.70 mm (.008 to .028 in)
SERVICE LIMIT	1.50 mm (.059 in)

To measure the ring end gap place the ring in the cylinder in the area of 8 to 16 mm (5/16 to 5/8 in) from top of cylinder.

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

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

### Ring Installation

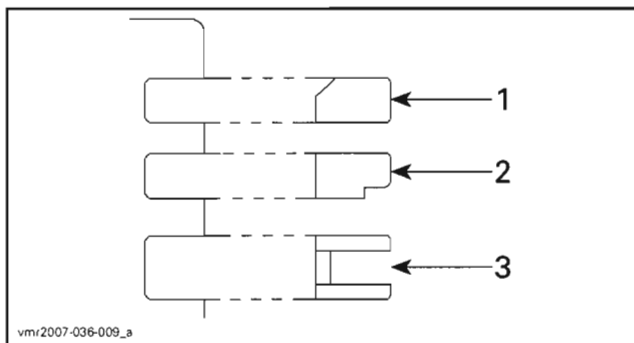
For installation, reverse the removal procedure. Pay attention to the following details.

**NOTE:** First install spring and then rings of oil scraper ring.

Install the oil scraper ring first, then the lower compression ring with the word "N and TOP " facing up, then the upper compression ring with the word "N and TOP" facing up.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 07 (INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER)



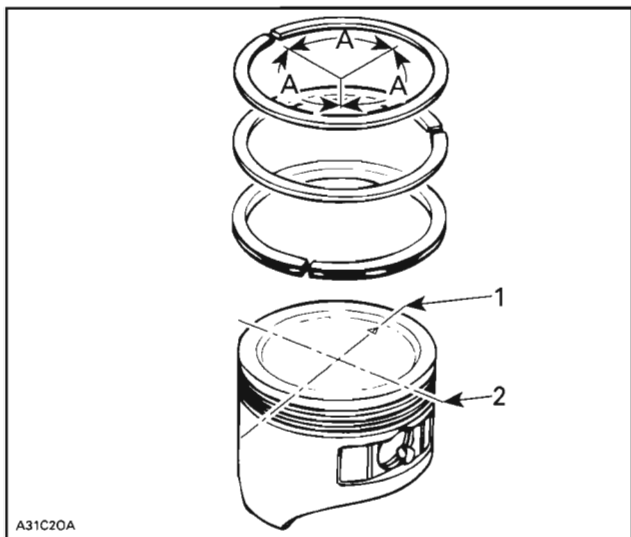
1. Upper compression ring
2. Lower compression ring
3. Oil scraper ring

**CAUTION:** Ensure that top and second rings are not interchanged.

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

Check that rings rotate smoothly after installation.

Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.



1. DO NOT align ring gap with piston thrust side axis
2. DO NOT align ring gap with piston pin bore axis
- A. 120°

# BOTTOM END

## SERVICE TOOLS

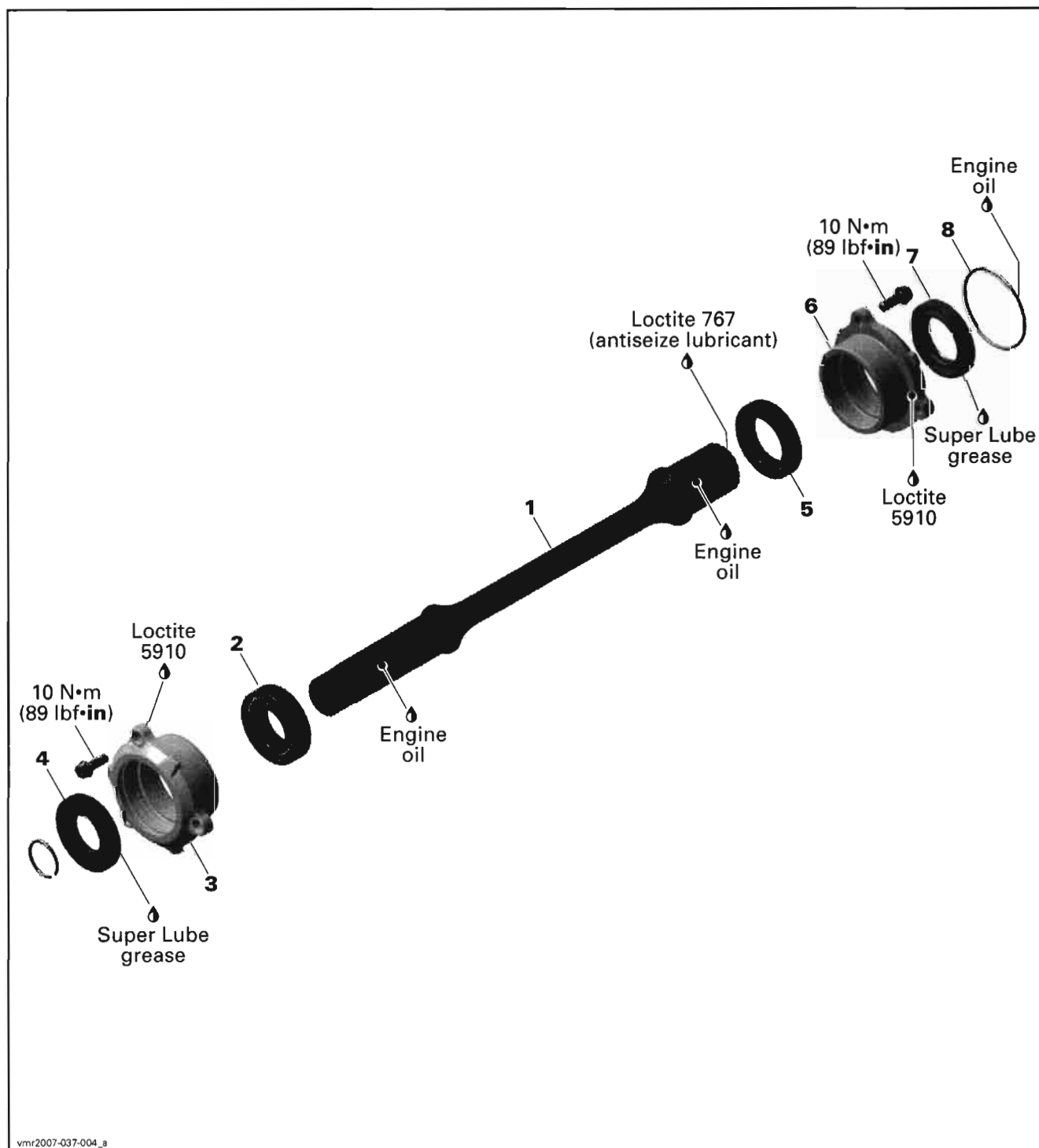
Description	Part Number	Page
crankshaft locking bolt.....	529 035 617 .....	129
plain bearing remover/installer.....	529 035 917 .....	126
oil seal installer .....	529 036 028 .....	118
oil seal protection sleeve .....	529 036 029 .....	118
crankcase support sleeve .....	529 036 031 .....	126
plain bearing remover/installer.....	529 036 032 .....	120-121
oil seal installer .....	529 036 033 .....	119

## SERVICE PRODUCTS

Description	Part Number	Page
Loctite 5910.....	293 800 081 .....	118
Loctite chisel .....	413 708 500 .....	118

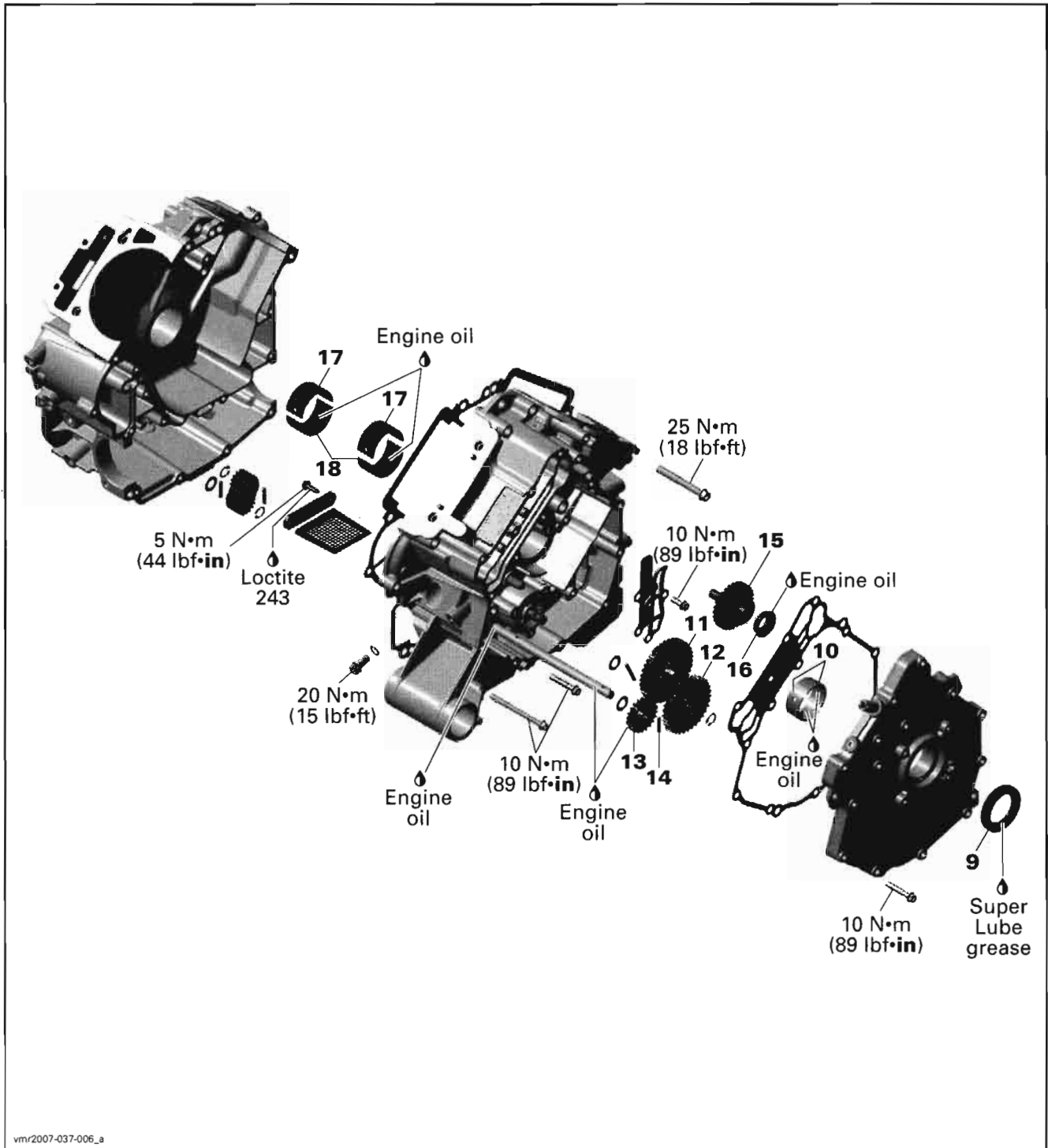


**ENGINE DRIVE SHAFT**

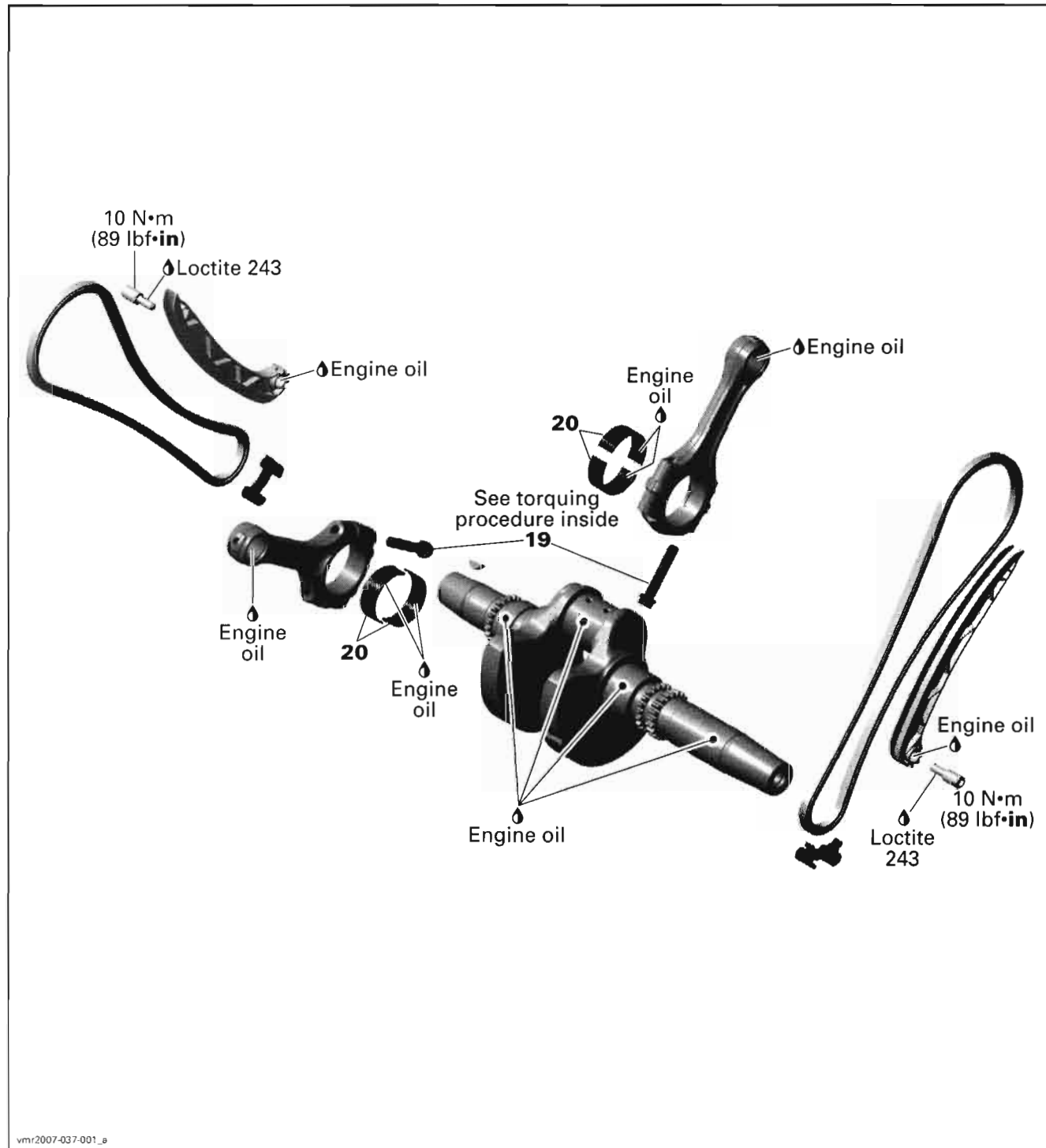


vmr2007-037-004\_a

### CRANKCASE AND PTO COVER



CRANKSHAFT



vmr2007-037-001\_a



## GENERAL

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

Clean threads before applying a threadlocker. Refer to *SELF-LOCKING FASTENERS* and *LOCTITE APPLICATION* in *INTRODUCTION* section.

### WARNING

Torque wrench tightening specifications must strictly be adhered to.

Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pin, etc.) must be replaced with new ones where specified.

## PROCEDURES

### ENGINE DRIVE SHAFT

#### Oil Seal Removal

To remove the front oil seal no. 4, no need to remove the engine. Lift the front of vehicle to avoid engine oil spillage. Separate the front propeller shaft from engine, refer to *FRONT DRIVE*.

For the rear oil seal no. 7 the gearbox removal is necessary.

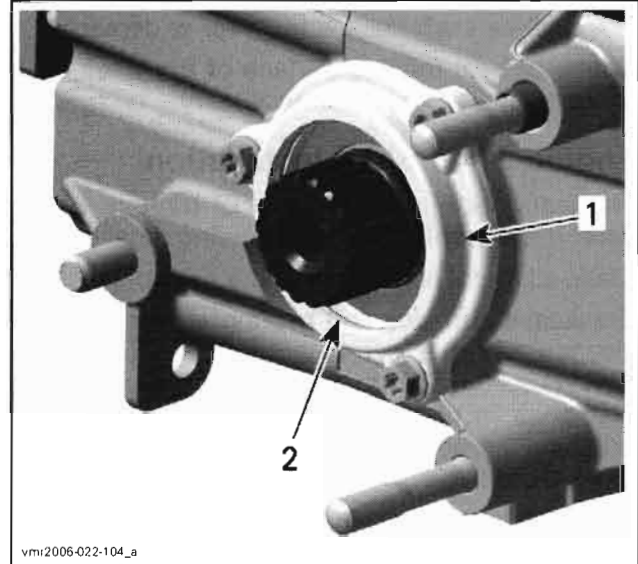
For oil seal installation, refer to *ENGINE DRIVE SHAFT INSTALLATION*.

#### Engine Drive Shaft Removal

**NOTE:** The engine drive shaft no. 1 is located inside the engine and comes through it to drive the front differential.

Separate gearbox from engine.

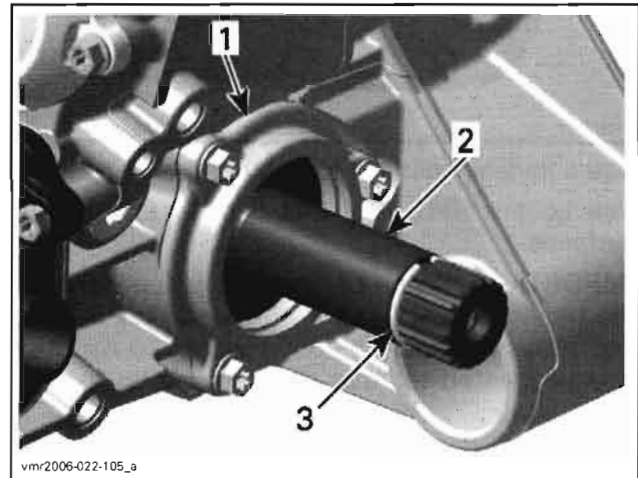
To the rear of engine, remove the bearing cover and its O-ring.



1. Bearing cover  
2. O-ring

Pull out drive shaft no. 1.

**CAUTION:** Check ends of the circlip for sharp edges or burr before removing the drive shaft, to avoid damaging the oil seal.



1. Bearing cover gear box side  
2. Drive shaft  
3. Circlip

Remove the other bearing cover no. 3 at the front of engine.

#### Engine Drive Shaft Inspection

Replace oil seals no. 4 and no. 7 and/or O-ring no. 8 if they are brittle, hard or damaged.

Check drive shaft bearings no. 2 and no. 5 for contamination and/or metal shavings. Check if bearings turn freely and smoothly. Replace if necessary.

Check drive shaft for cracks, bend, pitting or other visible damages.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)

Check drive shaft splines for wear or damages.

Check oil seal running surface of the drive shaft for scratches. Replace if necessary.

#### Engine Drive Shaft Installation

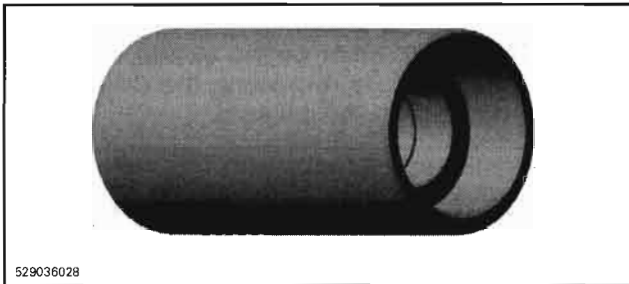
The installation is the reverse of removal procedure. Pay attention to the following details.

Clean all metal components in a solvent.

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

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

Then install drive shaft oil seals **no. 4** and **no. 7** with the oil seal installer (P/N 529 036 028).

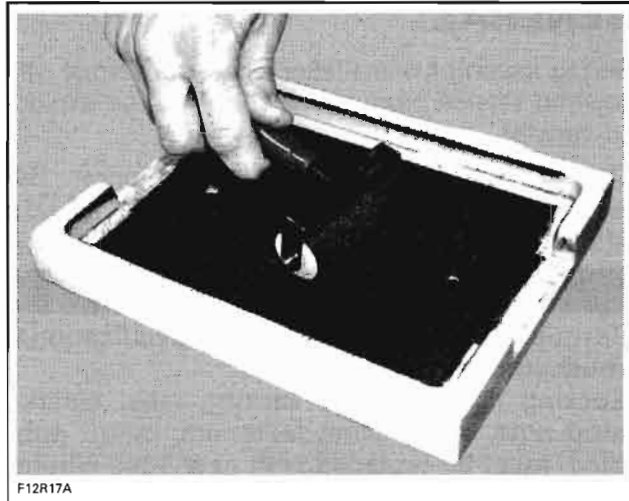


Use a suitable installer for installing bearings.

Use Loctite 5910 (P/N 293 800 081) on mating surfaces.

**IMPORTANT:** When beginning the application of the bearing cover 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.

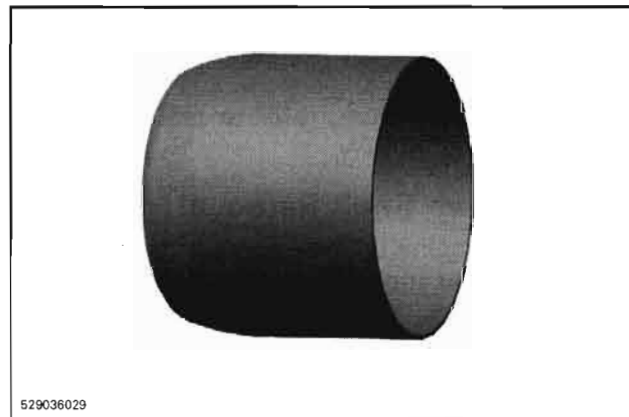
Use a plexiglass plate and apply some sealant on it. Use a soft rubber roller (50 - 75 mm (2 - 3 in)), available in arts products suppliers for printing, and roll the sealant to get a thin uniform coat on the plate (spread as necessary). When ready, apply the sealant on bearing cover surfaces.

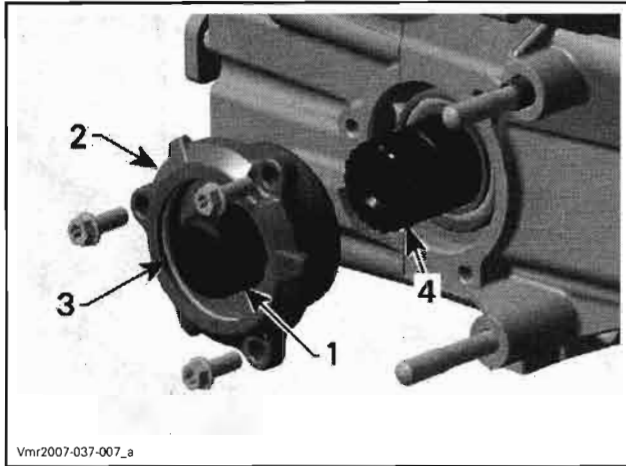


Do not apply in excess as it will spread out inside crankcase.

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

To install bearing cover **no. 6**, fit oil seal protection sleeve (P/N 529 036 029) into oil seal.





1. Protection sleeve
2. Bearing cover
3. O-ring
4. Drive shaft

Install bearing cover then place the O-ring no. 8 inside cover.

Finally check for axial play of the drive shaft.

## PTO COVER OIL SEAL

To replace oil seal no. 9 it is not necessary to remove engine from vehicle.

### PTO Oil Seal Removal

Remove CVT cover, drive and driven pulleys and air guide.

Remove oil seal no. 9 with a small flat screwdriver.

**CAUTION:** Avoid scoring surfaces with tool.

### PTO Oil Seal Inspection

Check oil seal running surface of crankshaft PTO side for grooves. Replace if necessary.

### PTO Oil Seal Installation

The installation is the reverse of the removal procedure.

Pay attention to the following details.

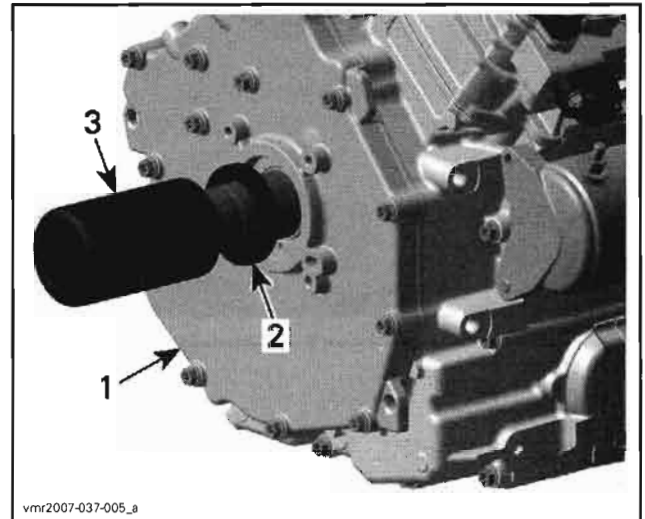
**CAUTION:** Oil seal must be installed with sealing lip toward the engine.

Push oil seal in place by using the oil seal installer (P/N 529 036 033).



vmr2006-044-010

OIL SEAL INSTALLER



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1. PTO cover
2. Oil seal
3. Oil seal installer

## PTO COVER

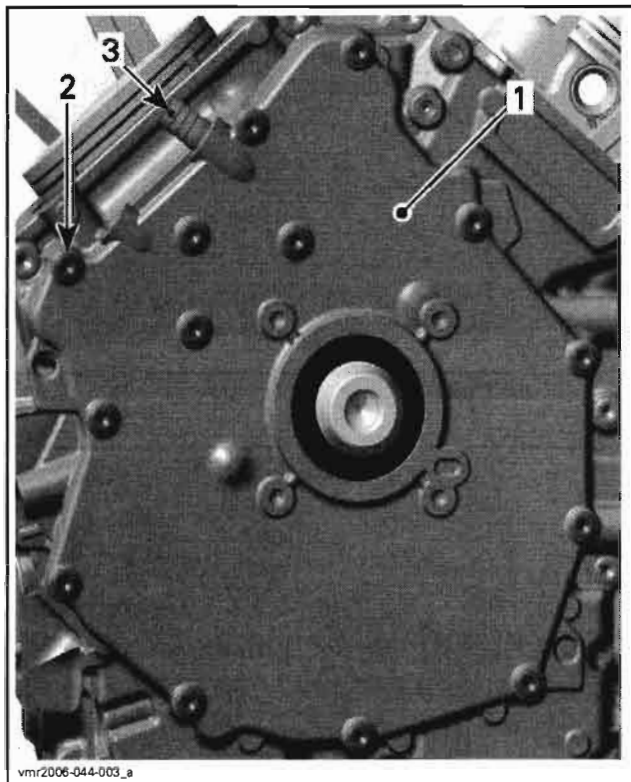
### PTO Cover Removal

Remove:

- CVT and air guide. Refer to *TRANSMISSION*
- disconnect vent hose
- PTO cover screws and pull PTO cover.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)



1. PTO cover
2. PTO cover screws
3. Vent hose nipple

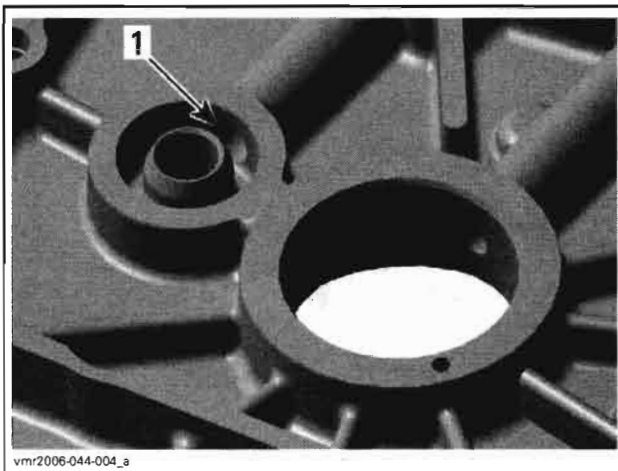
### PTO Cover Inspection

Check the PTO cover for cracks or other damage. Replace PTO cover if damaged.

Clean oil breather bore in PTO cover from contaminations with part cleaner then use an air gun to dry it.

#### **⚠ WARNING**

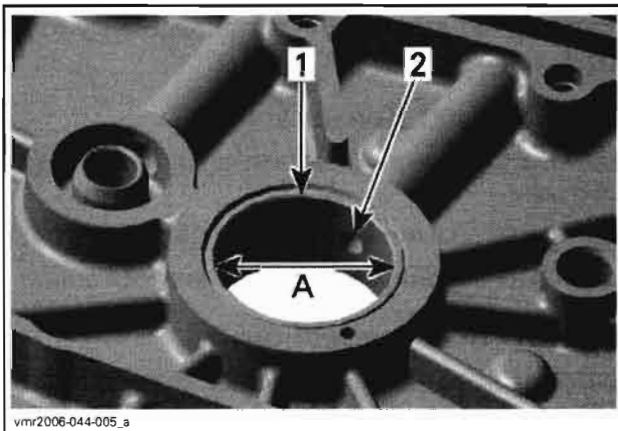
Always wear eye protector. Chemicals can cause a rash break out and injure your eyes.



1. Oil breather bore

Check plain bearings no. 10 for scorings or other damages.

**NOTE:** Measure plain bearing inside diameter and compare to crankshaft journal diameter (PTO support bearing). Refer to *CRANKSHAFT* in this section. Replace if the measurement is out of specification.



1. Plain bearing
2. Oil bore
- A. Measure plain bearing inside diameter

#### **PLAIN BEARING INSIDE DIAMETER (PTO side support bearing)**

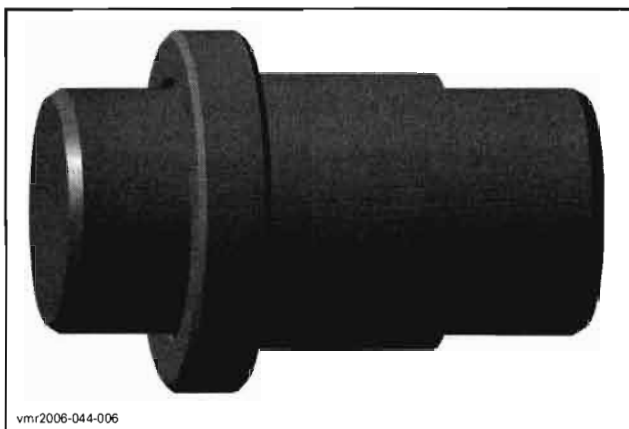
<b>SERVICE LIMIT</b>	34.120 mm (1.3433 in)
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### Plain Bearing Replacement Procedure

#### Plain Bearing Removal

Carefully remove the oil seal no. 9 with a screwdriver, without damaging the PTO cover.

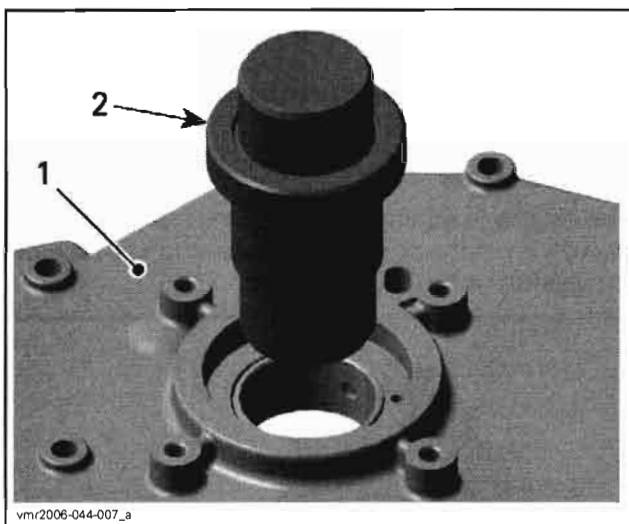
Push-out the plain bearings from the outside towards the inside using the plain bearing remover/installer (P/N 529 036 032).



vmr2006-044-006

PLAIN BEARING REMOVER/INSTALLER — PTO COVER

The PTO cover has to be supported from below with suitable support with straight surface, in order to prevent damage of the sealing surface.



vmr2006-044-007\_a

1. PTO cover
2. Plain bearing remover/installer

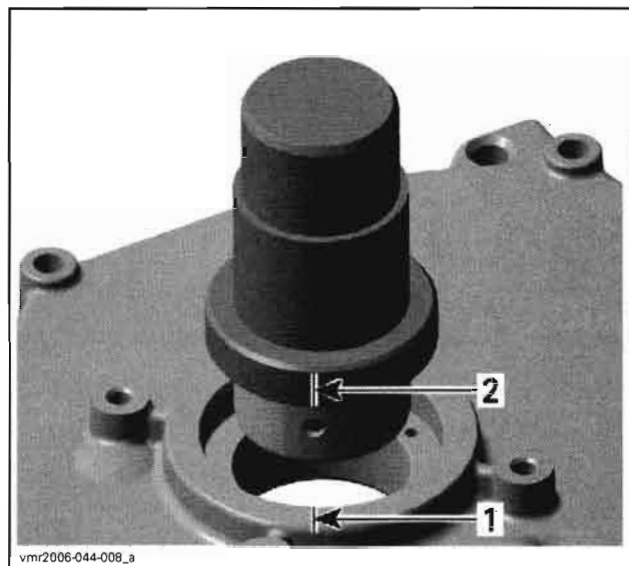
### Plain Bearing Installation

**CAUTION:** Unless otherwise instructed, never use hammer to install plain bearings. Use press only.

Install plain bearings with the proper plain bearing remover/installer (P/N 529 036 032) in a cool PTO cover. Do not lubricate plain bearings and/or PTO cover for installation.

Carefully press-in the plain bearings in the same direction as during disassembly, from the outside towards the inside. Support PTO cover with suitable support with straight surface, in order to prevent damage of the sealing surface.

**CAUTION:** Mark position of oil bore on PTO cover and on plain bearing remover/installer. Align mark on plain bearing remover/installer with mark on PTO cover.

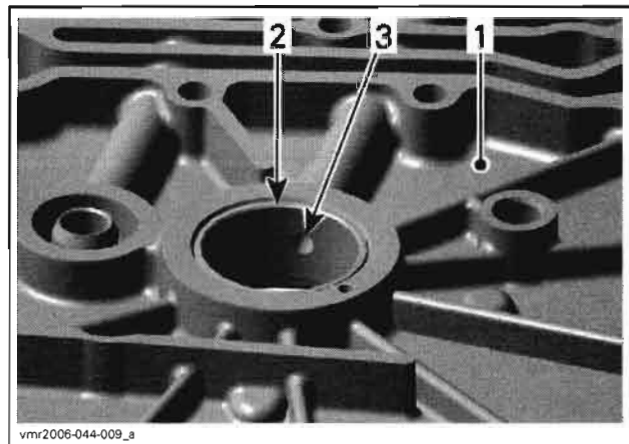


vmr2006-044-008\_a

1. Mark position of oil bore on PTO cover
2. Mark position of oil bore on plain bearing remover/installer

**NOTE:** Wrong oil bore position will stop oil supply to plain bearings and will damage the engine.

**CAUTION:** The partition of the plain bearings must be positioned near to oil bore in counter-clockwise direction (refer to no. 3 in next illustration).



vmr2006-044-009\_a

1. PTO cover (inside)
2. Partition
3. Oil bore

### PTO Cover Installation

For installation, reverse the removal procedure.

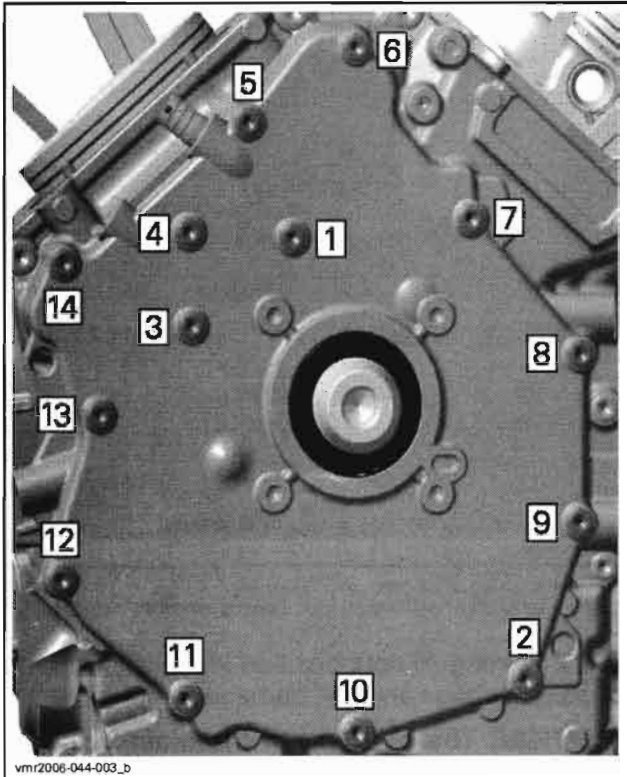
Pay attention to the following details.

**NOTE:** At installation, replace PTO cover gasket and oil seal.

Tightening sequence for screws on PTO cover is as per following illustration.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)

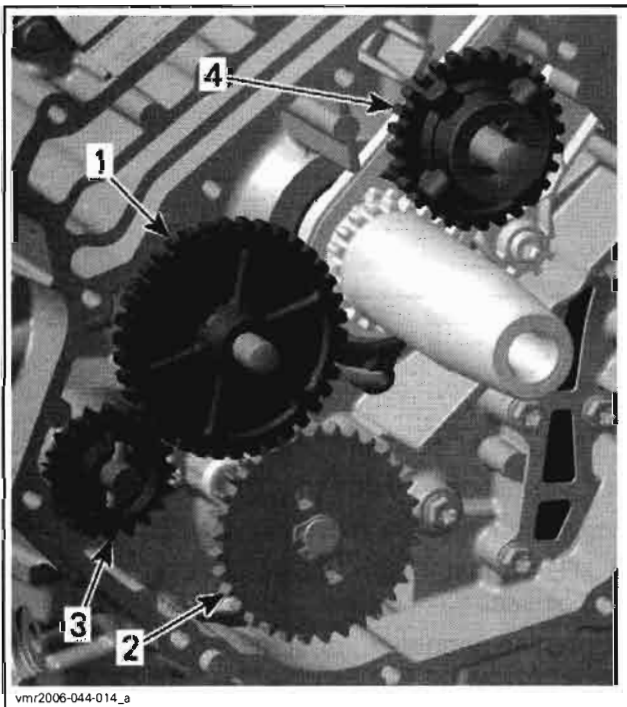


vmr2006-044-003\_b

TIGHTENING SEQUENCE

## DRIVE GEARS

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



vmr2006-044-014\_a

1. Intermediate gear
2. Oil pump gear
3. Water pump gear
4. Breather gear

## Drive Gear Removal

Remove:

- PTO cover (refer to *PTO COVER*)
- intermediate gear no. 11
- oil pump gear no. 12 (refer to *OIL PUMP in LUBRICATION SYSTEM*)
- water pump gear no. 13.

To remove water pump gear, pull the shaft assembly a bit out and turn it about one teeth until it stays out.

Now you can push water pump gear down. Remove needle pin no. 14 and pull water pump gear out.

Remove breather gear no. 15.

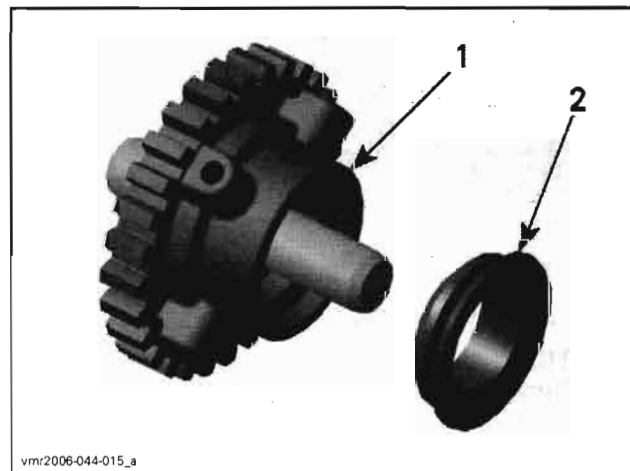
## Drive Gear Inspection

### Intermediate Gear/Oil Pump Gear/Water Pump Gear

Inspect gears for wear or other damage. Replace if damaged.

### Breather Gear

The engine is equipped with a breather gear which prevents engine oil coming out through the breathing system into the air box.



vmr2006-044-015\_a

1. Breather gear
2. V-ring

Inspect gear for wear or other damage.

Check ball bearing for excessive play and smooth operation. Replace breather gear assembly if necessary.

## Drive Gear Installation

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

**NOTE:** At installation replace the V-ring no. 16 of the breather gear.

Adequately oil the ball bearing of the breather gear.

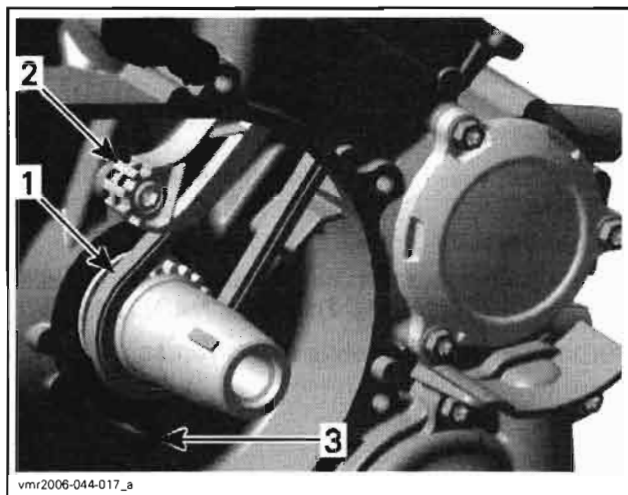
## TIMING CHAIN

The engine is equipped with two timing chains. One of the timing chain is located on engine MAG side behind the magneto cover. The second timing chain is located on engine PTO side behind the PTO cover.

### Timing Chain Removal (Magneto Side)

Remove:

- valve cover, chain tensioner and camshaft timing gear (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER*)
- magneto cover and rotor (refer to *MAGNETO SYSTEM*)
- timing chain guide and lower timing chain guide.



1. Timing chain
2. Timing chain guide
3. Lower timing chain guide

Carefully pull the timing chain sideward and down from the crankcase.

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

### Timing Chain Removal (PTO Side)

Remove:

- valve cover, chain tensioner and camshaft timing gear (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER* section)
- PTO cover (refer to *PTO COVER*)
- intermediate gear and breather gear (refer to *DRIVE GEARS*)
- timing chain guide and lower timing chain guide (see illustration above).

vmr2008-053

Carefully pull the timing chain sideward and down from the crankcase.

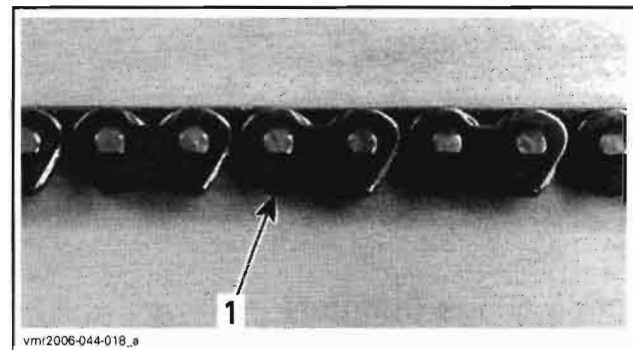
**NOTE:** Mark the operating direction of the timing chain before removal.

### Timing Chain Inspection

Inspection is the same for both timing chains.

**NOTE:** Check timing chain on camshaft timing gear for excessive radial play.

Check chain condition for wear and teeth condition.



1. Timing chain

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

### Timing Chain Installation

Installation is the same for both timing chains.

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

**NOTE:** Ensure to perform proper valve timing. Lock crankshaft (see *CRANKSHAFT*) and camshaft at TDC ignition (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER* section).

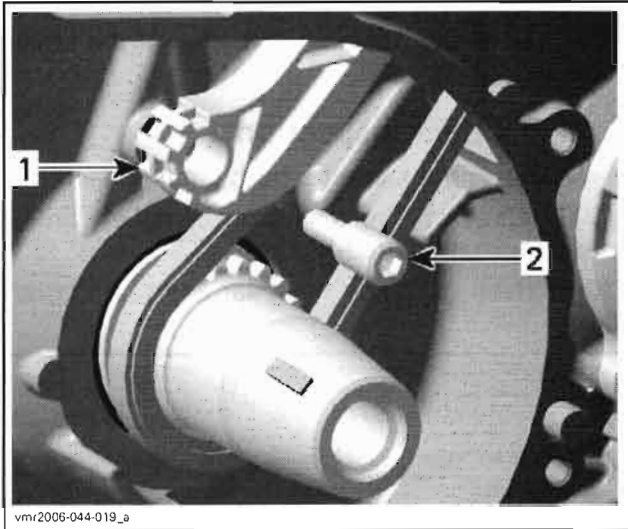
Install timing chain with camshaft timing gear then, adjust chain tension (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER* section).

**CAUTION:** Improper valve timing will damage engine components.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)

#### TIMING CHAIN GUIDE



1. Timing chain guide
2. Bearing screw

#### Chain Guide Removal

Refer to *TIMING CHAIN* above.

#### Chain Guide Inspection

Check timing chain guide for wear, cracks or other damage. Replace if necessary.

#### Chain Guide Installation

The installation is the reverse of the removal procedure.

#### CRANKCASE

**NOTE:** Before disassembly, drain engine oil and engine coolant.

#### Crankcase Disassembly

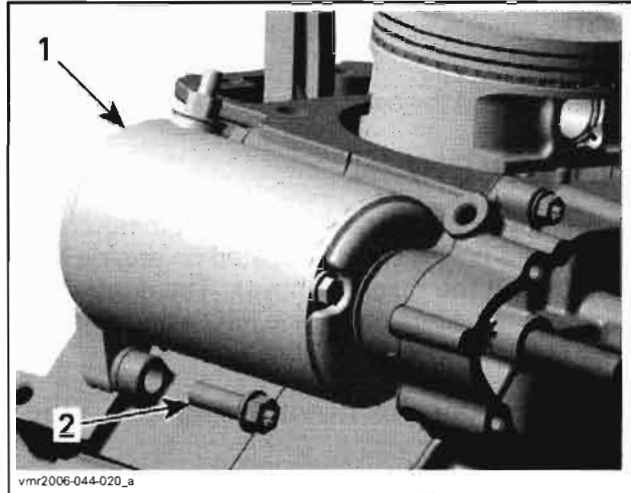
**NOTE:** Before splitting the crankcase, measure crankshaft axial play. Refer to *CRANKSHAFT*.

Remove:

- drive shaft (refer to *ENGINE DRIVE SHAFT*)
- PTO cover (refer to *PTO COVER*)
- drive gears (refer to *DRIVE GEARS*)

**NOTE:** Oil pump removal from crankcase is not necessary, but recommended to see condition of oil pump (refer to *LUBRICATION SYSTEM* section).

- electric starter

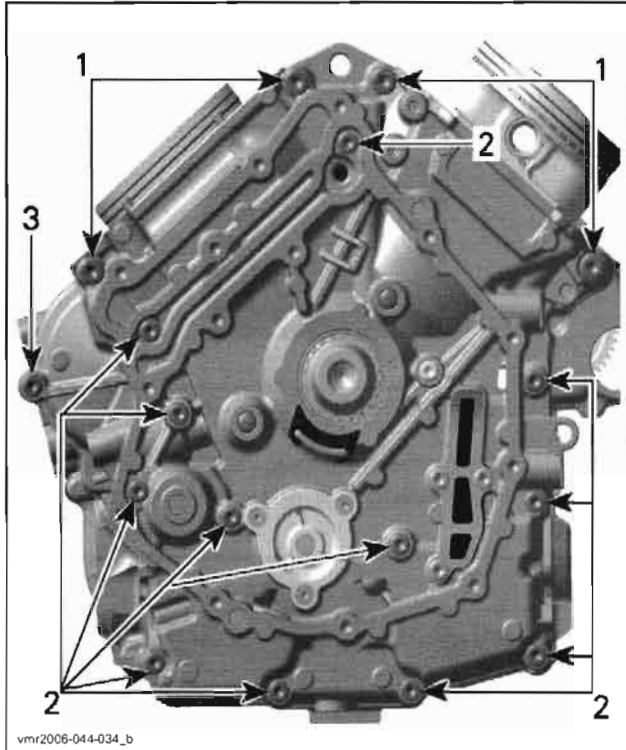


1. Electric starter
2. Screw

- magneto cover and rotor (refer to *MAGNETO SYSTEM* section)
- electric starter drive gears (refer to *MAGNETO SYSTEM* section)
- water pump housing (refer to *COOLING SYSTEM* section)
- oil filter (refer to *LUBRICATION SYSTEM* section)
- cylinder head and cylinder (refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER* section)
- timing chains and timing chain guides (refer to *TIMING CHAIN* and *TIMING CHAIN GUIDE*).

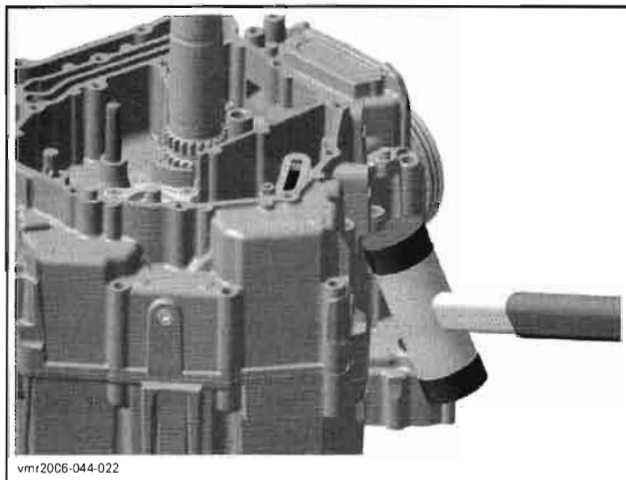
Remove retaining screws of crankcase.





- 1. Four screws M8 x 65
- 2. 12 screws M6 x 75
- 3. One screw M6 x 35

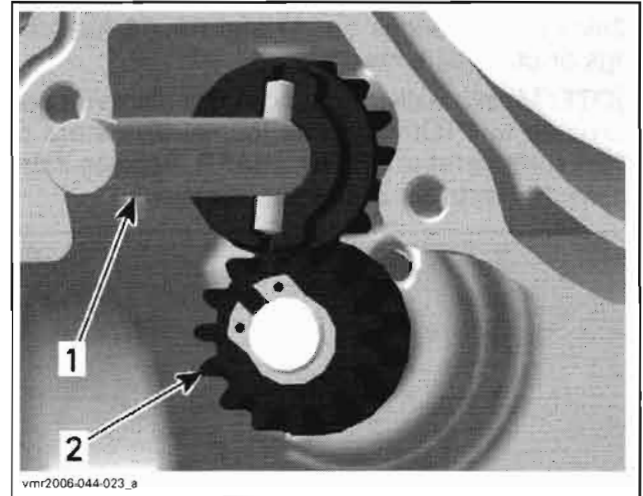
Carefully split crankcase halves by using a screwdriver and a soft hammer.



**NOTE:** During disassembly, do not damage the sealing surfaces of the crankcase halves.

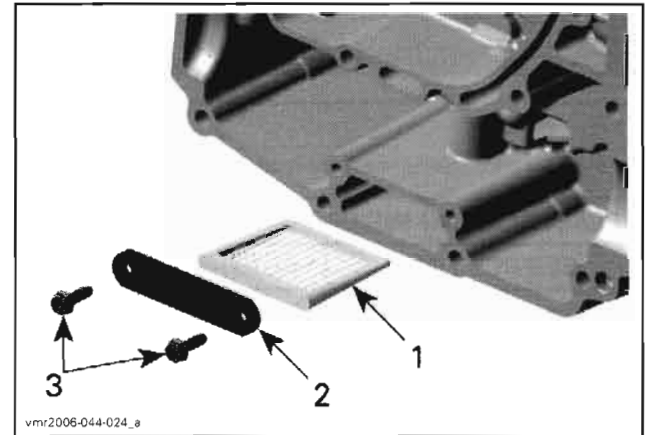
Pull crankshaft out of crankcase.

Remove the water pump intermediate shaft and the water pump gear.



- 1. Water pump intermediate shaft
- 2. Water pump gear

Remove engine oil strainer.



- 1. Engine oil strainer
- 2. Retaining plate
- 3. Screws

### Crankcase Cleaning

**⚠ WARNING**

Use safety goggles to avoid eye injuries.

Clean crankcase using a part cleaner.

Dry crankcase using compressed air.

Blow the oil supply lines.

### Oil Strainer

Clean the engine oil strainer (same procedure as for the crankcase).

### Crankcase Inspection

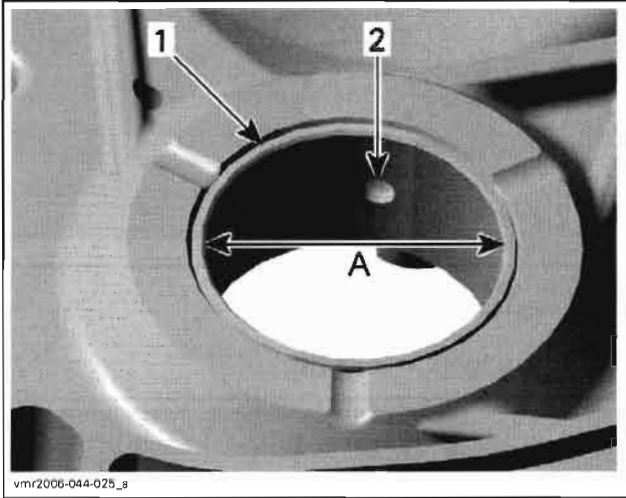
Check crankcase halves for cracks or other damage. Replace if damaged.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)

Check plain bearings no. 17 and no. 18 for scorings or other damages.

**NOTE:** Measure plain bearing inside diameter and compare to PTO/MAG side journal diameters of crankshaft (refer to *CRANKSHAFT*). Replace if the measurements are out of specification.



1. Plain bearing
2. Oil bore
- A. Measure plain bearing inside diameter

PLAIN BEARING INSIDE DIAMETER (PTO/MAG)	
SERVICE LIMIT	42.100 mm (1.6575 in)

### Plain Bearing Replacement

#### Plain Bearing Removal

**CAUTION:** Always support crankcase halves properly when ball bearings or plain bearings are removed. Damages to crankcase halves may occur if this procedure is not performed correctly.

**NOTE:** Always use a press for removal of plain bearings.

Remove plain bearings no. 17 and no. 18 with the proper plain bearing remover/installer (P/N 529 035 917).



PLAIN BEARING REMOVER/INSTALLER (P/N 529 035 917)

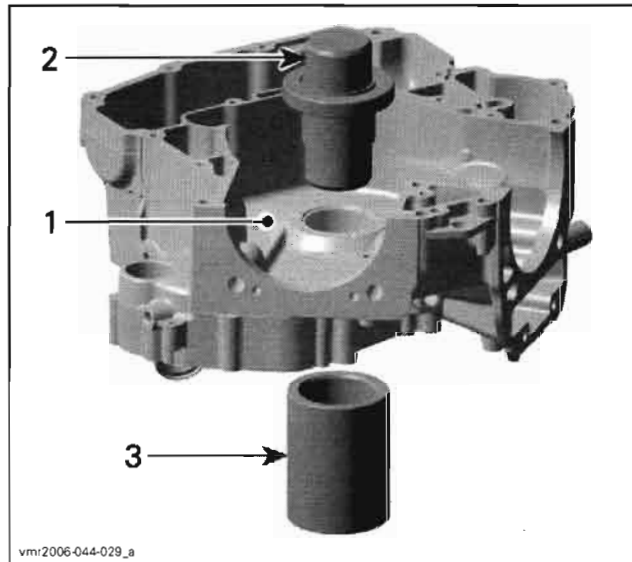
Carefully push the plain bearings out, from the crankcase half inside towards the outside.

**NOTE:** Place the proper crankcase support sleeve (P/N 529 036 031) under crankcase halves before removing plain bearings.



CRANKCASE SUPPORT SLEEVE (P/N 529 036 031)

**NOTE:** During disassembly, make sure not to damage the sealing surfaces of the crankcase halves.



#### PUSH PLAIN BEARINGS OUTSIDE

1. Crankcase half
2. Plain bearing remover/installer
3. Crankcase support sleeve (P/N 529 036 031)

#### Plain Bearing Installation

**CAUTION:** Unless otherwise instructed, never use hammer to install ball bearings or plain bearings. Use press only.

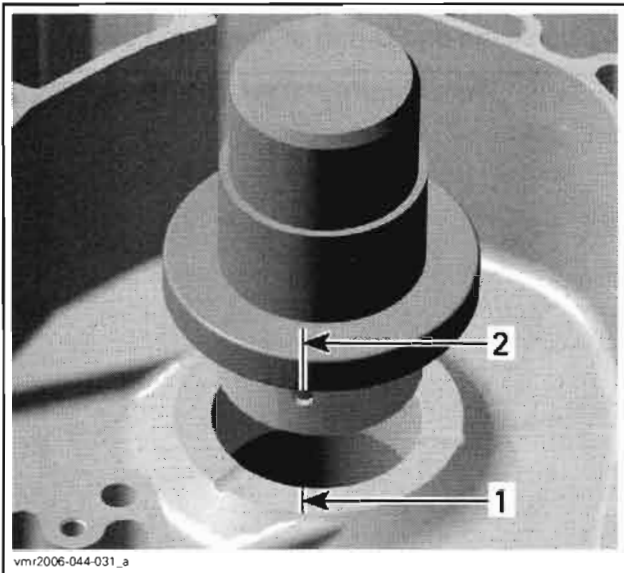
Install plain bearings with the proper plain bearing remover/installer (P/N 529 035 917) in a cool crankcase. Do not lubricate plain bearings and/or crankcase for installation.

**NOTE:** Place the proper crankcase support sleeve under crankcase halves before installing the plain bearings (refer to *BEARING REMOVAL PROCEDURE*).

Carefully press-in the plain bearings in the same direction as during disassembly, from the crankcase inside towards the outside.

During reassembly, make sure not to damage the sealing surfaces of the crankcase halves.

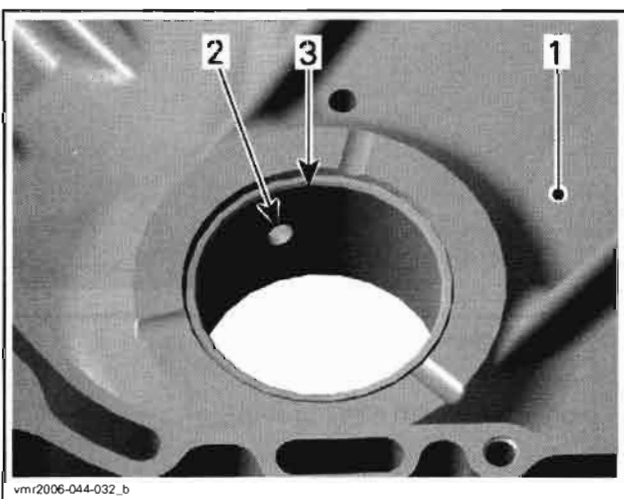
**CAUTION:** Mark position of oil bore on crankcase half and on plain bearing remover/installer. Align mark on plain bearing remover/installer with mark on crankcase half.



1. Oil bore position marked on crankcase
2. Oil bore position marked on plain bearing remover/installer

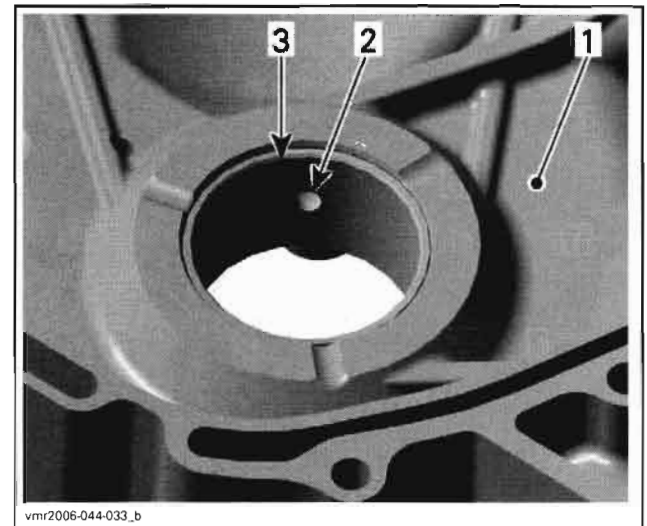
**NOTE:** Wrong oil bore position will stop oil supply to plain bearings and will cause engine damage.

**CAUTION:** The partition of the plain bearings in crankcase half MAG side must be positioned near to oil bore in clockwise direction (refer to no. 3 in next illustration).



1. Crankcase half MAG (inside)
2. Oil bore
3. Partition

**CAUTION:** The partition of the plain bearings in crankcase half PTO side must be positioned near to oil bore in counterclockwise direction (refer to no. 3 in next illustration).



1. Crankcase half PTO (inside)
2. Oil bore
3. Partition

**NOTE:** Use an O-ring ( $\varnothing$  42 x 1 to 1.5 mm (.04 to .06 in) thickness) to hold plain bearings in place during installation. The O-ring will disappear in the groove of the plain bearing remover/installer.

### Crankcase Assembly

The assembly of crankcase is essentially the reverse of removal procedure. However, pay attention to the following details.

Clean oil passages and make sure they are not clogged.

Clean all metal components in a solvent.

Install a new crankcase gasket.

Oil the plain bearings before mounting the crankshaft.

**CAUTION:** Correctly reinstall crankshaft (refer to *CRANKSHAFT*).

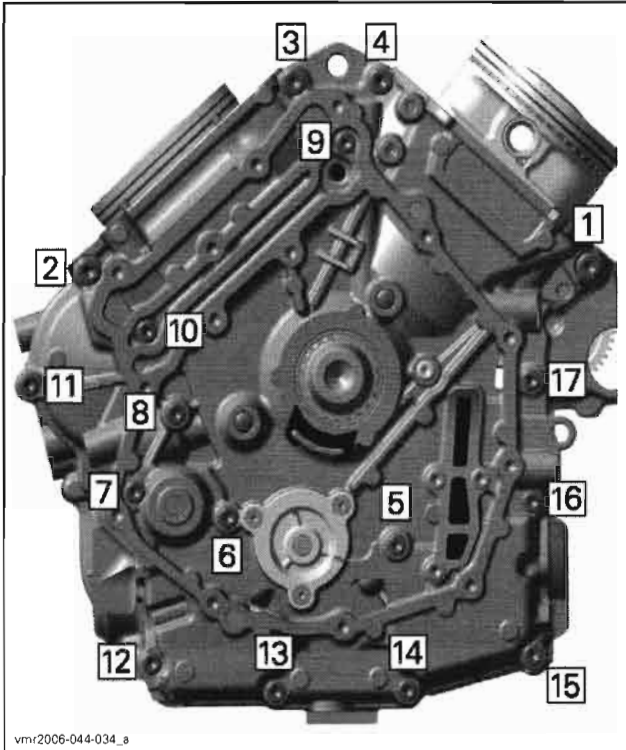
Properly reinstall engine oil strainer and screws.

Reinstall water pump shaft shafts/gears (refer to *COOLING SYSTEM* section).

Tightening sequence for screws on crankcase is as per following illustration.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

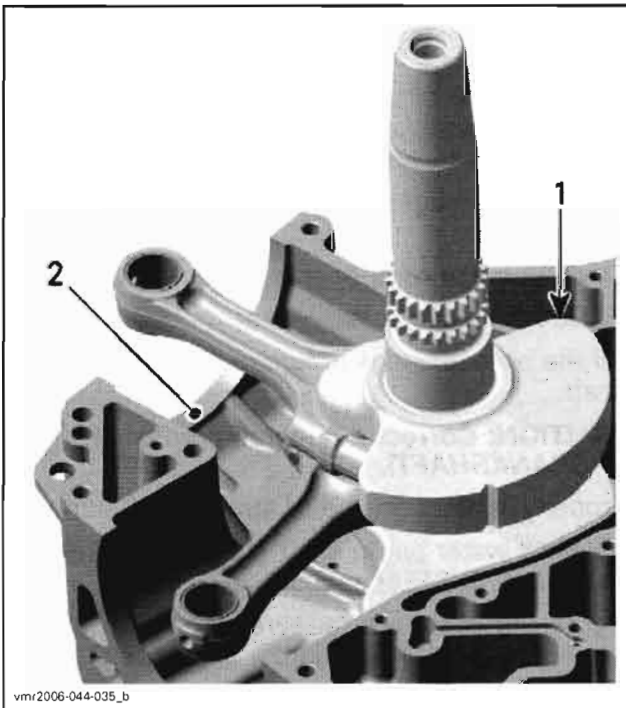
### Subsection 08 (BOTTOM END)



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TIGHTENING SEQUENCE

## CRANKSHAFT



vmr2006-044-035\_b

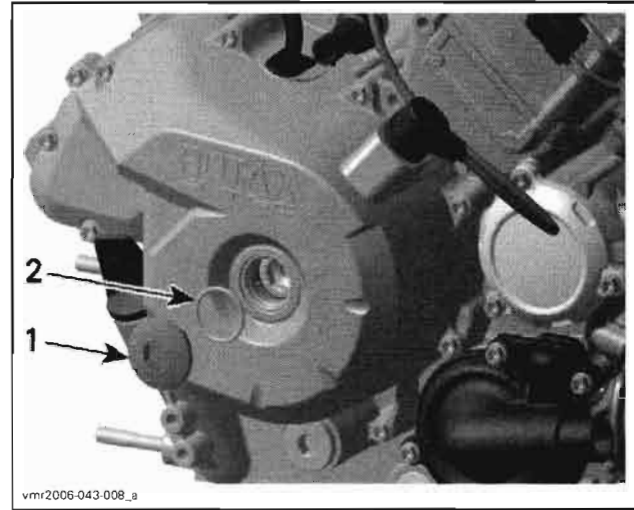
1. Crankshaft
2. Crankcase MAG

## Crankshaft Locking Procedure

NOTE: When crankshaft is locked, the rear piston (cylinder 2, rear) is at TDC ignition. Crankshaft can not be locked at cylinder 1 (front) TDC.

Remove:

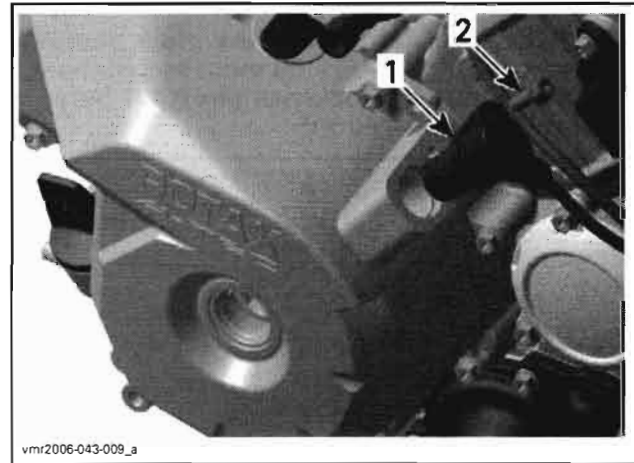
- spark plug cable and spark plug of both cylinders
- valve covers of both cylinders
- plug screw and O-ring of magneto cover



vmr2006-043-008\_a

1. Plug screw
2. O-ring

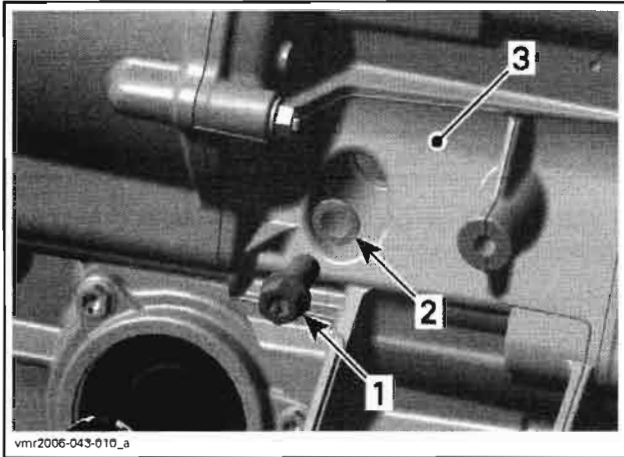
- crankshaft position sensor



vmr2006-043-009\_a

1. Crankshaft position sensor
2. Screw

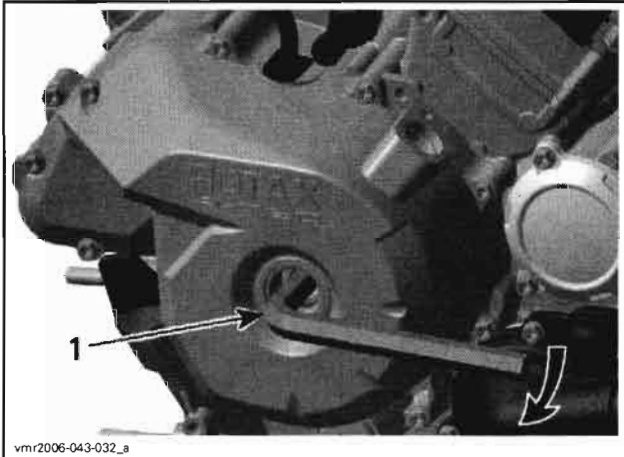
- plug screw with sealing ring.



vmr2006-043-010\_a

1. Plug screw
2. Sealing ring
3. Crankcase PTO side, front side

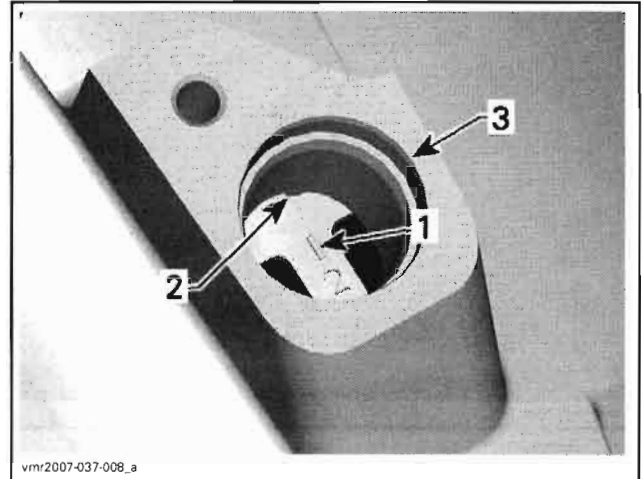
Use a 14 mm Allen key to turn crankshaft until piston 2, rear is at TDC ignition.



vmr2006-043-032\_a

1. Allen key 14 mm

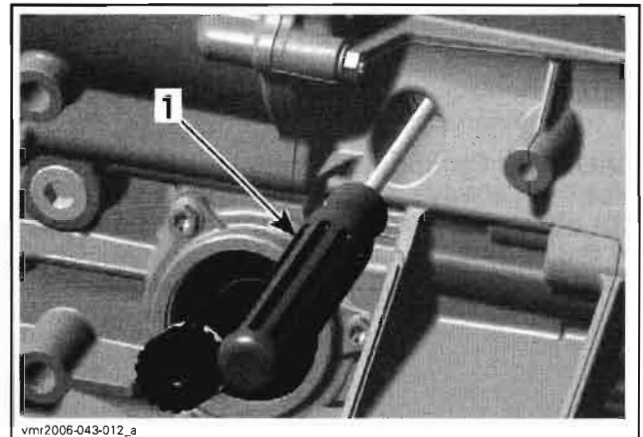
When rear piston is at TDC ignition, marks on magneto flywheel "2" and on the magneto cover are aligned.



vmr2007-037-008\_a

1. Mark "2" on magneto flywheel
2. Notch on magneto cover
3. Crankshaft position sensor location

Use a screwdriver to check if the groove in the crankshaft is aligned with the hole.



vmr2006-043-012\_a

1. Screwdriver

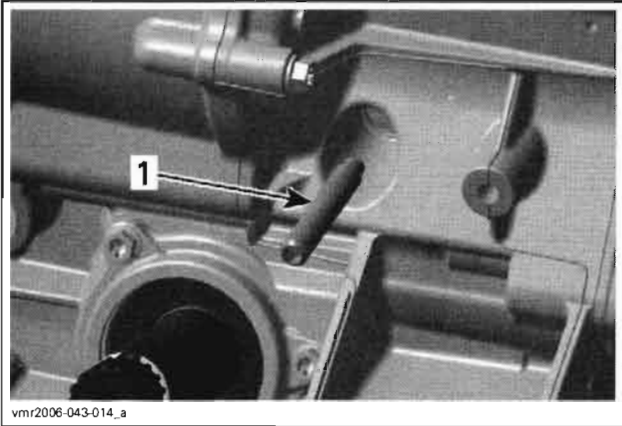
Lock crankshaft with crankshaft locking bolt (P/N 529 035 617).



vmr2006-043-013

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)



1. Crankshaft locking bolt

### Crankshaft Removal

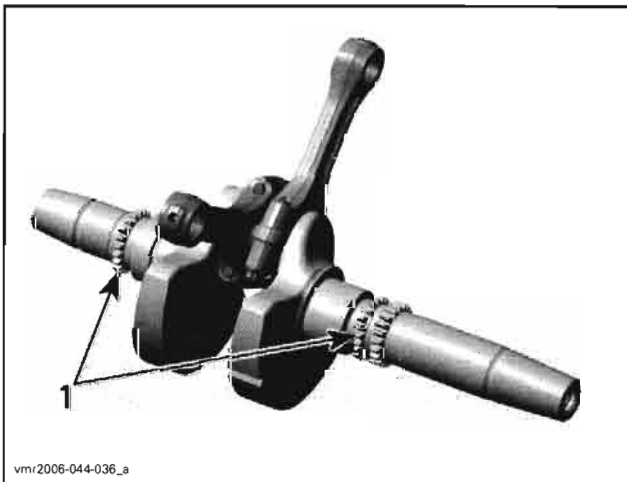
Refer to *CRANKCASE*.

### Crankshaft Inspection

**NOTE:** Check each bearing journal of crankshaft for scoring, scuffing, cracks or other signs of wear.

**NOTE:** Replace crankshaft if the gears are worn or otherwise damaged.

**CAUTION:** Components with less than the service limit always have to be replaced. If this is not observed, severe damage may be caused to the engine.



1. Crankshaft timing gears

### Crankshaft Axial Play

**NOTE:** Axial play needs to be measured before splitting the crankcase.

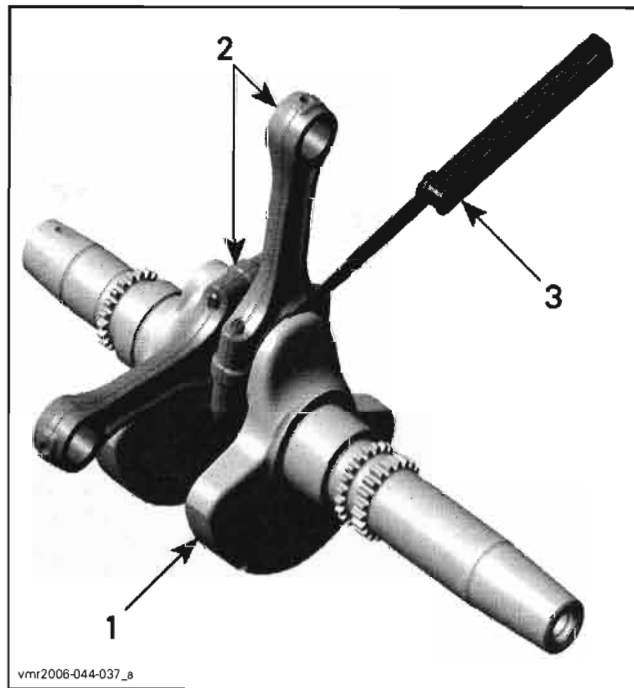
Measure play on PTO end, using a dial indicator.

CRANKSHAFT AXIAL PLAY	
NEW	0.200 to 0.500 mm (.008 to .020 in)
SERVICE LIMIT	0.6 mm (.024 in)

If play is out of specification, replace crankcase and/or crankshaft.

### Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between butting face of connecting rods and crankshaft counterweight. If the distance exceeds specified tolerance, replace the crankshaft.



1. Crankshaft  
2. Connecting rods  
3. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY	
NEW	0.200 to 0.500 mm (.008 to .020 in)
SERVICE LIMIT	0.6 mm (.024 in)

### Connecting Rod/Piston Pin Clearance

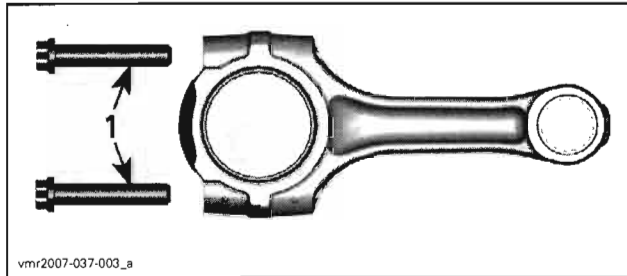
Refer to *INTAKE MANIFOLD, CYLINDER HEAD AND CYLINDER* section.

### Connecting Rod Big End Radial Play

**NOTE:** Prior to remove connecting rod from the crankshaft, mark big end halves together to ensure a correct reinstallation (cracked surface fits in only one position).

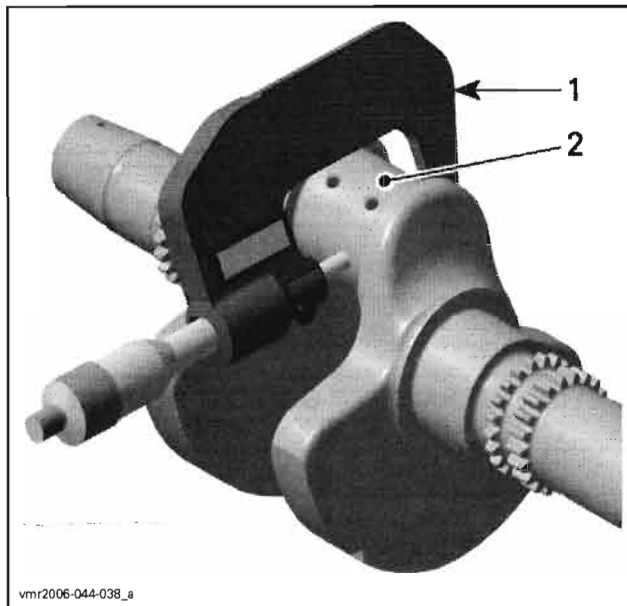
Remove connecting rods from crankshaft.

**CAUTION:** Always replace connecting rod screws no. **19** if removing the connecting rod. It is recommended to replace plain bearings no. **20**, in case of installing the connecting rod.



1. Connecting rod screws

Measure crankpin. Compare to inside diameter of connecting rod big end.

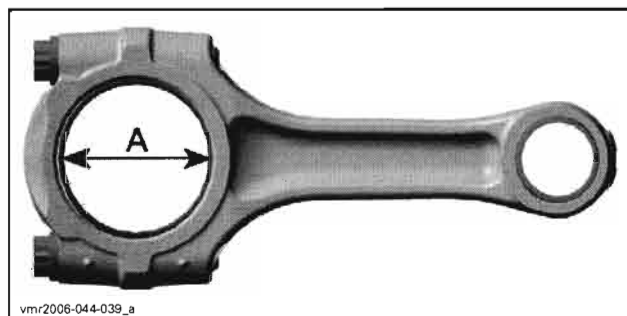


1. Micrometer  
2. Crankpin area for plain bearing

To measure the connecting rod big end diameter, use the OLD screws no. 19.

Install the OLD plain bearings no. 20 as they were mounted initially.

Do the torque procedure as described further.



A. Connecting rod big end plain bearing

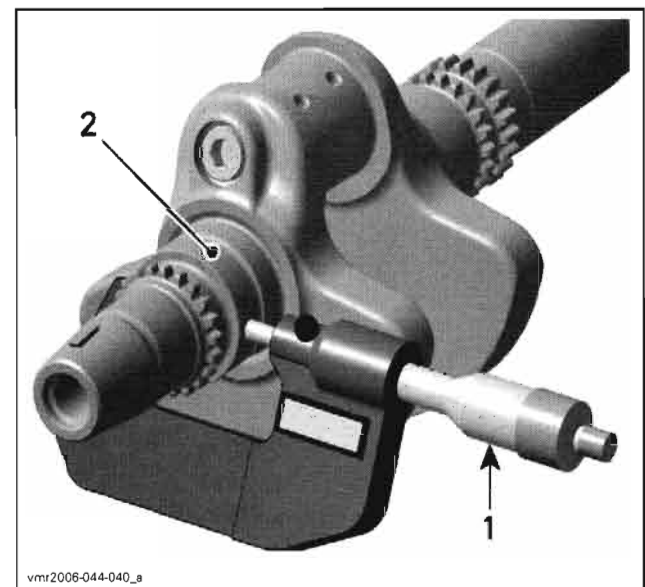
vmr2008-053

OUTLANDER 500	
CRANKSHAFT PIN DIAMETER	
NEW	35.064 to 35.080 mm (1.3805 to 1.3811 in)
SERVICE LIMIT	35.050 mm (1.3800 in)
CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	35.150 mm (1.3839 in)
CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.09 mm (.0035 in)

OUTLANDER 650/800	
CRANKSHAFT PIN DIAMETER	
NEW	40.009 to 40.025 mm (1.5752 to 1.5758 in)
SERVICE LIMIT	39.990 mm (1.5744 in)
CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	40.100 mm (1.5787 in)
CONNECTING ROD BIG END RADIAL CLEARANCE	
SERVICE LIMIT	0.09 mm (.0035 in)

**Crankshaft Radial Play MAG/PTO Side**

Measure crankshaft on MAG/PTO side. Compare to inside diameter of MAG/PTO plain bearing (refer to *CRANKCASE*).

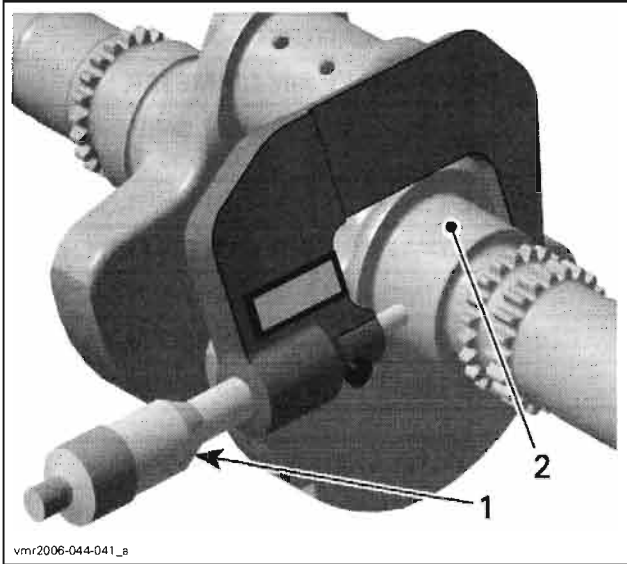


1. Micrometer  
2. Crankshaft area for MAG plain bearing

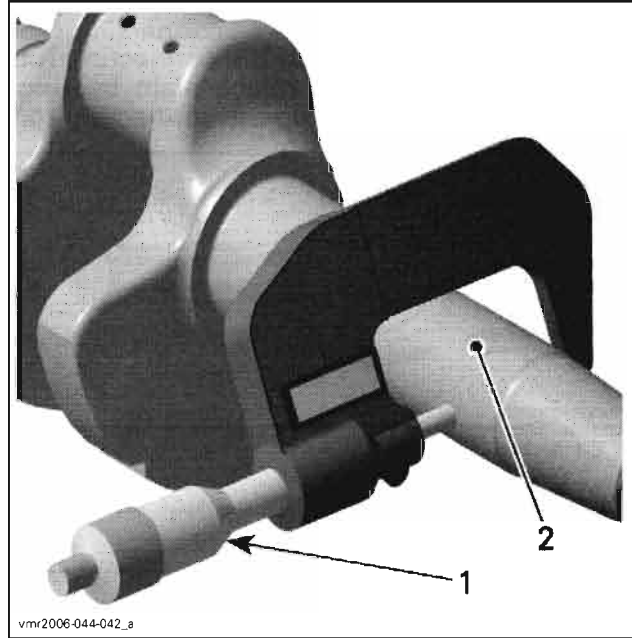
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**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**

**Subsection 08 (BOTTOM END)**



1. Micrometer  
2. Crankshaft area for PTO plain bearing



1. Micrometer  
2. Crankshaft journal (PTO support bearing)

<b>CRANKSHAFT MAG/PTO SIDE DIAMETER</b>	
NEW	42.024 to 42.040 mm (1.6545 to 1.6551 in)
SERVICE LIMIT	42.000 mm (1.6535 in)

<b>CRANKSHAFT MAG/PTO SIDE RADIAL CLEARANCE</b>	
SERVICE LIMIT	0.07 mm (.0031 in)

**Crankshaft Radial Play  
(PTO Side Support Bearing)**

Measure crankshaft journal of PTO support bearing. Compare to inside diameter of PTO support bearing in PTO cover (refer to *PTO COVER*).

<b>CRANKSHAFT JOURNAL DIAMETER (PTO support bearing)</b>	
NEW	34.024 to 34.040 mm (1.3395 to 1.3402 in)
SERVICE LIMIT	34.010 mm (1.3390 in)

<b>CRANKSHAFT PTO SUPPORT BEARING RADIAL CLEARANCE</b>	
SERVICE LIMIT	0.10 mm (.0039 in)

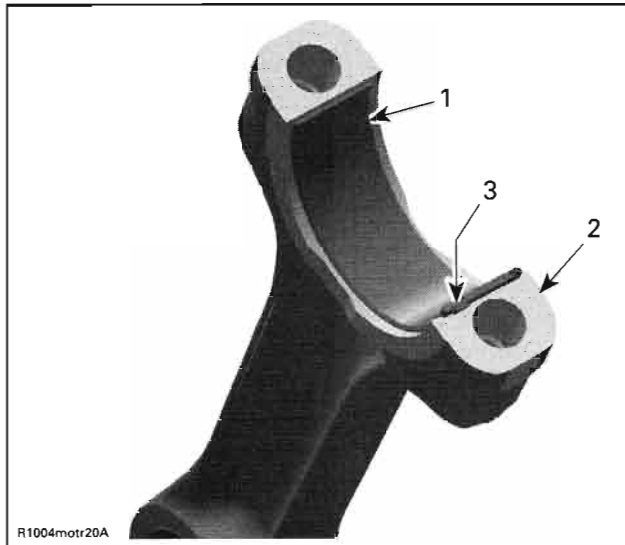
**Crankshaft Assembly**

For assembly, reverse the disassembly procedure. Pay attention to following details.

**NOTE:** Use NEW plain bearings no. 20, when connecting rod big end diameter is out of specification.

Put plain bearings correctly in place and clean the split surface on both sides (cracked area) carefully with compressed air.





1. Half plain bearing of connecting rod big end
2. Split surface of the connecting rod
3. Nose of plain bearing in line with connecting rod groove

**NOTE:** Oil the plain bearing surface of the connecting rod and crank pin before installation.

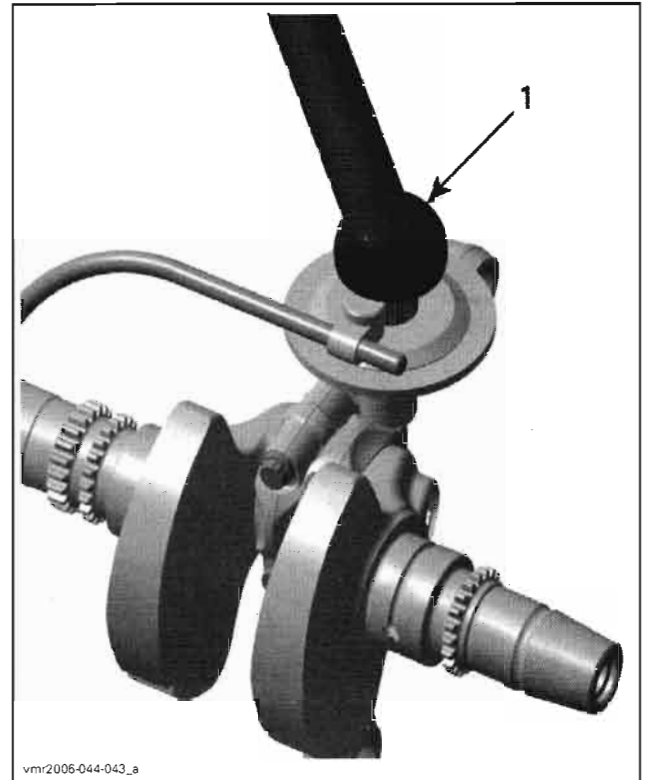
Torque **NEW** connecting rod screws no. 19 as per following procedure:

#### Outlander 500:

- First, install screws with half of the recommended torque. Do not apply any thread locker.
- Secondly, torque screws to 12 N•m (106 lbf•in).
- Finish tightening the screws with an additional 70° turn using an angle torque wrench.

#### Outlander 650 and 800:

- First, install screws with half of the recommended torque. Do not apply any thread locker.
- Secondly, torque connecting rod screws to 20 N•m (15 lbf•ft).
- Finish tightening the screws with an additional 60° turn using an angle torque wrench.



1. Angle torque wrench

**CAUTION:** Failure to strictly follow this procedure may cause screw to loosen and lead to engine damage. The plain bearing tapered end must be against the counterweight. Besides, as the "crankpin" screw has been stretched from the previous installation, it is very important to **use a new screw at assembly.**

**NOTE:** The running direction of the big end bearings and of the piston pins must not change.

#### Crankshaft Installation

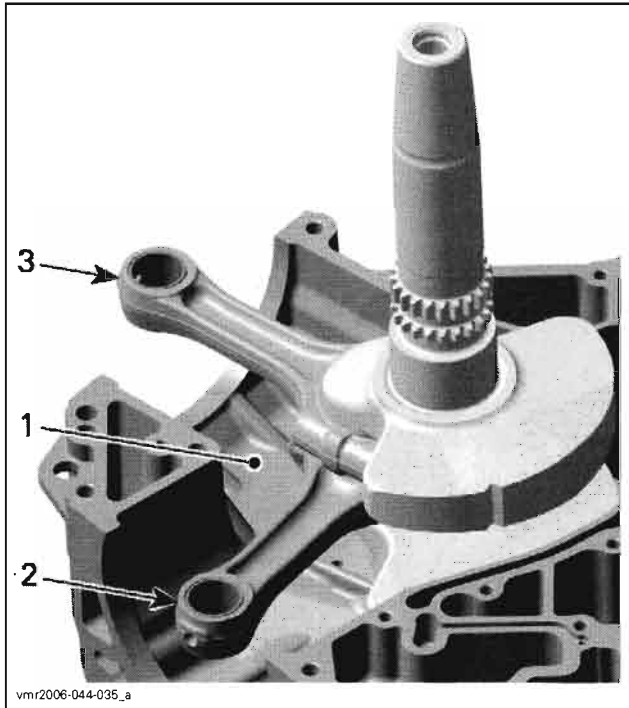
For installation of crankshaft in crankcase reverse the removal procedure. Pay attention to the following details.

Do not mix up the connecting rods of cylinders 1 and 2 during installation.

**CAUTION:** Observe the correct installation position when fitting the crankshaft with the connecting rods. The connecting rod **MAG** side has to face to cylinder 1.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 08 (BOTTOM END)



1. Crankcase half MAG side
2. Connecting rod cylinder 1
3. Connecting rod cylinder 2

**CAUTION:** Install CRANKSHAFT LOCKING BOLT to put crankshaft in TDC position before installing the camshaft and rocker arms (refer to *CRANKSHAFT LOCKING PROCEDURE*).

# GEARBOX AND 4X4 COUPLING UNIT

## SERVICE TOOLS

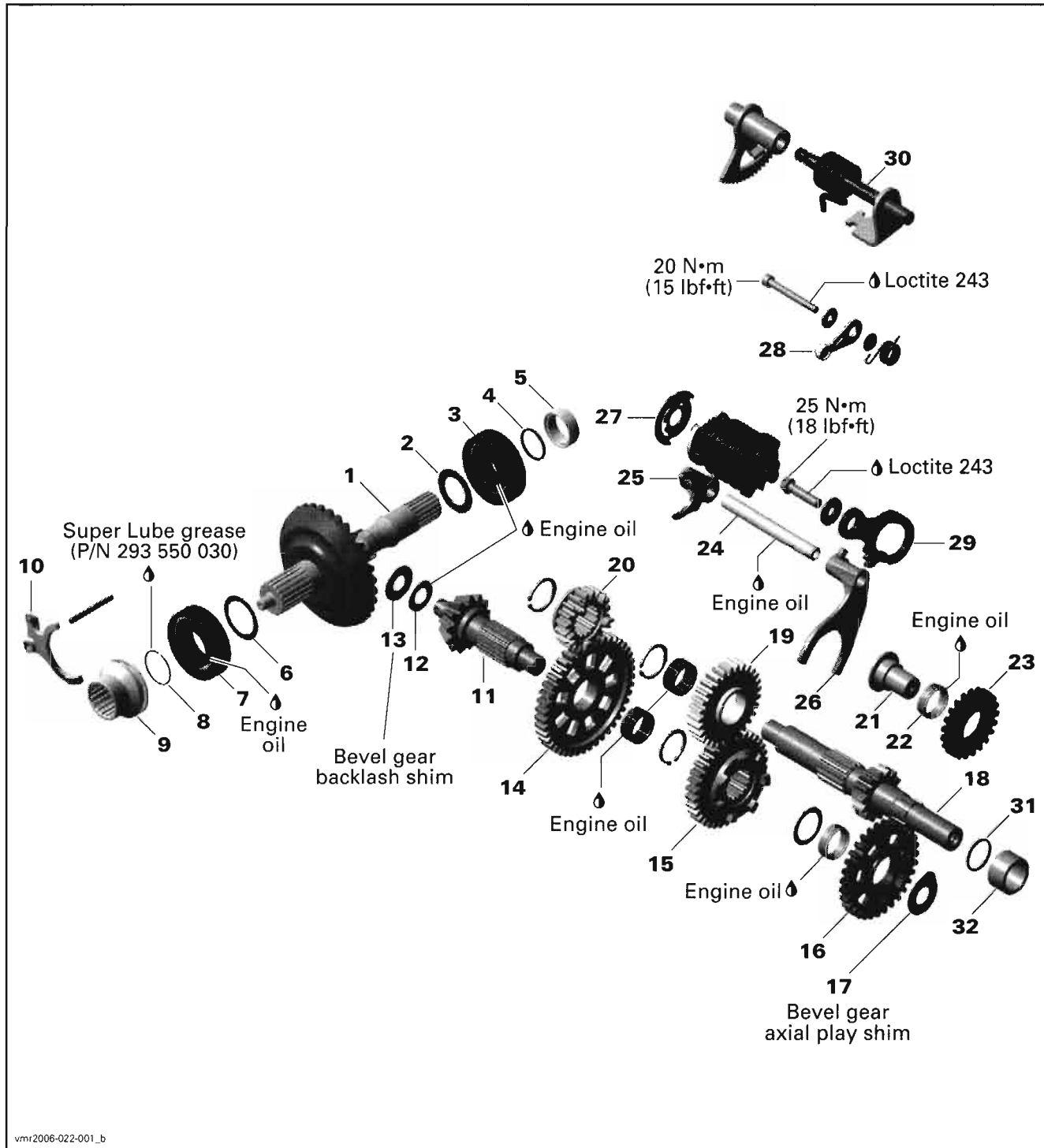
Description	Part Number	Page
installer handle.....	420 877 650 .....	142, 160
oil seal installer .....	529 035 758 .....	142
main shaft needle bearing installer.....	529 035 762 .....	160
bevel gear needle bearing installer.....	529 035 763 .....	160
Fluke 111 multimeter .....	529 035 868 .....	142
oil seal installer .....	529 036 028 .....	141
backlash measurement tool .....	529 036 030 .....	144

## SERVICE PRODUCTS

Description	Part Number	Page
Super Lube grease .....	293 550 030 .....	143, 149
Loctite 5910.....	293 800 081 .....	139-140, 148-149, 164
Loctite chisel (gasket remover) .....	413 708 500 .....	148, 156, 164
XP-S chaincase oil.....	413 801 900 .....	139
XP-S synthetic chaincase oil.....	413 803 300 .....	139

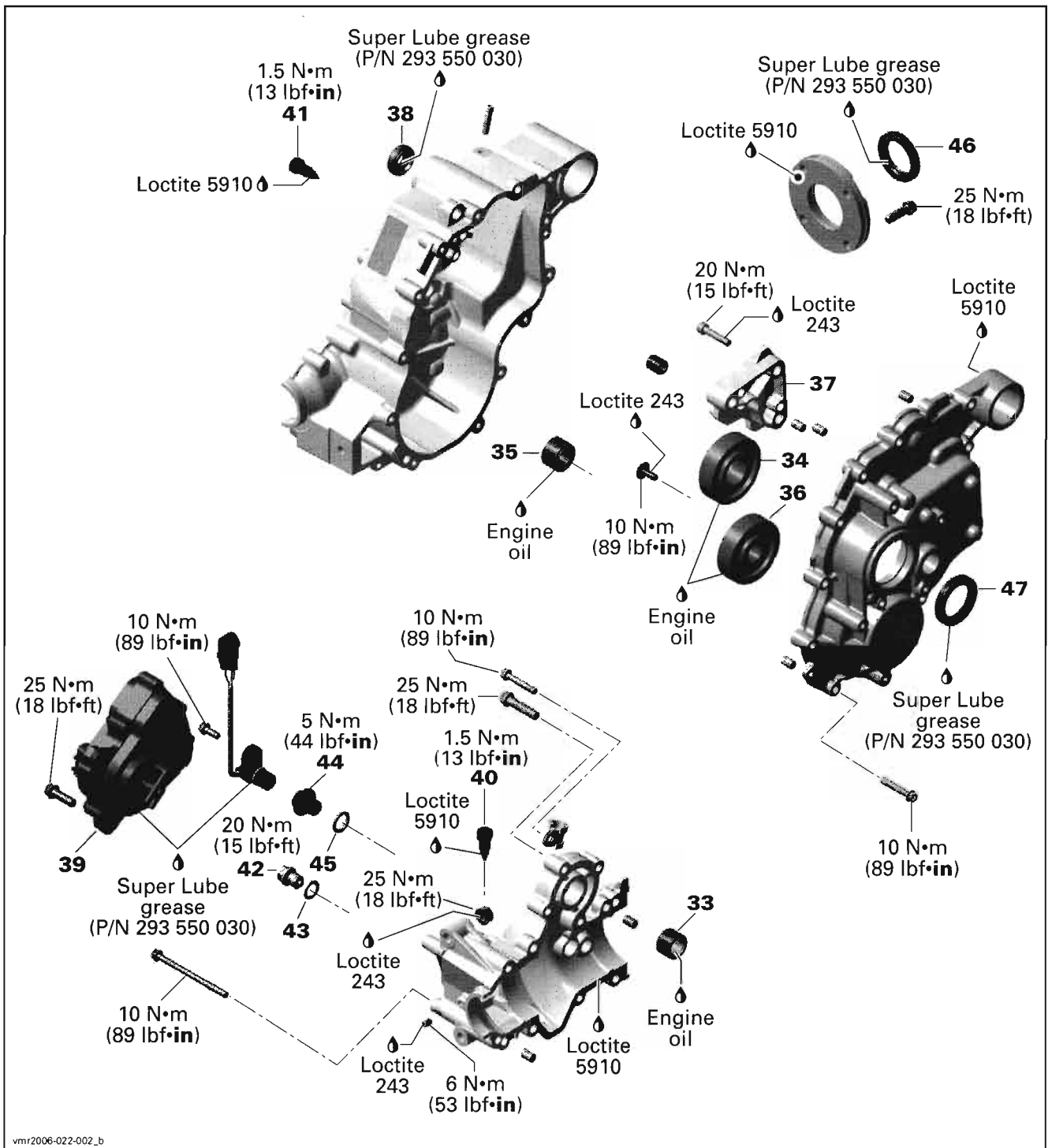


### GEARBOX COMPONENTS AND 4X4 COUPLING MECHANISM



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**GEARBOX HOUSING AND 4X4 ACTUATOR UNIT**



vmr2006-022-002\_b

## 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**

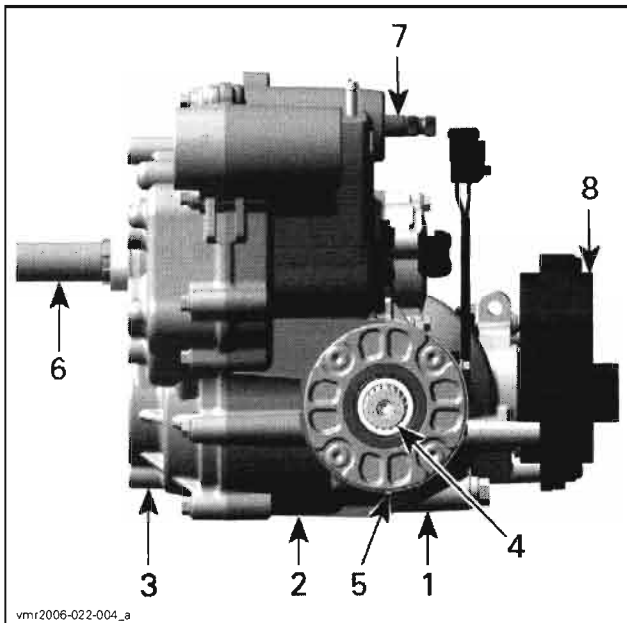
Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be installed or replaced with new ones where specified. If the efficiency of a locking device is impaired, it must be renewed.

Always drain the gearbox before working on it.

To remove gearbox, the engine removal is necessary. Refer to *ENGINE REMOVAL AND INSTALLATION*.

Remove drive and driven pulley and CVT air guide, refer to *CVT*.

## Overview



1. Right housing
2. Center housing
3. Left housing
4. Output shaft
5. Bearing cover
6. Countershaft
7. Shift shaft
8. Actuator

## MAINTENANCE

### GEARBOX OIL CHANGE

#### Draining Procedure

Prior to change the oil, ensure vehicle is on a level surface.

Oil change should be done with a warm engine.

### **⚠ WARNING**

The gearbox oil can be very hot.

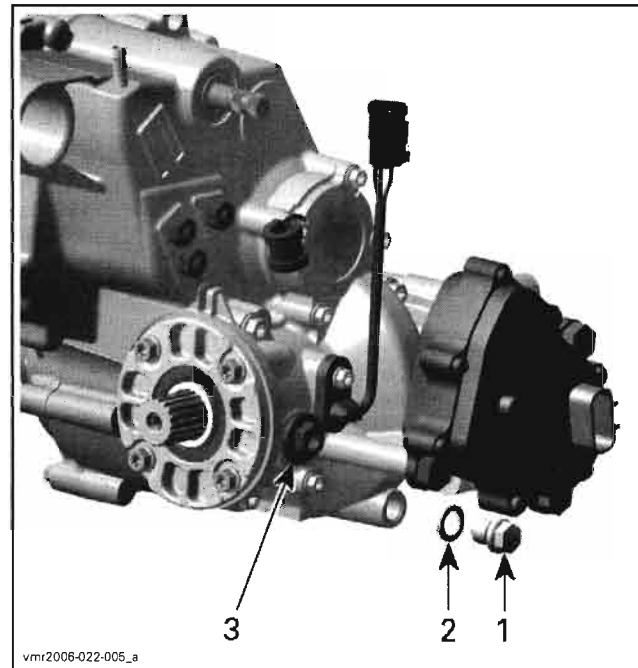
Place a drain pan under the gearbox drain plug area.

Clean drain plug area and remove magnetic drain plug no. 42 with its sealing ring no. 43 to drain gearbox oil.

Remove oil filler screw no. 44 including its O-ring no. 45.

**CAUTION:** Pay attention not to loose O-ring on drain plug screw.

Wait a while to allow oil flow out of gearbox.



1. Magnetic drain plug
2. Sealing ring
3. Oil filler screw

Dispose gearbox oil as per your local environmental regulations.

#### Inspection

Oil condition gives information about the teeth condition inside the gearbox. See *TROUBLESHOOTING* section.

Clean the magnetic drain plug from metal shavings and dirt. Presence of debris gives an indication of failure inside the gearbox. Check gearbox to correct the problem.

Change gasket ring no. 43 on the magnetic drain plug if damaged.

Replace O-ring no. 45 if brittle, hard or otherwise damaged.

**Filling Procedure**

Make sure that magnetic drain plug no. 42 is reinstalled and tight.

With the vehicle on a level surface, fill the gearbox through the oil filler hole with XP-S chaincase oil (P/N 413 801 900) or XP-S synthetic chaincase oil (P/N 413 803 300) or with an equivalent product until the oil reaches the lower threads of the oil filler hole (around 400 mL (13.5 oz U.S.)).

**PROCEDURES**

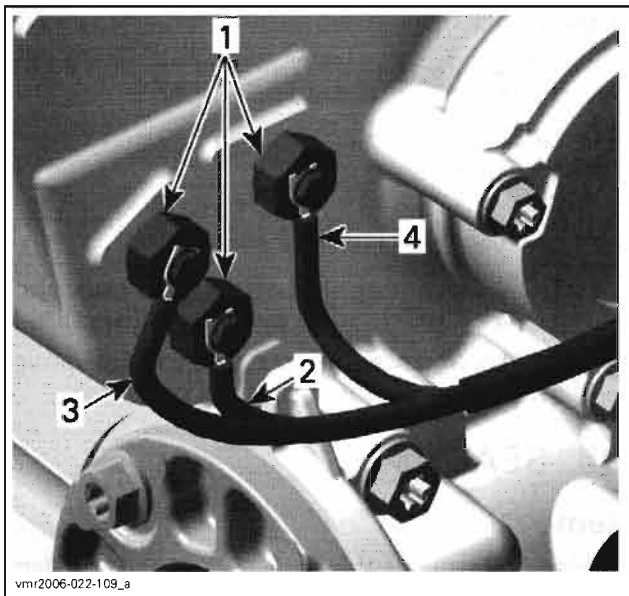
**GEARBOX POSITION INDICATOR SWITCHES**

**NOTE:** The gearbox removal is not necessary to reach the gearbox position indicator switches.

**Removal**

To reach the gearbox position indicator switches no. 41, remove the rear engine cover.

Remove screw retaining indicator switch wire.



1. Gearbox position indicator switches  
 2. BROWN/GREY wire  
 3. WHITE/GREY wire  
 4. ORANGE/GREY wire

Unscrew switch.

**Test**

Check if gearbox position indicator switches work properly as per following procedure:

Disconnect wires from switches.

**NOTE:** Remove insulating paint to obtain correct readings.

Put gearbox in park, reverse, neutral, high and low position.

Use a multimeter to measure the resistance from the indicator switch to engine ground. Compare results with the logic table below.

SHIFTER POSITION	CORRESPONDING SWITCH WIRES		
	BROWN/GREY	WHITE/GREY	ORANGE/GREY
L	X		X
H			X
N		X	X
R		X	
P	X	X	

An "X" indicates switch is making ground contact, thus there should be continuity (R is close to 0 Ohms).

A blank space indicates switch is not making contact, there should be no continuity (R = infinite).

If the indicator switch is good, check the vehicle harness and/or indicator lights.

**Installation**

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

Take care do not damage shifting indicator switches threads during installation.

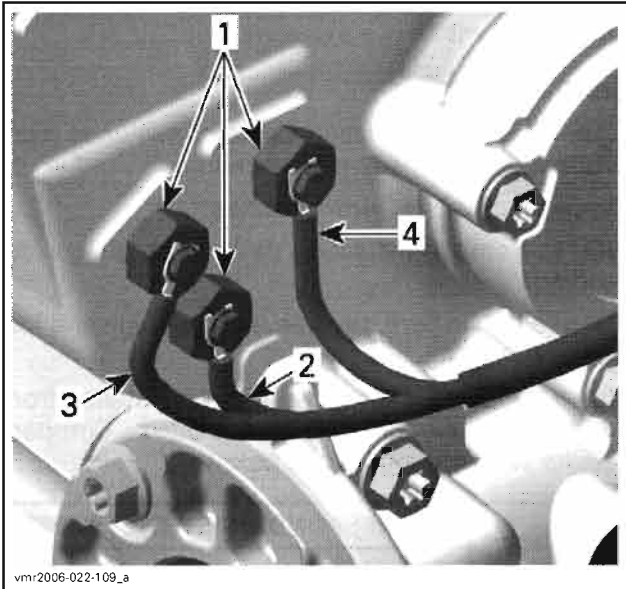
Apply carefully some Loctite 5910 (P/N 293 800 081) on threads of shifting indicator switches.

**CAUTION:** Do not apply Loctite 5910 on switch plunger, as it will lead to switch malfunction.

If all switches are removed, make sure to put the wires back in the right location.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Indicator switches
2. BROWN/GREY wire
3. WHITE/GREY wire
4. ORANGE/GREY wire

Spray a layer of electrical insulating paint or varnish over switches to prevent shorts and corrosion.



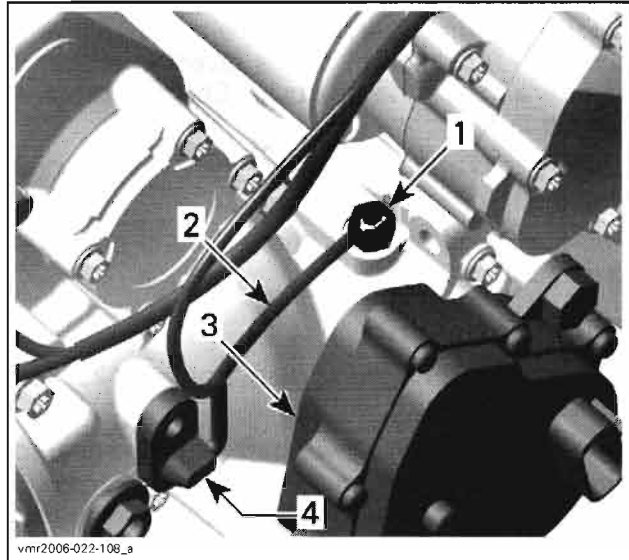
## 4WD INDICATOR SWITCH

**NOTE:** The gearbox removal is not necessary to reach the 4WD indicator switch.

### Removal

To reach the 4WD indicator switch no. 40, remove the rear engine cover.

Remove screw retaining 4WD indicator switch wire.



1. 4 WD indicator switch
2. BLACK/YELLOW wire for contact to 4WD
3. Actuator
4. Speed sensor

### Test

Measure switch resistance as follows.

SWITCH POSITION	SWITCH WIRE		RESISTANCE
2WD	BLACK/YELLOW	Engine ground	Infinite (0L)

If the resistance is out of specification, replace the 4WD indicator switch.

### Installation

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

Take care do not damage indicator switch threads during installation.

Apply carefully some Loctite 5910 (P/N 293 800 081) on threads of indicator switch.

**CAUTION:** Do not apply Loctite 5910 on switch plunger, as it will lead to switch malfunction.

Spray a layer of electrical insulating paint or varnish over switch to prevent shorts and corrosion.

## OIL SEALS

### Removal

Replace oil seals if they are brittle, hard or damaged.

A small flat screwdriver can be used to remove most of these oil seals.

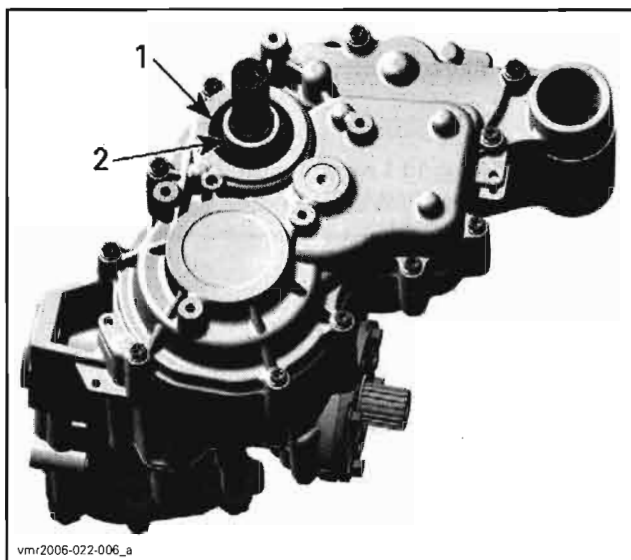


**CAUTION:** Avoid scoring housings, bearing cover, shift shaft, distance sleeve of countershaft or output shaft during oil seal removal.

### Countershaft Oil Seal

The countershaft oil seal no. 47 can be removed without removing gearbox from vehicle. Remove drive and driven pulley and CVT air guide.

**NOTE:** When oil seal is removed also inspect O-ring no. 31.



1. Countershaft oil seal  
2. Distance sleeve

### Shift Shaft Oil Seal

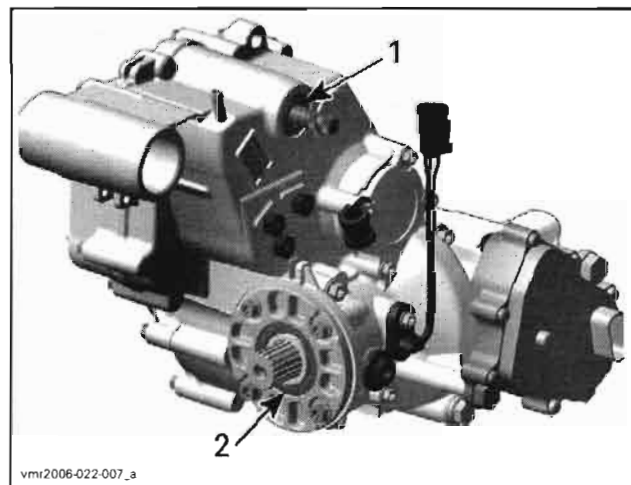
The shift shaft oil seal no. 38 can be removed without removing the gearbox from the vehicle.

Remove side panel and the shifting plate from shift shaft to reach the oil seal.

### Output Shaft Oil Seal

Removal of output shaft oil seal no. 46 requires that the rear propeller shaft is separated from the output shaft (refer to *DRIVE TRAIN* section). The removal of the gearbox or bearing cover is not necessary.

**NOTE:** When oil seal is removed also inspect O-ring no. 4.



1. Shift shaft oil seal  
2. Output shaft oil seal

### Inspection

Check bearings behind each oil seal for contamination and/or metal shavings.

Check oil seal running surfaces for scratches. Replace if necessary (see *GEARBOX* below).

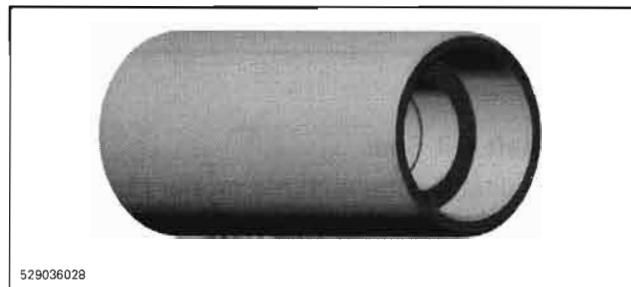
Check if the countershaft O-ring no. 31 and the output shaft O-ring no. 4 are brittle, hard or damaged. Replace if necessary.

### Installation

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

### Output Shaft and Countershaft Oil Seal

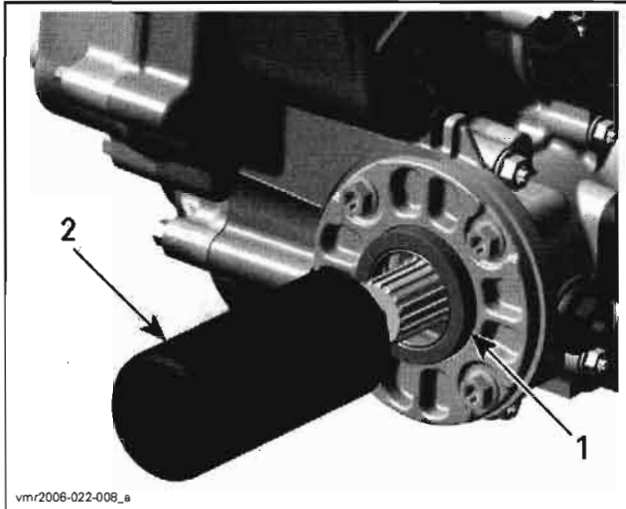
Install output shaft oil seal and countershaft oil seal with the oil seal installer (P/N 529 036 028).



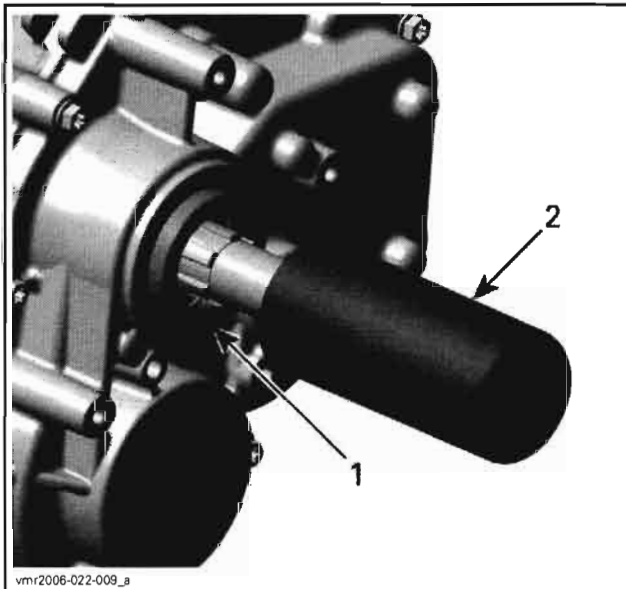
OIL SEAL INSTALLER

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Output shaft oil seal  
2. Oil seal installer

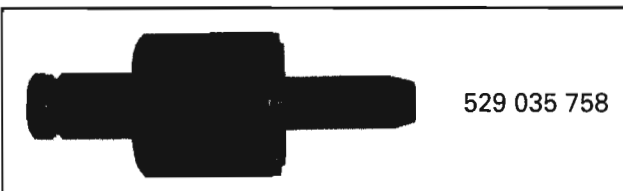


1. Countershaft oil seal  
2. Oil seal installer

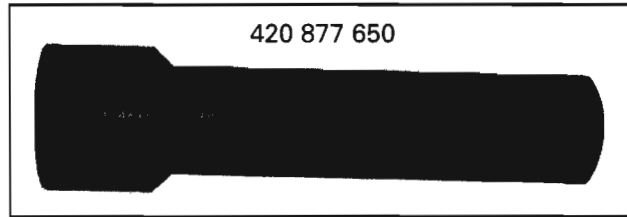
#### Shift Shaft Oil Seal

Using a suitable tube with the proper diameter to install the shift shaft oil seal.

If gearbox housing is apart, the oil seal installer (P/N 529 035 758) and installer handle (P/N 420 877 650) can be used for shift shaft oil seal installation.



529 035 758



420 877 650

**CAUTION:** Oil seal must be installed with sealing lip toward gearbox.

## ACTUATOR

### European Community Models (CE)

#### Test

Using the Fluke 111 multimeter (P/N 529 035 868), check if the 2WD/4WD selector works properly.



529 035 868

Remove the rear engine cover.

Unplug actuator connector.

- Turn ignition key ON and set engine run/stop switch to RUN.
- Measure voltage as follows.

SWITCH POSITION	SWITCH WIRE		VOLTAGE
2WD	WHITE/BLUE	WHITE	Battery voltage
4WD	WHITE/BLACK		

If the selector is out of specifications, check wires, connectors and replace the selector if necessary.

If the selector is good, check the vehicle harness.

If the vehicle harness is good, replace the actuator no. 39.

#### Removal

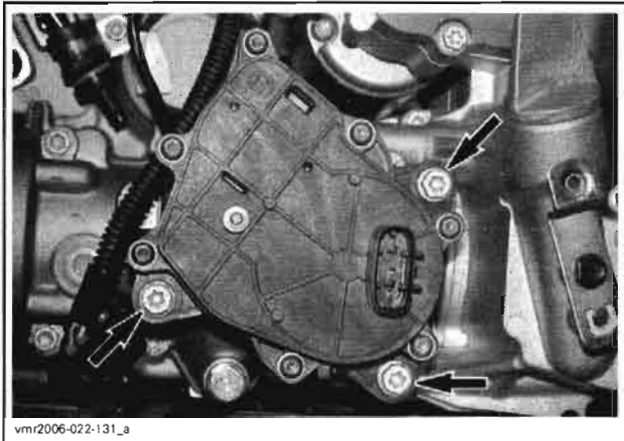
**NOTE:** Before beginning any servicing on the actuator, make sure the vehicle is in 4WD position. No need to remove engine from vehicle.

Remove the RH footrest and the rear engine cover. Refer to *BODY*.

Unplug actuator connector.

Place a drain pan under actuator.

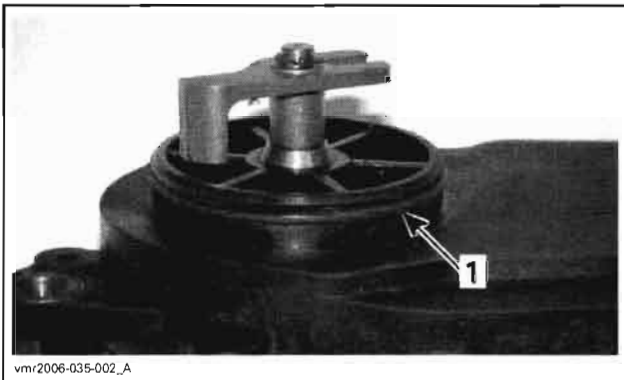
Unscrew actuator bolts.



When all actuator bolts are removed, pull the actuator out of housing.

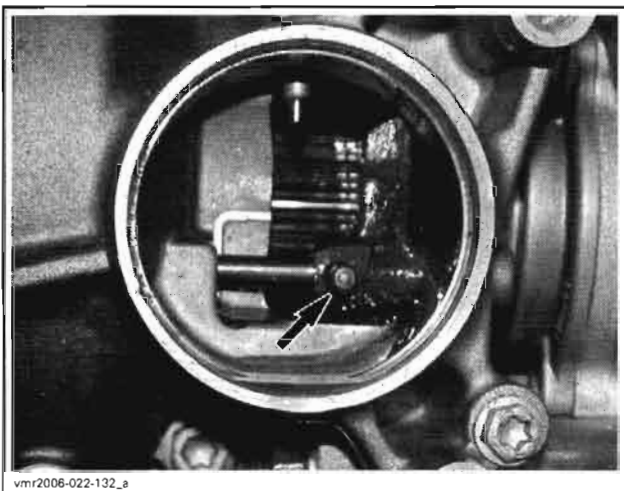
### Installation

Apply a small amount of Super Lube grease (P/N 293 550 030) on actuator O-ring.



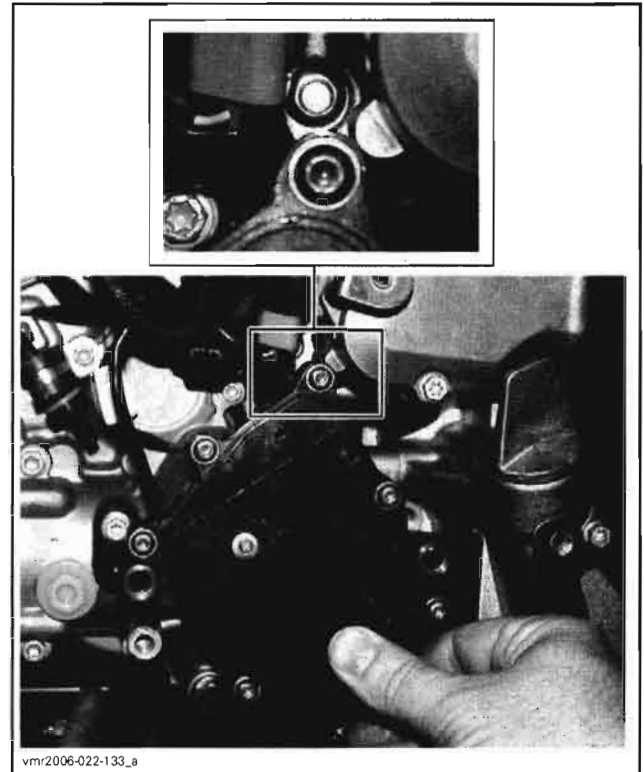
1. Actuator O-ring

Verify if coupling fork no. 10 is in 4WD position. The coupling fork should be positioned toward the front of vehicle.



vmr2008-054

Align the actuator fork with the pin on coupling fork no. 10 then push the actuator in the housing. See the following illustration to position the actuator correctly.



Rotate the actuator counterclockwise until it orients itself to mounting position.

**CAUTION:** Do not cut or break the actuator O-ring.

Install all actuator bolts then torque them to 25 N•m (18 lbf•ft).

Connect actuator.

Lift the front of vehicle.

Turn front wheels. The front propeller shaft should not turn (the PARK position must be selected).

If the front propeller shaft turns, the actuator is not installed correctly. Remove actuator and reinstall it.

Place ignition switch to ON position and select the 2WD position.

Turn front wheel again. The front propeller shaft. The shaft should turn easily.

If the front propeller shaft does not turn, the actuator is not installed correctly. Remove actuator and reinstall it.

**CAUTION:** Refill missing gearbox oil, refer to **GEARBOX OIL CHANGE** above.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)

Install all other removed parts.

## OUTPUT SHAFT AND COUPLING MECHANISM

Remove gearbox. Refer to *GEARBOX* further in this section.

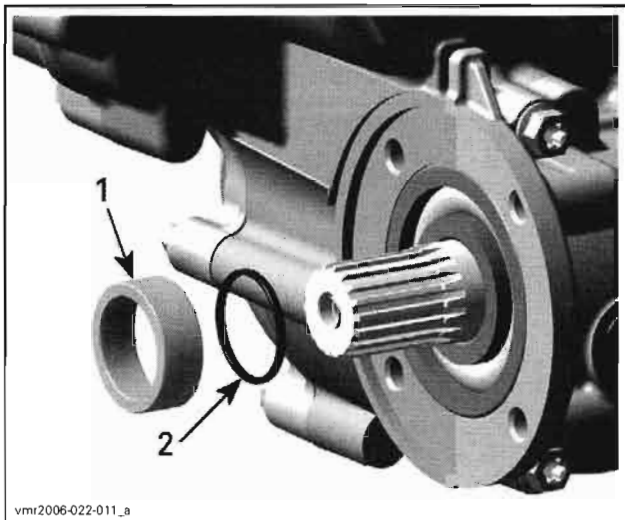
Before removing the right housing and output shaft **no. 1** measure the backlash on output shaft. This measure will indicate if output shaft adjustment is necessary.

### Output Shaft Backlash Procedure

Engage PARK position on the gear shaft to block gearbox.

Remove:

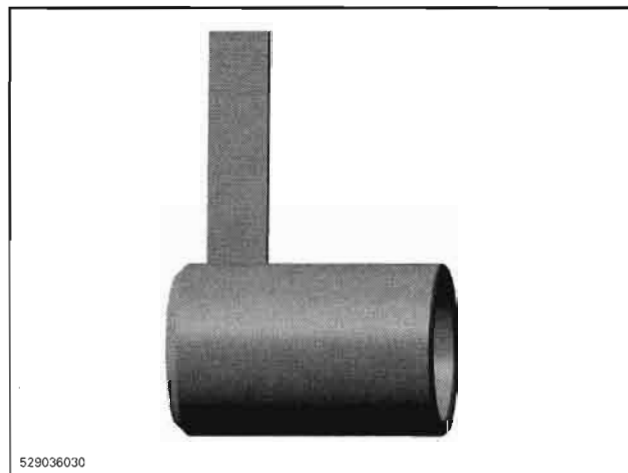
- bearing cover with oil seal



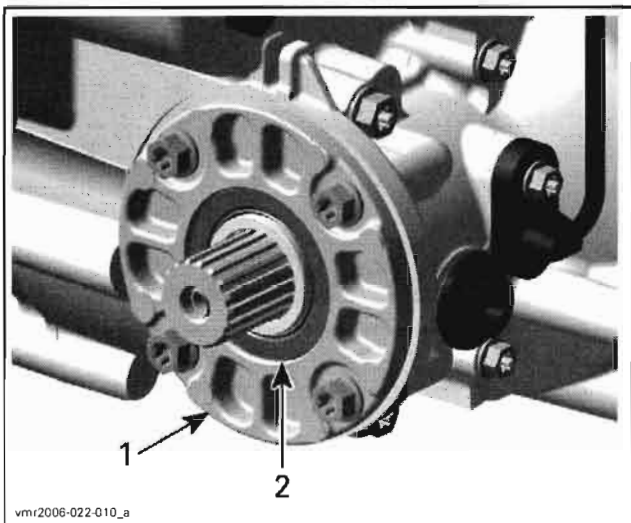
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1. Distance sleeve
2. O-ring

Install the backlash measurement tool (P/N 529 036 030) at the end of output shaft.



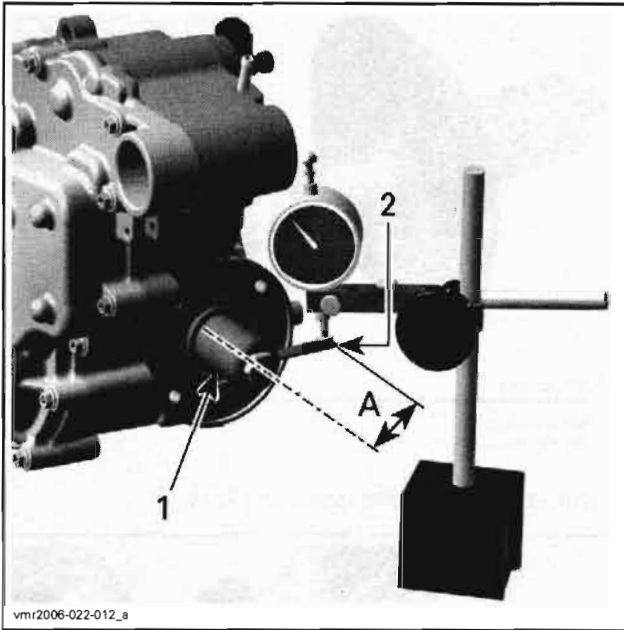
From center of tool bolt, measure 47 mm (1.85 in) and place a mark on the tab.



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1. Bearing cover
2. Oil seal

- distance sleeve
- O-ring.



- 1. Backlash measurement tool
- 2. Mark on tab
- A. 47 mm (1.85 in)

Position the head of the dial indicator, against the tab at a 90° angle and on the line. Then, gently rotate the output shaft.

This reading gives the backlash measurement. Refer to the following table for backlash specifications.

OUTPUT SHAFT BACKLASH	
NEW	0.10 to 0.20 mm (.0039 to .0079 in)
SERVICE LIMIT	0.25 mm (.0098 in)

If backlash is not within the specification, remove the output shaft and select the next thicker or thinner shim to meet the specifications.

**NOTE:** Use next thicker shim to increase backlash and next thinner shim to reduce backlash.

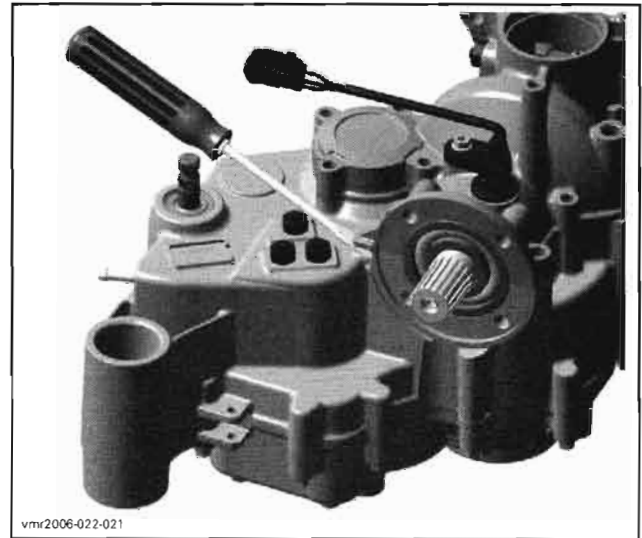
**Removal**

Remove actuator no. 39.

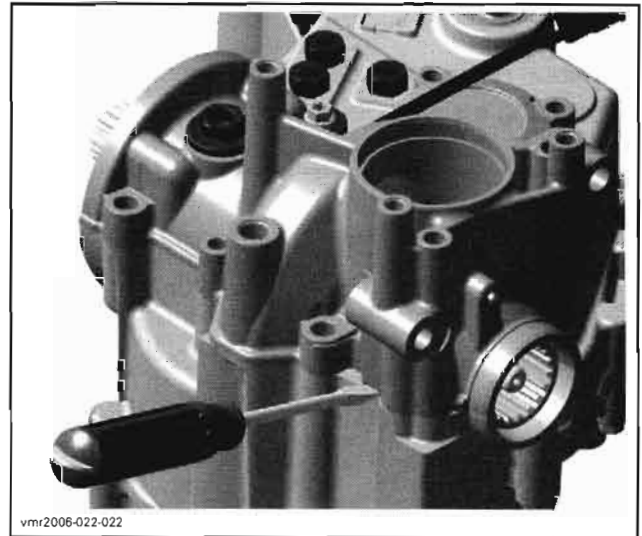
Remove the bearing cover with oil seal.

Unscrew all bolts retaining the right housing to the center housing.

To remove right housing, use 2 big screwdrivers.



POSITION FOR BIG FLAT SCREWDRIVER



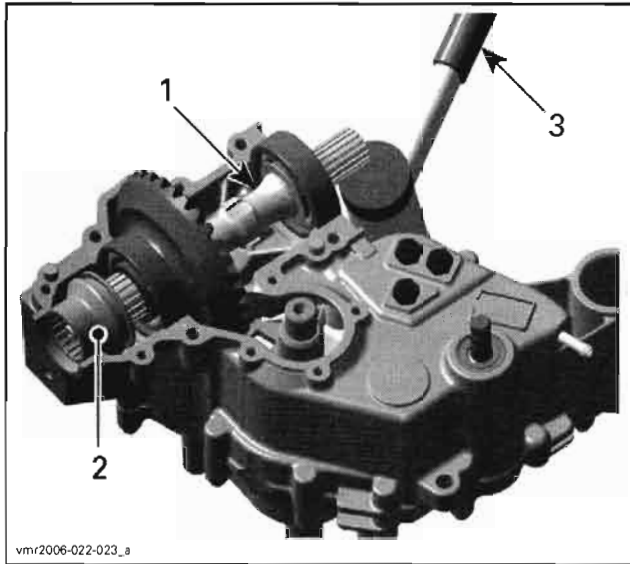
POSITION FOR BIG FLAT SCREWDRIVER

Remove output shaft.

**CAUTION:** Use a soft hammer to remove output shaft from center housing.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

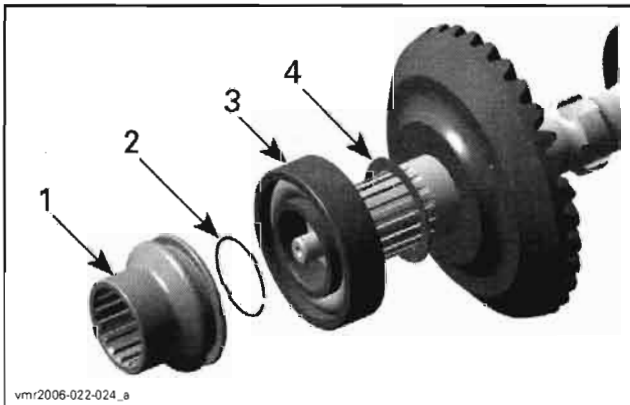
### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Output shaft
2. Coupling sleeve
3. Soft hammer

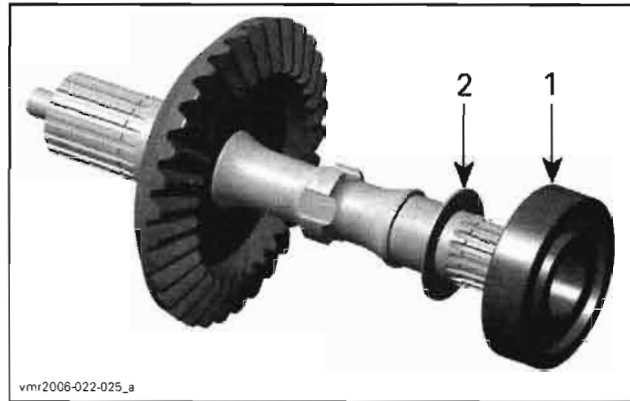
Continue removal procedure by removing:

- coupling sleeve, O-ring, ball bearing and thrust washer.



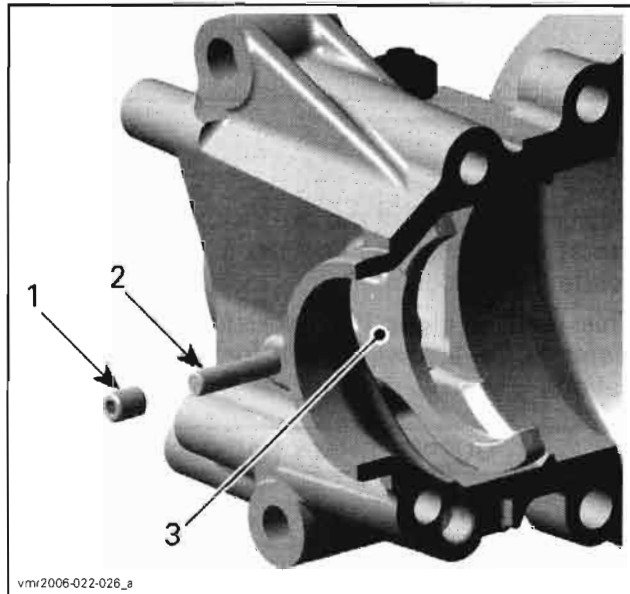
1. Coupling sleeve
2. O-ring
3. Ball bearing
4. Thrust washer

- ball bearing and thrust washer



1. Ball bearing
2. Thrust washer

- set screw, pin and coupling fork.



1. Set screw
2. Pin
3. Coupling fork

### Inspection

Check output shaft no. 1 and its gear for cracks, bend, pitting or other visible damages.

Check output shaft splines for wear or other damages.

**CAUTION:** Always replace output shaft and bevel gear shaft at the same time. Adjust these components upon replacement.

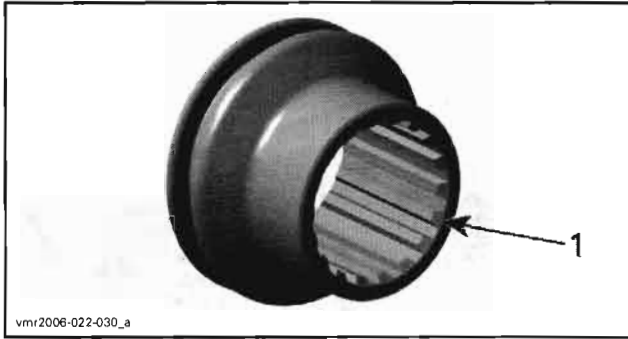
Check if the output shaft bearings no. 3 and no. 7 turn freely and smoothly. Replace if necessary.

Replace oil seal no. 46 if brittle, hard or damaged.

Replace O-rings no. 4 and no. 8 if brittle, hard or damaged.

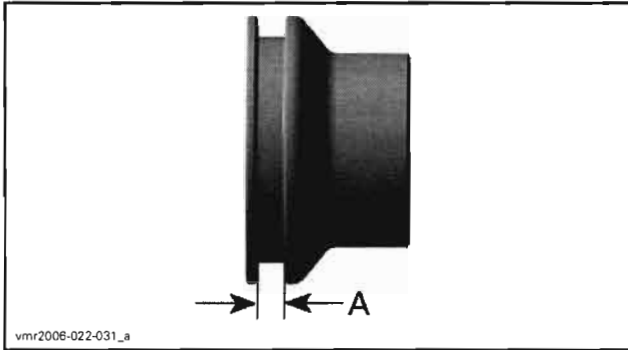
Check splines of coupling sleeve no. 9 for wear or other damages.

**Section 03 ENGINE AND GEARBOX (V490/V660/V810)**  
**Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)**



1. Inspect splines

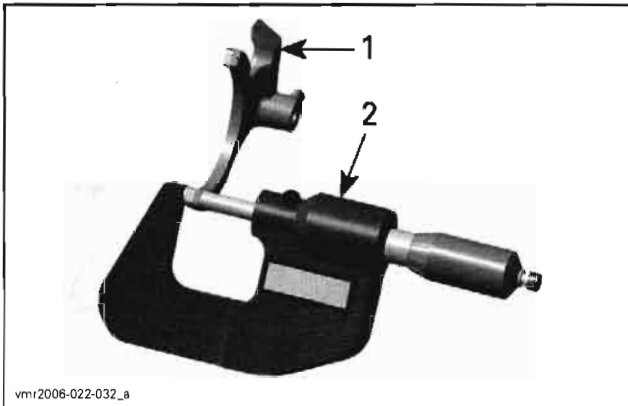
Measure the coupling sleeve groove width.



A. Groove width

COUPLING SLEEVE GROOVE WIDTH	
NEW	5.25 to 5.35 mm (.207 to .211 in)
SERVICE LIMIT	5.50 mm (.217 in)

Check coupling fork claw thickness.



1. Coupling fork  
 2. Micrometer

COUPLING FORK CLAW THICKNESS	
NEW	4.95 to 5.05 mm (.195 to .199 in)
SERVICE LIMIT	4.80 mm (.189 in)

Clean housing split surface and especially the bearing areas from metal particles or other contamination.

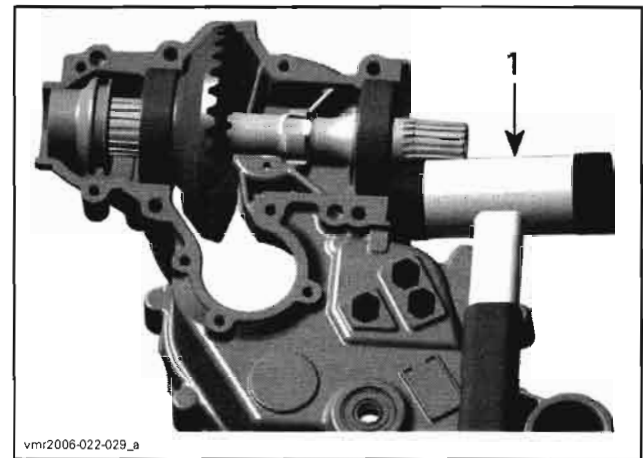
**Installation**

Install thrust washer no. 6, bearing no. 7, O-ring no. 8 and coupling sleeve no. 9 onto the output shaft.

Install thrust washer no. 2 and ball bearing no. 3. O-ring no. 4 and distance sleeve no. 5 are not installed at this time.

Place the output shaft into the center housing.

Use soft hammer to put bearing exactly in place against center housing.



1. Soft hammer

Clean the bearing cover location then attach bearing cover with oil seal to the housing.

Temporarily install the right housing with the four (4) M8 TORX screws beside bearing seats.

**NOTE:** Prior to tightening the TORX screws, tap on the gear end of output shaft with a soft hammer to take up all gear free play.

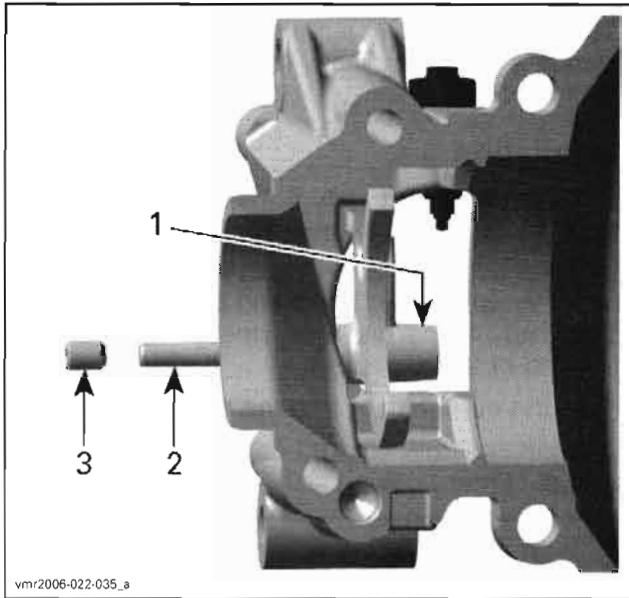
Verify output shaft backlash. Refer to *OUTPUT SHAFT BACKLASH PROCEDURE* in this section. Adjust as required.

If backlash is within specifications, remove dial indicator, backlash measuring tool, bearing cover and right housing.

**NOTE:** Install coupling fork, pin and set screw in right housing before applying sealant to the mating surface.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Coupling fork  
2. Pin  
3. Set screw

Clean all metal components in a solvent.

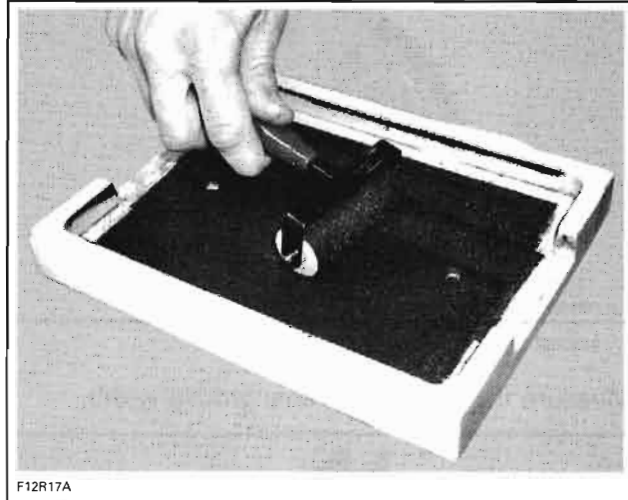
Housing mating surfaces are best cleaned using a combination of Loctite chisel (gasket remover) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

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

**IMPORTANT:** When beginning the application of 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.

Use Loctite 5910 (P/N 293 800 081) on mating surfaces.

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

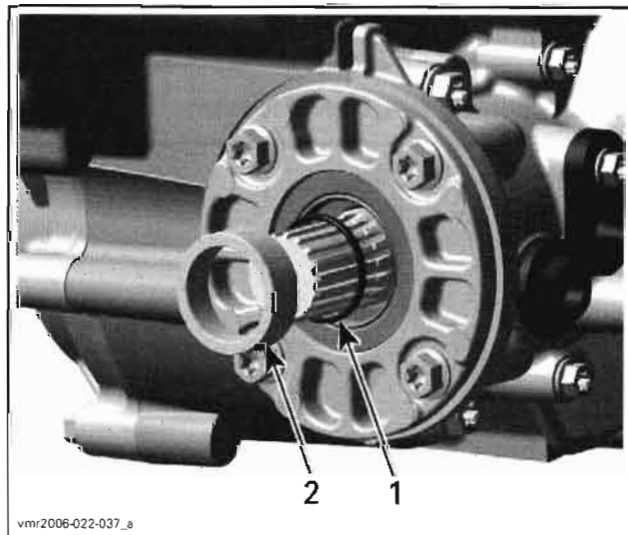


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Do not apply in excess as it will spread out inside housings.

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

Install all other screws on right housing then the O-ring no. 4 and the distance sleeve no. 5 on end of output shaft. Chamfered bore of distance sleeve has to face the engine.



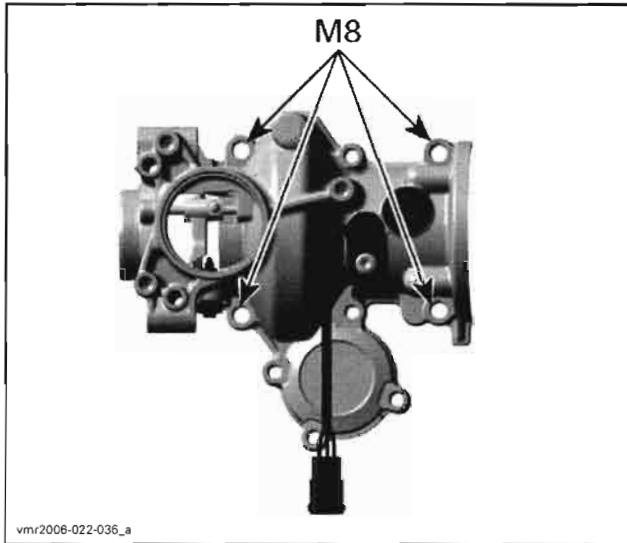
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1. O-ring  
2. Distance sleeve

**NOTE:** To install the right housing align the coupling fork no. 10 with the groove in the coupling sleeve no. 9.

First, torque the four (4) M8 Torx screws in a criss-cross sequence by hand then retighten to 25 N•m (18 lbf•ft).





Tighten all M6 Torx screws to 10 N•m (89 lbf•in)  
 Before installing bearing cover, apply Loctite 5910 (P/N 293 800 081) on the housing and Super Lube grease (P/N 293 550 030) on seal.  
 Install the actuator, refer to *ACTUATOR*.  
 Once this is done, complete final assembly.

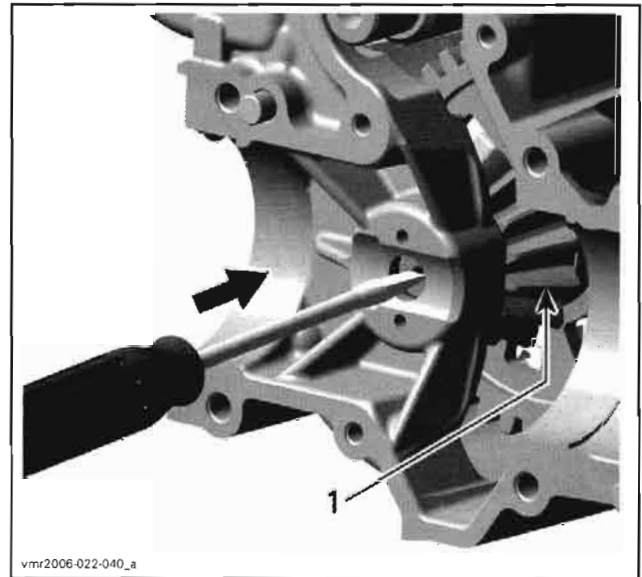
**GEARBOX**

**Removal**

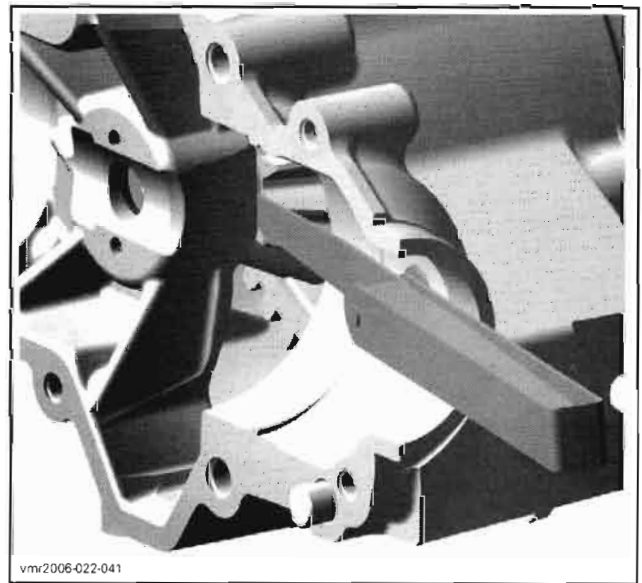
Remove engine from vehicle and place it on footrest support. Refer to *ENGINE REMOVAL AND INSTALLATION* for the procedure.  
 Drain gearbox. Refer to *GEARBOX OIL CHANGE* in *MAINTENANCE* of this section for the procedure.  
 Unscrew the three (3) nuts that attach the gearbox to the engine.  
 Pull gearbox to separate it from engine.

**Disassembly**

**NOTE:** During gearbox disassembly, inspect the condition of each part closely.  
 Remove the output shaft. Refer to *OUTPUT SHAFT AND COUPLING MECHANISM* in this section.  
 Push bevel gear no. 11 with a pin slightly down and measure the axial clearance of bevel gear with a feeler gauge.  
**NOTE:** Bevel gear axial clearance must be measured before center and left housings separation.



1. Bevel gear



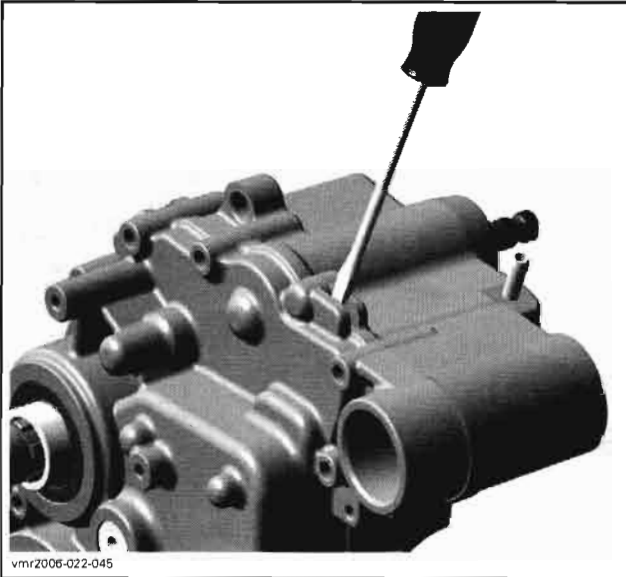
MEASURE AXIAL CLEARANCE OF BEVEL GEAR

BEVEL GEAR AXIAL CLEARANCE	
NEW	0.02 to 0.15 mm (.00079 to .0059 in)
SERVICE LIMIT	0.19 mm (.0075 in)

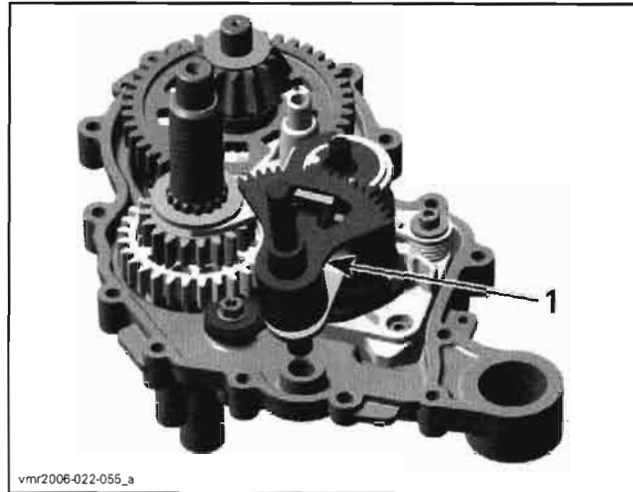
Unscrew the left housing screws.  
 Place the left housing on a wood stand, center housing pointing upwards.  
 Using 2 big flat screwdrivers, lift the center housing.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



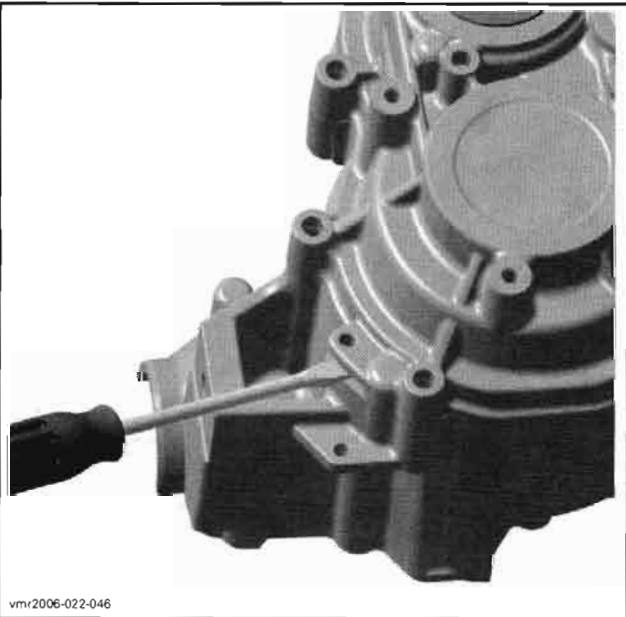
POSITION FOR BIG FLAT SCREWDRIVER



1. Shift shaft assembly

Remove shift fork shaft.

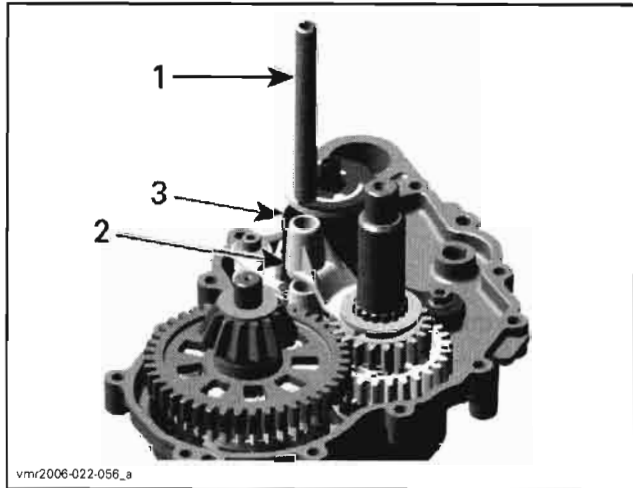
Remove disengage shift fork from shift drum.



POSITION FOR BIG FLAT SCREWDRIVER

Remove center housing completely.

Remove shift shaft assembly.

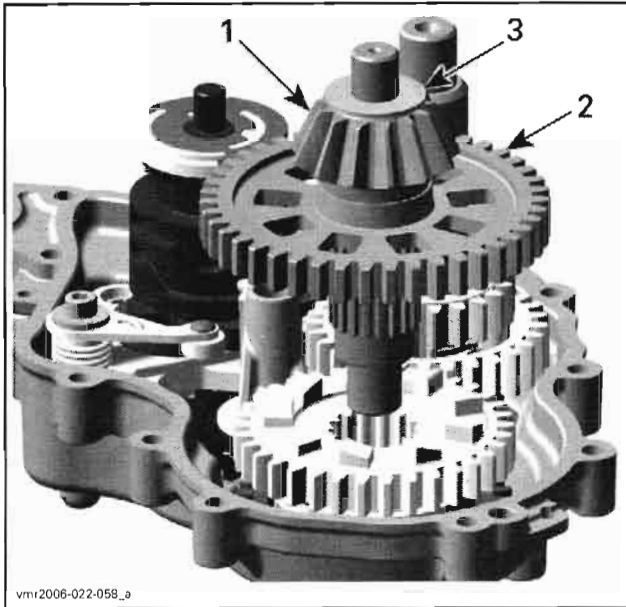


1. Shift fork shaft  
2. Shift fork  
3. Shift drum

Remove bevel gear shaft with low range gear assembly and shim.

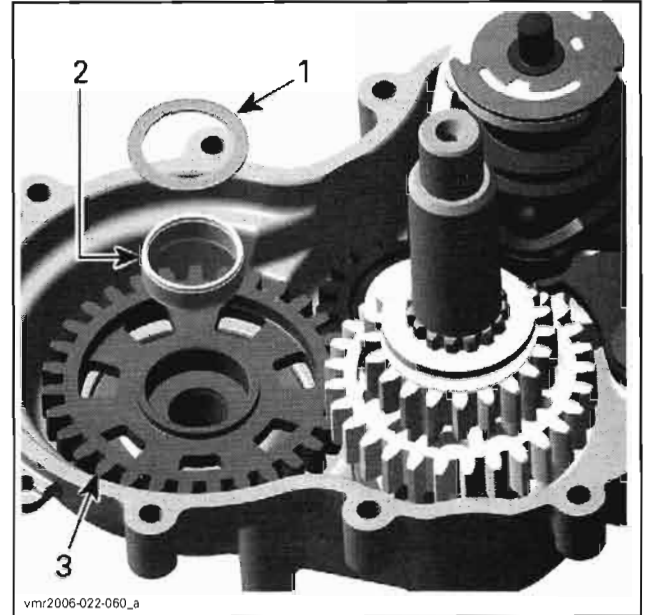
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



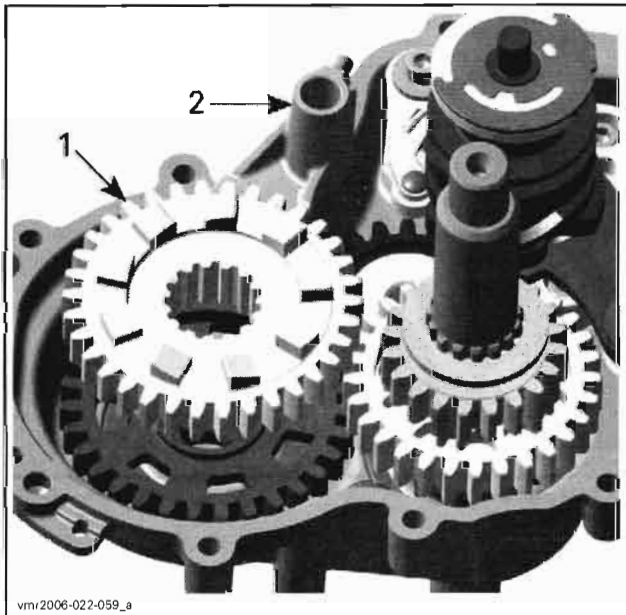
1. Bevel gear
2. Low range gear
3. Shim

Remove sliding gear with shift fork.



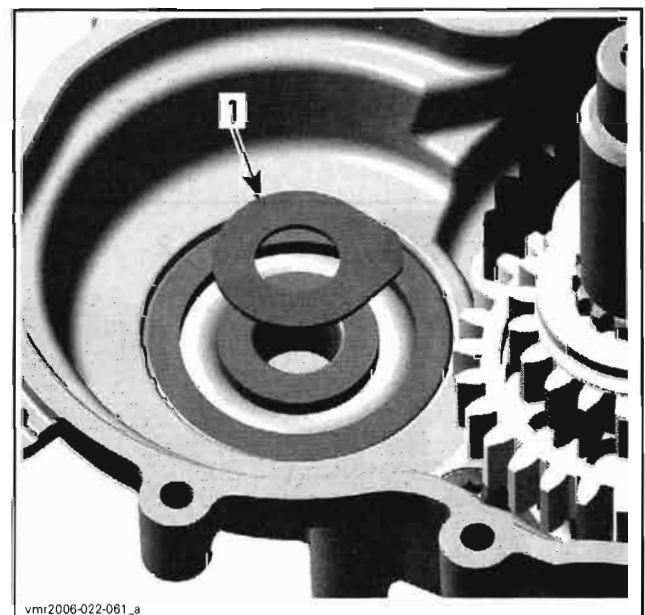
1. Thrust washer
2. Needle bearing
3. Reverse gear

Remove shim on CVT side.



1. Sliding gear
2. Shift fork

Remove thrust washer, needle bearing and reverse gear.

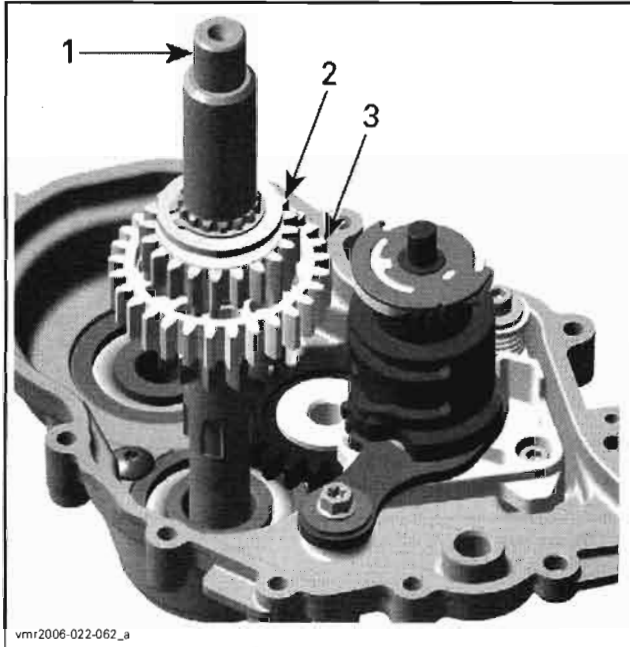


1. Shim on CVT side

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

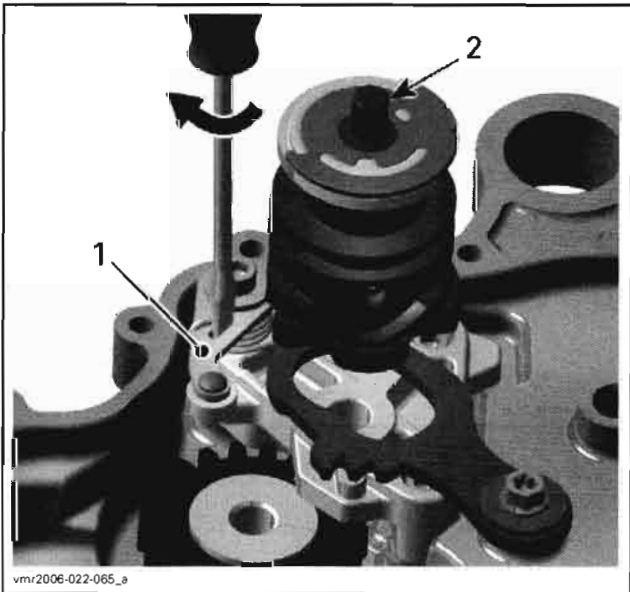
### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)

Remove countershaft no. 18 with low range gear and high range gear assembly.



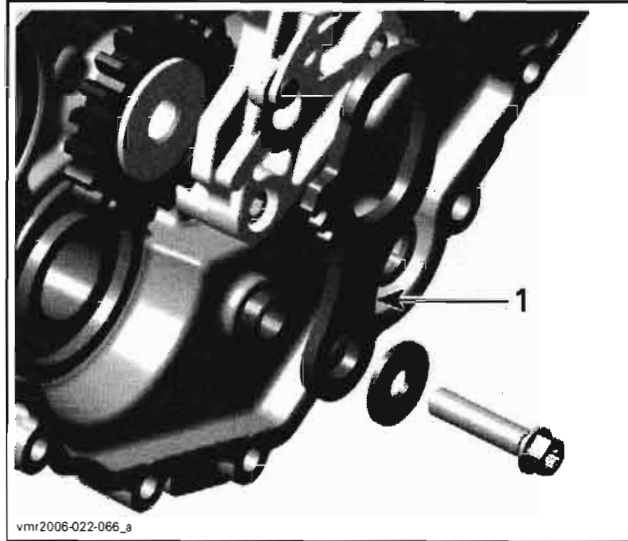
1. Countershaft
2. Low range gear
3. High range gear

Insert a flat screwdriver in the slot of index lever. Turn screwdriver clockwise and remove shift drum.



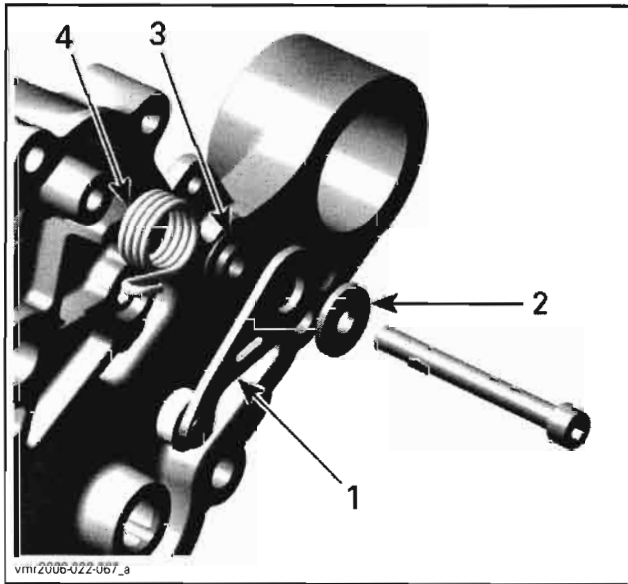
1. Index lever
2. Shift drum

Continue by removing the following;  
– parking lock lever



1. Parking lock lever

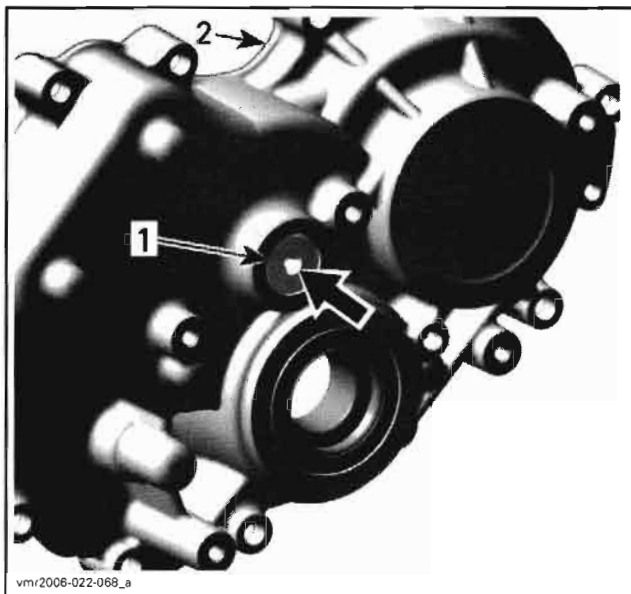
– index lever with washer, step ring and spring



1. Index lever
2. Washer
3. Step ring
4. Index spring

– support flange no. 37.

To remove intermediate gear no. 23 and needle bearing no. 22, use a press bench to push out the intermediate gear shaft no. 21.



**PRESS SHAFT IN THE DIRECTION AS SHOWN BY THE ARROW**  
 1. Intermediate gear shaft  
 2. Left housing

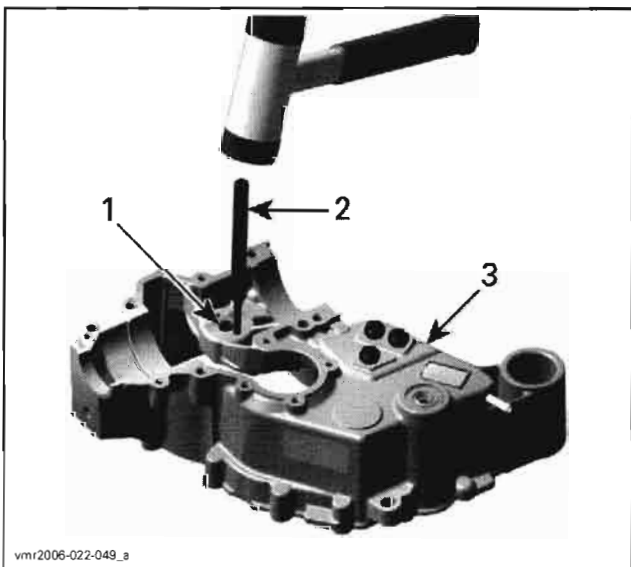
**Bearing Removal in Housing**

If necessary heat housing up to 100°C (212°F) before removing ball bearings or needle bearings.

**⚠ WARNING**  
 Clean oil, outside and inside, from housing before heating.

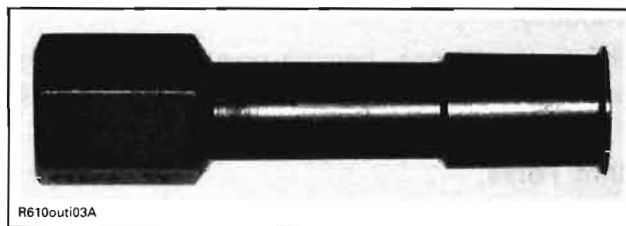
**CAUTION:** Always support gearbox housings properly when ball bearings or needle bearings are removed. Housing damages may occur if this procedure is not performed correctly.

To remove bevel gear needle bearing use a punch.

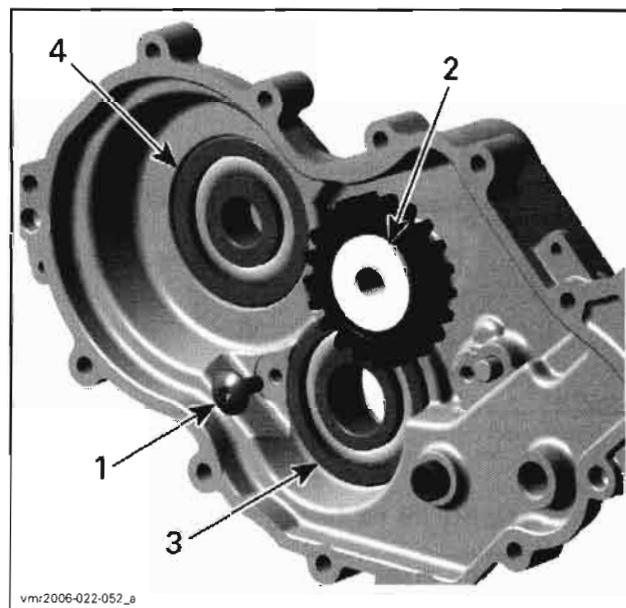


1. Bevel gear needle bearing  
 2. Punch  
 3. Center housing

To remove ball bearings of bevel gear no. 36 and needle bearing of countershaft no. 33, use a blind hole bearing puller.



For countershaft ball bearing, remove screw and intermediate gear shaft, then push with a suitable puller from outside in.



1. Screw  
 2. Intermediate gear shaft  
 3. Ball bearing countershaft  
 4. Bevel gear ball bearing

**Inspection**

Always verify for the following when inspecting gearbox components:

- gear teeth damage
- worn or scoured bearing surfaces
- worn or scoured shift fork
- worn or scoured shift fork shaft
- rounded engagement dogs and slots
- bent shift forks
- bent shift fork shaft
- worn shift fork engagement pins
- worn tracks on shift drum
- worn shift fork engagement groove
- worn splines on shafts and gears.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)

#### Bearings

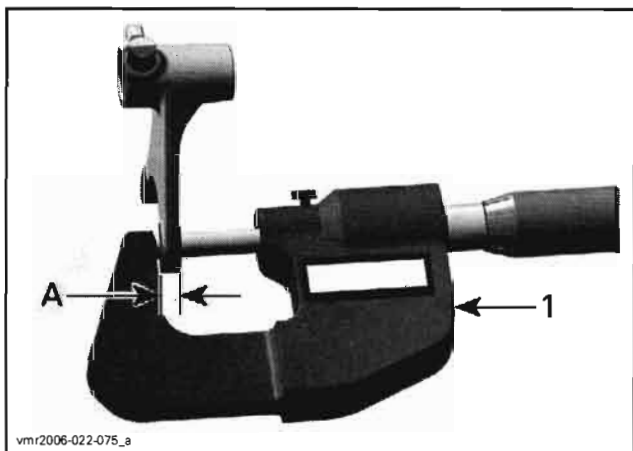
Check if bearings no. 34 and no. 36 as well as needle bearings no. 33 and no. 35 turn freely and smoothly.

Check all bearings, bearing points, tooth flanks, taper grooves and annular grooves. Annular grooves must have sharp edges.

#### Shift Forks

Check both shift forks for visible damage, wear or bent shift fork claws.

Measure the shift fork claw thickness.



1. Micrometer  
A. Shift fork claw thickness

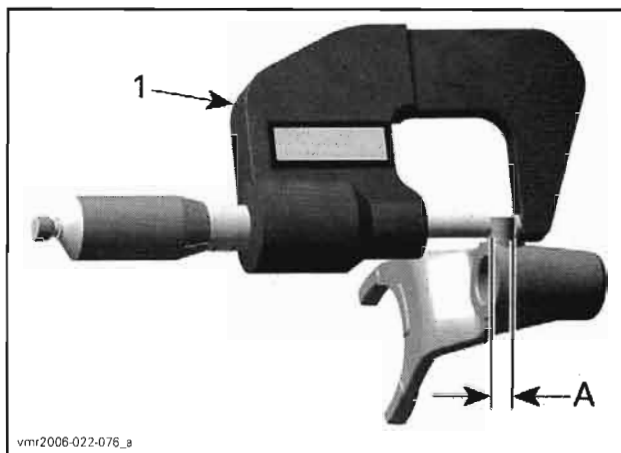
– Shift fork no. 25 for high gear shifting.

SHIFT FORK CLAW THICKNESS (high gear shifting)	
NEW	4.80 to 4.90 mm (.189 to .193 in)
SERVICE LIMIT	4.70 mm (.185 in)

– Shift fork no. 26 for low/reverse gear shifting.

SHIFT FORK CLAW THICKNESS (low/reverse gear shifting)	
NEW	5.10 to 5.20 mm (.200 to .205 in)
SERVICE LIMIT	5.00 mm (.197 in)

Measure shift fork pins.



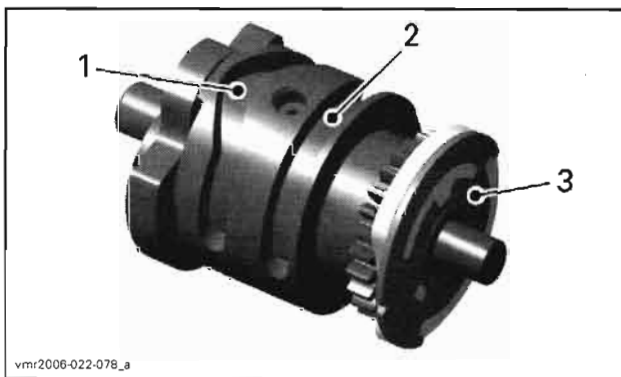
1. Micrometer  
A. Shift fork pin diameter

SHIFT FORK PIN DIAMETER	
NEW	6.920 to 6.970 mm (.272 to .274 in)
SERVICE LIMIT	6.850 mm (.270 in)

#### Shift Drum

Check shift drum tracks for scouring or heavy wear, like rounded engagement slots.

Replace isolating washer no. 27 if there are signs of wear or visible damages.



1. Track for the low/reverse gear shift fork  
2. Track for the high gear shift fork  
3. Isolating washer on the shift drum

#### Levers

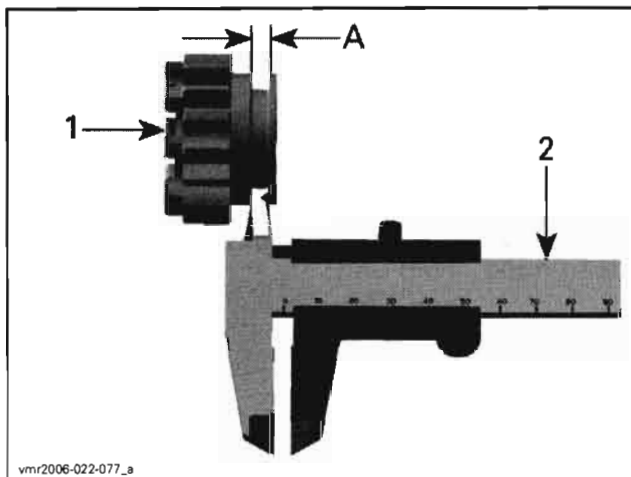
Check parking lever no. 29 for cracks or other damages.

Index lever with roller no. 28 must move freely.

#### Gears

**NOTE:** Replace gears only together with the corresponding meshing gears. Always replace circlips and use special pliers to install them.

Measure the width of shift fork engagement groove.



1. Main gear  
2. Caliper  
A. Width for engagement of shift fork

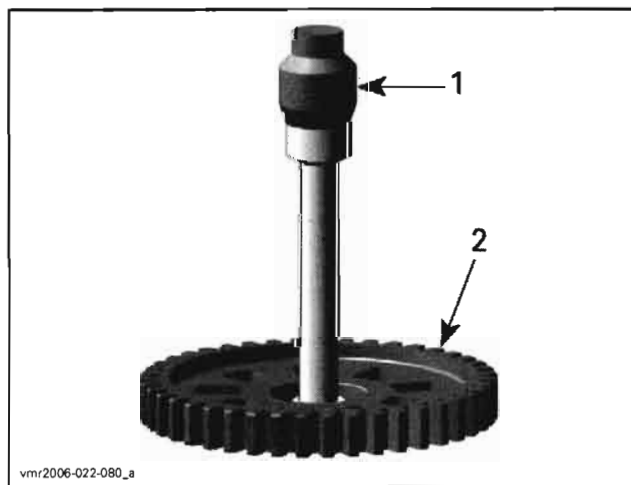
– Gear no. 20 for high gear shifting.

WIDTH OF SHIFT FORK ENGAGEMENT GROOVE (high gear shifting)	
NEW	5.00 to 5.10 mm (.197 to .201 in)
SERVICE LIMIT	5.20 mm (.205 in)

– Gear no. 15 for low/reverse gear shifting.

WIDTH OF SHIFT FORK ENGAGEMENT GROOVE (low/reverse gear shifting)	
NEW	5.30 to 5.40 mm (.209 to .213 in)
SERVICE LIMIT	5.50 mm (.217 in)

Check free pinions no. 14, no. 16, no. 19 and no. 23 for wear.



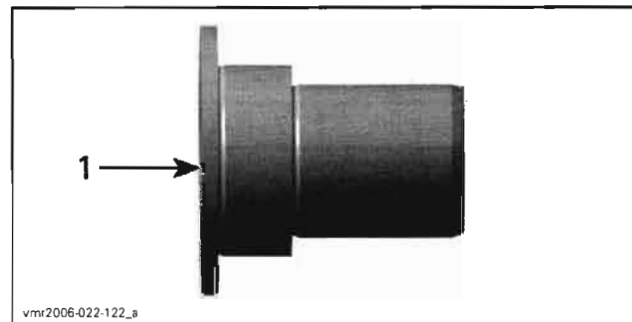
TYPICAL  
1. Micrometer  
2. Free pinion

DIAMETER FREE PINION	
NEW	29.000 to 29.013 mm (1.1417 to 1.1422 in)
SERVICE LIMIT	29.015 mm (1.1423 in)

**Shafts**

Check shift shaft no. 30 for worn splines and gears.

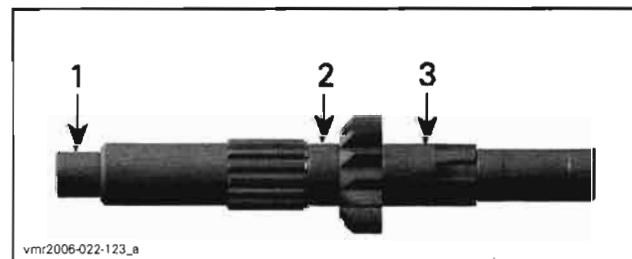
Check intermediate shaft for wear.



1. Intermediate gear bearing

INTERMEDIATE GEAR SHAFT	
NEW	24.979 to 25.000 mm (.9834 to .9842 in)
SERVICE LIMIT	24.977 mm (.9833 in)

Check countershaft for wear.



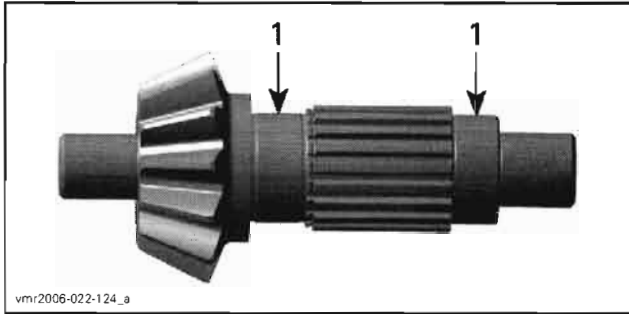
1. MAG side  
2. Free pinion bearing  
3. CVT side

COUNTERSHAFT	
SERVICE LIMIT	
MAG side	17.990 mm (.708 in)
Free pinion bearing	24.970 mm (.983 in)
CVT side	24.970 mm (.983 in)

Check bevel gear shaft.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Free pinion bearings

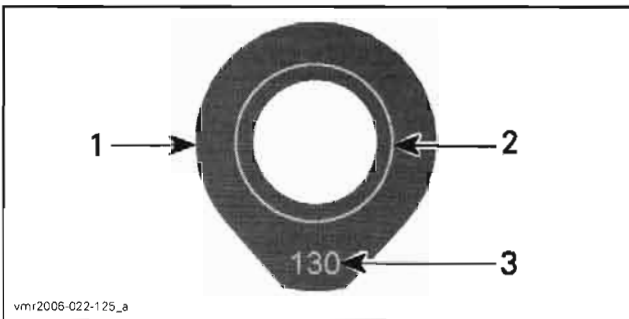
Clean mating surface of housing before taking measurements using a combination of Loctite chisel (gasket remover) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

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

BEVEL GEAR SHAFT	
SERVICE LIMIT	
Free pinion bearing	24.984 mm (.9836 in)

### Shims

Always replace shim by a new one with the same thickness, when reassembling the gearbox with existing output shaft no. 1 and bevel gear shaft no. 11.



1. Shim for adjusting the bevel gear on center housing side  
2. Area where wear signs appear  
3. Thickness of the shim

## Adjustment

### Bevel Gear

**NOTE:** Only necessary if the backlash and axial clearance of the bevel gear is out of specification or if parts are changed (output shaft, bevel gear shaft or housing).

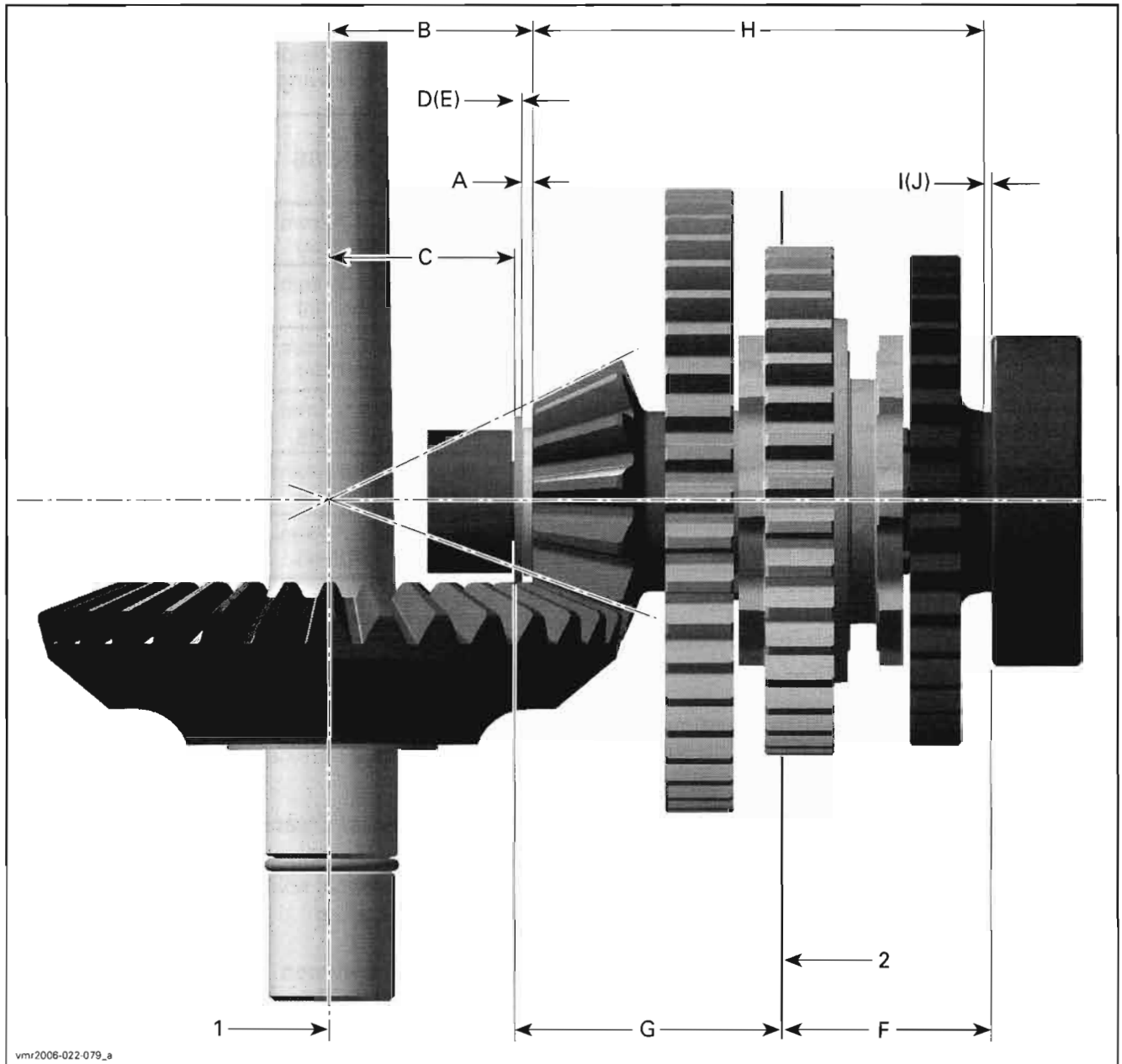
There are 2 adjustments to perform on the bevel gear.

- bevel gear backlash on center housing
- bevel gear axial clearance on left housing.

The bevel gear backlash is adjusted by finding the proper shim thickness **E** as per following illustration.

The bevel gear axial clearance is adjusted by finding the proper shim thickness **J** as per following illustration.





vmr2006-022-079\_a

1. Mating surface — output shaft
2. Mating surface — left housing

### Bevel Gear Backlash Procedure

Use the following course of calculation to determine the theoretical shim thickness D:

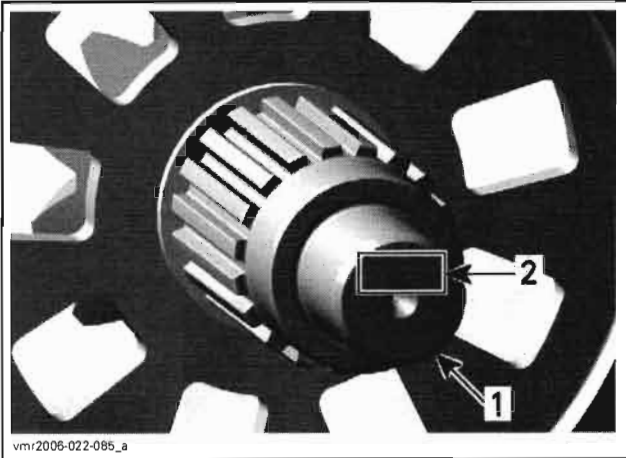
$$D = B - C - A$$

**B** = The distance between the thrust surface of the bevel gear and the theoretical center of its taper. This is defined by manufacturer and is written on the bevel gear shaft.

This bevel gear reference number could be between - 10 and + 10.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Bevel gear
2. Bevel gear reference number

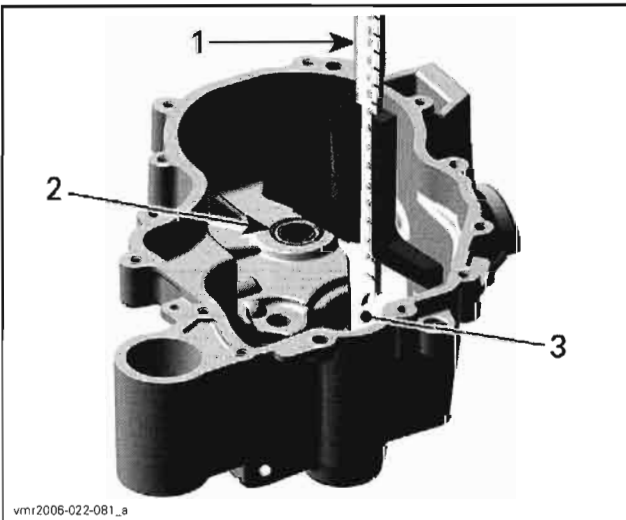
Use following formula to find out value **B**.

$$B = \left( \frac{\text{Bevel gear reference number}}{100} \right) + 37.8$$

For example: bevel gear reference number = - 3.

$$B = (- 3/100) + 37.8 = 37.77$$

**C** = Distance between the shim thrust surface in the center housing and the mating surface to left housing.



1. Deep gauge — measurement **C**
2. Shim surface in center housing
3. Mating surface to left housing

**A** = 2 mm (.0787 in) nominal thickness of axial needle bearing no. 12.

When the measurements are taken, calculate the theoretical shim thickness **D** using the formula ( $D = B - C - A$ ).

Take the obtained theoretical shim thickness **D** and choose the corresponding shim number **E** according to the following table.

THEORETICAL SHIM THICKNESS <b>D</b>	SHIM NUMBER <b>E</b>
1.20 mm to 1.29 mm (.0472 to .0508 in)	120
1.30 mm to 1.39 mm (.0512 to .0547 in)	130
1.40 mm to 1.49 mm (.0551 to .0587 in)	140
1.50 mm to 1.59 mm (.0591 to .0626 in)	150
1.60 mm to 1.69 mm (.0630 to .0665 in)	160
1.70 mm to 1.79 mm (.0669 to .0705 in)	170
1.80 mm to 1.89 mm (.0709 to .0744 in)	180

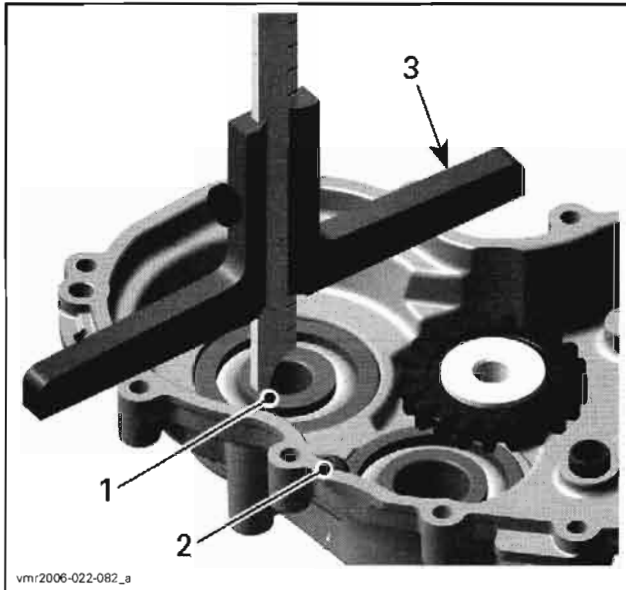
**NOTE:** For example, if the theoretical shim thickness **D** is 1.53 mm (.0602 in), choose the corresponding shim number 150 **E**. The shim number 150 represents a nominal value equal to 1.50 mm (.0591 in).

#### Bevel Gear Axial Clearance Procedure

Use the following course of calculation to determine the theoretical shim thickness **I**:

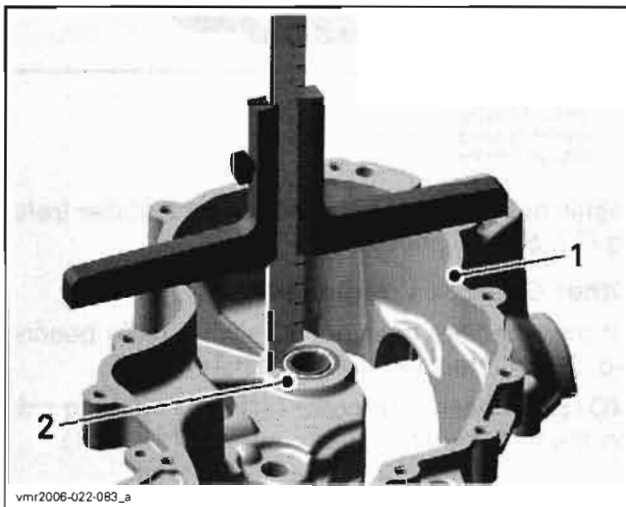
$$I = F + G - H - A - E$$

**F** = Distance between mating surface of left housing to ball bearing inner race.



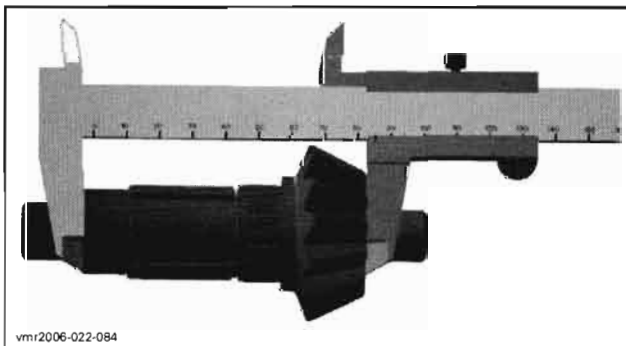
1. Ball bearing inner race  
2. Mating surface of left housing  
3. Depth gauge

**G** = Distance between mating surface of center housing and shim surface.



1. Mating surface of center gear housing  
2. Shim surface

**H** = Distance between thrust surfaces of bevel gear shaft.



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**A** = 2 mm (.0787 in) nominal thickness of axial needle bearing no. 12.

**E** = The shim number nominal value as found in the *BEVEL GEAR BACKLASH PROCEDURE*. For example, shim number 150 represents a value of 1.50 mm (.0591 in).

When the measurements are taken, calculate the theoretical shim thickness **I** using the formula ( $I = F + G - H - A - E$ ).

Take the obtained theoretical shim thickness **I** and choose the corresponding shim number **J** according to the following table.

THEORETICAL SHIM THICKNESS <b>I</b>	SHIM NUMBER <b>J</b>
1.22 mm to 1.31 mm (.0480 to .0516 in)	120
1.32 mm to 1.41 mm (.0519 to .0555 in)	130
1.42 mm to 1.51 mm (.0559 to .0594 in)	140
1.52 mm to 1.61 mm (.0598 to .0634 in)	150
1.62 mm to 1.71 mm (.0638 to .0673 in)	160
1.72 mm to 1.81 mm (.0677 to .0713 in)	170
1.82 mm to 1.91 mm (.0717 to .0752 in)	180

For example, if the theoretical shim thickness **I** is 1.53 mm (.0602 in), choose the corresponding shim number 150 **J**.

Bevel gear axial clearance of 0.02 to 0.11 mm (.00079 to .00433 in) is included in the above table.

### Assembly

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

#### Bearing Installation in Housing

Unless otherwise instructed, never use hammer to install ball bearings or needle bearings. Use press machine only.

If necessary heat housings up to 100°C (212°F) before installing ball bearings or needle bearings.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)

#### **WARNING**

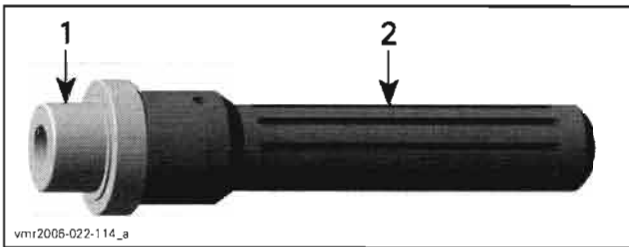
Clean oil, outside and inside, from housing before heating.

Place new bearing in freezer for 10 minutes before installation.

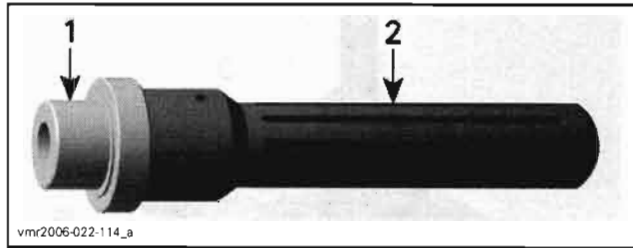
Use a suitable installer for installing ball bearings of countershaft and bevel gear.

**NOTE:** Place gearbox housings on a wood stand before installing bearings **no. 34** and **no. 36**.

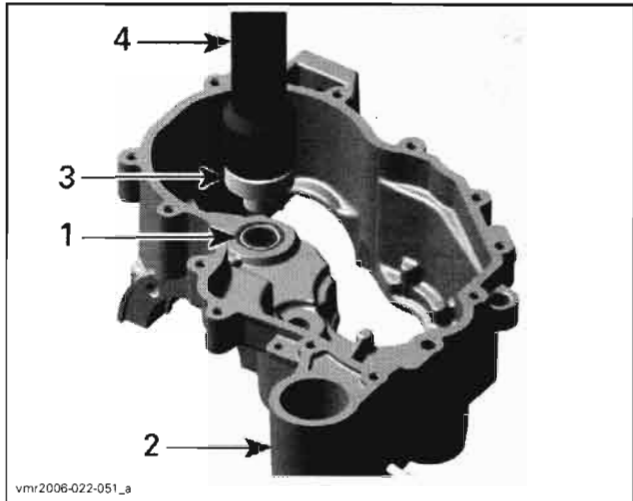
Install countershaft needle bearing **no. 33** with the main shaft needle bearing installer (P/N 529 035 762) and the installer handle (P/N 420 877 650) in right housing.



1. Needle bearing installer
2. Installer handle



1. Needle bearing installer
2. Installer handle



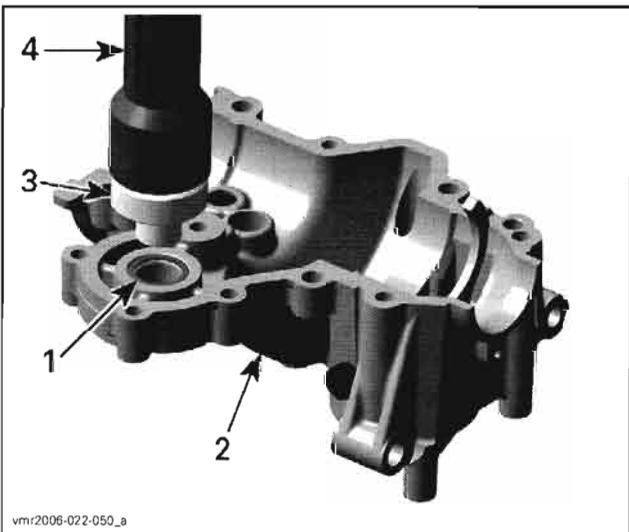
1. Bevel gear needle bearing
2. Center housing
3. Needle bearing installer
4. Installer handle

Install new oil seals with the proper installer (refer to *OIL SEALS* above).

#### Other Gearbox Components

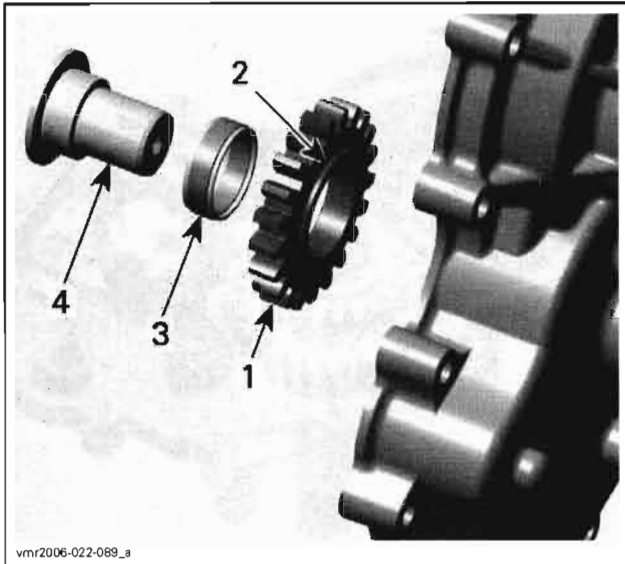
Fit intermediate gear **no. 23** with needle bearing **no. 22** on intermediate gear shaft **no. 21**.

**NOTE:** Fit gear with collar facing to housing side on the intermediate shaft.



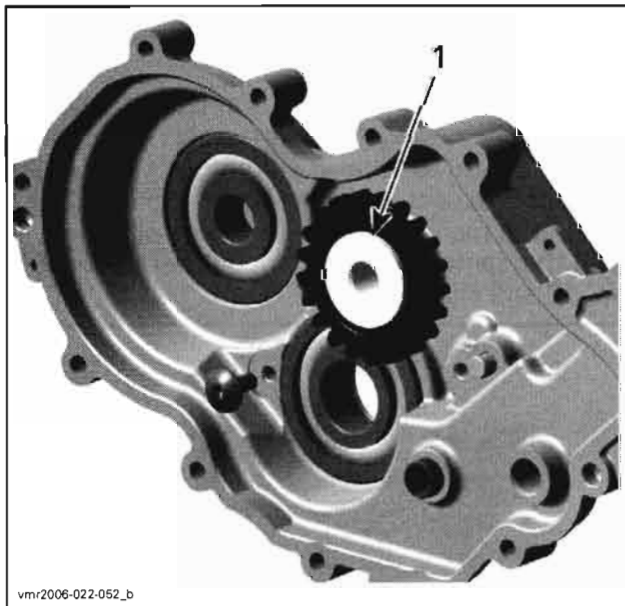
1. Countershaft needle bearing
2. Right housing
3. Needle bearing installer
4. Installer handle

Install bevel gear needle bearing **no. 35** using the bevel gear needle bearing installer (P/N 529 035 763) and the installer handle (P/N 420 877 650).



1. Intermediate gear
2. Collar facing housing
3. Needle bearing
4. Intermediate gear shaft

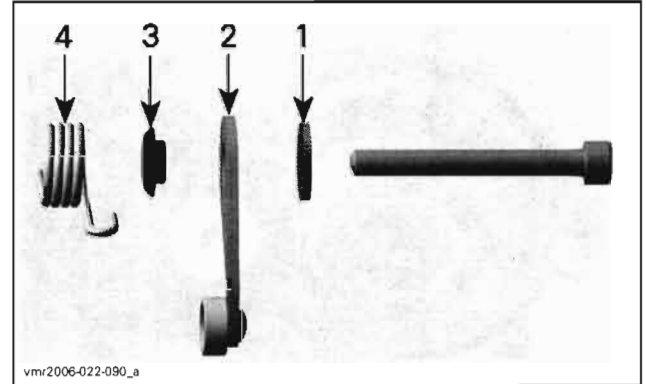
Press intermediate gear shaft in the left housing.



1. Intermediate gear shaft

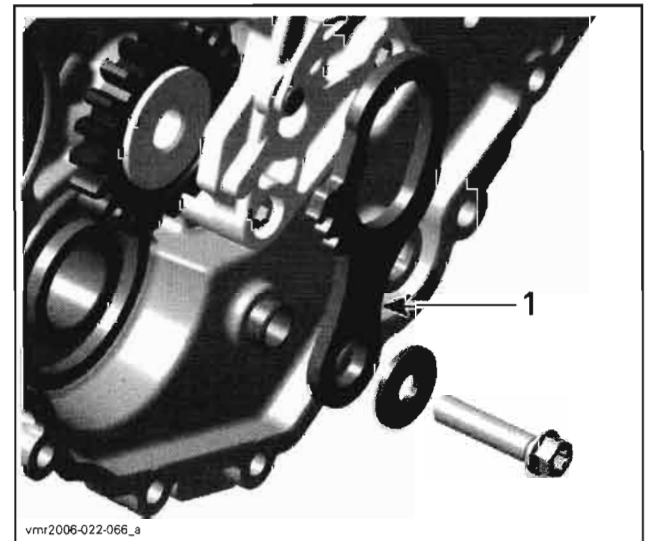
Fit support flange no. 37 in the left housing and install index lever.

**NOTE:** Fit step ring into index lever.



1. Washer
2. Index lever
3. Step ring
4. Index spring

Install parking lock lever, teeth showing to countershaft.

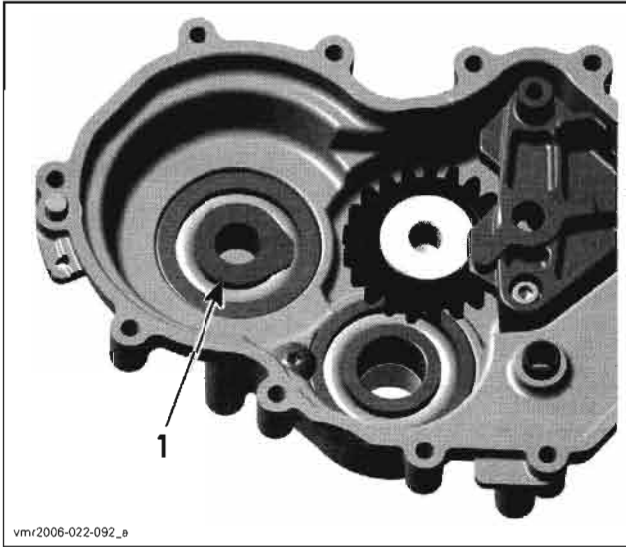


1. Parking lock lever

Place shim of CVT side on bearing.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

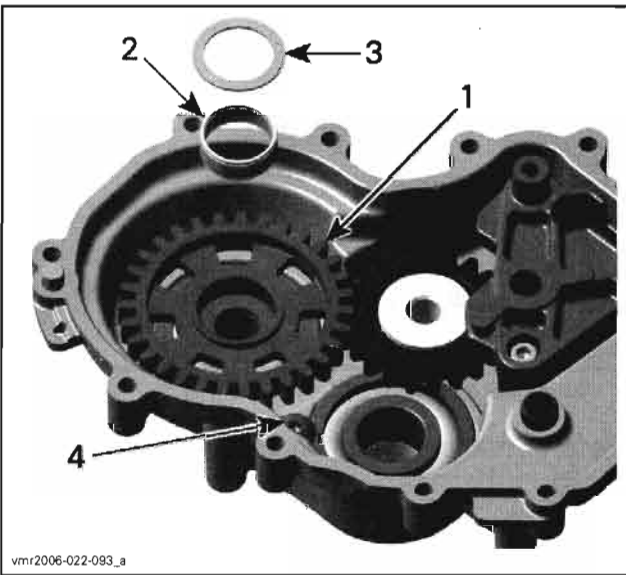
### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Shim CVT side

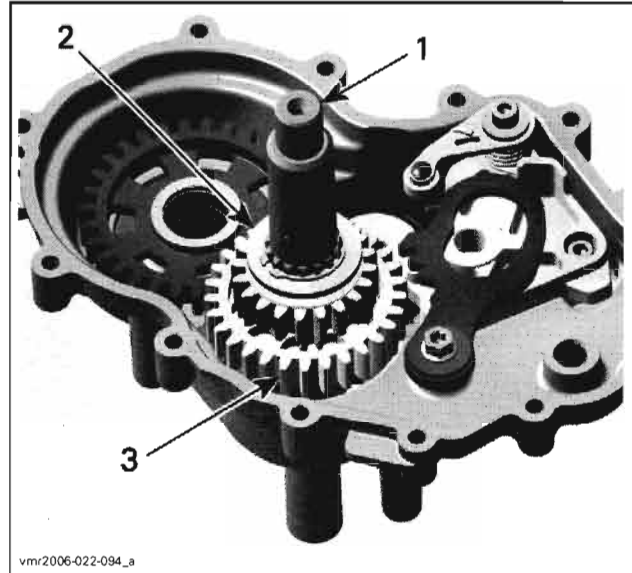
Place reverse gear with needle bearing and thrust washer.

**NOTE:** Check if the screw to secure countershaft bearing is installed.



1. Reverse gear
2. Needle bearing
3. Thrust washer
4. Countershaft bearing screw

Install countershaft with low gear and high gear assembly.

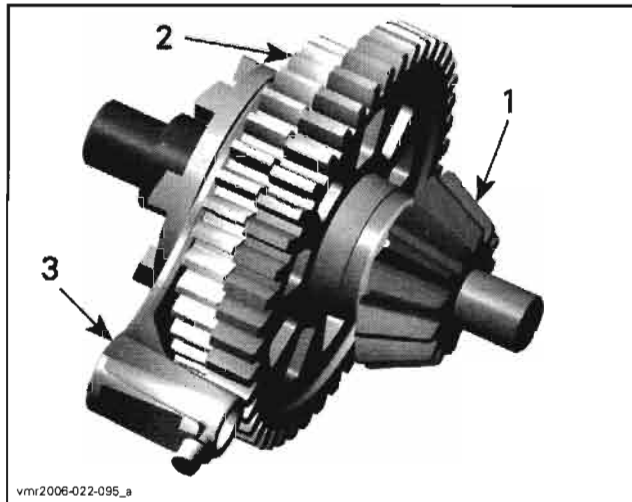


1. Countershaft
2. Low gear
3. High gear

Install a new shim no. 17 onto bevel gear shaft, fork side.

Install bevel gear with sliding gear assembly together with shift fork.

**NOTE:** If a new bevel gear and output shaft are used, it is necessary to verify the shim adjustment prior to finalize assembly. Refer to *ADJUSTMENT* above in this section. If the existing bevel gear is used, it is mandatory to use a new shim no. 17 with the same thickness, a new needle bearing no. 12 and shim no. 13.

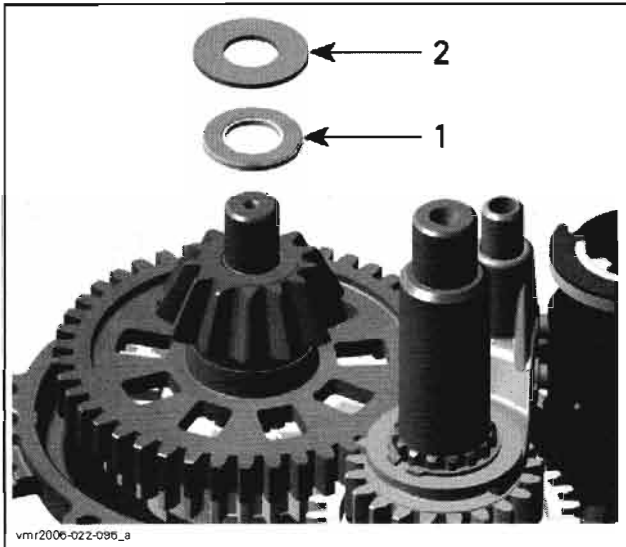


1. Bevel gear
2. Sliding gear
3. Shift fork

Install a new needle bearing and shim.

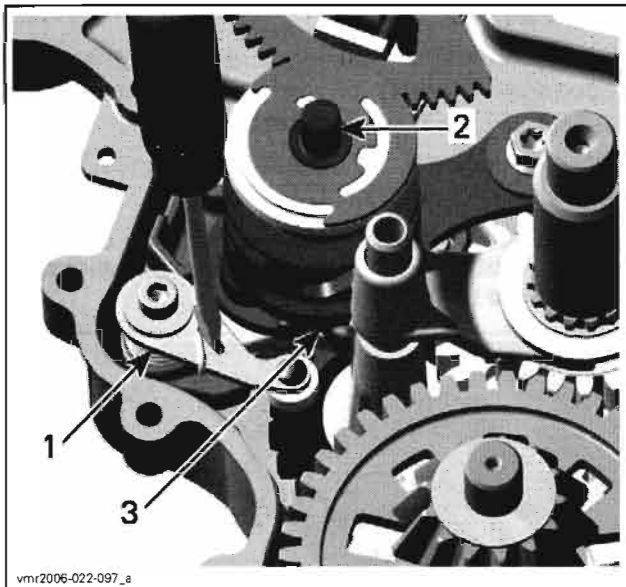
## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)

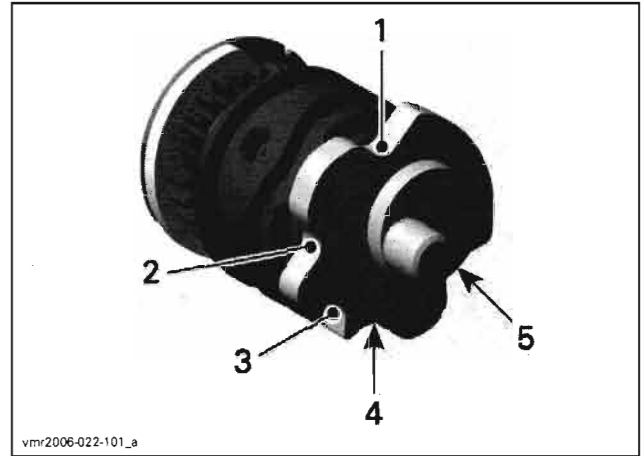


1. Needle bearing
2. Shim

Insert a flat screwdriver in the slot of the index lever, turn screwdriver clockwise and install shift drum on neutral position as per following illustration.



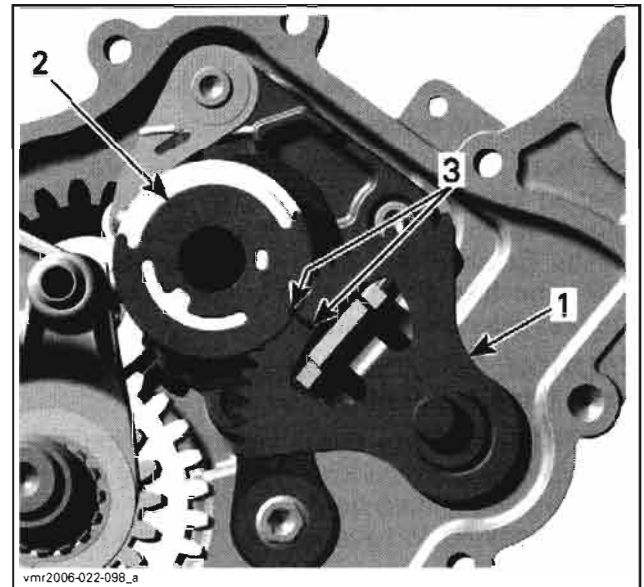
1. Index lever
2. Shift drum
3. Neutral position



1. Parking stop location
2. Reverse stop location
3. Neutral stop location
4. High gear stop location
5. Low gear stop location

Install shift shaft assembly.

**NOTE:** Marks on shift drum/isolating washer and shift shaft must align.



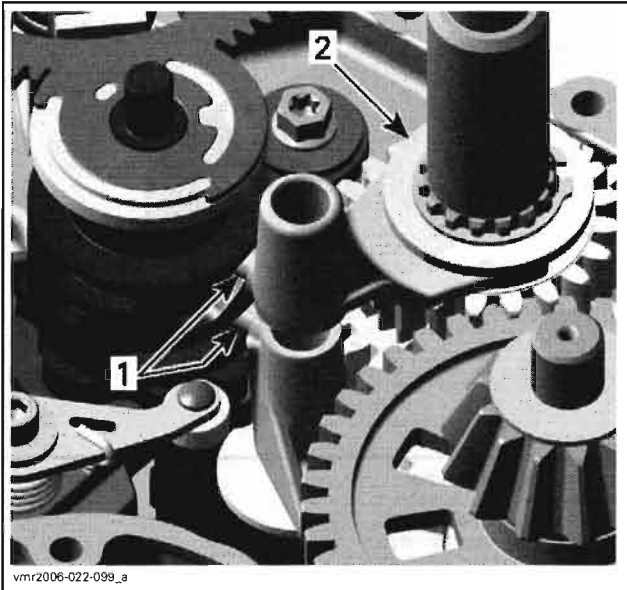
1. Shift shaft assembly
2. Isolating washer
3. Marks

Install shift fork no. 25 then engage both shift fork pins in their corresponding groove on the shift drum.

**NOTE:** Move sliding gears to facilitate engagement of pins inside grooves.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 09 (GEARBOX AND 4X4 COUPLING UNIT)



1. Shift fork pins
2. Sliding gear

Install shift fork shaft no. 24.

**NOTE:** Run all gears as a final function check before installing center housing.

Now, close the housings by doing the following:

Clean all metal components in a solvent.

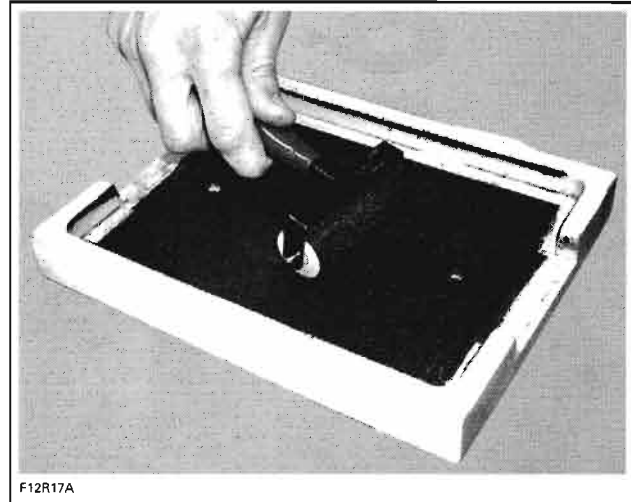
Gearbox housing mating surfaces are best cleaned using a combination of Loctite chisel (gasket remover) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

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

**IMPORTANT:** When beginning the application of the gear housing 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.

Use Loctite 5910 (P/N 293 800 081) on mating surfaces.

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



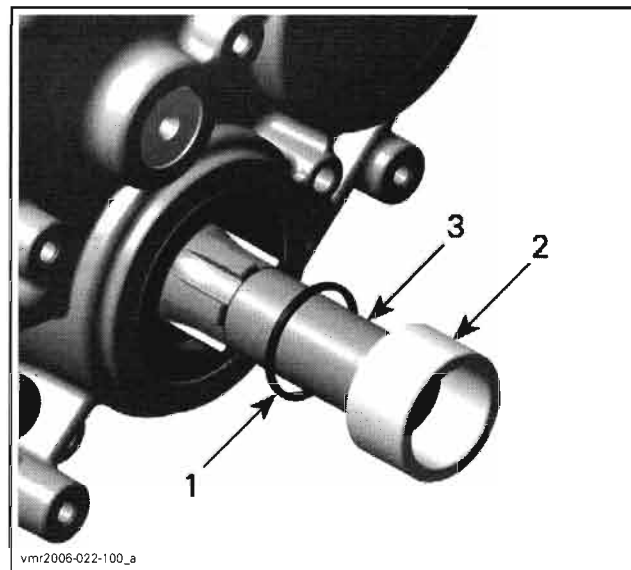
Do not apply in excess as it will spread out inside gear housing.

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

Hand-torqued gear housing screws in a crisscross sequence. Repeat procedure, retightening all screws to 10 N•m (89 lbf•in).

Install O-ring no. 31 including distance sleeve no. 32 on countershaft CVT side.

**CAUTION:** Place O-ring including distance sleeve right away. Chamfered bore of distance sleeve has to face the gearbox.



COUNTERSHAFT END CVT SIDE

1. O-ring
2. Distance sleeve
3. Countershaft end CVT side



Refer to *OUTPUT SHAFT AND COUPLING MECHANISM* to install these components. Measure the output shaft backlash.

### **Installation**

The installation is the reverse of the removal procedure.



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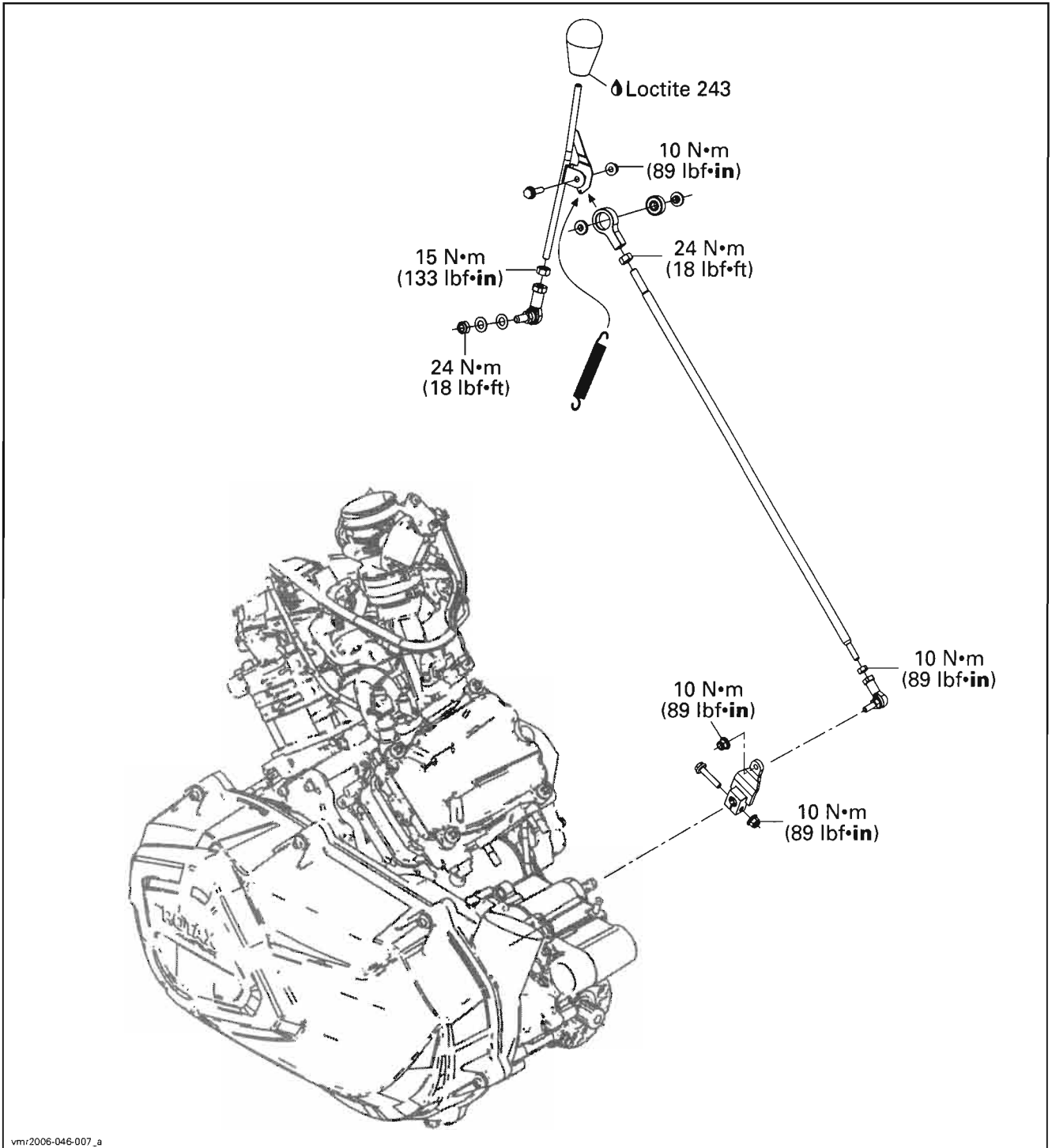
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# SHIFTER

## SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243 (blue).....	293 800 060 .....	169



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## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 10 (SHIFTER)

## GENERAL

Before performing any servicing on the transmission linkage system, be sure the transmission lever is on NEUTRAL position and the parking brake is applied.

During assembly/installation, use the torque values and services 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 (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced with a new one.

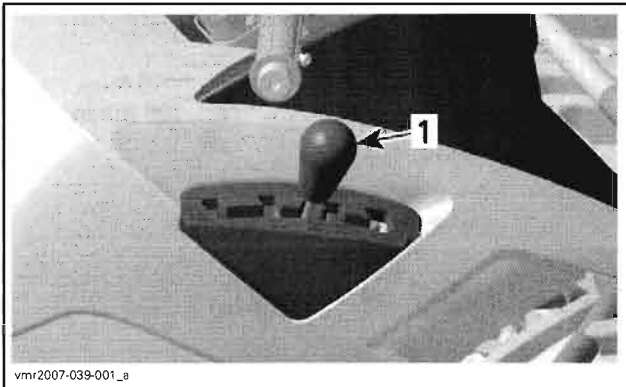
## PROCEDURES

### TRANSMISSION LEVER

#### Shifter Lever Removal

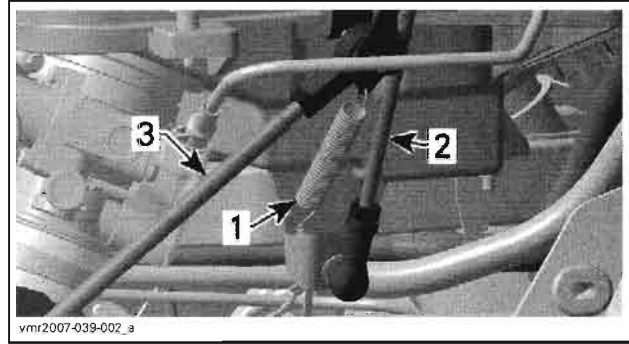
To remove the transmission lever, do the following:

- Place transmission lever in NEUTRAL position.
- Apply parking brake.
- Unscrew the transmission lever handle.



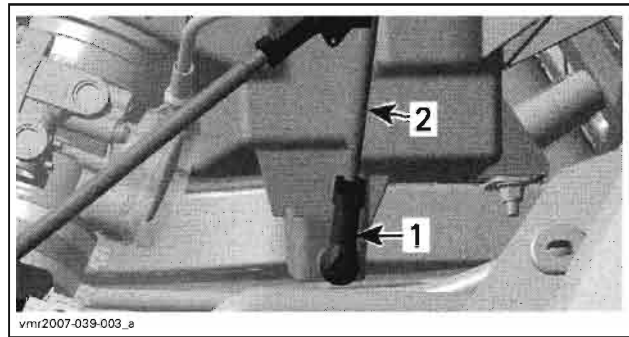
1. Transmission lever handle

- Remove the RH side panel and the console. Refer to *BODY*.
- Detach tension spring from bracket.



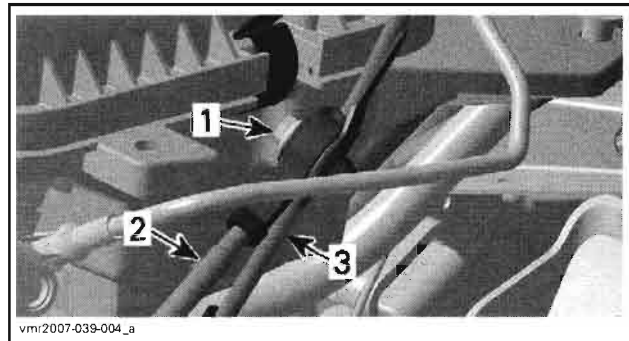
1. Tension spring  
2. Transmission lever  
3. Link rod

- Detach tie-rod end from bracket.



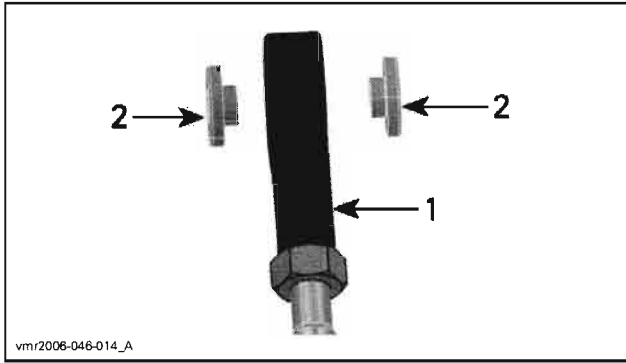
1. Tie-rod end  
2. Transmission lever

- Unscrew link rod bolt.

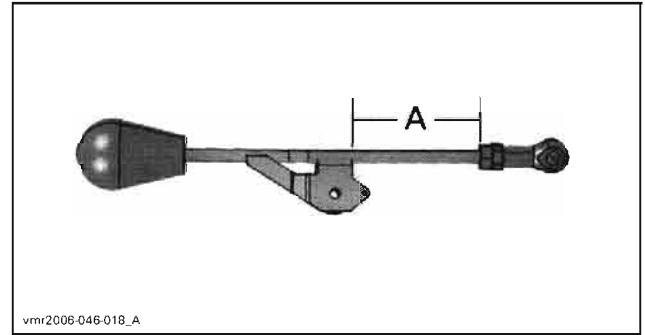


1. Link rod bolt  
2. Link rod  
3. Transmission lever

Pull link rod out of transmission lever bracket, pay attention not to lose bushings located each side of link rod anchor.



- 1. Link rod anchor
- 2. Bushings



A. 82 mm ± 1 mm (3.228 in ± .039 in)

### Shifter Lever Inspection

Check the transmission lever for bending or cracks.

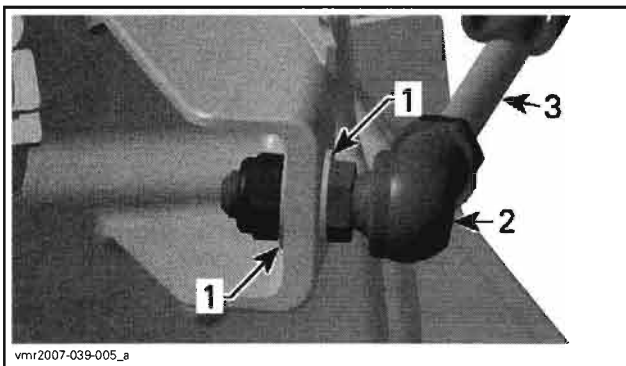
Check the tie-rod at the end of lever.

Replace the lever or the tie-rod if necessary.

### Shifter Lever Installation

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

Place a washer on both sides of bracket when installing tie-rod end on bracket.



- 1. Washers
- 2. Tie-rod end
- 3. Transmission lever

Apply Loctite 243 (blue) (P/N 293 800 060) on transmission lever threads before installing the handle.

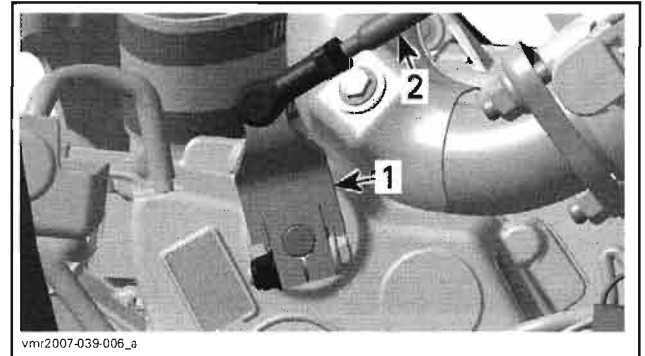
If the tie-rod end replacement is necessary, use the following illustration to position the tie-rod properly.

### LINK ROD

#### Link Rod Removal

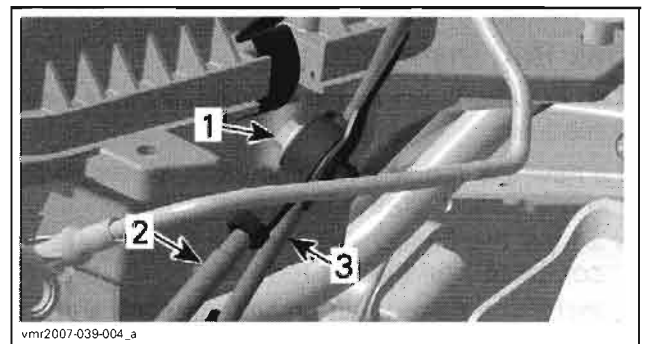
Remove RH side panel and rear engine cover.

Remove link rod from shifting plate.



- 1. Shifting plate
- 2. Link rod

At the other end of link rod, unscrew link rod bolt.

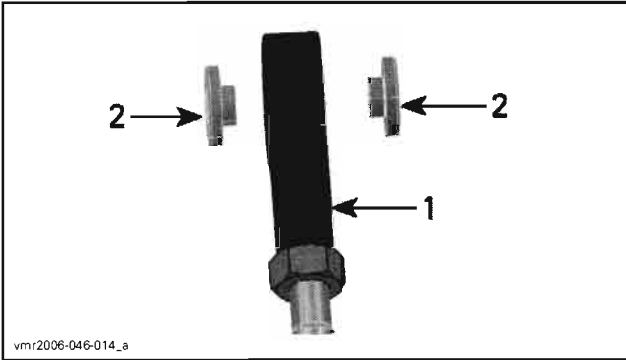


- 1. Link rod bolt
- 2. Link rod
- 3. Transmission lever

Pull link rod out of transmission lever bracket, pay attention not to loose bushings located each side of link rod anchor.

## Section 03 ENGINE AND GEARBOX (V490/V660/V810)

### Subsection 10 (SHIFTER)

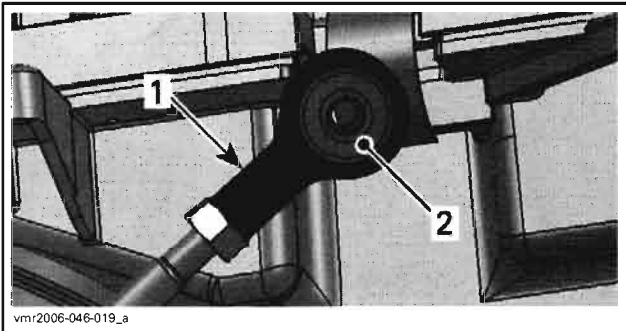


1. Link rod anchor
2. Bushings

### Link Rod Inspection

Check link rod for bending or cracks.

Check ball bearing in link rod anchor. The bearing should turn smoothly and freely.



1. Link rod anchor
2. Ball bearing

Check tie-rod end for wear and excessive play.

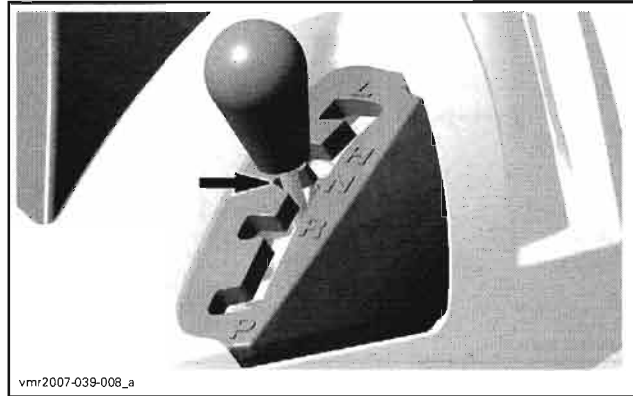
Replace all defective parts.

### Link Rod Installation

If no new parts are installed, reverse the removal procedure.

If a new link rod, link rod anchor or a new tie-rod end is installed, do the following:

- Screw the tie-rod end and the link rod anchor completely on the link rod.
- Install the tie-rod end on shifting plate and link rod anchor on transmission lever.
- Be sure gearbox is engaged on NEUTRAL position.
- Turn link rod until the transmission lever is located in the middle of the NEUTRAL slot.



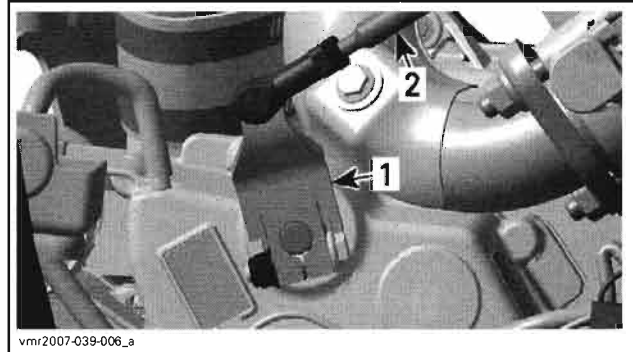
- Torque jam nuts, one on both ends of link rod.
- Verify if the transmission lever moves into the PARK and LOW slots. If not, the gearbox was not engaged on NEUTRAL. Place gearbox on NEUTRAL position and redo the procedure.
- Install removed parts and test drive to confirm all is working well.

## SHIFTING PLATE

### Shifting Plate Removal

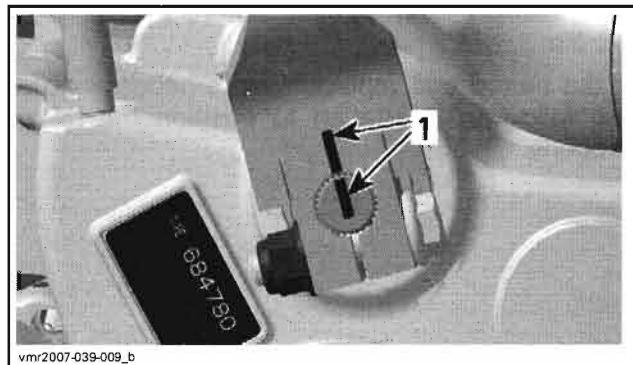
**NOTE:** Do not remove shifting plate needlessly.

Remove link rod from shifting plate.



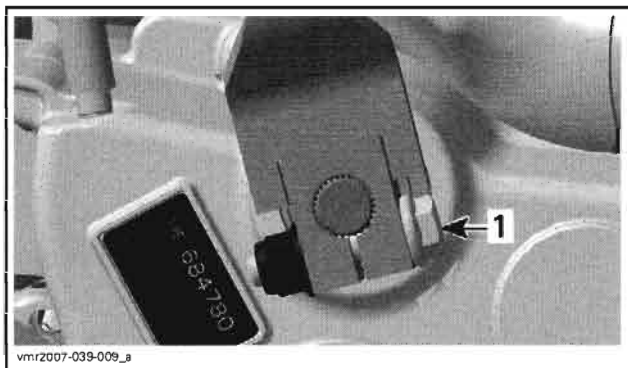
1. Shifting plate
2. Link rod

**NOTE:** Mark the location of shifting plate before removing it from shift shaft.



1. Mark both parts position

Remove shifting plate bolt.



1. Shifting plate bolt

### Shifting Plate Inspection

Check shifting plate for cracks, bending or other damages. Replace if necessary.

### Shifting Plate Installation

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

Be sure the gearbox is engaged on NEUTRAL before performing this procedure.

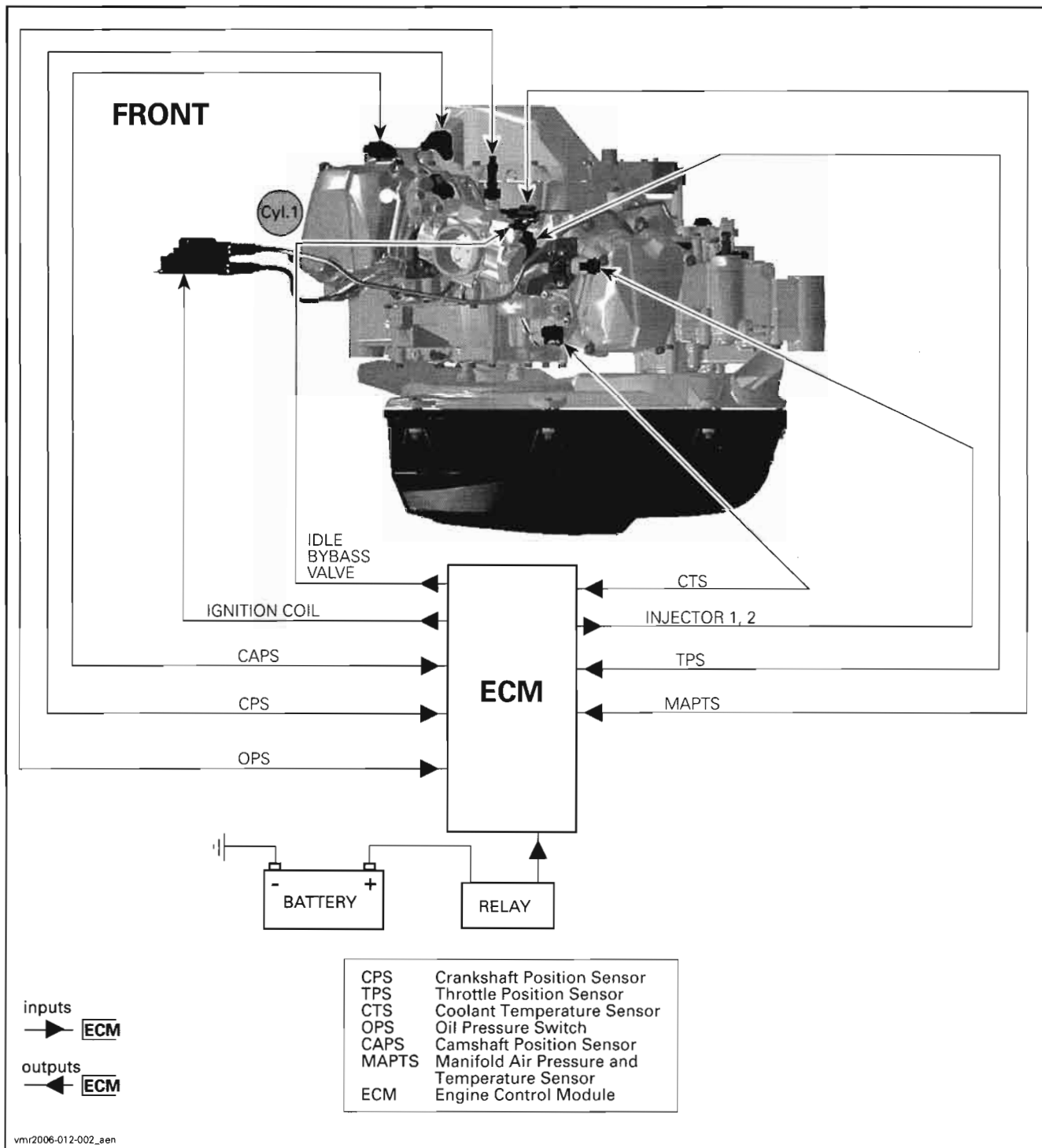
Align shifting plate mark with shift shaft mark. If new parts are used, align shifting plate slot with the shift shaft location without splines.

Install all removed parts and test drive to confirm all is working well.





# OVERVIEW



ENGINE MANAGEMENT SYSTEM OVERVIEW

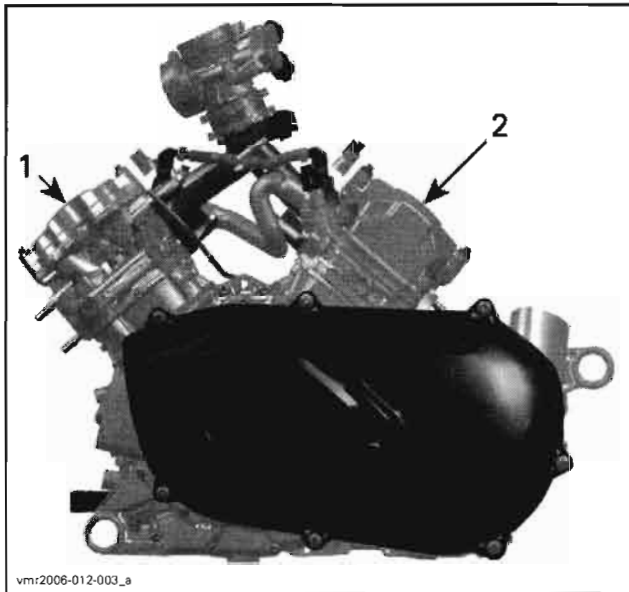
## OPERATING PRINCIPLE

A highly advanced engine management system (EMS) has been used to ensure a high power output with cleaner combustion.

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

1. Air induction.
2. Fuel system.
3. Electrical system.

**NOTE:** The cylinders are referenced as 1 (front) and 2 (rear).



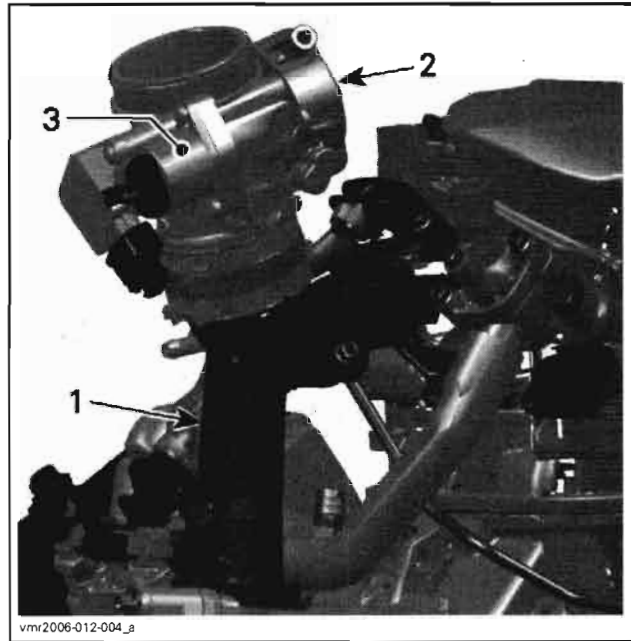
1. Cylinder 1 (front)
2. Cylinder 2 (rear)

## AIR INDUCTION

Air flows through air silencer, air filter, throttle body, intake manifold and then goes into combustion chamber.

### Throttle Body

The 46 mm throttle body is mounted on top of intake manifold. Fitted on the throttle body, there is the TPS and the idle bypass valve which allows the ECM to control the idle speed while the throttle plate is closed.



1. Intake manifold
2. Throttle body
3. Idle bypass valve

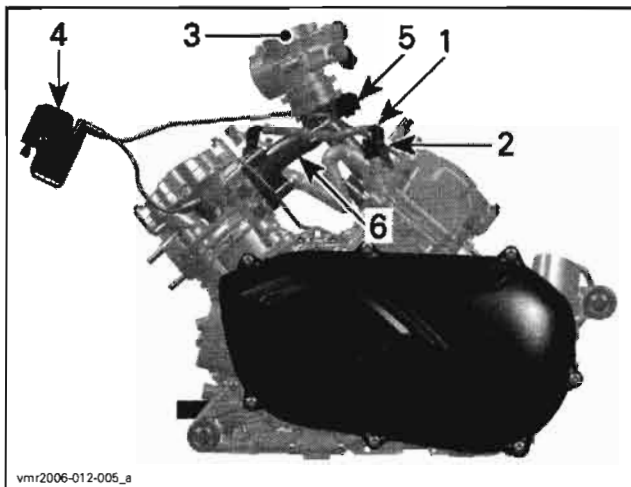
### Intake Manifold

The intake manifold is mounted on the top of the engine on both cylinder heads. It provides support for the throttle body, fuel injectors, the fuel rails and the MAPTS (manifold air pressure and temperature sensor).

The air intake manifold is a resonator between the throttle body and the air intake at the cylinder heads.

## FUEL SYSTEM

When the intake valve reaches the correct position, the ECM (engine control module) opens the fuel injector and fuel is discharged into the intake port at the air intake manifold by the high fuel pressure inside the fuel rail. The air/fuel mixture enters then the combustion chamber through the open intake valve. This mixture is then ignited by the spark plug.



vmr2006-012-005\_a

1. Fuel rail (2)
2. Injector (2)
3. Throttle body
4. Ignition coil
5. Manifold air pressure and temperature sensor (MAPTS)
6. Intake manifold

### Fuel Rail

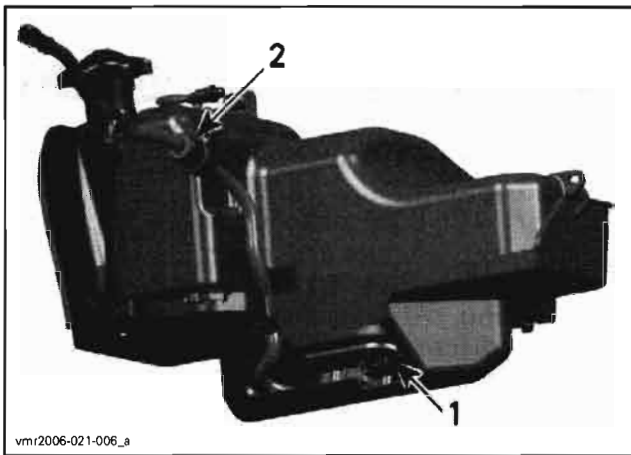
Two fuel rails, one for each injector, are mounted on the intake manifold. The fuel rails ensure all the time, that enough fuel can be delivered to the fuel injectors. The fuel rails are fed by the fuel pump with the properly regulated fuel pressure.

### Fuel Injector

Two fuel injectors (one per cylinder) are used to inject fuel into the intake port of the cylinder head.

### Fuel Pump Module

The fuel pump module is underneath fuel tank. The module includes fuel pump, fuel pressure regulator and fuel level sensor. Refer to *FUEL SYSTEM*.



vmr2006-021-006\_a

1. Fuel pump module
2. In-line fuel filter

### Fuel Pressure Regulator

A fuel pressure regulator controls the pressure in the system and allows excess fuel to return to the fuel tank. Refer to *FUEL SYSTEM*.

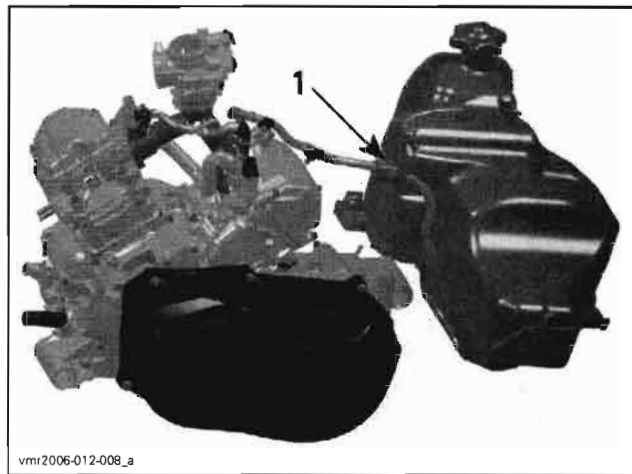


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1. Fuel pressure regulator

### Fuel Filter

The fuel filter is located between engine and fuel tank. Refer to *FUEL SYSTEM*.



vmr2006-012-008\_a

1. Fuel filter

## ELECTRICAL SYSTEM

A communication link (CAN lines) is used to communicate between the ECM and the multifunction speedometer. CAN lines consist of a pair of wires (WHITE/BEIGE and BEIGE/GREEN).

The communication link is also used to communicate with the B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE*.

The speedometer multifunction display can show fault codes. Refer to *EMS DIAGNOSTIC*.

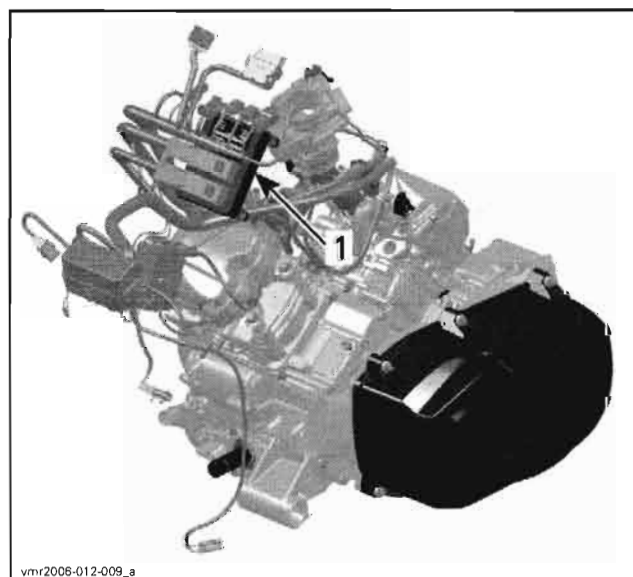
### Engine Control Module (ECM)

The ECM controls the electrical system and the engine management functions, by processing the information given by various sensors.



TYPICAL  
1. ECM

The ECM is located in front of steering column.



1. ECM location

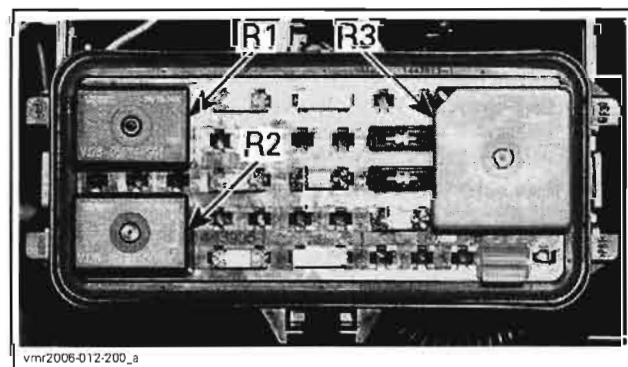
The ECM features a permanent memory that will keep the programmed ignition key(s) active, fault codes, customer information and other engine information, even when the battery is removed from the vehicle.

The ECM features a self-diagnostic mode when ignition key is turned on. However, some components need the engine to be running so that they can be monitored. Some problems will turn on a warning lamp or will set the engine in limp home mode. Refer to *EMS DIAGNOSTIC* section for more information.

### Power Distribution

Three relays are used to distribute power to different components. When ignition key is turned ON and engine run/stop switch is in RUN position, relay 2 is energized and in turn, it supplies the windings of relay 1 and relay 3. The ECM provides the trigger signal to activate each relay individually. Refer to the following diagram.

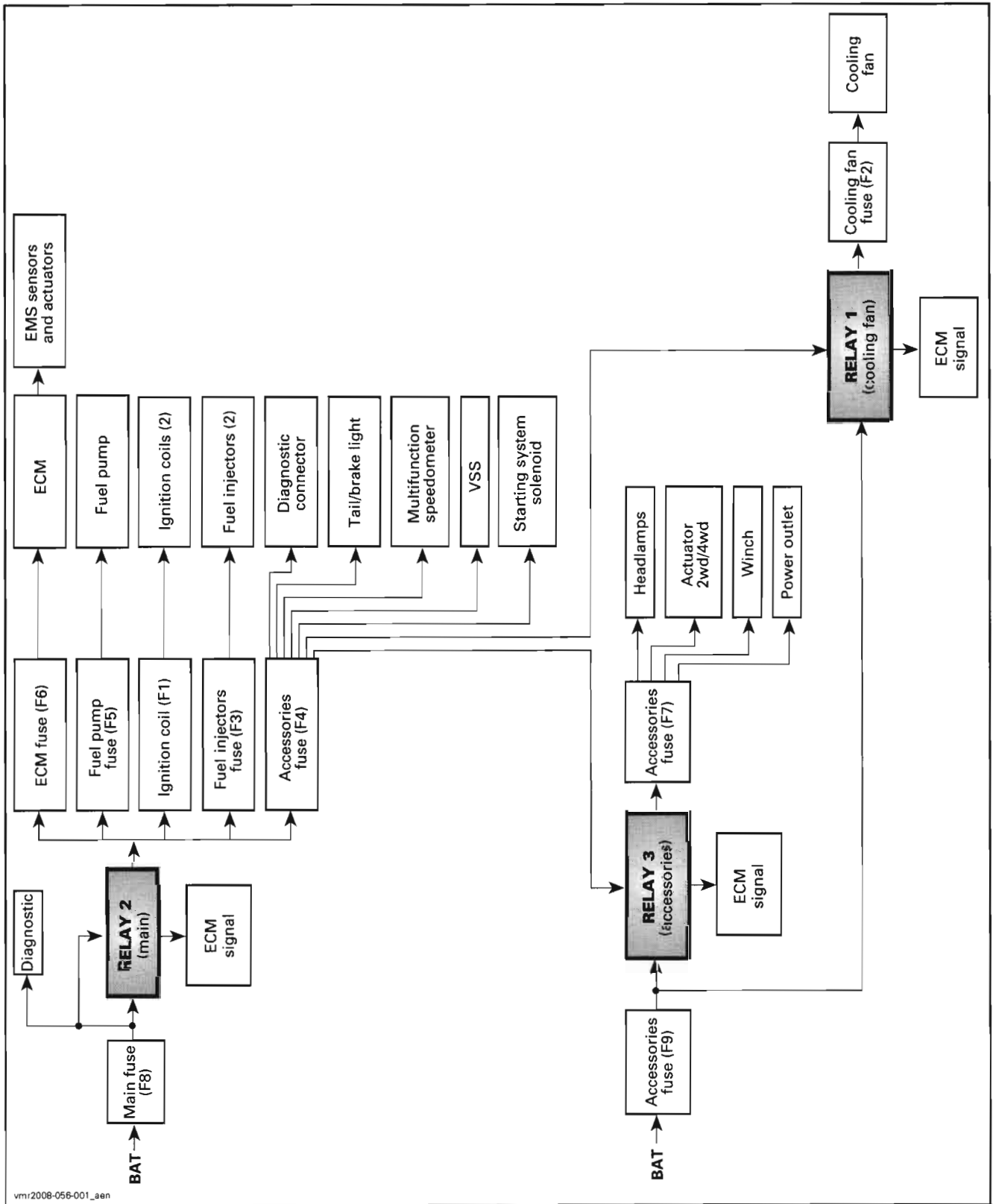
When starting engine, relay 1 and 3 are temporary disabled to make all power available for the starter, the fuel pump and the EMS.



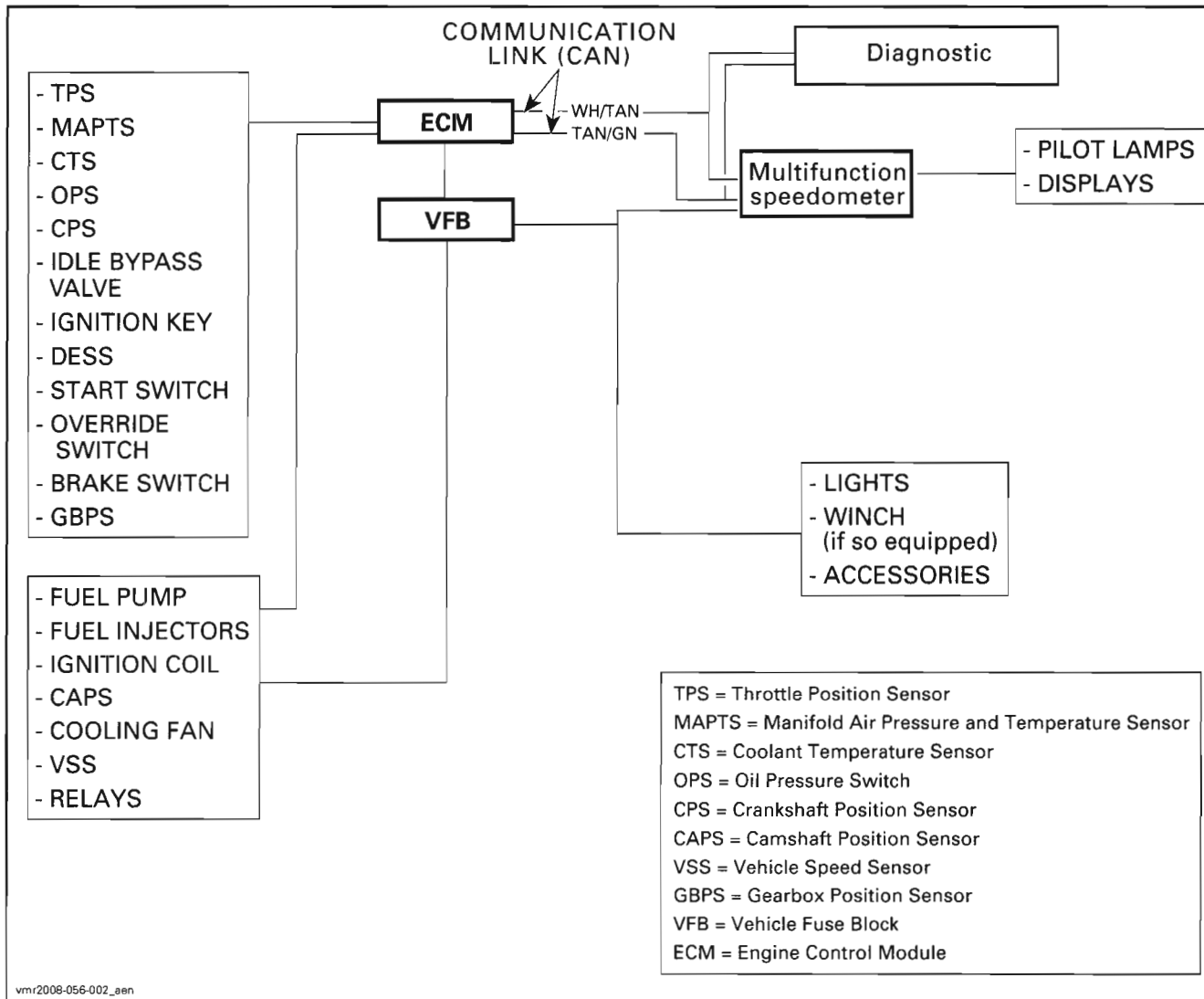
R1: Cooling fan  
R2: Main  
R3: Accessories

**⚠ WARNING**

Some components are continuously powered by the VFB when ignition key is turned on and engine run/stop switch is in RUN position. The ECM switches the circuit to the ground to complete the electrical circuits it controls. Take this into account when troubleshooting. Always disconnect the battery prior to disconnecting any electric or electronic parts.



**ECM and VFB Interaction with the Electrical System**



**ENGINE MANAGEMENT SYSTEM**

The EMS calculates the proper air/fuel mixture and ignition timing for each cylinder separately.

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.

**ELECTRONIC FUEL INJECTION**

The ECM reads the signals from different sensors which indicate engine operating conditions at milli-second intervals.

Signals from sensors are used by the ECM to determine the injection parameters (fuel maps) required for optimum air-fuel ratio.

The CPS, the MAPTS and the TPS are the primary sensors used to control the injection and ignition timing. Other sensors (like temperature sensors, etc.) are used for secondary input.

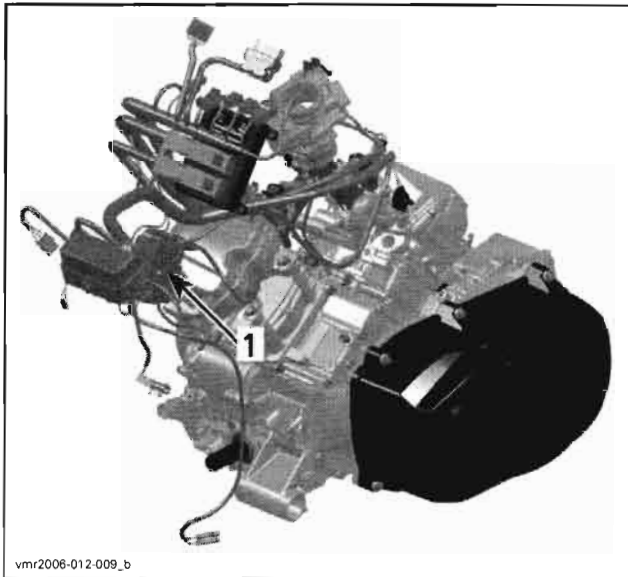
**IGNITION**

The ignition system is fully managed by the ECM which controls the ignition system parameters, such as spark timing, duration and firing order to achieve the proper engine requirements.

**Ignition Coil**

A double ignition coil induces voltage to a high level in the secondary winding to produce a spark at each spark plug independently.

The ignition coil receives input from the ECM. Ignition coil is located in front of engine.



1. Ignition coil location

## Ignition Timing

The ECM is programmed with data (it contains ignition mappings) for optimum ignition timing under all operating conditions. Using engine operating conditions provided by the sensors, the ECM controls the ignition timing for optimum engine operation. There is no adjustment to perform.

## ENGINE MODES OF OPERATION

### Engine RPM Limiter

The ECM will limit the maximum engine speed when vehicle shifter is in:

- forward position (Hi and LO individually)
- neutral position
- park position
- reverse position.

The ECM uses the CPS and the GBPS (gearbox position sensor) for this function.

An override switch, on the handlebar, allows the engine speed to run higher than the RPM limiter when more power is needed in reverse operation. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.

### Vehicle Speed Limiter

The ECM will limit the maximum vehicle speed both in 2WD and in 4WD. For this purpose, the ECM uses the VSS (vehicle speed sensor) and the GBPS (gearbox position sensor).

## Limp Home Mode

Besides the signals seen above, the ECM may automatically set default parameters to the engine management to ensure the adequate operation of the engine if a component of the fuel injection system is not operating properly. The engine will operate with reduced performance to protect the engine. In more severe cases, the engine RPM will be limited, also to protect the engine.

These performance-reduced modes allow the rider to go back home which would not be otherwise possible without this advanced system. Refer to the *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* for a complete chart.

When a sensor failure occurs, the ECM will send out a signal to the multifunction speedometer to warn the operator.

**NOTE:** LIMP MODE will be displayed in the multifunction speedometer and check engine light will flash. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.

When minor fault occurs, the fault and message in the multifunction speedometer may disappear automatically when the ignition key is turned off and kept off until lights turn off in multifunction speedometer, then turned back on.

In the following situations, engine RPM will be limited.

CONDITION	MAX ALLOWED RPM
High engine temperature	4000
Low battery voltage	5000
Low oil pressure	
Safety fuel cut-off (TPS or internal memory error)	
High battery voltage	7000

## Drowned Mode (flooded engine)

If engine is fuel-flooded and does not start, this special mode can be activated to prevent fuel injection and ignition while cranking. Proceed as follows to activate it.

With ignition key in ignition switch while engine is stopped, press and HOLD throttle lever at WOT position.

Press the start button. The mode is now on.

Releasing throttle lever will bring back the normal mode.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 01 (OVERVIEW)

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If engine does not start, it may be necessary to remove spark plugs and crank engine with rags over spark plug holes. Refer to *ADJUSTMENT AND REPAIR PROCEDURES* subsection.

#### **WARNING**

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

## MONITORING SYSTEM

The ECM monitors the electronic components of the fuel injection system and also parts of the electrical system. When a fault occurs, the ECM sends out signals to the multifunction speedometer to inform you of a particular condition. Refer to the *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* for the fault codes chart.

### Battery Voltage Warning Device

When the battery voltage is either too low or too high, the ECM sends out a signal to the multifunction speedometer.

**NOTE:** Either LO BATT or HI BATT will be displayed in the multifunction speedometer and check engine light will flash. Limp home will be set.

### Low Oil Pressure Warning Device

When the engine oil pressure falls under a certain level, the ECM sends out a signal to the multifunction speedometer.

**NOTE:** LOW OIL will be displayed in the multifunction speedometer and check engine light will flash. Limp home will be set.

### Brake Monitoring

The ECM monitors the brakes through the brake switch. If parking brake is activated or the driver inadvertently keeps the brake depressed for more than 15 seconds (either when vehicle moves or not), the ECM sends out a signal to the speedometer. BRAKE will be displayed in the multifunction speedometer.

### Shutdown Mode

When engine run/stop switch is turned OFF or ignition key is turned OFF position, speedometer will turn off within 15 seconds. All the electrical system is cut-off.

**Engine not running:** When engine run/stop switch is in RUN position and ignition key is left in the ON position, the accessories are powered. After 15 minutes, the ECM shuts down all functions except multifunction speedometer. ECM and multifunction speedometer will draw power.

**NOTE:** If engine starting is desired at this point, it is required to turn ignition key OFF, wait until speedometer turns OFF then, turn key back ON.

To prevent battery drain, always turn OFF either ignition key or engine run/stop switch.

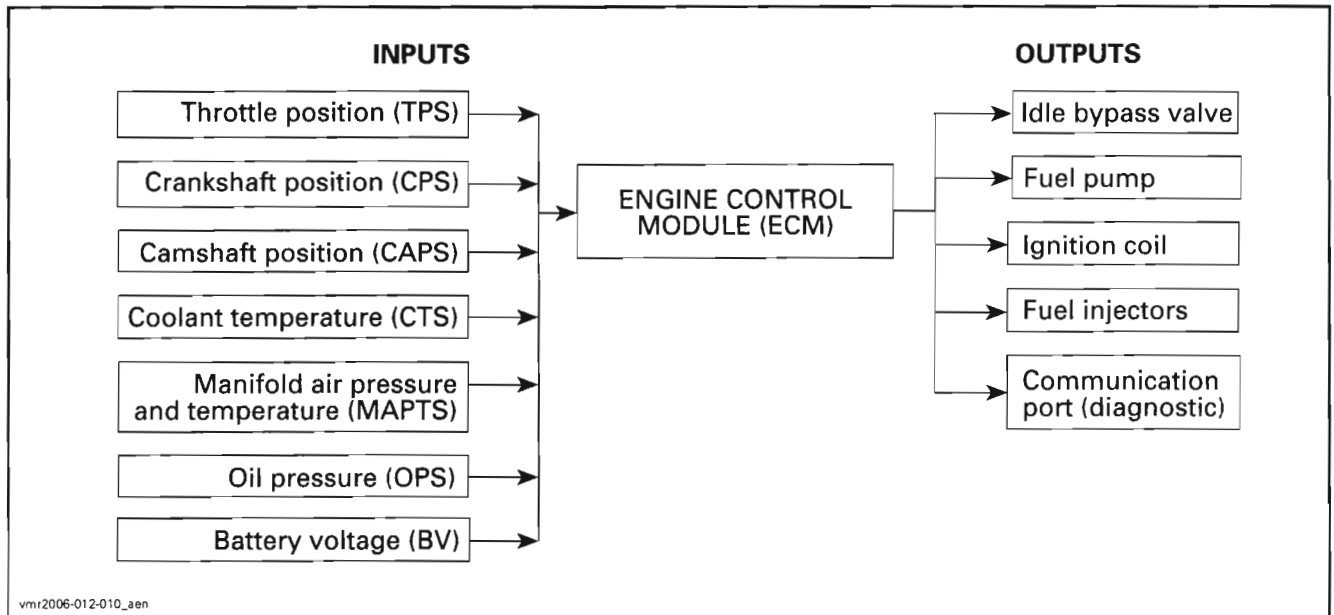
## DIAGNOSTIC MODE

The fault codes are recorded in the memory of the ECM. They can be checked by using the software B.U.D.S.

Refer to the *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.



ENGINE MANAGEMENT SYSTEM FLOW CHART





# EMS DIAGNOSTIC

## GENERAL

Here is the basic order suggested to diagnose a suspected engine management or fuel injection related problem:

- Check the chart in the *TROUBLESHOOTING* section to have an overview of problems and suggested solutions.
- Check if the engine management system (EMS) pilot lamp is ON or blinks. If so, use the B.U.D.S. software and look for fault codes to diagnose the trouble.

**NOTE:** When a fault code is present, the EMS pilot lamp will turn on. When EMS is in limp home mode, the lamp will blink.

- Check all fuses.
- Check relay(s).
- Check fuel pressure.
- Check spark plugs condition.
- Check all connections of the wiring harness.
- Refer to *ADJUSTMENT AND REPAIR PROCEDURES* section for procedures.

When using the service action suggested in the **Fault** section of B.U.D.S., the system circuits are referred to as 2-A-41, which means connector "A" on the ECM and pin 41. The first digit (2) indicates connector location in vehicle such as shown in the *WIRING DIAGRAMS*.

## On-Board Diagnostic

Fault codes starting with the letter "P" followed by 4 digits (P-1234) can be displayed in the multifunction gauge for troubleshooting.

Proceed as follows:

**NOTE:** Renegade gauge is shown but procedures apply to Outlander models as well.

Turn ignition key to lights ON position.



Use the mode button and scroll to Engine Hour (EH) on the gauge.



Press and HOLD mode button while QUICKLY toggling HI - LO beam.

**NOTE:** A minimum of 3 HI - LO toggles must be completed within 2 seconds.



Step 1: Press and hold  
Step 2: Quickly toggle HI - LO beam

If there is no P-Code, the "No Active P Codes" will be displayed.

If there is any P-Code, it will be displayed.

- If there is more than one P-Code, they will automatically scroll.
- Once the last P-Code is displayed, gauge displays END then defaults back to normal operation.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

## FAULT CODES

### General

The faults saved in the ECM (Engine Control Module) are kept even if the battery is disconnected.

**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 the appropriate counter(s) and will also record that the problem has been fixed in the ECM memory.

Many fault codes at the same time is likely to be burnt fuse(s) or a faulty relay.

For more information pertaining to the fault codes (state, count, first, etc.) and report, refer to B.U.D.S. online help.

### TPS (Throttle Position Sensor) Faults

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

#### TPS "OUT OF RANGE" Fault

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

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

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

#### TPS "ADAPTATION FAILURE" Fault

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

Following problems can be caused by a TPS "Adaptation Failure":

- Idle speed is out of range.
- Engine stops when throttle is released quickly.
- Engine runs inconsistent in low partload or low RPM.

POSSIBLE CAUSES	ACTION
Sensor has been replaced and TPS closed position not reset	Reset Closed Throttle and Idle Actuator.
Throttle body has been replaced and TPS closed position not reset	Reset Closed Throttle and Idle Actuator.
ECM has been replaced and TPS closed position not reset	Reset Closed Throttle and Idle Actuator.
Throttle cable too tight	Tighten and reset Closed Throttle and Idle Actuator.
Sensor is loose	Tighten and reset Closed Throttle and Idle Actuator.
Throttle bracket is loose	Tighten and reset Closed Throttle and Idle Actuator.
Idle speed screw (tamper proof) worn or loose	Change throttle body.
Idle bypass valve replaced but not reset	Reset Closed Throttle and Idle Actuator using B.U.D.S.

#### Fault Code P2119

Wrong ECM. Installed ECM is not appropriate for the vehicle. Engine will crank but will not start. Refer to *PARTS CATALOG* for proper ECM according to vehicle.

## FAULT CODE TABLE

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
P0106	Air pressure sensor voltage out of range	Sensing port dirty or blocked. Sensor failure or unexpected reading at idle. Sensor fallen out of intake manifold.	Make sure sensor's connector is fully inserted. Check for approximately 5 volts between sensor connector pins 1 and 3. Check system circuits 2-A-12, 2-A-28 and 2-A-40.	Engine pilot lamp/check engine and limp home	Limp home	No rev limit but air pressure is set to a default value
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 sensor connector pins 1 and 3. Check system circuits 2-A-12, 2-A-28 and 2-A-40.	Engine pilot lamp/check engine and limp home after a few seconds	Limp home	No rev limit but air pressure is set to a default value
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 sensor connector pins 1 and 3. Check system circuits 2-A-12, 2-A-28 and 2-A-40.	Engine pilot lamp/check engine and limp home	Limp home	No rev limit but air pressure is set to a default value
P0111	Air temperature sensor functional problem	Intermittent air temperature sensor reading or circuit wires shorted to ground.	Check system circuits 2-A-7 and 2-A-21. Replace the sensor if necessary.	Engine pilot lamp/check engine and limp home	Limp home	No rev limit but air temperature is set to a default value
P0112	Air temperature sensor voltage too low	Air temperature sensor or circuit wires shorted to ground.	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. If the fault code is different, replace the sensor. Check system circuits 2-A-7 and 2-A-21.	Engine pilot lamp/check engine and limp home	Limp home	No rev limit but air temperature is set to a default value
P0113	Air temperature sensor voltage too high	Disconnected sensor or sensor's resistance too high.	Check for disconnected air temperature sensor on the intake. Check the air temperature sensor for approximately 2000 to 4200 ohms at 10 to 25°C (50 to 77°F). Replace the sensor if necessary. Check system circuits 2-A-7 and 2-A-21.	Engine pilot lamp/check engine and limp home	Limp home	No rev limit but air temperature is set to a default value
P0116	Engine temperature sensor functional problem	Intermittent engine temperature sensor reading or circuit wires shorted to ground.	Check system circuits 2-A-11 and 2-A-27. Replace the sensor if necessary.	Engine pilot lamp/check engine and limp home	No effect	No rev limit but engine temperature is set to a default value

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
P0117	Engine temperature sensor voltage too low	Engine temperature sensor or circuit wires shorted to ground.	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. If the fault code is different, replace the sensor. Check for leakage between sensor's connection and ground. Check system circuits 2-A-11 and 2-A-27.	Engine pilot lamp/check engine and limp home	No effect	No rev limit but engine temperature is set to a default value
P0118	Engine temperature sensor voltage too high	Disconnected sensor or sensor's resistance too high.	Check for disconnected engine temperature sensor. Check the engine temperature sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Replace the sensor if necessary. Check system circuits 2-A-11 and 2-A-27.	Engine pilot lamp/check engine and limp home	No effect	No rev limit but engine temperature is set to a default value
P0122	Throttle position sensor voltage too low	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Check system circuits 2-A-24, 2-A-25 and 2-A-39. Refer to the <i>SERVICE MANUAL</i> for complete throttle position sensor testing procedure.	Engine pilot lamp and check engine	Engine will not start	
P0123	Throttle position sensor voltage too high	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Check system circuits 2-A-24, 2-A-25 and 2-A-40. Refer to the <i>SERVICE MANUAL</i> for complete throttle position sensor testing procedure.	Engine pilot lamp and check engine	Engine will not start	
P0231	Fuel pump open circuit or shorted to ground	Damaged or disconnected fuel pump, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check for damaged or disconnected connector on fuel pump. Check for approximately 1 ohm between pins 5-FP-3 and 5-FP-4 of the fuel pump connector. Check for approximately 1 ohm between pins F5 and 2-B-29.	Engine pilot lamp and check engine	Will not run	
P0232	Fuel pump shorted to battery	Damaged fuel pump, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check for approximately 1 ohm between pins 5-FP-3 and 5-FP-4 of the fuel pump connector. Check for approximately 1 ohm between pins F5 and 2-B-29. Check if system circuit 2-B-29 is shorted to 12 V.	Engine pilot lamp and check engine	Will not run long	

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
P0261	Cylinder #1 injector open circuit or shorted to ground	Blown fuse, damaged or disconnected injector, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F1. Check connections on injector. Check for approximately 14.5 ohms on injector. Check system circuit 2-A-15. Check connector CJ connecting the two harnesses together.	Engine pilot lamp/check engine and limp home	Engine pilot lamp/check engine and limp home	No rev but cylinder 1 will not work properly
P0262	Cylinder #1 injector shorted to battery	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 14.5 ohms on injector. Check if system circuit 2-A-15 is shorted to 12 V.	Engine pilot lamp/check engine and limp home	Engine pilot lamp/check engine and limp home	No rev but cylinder 1 will not work properly
P0264	Cylinder #2 injector open circuit or shorted to ground	Blown fuse, damaged or disconnected injector, damaged or disconnected circuit wires, damaged ECM output pins.	Check fuse F1. Check connections on injector. Check for approximately 14.5 ohms on injector. Check system circuit 2-A-33. Check connector CJ connecting the two harnesses together.	Engine pilot lamp/check engine and limp home	Engine pilot lamp/check engine and limp home	No rev but cylinder 2 will not work properly
P0265	Cylinder #2 injector shorted to battery	Damaged injector, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 14.5 ohms on injector. Check if system circuit 2-A-33 is shorted to 12 V.	Engine pilot lamp/check engine and limp home	Engine pilot lamp/check engine and limp home	No rev but cylinder 2 will not work properly
P0336	High engine RPM detected	CPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Check for metal deposit on sensor. Check circuit between 2-A-5, 2-A-19 and 4-CPS-1, 4-CPS-2. Replace sensor if necessary.	Engine pilot lamp and check engine	Erratic engine behavior	
P0337	No crankshaft signal detected	Damaged circuit wires, damaged CPS or damaged tooth wheel.	Check for metal deposit on sensor. Check circuit between 2-A-5, 2-A-19 and 4-CPS-1, 4-CPS-2. Replace sensor if necessary.	Engine pilot lamp and check engine	No start	
P0339	Crankshaft signal fault	CPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Check for metal deposit on sensor. Check circuit between 2-A-5, 2-A-19 and 4-CPS-1, 4-CPS-2. Replace sensor if necessary.	Engine pilot lamp and check engine	Will not run	
P0344	Cam phase sensor signal missing	Blown fuse, damaged circuit wires or damaged sensor.	Check fuse F4. Check for 12 volts between sensor's connector pins 1 and 3. Check system circuits 2-A-20, 2-A-34 and F4.	Engine pilot lamp and check engine	Limp home	No rev but calculation of RPM will be less precise. Cold start will take more time.
P0351	No ignition output stage cylinder #1	Blown fuse, damaged circuit wires, damaged connector or damaged ignition coil.	Check fuse F3. Check for $2.2 \pm 0.3$ ohm between ignition coil pins. Check connector HIC connecting the two harnesses together. Check system circuit 2-A-1.	Engine pilot lamp/check engine and limp home	Limp home	No rev but cylinder 1 will not work properly

**Section 04 ENGINE MANAGEMENT (V490/V660/V810)****Subsection 02 (EMS DIAGNOSTIC)**

<b>P-CODE</b>	<b>DESCRIPTION</b>	<b>CAUSE</b>	<b>ACTION</b>	<b>GAUGE</b>	<b>ENGINE REACTION</b>	<b>DESCRIPTION OF LIMP HOME EFFECT</b>
P0352	No ignition output stage cylinder #2	Blown fuse, damaged circuit wires, damaged connector or damaged ignition coil.	Check fuse F3. Check for $2.2 \pm 0.3$ ohm between ignition coil pins. Check connector HIC connecting the two harnesses together. Check system circuit 2-A-1.	Engine pilot lamp/check engine and limp home	Limp home	No rev but cylinder 2 will not work properly
P0480	Engine fan short-circuit to battery	Blown fuse, damaged fan relay, damaged circuit wires, damaged pins or damaged ECM output pin.	Check fuse F4. Check for approximately 12 volts between 3-PF-1D and engine ground. Check system circuit 2-B-3.	Engine pilot lamp and check engine	No effect	
P0480	Engine fan short-circuit to ground or open	Blown fuse, damaged fan relay, damaged circuit wires, damaged or disconnected pins or damaged ECM output pin.	Check fuse F4. Check for disconnected relay or pin 3-PF-1 D and 3-PF-1E. Check for approximately 12 volts between 3-PF-1D and engine ground. Check system circuit 2-B-3.	Engine pilot lamp and check engine	No effect	
P0505	Idle air control valve 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 system circuits 2-A-35, 2-A-36, 2-A-37 and 2-A-38. Check for damaged connector or damaged ECM output pins.	Engine pilot lamp and check engine	Erratic engine behavior	
P0505	Idle air control valve 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 system circuits 2-A-35, 2-A-36, 2-A-37 and 2-A-38. Check for damaged connector or damaged ECM output pins.	Engine pilot lamp and check engine	Erratic engine behavior	
P0513	Incorrect DESS® key	DESS key not programmed. Wrong DESS key used. Bad contact on the DESS key. DESS key failure.	Clean DESS key. Program the DESS key.	Check engine/incorrect DESS	Will not start	



## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
P0520	Oil pressure switch functional problem	Low oil level, engine leak, oil pump failure, damaged sensor, damaged or shorted circuit wires.	Check oil level. Check oil pressure switch resistance. With engine stopped, the resistance should be less than 1 ohm. With engine running, the resistance of oil switch should be infinitely high (OL). Check system circuit 2-A-10 to engine ground.	Engine pilot lamp and check engine	No effect	
P0562	Battery voltage too low	Battery failure, damaged circuit wires, damaged or disconnected magneto and regulator.	Check battery voltage for 12 to 13 volts with engine stopped. Check battery voltage for 13.8 to 15.0 volts with engine idling. Check connections on magneto and regulator.	Engine pilot lamp/check engine/low batt and limp home	Limp home	Rev at 5000
P0563	Battery voltage too high	Bad battery, damaged circuit wires or damaged regulator. An external battery charger may have been used.	Check battery voltage for 13.8 to 15.0 volts with engine idling. Check connections on battery. Replace regulator if necessary.	Engine pilot lamp/check engine/hi batt and limp home	Limp home	Rev at 7000
P0600	CAN Bus Off	Communication error between cluster and ECM and/or B.U.D.S.	Check for damaged circuit between 1-CI-23, 4-B-29 and 2-DB-1. Check for damaged circuit between 1-CI-24, 4-B-27 and 2-DB-2. Replace cluster if necessary.	No ECU communication	No effect	
P0600	CAN ID 514 missing	Communication error between cluster and ECM and/or B.U.D.S.	Check system circuits 2-B-27 and 2-B-28 with 1-CI-23 and 1-CI-24. Refer to the <i>SERVICE MANUAL</i> for more details.	No ECU communication	No effect	
P0601	Throttle position sensor adaptation failure	Wrong throttle body mechanical position during reset of closed TPS 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.	Engine pilot lamp/check engine		
P0601	Module call monitoring	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		
P0602	ECM not coded	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine	Will not start	
P0604	RAM fault	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		
P0605	EEPROM fault	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
P0605	EEPROM checksum fault	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		
P0605	Coding ID checksum fault	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		
P0605	Coding checksum fault	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		
P0605	Programming checksum fault	Damaged ECM or faulty programming.	Try updating the ECM. If the problem persists, replace the ECM.	Engine pilot lamp/check engine		
P0608	Sensor's power supply voltage too low	Inverted connectors between air pressure sensor and TPS. Damaged circuit wires, shorted air pressure sensor or shorted TPS.	Check system circuits 2-A-12, 2-A-28, 2-A-40, 2-A-24, 2-A-25 and 2-A-39.	Engine pilot lamp/check engine	Limp home	No rev but all associated sensors will be set to a default value
P0608	Sensor's power supply voltage too high	Damaged circuit wires, TPS or air pressure sensor shorted to a supply.	Check system circuits 2-A-12, 2-A-28, 2-A-40, 2-A-24, 2-A-25 and 2-A-39.	Engine pilot lamp/check engine	Limp home	No rev but all associated sensors will be set to a default value
P0616	Starter relay open circuit or shorted to ground	Blown fuse, damaged or disconnected starter relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse F4. Disconnect the starter relay and check for approximately 7.3 ohms between the small starter relay terminals. Check for approximately 12 volts between starter relay OR/GN wire and ground. Check system circuit 2-B-31.	Engine pilot lamp/check engine	Will not start	
P0617	Starter relay shorted to battery	Damaged solenoid, damaged circuit wires, damaged connector or damaged ECM output pins.	Disconnect the starter relay and check for approximately 7.3 ohms between the small starter relay terminals. Check if system circuit 2-B-31 is shorted to 12 V.	Engine pilot lamp/check engine	Will not start	
P0705	Transmission range sensor circuit malfunction (PRNHL)	Improbable combination of transmission switches.	Check for disconnected or damaged transmission contact. Check circuit 2-A-2, 2-A-6 and 2-A-31. Refer to <i>B.U.D.S. TRANSMISSION</i> switch diagnostic. Refer to <i>SERVICE MANUAL</i> for transmission service.	Check engine/"E" is displayed	Limp home	No rev but engine will react as if the gear were in high
P1102	Throttle position sensor adaptation failure	Wrong throttle body mechanical position during reset of closed TPS 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.	Engine pilot lamp/check engine		

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
P1104	Throttle position sensor adaptation failure	Wrong throttle body mechanical position during reset of closed TPS 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.	Engine pilot lamp/check engine		
P1116	High temp	High temperature of the cooling liquid.	Refer to <i>SERVICE MANUAL</i> for high engine temperature.	Check engine/hi temp	Limp home	Rev at 4050
P1148	Safety fuel cut off detected	TPS adaptation failure, TPS failure, damaged ECM memory or battery voltage out of range.	Check cable adjustment. Check idle stop for wear. Make sure throttle plate is against throttle stop. Reset closed TPS.	Engine pilot lamp/check engine	Limp home	Rev at 5000
P1202	Oil pressure switch still closed	Low oil level, engine leak, oil pump failure, damaged sensor, damaged or shorted circuit wires.	Check oil level. Check oil pressure switch resistance. With engine stopped, the resistance should be less than 1 ohm. With engine running, the resistance of oil switch should be infinitely high (OL). Check system circuit 2-A-10 to engine ground.	Engine pilot lamp/check engine	No effect	
P1203	Oil pressure switch leakage	Low oil level, engine leak, oil pump failure, damaged sensor, damaged or shorted circuit wires.	Check oil level. Check oil pressure switch resistance. With engine stopped, the resistance should be less than 1 ohm. With engine running, the resistance of oil switch should be infinitely high (OL). Check system circuit 2-A-10 to engine ground.	Engine pilot lamp/check engine	No effect	
P1520	Low oil	Low oil detected in engine.	Refer to <i>SERVICE MANUAL</i> for low oil service.	Check engine/low oil	Limp home	Rev at 4000
P1655	DESS® line shorted to battery	Damaged circuit wires or mixed up connection pins.	Check system circuits 2-B-38, and 2-B-39 with 1-CC-C and 1-CC-D.	Check engine/incorrect DESS	Will not start	
P1656	DESS® line shorted to ground	Damaged circuit wires or mixed up connection pins.	Check system circuits 2-B-38, and 2-B-39 with 1-CC-C and 1-CC-D.	Check engine/incorrect DESS	Will not start	
P1675	Relay 2 shorted to battery	Damaged relay, damaged circuit wires, damaged connector or damaged ECM output pins.	Check for approximately 100 ohms between relay pins 85 and 86. Check if system circuit 2-B-14 is shorted to 12 V.	Engine pilot lamp/check engine	ECM will not do memory tracking sequence	

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 02 (EMS DIAGNOSTIC)

P-CODE	DESCRIPTION	CAUSE	ACTION	GAUGE	ENGINE REACTION	DESCRIPTION OF LIMP HOME EFFECT
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 F4. Check for approximately 100 ohms between relay pins 85 and 86. Check system circuit 2-B-14.	Engine pilot lamp/check engine	ECM will not do memory tracking sequence	
P1683	CAN RAM Fault	Communication error between cluster and ECM and/or B.U.D.S.	Check for damaged circuit between 1-CI-23, 4-B-29 and 2-DB-1. Check for damaged circuit between 1-CI-24, 4-B-27 and 2-DB-2. Replace cluster if necessary.	Engine pilot lamp/check engine	No effect	
P2119	ECU wrong	Incorrect ECU or cluster for engine.	Install proper recommended ECU or gauge for vehicle.	Engine pilot lamp/check engine	Will not start	



# ADJUSTMENT AND REPAIR PROCEDURES

## SERVICE TOOLS

Description	Part Number	Page
pliers .....	295 000 070 .....	206
ECM adapter.....	420 277 010 .....	195
tachometer .....	529 014 500 .....	197
Fluke 111 multimeter .....	529 035 868 .....	195, 199
Back probe test wires.....	529 036 063 .....	195

## SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243.....	293 800 060 .....	212, 216, 218

## GENERAL

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

It is important to ensure that the mechanical integrity of the engine/propulsion system is present:

- good transmission system operation
- good engine compression and properly operating mechanical components, no leaks etc.
- fuel pump connection and fuel lines without leaks.

Check the chart in *TROUBLESHOOTING* section to have an overview of problems and suggested solutions.

When replacing a component, always check its operation after installation.

## FUEL SYSTEM

### WARNING

Fuel is flammable and explosive under certain conditions. Ensure work area is well ventilated. Do not smoke or allow open flames or sparks in the vicinity.

### WARNING

Always disconnect battery prior to working on the fuel system. Always disconnect battery exactly in the specified order, BLACK (-) cable first. It is recommended to disconnect electrical connections prior to disconnecting fuel lines.

### WARNING

The fuel system of a fuel injection system holds much more pressure than on a carbureted ATV. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here.

- Use the B.U.D.S. software to release the fuel pressure in the system (refer to *EMS DIAGNOSTIC*). Look in the **Activation** section of the software B.U.D.S.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

#### WARNING

Fuel lines remain under pressure at all times. Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses. Proceed with care when removing/installing pressure test equipment or disconnecting fuel line connections. Use the software B.U.D.S. to release fuel pressure prior to removing a hose. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to minimize spilling. Wipe off any fuel spillage in the engine compartment. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Never use a hose pincher on injection system high pressure hoses. Replace any damaged or deteriorated fuel lines.

When the repair is completed, ensure that all hoses are connected and secured. Perform the *FUEL PRESSURE TEST* and the *FUEL TANK LEAK TEST* as explained in *FUEL TANK AND FUEL PUMP* section.

#### WARNING

Always perform the fuel pressure test if any component has been removed. A pressure test must be done before turning the ignition key to ON and setting the engine run/stop switch to RUN. The fuel pump is activated each time in these conditions. After performing a fuel pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

To locate a leak, pressurize the system. Check for leaking fuel or fuel odor. Spray soapy water on all hose connections, fuel rail and injectors. Air bubbles will show the leaking area.

## ELECTRICAL SYSTEM

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

- battery
- fuses
- relay(s)
- diodes
- DESS
- ignition (spark)
- ground connections
- wiring connectors
- multifunction gauge.

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

Never use a battery charger to substitute temporarily the battery, as it may cause the ECM (engine control module) to work erratically or not to work at all. Check related-circuit fuse solidity and condition with an ohmmeter. Visual inspection could lead to false results.

#### WARNING

Some EMS components are continuously powered by the VFB (Vehicle Fuse Block) when ignition key is turned on and engine run/stop switch is set in RUN position. The ECM switches the circuit to the ground to complete the electrical circuits it controls. Take this into account when troubleshooting. Always disconnect the battery prior to disconnecting any electric or electronic parts.

Pay particular attention to ensure that pins are not out of their connectors or out of shape.

When probing terminals, pay attention not to bend the terminal as this could bring a loose connection that would be difficult to troubleshoot.

#### WARNING

Ensure all terminals are properly crimped on wires and connector housings are properly fastened.

Before replacing an ECM, always check electrical connections. Make sure terminals are properly crimped on wires and fastened in housing, and that they are free of corrosion or moisture. Check if wiring harness shows any signs of scoring. Ensure proper electrical connection. Particularly check ECM ground connections. A "defective module" could possibly be repaired simply by unplugging and replugging the ECM. The voltage and current might be too weak to go through dirty wire pins.

For the electrical connectors, pay attention to the following:

- ECM connectors: Do not apply dielectric grease or any other lubricant.
- Other connectors: Apply a silicon-based dielectric grease or other appropriate lubricant.

Ensure that all electronic components are genuine. Any modification on the wiring harness may lead to generate fault codes or bad operation.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

**NOTE:** For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.

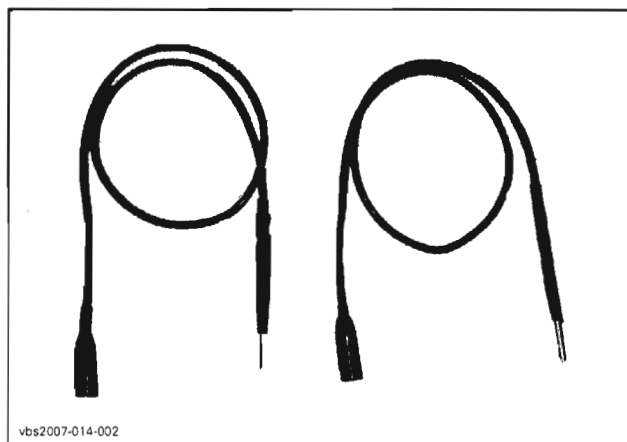
After a problem has been solved, ensure to clear the fault(s) in the ECM using the B.U.D.S. software. Refer to *EMS DIAGNOSTIC* subsection.

#### Diagnostic Tools

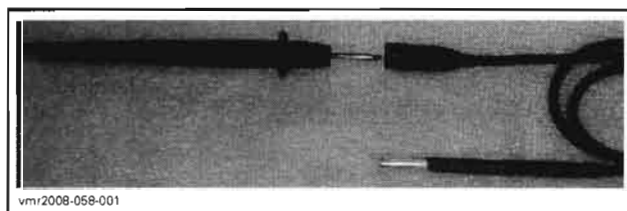
To perform verifications, use the Fluke 111 multi-meter (P/N 529 035 868).



To easily probe wire terminals through the back of their connectors, Back probe test wires (P/N 529 036 063) can be used.

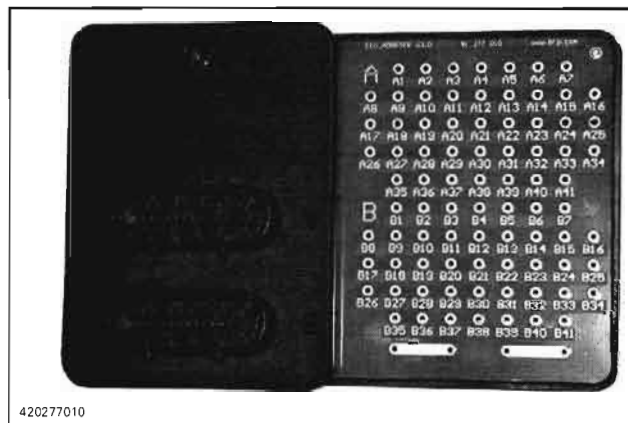


They can be inserted at the end of the standard probes of the Fluke 111 multimeter (P/N 529 035 868).

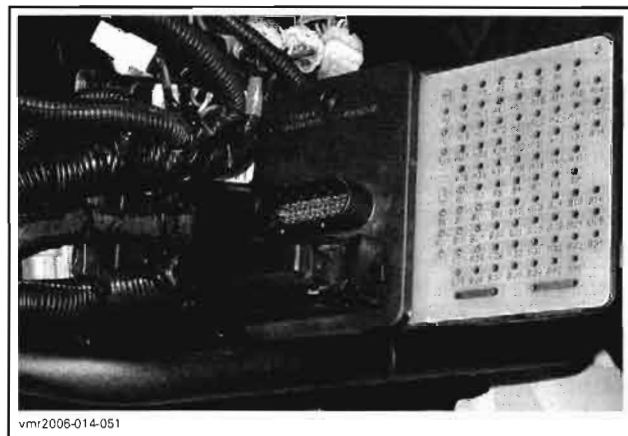


The most recommended and safest method to probe ECM connector terminals is to use the ECM adapter (P/N 420 277 010). This tool will prevent deforming or enlarging terminals which would lead to bad ECM terminal contact creating intermittent or permanent problems.

vmr2008-058



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



#### Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (68°F). The resistance value of a resistance varies with the temperature. The resistance value for usual resistor or windings (such as injectors) **increases** as the temperature increases. However, our temperature sensors are NTC types (Negative Temperature Coefficient) and work the opposite which means that the resistance value **decreases** as the temperature increases. Take it into account when measuring at temperatures different from 20°C (68°F). Use this table for resistance variation relative to temperature for **temperature sensors**.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

TEMPERATURE SENSOR TABLE			
TEMPERATURE		RESISTANCE (ohms)	
°C	°F	MAPTS	CTS
- 40	- 40	—	45000
- 30	- 22	28000	28000
- 20	- 4	14500	15000
0	32	5500	5750
20	68	2500	2600
40	104	1200	1200
60	140	600	600
80	176	320	320
100	212	180	180
130	266	90	90

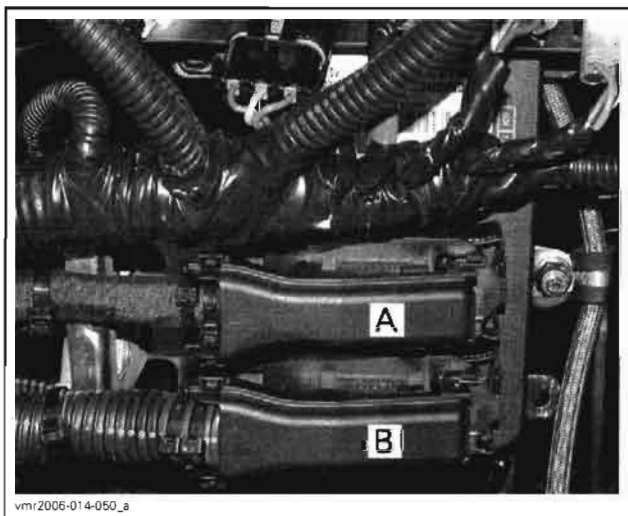
CONVERSION CHART FOR TEMPERATURE SENSORS

The resistance value of a temperature sensor may test good at a certain temperature but it might be defective at other temperatures. If in doubt, try a new sensor.

Also remember this validates the operation of the sensor at room temperature. It does not validate the over temperature functionality. To test it, the sensor could be removed from the engine and heated with a heat gun while it is still connected to the harness to see if the ECM will detect the high temperature condition and generate a fault code.

### ECM Connectors

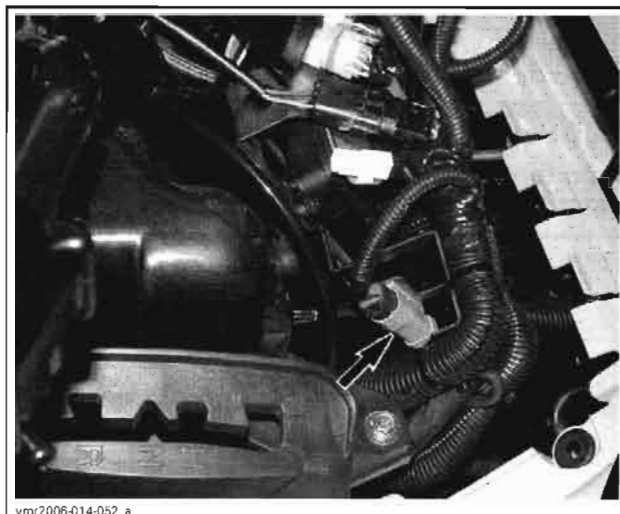
The ECM connectors are identified by the letter "A" and "B".



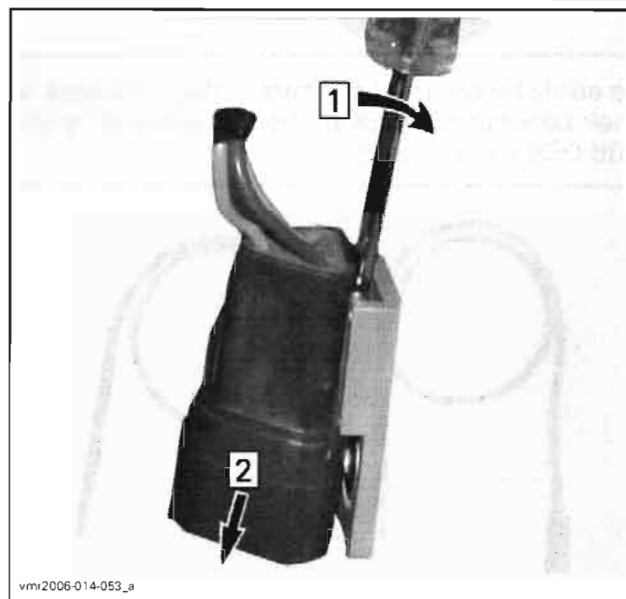
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### Engine Connector

Remove center panel and dashboard. Refer to BODY.



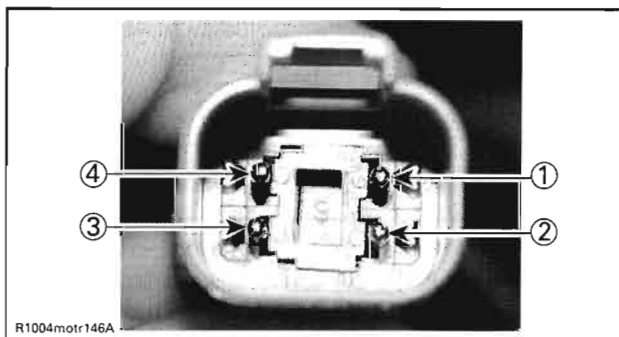
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vmr/2006-014-053\_a

TYPICAL — CONNECTOR REMOVAL

Use this illustration to locate the pin numbers on the engine connector when performing tests.



ENGINE CONNECTOR PIN-OUT (ENGINE SIDE)



## BASIC ADJUSTMENTS

### IDLE SPEED

The idle speed is not adjustable. The ECM controls the idle speed of the engine.

**CAUTION:** Never attempt to adjust the sealed idle stop screw. It is calibrated at the factory. If the screw adjustment is changed, the throttle body must be replaced.

If desired, the engine RPM can be verified with the tachometer (P/N 529 014 500).

Install the tachometer wire on spark plug cable.

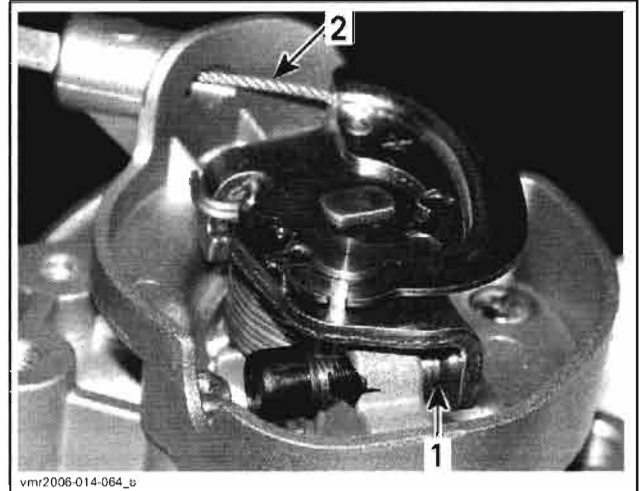


### THROTTLE CABLE

Mechanically adjust the throttle cable as follows.

Handlebar and throttle cable must be at their normal position. Throttle cable routing must have been performed before adjusting cable.

Activate throttle lever a few times. Make sure throttle cam of throttle body rests against set screw without any tension in the cable.



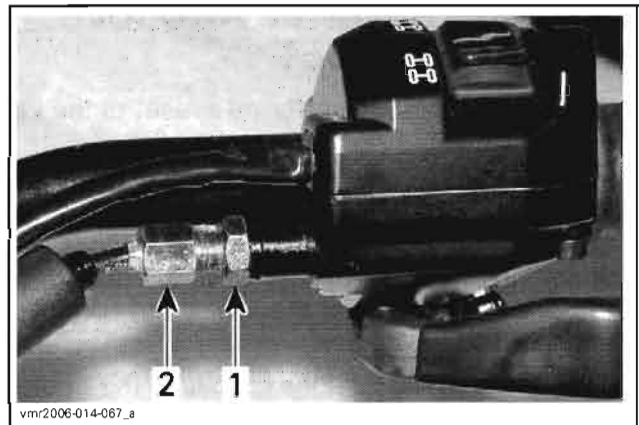
1. Contact here
2. Free-play here

**CAUTION:** If there is no free-play at idle position, it may cause poor idling and startability problems. Improper cable adjustment will cause strain on cable and/or damage cable bracket or throttle lever at handlebar.

#### WARNING

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

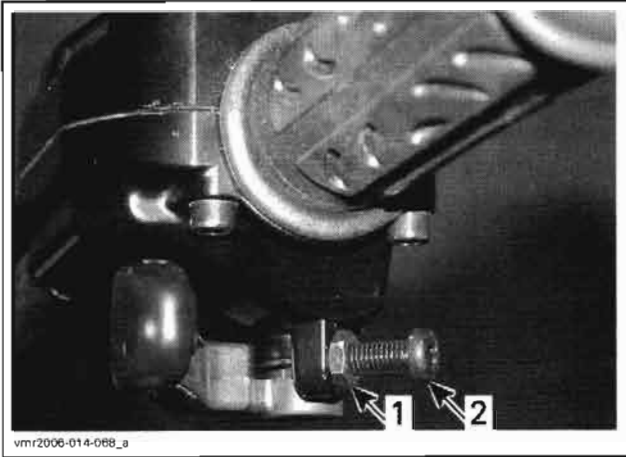
If adjustment is needed, proceed with adjuster at handlebar. Adjust to have 2 mm (.078 in) free-play. When done, slide back cable protector over adjuster.



1. Adjuster lock nut
2. Adjuster

Turn handlebar side to side and ensure there is still free-play in each position.

To ensure there is no strain in the cable at wide open position:



1. Adjuster lock nut
2. Adjuster

- Fully depress throttle lever and hold.
- Slacken adjuster lock nut/adjuster until it just releases lever.
- Turn adjuster clockwise until it touches lever again.
- From there, tighten adjuster 1/2 turn (to remove strain in cable).
- Tighten lock nut.
- Release throttle lever.

Reinstall throttle body cover.

#### Closed Throttle and Idle Actuator Reset

Perform the Closed Throttle and Idle Actuator reset.

### CLOSED THROTTLE AND IDLE ACTUATOR RESET

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

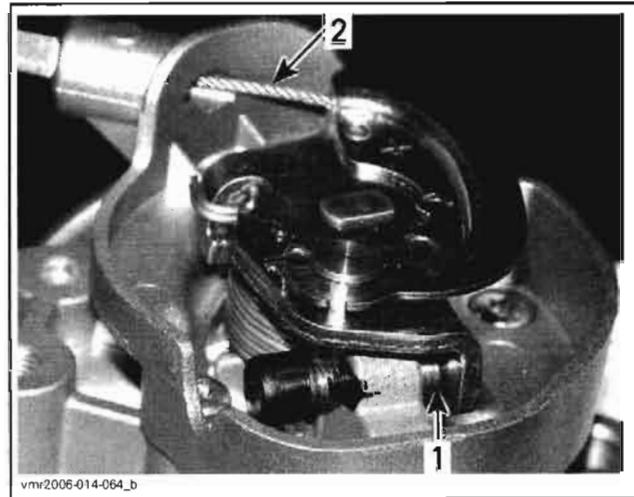
This reset is very important. The setting of the TPS will determine the basic parameters for all fuel mapping and several ECM calculations and the setting of the idle bypass valve will determine the basic parameters for the idle speed control of the engine.

**NOTE:** Reset must be done each time the throttle position sensor (TPS) is loosened or removed or throttle body is replaced or ECM is replaced.

**CAUTION:** An improperly set TPS or idle bypass valve may lead to poor engine performance and emission compliance could possibly be affected. In addition, improper idle bypass valve reset may lead to poor engine starting, improper idle (too low or too high) and engine stop on deceleration.

Use the B.U.D.S. software to perform this adjustment.

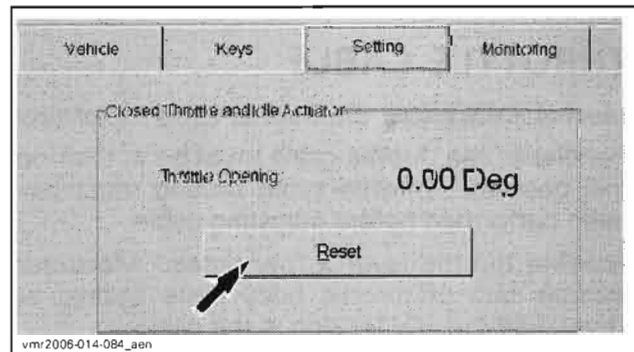
Remove throttle body cap and ensure the throttle cam of throttle body rests against set screw without any tension in the cable.



1. Contact here
2. Free-play here

Open throttle approximately one quarter then quickly release. Repeat 2 - 3 times to settle throttle plate. If stopper does not rest against its stop lever, perform throttle cable adjustment. Refer to *THROTTLE BODY* in this section.

To reset valve and TPS, click on the **Reset** button in the **Setting** section of B.U.D.S.



**NOTE:** No message will be displayed if operation is successful. If operation is wrong, an error message will be displayed.

**NOTE:** There is no idle speed adjustment to perform. The ECM takes care of that. If TPS is not within the allowed range while resetting the Closed Throttle and Idle Actuator, the ECM will generate a fault code and will not accept the setting.

Start engine and make sure it operates normally through its full engine RPM range. If fault codes appear, refer to *EMS DIAGNOSTIC* section for more information.

## IGNITION TIMING

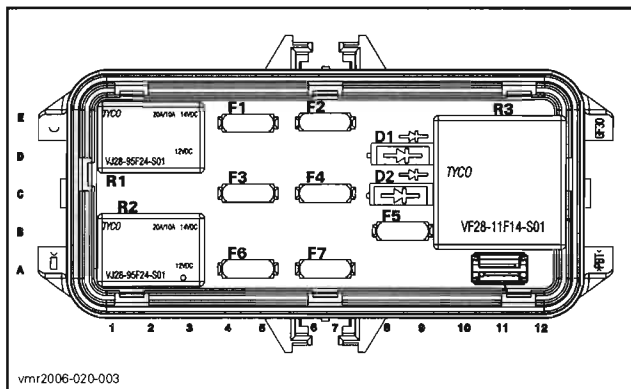
The ignition timing is not adjustable.

## REPAIR PROCEDURES

### MAIN RELAY (R2)

#### Relay (R2) Installation

**NOTE:** Relays may be inverted by 180° at installation and they will work correctly. Ensure to align tabs of relay with terminals of fuse holder at installation.



R2: Main relay

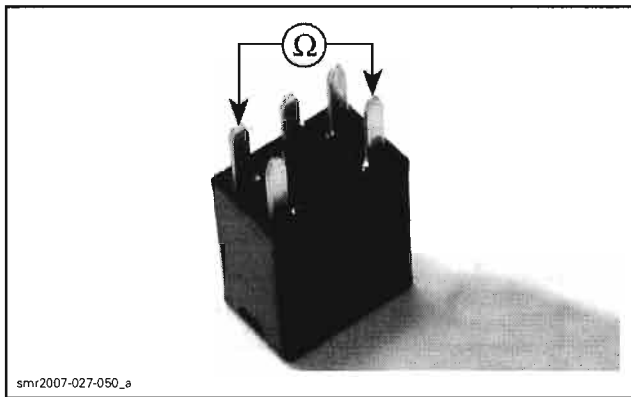
#### Relay (R2) Continuity Test

Remove relay.

Use the Fluke 111 multimeter (P/N 529 035 868), and select the  $\Omega$  position.

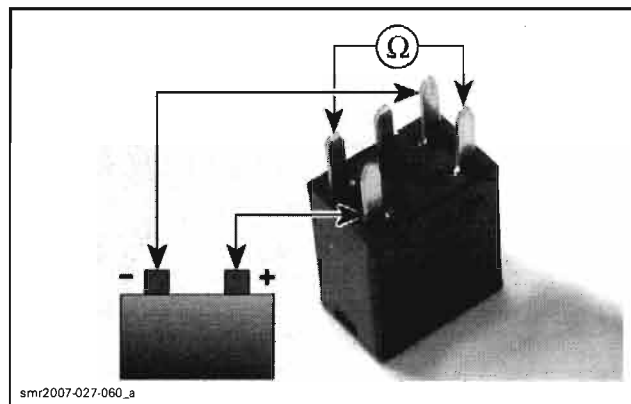
Probe relay as follows.

TERMINAL		RESISTANCE
30	87	Open circuit (OL)



Connect battery as shown and probe relay again as follows.

TERMINAL		RESISTANCE
30	87	0.5 $\Omega$ max. (continuity)



If relay failed any test, replace it.

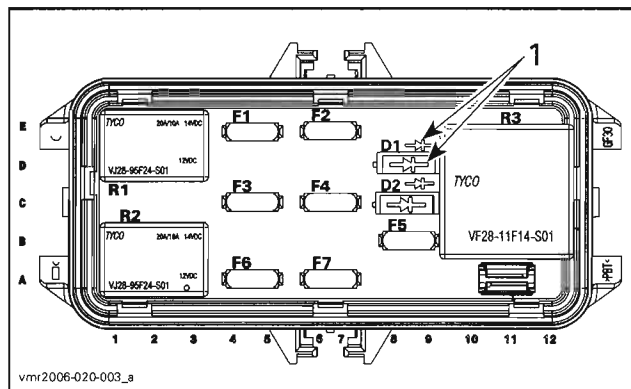
### D1 DIODE (ECM)

The diode D1 is located in the fuse holder.

The fuse holder is located in the front service compartment.

#### Diode (D1) Installation

Validate D1 diode installation as shown.



1. Position symbol on diode in same direction as symbol on fuse holder

### Problems Related to Diode D1

ECM does not turn on	<ul style="list-style-type: none"> <li>- Missing diode</li> <li>- Inverted diode installation</li> <li>- Defective diode (open)</li> </ul>
ECM does not turn off (engine will not shut off)	<ul style="list-style-type: none"> <li>- Defective diode (shorted)</li> </ul>

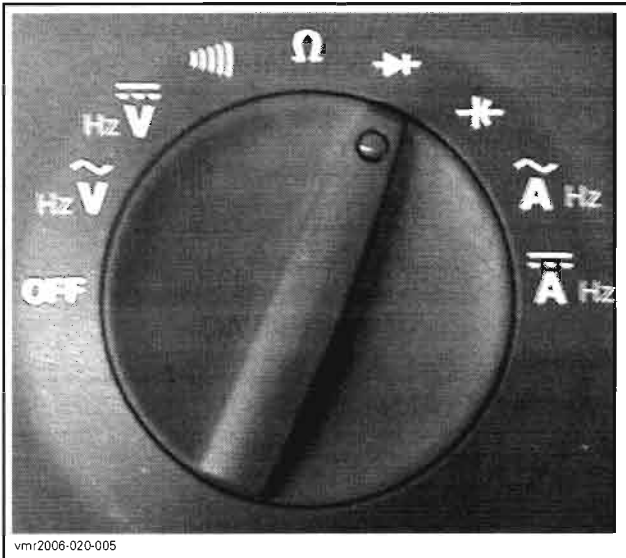
## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

#### Diode (D1) Test

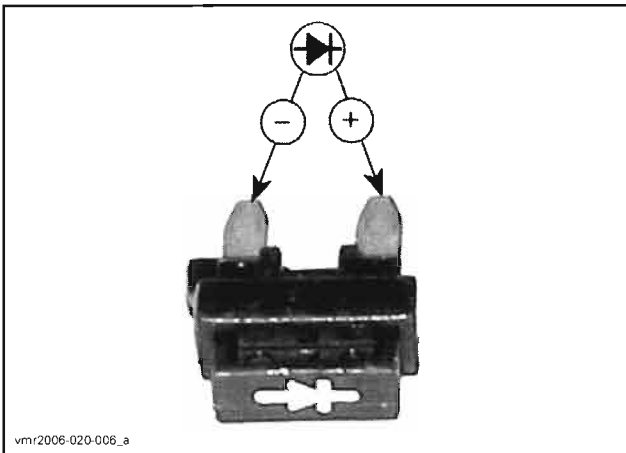
Remove diode and lay down on a non-metallic table.

Set multimeter as shown.



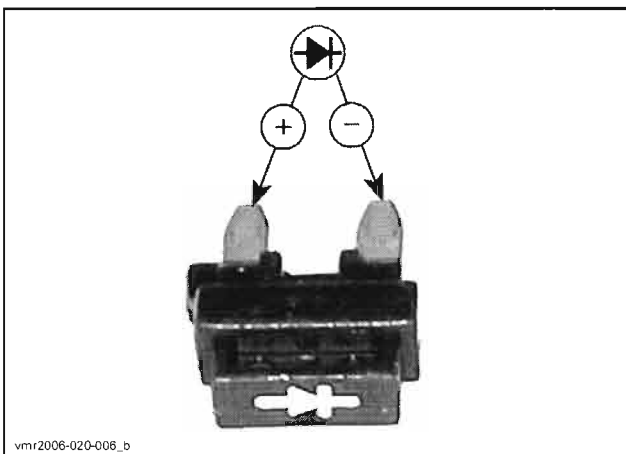
vmr2006-020-005

Probe diode paying attention to proper polarity.



vmr2006-020-006\_a

**MUST BE OPEN CIRCUIT**



vmr2006-020-006\_b

**MUST BE AROUND 0.5 V**

If diode fail any test, replace it.

## ENGINE CONTROL MODULE (ECM)

### Quick Test to Validate ECM Operation

Turn ignition key to ON AND set engine run/stop switch to RUN.

**NOTE:** When both switches are ON, it triggers the ECM and it then turns on.

#### QUICK INDICATION THAT ECM IS NOT WORKING (assuming the observed component is working)

Multifunction gauge does not turn on.

Fuel pump does not turn on for approx. 5 seconds (when turning key on and setting engine run/stop switch RUN).

Rear light does not turn on.

Headlamp do not turn on (with ignition key at light position).

### If Engine Stop Running for no Reason

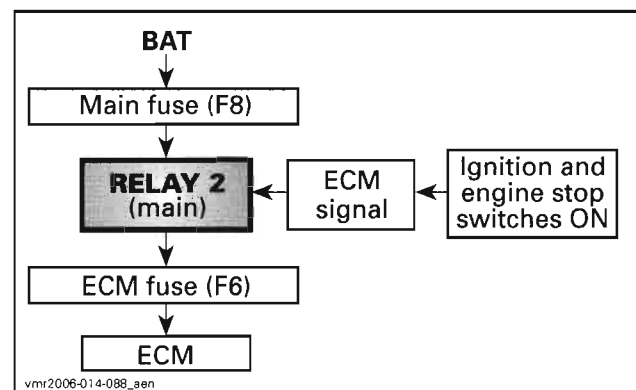
It may be caused by the ECM that is improperly reset (it restarts).

- If it occurs when using the winch, check diodes D5 and D6. Refer to *LIGHTS, GAUGE AND ACCESSORIES* section for diode testing procedure.
- If it occurs at any time, check diode D2. Refer to *STARTING SYSTEM* section for diode testing procedure.

### ECM Power Supply and Ground Pinout

FUNCTION	CONNECTOR PIN
Power 12 Vdc	B-11
Grounds	B1, B2, B32 and B41

### ECM Power Supply Verification



vmr2006-014-088\_aen

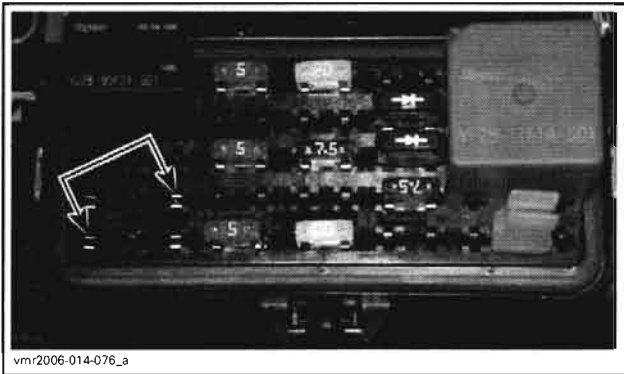
**Section 04 ENGINE MANAGEMENT (V490/V660/V810)**  
**Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)**

**NOTE:** If engine is not started within 15 minutes after ignition switch was turned on and engine run/stop switch was set to RUN, ECM will go in sleep mode and will cut power to everything except the multifunction gauge. To exit that mode, turn off ignition key and WAIT until multifunction gauge turns off then, turn ignition key back on.

Check fuses F8 and F6.

Check main relay R2.

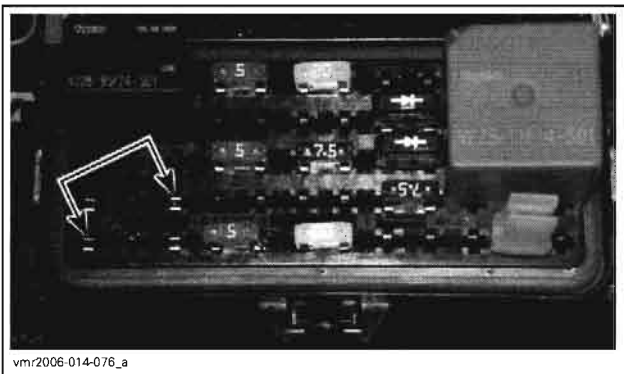
To check relay operation, remove relay and bypass it with a jumper between terminals as shown.



If ECM does NOT Work when Bypassing Relay R2:

Problem is on the contact side of relay circuit, check wiring/connectors from battery to ECM.

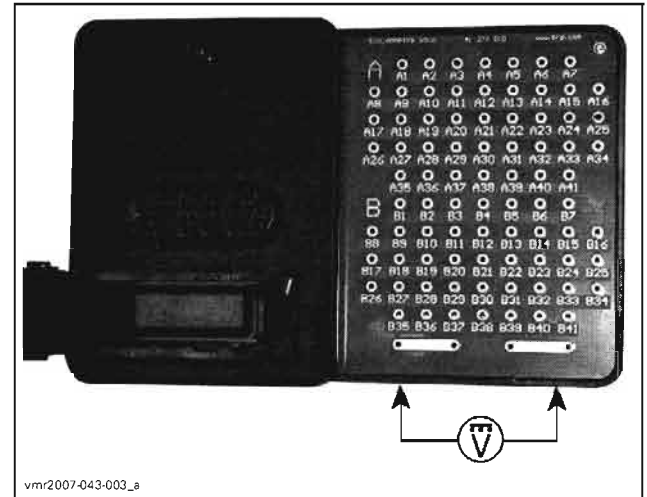
- Disconnect connector "B" from ECM.
- Keep the jumper to bypass relay.



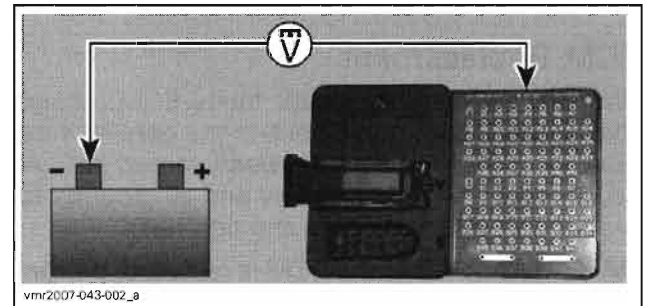
- Read voltage as follows.

ECM CONNECTOR "B"		MEASUREMENT
PIN		VOLTAGE
B-1 (ground)	B-11	12 Vdc

- If voltage is good, check ignition switch, engine run/stop switch and their wiring/connectors. Refer to *IGNITION SYSTEM*. If they test good, check **signal side of relay** as described under *IF ECM WORKS WHEN BYPASSING RELAY* below.
- If voltage is not good, read voltage as follows.



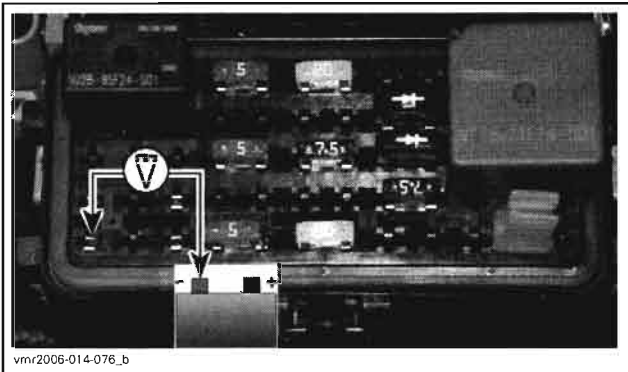
ECM CONNECTOR "B"		MEASUREMENT
PIN		VOLTAGE
B-11	Battery ground	Battery voltage



- If voltage is now good, check ECM ground circuits and battery ground.
- If voltage is still not good, remove jumper in fuse box and read voltage as follows.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)



- If voltage is now good, check wiring/connectors from fuse block to ECM.
- If voltage is NOT good, check wiring/connectors from battery to fuse block.

#### If ECM WORKS when Bypassing Relay:

Relay is likely to be faulty. Test relay. Refer to *MAIN RELAY (R2)* above in this section.

If relay tested good, problem is on the **input signal of relay circuit**. Do the following:

- Check diode D1. Refer to *DIODE D1 (ECM)* above in this section.
- Check wiring/connectors from battery to fuse block.
- Check wiring/connectors from fuse block to ECM.
- Try a new ECM.

### ECM Replacement

Prior to replacing a possibly faulty ECM, ensure that all the recommendations in the general introduction of this section have been carried out. Also, check ECM power supply and all grounds for proper contact/cleanliness and tightness.

**IMPORTANT:** When the ECM is replaced, the ignition key(s) and the **Closed Throttle and Idle Actuator** must be reprogrammed/reset. Refer to their specific section for adjustment.

To allow transferring the previous recorded information from the old ECM to the new one, use the B.U.D.S. software. Select ECM, **Replace** in the **Module** menu. Follow instructions in its help system.

**NOTE:** If the old ECM still works, its information must be read by B.U.D.S. before being removed from the vehicle in order to transfer vehicle information and history to the new ECM.

Disconnect battery cables.

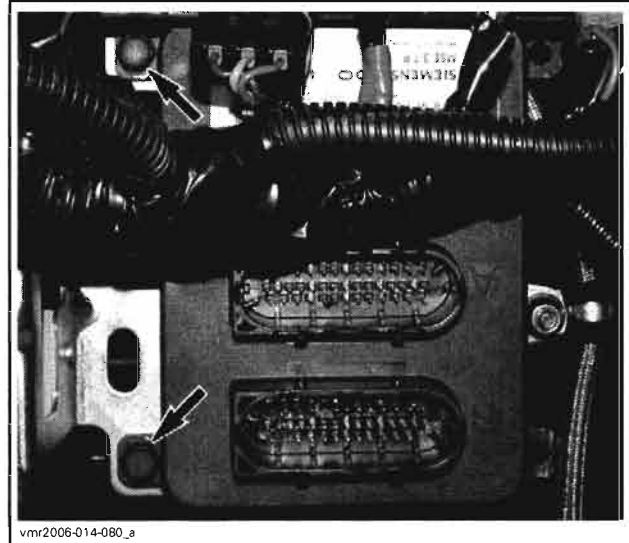
#### **WARNING**

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

Remove center panel and dashboard. Refer to *BODY*.

Disconnect both connectors from ECM.

Unscrew retaining screws and remove the ECM from vehicle.

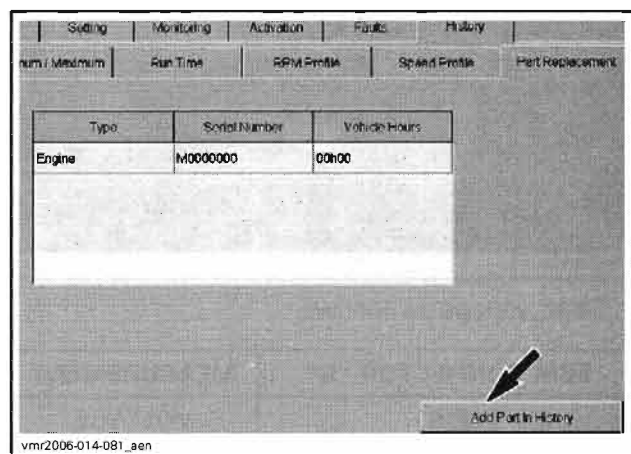


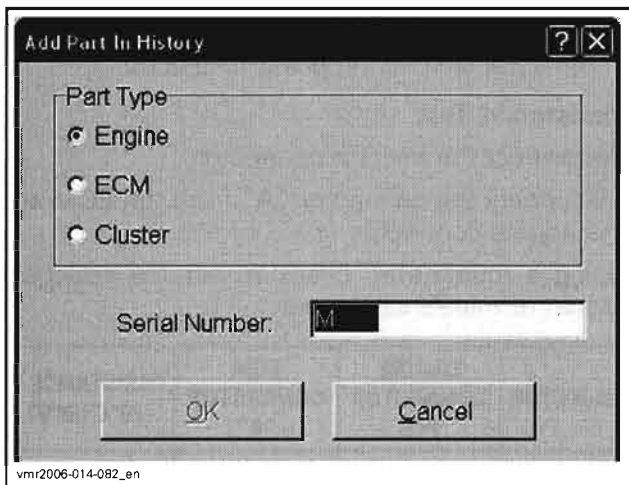
Install the new ECM to the vehicle.

Reconnect connectors to ECM, and then battery cables.

Transfer the data from the previous ECM to the new one using B.U.D.S. then proceed with the required resets and reprogram ignition key(s), if you were unable to transfer the data.

**NOTE:** If data cannot be transferred, manually enter information in **Vehicle** tab and **Engine serial number** in **History, Part Replacement**.

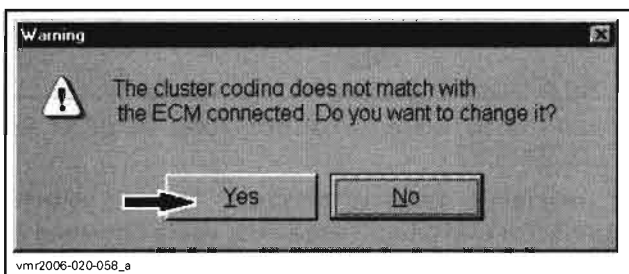




After performing the required resets, ensure to clear all faults from the newly replaced ECM.

### Security Exchange

If you get the message shown in the following illustration, the installed ECM is not appropriate for the vehicle or its calibration has been changed. Engine will crank but will not start.



If it occurred just after replacing the ECM, refer to *PARTS CATALOG* to get the proper ECM according to vehicle.

If you get this message after you have purposely changed the ECM calibration, Click "Yes" to update the system and to allow engine starting.

**CAUTION:** It is not recommended to start an engine with the wrong calibration.

## FUEL INJECTOR

### Leakage Test

The leakage test is validated when performing the "fuel delivery system diagnostic flow chart" in *FUEL TANK AND FUEL PUMP*.

### Electrical Test

Turn ignition key ON and set engine run/stop switch to RUN.

Using the B.U.D.S. software, energize the fuel injector from the **Activation** section.



You should hear the injector working.

This will validate the injector mechanical and electrical operation.

If the injector does not work, check injector power supply.

### Voltage Test

Disconnect the connector from the injector.

**NOTE:** If connector is hard to unlock, gently use a screwdriver to release connector.



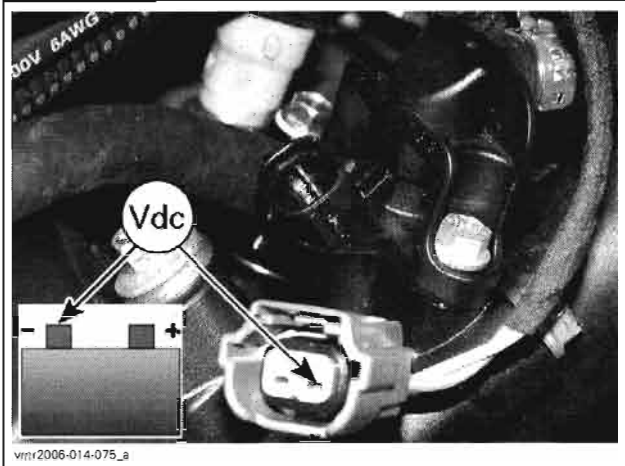
**NOTE:** It is not necessary to activate the injector since it is continuously powered.

Use a multimeter and set it to Vdc. Read voltage.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

CYLINDER	INJECTOR CONNECTOR		MEASUREMENT
	WIRE		
FRONT	VIOLET/ BLUE	Battery ground	12 Vdc
REAR			



If supply voltage is good, check ground circuit between injector and ECM (see *WIRING DIAGRAMS*).

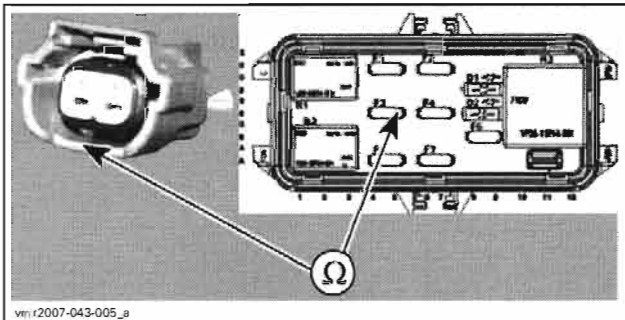
- If ground circuit is faulty, repair/replace.
- If ground circuit is good, refer to *ECM REPLACEMENT*.

If supply voltage is not good, check continuity between fuse F3 and injector (see *WIRING DIAGRAMS*).

**NOTE:** Probe fuse exactly as shown. This validates fuse at the same time.

Use a multimeter and set it to  $\Omega$ . Read resistance.

CYLINDER	INJECTOR CIRCUIT		MEASUREMENT
	WIRE		
FRONT	VIOLET/ BLUE	Fuse F3	Close to 0 $\Omega$
REAR			



- If continuity is good, check relay and wiring from battery.

- If continuity is faulty, check fuse and if ok, repair/replace wiring going to injector.

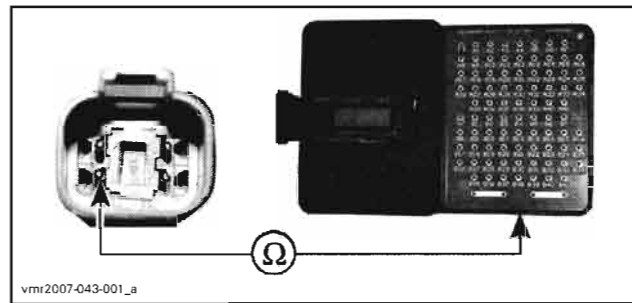
#### Resistance Test

Reconnect the injector connector.

Disconnect the connector "A" from the ECM and the engine connector.

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

INJECTOR	ENGINE CONNECTOR PIN	ECM CONNECTOR "A"	RESISTANCE @ 20°C (68°F)
FRONT	3	A-15	13.8 - 15.2 $\Omega$
REAR		A-33	

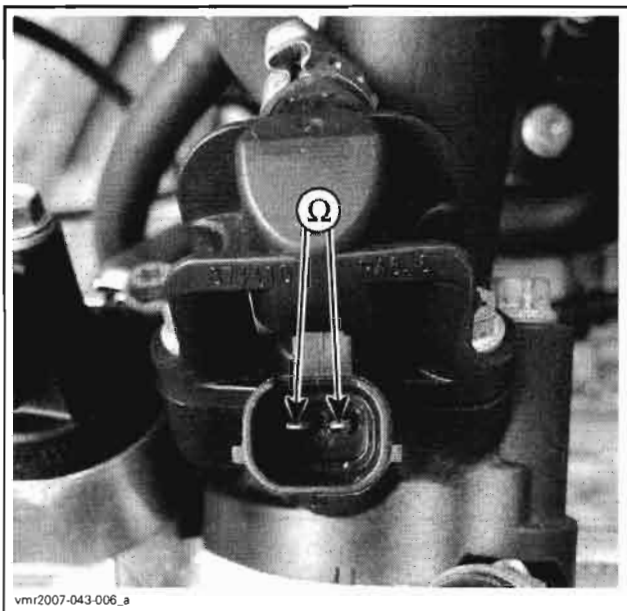


If resistance value is correct, refer to *ECM REPLACEMENT*.

If resistance value is incorrect, remove injector connector and check resistance value between injector pins as follows.

INJECTOR	INJECTOR PIN		RESISTANCE @ 20°C (68°F)
FRONT	1	2	13.8 - 15.2 $\Omega$
REAR			





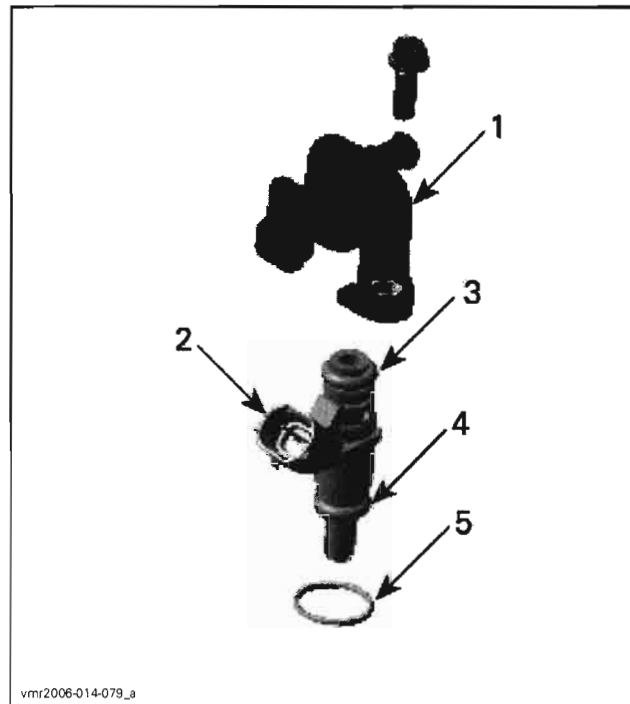
If readings are out of specifications, replace injector.

If readings are good, repair/replace wiring going to injector.

### Fuel Injector Replacement

#### Removal

Before removing the injector, the fuel rail has to be removed from the engine. Refer to *FUEL RAIL* for the procedure.



#### FUEL RAIL ASS'Y

1. Fuel rail
2. Fuel injector
3. Injector top O-ring
4. Injector bottom O-ring
5. Manifold O-ring

The fuel injector can be easily pulled out of the fuel rail.

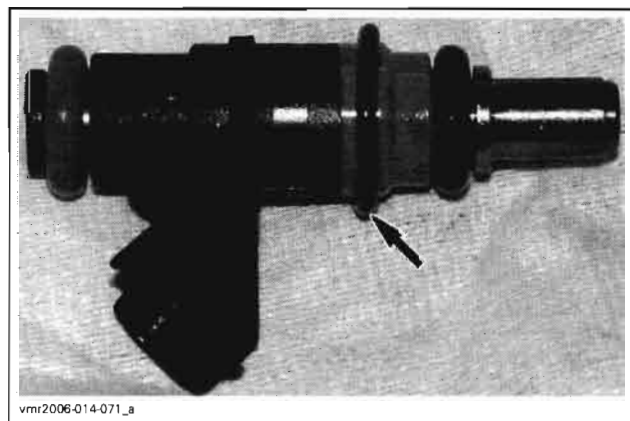
#### Installation

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

Apply a thin film of engine oil to O-rings to ease insertion in rail.

Install new O-rings, if you reinstall a used injector then insert the fuel injector in place with your hand. Do not use any tool.

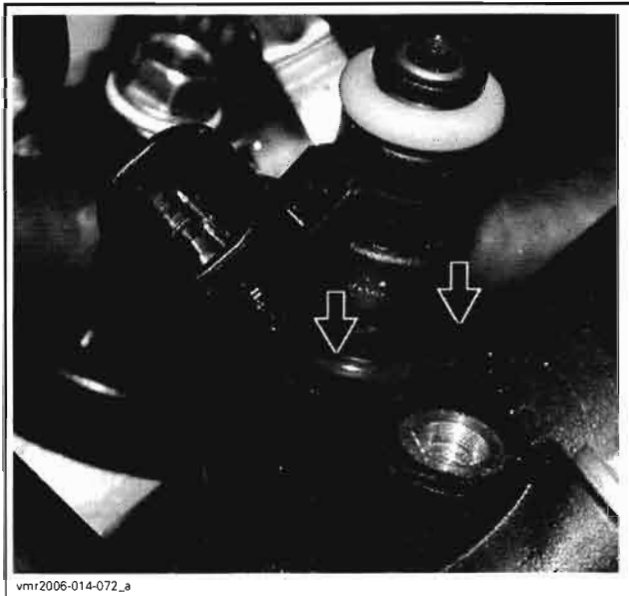
Position the manifold O-ring as shown on injector.



## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

Carefully insert injector in manifold paying attention to the manifold O-ring. Gently push in evenly all around while inserting injector. O-ring must be completely inserted and not visible, before finishing pushing injector.



Firmly push injector until it bottoms.  
Reinstall fuel rail. See above.

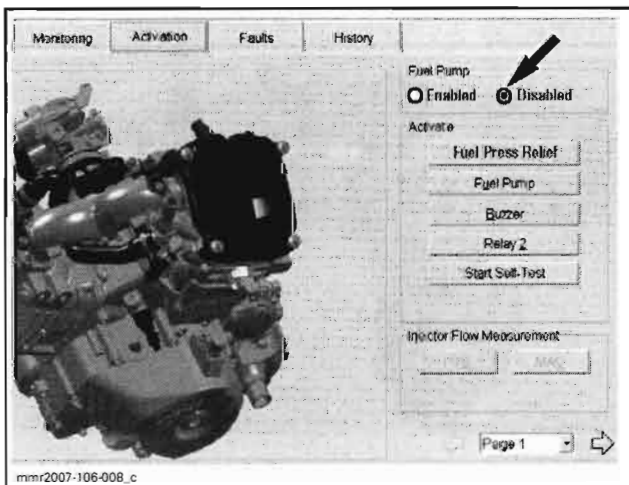
## FUEL RAIL

Pressure at fuel rails is supplied and controlled by the fuel pump module. Refer to *FUEL TANK AND FUEL PUMP* for pressure test.

### Fuel Rail Replacement

#### Removal

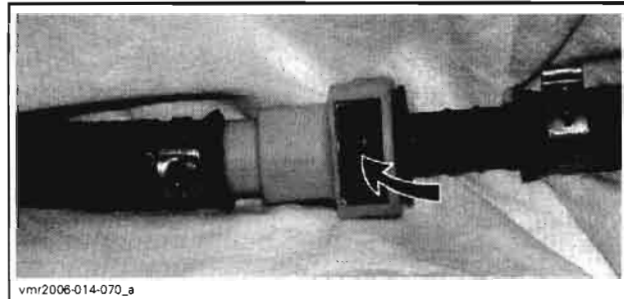
Disable fuel pump using B.U.D.S. Look in the **Activation** tab.



Release fuel pressure by running engine until it runs out of gas.

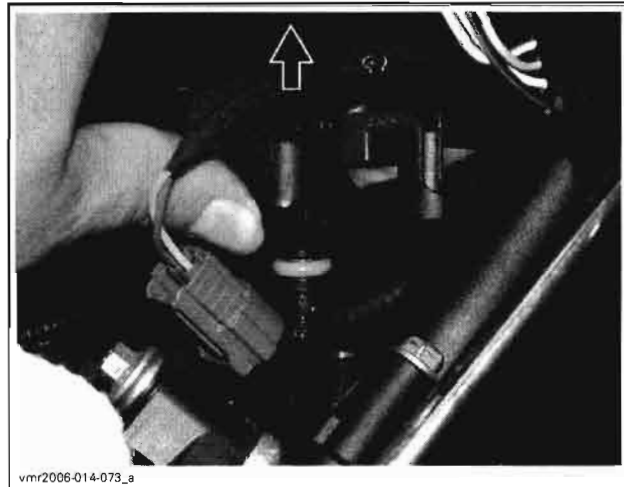
Turn ignition key off.

Wrap a rag around the inlet hose and release the quick fitting.



Unscrew rail retaining screws.

Gently pull rail up by hand.



To disconnect fuel rail, cut clamp on fuel hose using pliers (P/N 295 000 070). Refer to *FUEL TANK AND FUEL PUMP* for clamp removal/installation procedures.

**NOTE:** If fuel rail is removed purposely to access fuel injector, it is not necessary to cut hose clamp. Only to replace fuel rail.

#### Installation

For installation, reverse the removal process but pay attention to the following.

Install new clamps using pliers as per removal (if fuel rail was replaced).

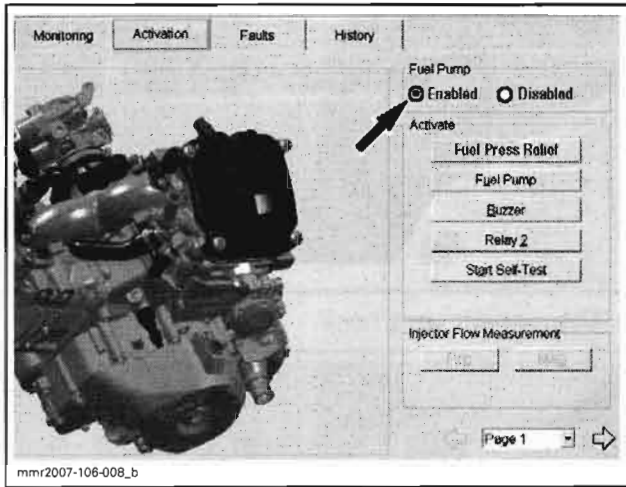
A thin film of injection oil should be applied to O-rings of fuel injector to ease installation of fuel rail.

Install new O-rings.

Install fuel rail and evenly tighten screws a little at a time each side.

Tightening torque of the rail retaining screws is 6 N•m (53 lbf•in).

After securing inlet hose at quick fitting, re-enable fuel pump using B.U.D.S.

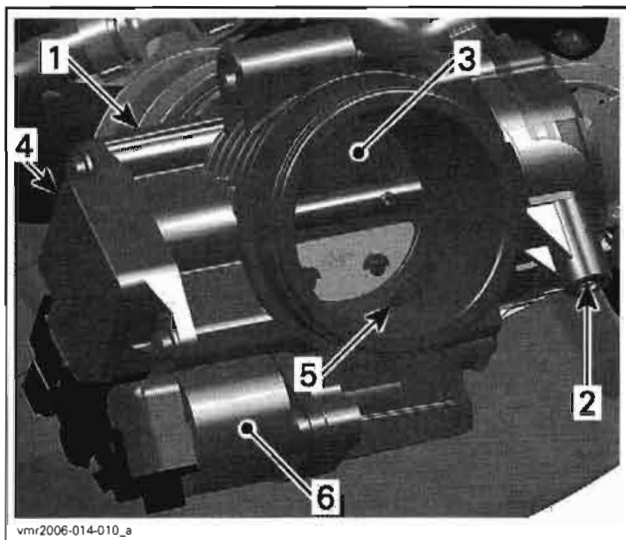


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**WARNING**

Perform a fuel pressure test and ensure that there is no leak. Refer to *FUEL TANK AND FUEL PUMP*. Run engine and check for leaks.

**THROTTLE BODY**



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1. Throttle body
2. Throttle cable attachment
3. Throttle plate
4. TPS
5. Idle bypass channel
6. Idle bypass valve

**Mechanical Inspection**

Check that the throttle plate moves freely and smoothly when depressing throttle lever.

**IMPORTANT:** Never attempt to adjust the sealed idle stop screw. It is calibrated at the factory. If the screw adjustment is changed, the throttle body must be replaced.



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Before replacing any part, check the following as these could be causing the fault. Perform the test while the engine is off.

- Throttle cable adjustment too tight. Not returning fully to idle stop.
- Throttle body idle set screw is loose or worn.
- TPS is loose.
- Idle bypass valve is loose.
- Corroded or damaged wiring or connectors.
- Throttle body has been replaced and the **Closed Throttle and Idle Actuator** reset has not been performed.
- ECM has been replaced and the **Closed Throttle and Idle Actuator** reset has not been performed.

**Electrical Inspection**

Refer to *THROTTLE POSITION SENSOR (TPS)* and *IDLE BYPASS VALVE* in this section.

**Throttle Body Replacement**

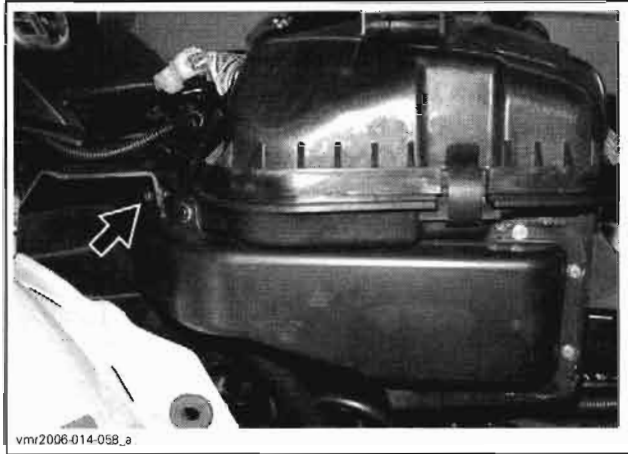
**Removal**

To remove the throttle body from engine, proceed as follows:

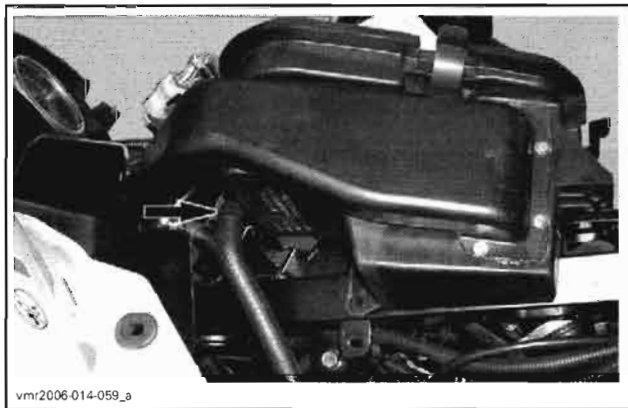
- Remove side panels, center panel and dashboard. Refer to *BODY*.
- Remove air box retaining fasteners.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)



- Disconnect vent hose.



- Detach throttle cable from shifter panel.

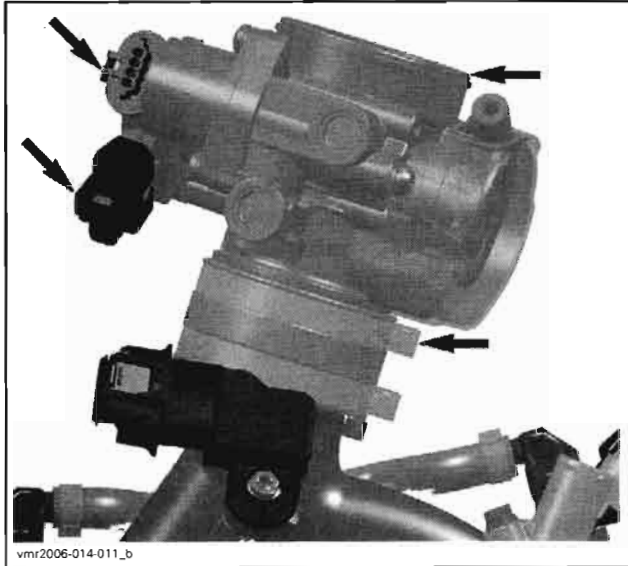


- Remove dart.

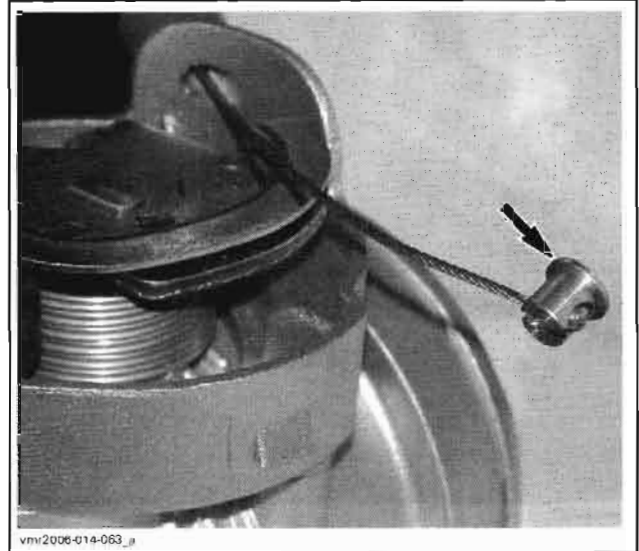


- Disconnect TPS and idle bypass valve connectors.
- Detach throttle body from intake manifold.

**Section 04 ENGINE MANAGEMENT (V490/V660/V810)**  
Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

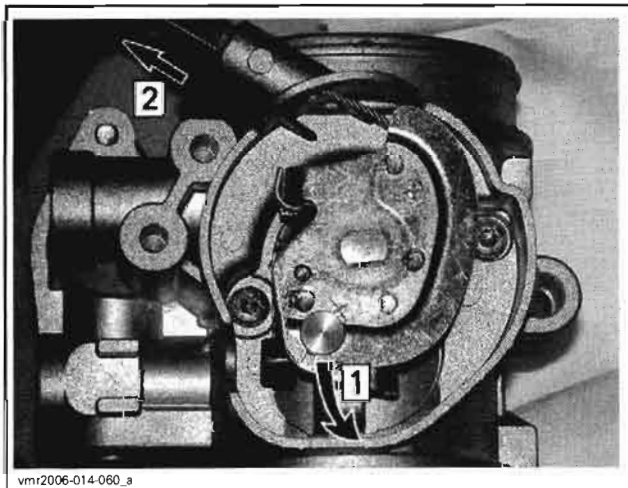


- Gently move throttle body away to detach throttle cable.
- Remove throttle body cover.
- Detach throttle cable.



Do not reinstall cover yet.

Install throttle body on intake manifold. Ensure to index throttle body tab with boot notch.



**Installation**

Installation of the new throttle body is the reverse of the removal procedure. Pay attention for the following details.

Properly install cable barrel to throttle cable end.



## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)



Clip throttle cable to shifter panel.



Gently pull throttle cable toward rear to have a gap between cable and shifter mechanism.



GAP HERE

#### **WARNING**

Ensure shifter mechanism does not touch throttle cable. Depress throttle lever several times to ensure it properly returns.

For TPS and idle bypass valve replacement procedures, refer to the respective paragraph in this section.

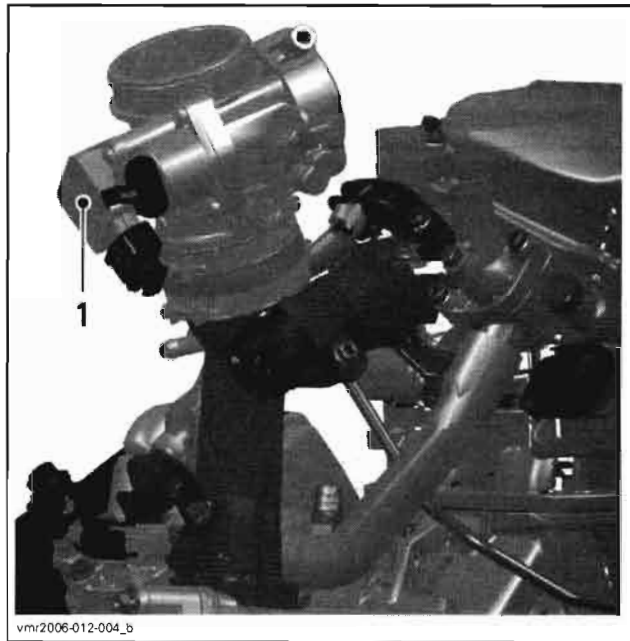
#### Adjustment

When the throttle body has been replaced, perform throttle cable adjustment and the **Closed Throttle and Idle Actuator** reset. Refer to *BASIC ADJUSTMENTS* in this section.

## THROTTLE POSITION SENSOR (TPS)

### General

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 position sensor (TPS)

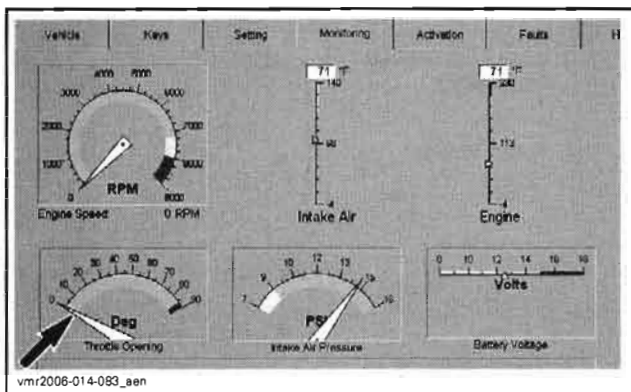
**IMPORTANT:** Prior to testing the TPS, ensure that mechanical components/adjustments of throttle body are adequate.

The EMS may generate several fault codes pertaining to the TPS. Refer to *EMS DIAGNOSTIC* section for more information.

### TPS Wear Test

While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.

Using the B.U.D.S. software, use the **Throttle Opening** display under **Monitoring**.

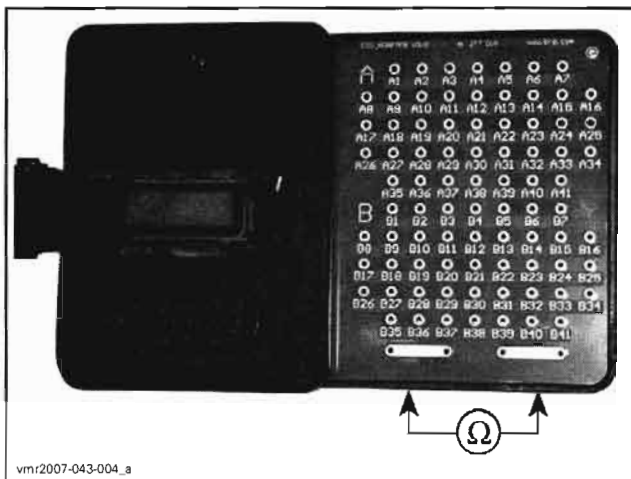


Slowly and regularly depress the throttle. Observe the needle movement. It must change gradually and regularly as you move the throttle. If the needle "sticks", bounces, suddenly drops or if any discrepancy between the throttle movement and the needle movement is noticed, it indicates that the TPS needs to be replaced or the computer used may be too slow to transfer data fast enough for real time display.

**TPS Resistance Test**

Ensure TPS is connected to wiring harness. Disconnect the connector "A" from the ECM. Using a multimeter, check resistance values on ECM connector as per the following table.

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



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

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

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

Reconnect ECM connector.

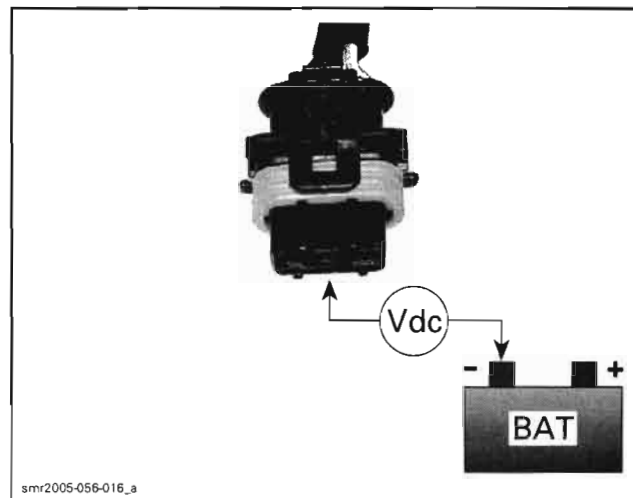
**TPS Input Voltage Test**

Disconnect connector from TPS.

Turn ignition key ON and set engine run/stop switch to RUN.

Check the voltage readings from harness connector as follows.

CONNECTION	VOLTAGE
Pin 1 with battery ground	5.0 V
Pin 2 with battery ground	0 V
Pin 3 with battery ground	4.75 - 5 V



If voltage test is not good, check/repair wiring harness. If wiring tests good, refer to *ECM REPLACEMENT*.

If voltage test is good, everything is in order (assuming resistance test was performed).

**TPS Replacement**

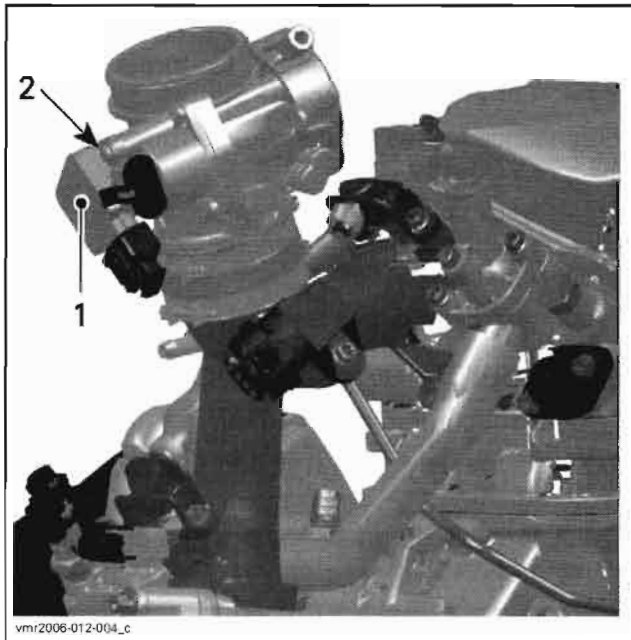
Remove center panel and dashboard. Refer to *BODY*.

Loosen two screws retaining the TPS.

Remove TPS.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)



#### THROTTLE BODY

1. Throttle position sensor (TPS)
2. Screws

Install the new TPS.

Apply Loctite 243 (P/N 293 800 060) on the TPS retaining screws, then torque to 3 N•m (27 lbf•in).

Reinstall remaining removed parts.

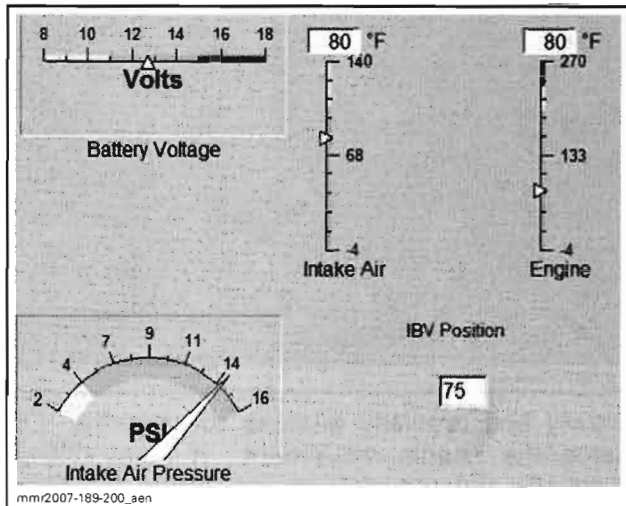
Proceed with the **Closed Throttle and Idle Actuator Reset**. See *BASIC ADJUSTMENTS* at the beginning of this section.

## IDLE BYPASS VALVE (IBV)

An idle bypass valve with good resistance measurement can still be faulty. It is also possible that a mechanical failure occurs which is not detectable without measuring the air flow. Replacing the idle bypass valve may be necessary as a test.

### IBV Information in B.U.D.S. Software

The IBV position (Idle Bypass Valve) is displayed for information purposes only.



This value implies no maintenance, it is NOT adjustable.

The IBV 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.

IBV STEPS IN B.U.D.S.	VALVE POSITION
0	Fully closed
Typical values: 25 - 50 <sup>(1)</sup>	Partially open
150	Fully open

<sup>(1)</sup> Typical IBV values at idle are given for a warm engine and vary depending on altitude, air temperature and production tolerances.

The ECM constantly controls the IBV to maintain its target idle speed when the throttle is closed.

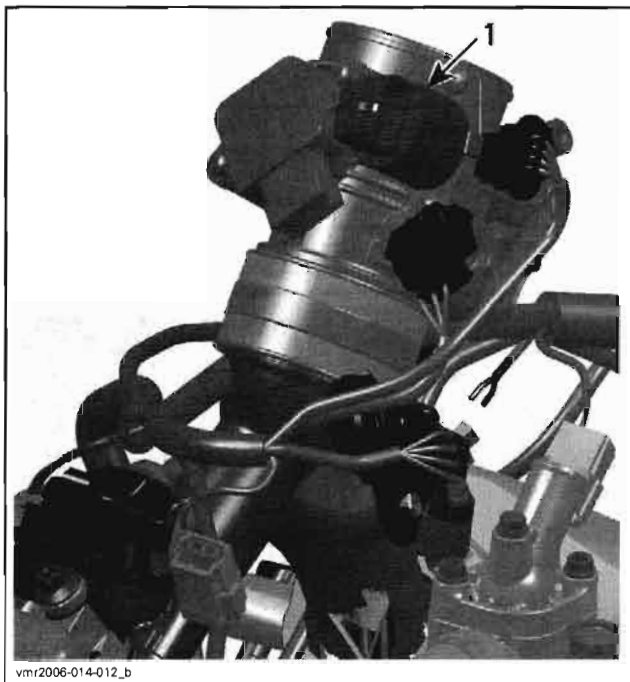
**NOTE:** An engine giving an IBV position outside of this range is not necessarily faulty. It may only give clues if poor idle or light throttle behavior is experienced. Lower values may indicate a leakage in the air intake system; higher values can suggest a dirty throttle body, obstructed idle by-pass valve passage etc.

### IBV Resistance Test

Disconnect idle bypass valve from the wiring harness.

Using a multimeter, check the resistance in both windings.



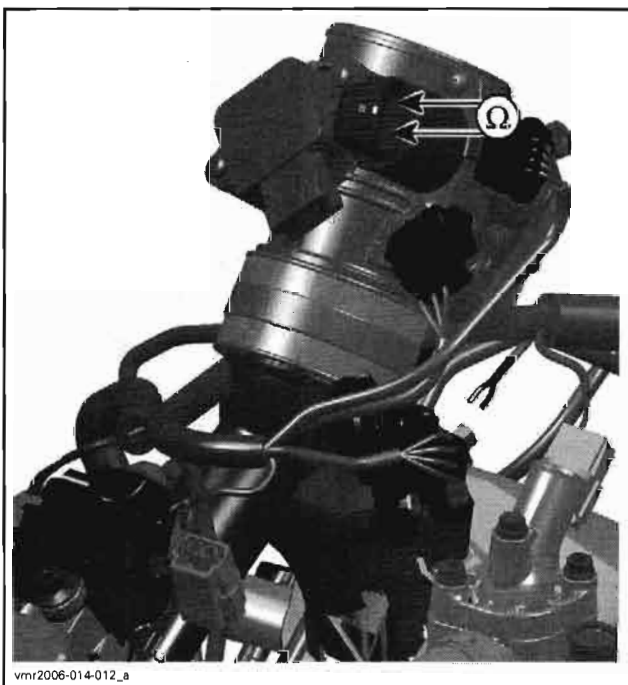


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1. Idle bypass valve

Check the resistance between pins as shown.

IDLE BYPASS VALVE		MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
1	4	50
2	3	



vmr2006-014-012\_a

If the resistance of one or both windings is not good, replace the idle bypass valve.

If resistance test of valve windings is good, check continuity of circuits A-35, A-36, A-37, A-38. If not good, check/repair wiring/connectors.

### IBV Visual Inspection

**NOTE:** Make sure the ignition key is turned off during the following procedure.

Remove idle bypass valve from throttle body.

Check the piston and bypass channel for dirt/ deposits which can cause a sticking piston.

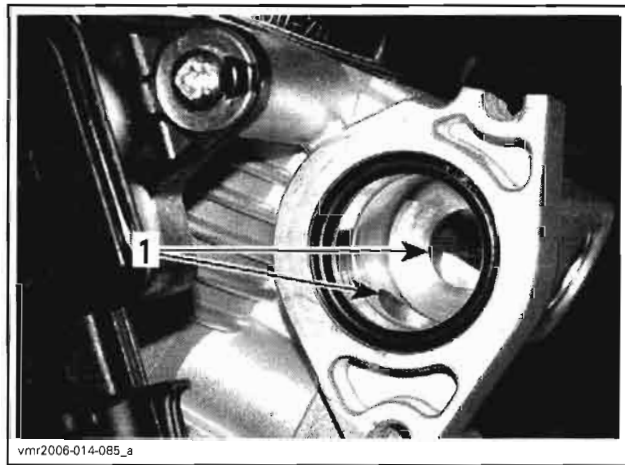
**CAUTION:** Always keep the ignition key turned OFF, while the idle bypass valve is removed.

**CAUTION:** Do not try to operate the piston of the idle bypass valve when it is dismounted. Also do not move the piston by hand. The drive screw is very sensitive and may be destroyed.

Using a part cleaner, clean idle bypass in throttle body from contamination then use an air gun to dry it.

### **WARNING**

Always wear eye protector. Chemicals can cause a rash break out and injure your eyes.



vmr2006-014-085\_a

1. Clean bore from contamination

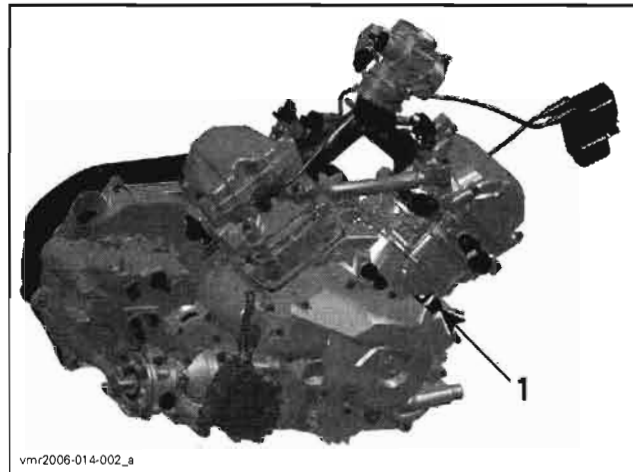
Clean all remaining parts and install the idle bypass valve on the throttle body.

Proceed with the **Closed Throttle and Idle Actuator Reset**. See procedure in *BASICS ADJUSTMENTS* at the beginning of this section.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

## CRANKSHAFT POSITION SENSOR (CPS)



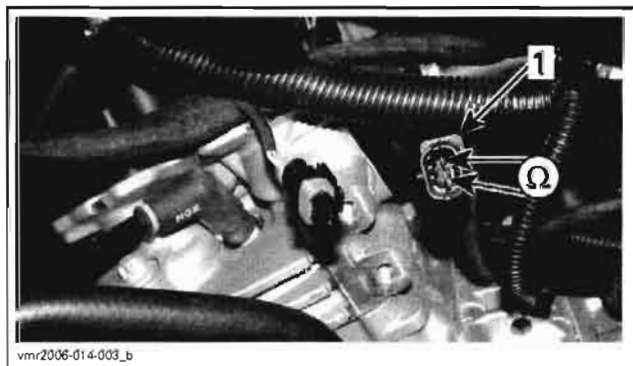
1. CPS connector

**NOTE:** Take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth. First check fault codes (refer to *EMS DIAGNOSTIC*) then check the teeth condition if necessary (refer to *MAGNETO SYSTEM*).

### CPS Resistance Test

Disconnect CPS wiring harness connector. Probe terminals as shown.

CPS CONNECTOR		MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
1	2	700 - 900 $\Omega$



LH SIDE OF VEHICLE

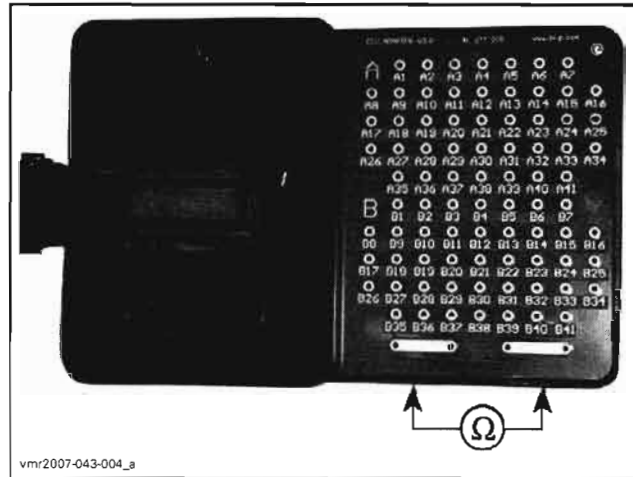
1. CPS connector

If resistance is not within specifications, replace the CPS.

If resistance tests good, reconnect the CPS connector and disconnect the connector "A" on the ECM.

Using a multimeter, recheck resistance as per table.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
A-5	A-19	700 - 900 $\Omega$

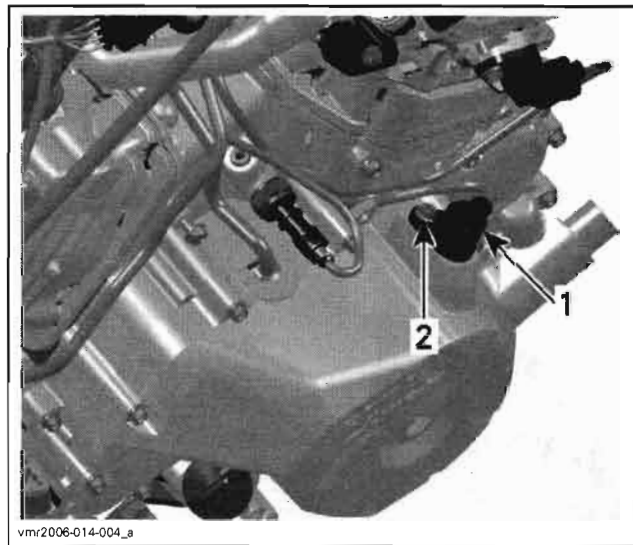


If resistance value is correct, refer to *ECM REPLACEMENT*.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CPS.

### CPS Replacement

Unplug connector and remove CPS.

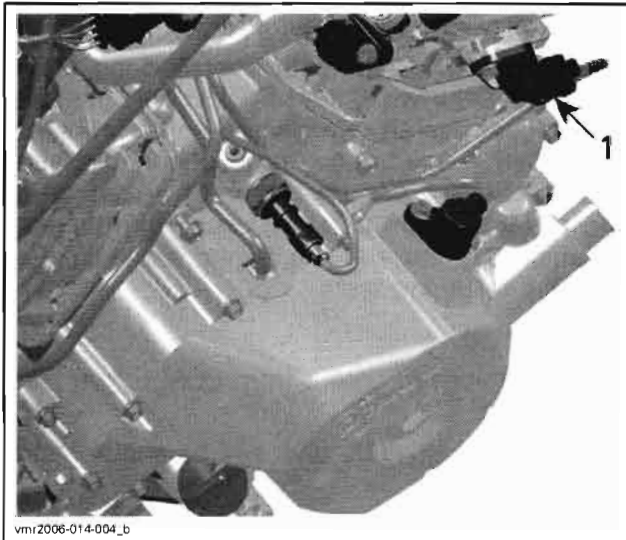


1. CPS  
2. Retaining screw

Install new CPS and secure harness with a locking tie.

Tightening torque of the CPS retaining screws is 10 N•m (89 lbf•in).

### CAMSHAFT POSITION SENSOR (CAPS)



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1. CAPS

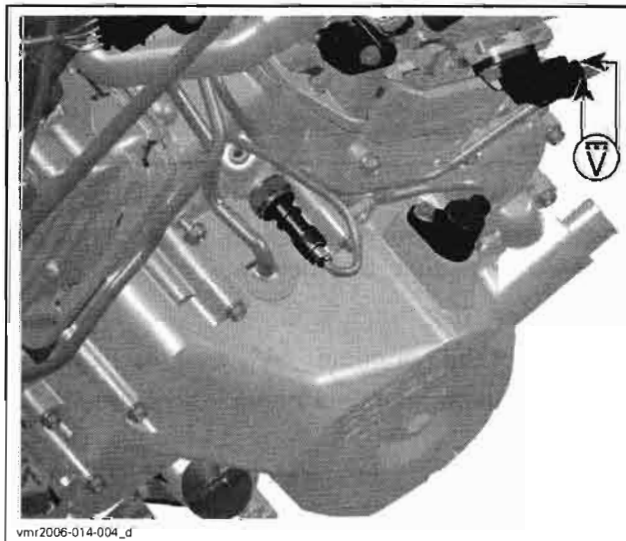
#### CAPS Voltage Test

Turn ignition key ON and set engine run/stop switch to RUN.

Use a multimeter and set it to Vdc.

Back-probe connector and read voltage as follows.

CAPS CONNECTOR		VOLTAGE
ORANGE/GREEN	BLACK/GREEN	Battery voltage



vmr2006-014-004\_d

If voltage is not good, check/repair wiring/connectors.

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If voltage is good, do the following test. Remove CAPS sensor from engine. Ensure connector is plugged. Use a multimeter and set it to Vdc. Back-probe connector and read voltage as follows.

CAPS CONDITION	CAPS CONNECTOR		VOLTAGE
Free	ORANGE/ GREEN	YELLOW/ GREEN	Close to 0 Vdc



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CAPS CONDITION	CAPS CONNECTOR		VOLTAGE
Metallic object on sensor	ORANGE/ GREEN	YELLOW/ GREEN	Battery voltage



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## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

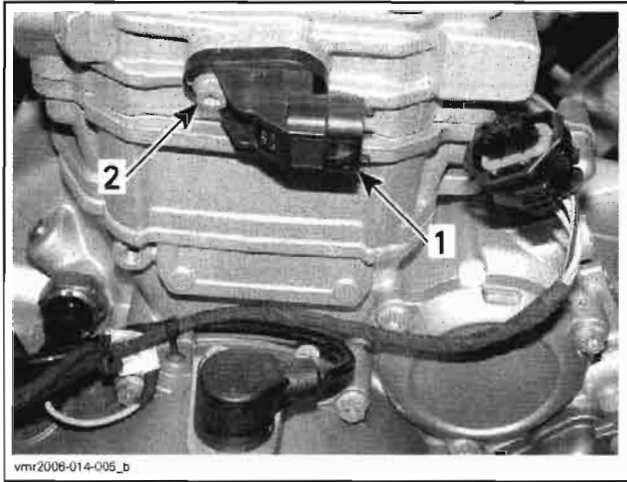
### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

If voltage is appropriate, check/repair wiring/connector between sensor and ECM. If it is good, refer to *ECM REPLACEMENT*.

If voltage is wrong, try a new CAPS.

#### CAPS Replacement

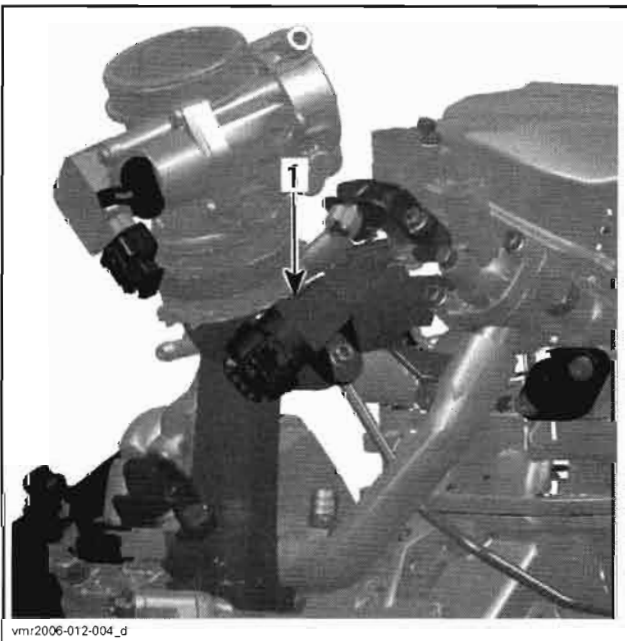
Unscrew the retaining screw and replace the CAPS. Ensure to reinstall O-ring.



1. CAPS
2. Retaining screw

Apply Loctite 243 (P/N 293 800 060) on thread and torque to 10 N•m (89 lbf•in).

#### MANIFOLD AIR PRESSURE AND TEMPERATURE SENSOR (MAPTS)



1. Manifold air pressure and temperature sensor (MAPTS)

**NOTE:** This sensor is a multifunction device.

#### Sensor Pressure Function

When engine is started and it runs at idle speed, the sensor takes the atmospheric pressure and stores it in the ECM. Thereafter, it takes the manifold air pressure at operating RPMs.

Ensure sensor is correctly installed on intake manifold. Otherwise, the MAPTS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. Remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

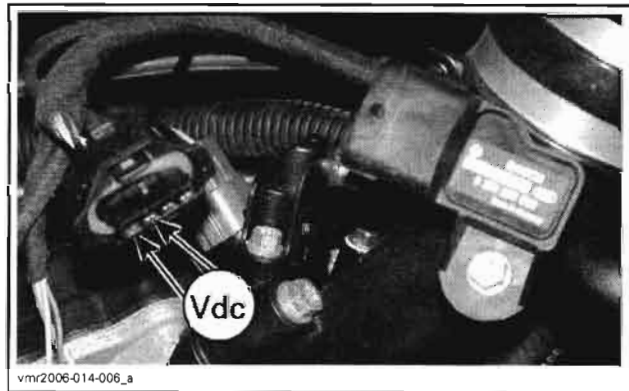
#### Voltage Test

Check the voltage output from ECM to the pressure sensor.

Turn ignition key ON and set engine run/stop switch to RUN.

Disconnect plug connector from MAPTS and connect a voltmeter as shown.

MAPTS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
1	3	5 Vdc



If voltage test is good, replace the MAPTS.

If voltage test is not good, check the continuity of the MAPTS circuit. See below.

#### Resistance Test

Disconnect the connector "A" from the ECM.

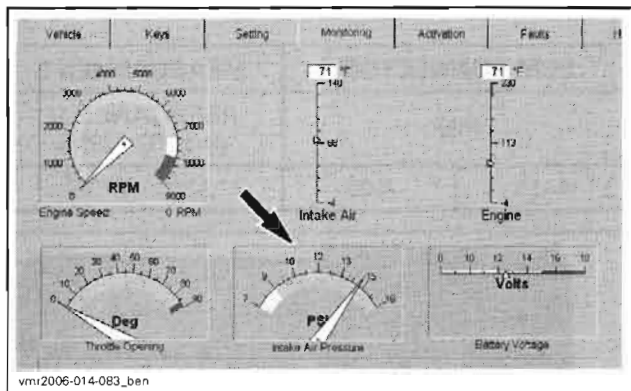
Using a multimeter, check continuity of circuits 12, 28 and 40.

If wiring harness is good, refer to *ECM REPLACEMENT*.

Otherwise, repair the connectors or replace the wiring harness between ECM connector and the MAPTS.

### Quick Test

Using B.U.D.S. software, look the MAPTS from the **Monitoring** section and read out the pressure value while engine is stopped.



Perform the same test with a new MAPTS and compare both readings.

Values have to be within  $\pm 3.4$  kPa (0.5 PSI).

If old MAPTS's value is out of this range, replace it.

### Sensor Temperature Function

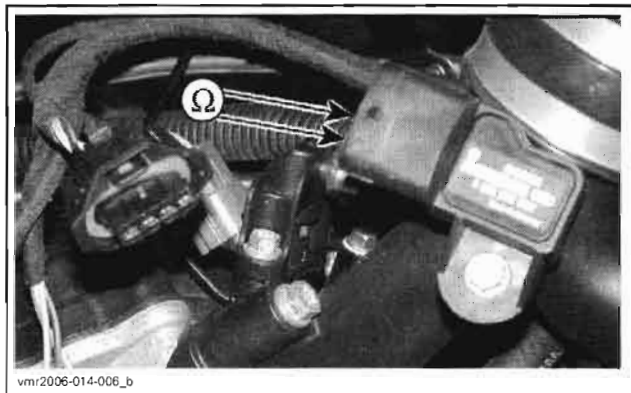
The sensor also monitors the temperature at manifold.

### Resistance Test

Disconnect the connector from the MAPTS.

Using a multimeter, check the resistance of the sensor itself as shown.

MAPTS		MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
1	2	2280 - 2740

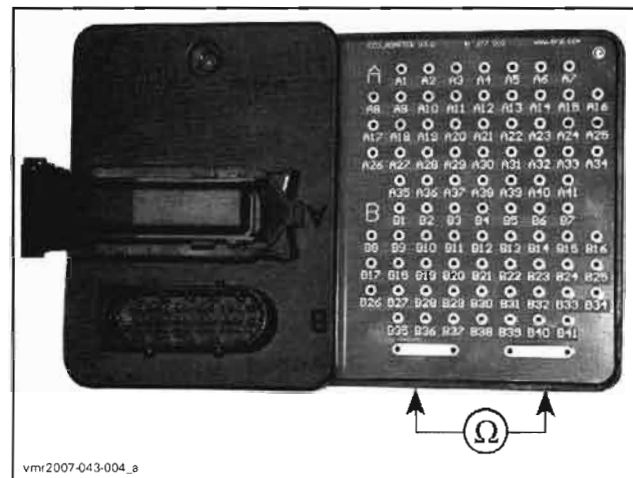


If resistance is not within specification, replace the MAPTS.

If resistance tests good, reconnect the MAPTS and disconnect the connector "A" from the ECM.

Using a multimeter, recheck resistance value between pins as shown.

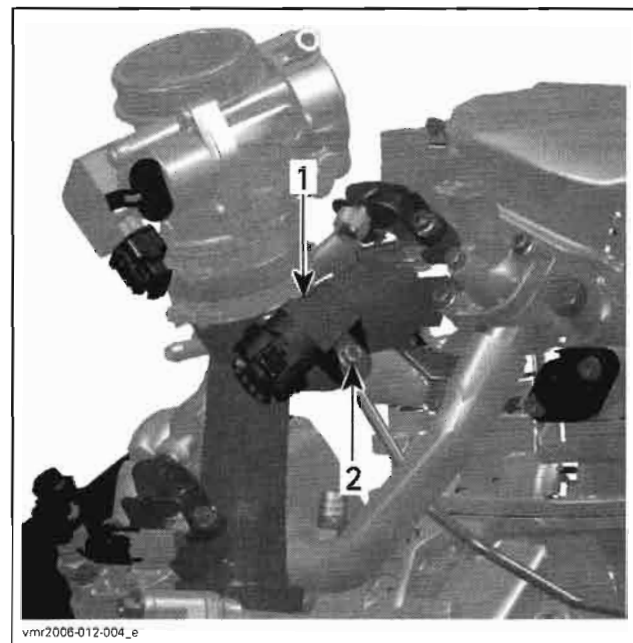
ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
A-7	A-28	2280 - 2740



If resistance value is correct, refer to *ECM REPLACEMENT*.

If resistance value is incorrect, inspect/repair/replace wiring harness between ECM connector and the MAPTS.

### MAPTS Replacement



1. MAPTS
2. Retaining screw

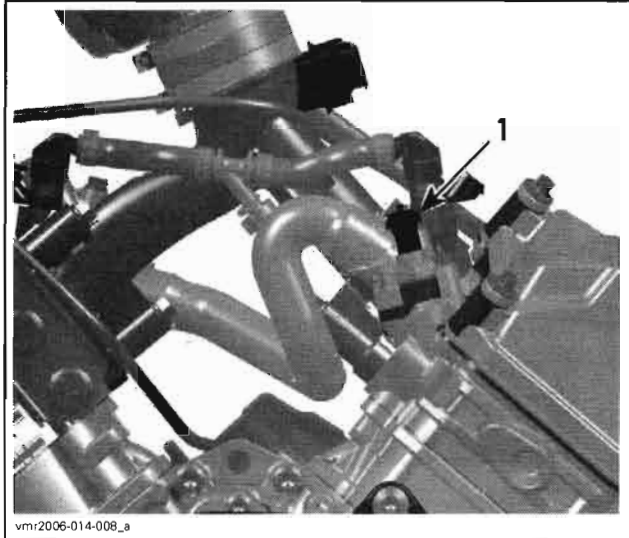
Disconnect MAPTS connector and remove the MAPTS.

## Section 04 ENGINE MANAGEMENT (V490/V660/V810)

### Subsection 03 (ADJUSTMENT AND REPAIR PROCEDURES)

Apply Loctite 243 (P/N 293 800 060) on screw then torque to 6 N•m (53 lbf•in).

## COOLANT TEMPERATURE SENSOR (CTS)

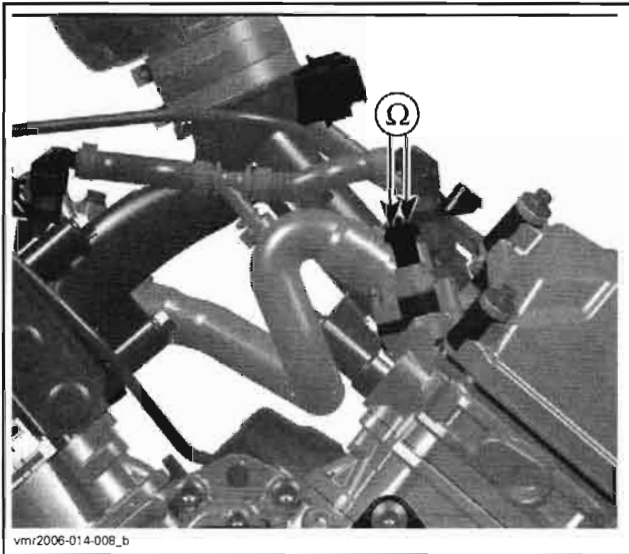


1. Coolant temperature sensor (CTS)

### CTS Resistance Test

Disconnect the plug connector from the CTS and check the resistance of the sensor itself.

CTS SENSOR		MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
1	2	2280 - 2740

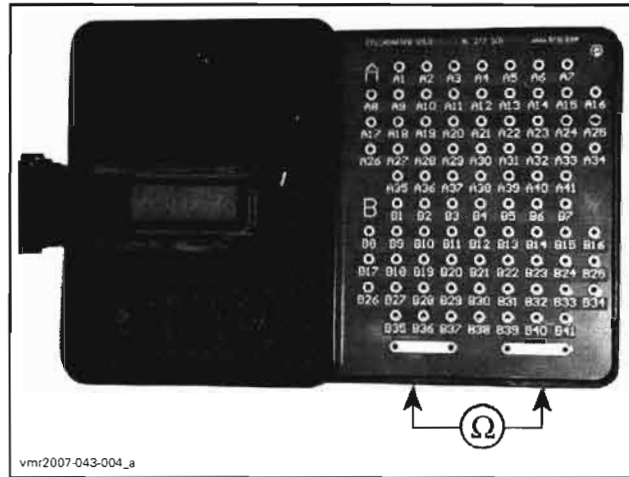


If resistance is out of specification, replace the CTS.

If resistance tests good, reconnect the CTS and disconnect the ECM connector "A" from the ECM.

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

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



If resistance value is correct, refer to *ECM REPLACEMENT*.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CTS.

### CTS Replacement

Disconnect CTS connector and remove CTS.

Install the new CTS and torque to 16 N•m (142 lbf•in).

Reinstall remaining removed parts.

Refill and bleed the cooling system, refer to *COOLING SYSTEM* subsection.

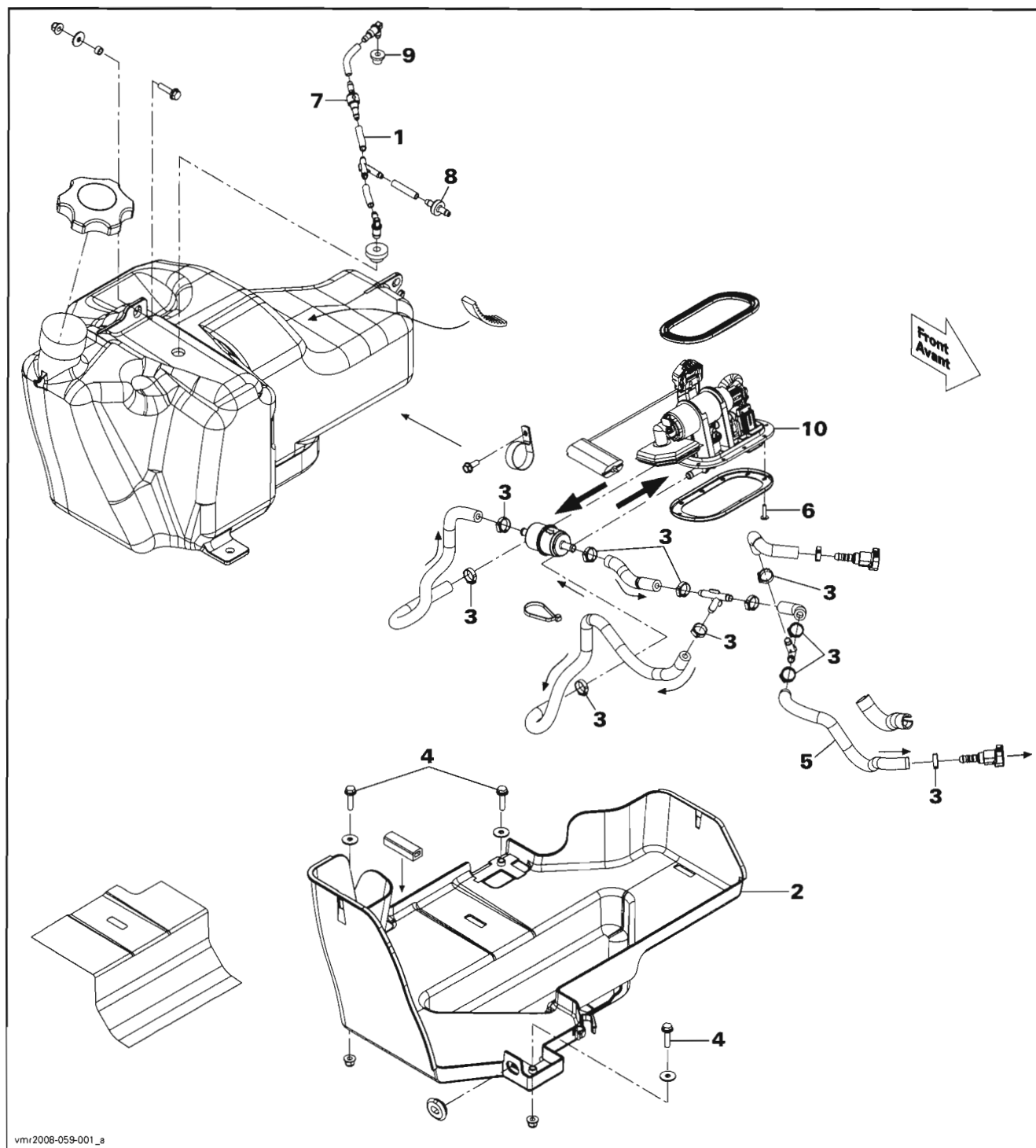
# FUEL TANK AND FUEL PUMP

## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
pliers .....	295 000 070 .....	225
small hose pincher.....	295 000 076 .....	221
vacuum/pressure pump.....	529 021 800 .....	222
pressure gauge.....	529 035 709 .....	224
T-fitting .....	529 036 023 .....	224

# Section 05 FUEL SYSTEM

## Subsection 01 (FUEL TANK AND FUEL PUMP)



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## GENERAL

### WARNING

Fuel is flammable and explosive under certain conditions. Ensure work area is well ventilated. Do not smoke or allow open flames or sparks in the vicinity.

### WARNING

Always disconnect battery prior to working on the fuel system. Always disconnect battery exactly in the specified order, BLACK (-) cable first. It is recommended to disconnect electrical connections prior to disconnecting fuel lines.

Whenever working on fuel system, always verify for water or dust infiltration in reservoir.

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, self-locking fasteners, cotter pin, etc.) must be replaced with new ones.

### WARNING

The fuel system of a fuel injection system holds much more pressure than on a carbureted ATV. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here.

- Use the B.U.D.S. software to release the fuel pressure in the system. Look in the Activation section.

### WARNING

Fuel lines remain under pressure at all times. Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses. Proceed with care when removing/installing pressure test equipment or disconnecting fuel line connections. Use the B.U.D.S. software to release fuel pressure prior to removing a hose. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to minimize spilling. Wipe off any fuel spillage in the engine compartment. Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Never use a hose pincher on injection system high pressure hoses. Replace any damaged or deteriorated fuel lines.

When the repair is completed, ensure that all hoses are connected and secured. Perform the *FUEL PRESSURE TEST* and the *FUEL TANK LEAK TEST* as explained in this section.

### WARNING

Always perform the fuel pressure test if any component has been removed. A pressure test must be done before turning the ignition key to ON and setting the engine run/stop switch to RUN. The fuel pump is activated each time in these conditions. After performing a fuel pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

To locate a leak, pressurize the system. Check for leaking fuel or fuel odor. Spray soapy water on all hose connections and injectors. Air bubbles will show the leaking area.

## INSPECTION

### FUEL TANK LEAK TEST

### WARNING

Ensure to also perform the fuel pressure test.

Fill up fuel tank.

Remove the RH side panel. Refer to *BODY*.

Install a small hose pincher (P/N 295 000 076) on vent line (OUTLET side) no. 1.

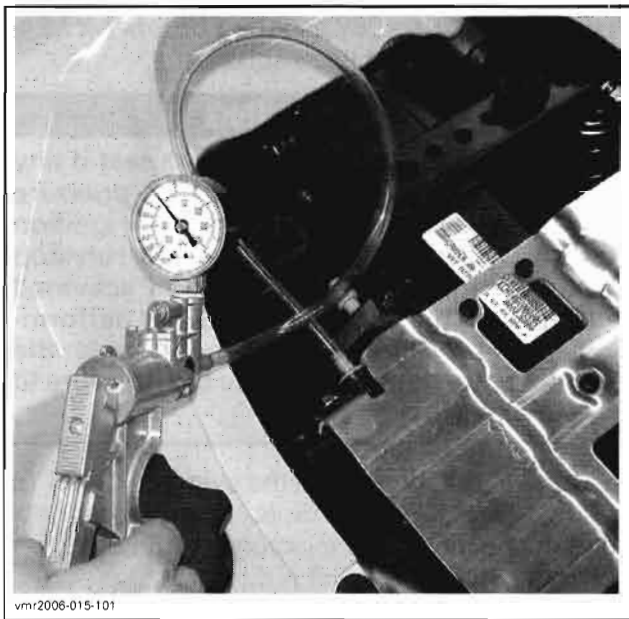
## Section 05 FUEL SYSTEM

### Subsection 01 (FUEL TANK AND FUEL PUMP)



*PINCHER ON OUTLET SIDE*

Using the vacuum/pressure pump (P/N 529 021 800), pressurize fuel tank through vent line (INLET side).



*PUMP ON INLET SIDE*

Pressurize fuel tank as follows.

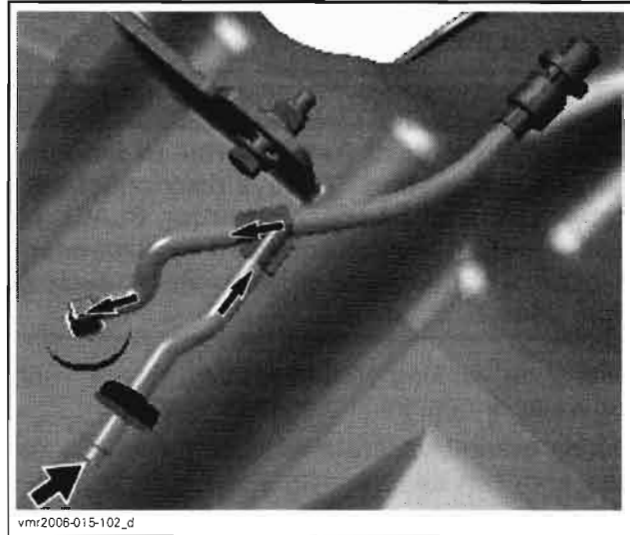
PRESSURE	TIME WITHOUT PRESSURE DROP
21 kPa (3 PSI)	3 minutes

If pressure drops, locate fuel leak(s) and repair/replace leaking component(s).

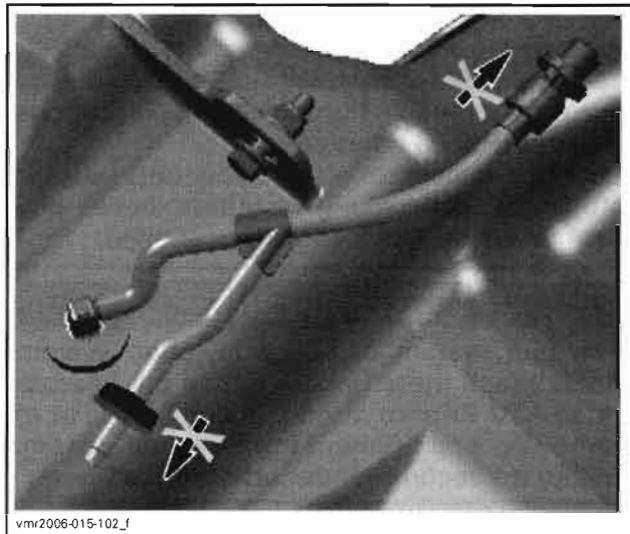
To ease locating leak(s), spray soapy water on components; bubbles will indicate leak location(s).

### Check Valve and Pressure Relief Valve Operation

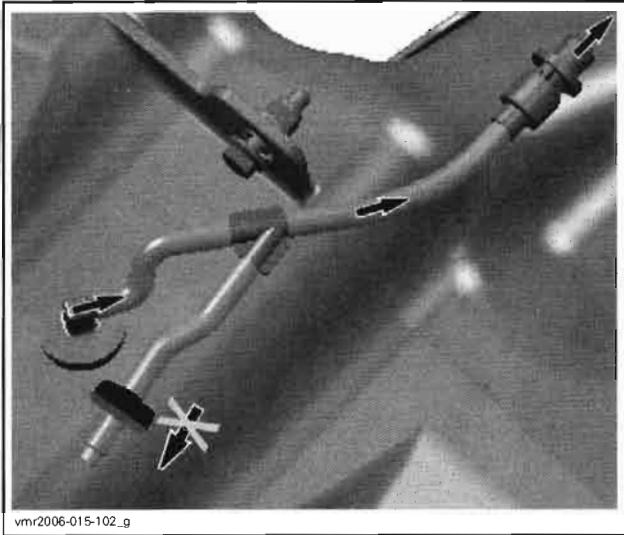
Air can enter fuel tank at all times through INLET side (check valve).



The check valve prevents fuel to flow out. Air cannot go out through pressure relief valve.



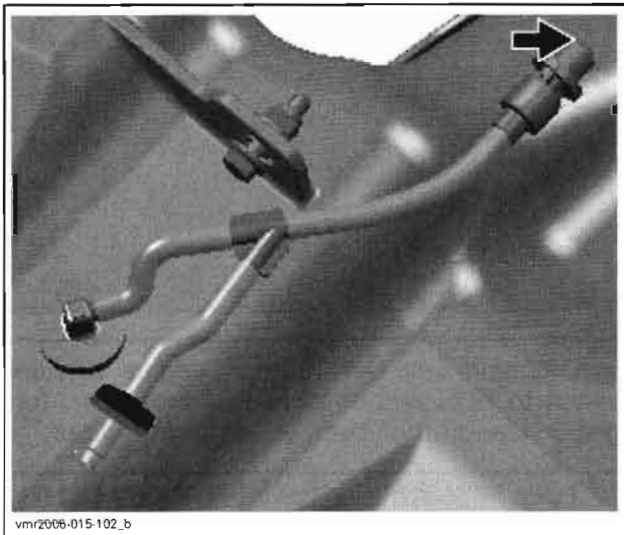
If pressure in fuel tank builds up and exceeds 2.5 - 7.6 kPa (.36 - 1.1 PSI), **pressure relief valve** opens and let excess pressure evacuate through OUT-LET side.



**Test**

While tank is still pressurized from the above test, do the following:

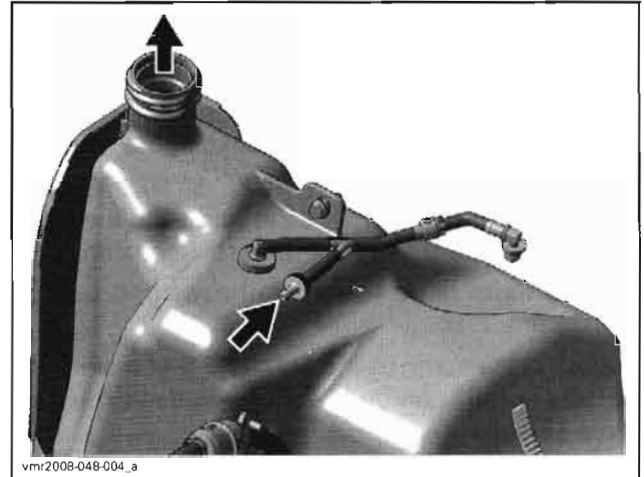
When removing hose pincher, alternately touch and release end of pressure relief valve **no. 7**. You should feel pressurized air flowing out indicating relief valve is working.



Ensure grommet **no. 9** is not plugged.

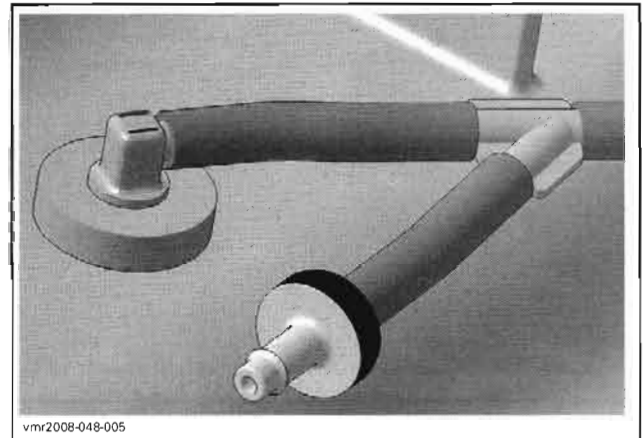
Remove fuel tank cap.

Blow air from outlet nipple. Air must freely flows towards fuel tank neck.

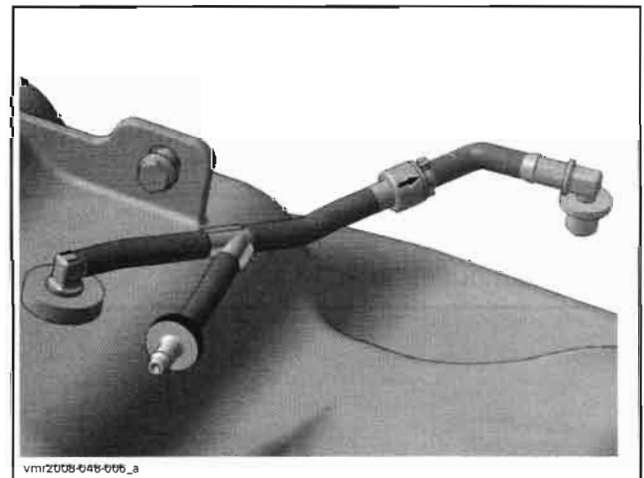


**Installation**

Always reinstall check valve with the black side as shown.



Always reinstall pressure relief valve according to arrow on valve as shown.



## Section 05 FUEL SYSTEM

### Subsection 01 (FUEL TANK AND FUEL PUMP)

## FUEL PRESSURE TEST

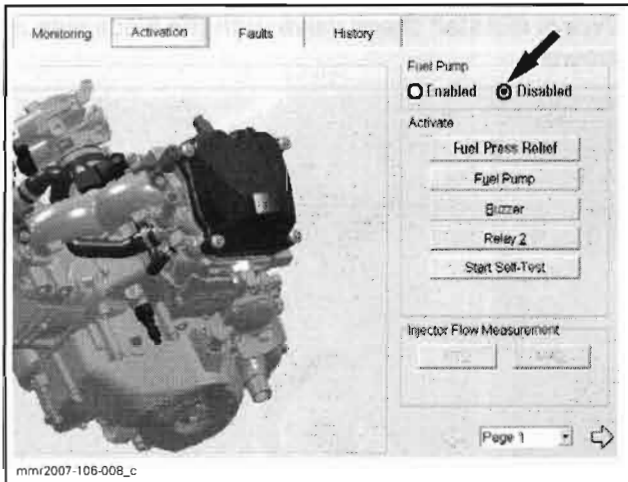
The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator, the fuel pump and leaks in the system.

**NOTE:** Refer also to the *FUEL SYSTEM DIAGNOSTIC FLOW CHART* at the end of this section to help diagnose a fuel system related problem.

Ensure there is no leak from hoses and fittings. Repair any leak.

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

Disable fuel pump using B.U.D.S. Look in the Activation tab and select Disabled.

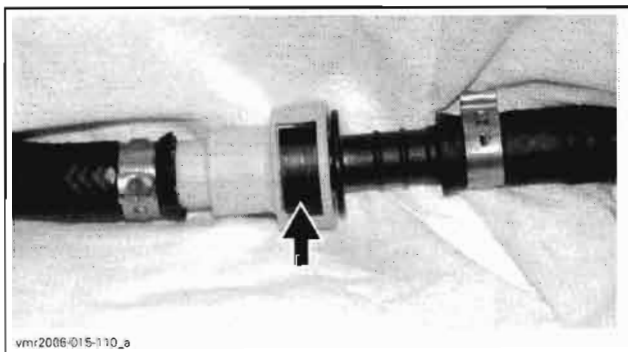


Release fuel pressure by running engine until it runs out of gas.

### **WARNING**

The fuel hose may be under pressure. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the pressure. Wipe off any fuel spillage inside engine compartment.

Ensure there is enough gas in fuel tank. Disconnect outlet hose.

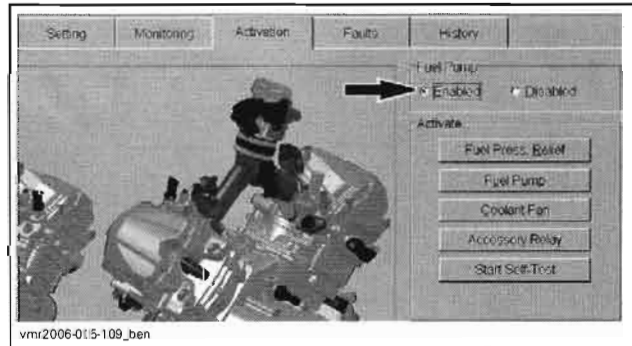


Install fuel pressure gauge (P/N 529 035 709) and T-fitting (P/N 529 036 023) between disconnected hoses (in-line installation).



1. T-fitting — In-line installation
2. Fuel pressure gauge connection

Using B.U.D.S., reactivate fuel pump by selecting Enabled.



Turn ignition key ON and set engine run/stop switch to RUN and observe fuel pressure. Turn ignition key off then back on. Repeat the test.

FUEL PRESSURE

350 kPa (51 PSI)

A rapid pressure drop indicates leakage either from the fuel rail or from the fuel pump check valve. Check fuel rail for leaks. If it is not leaking then replace fuel pump.

A slow pressure drop indicates leakage either from the fuel injector or from the fuel pressure regulator. Check fuel injector for leaks. If it is not leaking then replace fuel pump.

If there is no leakage, **start engine** and observe fuel pressure. The fuel pressure should be the same as above.

If pressure is within limits, fuel pump and pressure regulator are working adequately.

Release fuel pressure in the system using B.U.D.S. Look in the **Activation** tab.

Remove pressure gauge from inlet hose. Reconnect inlet hose.

**⚠ WARNING**

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

Reinstall removed parts.

## PROCEDURES

### FUEL HOSE AND OETIKER CLAMPS

#### Fuel Hose Replacement

When replacing fuel hoses, be sure to use hoses and clamps as available from BRP parts department. This will ensure continued proper and safe operation.

**⚠ WARNING**

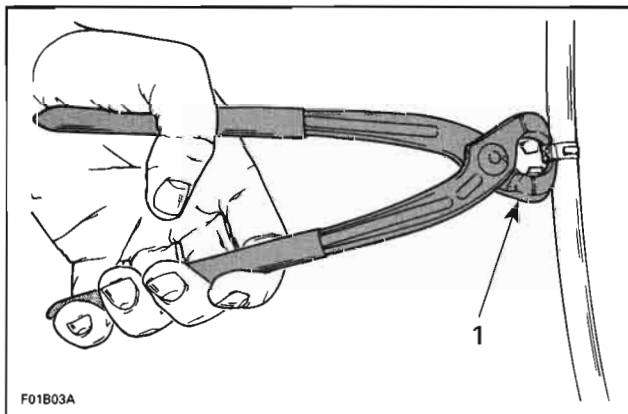
Use of improper fuel lines could compromise fuel system integrity.

**⚠ WARNING**

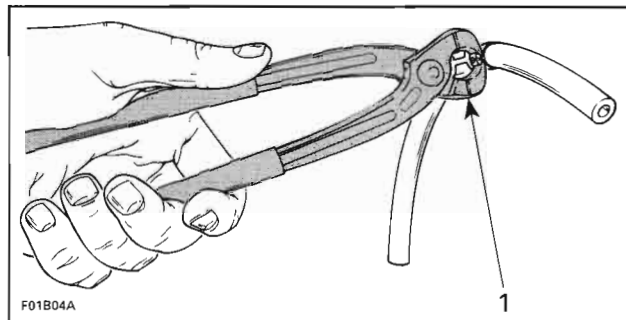
Whenever removing a hose in the fuel system, always use new Oetiker clamps at assembly. Then, validate fuel tightness by performing a fuel pressure test.

#### Oetiker Clamp Replacement

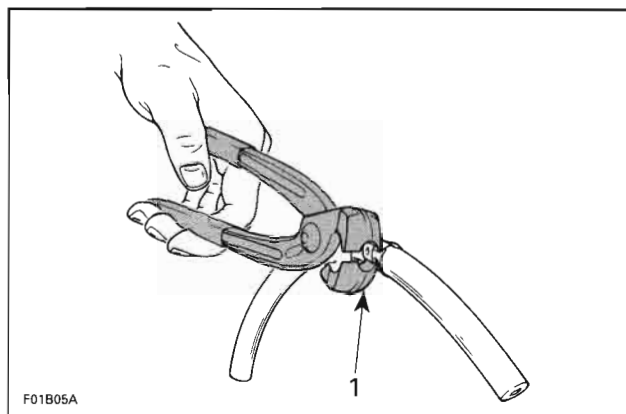
To secure or cut Oetiker clamps no. 3 on fuel lines, use pliers (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



1. Securing clamp in limited access

### IN-LINE FUEL FILTER

Replace fuel filter as per maintenance chart schedule. Refer to *MAINTENANCE*.

#### Filter Removal

Detach filter from body.



Remove Oetiker clamps and pull hoses off.

#### Filter Inspection

If fuel filter is suspected to be clogged, it may be checked as follows.

## Section 05 FUEL SYSTEM

### Subsection 01 (FUEL TANK AND FUEL PUMP)

Using low compressed air, check if fuel filter is clogged. Air should flow easily through filter. In doubt, install a new filter.

#### Filter Installation

Use arrow on filter to position it according to fuel flow.



TYPICAL

## FUEL TANK

### Fuel Tank Draining

#### WARNING

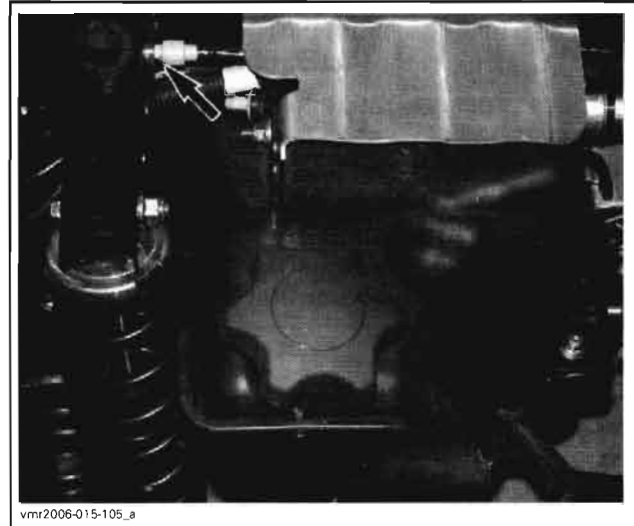
Never perform this operation when the engine and/or the exhaust system is/are hot. Never use a hose pincher on injection system high pressure hoses.

Remove fuel tank cap and siphon gas in an approved fuel container.

### Fuel Tank Removal

Remove side panels (refer to *BODY*).

Disconnect vent line (OUTLET side) from body.



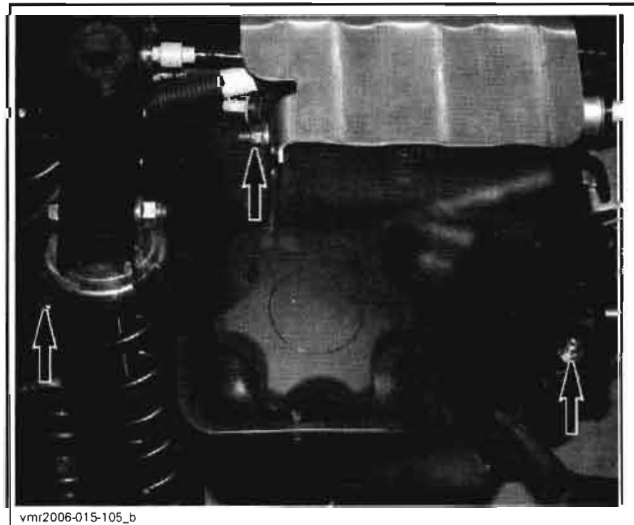
FENDER REMOVED FOR CLARITY

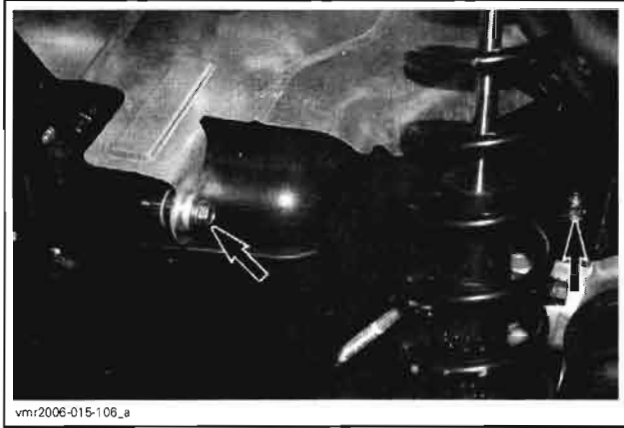
Disconnect fuel line no. 5 at quick connect. See *FUEL PUMP* below.

Detach in-line fuel filter from body.

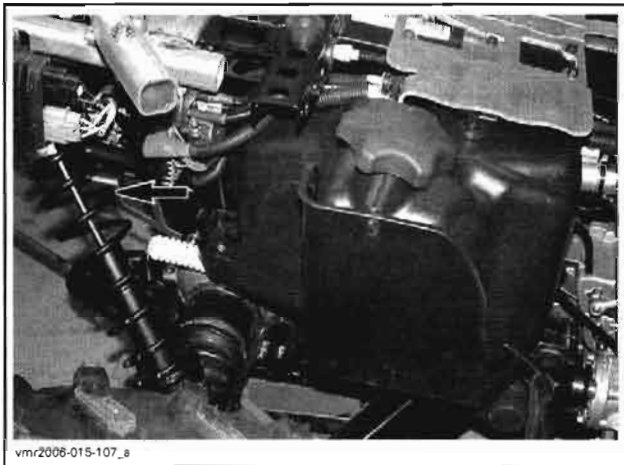


Remove retaining screws no. 4.





Lift frame just enough to extend RH rear shock absorber. Remove upper screw and move shock absorber away.



*FENDER REMOVED FOR CLARITY*

Bend fender then pull out the fuel tank through the RH side of vehicle. Pull enough to reach fuel pump connector and unplug it.



### Fuel Tank Protector

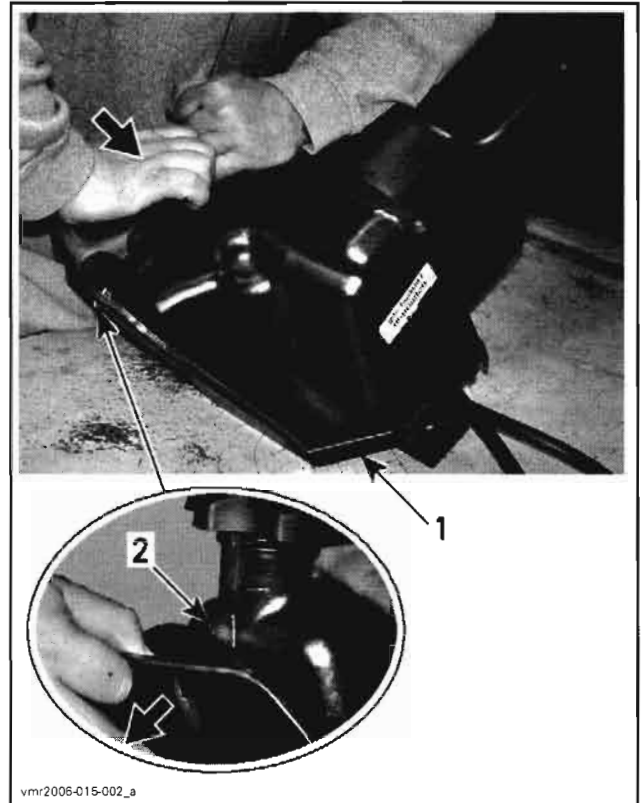
To release protector no. 2 from tank:

**NOTE:** This procedure should be done with parts at room temperature.

- Work on a stable table.

vmr2008-059

- Lay down front of fuel tank on table.
- Firmly push on top of fuel tank and hold.
- Pull out protector from tank tab.



1. Tank protector
2. Tank tab

- Completely remove protector.

### Fuel Tank Inspection

Inspect fuel tank for any damage or cracks which may result in fuel leaks. If so, replace tank with a new one. Inspect tank and protector attachment points for damage. Inspect protector for damage.

### Fuel Tank Installation

**NOTE:** Removing top plate from frame to ease routing hoses and wiring.

Secure tank into protector. Reverse removal procedure.

Reconnect fuel pump connector.

Insert the fuel tank into the frame.

Reconnect hoses.

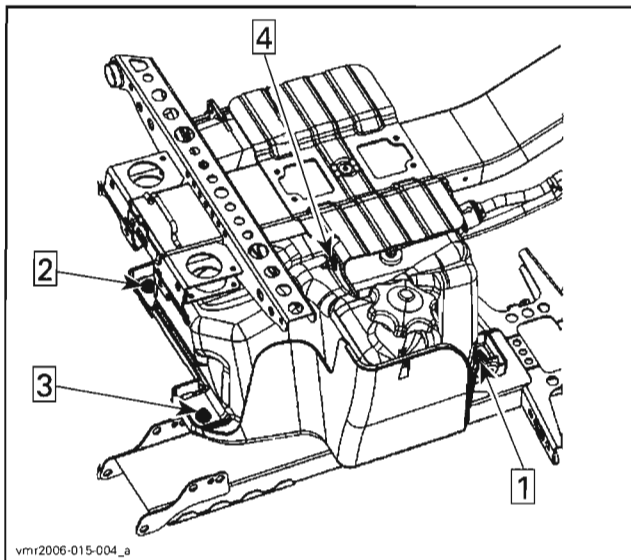
Tighten retaining screws as per following sequence.

**⚠ WARNING**

Ensure wiring is on the top of fuel tank.

## Section 05 FUEL SYSTEM

### Subsection 01 (FUEL TANK AND FUEL PUMP)



Install gearbox vent tube in its hook on fuel tank protector.

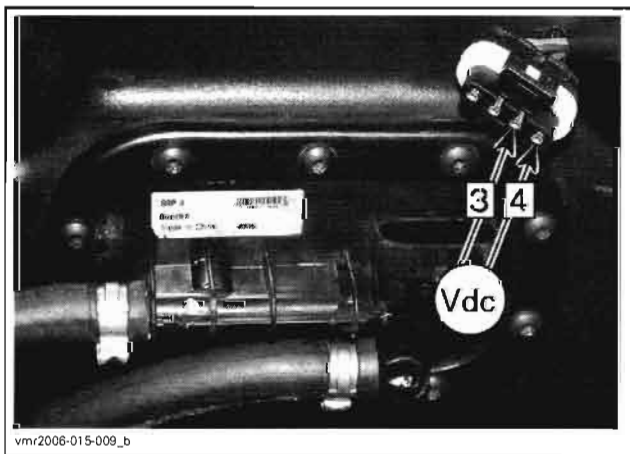
Refuel tank and ensure there are no leaks by performing the *FUEL TANK LEAK TEST* and the *FUEL PRESSURE TEST* as described in this section.

## FUEL PUMP

### Fuel Pump Circuit Test

Turn ignition key ON and set engine run/stop switch to RUN.

Read voltage as follows.

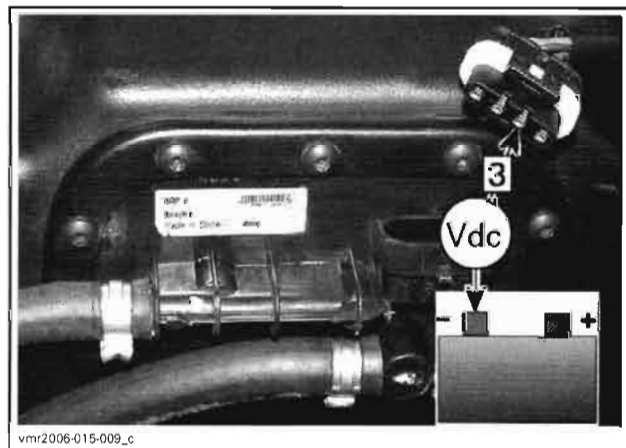


OBSERVATION	SIGNIFICATION
Battery voltage is read for approx 2 seconds then, it will drop to approx. 11 Vdc	<ul style="list-style-type: none"> <li>- It validates relay R2 supplies power to fuel pump.</li> <li>- It validates the ground circuit through ECM.</li> <li>- When voltage drops to approx 11 Vdc, it validates the ECM works to switch fuel pump on and off.</li> </ul>
Battery voltage is not read	<ul style="list-style-type: none"> <li>- Fuel pump power supply circuit from relay R2 is defective.</li> <li>- Fuel pump ground circuit to ECM is defective.</li> <li>- ECM is faulty.</li> </ul>

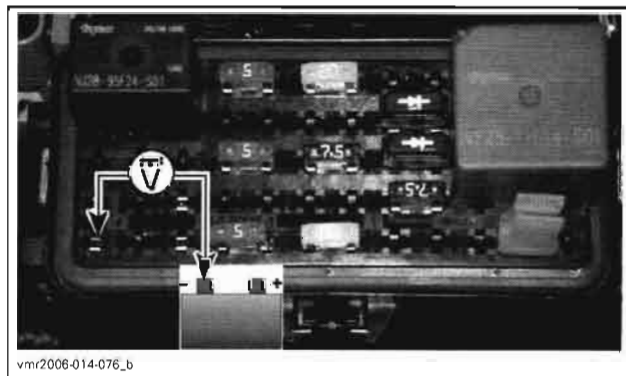
If battery voltage is not read, check the fuel pump power supply and ground circuits as follows.

### Fuel Pump Power Supply

Recheck voltage as follows.



If battery voltage is not read, remove relay R2 and read voltage as follows.



If voltage is now good, check fuse block wiring and wiring/connectors between fuse block and fuel pump.

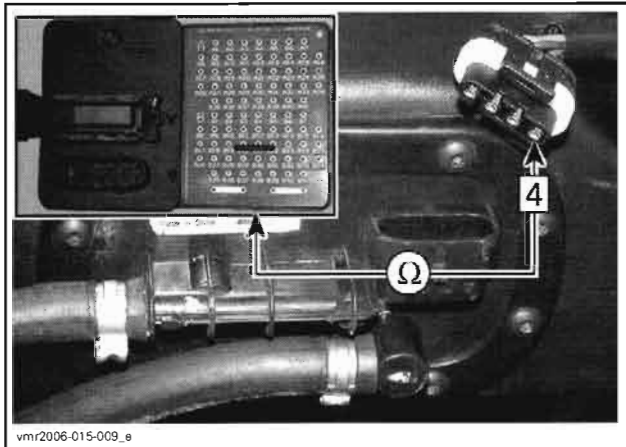


If battery voltage is read, check fuel pump ground circuit to ECM.

**Fuel Pump Ground Circuit**

Check continuity of fuel pump circuit going to ECM.

ECM CONNECTOR	FUEL PUMP CONNECTOR	MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
B-29	4	Close to 0 $\Omega$



If it is good, check ECM. Refer to *ENGINE MANAGEMENT*.

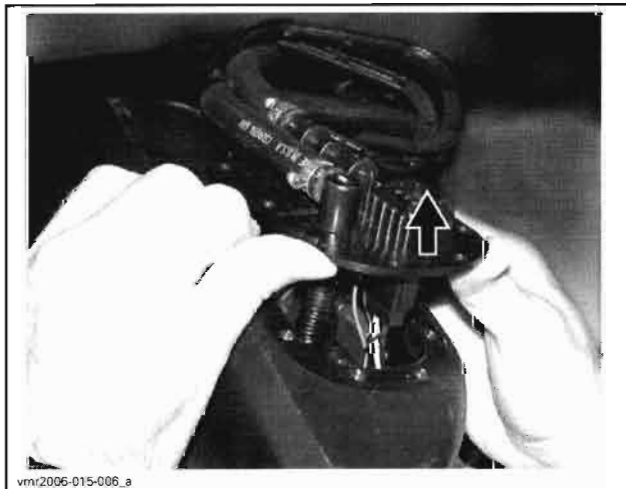
**Fuel Pump Removal**

Use B.U.D.S. to release fuel pressure. Look in **Activation** tab.

Remove fuel tank.

Remove fuel pump retaining screws no. 6.

Gently push pump up as shown.



GASKET AND FLANGE NOT SHOWN FOR CLARITY PURPOSES ONLY

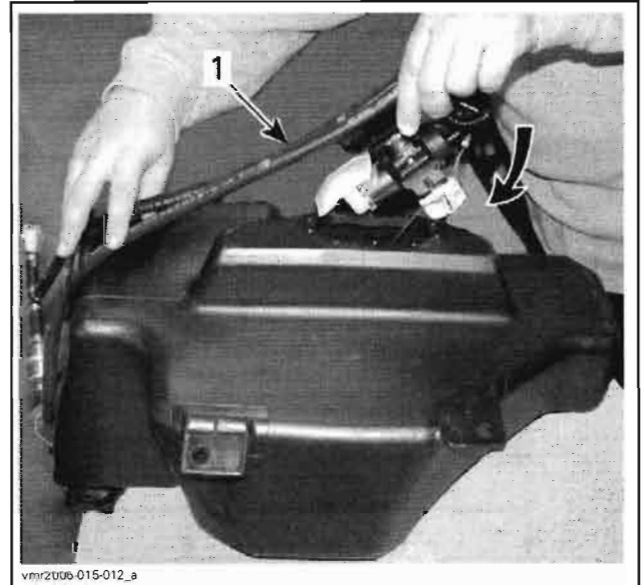
**CAUTION:** While pulling out the fuel pump, pay attention to fuel sensor float arm. Float arm can get stuck and bend which can reduce the fuel sensor capabilities.

**Fuel Pump Installation**

For installation, reverse the removal process but pay attention to the following.

Install a new gasket.

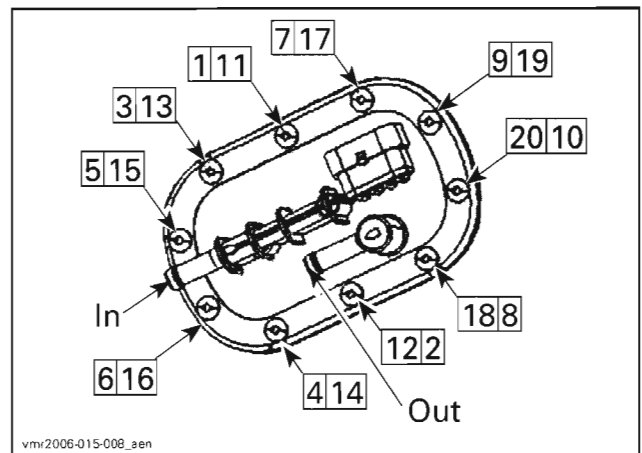
Pay attention to pump orientation as shown.



GASKET AND FLANGE NOT SHOWN FOR CLARITY PURPOSES ONLY  
 1. Fuel line on this side

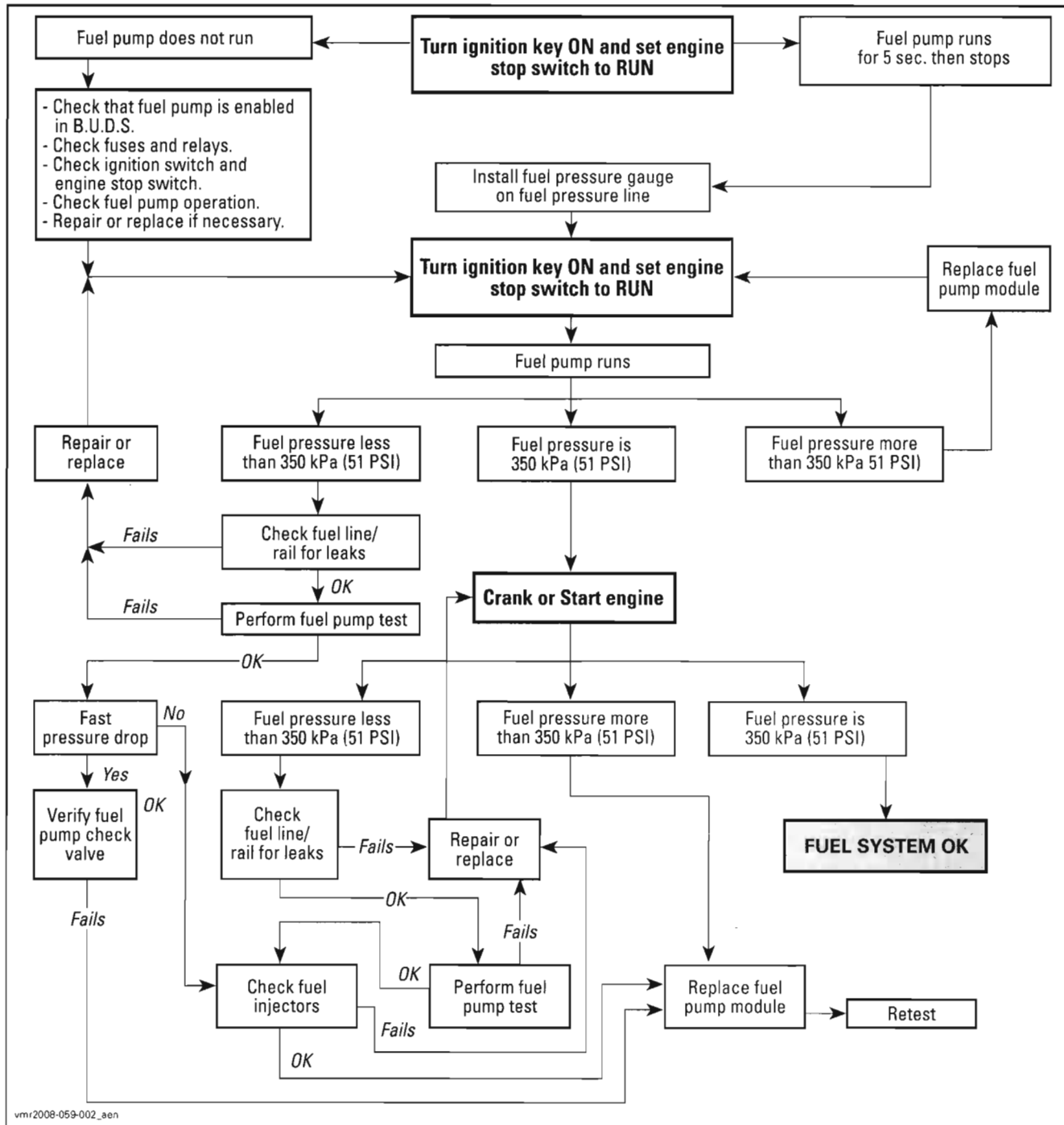
Tighten retaining screws as per illustrated sequence. For the first sequence from 1 to 10, turn screws only to make a contact between parts, do not tighten yet. For sequence 11 to 19, properly torque to 2 N•m (18 lbf•in).

Install hoses properly on IN and OUT nipples.



vmr2006-015-008\_aen

**FUEL SYSTEM DIAGNOSTIC FLOW CHART**



# COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE



## SERVICE TOOLS

Description	Part Number	Page
Optional extension cable .....	529 035 697 .....	232
Optional extension cable .....	529 035 703 .....	231
Communication kit.....	529 035 981 .....	231
MPI-2.....	529 036 018 .....	232
Diagnostic cable .....	710 000 851 .....	232

## COMMUNICATION TOOLS

Two different MPI (Multi-Purpose Interface) can be used with B.U.D.S. software: MPI and MPI-2.

### MULTI-PURPOSE INTERFACE (MPI)

PART REQUIRED
PC computer
B.U.D.S. software Use latest version available on BOSSWeb
Communication kit (P/N 529 035 981)

Optional extension cable (P/N 529 035 703)


### MPI Supply

The MPI can use the vehicle power for its supply. Four AA batteries or an AC/DC power supply can also be used. Make sure to respect MPI specification if a power supply is used.

### Connections with Vehicle

**⚠ 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 service compartment cover and locate communication connector.

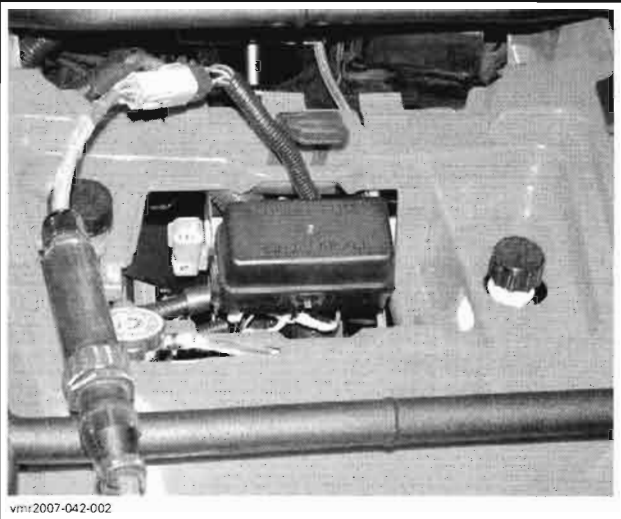
Unplug communication connector.



Connect the 6-pin adapter to the vehicle connector.

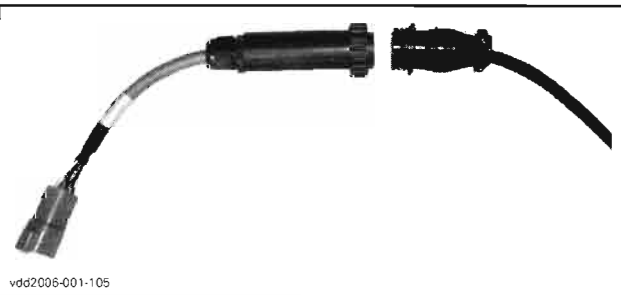
**Section 06 ELECTRICAL SYSTEM**

**Subsection 01 (COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE)**



vmr2007-042-002

Connect the diagnostic cable to the 6-pin adapter.



vdd2006-001-105

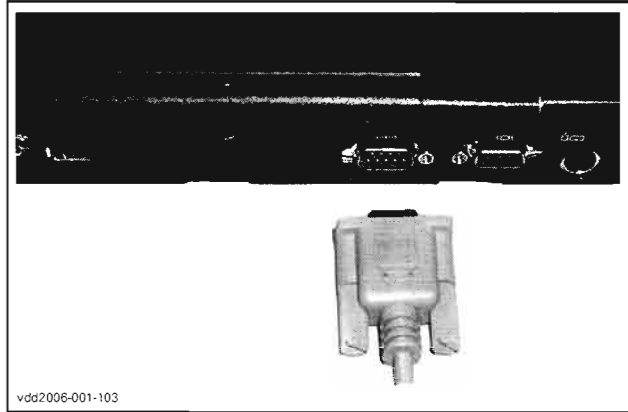
Connect the other diagnostic cable connector to MPI connector.

Connect serial cable to MPI connector.



vdd2006-001-102

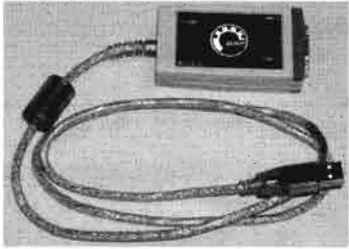
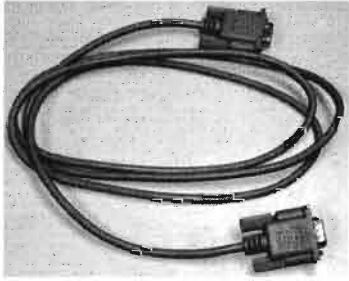

Connect remaining serial cable connector to the serial port of a PC (personal computer).



vdd2006-001-103

Use B.U.D.S. software as described further in *B.U.D.S. SOFTWARE*.

**MULTI-PURPOSE INTERFACE-2 (MPI-2)**

PART REQUIRED
PC computer
B.U.D.S. software Use latest version available on BOSSWeb
MPI-2 (P/N 529 036 018)

Optional extension cable (P/N 529 035 697)

Diagnostic cable (P/N 710 000 851)


### MPI-2 Supply

The MPI-2 uses the USB power of the PC computer for its supply.

### Connections with Vehicle

#### **⚠ 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 service compartment cover and locate communication connector.

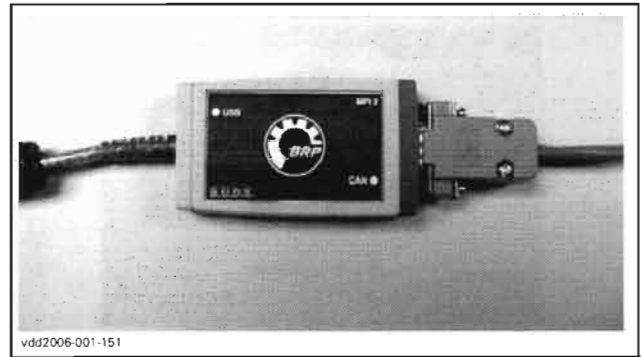
Unplug communication connector.



Connect diagnostic cable to vehicle connector.



Connect remaining connector to MPI-2 connector.



Connect remaining MPI-2 connector to the USB port of a PC (personal computer).



Use B.U.D.S. software as described further in *B.U.D.S. SOFTWARE*.

### B.U.D.S. SOFTWARE

B.U.D.S. (Bombardier Utility and Diagnostic Software) is designed to program key(s), 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.

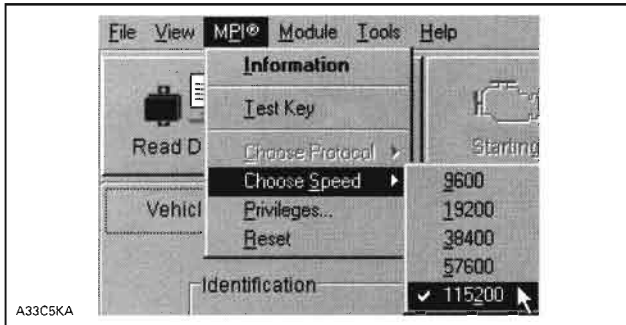
Ensure to use the latest B.U.D.S. version available on BOSSWeb.

When using the B.U.D.S. software:

- Turn ignition switch ON and set engine run/stop switch to RUN to activate the communication.
- Ensure that 115200 speed is properly selected in "MPI" under "Choose speed".

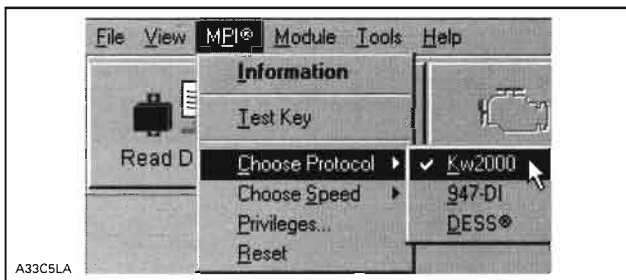
## Section 06 ELECTRICAL SYSTEM

### Subsection 01 (COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE)



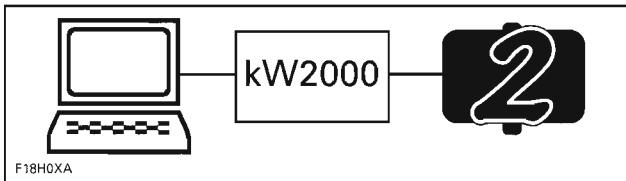
**NOTE:** If you are using an old PC computer, it may be necessary to use a slower speed so that the communication works.

- Ensure that the protocol “Kw2000” is properly selected in “MPI” under “Choose protocol.”



- Ensure the status bar shows KW2000 with the number 2 to its right.

**NOTE:** Number 2 means that 2 “ECU” are connected (ECM and multifunction gauge).



**CONNECTION SUCCESSFUL — ECM AND MULTIFUNCTION GAUGE ARE CONNECTED**

If an “X” is shown, this means that no communication between MPI and ECM/multifunction gauge takes place. Possible causes are:

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

### Changes in ECM

Anytime a change is brought in ECM through B.U.D.S., there will be an “EMS Tracking” message that will say “Remove key from vehicle”. When this occurs, remove the key from ignition switch and wait until the message disappears (it lasts approximately 15 seconds after key removal).

# IGNITION SYSTEM

## SERVICE TOOLS

Description	Part Number	Page
ECM adapter.....	420 277 010 .....	235
Fluke 111 multimeter .....	529 035 868 .....	235

## 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 *EMS DIAGNOSTIC* sub section.

The EMS controls the ignition system. For more information, refer to *ENGINE MANAGEMENT* section.

The battery supplies the primary side of ignition coil through a relay while the ECM completes the circuit for each cylinder by switching it to the ground at the right moment. The ECM can detect open and short circuit in the primary winding but it does not check the secondary winding.

**⚠ WARNING**

Never check for engine ignition spark from an open coil and/or spark plug as spark may cause potential fuel vapor to ignite.

### Ignition Timing

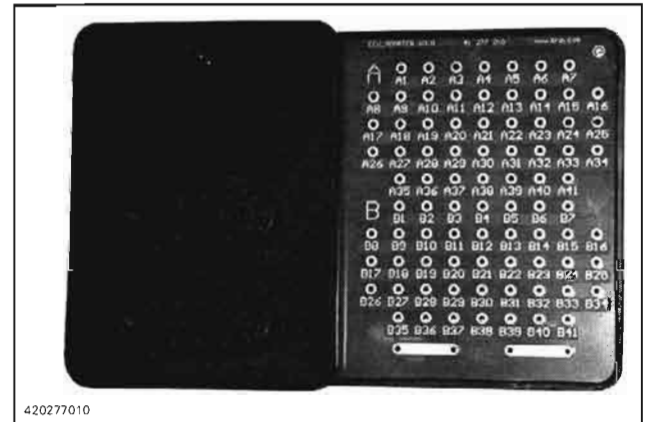
Ignition timing is not adjustable.

### Tools

For best electrical measurement results, use the Fluke 111 multimeter (P/N 529 035 868).



**NOTE:** To probe the ECM connector terminals, use the ECM adapter (P/N 420 277 010) to prevent damaging terminals. Refer to *ENGINE MANAGEMENT* for more information.



## PROCEDURES

### IGNITION SWITCH

#### Quick Test

Set engine run/stop switch (located on multifunction switch housing) in the RUN position.

Turn ignition switch to ON position.

If multifunction speedometer turns on (assuming it works), the ignition switch and engine run/stop switch are good.

If multifunction speedometer does not turn on, check the following in this order:

- ECM is properly powered (refer to *ENGINE MANAGEMENT*)
- ignition switch
- engine run/stop switch.

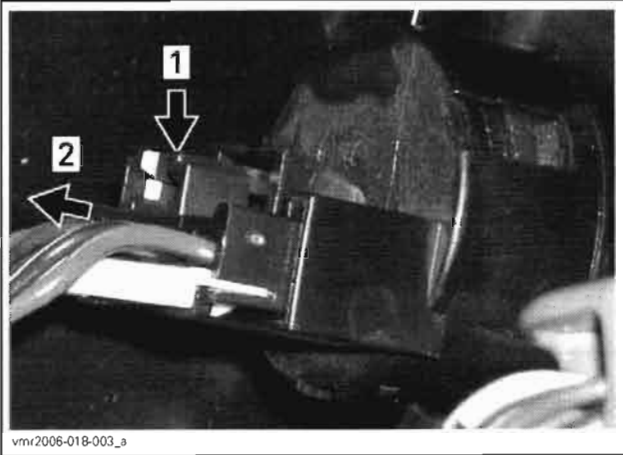
#### Switch Resistance Test

Remove center panel and dashboard. Refer to *BODY*.

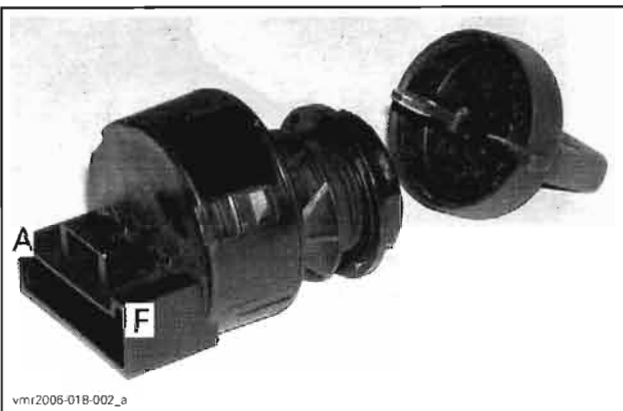
Unplug ignition switch connector.

## Section 06 ELECTRICAL SYSTEM

### Subsection 02 (IGNITION SYSTEM)



Using a multimeter, test switch as follows.



PINOUT

IGNITION SWITCH	PIN		RESISTANCE @ 20°C (68°F)
OFF	B	E	Infinite (0L)
ON with lights			1 Ω max.
ON without lights			

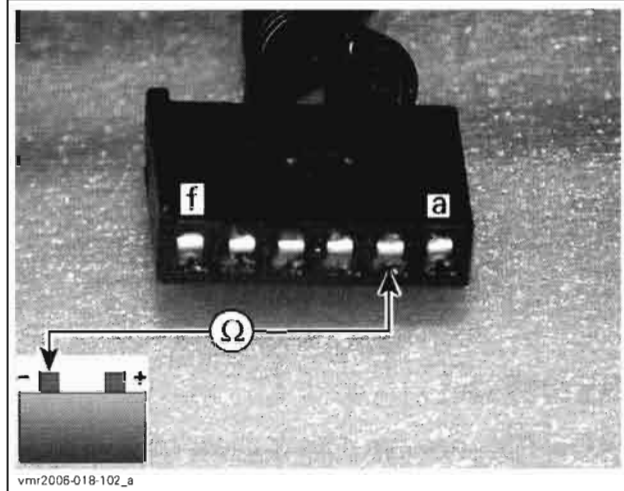
If switch is out of specification, replace with a new one.

If switch tests good, continue testing.

#### Switch Wiring Test (Ignition Function)

Wiring Test between Ignition Switch and Battery Ground

IGNITION SWITCH CONNECTOR		RESISTANCE @ 20°C (68°F)
Pin "B"	Battery ground	Close to 0 Ω

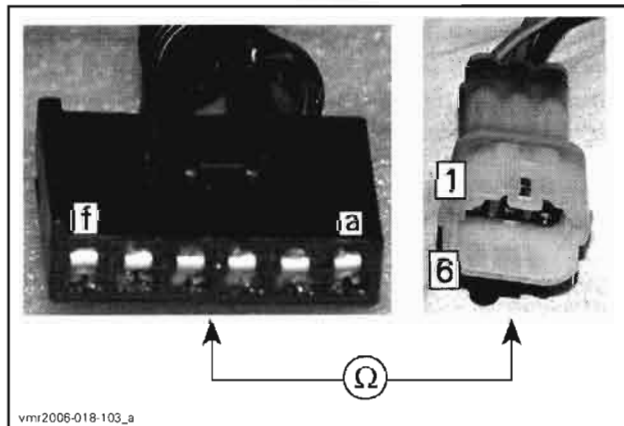


If out of specification, repair wiring/connector.

If as per specification, continue testing.

#### Wiring Test Between Ignition Switch and Multifunction Switch

IGNITION SWITCH CONNECTOR	MULTIFUNCTION SWITCH CONNECTOR (MG1)	RESISTANCE @ 20°C (68°F)
Pin E	Pin 2	Close to 0 Ω



If out of specification, repair wiring/connector.

#### Switch Wiring Test (DESS Function)

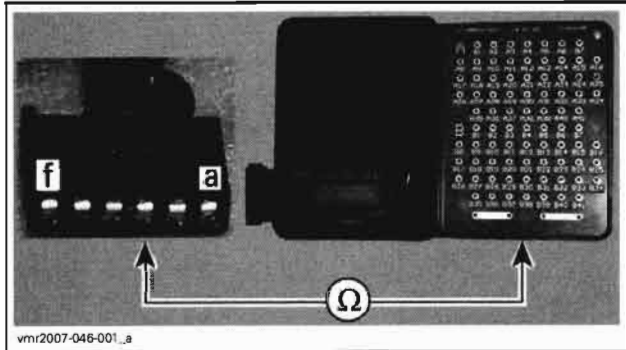
Wiring Test Between Ignition Switch and ECM

Unplug ignition switch connector and disconnect connector B from ECM.

Check continuity of wiring between ignition switch and ECM as follows.



IGNITION SWITCH CONNECTOR	ECM CONNECTOR	RESISTANCE @ 20°C (68°F)
C	B-39	Close to 0 Ω
D	B-38	



If any test fails, repair wiring/connector.

## ENGINE RUN/STOP SWITCH

**NOTE:** The engine run/stop switch is located on multifunction switch housing.

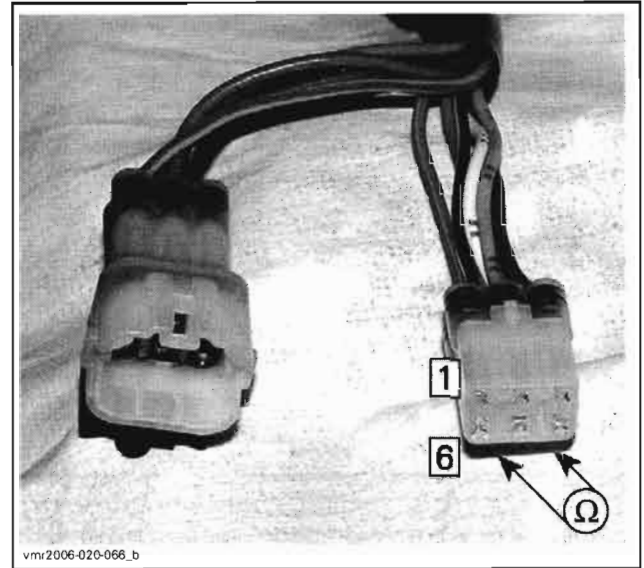
### Quick Test

Refer to *IGNITION SWITCH* above.

### Switch Resistance Test (Ignition Function)

Using a multimeter, test switch as follows.

POSITION	MULTIFUNCTION SWITCH CONNECTOR (MG1) (run/stop)		RESISTANCE @ 20°C (68°F)
	RUN	1	2
STOP	Infinite (0L)		

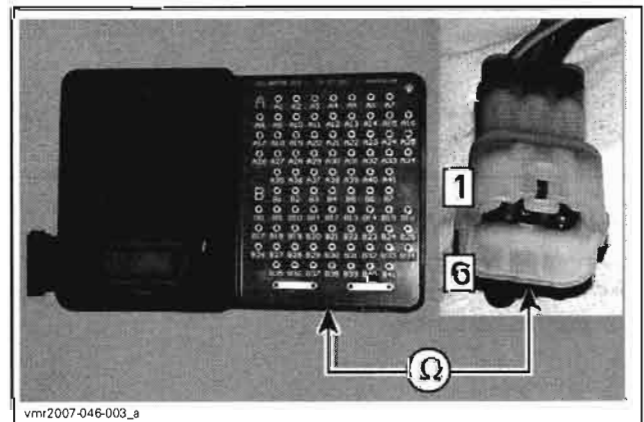


If switch is out of specification, replace with a new one.

### Switch Wiring Test (Ignition Function)

#### Wiring Test Between Multifunction Switch and ECM

ECM CONNECTOR	MULTIFUNCTION SWITCH CONNECTOR	RESISTANCE @ 20°C (68°F)
B-26	Pin 1	Close to 0 Ω



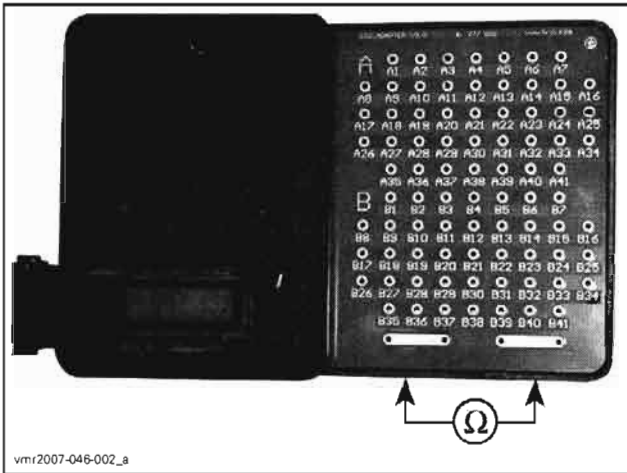
### Switch Resistance Test (DESS Function)

Check multifunction switch as follows.

MULTIFUNCTION SWITCH	ECM CONNECTOR		RESISTANCE @ 20°C (68°F)
	STOP	B-38	B-39
RUN	Infinite (0L)		

## Section 06 ELECTRICAL SYSTEM

### Subsection 02 (IGNITION SYSTEM)



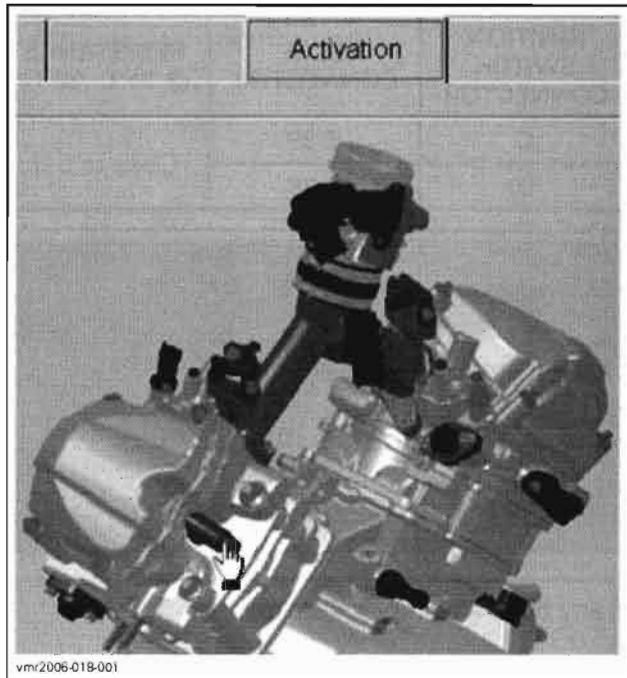
If any test fails, check continuity of wiring/connectors. If they test good, replace switch.

## IGNITION COIL



### Quick Test with B.U.D.S.

Using the vehicle communication kit (VCK) with the B.U.D.S. software, energize the ignition coil for each spark plug.



You should hear the spark occurring. In doubt, use an inductive spark tester. If there is no spark, perform the following checks.

**NOTE:** Keep in mind that even if there is a spark during this static test, voltage requirement is higher to produce a spark in the combustion chamber when engine is running. Ignition coil could be not working in real operation. Replacing ignition coil may be necessary as a test.

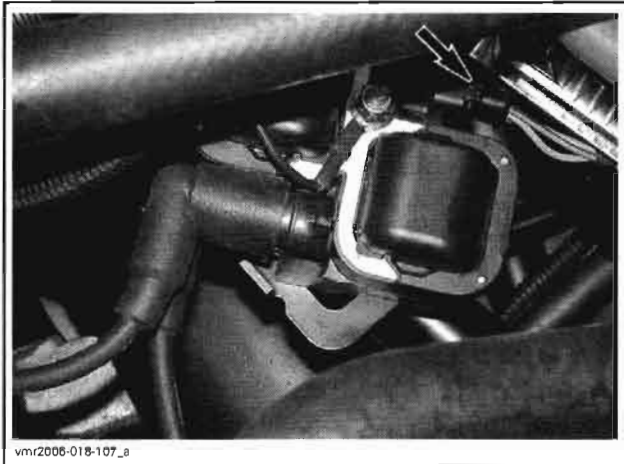
**NOTE:** Ensure spark plug cable is on the appropriate cylinder.

### Ignition Coil Input Voltage

Ensure ignition coil is properly powered as follows. Remove RH inner fender. Refer to *BODY*.



Disconnect the 3-pin connector from the ignition coil and check the voltage supplied by the main relay.

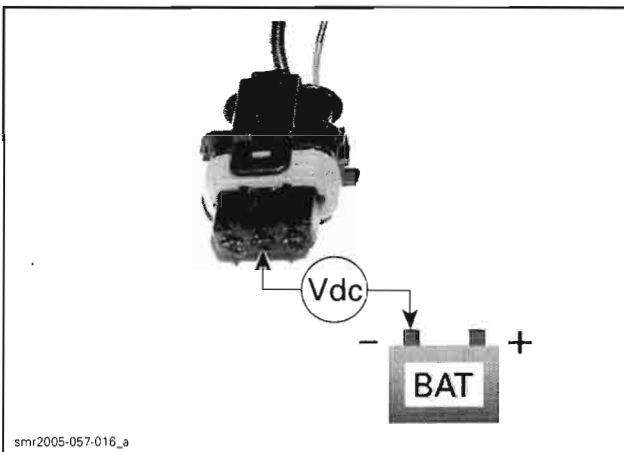


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Turn ignition switch to ON and set engine run/stop switch to RUN.

Using a multimeter, read voltage.

IGNITION COIL CONNECTOR	VOLTAGE
Pin 2 with battery ground	12 V



smr2005-057-016\_a

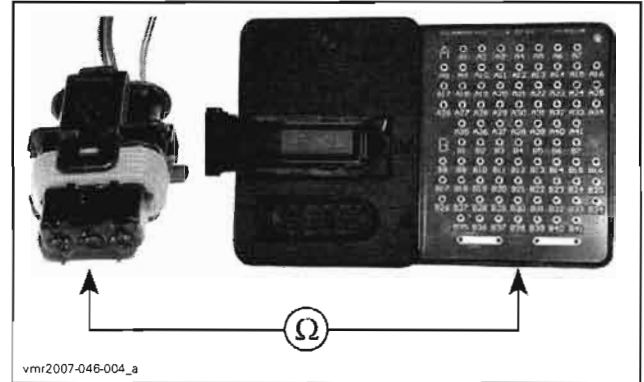
*TYPICAL*

The voltage should be 12 V.

If 12 V is NOT read, check continuity of ignition coil supply circuit.

If 12 V is read, disconnect the ECM connector "A" and check the continuity of appropriate circuit.

COMPONENT	CIRCUIT NUMBER (ignition coil connector)	CIRCUIT NUMBER (ECM connector)
Cylinder 1 (front)	1	A-1
Cylinder 2 (rear)	3	A-41



vmr2007-046-004\_a

If wiring harness is defective, repair the connector or replace the wiring harness between ECM connector and the ignition coil.

If wiring harness is good, refer to ECM in *ENGINE MANAGEMENT*.

### Ignition Coil Resistance Test

An ignition coil with good resistance measurement can still be faulty. Voltage leak can occur at high voltage level which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

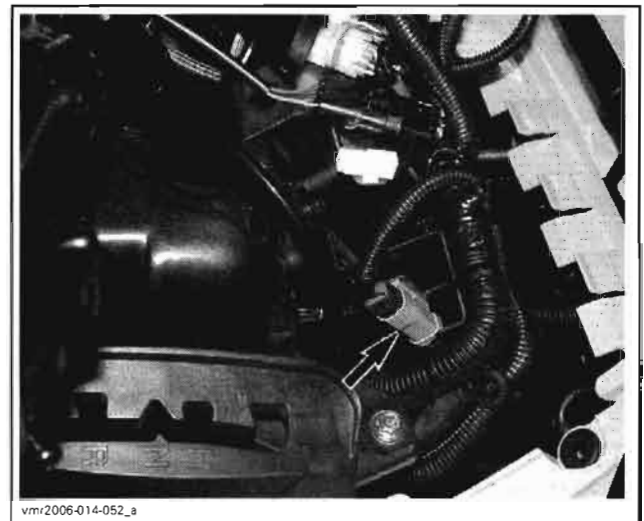
Disconnect ignition cable from spark plug.

#### Primary Windings

Reconnect connector to ignition coil.

Remove center panel and dashboard. Refer to *BODY*.

Disconnect engine connector.



vmr2006-014-052\_a

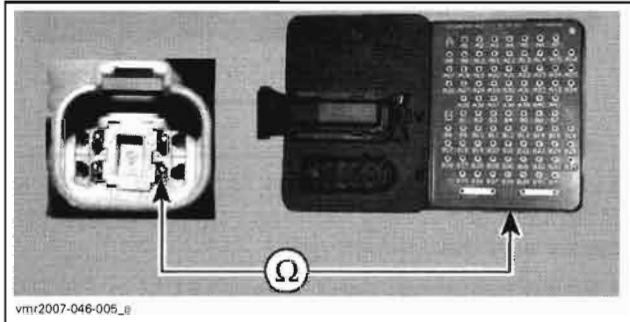
Disconnect "A" connector from ECM.

Using a multimeter, check resistance in primary windings as follows.

## Section 06 ELECTRICAL SYSTEM

### Subsection 02 (IGNITION SYSTEM)

PRIMARY CIRCUIT	ENGINE CONNECTOR	ECM CONNECTOR "A"	RESISTANCE @ 20°C (68°F)
Front	Pin 2	A-1	.3 - .6 Ω
Rear		A-41	



If any resistance is not good, replace ignition coil. If the windings test good, check wiring/connectors and if adequate, try a new ECM.

#### Secondary Windings

Due to the integrated diode, it is not possible to take any resistance measurement of the secondary winding.

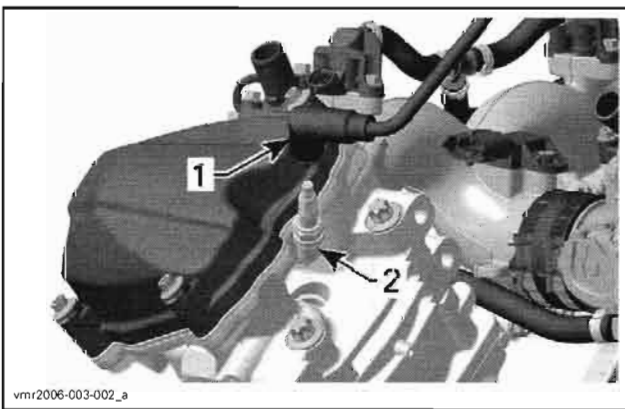
## SPARK PLUG

### Spark Plug Removal

Unplug the spark plug cable.

Clean the spark plug area with pressurized air.

Unscrew spark plug.

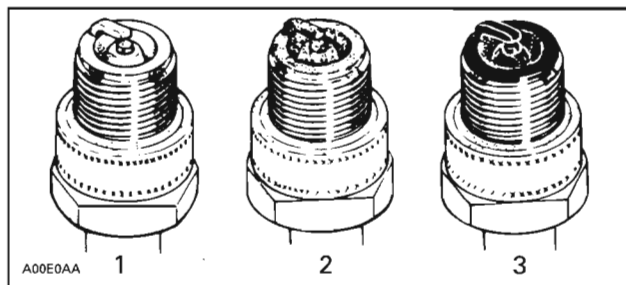


**TYPICAL**  
1. Spark plug cable  
2. Spark plug

### Troubleshooting Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption. This is due to a loss of compression. Other possible causes are: prolonged idling or low-speed riding, a clogged air filter, incorrect fuel, defective ignition system, incorrect spark plug gap, lubricating oil entering the combustion chamber, or too cold spark plug. The plug face of a fouled spark plug has either a wet black deposit or a black carbon fouling. Such coatings form a conductive connection between the center electrode and ground.

### Spark Plug Analysis



#### TYPICAL

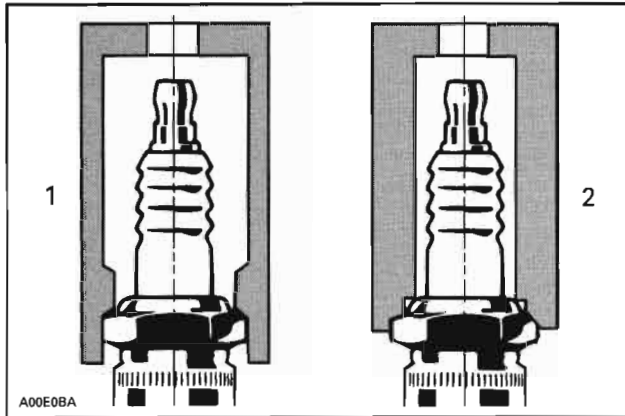
1. Overheated (light grey, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, grey, melted coating)

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 regular intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

### Spark Plug Installation

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

- Using a wire feeler gauge, set electrode gap as specified in *TECHNICAL SPECIFICATIONS*.
- Apply antiseize lubricant over the spark plug threads to prevent possible seizure.
- Hand screw spark plug into cylinder head and tighten with a torque wrench and a proper socket.



1. *Proper socket*
2. *Improper socket*

– Torque spark plug to 20 N•m (15 lbf•ft).



*Midwest Manuals*

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# CHARGING SYSTEM

## SERVICE TOOLS

Description	Part Number	Page
Fluke 111 multimeter .....	529 035 868 .....	244
4-pin magneto harness adapter .....	529 036 021 .....	246-247

## SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
Snap-on inductive ammeter.....	MT110 .....	244

## SERVICE PRODUCTS

Description	Part Number	Page
dielectric grease .....	293 550 004 .....	250

## GENERAL

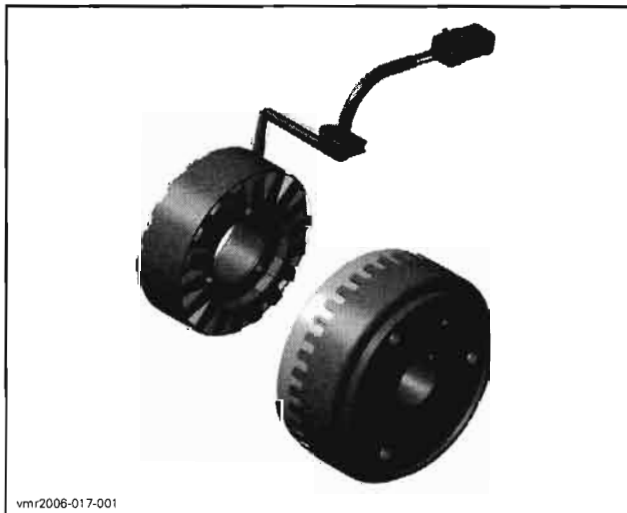
The purpose of the charging system is to keep the battery at a full state of charge.

**NOTE:** For an overview of the vehicle electrical system, refer to *ENGINE MANAGEMENT*.

### Magneto

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).

The magneto has a 3 phase series stator.



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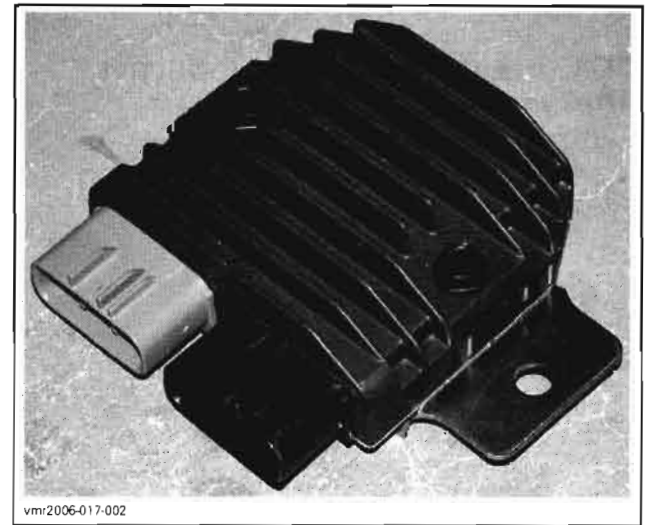
TYPICAL

### Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage as follows to prevent any damage to electrical components.

MODEL	VOLTAGE Vdc
All	14.8



vmr2006-017-002

**Section 06 ELECTRICAL SYSTEM**  
**Subsection 03 (CHARGING SYSTEM)**

**NOTE:** If the battery will not stay charged, the problem can be any of the charging system components. If these all check good, try a new voltage regulator/rectifier.

**Battery**

The battery is the DC source for the electric starter, the ECM and all accessories.

**PROCEDURES**

**NOTE:** First, ensure that battery is in good condition prior to performing the following test.

For best results, use the Fluke 111 multimeter (P/N 529 035 868).



If the battery is regularly discharged, check battery and solenoid terminals.

**VOLTAGE  
REGULATOR/RECTIFIER**

**Static Test: Continuity**

Due to internal circuitry, there is no static test available.

**DC Current Test with an Inductive  
Ammeter**

Pull out cover.



Use a Snap-on inductive ammeter (P/N MT110) or equivalent and place it over the RED wire going out of voltage regulator/rectifier.

- Start engine.
- Read current.

TEST ENGINE SPEED	CURRENT
4000 RPM	Approx. 3 - 7 A

- If current is below specification, check magneto (stator) output prior to concluding that rectifier is faulty.

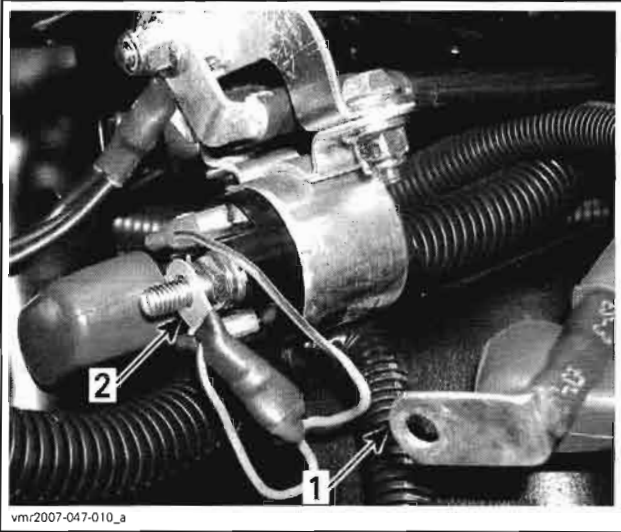
**DC Current Test with a Multimeter**

**⚠ WARNING**

Pay attention not to touch chassis with any tool when disconnecting/connecting wires. Pay attention so that battery positive post does not touch chassis when moving battery.

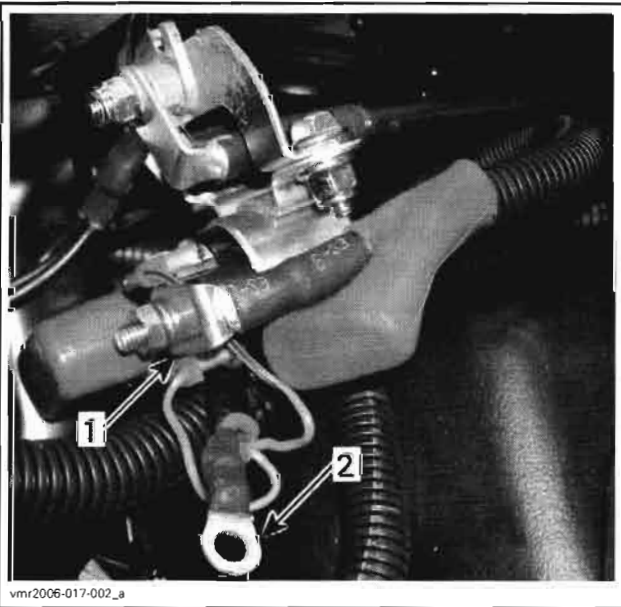
- Disconnect battery cable and voltage regulator/rectifier wire from solenoid post.





1. Move battery cable away to remove wire underneath  
 2. Remove this wire

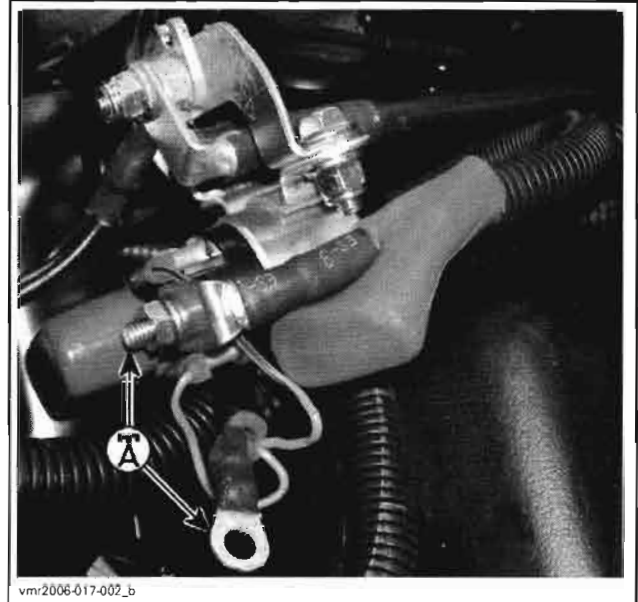
- Reconnect battery cable.



1. Battery cable installed  
 2. Voltage regulator/rectifier wire disconnected

- Set multimeter to Adc.
- Start engine.
- Connect multimeter probes between voltage regulator/rectifier wire and solenoid post.
- Read current.

TEST ENGINE SPEED	CURRENT
4000 RPM	Approx. 3 - 7 A



- If current is below specification, check magneto (stator) output prior to concluding that rectifier is faulty.
- Properly reconnect voltage regulator/rectifier wire.

**Voltage Test**

Proceed as follows:

- Release battery strap. Pull back battery to reach battery posts.
- Start engine.
- Connect a multimeter to battery posts. Set multimeter to Vdc scale.
- Start engine.
- Read voltage.

TEST ENGINE SPEED	VOLTAGE
4000 RPM	14.4 - 15.2 Vdc

## Section 06 ELECTRICAL SYSTEM

### Subsection 03 (CHARGING SYSTEM)



vmr2006-017-003\_a

If voltage is above specification, replace voltage regulator/rectifier.

**NOTE:** If voltage exceeds 19 Vdc, gauge will display OVER VOLTAGE. In this case, replace voltage regulator/rectifier by a new one.

If voltage is below specification, check stator, wiring and connections.

Properly secure battery.

Reinstall cover.

## STATOR

Remove seat and RH side panel.

Remove protective plate as necessary.

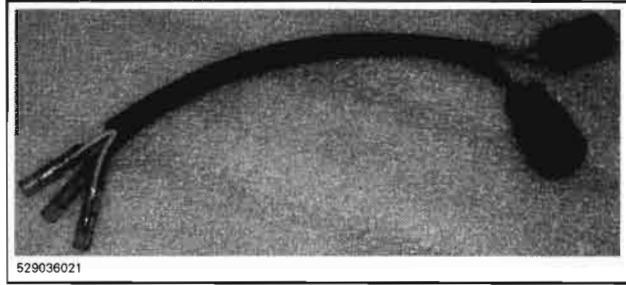
### Static Test: Continuity

- Disconnect the magneto wiring harness connector.

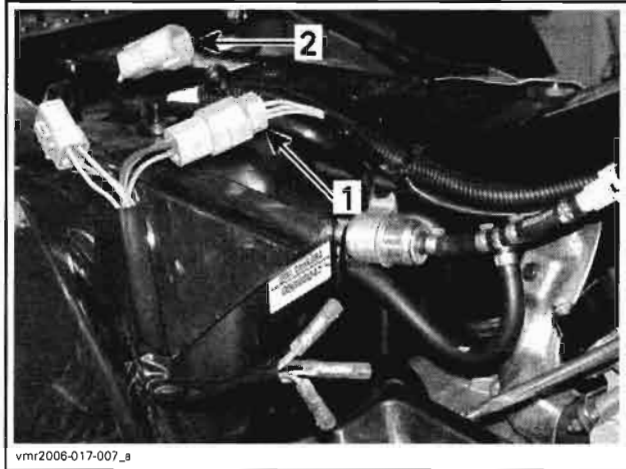


vmr2006-017-006

- Install the 4-pin magneto harness adapter (P/N 529 036 021) on magneto connector. Leave the other connector unplugged.



529036021

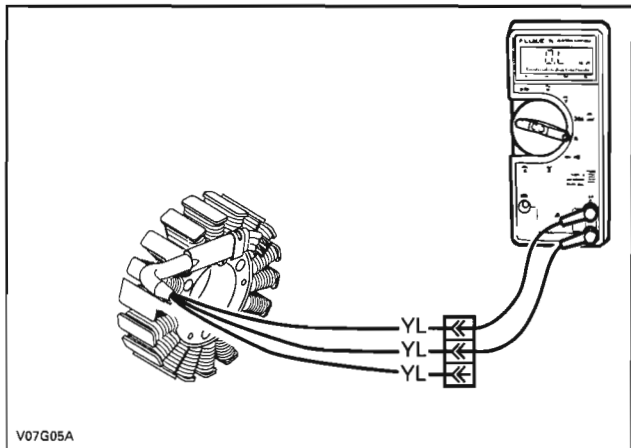


vmr2006-017-007\_a

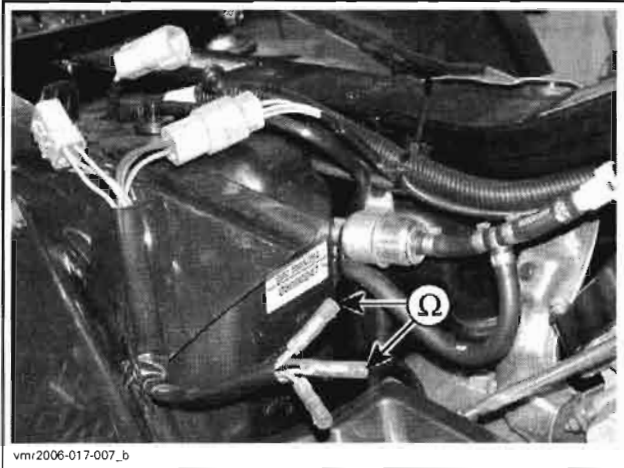
1. Magneto connector
2. Leave this tool connector unplugged

- Set multimeter to  $\Omega$ .
- Connect multimeter between YELLOW wires.
- Read resistance.

TERMINAL	RESISTANCE @ 20°C (69°F)
1 and 2	0.1 - 1 $\Omega$
1 and 3	
2 and 3	



TYPICAL



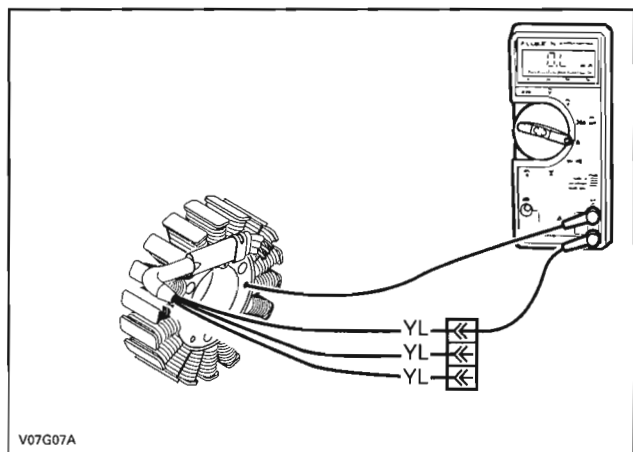
- If any reading is out of specification, replace stator.
- Replug connectors properly.

**Static Test: Insulation**

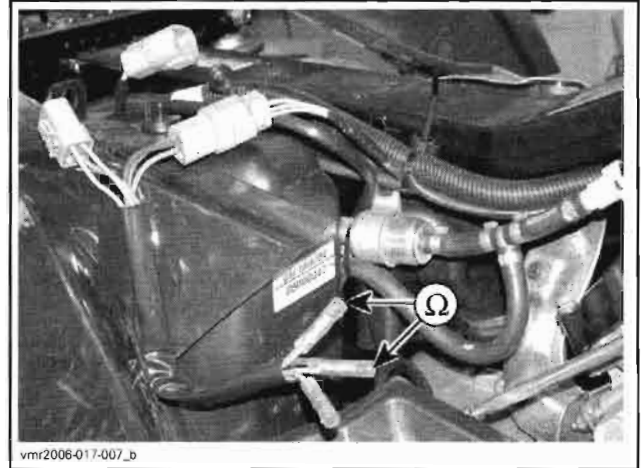
Keep connector as for the previous continuity test.

- Set multimeter to Ω.
- Connect multimeter between any YELLOW wire and engine ground.
- Read resistance.

PROBE	RESISTANCE @ 20°C (69°F)
Any YELLOW wire and engine ground	Infinity (open circuit)



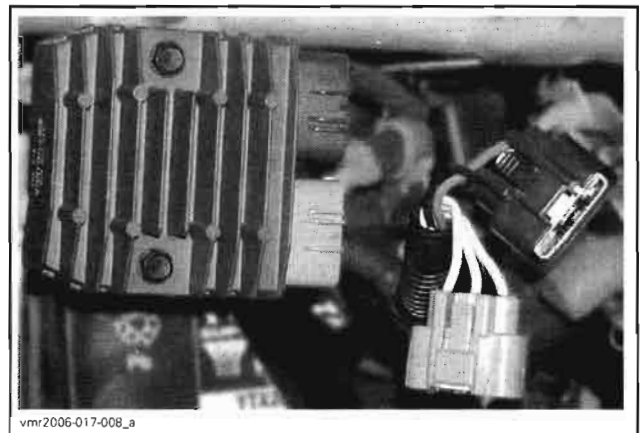
TYPICAL



- If there is a resistance or continuity, the stator coils and/or the wiring is grounded and needs to be repaired or replaced.
- Replug connectors properly.

**Dynamic Test: AC Voltage**

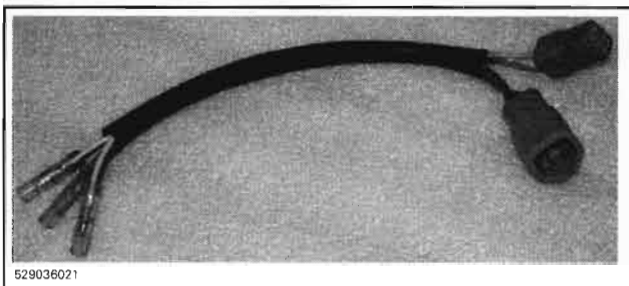
1. Disconnect the voltage regulator/rectifier connectors.



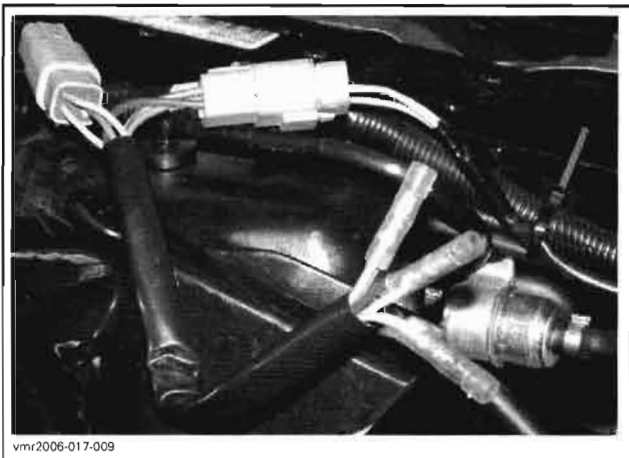
2. Unplug magneto wiring harness connector.



3. Install the 4-pin magneto harness adapter (P/N 529 036 021) between unplugged connectors.

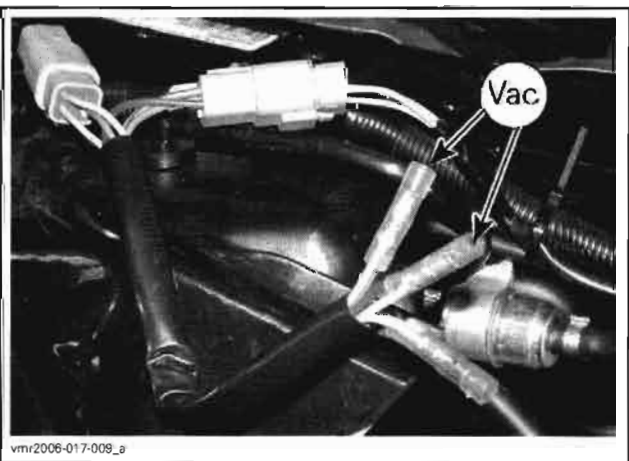


**NOTE:** Both connectors must be plugged.



4. Set multimeter to Vac scale.
5. Start engine.
6. Connect multimeter between YELLOW wires.
7. Read voltage.

TEST ENGINE SPEED	TERMINAL	VOLTAGE
4000 RPM	1 and 2	10 - 25 Vac
	1 and 3	
	2 and 3	



8. If voltage is lower than specification, replace stator.
9. Replug connectors properly.

## BATTERY

### Battery Information

These vehicles are equipped with a VRLA battery (Valve Regulated Lead Acid). It is a **maintenance-free type battery**.

Refer to battery manufacturer's instructions for proper filling, activation and routine charging procedures.

### Troubleshooting

#### Discharged or Weak Battery

- battery posts and/or cable terminal oxidized
- loose or bad connections
- faulty battery (does not keep a full charge)
- main system fuse burnt, faulty wiring/connections, voltage regulator/rectifier or stator.

#### Battery Unloaded Test

**NOTE:** An unloaded test is made on a battery without discharging current. It is the simplest and most commonly used. However, be aware that the voltage test can be good, while the battery does not have enough power to crank the engine. A load test gives a more accurate condition of the battery.

Check the charge condition using a multimeter.

With a multimeter, voltage readings appear instantly to show the state of charge. Always respect polarity.

FULLY CHARGED BATTERY VOLTAGE
12.6 Vdc minimum

#### Battery Load Test

This is the best test of the batteries condition. Use a load testing device that has an adjustable load.

Apply a load of 3 times the ampere-hour rating of the battery. At 14 seconds into the test, check battery voltage.

TIME TO MEASURE INTO TEST	VOLTAGE
14 seconds	Min. 10.5 Vdc

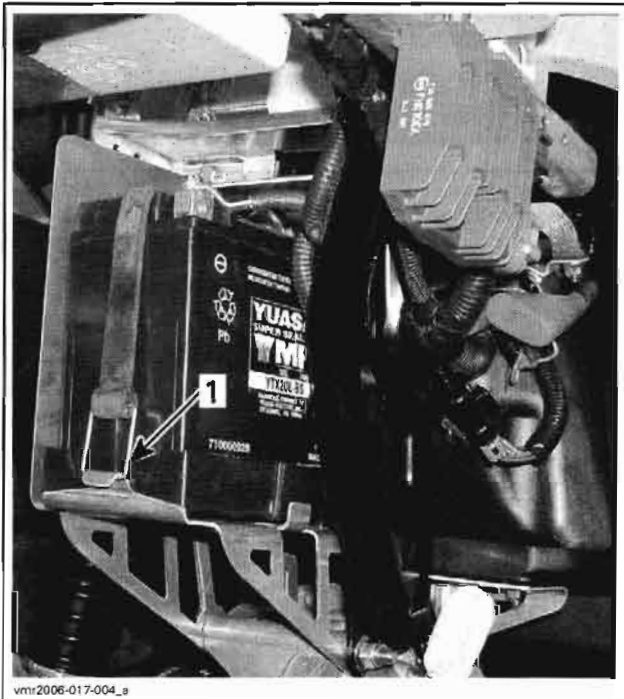
## Battery Removal

### **⚠ WARNING**

Always respect this order for removal; disconnect BLACK (-) cable first. Electrolyte or fuel vapors can be present and a spark may ignite them and possibly cause personal injuries.

### **Outlander 500/650/800 Series**

Release battery strap.



1. Strap

Pull back battery to reach battery posts.



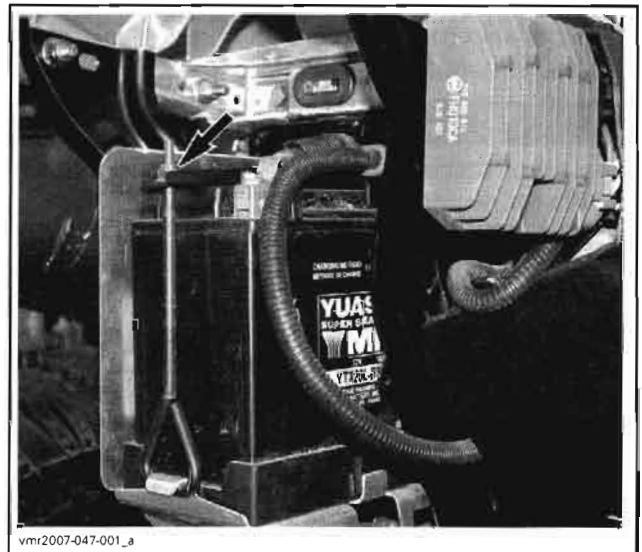
Disconnect BLACK (-) cable first, then the RED (+) cable.

Remove battery.

### **Renegade Models**

Remove storage box.

Unfasten retaining rod.



Pull out top bracket.

Disconnect BLACK (-) cable first, then the RED (+) cable.

Remove battery.

### **Battery Cleaning**

Clean the battery rack, cables and battery posts using a solution of baking soda and water.

## Section 06 ELECTRICAL SYSTEM

### Subsection 03 (CHARGING SYSTEM)

Remove corrosion (if so) from battery cable terminals and battery posts using a firm wire brush. Rinse with clear water and dry well.

#### Battery Inspection

Visually inspect battery casing for cracks or other damage. If casing is damaged, replace battery and thoroughly clean battery rack with water and baking soda.

Inspect battery posts condition, battery rack mounting, straps and strap attachment points.

#### Battery Storage

If the battery is in storage or used infrequently, disconnect the battery cables to eliminate drain from electrical equipment.

For extended storage, remove the battery from vehicle.

Clean battery terminals and cable connections using a wire brush. Apply a light coat of dielectric grease (P/N 293 550 004) on terminals.

Clean battery casing using a solution of baking soda and water. Rinse battery with clear water and dry well using a clean cloth.

Regularly charge battery as per manufacturer's recommendations.

For other recommendations during storage, refer to battery manufacturer's instructions.

#### **⚠ WARNING**

Ensure to store battery in a safe place, out of reach for children.

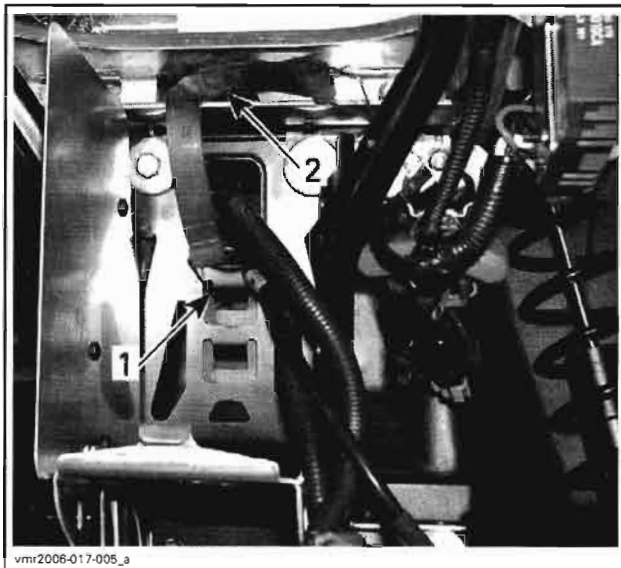
#### Battery Installation

#### **⚠ WARNING**

Always connect RED (+) cable first then BLACK (-) cable.

#### **Outlander 500/650/800 Series**

Temporary hook battery strap as shown.

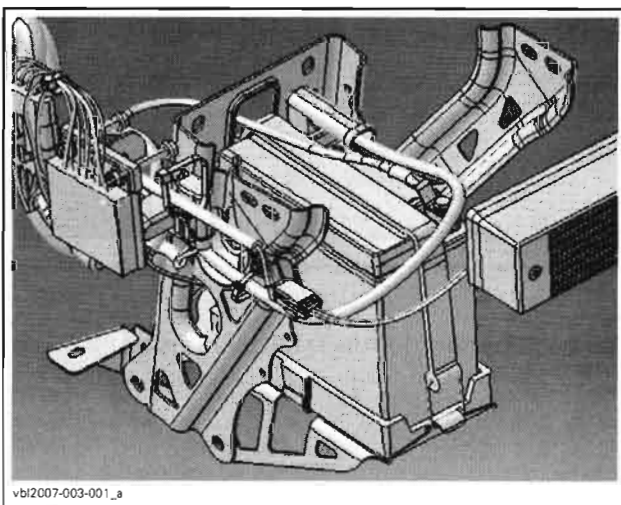


1. Hook at bottom
2. Temporary squeeze strap here

Temporary put battery in rack.

Connect battery cables.

Properly position battery with positive post towards front and negative post at rear. Route cables as shown.



Secure with strap.



1. Secured strap

**Renegade Models**

Reinstall battery in vehicle. Secure retaining rod.  
Reinstall storage box.

**MAIN GROUND**

Pull out cover.



Ensure main ground connection is clean and tight.







# STARTING SYSTEM

## SERVICE TOOLS

Description	Part Number	Page
ECM adapter.....	420 277 010 .....	254
Fluke 111 multimeter .....	529 035 868 .....	253

## SERVICE PRODUCTS

Description	Part Number	Page
dielectric grease .....	293 550 004 .....	259

## GENERAL

First ensure the problem is not related to engine mechanical components. If not, test the starting system.

Causes of problems are not necessarily related to starter but may be due to the following:

- burnt fuse
- faulty battery
- D2 diode
- relay
- start button
- ignition Switch
- engine run/stop switch
- starting solenoid
- electrical cables
- connections.

Check these components before removing starter. Consult the *TROUBLESHOOTING* section for a general view of possible problems.

### Engine Cranking Conditions

The following conditions must be met to allow engine cranking.

Ignition switch turned ON
Engine run/stop switch in RUN position
Transmission in Park or Neutral position
<b>NOTE:</b> Engine can be cranked in other positions if any brake lever is held when pressing start button.
Start button is pressed and held (within 15 minutes since ignition key was turned on. Otherwise, it will be required to turn ignition switch OFF, wait until multifunction gauge turns off then turn ignition back ON).

### Battery

To check battery condition, refer to *CHARGING SYSTEM* section.

### Ignition Switch and Engine Run/Stop Switch

To validate ignition switch and engine run/stop switch operations, refer to *IGNITION SYSTEM*.

### Electrical Cables and Connections

Check all connections, cables and wires. Tighten any loose connections. Replace any chafed wires/cables.

### Tools

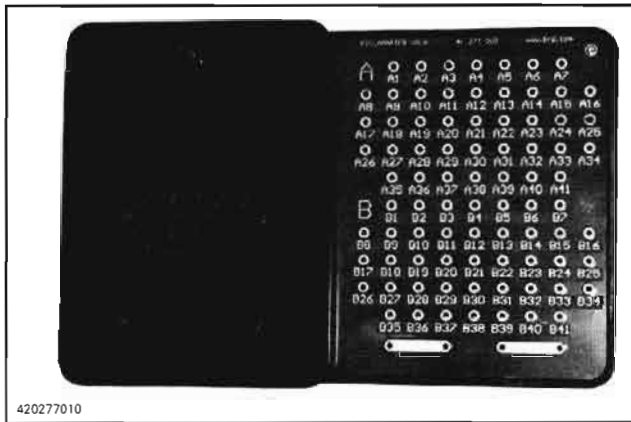
For best electrical measurement results, use the Fluke 111 multimeter (P/N 529 035 868).

## Section 06 ELECTRICAL SYSTEM

### Subsection 04 (STARTING SYSTEM)



To probe the ECM connector terminals, use the ECM adapter (P/N 420 277 010) to prevent damaging terminals. Refer to *ENGINE MANAGEMENT* for more information.



## PROCEDURES

### FUSES

Make sure the main fuse (F8) and the accessories fuse (F4) is (are) in good condition.

**NOTE:** If fuse F4 continuously burns, diode D2 is likely defective.

**NOTE:** The solenoid may be the cause of a burnt fuse. If the solenoid test good, one of the accessory may be defective.

### D2 DIODE (starter solenoid)

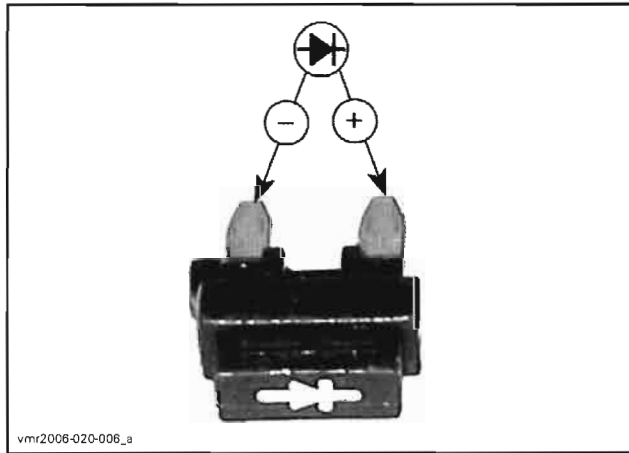
#### Diode Test

Remove diode and lay down on a non-metallic table.

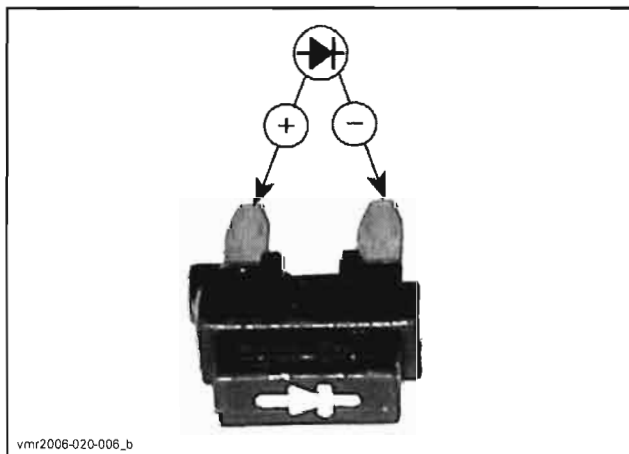
Set multimeter as shown.



Probe diode paying attention to proper polarity.



**MUST BE OPEN CIRCUIT**

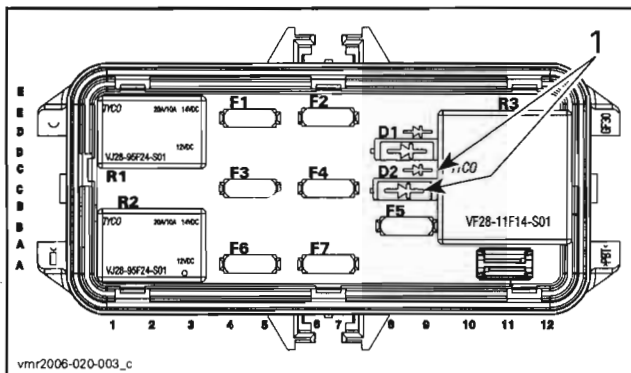


**MUST BE AROUND 0.5 V**

If diode fail any test, replace it.

### Diode Installation

Pay attention to the installation direction to allow proper operation.



1. Position symbol on diode in same direction as symbol on fuse holder

### START BUTTON

#### Quick Test

When engine does not crank, here is a quick tip to see if start button works:

- Set engine run/stop switch in RUN position.
- Turn ignition switch on. Wait approx. 5 seconds so that fuel pump stops.
- Press start button. You should hear fuel pump run for approximately 5 seconds. If so, the start button is working.
- If start button does not work, proceed with the tests below.
- If start button is working, depress brake pedal and try start button again.
- If engine starts, check the gearbox position sensor (GBPS). Refer to *GEARBOX*.
- If engine does not start, check the other components of the starting system.

#### Test with B.U.D.S.

Use the vehicle communication kit (VCK) with the B.U.D.S. software. Use the **Monitoring** tab. Press the vehicle's start button and look at the **Start button LED**.



It should turn on, indicating the starting system is working on the input side of the starting system (start button, ECM and wiring).

If it turns on, you are knowing now the problem is on the output side of the starting system (ECM output signal to starting solenoid, wiring harness going to the solenoid and starter motor).

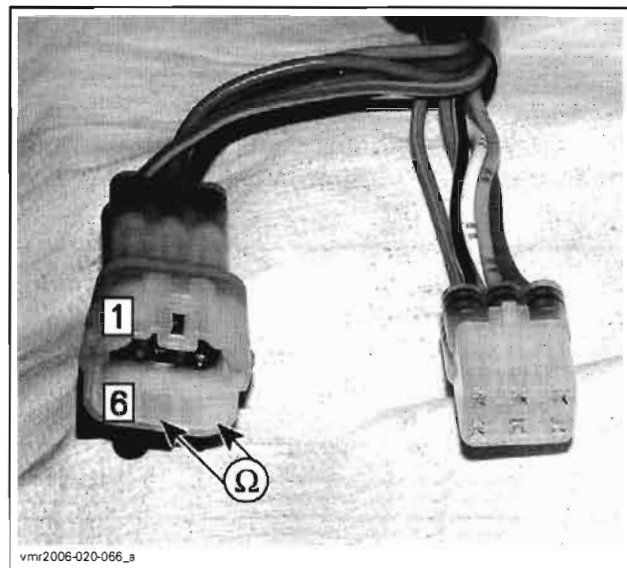
If it does not turn on, check the start button as follows.

#### Start Button Resistance Test

Remove center panel and dashboard. Refer to *BODY*.

Using a multimeter, measure the resistance between the following wires.

POSITION	MULTIFUNCTION SWITCH CONNECTOR (MG2) PIN (start)		RESISTANCE
Switch released			Infinite (0L)
Switch depressed and held	1	6	0.6 Ω max.



Replace multifunction switch if defective.

If switch tests good, check wiring as follows.

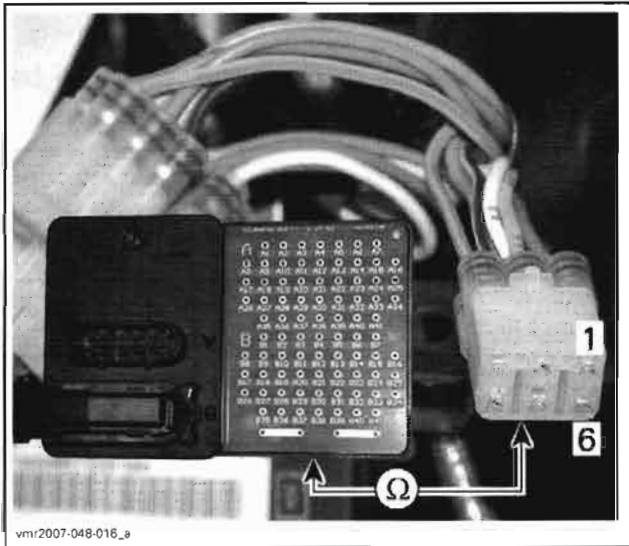
#### Start Button Wiring Test

Disconnect ECM connector "B".

Test continuity of wiring between start button connector and ECM connector as follows.

**Section 06 ELECTRICAL SYSTEM**  
**Subsection 04 (STARTING SYSTEM)**

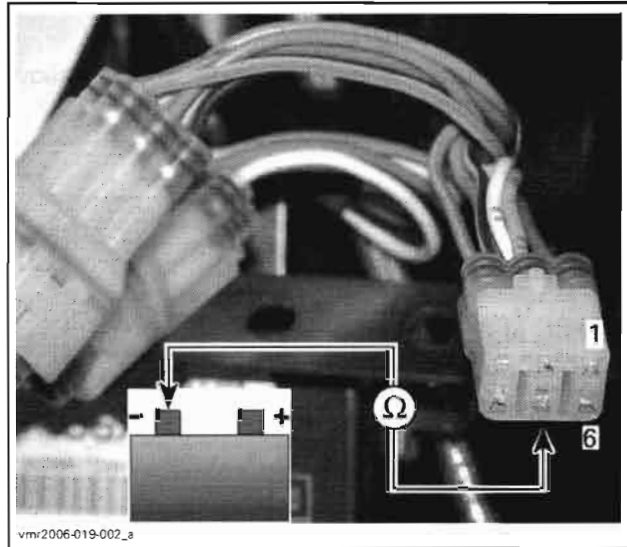
CONNECTOR		RESISTANCE @ 20°C (68°F)
ECM	MULTIFUNCTION SWITCH (MG2) PIN (harness side) (start)	
PIN		
B-21	1	1 Ω max.



Reconnect ECM connector "B".

If switch tests good, test continuity of wiring between start button connector and battery ground as follows.

CONNECTOR		RESISTANCE @ 20°C (68°F)
MULTIFUNCTION SWITCH (MG2) (start)	BATTERY	
PIN		
6	Battery ground	1 Ω max.

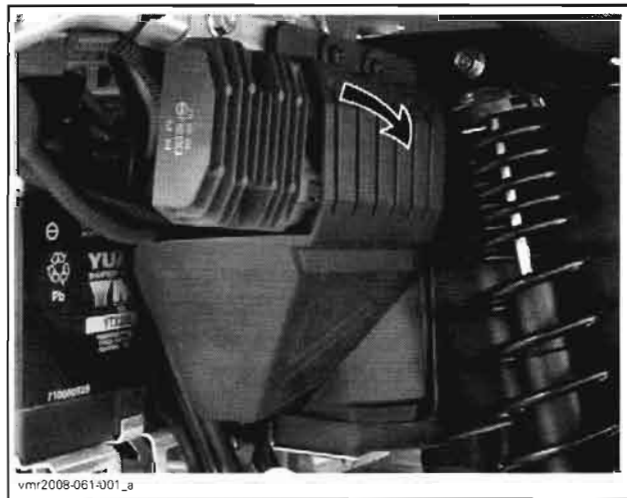


If wiring is faulty, repair/replace harness and/or connectors. If it tests good, check D2 diode. Refer to *D2 DIODE (STARTER SOLENOID)* above.

**STARTING SOLENOID**

NOTE: Solenoid is located on the frame, besides battery rack.

Pull out cover.





Inspect connections and clean as necessary.

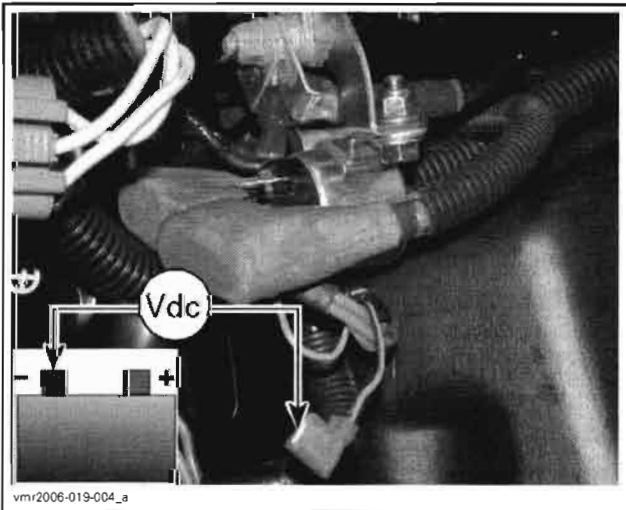
### Solenoid Signal Test

Disconnect connector with ORANGE/GREEN wire from solenoid and check voltage as follows.

Turn ignition key ON and set engine run/stop switch to RUN.

Read voltage (do not press start button).

SOLENOID CONNECTOR (harness side)	VOLTAGE
ORANGE/GREEN with battery ground	12 Vdc



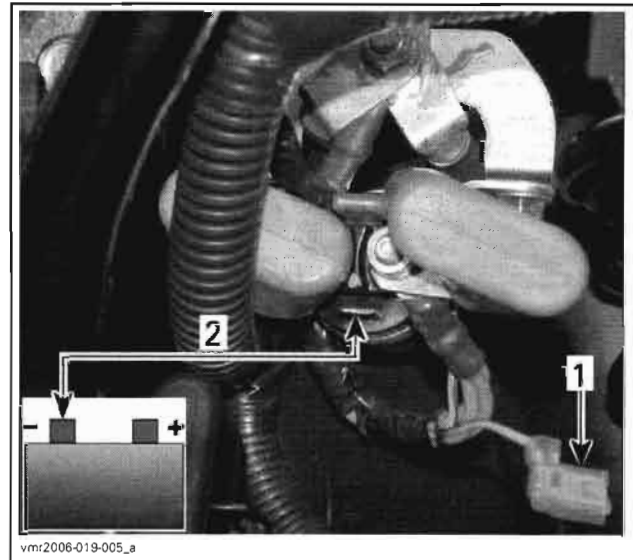
If voltage is not adequate, check accessories fuse (F4). If fuse is good, test continuity of wiring between solenoid and fuse F4.

If voltage is adequate, do the following test.

Reconnect ORANGE/GREEN terminal to solenoid.

Disconnect ORANGE/BROWN terminal from solenoid.

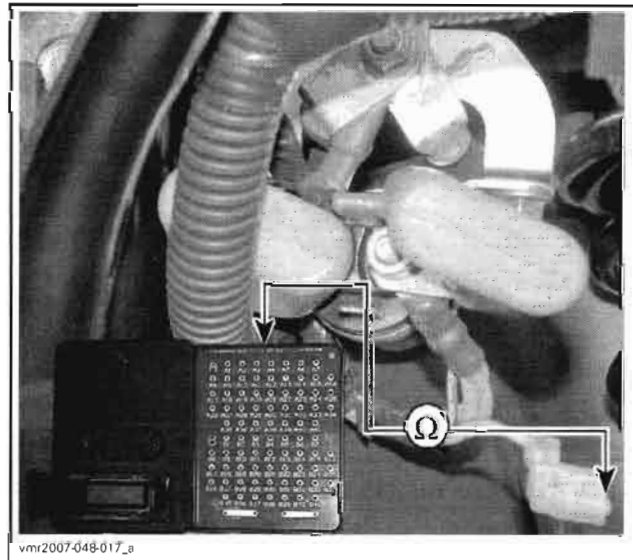
Connect a jumper wire between solenoid terminal and battery ground.



1. Disconnect ORANGE/BROWN terminal
2. Jumper to battery ground

If solenoid works, check wiring/connectors for continuity as follows.

ECM CONNECTOR PIN	SOLENOID TERMINAL (harness side)	RESISTANCE @ 20°C (68°F)
B-31	ORANGE/BROWN	Close to 0 Ω



If solenoid does not work, test solenoid.

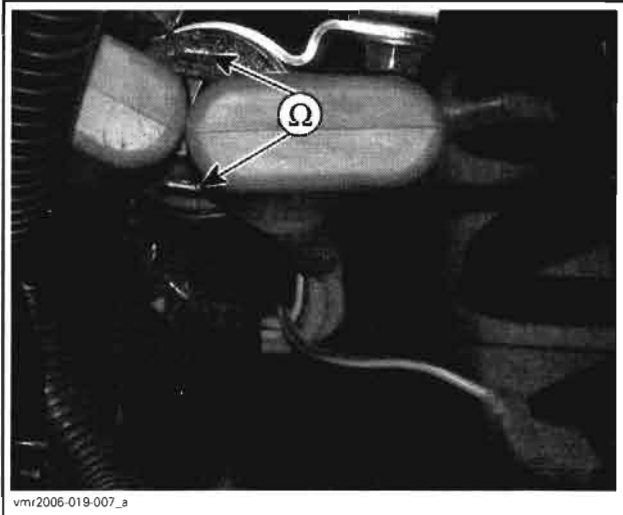
### Static Test: Continuity

Disconnect terminals from solenoid.

With a multimeter, check primary winding resistance as follows.

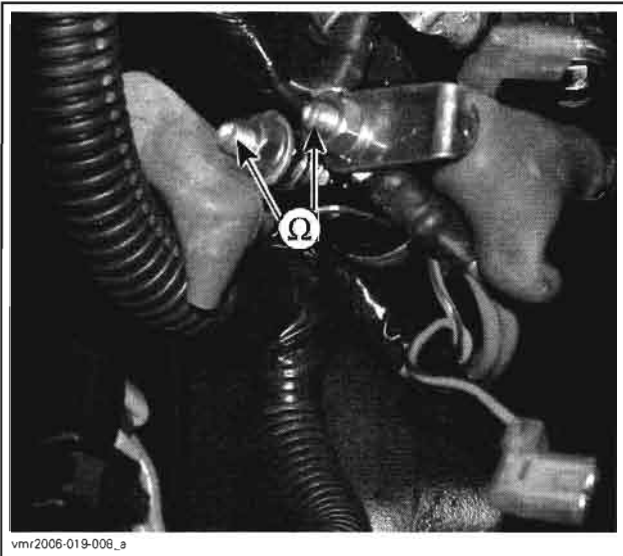
**Section 06 ELECTRICAL SYSTEM**  
**Subsection 04 (STARTING SYSTEM)**

SOLENOID TERMINAL		MEASUREMENT
		RESISTANCE @ 20°C (68°F)
A	B	Approximately 5 Ω



Check for stuck solenoid plunger.

SOLENOID CONNECTOR		MEASUREMENT
Battery post	Starter post	Open circuit



If any measurement is out of specification, replace solenoid.

**Dynamic Test**

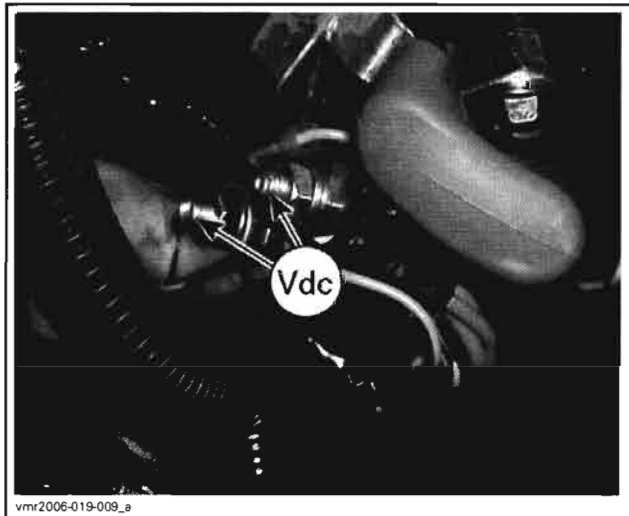
Turn ignition key ON and set engine run/stop switch to RUN.

For the following test, we do not want the engine to run. Set ECM in engine drowned mode as follows:

- Depress and hold throttle lever at full throttle position.
- Install a rubber band or some tape to maintain throttle lever in this position while testing.

Depress start button and while engine is cranking, measure the voltage drop as follows with a multi-meter.

SOLENOID CONNECTOR		MEASUREMENT
Post coming from battery	Post going to starter	0.2 Vdc max.



**⚠ WARNING**  
 Remove any rubber band or tape from throttle lever to release it.

If voltage is out of specification, replace solenoid. If solenoid tests good, check the electric starter. Reinstall cover.

**ELECTRIC STARTER**

**Starter Test**

Using booster cables, carefully supply current from the battery directly to the starter. Connect the BLACK (-) cable first. Then connect the remaining jumper cable from the battery then to the starter.

If starter turns ensure the cables/connections from solenoid to starter are in good condition.

If starter does not turn, replace starter.

### Starter Removal

Turn OFF ignition switch.

Disconnect BLACK (-) cable from battery.

**⚠ WARNING**

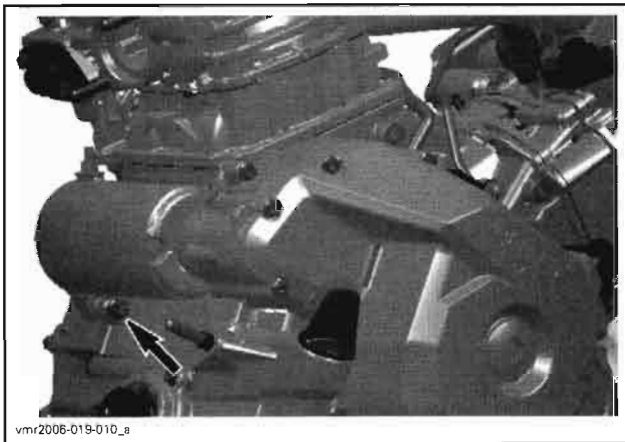
Always disconnect BLACK (-) cable first and reconnect last.

Remove the RH side cover and the engine cover (refer to *BODY*).

Disconnect RED (+) cable from starter.

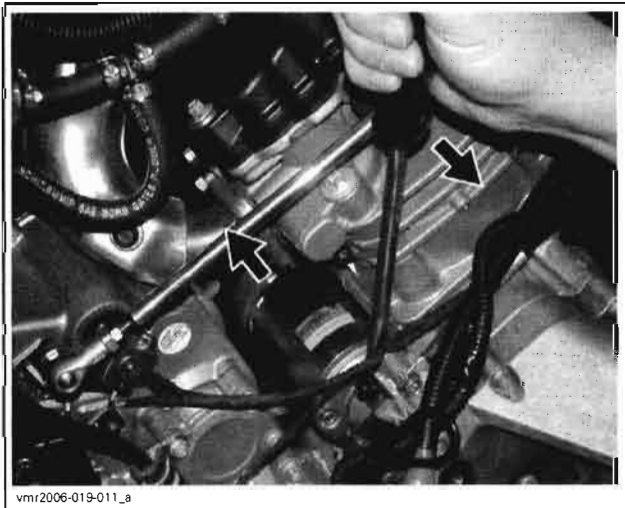
Clean starter area.

Remove starter mount screw.



SOME PARTS REMOVED FOR CLARITY PURPOSE ONLY

Carefully pry starter out of its housing.



Pull starter out.



### Starter Installation

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

Make sure that starter and engine mating surfaces are free of debris. Serious problem may arise if the starter is not properly aligned.

Bring starter close to its location. Rotate it so that its mounting ear allows installation in engine housing. Push in place and align mounting ear to install screw.

Torque starter screw to 25 N•m (18 lbf•ft).

Connect the RED (+) cable to the starter and torque nut to 6 N•m (53 lbf•in). Apply dielectric grease (P/N 293 550 004) on terminal and nut.

First connect RED (+) cable to battery then connect the BLACK (-) cable.

**⚠ WARNING**

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

Test starter operation.





# DIGITALLY ENCODED SECURITY SYSTEM (DESS)

## 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 *EMS DIAGNOSTIC*.

The ignition key contains a ROM chip with a unique digital code that is the equivalent of a unique teeth pattern on a conventional key.

When the ignition key is turned ON, the ECM is powered up as well as the multifunction speedometer and the accessories. Then, the ECM reads the ignition key and, if it is not recognized, no engine starting will be possible.

**NOTE:** When a key is not recognized by the ECM, INVALID KEY will be displayed in the multifunction speedometer.

To work on a particular DESS-equipped vehicle, the ignition key must have been programmed first.

**NOTE:** All ignition keys have the same teeth pattern. Therefore, they can be used and turned in the switch of any DESS-equipped vehicle. However, unless the DESS system recognizes (in the ECM) a valid programmed key, the engine starting will not be allowed.

**NOTE:** Actually, it is the memory of the ECM that is programmed to recognize the digital code of the ignition key.

The system is quite flexible. Up to 8 ignition keys may be programmed in the memory of the ECM. They can also be erased individually or all at once.

Note that the DESS circuitry is already activated on all new ECM.

## DESS KEY PROGRAMMING

Use the latest B.U.D.S. software available from BOSSWeb. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* for proper connection instructions.

The B.U.D.S. software is designed to allow, among other things, the programming of ignition key(s) and entering customer information.

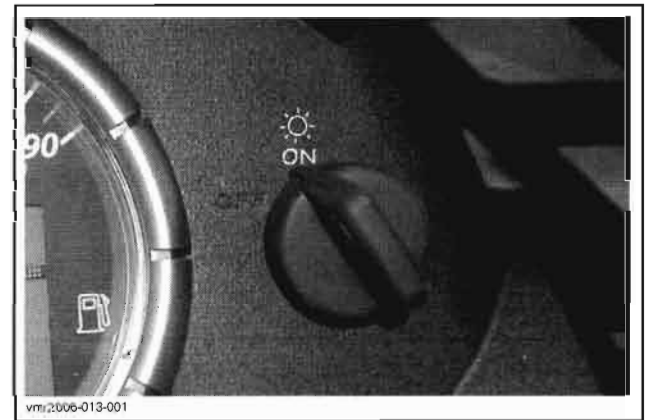
For more information pertaining to the use of the software B.U.D.S., use its help which contains detailed information on its functions.

## WARNING

If the computer you are using is connected to the 110 Vac power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the VCK.

Connect the MPI or the MPI-2 interface as described in *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE*.

Install key in ignition switch and turn it to ON.



Ensure engine run/stop switch is in RUN position.

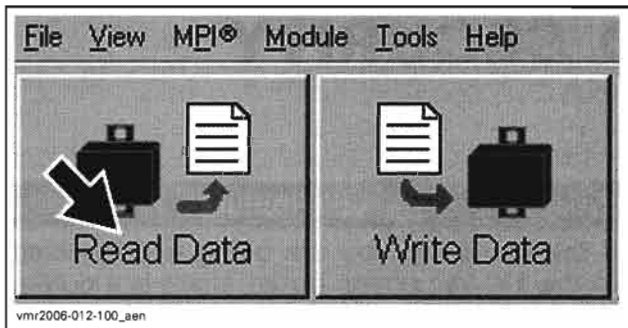


1. Run

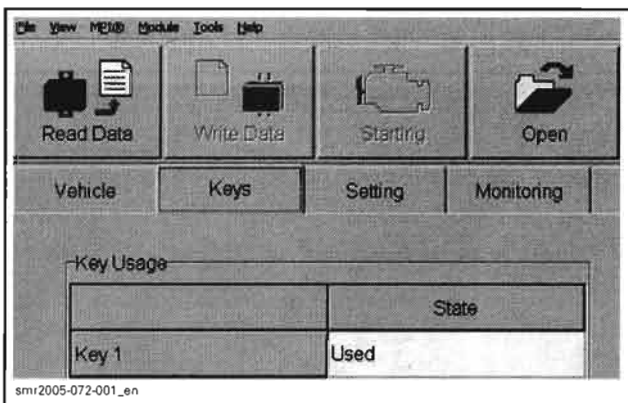
Read ECM using Read Data button.

## Section 06 ELECTRICAL SYSTEM

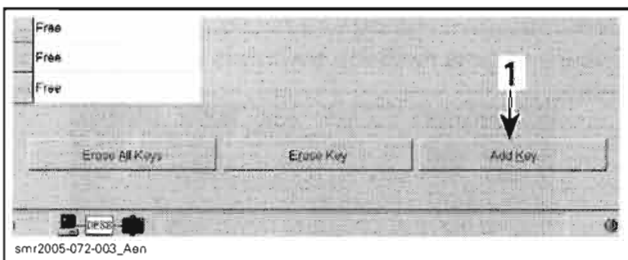
### Subsection 05 (DIGITALLY ENCODED SECURITY SYSTEM)



Turn ignition key OFF and remove key.  
Install the new key to be programmed.  
Turn ignition key ON.  
Click on **Keys** tab.



Click on ADD KEY button on bottom of screen.

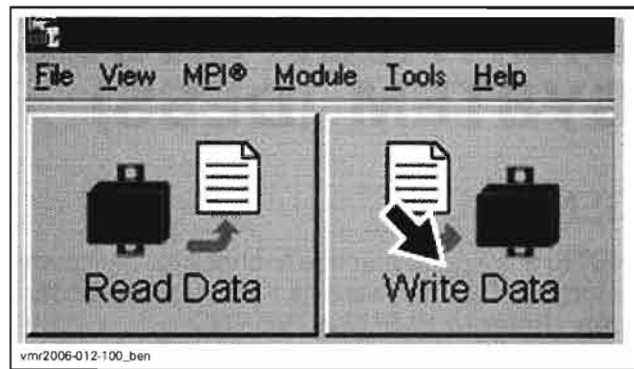


1. Click on this tab

A new key is now saved in the computer.

**NOTE:** To program other key(s), install a new key in ignition switch, turn it ON and click again on **Add Key** tab.

Ensure to save new data in ECM using **Write Data** button.



## TROUBLESHOOTING

If DESS key is not recognized by the ECM, key is defective or there is a wiring problem, CHECK ENGINE light will turn on and a message will be displayed in the multifunction speedometer.

Ensure DESS wiring is not reverted (BLACK/GREEN and ORANGE/RED).

To test wiring and ignition switch, refer to *IGNITION SYSTEM* section.

# LIGHTS, GAUGE AND ACCESSORIES

## SERVICE TOOLS

Description	Part Number	Page
Fluke 111 multimeter .....	529 035 868 .....	263-265
Back probe test wires.....	529 036 063 .....	264

## GENERAL

**NOTE:** For a complete overview of the vehicle electrical system, refer to *ENGINE MANAGEMENT*.

### ⚠ WARNING

It is recommended to always disconnect the battery when replacing any electric or electronic parts. Always disconnect battery exactly in the specified order, BLACK (-) cable first. Do not place tools on battery. Clean threads before applying a threadlocker. Refer to *SELF-LOCKING FASTENERS* and *LOCTITE APPLICATION* at the beginning of this manual for complete procedure. During assembly/installation, use the torque values and service products as in the exploded views. Torque wrench tightening specifications must strictly be adhered to. Locking devices (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be replaced with new ones.

## Diagnostic

The following gives general electrical-related problems. For specific system-related problems, refer to proper system section.

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

**IMPORTANT:** When solving an electrical problem, the first thing to do is to check battery condition as well as its cables and connections. Also ensure the ignition switch is turned on and engine run/stop switch is set to RUN. Check solidity (close to battery) and related-circuit fuse condition with an ohmmeter (visual inspection could lead to false results). Also visually examine harness and connections.

**IMPORTANT:** In an usual electric circuit, the battery supplies a switch which then supplies the electric component. Therefore the switch opens and closes the positive side of the circuit. In circuits controlled by the ECM, the battery supplies the electric component and the ECM works as a switch to complete the circuit to the ground. Take this into account when troubleshooting the electrical system.

Pay attention to ground wires.

### Checking for Shorts Between 2 Wires

When checking continuity of a wire in a circuit, wires should be checked for short circuit as follows.

Make sure to isolate circuit by unplugging connectors.

Let's suppose that the circuit to be checked has a RED and a BLACK wire. Using an ohmmeter, measure the resistance between the RED and the BLACK wire. The resistance should be infinite (0L). Otherwise, there is a short circuit between both wires. We must therefore identify and correct the fault.

### Recommended Tools

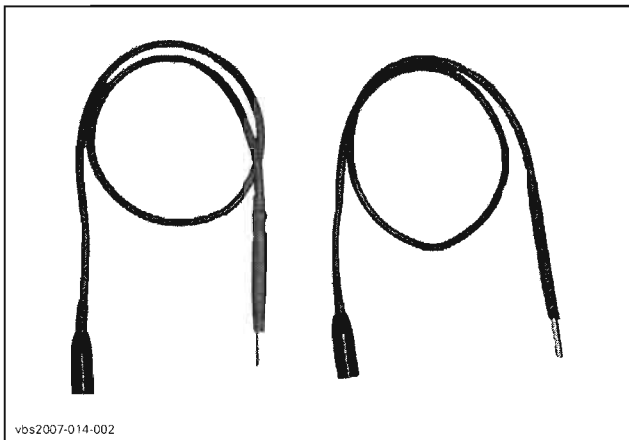
For best results, use the Fluke 111 multimeter (P/N 529 035 868).



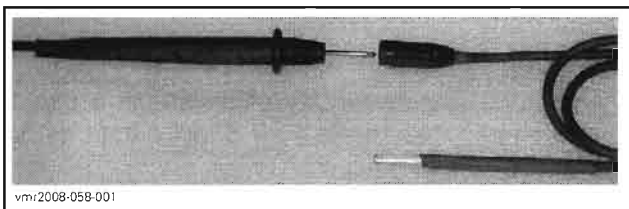
## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)

To easily probe wire terminals through the back of their connectors, Back probe test wires (P/N 529 036 063) can be used.



They can be inserted at the end of the standard probes of the Fluke 111 multimeter (P/N 529 035 868).



## Electrical Connectors

Pay particular attention to ensure that pins are not out of their connectors or damaged. The troubleshooting procedures cover problems not resulting from one of these causes.

**CAUTION:** Ensure all terminals are properly crimped on wires and connector housings are properly fastened. replacing any electric or electronic part(s), always check electrical connections. Make sure that they are tight and they make good contact and are corrosion-free. The voltage and current might be too weak to go through dirty wire pins. Check the posts for signs of moisture, corrosion or if they look dull. Clean pins properly and then coat them with silicon-based dielectric grease or other appropriate lubricant (except if otherwise specified) when reassembling them. See connectors information in *ELECTRICAL CONNECTORS*.

## PROCEDURES

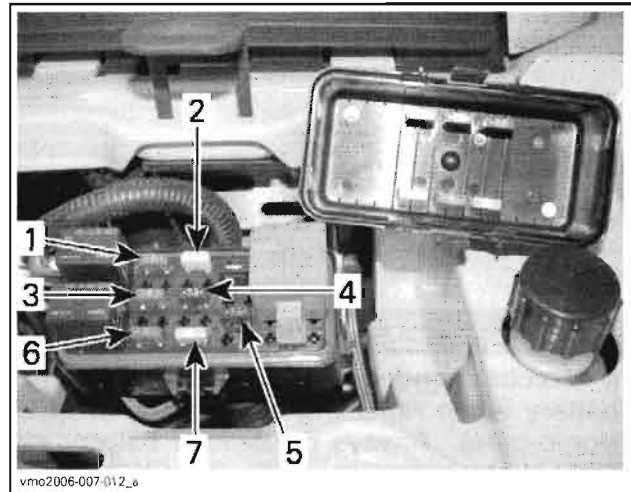
### FUSES

If a fuse is damaged, replace it with one of the same rating.

**CAUTION:** Do not use a higher rated fuse as this can cause severe damage.

Fuses are located in the front service compartment and at the back near battery (under cover).

### Fuses in Front Service Compartment



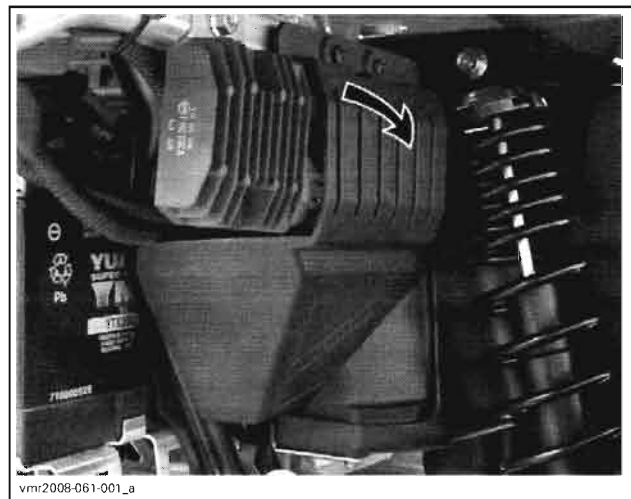
#### FRONT — FUSES LOCATION

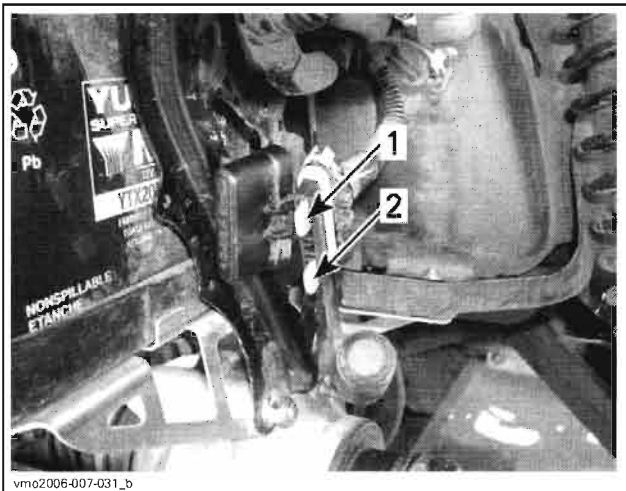
1. (F1) Ignition coils
2. (F2) Cooling fan
3. (F3) Fuel injectors
4. (F4) Accessories
5. (F5) Fuel pump
6. (F6) Engine Control Module (ECM)
7. (F7) Accessories

**NOTE:** A short circuited D5 or D6 diode will cause fuse F7 to burn. Refer to *D5 AND D6 DIODES (WINCH RELAY)* further in this section.

### Fuses located at the Rear

Remove cover.

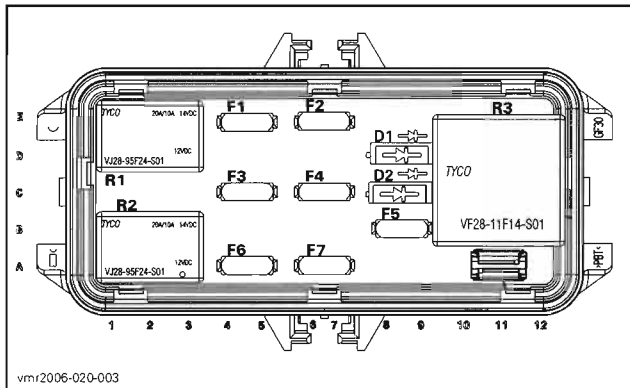




**REAR — FUSES LOCATION**  
1. (F9) Accessories  
2. (F8) Main

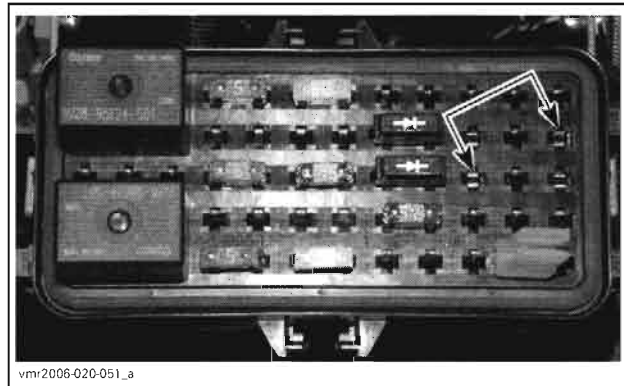
### ACCESSORY RELAY (R3)

**NOTE:** Relay may be inverted by 180° at installation and it will work correctly. Ensure to align tabs of relay with terminals of fuse holder at installation.



R3: Accessory relay

The easiest way to check a relay is to remove it and bypass it with a jumper. If the components then work, test relay. If it tested good, check wiring/connectors. See illustration to find where to bypass the relay.



RELAY R3 (ACCESSORIES)

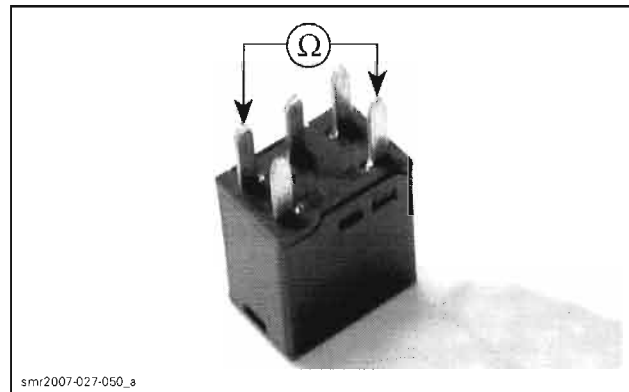
### Relay Continuity Test

Remove relay.

Use the Fluke 111 multimeter (P/N 529 035 868), and select the  $\Omega$  position.

Probe relay as follows.

TERMINAL		RESISTANCE
30	87	Open circuit (OL)

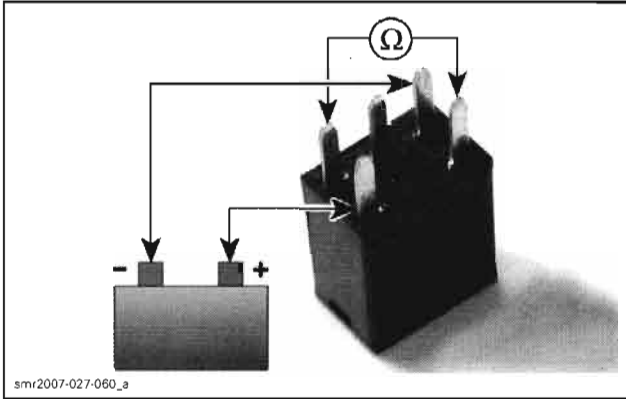


Connect battery as shown and probe relay again as follows.

TERMINAL		RESISTANCE
30	87	0.5 $\Omega$ max. (continuity)

## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)



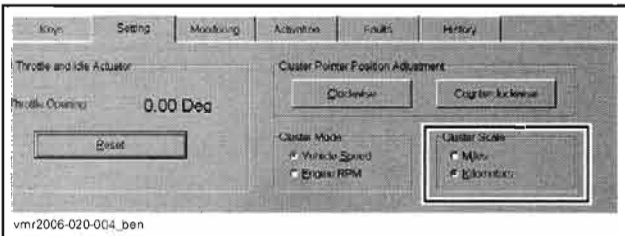
If relay failed any test, replace it.

## MULTIFUNCTION GAUGE

### Unit Selection (MPH vs km/h)

The multifunction gauges are factory preset in Imperial units but it is possible to change them to Metric units

Use B.U.D.S. software. Go in **Setting** tab and use **Cluster Scale**.



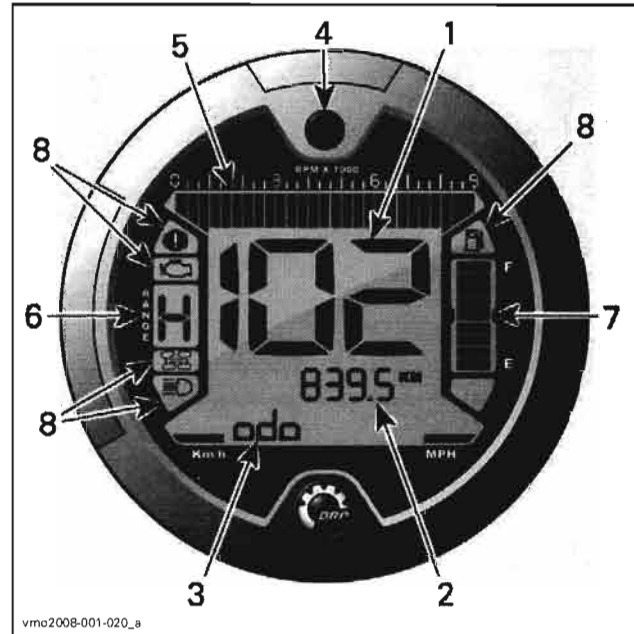
### Outlander 500/650/800 Series



1. Unit selection

## Gauge Operation

### Outlander 500/650/800 Series



1. Display 1 (speedometer)
2. Display 2 (mode)
3. Display 3 (mode/message)
4. Display selector button
5. Tachometer
6. Transmission position display
7. Fuel level display
8. Indicator lamps

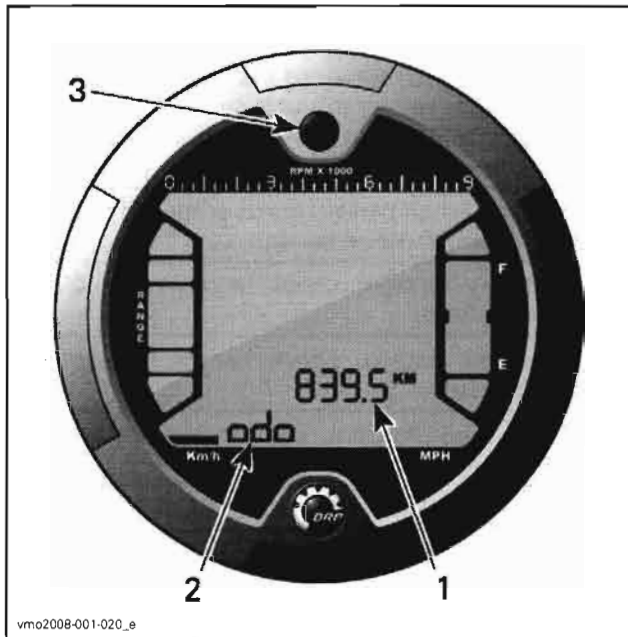
### Display 1 (Speedometer)

This display will show vehicle speed.



1. Vehicle speed
2. Unit selection

**Display 2 (mode)**



1. Display 2 (mode)
2. Display 3 (mode/message)
3. Selector button

By pressing the selector button, the following modes can be displayed:

- odometer (ODO)
- trip meter (TRIP)
- hour meter (TRIP TIME)
- vehicle hour meter (ENGINE HOURS)
- engine revolutions per minute (RPM).

**Display 3 (mode/message)**



1. Display 3 (mode/message)
2. Display 2 (mode)

This display will show either an abbreviation of the mode selected in display 2 or will communicate important messages to the operator if an anomaly occurs.

Abbreviation Mode:

- ODO (odometer)
- TRIP (trip meter)
- TRIP TIME (hour meter)
- ENGINE HOURS (vehicle hour meter)
- RPM (engine revolutions per minute).

## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)

Message Mode:

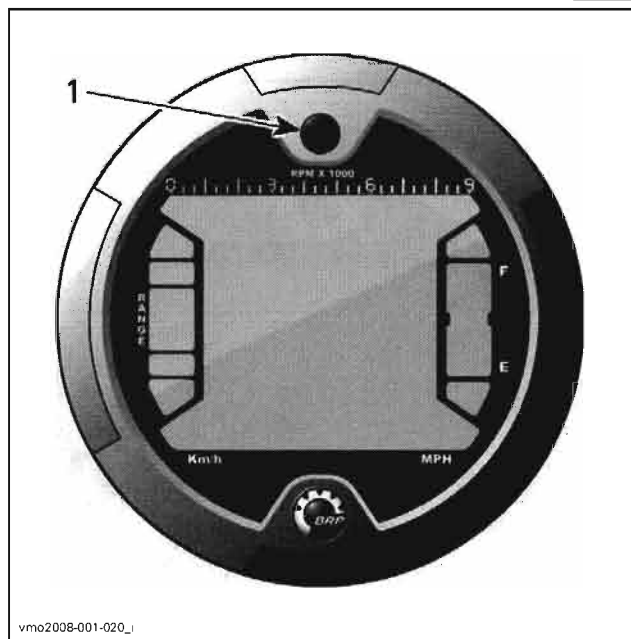
MESSAGE	PILOT LAMP(S) ON	DESCRIPTION
INVALID KEY	Check engine	Indicates that you have used the wrong ignition key, use the proper key for this vehicle. It is also possible that the ignition key has a bad contact, remove and clean key.
PARK BRAKE	Parking brake	Is displayed when parking brake is applied for more than 15 seconds (while riding).
LO BATT	Check engine	Low battery voltage, check battery voltage and charging system.
HI BATT	Check engine	High battery voltage, check battery voltage and charging system.
LOW OIL <sup>(1)</sup>	Check engine	Engine low oil pressure, stop engine immediately and check oil level.
HI TEMP <sup>(2)</sup>	Check engine	Engine is overheating, refer to <i>COOLING SYSTEM</i> .
LIMP HOME	Check engine	Serious fault detected by the engine management that can change the normal operation of the engine. Check engine indicator lamp will also blink, refer to <i>ENGINE MANAGEMENT</i> for more details.
CHECK ENGINE	Check engine	Engine management fault. Check engine indicator lamp will also be ON, refer to <i>ENGINE MANAGEMENT</i> for more details.
MAINTENANCE SOON	Check engine	Periodic maintenance required. <b>NOTE:</b> To reset message, use B.U.D.S. software and click <b>Reset Service</b> button in <b>Vehicle</b> tab.
NO ECM COMMUNICATION	Check engine	Communication error between multifunction gauge and engine control module (ECM). Refer to <i>ENGINE MANAGEMENT</i> .

**CAUTION:** <sup>(1)</sup> If the light does not turn off right after engine starting, stop engine. Check engine oil level. Refill if necessary. If the oil level is good, see *LUBRICATION*.

**CAUTION:** <sup>(2)</sup> If the light does not turn off right after engine starting, stop engine. See *COOLING SYSTEM*.

#### Display Selector Button

Button used to navigate between modes or to reset data depending on the feature selected.

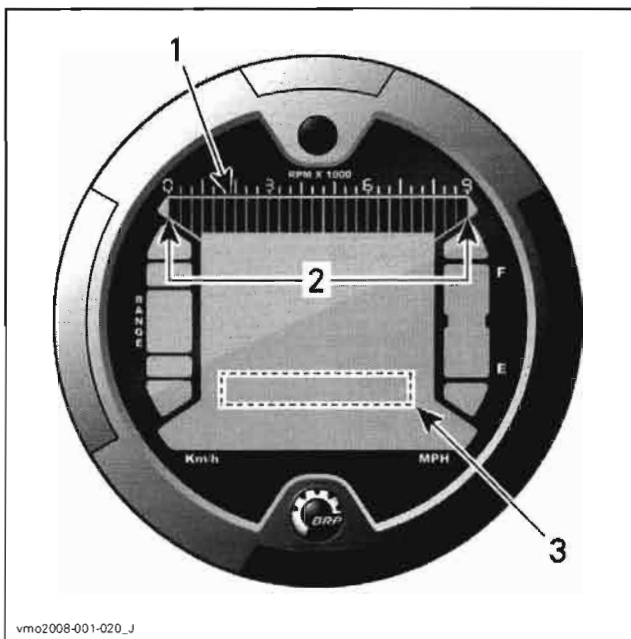


1. Selector button



**Tachometer**

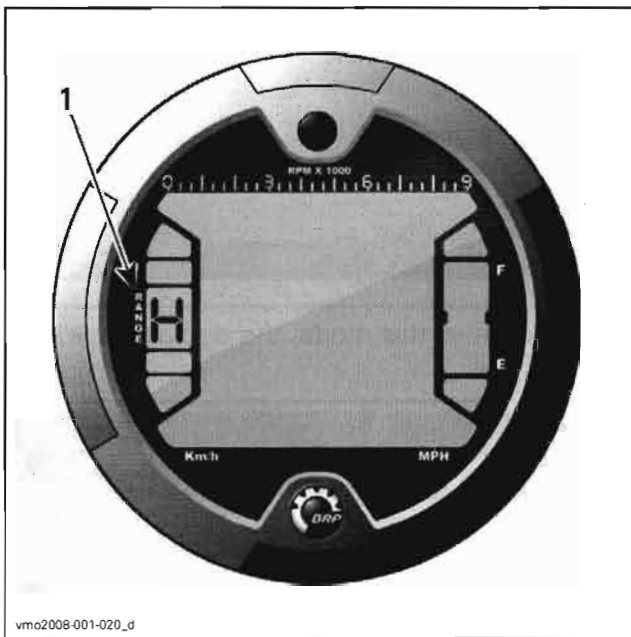
Measures engine revolutions per minute (RPM).  
 Multiply by 1000 to obtain the actual revolutions.



1. Tachometer
2. Operating range
3. Tachometer via display 2 (mode)

**Transmission Position Display**

This display will show transmission position.



1. Transmission position

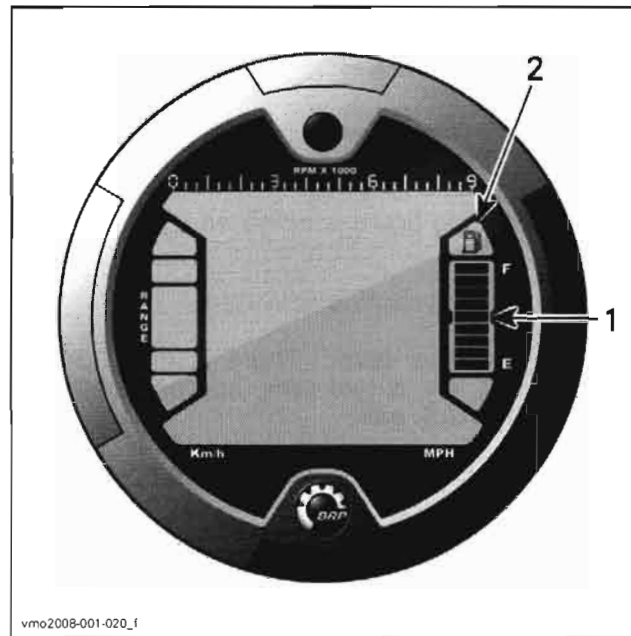
DISPLAY	FUNCTION
P	Park
R	Reverse
N	Neutral
H	High gear
L	Low gear

**NOTE:** If the letter "E" is displayed in the transmission position display, it means that there is an electrical communication error. Refer to *ENGINE MANAGEMENT*.

**Fuel Level Display**

Bar gauge that continuously indicates the amount of fuel left in the fuel tank.

Also, an indicator lamp will indicate a low-fuel condition as only one bar is displayed.

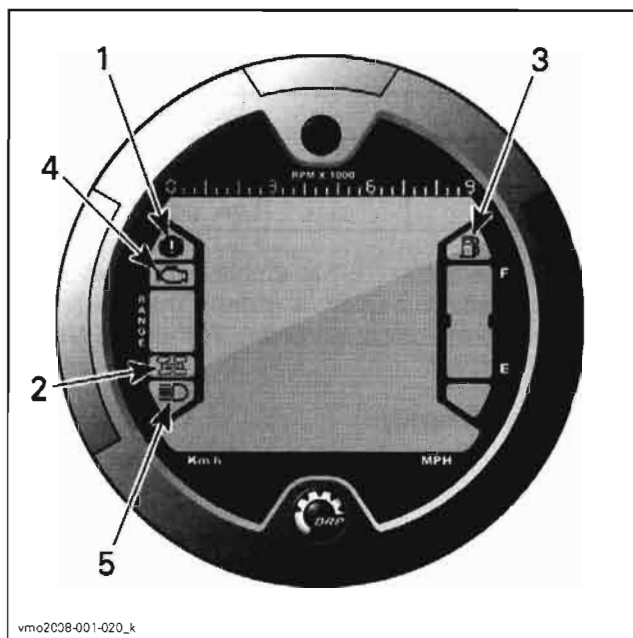


1. Fuel level display
2. Low fuel indicator lamp

## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)

#### Indicator Lamps



1. Parking brake indicator lamp
2. 4WD indicator lamp
3. Low fuel level indicator lamp
4. Check engine indicator lamp
5. High beam indicator lamp



Parking brake is activated.



4WD system is activated.



Low fuel level. There is only 30% of fuel left in fuel tank, approximately 6 L (1.6 U.S. gal).



Check engine/DESS system operation.



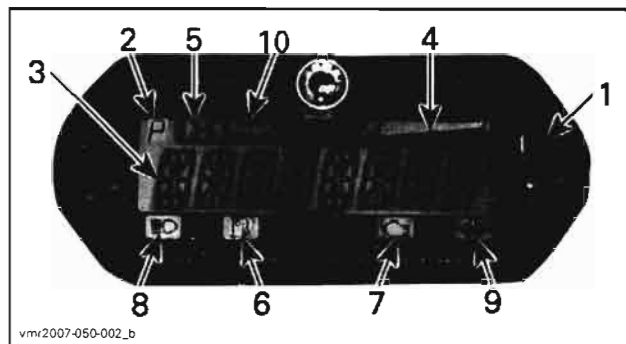
High headlamp beam position selected.

#### Renegade Models

This vehicle is equipped with an electronic multi-function gauge.



It is backlit every time the ignition switch is turned ON and engine run/stop switch is set to RUN.



1. Multifunction display selector button
2. Transmission position display
3. Multifunction display
4. Fuel level display
5. 4WD indicator lamp
6. Low fuel level indicator lamp
7. Check engine indicator lamp
8. High beam indicator lamp
9. Flasher/hazard signal indicator lamp (Europe only)
10. MPH, Km/h indicator lamp

#### Multifunction Display (Normal Display Mode)

After vehicle startup, the normal display mode shows either:

- vehicle speed
- engine revolution per minute (RPM)
- both parameters simultaneously (combined mode).

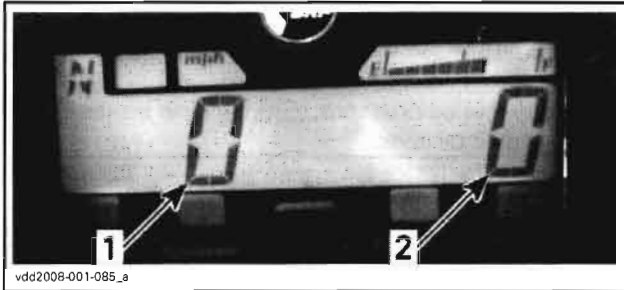
Speed Mode: in this mode, the display shows the speed of the vehicle either in km/h or in MPH.



RPM Mode: in this mode, the display shows the engine RPM.



Combined Mode: in this mode, the display shows the speed of the vehicle and the engine RPM.



1. Vehicle speed
2. Engine RPM

Mode Selection: to change from one mode to the other, proceed as follows:

1. Turn ignition key to ON. Wait until 'greeting' is finished.
2. Press and release selector button once to display OD (odometer).

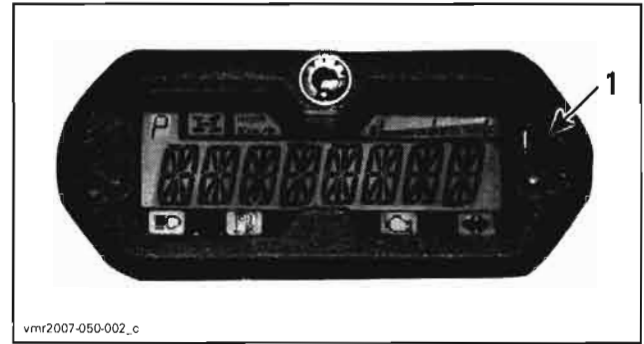


3. Press selector button and HOLD for 2 seconds. This will change the displayed mode to either Speed, RPM or Combined.
4. To select another mode, repeat steps 2 and 3 until you get the mode desired.

#### Multifunction Display (temporary display mode)

Press and release selector button to change the normal display mode to the following temporary mode:

- odometer
- trip meter (resettable)
- hour meter (resettable)
- vehicle hour meter.



1. Selector button

The gauge will display the selected mode for 10 seconds then will return to the normal display mode.

While in a resettable mode, push and HOLD selector button for 2 seconds to reset it.

#### Multifunction Display Codes/Messages

Fault Codes:

Fault codes (if so) can be displayed in the gauge. Refer to *ENGINE MANAGEMENT*.

Messages:

The following messages can also be viewed in the multifunction display:

## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)

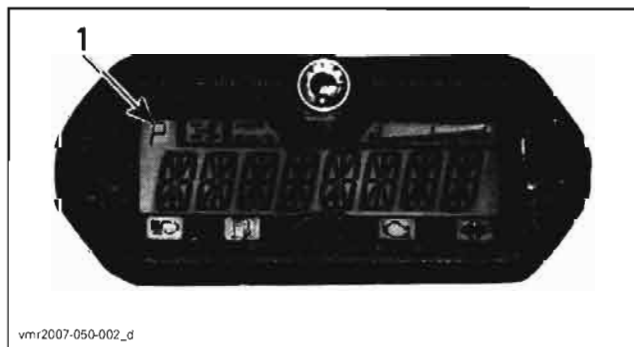
MESSAGE	DISPLAY FREQUENCY	CHECK ENGINE LAMP	DESCRIPTION
INVALID KEY	—	—	Indicates that you have used the wrong ignition key, use the proper key for this vehicle. It is also possible that the ignition key has a bad contact, remove and clean key.
BRAKE	—	—	Displayed whenever brake is used more than 15 seconds.
LO BATT	Every 5 seconds	ON	Low battery voltage. Check battery voltage and charging system.
HI BATT	Every 5 seconds	ON	High battery voltage. Check battery voltage and charging system.
LOW OIL <sup>(1)</sup>	Every 5 seconds	ON	Engine low oil pressure. Stop engine immediately and check oil level.
LOW FUEL	Every 5 seconds	—	Low fuel indicator lamp also turns on. Refer to <i>INDICATOR LAMPS</i> .
HI TEMP <sup>(2)</sup>	Every 5 seconds	ON	Engine is overheating. Refer to <i>COOLING SYSTEM</i> .
LIMP HOME	Every 5 seconds	Blinking	Serious fault on the engine that can change the normal operation of the engine. Refer to <i>ENGINE MANAGEMENT</i> for more details.
CHECK ENGINE	Every 5 seconds	ON	EMS fault. Refer to <i>ENGINE MANAGEMENT</i> for more details.
MAINTENANCE SOON	Every 30 minutes	ON	Periodic maintenance required. <b>NOTE:</b> To reset message, use B.U.D.S. software and click <b>Reset Service</b> button in <b>Vehicle</b> tab.
NO ECM COMMUNICATION	—	—	Communication error between gauge and engine control module (ECM). Refer to <i>ENGINE MANAGEMENT</i> .

**CAUTION:** <sup>(1)</sup> If the light does not turn off right after engine starting, stop engine. Check engine oil level. Refill if necessary. Do not use the vehicle until repaired.

**CAUTION:** <sup>(2)</sup> If the light does not turn off right after engine starting, stop engine. Do not use the vehicle until repaired.

#### Transmission Position Display

This display will show transmission position.



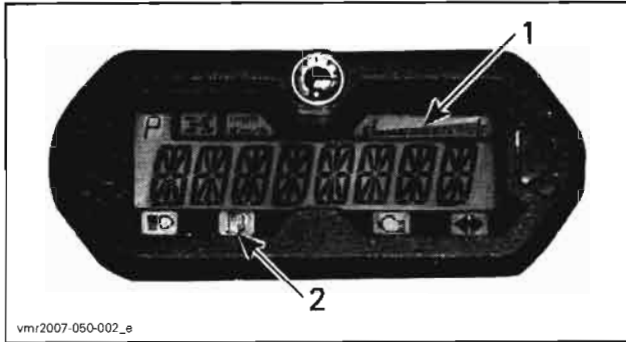
1. Transmission position

DISPLAY	FUNCTION
P	Park
N	Neutral
R	Reverse
H	High gear
L	Low gear

**NOTE:** If the letter "E" is displayed in the transmission position display, it means that there is an electrical communication error.

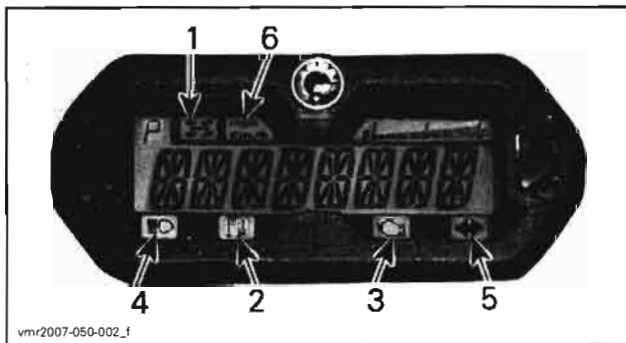
#### Fuel Level Display

Bar gauge continuously indicates the amount of fuel in the fuel tank while riding.





1. Fuel level display
2. Low fuel indicator lamp


### Indicator Lamps





1. 4WD indicator lamp
2. Low fuel level indicator lamp
3. Check engine indicator lamp
4. High beam indicator lamp
5. Flasher/Hazard signal indicator lamp (Europe only)
6. MPH or km/h indicator lamp

 When this indicator is ON, it indicates the 4WD system is activated.

 When this indicator is ON, it indicates that there is only 30% of fuel left in fuel tank, approximately 6 L (1.6 U.S. gal).

 When this indicator is ON, it indicates an engine fault code, look for message in multifunction display. When this indicator blinks, it indicates that the LIMP HOME mode is activated, refer to *TROUBLESHOOTING* for more details.

 When this indicator is ON, it indicates high intensity is selected on the headlamps and ignition key is in LIGHTS position.

 When this indicator is blinking, it indicates the flasher/hazard is activated (Europe only).

 **mph**  
**Km/h** The proper lamp turns on to indicate the unit the speedometer uses.

### Function Display Problems

When the functions do not display, check for fault code(s). Refer to *ENGINE MANAGEMENT* section. When a specific function does not work, proceed as follows.

#### Fuel Level

As a quick test with B.U.D.S., go in **Activation** tab and activate fuel level display area.

If it does not work, check wiring/connectors and if they are good, try a new multifunction gauge.

If it works, check fuel level sender. Refer to procedure further in this section.

#### Transmission Position Display

If the letter "E" is displayed in transmission position display, there is an electrical communication error. Refer to *GEARBOX AND 4X4 COUPLING UNIT*.

As a quick test with B.U.D.S., go in **Activation** tab and activate transmission position display area.

If it does not work, try a new multifunction gauge.

If it works, check gearbox switches. Refer to *GEARBOX AND 4X4 COUPLING UNIT*.

#### 2/4WD Pilot Lamp

As a quick test with B.U.D.S., go in **Activation** tab and activate 2/4WD lamp area.

If it does not work, try a new multifunction gauge.

If it works, check gearbox switch. Refer to *GEARBOX AND 4X4 COUPLING UNIT*.

#### HI Beam Pilot Lamp

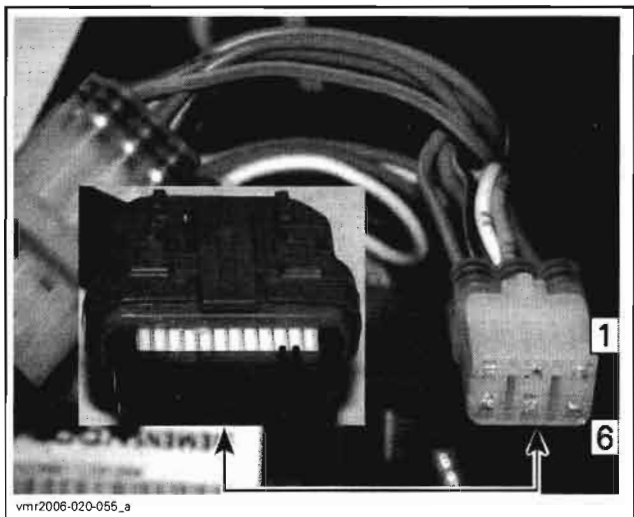
As a quick test with B.U.D.S., go in **Activation** tab and activate HI beam lamp area.

If it does not work, try a new multifunction gauge.

If it works, check if headlamp work. If headlamp do not work, refer to *HEADLAMP*. If headlamp work, check wire/connectors between multifunction gauge and low/hi beam switch.

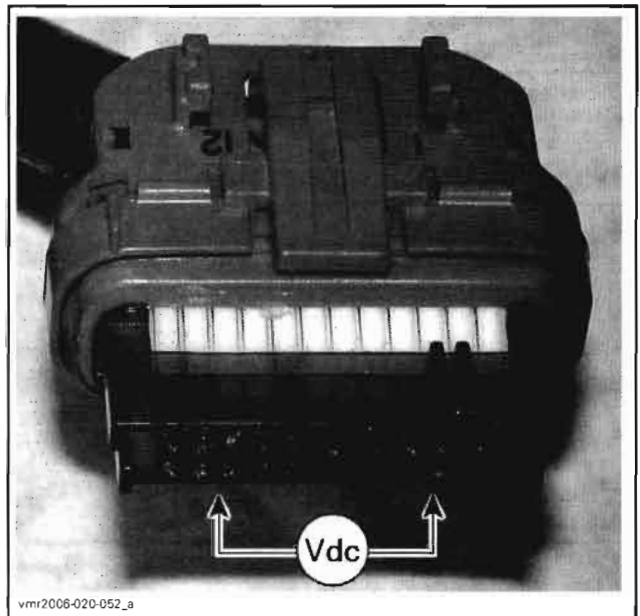
GAUGE CONNECTOR	MULTIFUNCTION SWITCH CONNECTOR (MG2)	RESISTANCE
Pin 5	Pin 5	Close to 0 Ω

**Section 06 ELECTRICAL SYSTEM**  
**Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)**



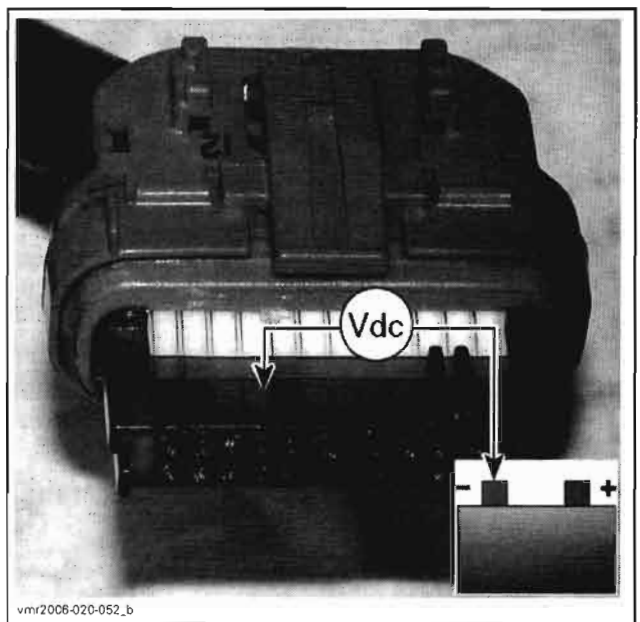
Disconnect gauge connector. Turn ignition key ON and set engine run/stop switch to RUN. Read voltage from vehicle harness as follows.

GAUGE CONNECTOR (harness side)		VOLTAGE
Pin 17	Pin 20	Battery voltage



If there is no voltage, recheck voltage as follows.

GAUGE CONNECTOR (harness side)		VOLTAGE
Pin 17	Battery ground	Battery voltage



If voltage is not appropriate, check/repair wiring and/or connectors from battery.

If wire is faulty, replace/repair.

**Multifunction Gauge Pinout**

FUNCTION	PIN
Power 12 Vdc	17
Ground	20
CAN line	18
CAN line	19
Fuel level gauge supply	4
Fuel level gauge ground	21
2/4WD switch signal	7
HI beam signal	5

**Voltage Test**

QUICK CHECK		
OBSERVATION	POSSIBLE CAUSE	
Multifunction gauge does not turn on	Burnt fuse (F8)	
	Faulty relay (main)	
	Burnt fuse (F4)	
	ECM not powered:	- burnt fuse (F6) - defective diode (D1) - defective ECM
	Defective multifunction gauge	
	Faulty multifunction switch or key	
	Wiring/connectors	

If battery voltage is good, check ground circuit (pin 20) wiring/connector. If they test good, temporarily connect pin 20 to battery ground. If multifunction gauge turns on, try a new ECM.

When everything else has been tested and multifunction still does not turn on, try a new one.

### Multifunction Gauge Removal

#### **Outlander 500/650/800 Series**

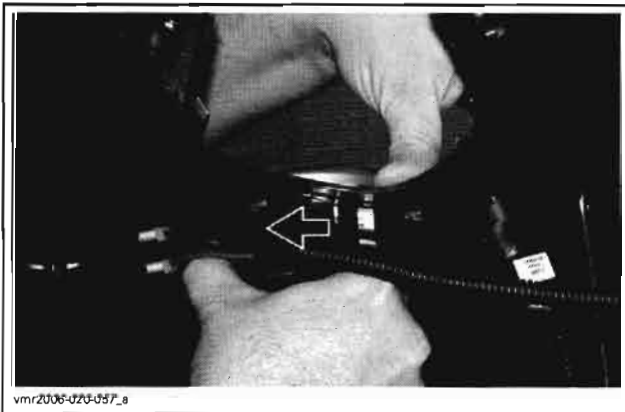
Remove center panel and dashboard. Refer to *BODY*.

Unplug gauge connector.

Locate locking tab then push edge of dashboard to release tab.



While holding tab, rotate gauge to unlock.



#### **Renegade Models**

Remove dashboard. Refer to *BODY*.

Push gauge tabs while pulling it out.

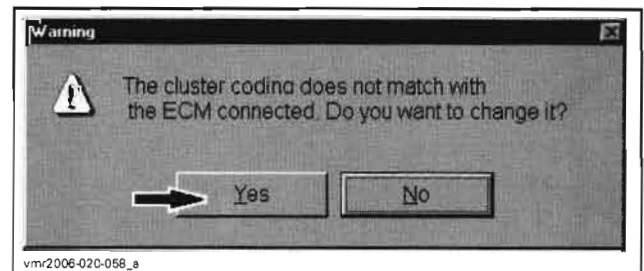


### Multifunction Gauge Installation

For the installation, reverse the removal procedure.

### New Multifunction Gauge Registration (coding)

Whenever multifunction gauge is replaced, it is required to use B.U.D.S. to register it in ECM. Simply click **Yes** when the following message appears.



**IMPORTANT:** If a multifunction gauge from another vehicle model is installed and is not registered in ECM through B.U.D.S., engine starting will not be allowed until gauge is registered with proper coding.

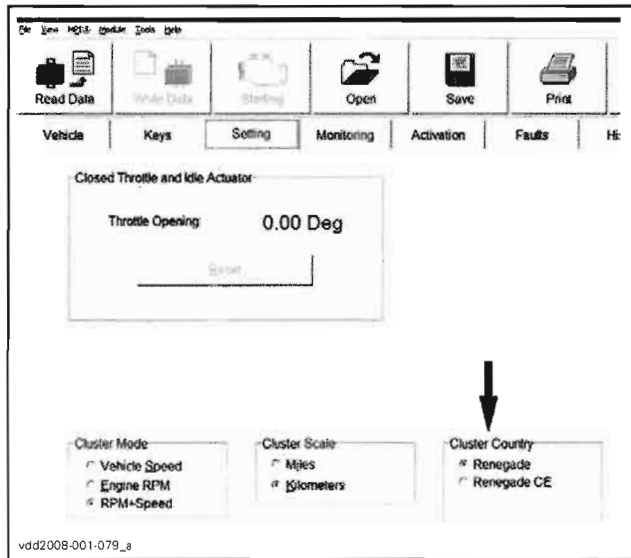
### Country Selection

#### **Renegade Models**

To enable flasher pilot lamp in gauge of European Community (CE) models, use B.U.D.S. software and set cluster country to Renegade CE under Settings.

## Section 06 ELECTRICAL SYSTEM

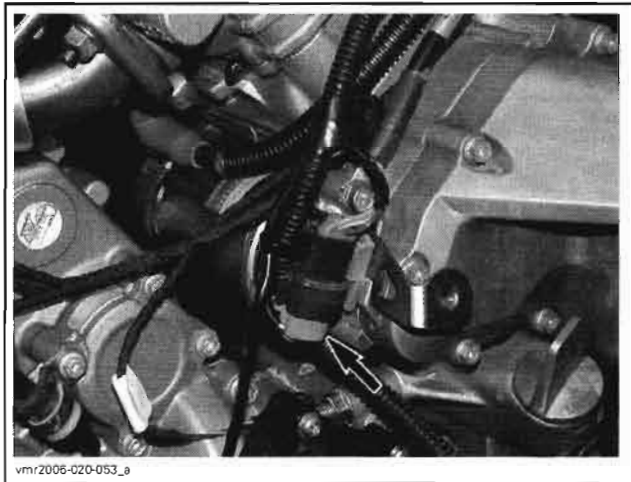
### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)



Outside Europe, select Renegade.

## VEHICLE SPEED SENSOR (VSS)

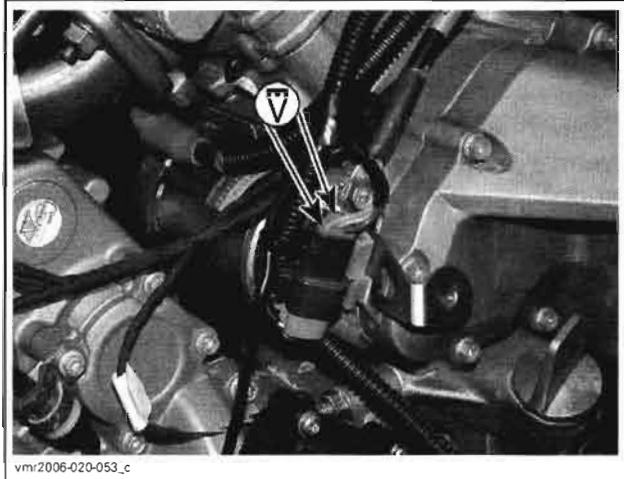
Locate VSS connector in gearbox area.



TYPICAL — V810 ENGINE SHOWN

Turn ignition key ON.  
Set engine run/stop switch to RUN.  
Use a multimeter and set it to Vdc.  
Back-probe connector and read voltage as follows.

SPEED SENSOR CONNECTOR (harness side)		VOLTAGE
ORANGE/ GREEN	BROWN/ ORANGE	Battery voltage



If voltage is not good, check/repair wiring/connectors.

If voltage is good, do the following test.

Lift rear of vehicle so that rear wheels are off the ground.

Set transmission to 2WD and to Neutral.

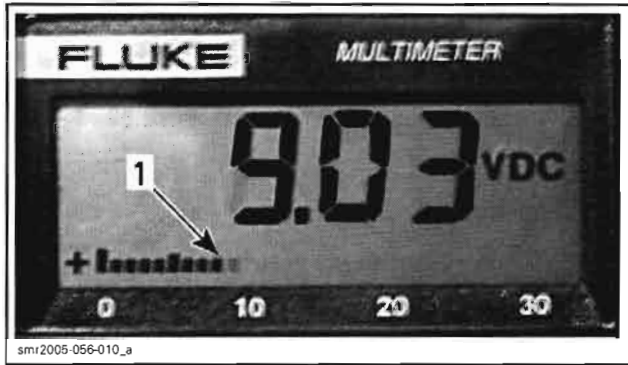
Back-probe connector and read voltage while slowly rotating rear wheels with your hands.

SPEED SENSOR CONNECTOR (harness side)		VOLTAGE
ORANGE/ GREEN	PINK	Alternate reading of: battery voltage, approx. 0 Vdc, battery voltage and so on



**NOTE:** Since we measure pulsating voltage, the numeric display will continuously change. The analog display may be easier to follow.





1. Analog display

If voltage is appropriate, check/repair wiring/connector between sensor and ECM. If it is good, try a new ECM.

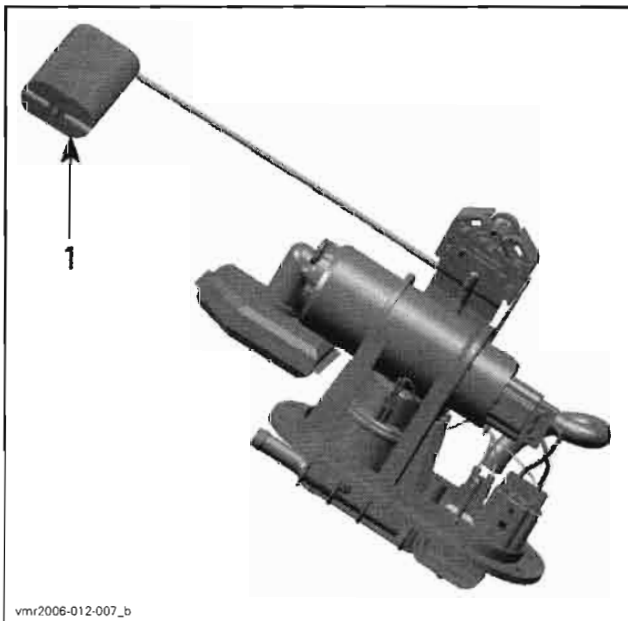
If voltage is wrong, try a new sensor.

**NOTE:** Whenever the VSS is found defective, check diode D2. It could be the cause of the VSS failure.

Test diode D2 as explained in *STARTING SYSTEM* section.

## FUEL LEVEL SENDER

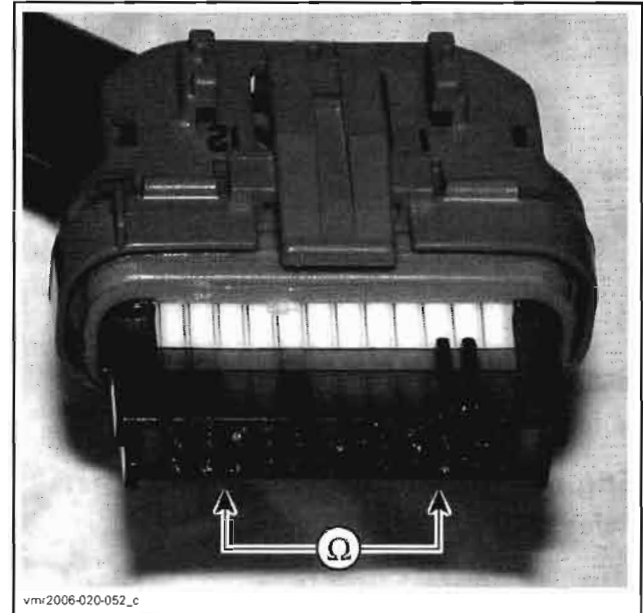
The fuel level sender is part of the fuel pump module mounted inside the fuel reservoir.



**FUEL PUMP MODULE**  
1. Float and arm

Disconnect multifunction gauge connector.  
Measure resistance as per table.

FUEL LEVEL AT GAUGE CONNECTOR		FLOAT POSITION	RESISTANCE MEASUREMENT 20°C (68°F)
Pin 12	Pin 15	Float down (empty)	100 ± 7 Ω
		Float up (full)	5 ± 2 Ω



If resistance is not within empty and full values (depending on fuel quantity), check and repair wiring and/or connectors between multifunction gauge and fuel level sender. If they test good, replace fuel pump module. Refer to *FUEL TANK AND FUEL PUMP*.

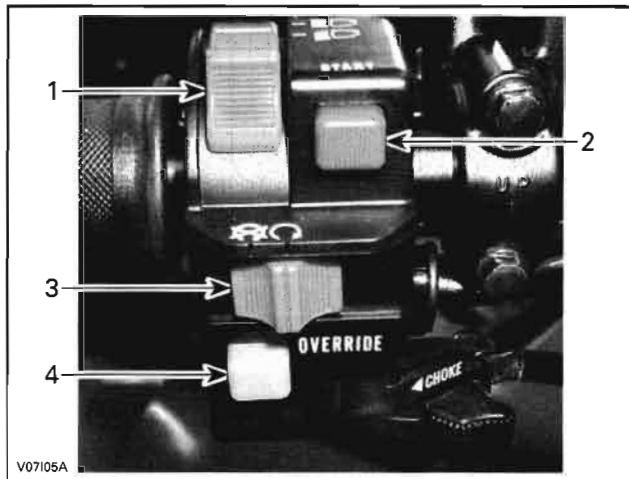
If fuel level sender and wiring/connectors are good, try a new multifunction gauge.

## MULTIFUNCTION SWITCH

Apply parking brake, place transmission lever in NEUTRAL position and start engine.

## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)



1. Low/Hi beam switch
2. Start switch
3. Engine run/stop switch
4. Override switch

#### Start Switch

Refer to *STARTING SYSTEM*.

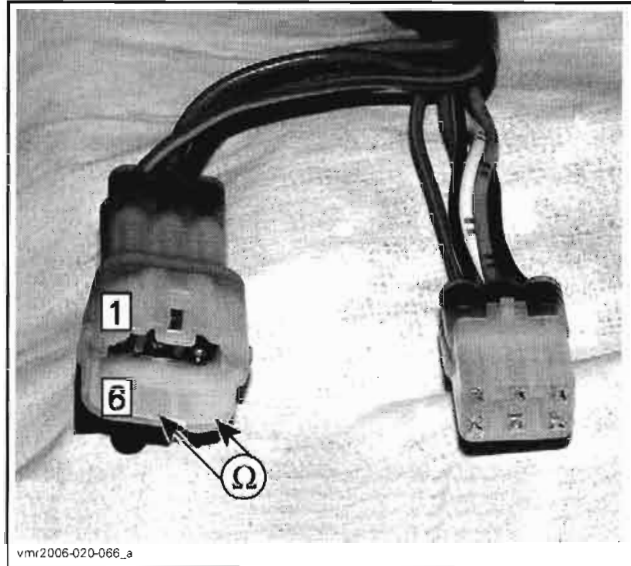
#### Engine Run/Stop Switch

Refer to *IGNITION SYSTEM*.

#### Low/Hi Beam Switch

Using a multimeter, measure the resistance as follows.

POSITION	MULTIFUNCTION SWITCH CONNECTOR (MG2)		RESISTANCE @ 20°C (68°F)
Switch to LO	Pin 2	Pin 4	0.2 Ω max.
Switch to HI	Pin 5	Pin 4	

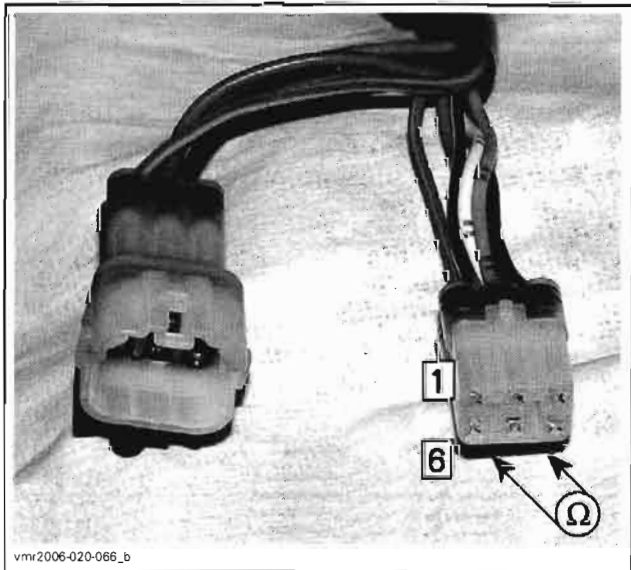


Replace multifunction switch if defective.

#### Override Switch

Using a multimeter, measure the resistance between the following wires.

SWITCH POSITION	MULTIFUNCTION SWITCH CONNECTOR (MG1)		RESISTANCE @ 20°C (68°F)
	Pin 5	Pin 6	
Released			0.2 Ω max.
Pushed			Open (0L)



Replace multifunction switch if defective.

## 12-VOLT AUXILIARY POWER OUTLET

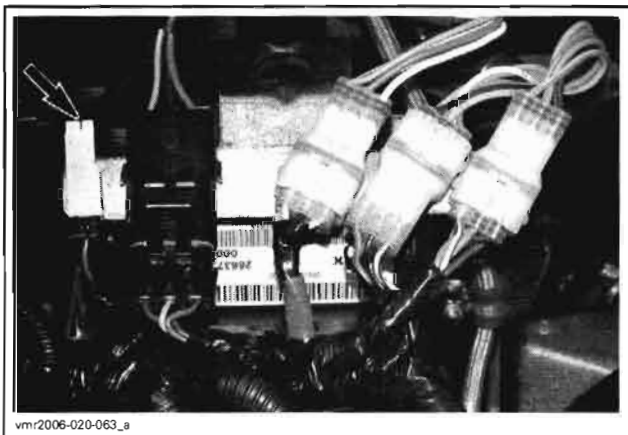
The 12-volt auxiliary power outlet allows the installation of additional accessories.

### 12-Volt Auxiliary Power Outlet Test

Remove center panel and dashboard. Refer to *BODY*.

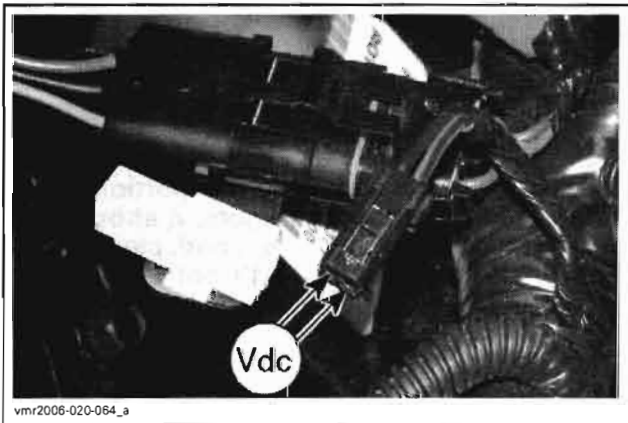
Turn ignition key on and set engine run/stop switch to RUN.

Unplug power outlet connector.



Using a multimeter, measure the voltage as follows.

WIRE COLOR		VOLTAGE
RED/BLACK	BLACK	12 - 14.5 Vdc



- No voltage:
  - Check fuses F4, F7, relay R3 (accessories) and wiring condition.
- Voltage is good:
  - Check accessories.

## 12-VOLT POWER OUTLET

### 12-Volt Power Outlet Removal

Remove console. Refer to *BODY*.

Unplug the connectors of the power outlet.

Unscrew the retaining nut.

### 12-Volt Power Outlet Installation

Reverse the removal procedure.

### 12-Volt Power Outlet Test

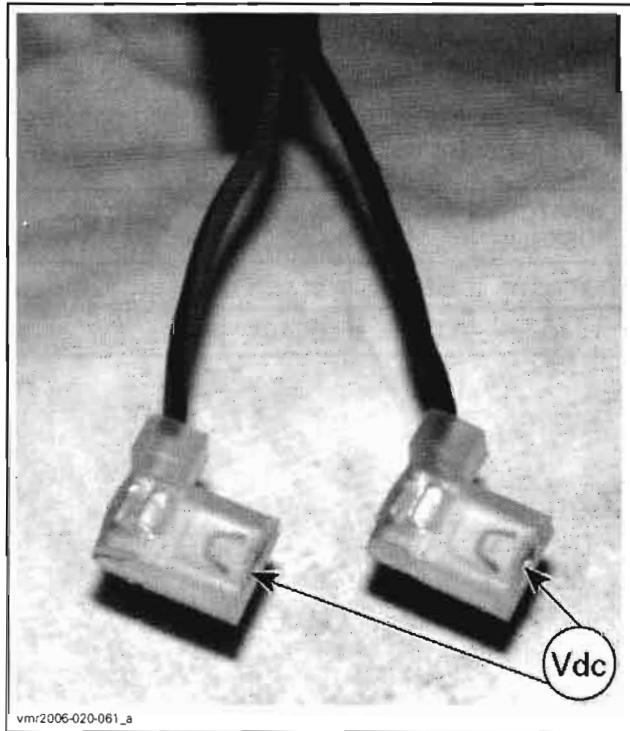
Remove center panel and dashboard. Refer to *BODY*.

Turn ignition key on and set engine run/stop switch to RUN.

Unplug the power outlet connectors.

Using a multimeter, measure the voltage as follows.

WIRE COLOR		VOLTAGE
RED/BLACK	BLACK	12 - 14.5 Vdc



Ensure to reconnect RED/BLACK wire to positive terminal.

**Section 06 ELECTRICAL SYSTEM**  
**Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)**



- No voltage:
  - Check fuses F4, F7, relay R3 (accessories) and wiring condition.
- Voltage is good:
  - Change power outlet.

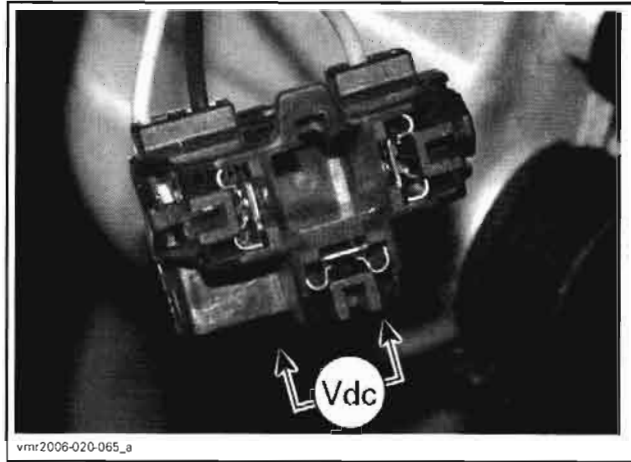
**HEADLAMP**

**Headlamp Test**

Disconnect headlamp connector. Refer to *BULB REPLACEMENT*.

Using a multimeter, measure the voltage on headlamp connector as follows.

SWITCH POSITION	WIRE COLOR		VOLTAGE
LO beam	GREEN	BLACK	12 - 14.5 Vdc
HI beam	BLUE	BLACK	



TYPICAL

- Voltage is good:
  - Change headlamp bulb(s).
- No voltage:
  - Check fuses F4, F7, relay R3 (accessories) and wiring condition.
  - Check ignition switch as follows.

SWITCH POSITION	PIN		RESISTANCE @ 20°C (68°F)
OFF	A	F	Infinite (OL)
ON with lights			1 Ω max.
ON without lights			Infinite (OL)

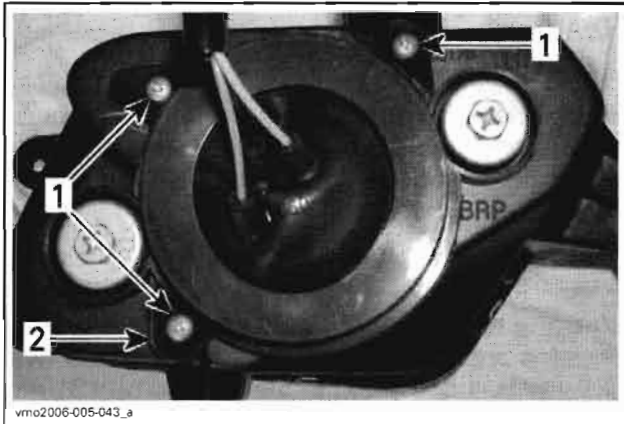
- Check low/hi beam switch. refer to *MULTI-FUNCTION SWITCH* elsewhere in this section.

**Bulb Replacement**

**CAUTION:** Never touch glass portion of an 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.

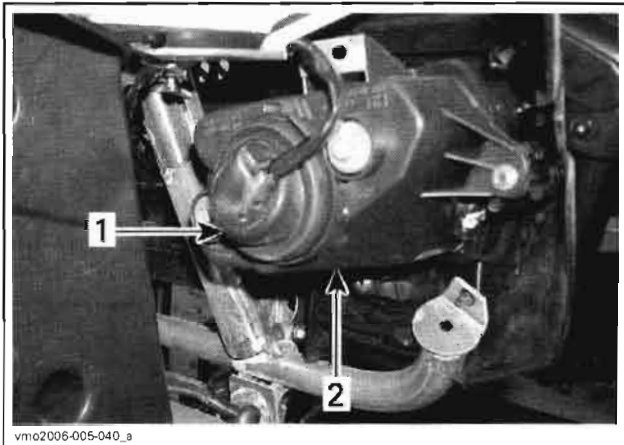
**All Models except Renegade**

Remove cover screws.



- 1. Screws
- 2. Cover

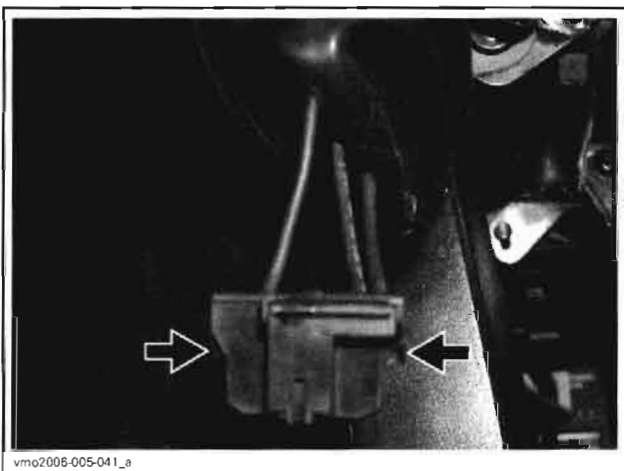
Remove rubber protector over headlamp housing.



- 1. Rubber protector
- 2. Headlamp housing

Unplug connector from headlamp.

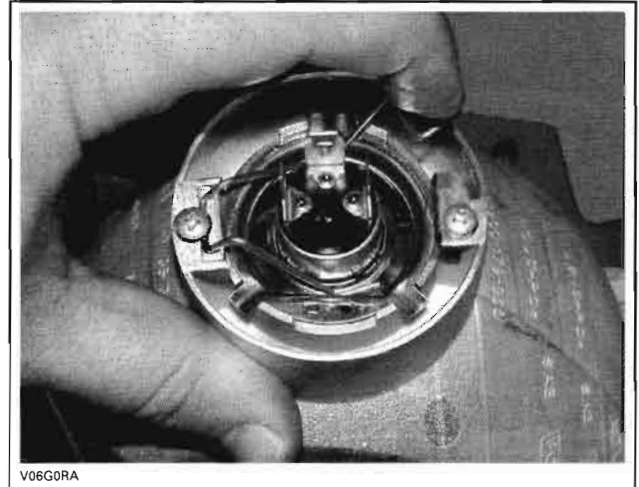
**NOTE:** Use small locking tab to unlock connector then pull on connector.



**PUSH ON LOCKING TAB TO UNLOCK CONNECTOR**

Press the spindle then push it on the side to unlock headlamp bulb.

vmr2008-064



V06G0RA

*TYPICAL*

Lift and hold the spindle then remove the bulb.



V06G0SA

*TYPICAL*

Properly reinstall removed parts in the reverse order of their removal.

Validate headlamp operation.

**Renegade Models**

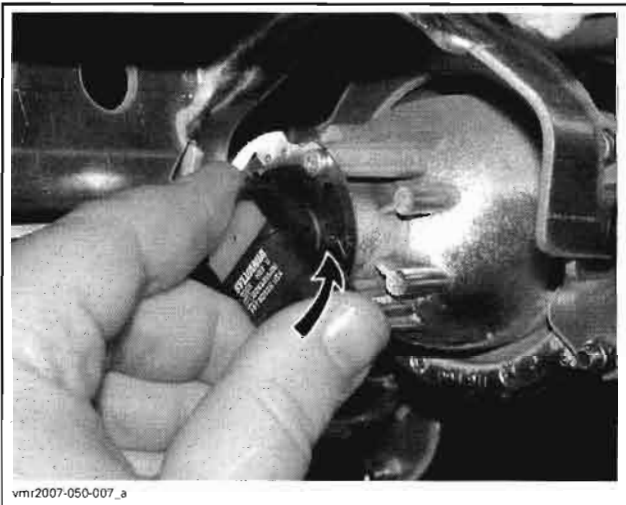
**NOTE:** The same headlamp is used on both sides of vehicle and for LO and HI beams.

Unplug connector from bulb.

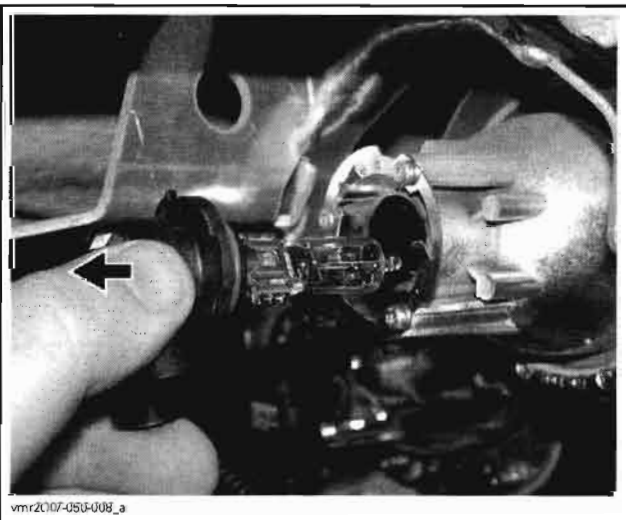
**Section 06 ELECTRICAL SYSTEM**  
**Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)**



Rotate bulb.



Pull out bulb.



Properly reinstall removed parts in the reverse order of their removal.

Validate headlamp operation.

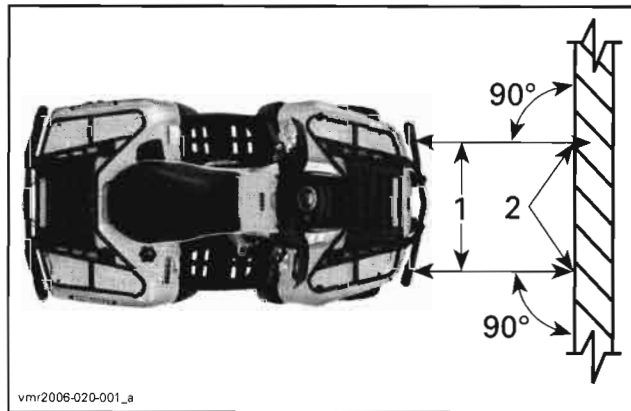
**Headlamp Beam Aiming**

Select high intensity.

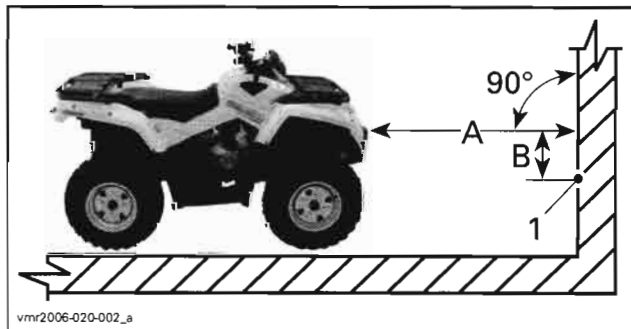
Beam aiming is correct when center of high beam is 131 mm (5 in) below the headlamp horizontal center line, scribed on a test surface, 5 m (17 ft) away.

**NOTE:** Sit down the driver or place the same weight on the vehicle.

Measure headlamp center distance from ground. Scribe a line at this height on test surface (wall or screen). Light beam center should be 131 mm (5 in) below scribed line.



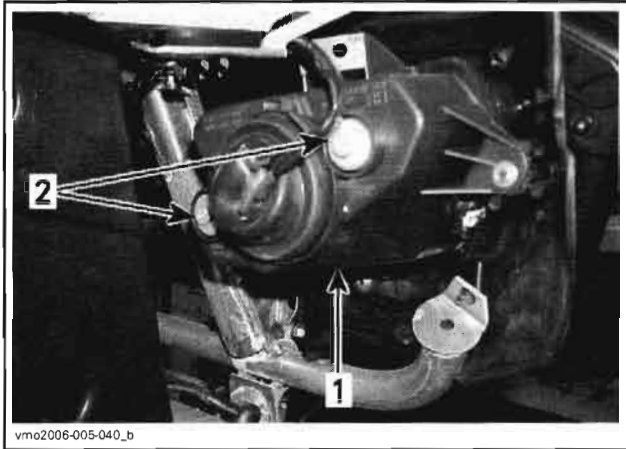
1. Headlamp center lines
2. Light beam center



1. Light beam center
- A. 5 m (17 ft)
- B. 131 mm (5 in)

**Adjustment**

Turn adjustment screws to adjust beam height and side orientation as described below. Adjust both headlamps evenly.

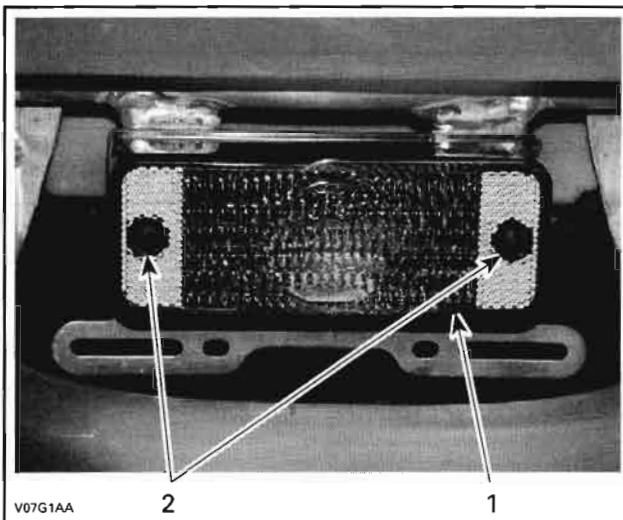


**TYPICAL**  
 1. Headlamp cover  
 2. Adjustment screws

## TAILLIGHT

### Bulb Replacement

Unscrew lens screws to expose bulb.



**TYPICAL**  
 1. Lens  
 2. Screws

Push bulb in and hold while turning counterclockwise to release.

Install the new bulb by first pushing in while turning clockwise.

## WINCH

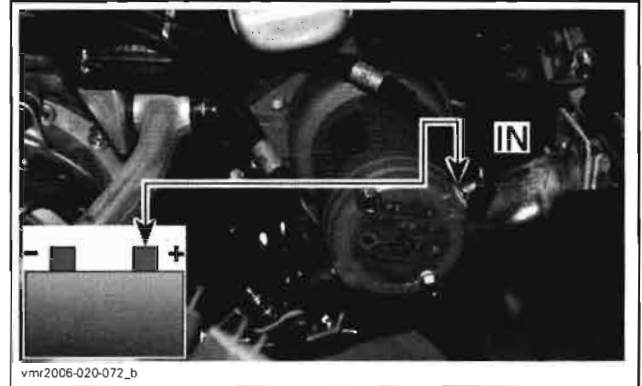
### *XT Models Only*

#### Winch Test

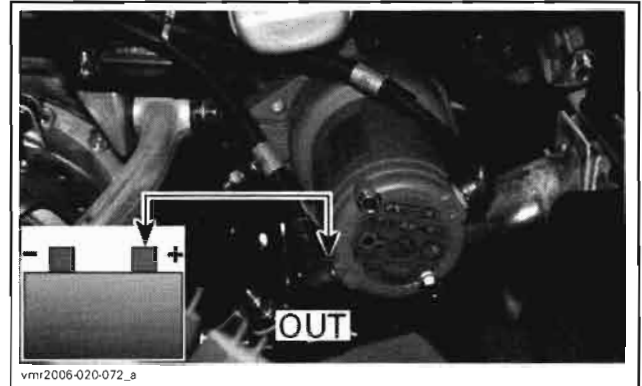
##### Winch Motor

Using boosting cables, connect battery power to IN post of winch then to OUT post.

vmr2008-064



vmr2006-020-072\_b



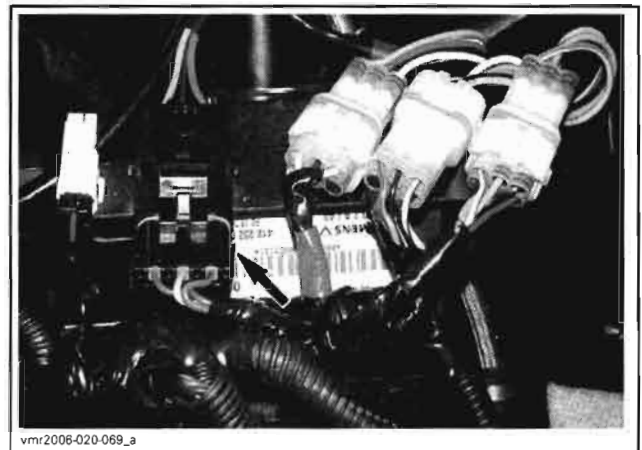
vmr2006-020-072\_a

If motor does not turn in any test, replace motor. If it works, continue testing.

#### Voltage Supply to Switch

Remove center panel and dashboard. Refer to *BODY*.

Disconnect the winch control switch connector.



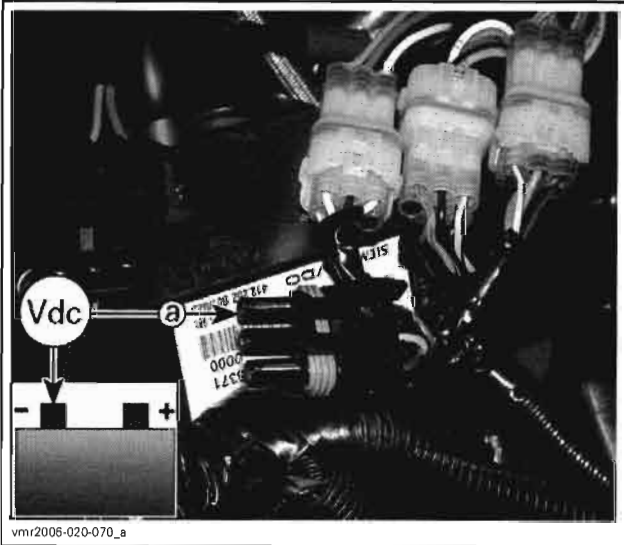
vmr2006-020-069\_a

Using a multimeter, measure the resistance as follows.

## Section 06 ELECTRICAL SYSTEM

### Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)

WINCH SWITCH CONNECTOR (harness side)		VOLTAGE
Pin A	Battery ground	12 Vdc



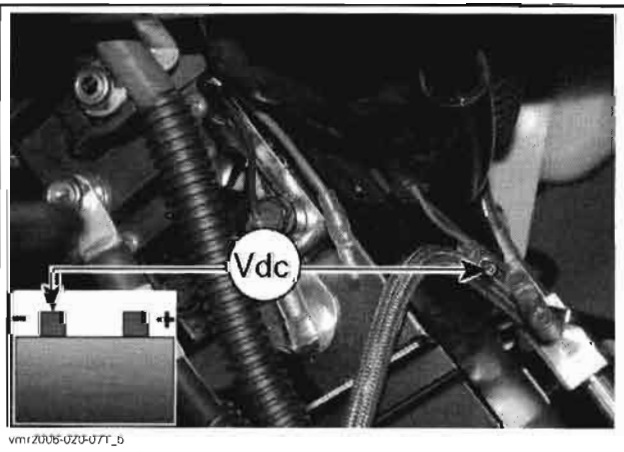
If there is no voltage, check fuses F9, F7, relay R3 (accessories) and wiring condition.

If there is voltage, test switch as follows.

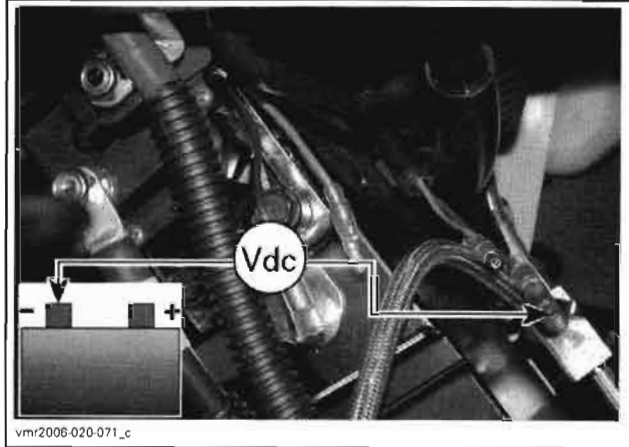
#### Winch Control Switch

Disconnect terminals at winch relay.

POSITION	TERMINAL	VOLTAGE
Switch pressed to IN and held	LIGHT/BLUE and battery ground	12 Vdc



POSITION	TERMINAL	VOLTAGE
Switch pressed to OUT and held	GREEN/BLUE and battery ground	12 Vdc



If there is no voltage in either test, check wiring/connectors. If they are good, replace winch switch.

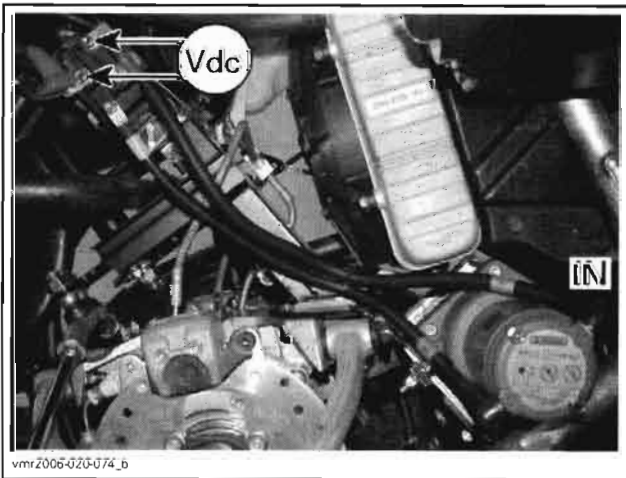
If there is voltage, test winch relay as follows.

#### Winch Relay

Reconnect terminals at winch relay.

Measure voltage drop between relay and motor as follows.

POSITION	RELAY TERMINAL	VOLTAGE DROP
Switch pressed to IN and held	Battery post and IN cable	0.2 Vdc max.



POSITION	RELAY TERMINAL	VOLTAGE DROP
Switch pressed to OUT and held	Battery post and OUT cable	0.2 Vdc max.





If voltage drop read is higher than specification in either test, check wiring/connectors. If they are good, replace winch relay.

If voltage read is battery voltage, the relay does not close. Replace with a new one.

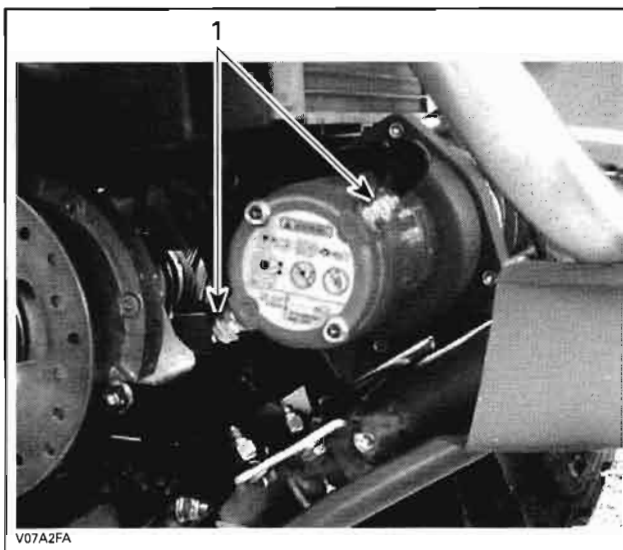
### Winch Removal

Disconnect, the battery BLACK (-) cable first, then the RED (+) cable.

**⚠ WARNING**

Always respect this order for disassembly; disconnect BLACK (-) cable first. Electrolyte or fuel vapors can be present in engine compartment and a spark may ignite them and possibly cause personal injuries.

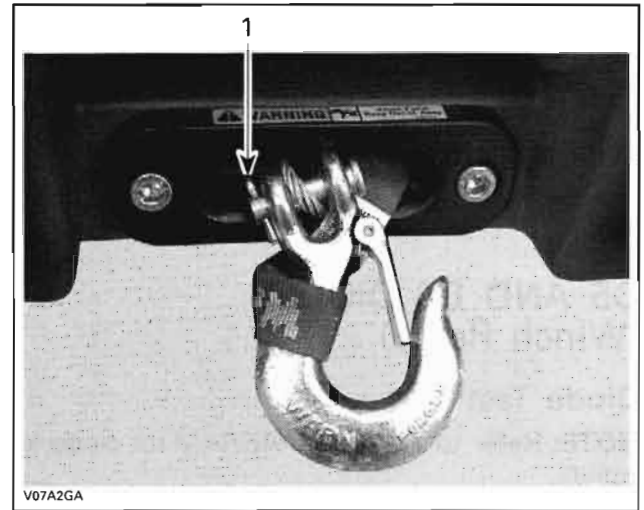
Disconnect the winch power cables.



1. Power connections

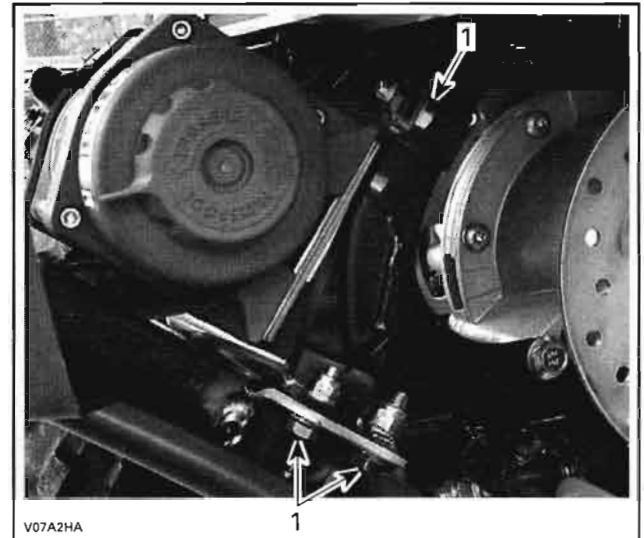
**NOTE:** Note the position of the power cables for reinstallation.

Remove:  
 – locking pin



1. Locking pin

– hook  
 – bolts retaining the winch from both LH and RH sides.



1. Bolts to be removed

Remove winch.

### Winch Installation

For the installation, reverse the removal procedure.

## WINCH CONTROL SWITCH

### Winch Control Switch Test

Refer to *WINCH* above.

**Section 06 ELECTRICAL SYSTEM**  
**Subsection 06 (LIGHTS, GAUGE AND ACCESSORIES)**

**Winch Control Switch Removal**

Remove screws retaining winch control switch to handlebar.

Remove steering cover, refer to *BODY*.

Disconnect the winch control switch connector.

**Winch Control Switch Installation**

For the installation, reverse the removal procedure.

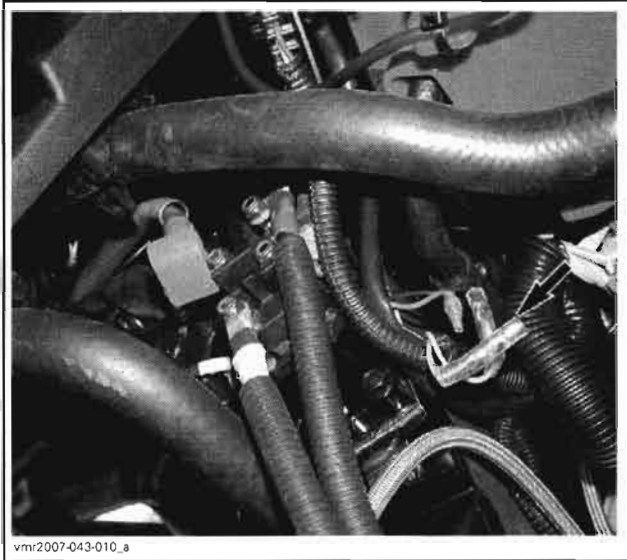
**D5 AND D6 DIODES  
(Winch Relay)**

**Diode Test**

**NOTE:** Refer to *WIRING DIAGRAM* for diode location.

Remove center panel and dashboard. Refer to *BODY*.

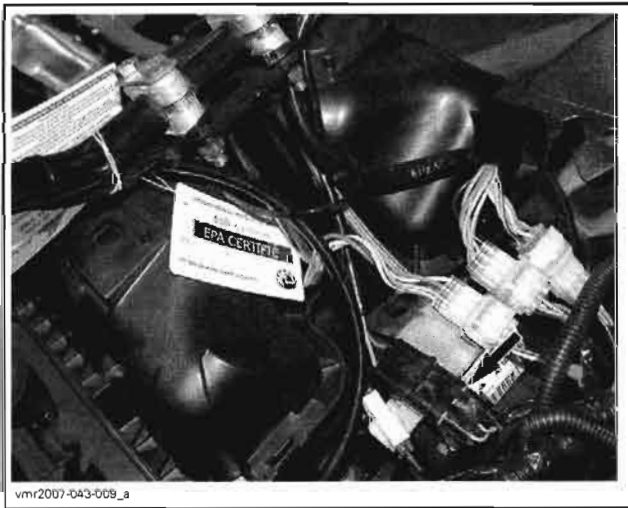
Disconnect winch switch connector.



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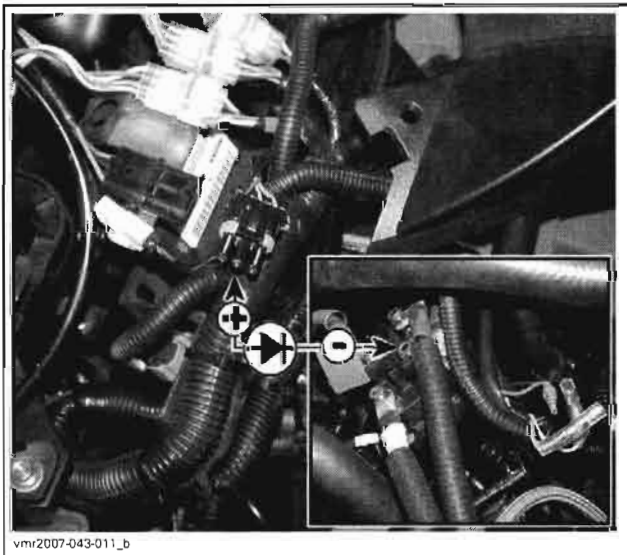
DIODE	WIRE TO DISCONNECT AT WINCH RELAY	WIRES TO PROBE (harness side)	
		WINCH SWITCH CONNECTOR	WINCH RELAY POST
D5	GREEN/BLUE (green on relay)	GREEN/BLUE	Ground
D6	LIGHT BLUE (black on relay)	LIGHT BLUE	

Probe diode wires paying attention to proper polarity. See illustrations.



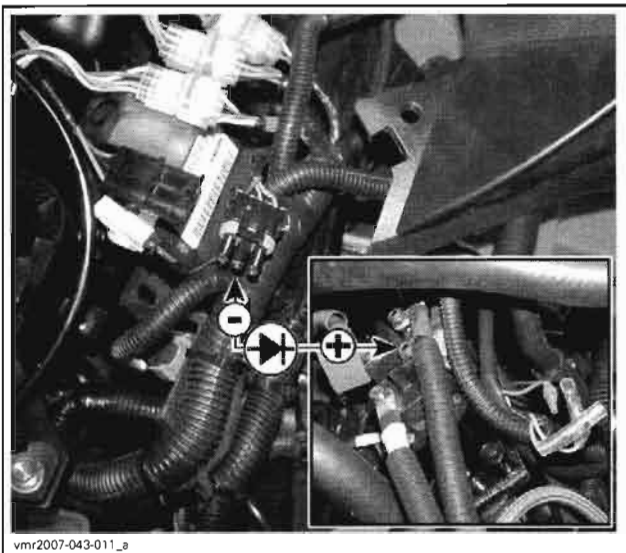
vmr2007-043-009\_a

Disconnect appropriate wire going to winch relay (behind RH front wheel). Refer to table.



vmr2007-043-011\_b

**MUST BE OPEN CIRCUIT**



*MUST BE AROUND 0.5 V*

If any diode test fail, replace diode.

**NOTE:** Diodes are located in wiring harness approximately where shown.



Properly reinstall removed parts.



*Midwest Manuals*

[sales@midwestmanuals.com](mailto:sales@midwestmanuals.com)

[www.midwestmanuals.com](http://www.midwestmanuals.com)

[www.midwestmanuals.com](http://www.midwestmanuals.com)  
[Sales@midwestmanuals.com](mailto:Sales@midwestmanuals.com)

# CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

## SERVICE TOOLS

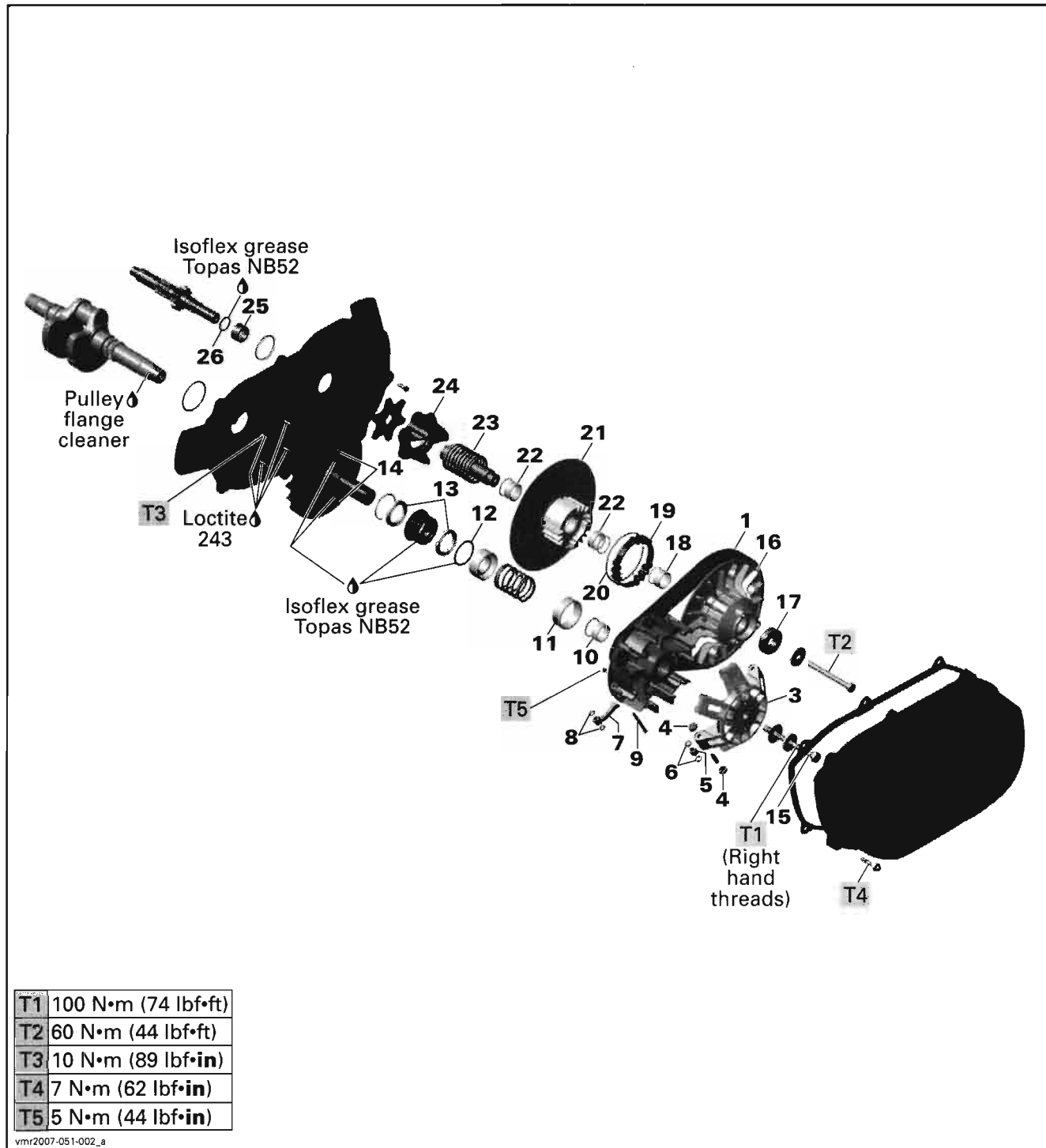
Description	Part Number	Page
pulley holding tool.....	529 006 400 .....	293
drive pulley puller.....	529 035 746 .....	293
driven pulley expander.....	529 035 747 .....	291
pulley holding tool.....	529 035 771 .....	300

## SERVICE PRODUCTS

Description	Part Number	Page
Isoflex grease Topas NB 52.....	293 550 021 .....	298-299
pulley flange cleaner.....	413 711 809 .....	295, 301

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



**GENERAL**

**NOTE:** For a better understanding, the following illustrations are taken with engine out of vehicle. To perform the following instructions, it is not necessary to remove engine.

This CVT is lubrication free. Never lubricate any components except drive pulley one-way clutch and friction washer.

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.

**⚠ WARNING**  
Never touch CVT while engine is running. Never drive vehicle when CVT cover is removed.

**⚠ WARNING**  
Any drive pulley repairs must be performed by an authorized Can-Am dealer. Subcomponent installation and assembly tolerances require strict adherence to procedures detailed.

**CAUTION:** Never use any type of impact wrench at drive pulley removal and installation.

**⚠ WARNING**  
The clutch assembly is a precisely balanced unit. Never replace parts with used parts from another clutch assembly.

**CAUTION:** These pulleys have metric threads. Do not use SAE threads puller. Always tighten puller by hand to ensure that the drive pulley has the same type of threads (metric vs SAE) prior to fully tightening.

**PROCEDURES**

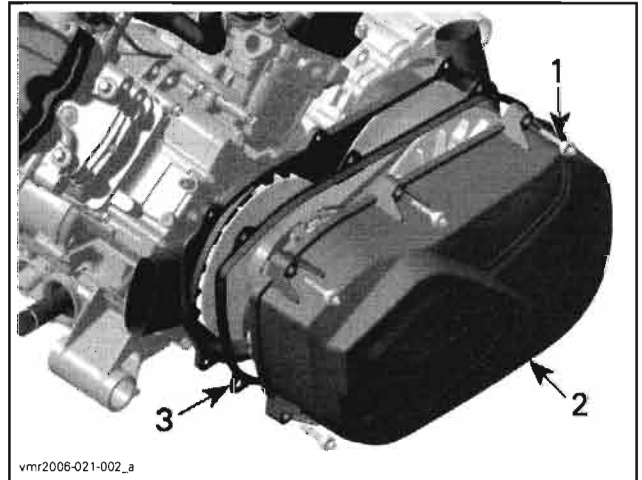
**DRIVE BELT**

**Removal**

Remove CVT cover screws.

**NOTE:** Remove the center top screw last. This screw allows to support the cover during removal.

Remove the CVT cover and its gasket.

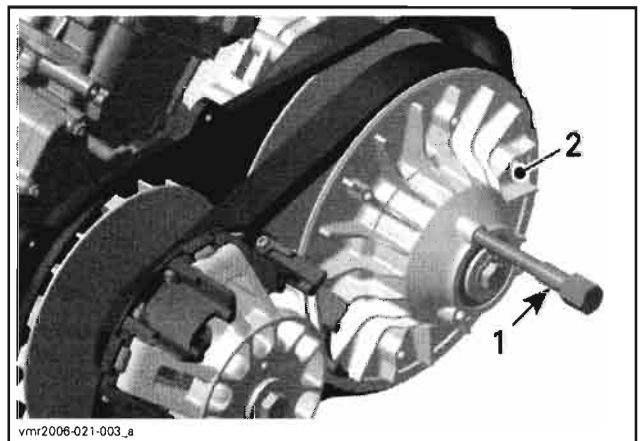


- 1. CVT cover screw
- 2. CVT cover
- 3. Gasket

Open driven pulley with the driven pulley expander (P/N 529 035 747).



Screw tool in the threaded hole of driven pulley and tighten to open the pulley.

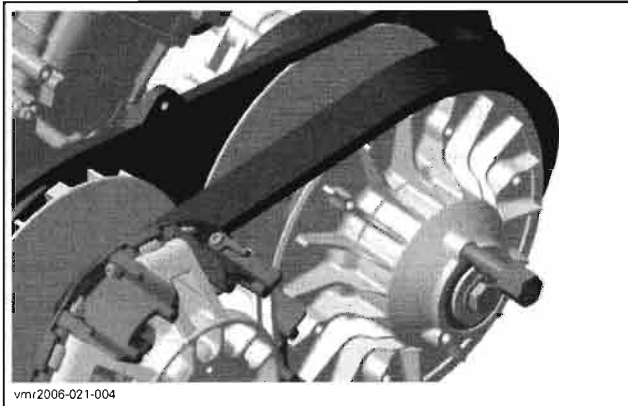


- 1. Driven pulley expander
- 2. Fixed sheave of driven pulley

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

To remove belt, slip the belt over the top edge of fixed sheave, as shown.



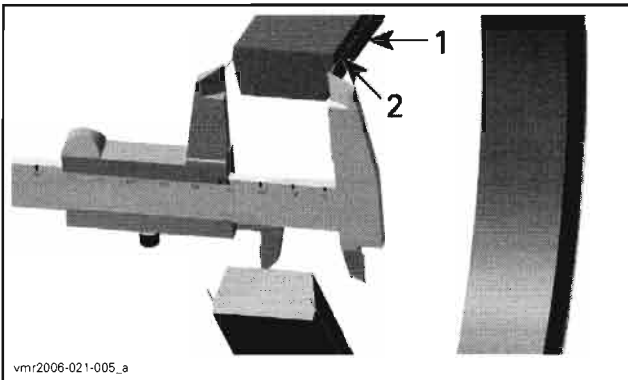
vmr2006-021-004

#### Inspection

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

Check drive belt width at cord level. Replace if it is out of specification (see table below).

DRIVE BELT WIDTH	
SERVICE LIMIT	30.00 mm (1.181 in)



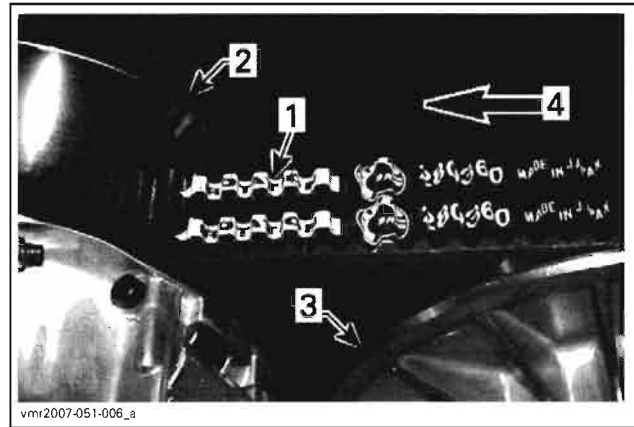
vmr2006-021-005\_a

1. Drive belt
2. Cord in drive belt

#### Installation

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

The maximum drive belt life span is obtained when the drive belt has the proper rotation direction. Install it so that the arrow printed on belt is pointing towards front of the vehicle, viewed from top.

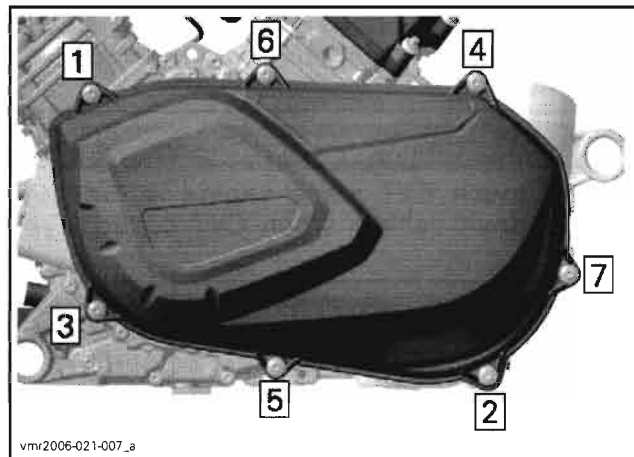


vmr2007-051-006\_a

1. Arrow printed on belt
2. Drive pulley (front)
3. Driven pulley (rear)
4. Rotation direction

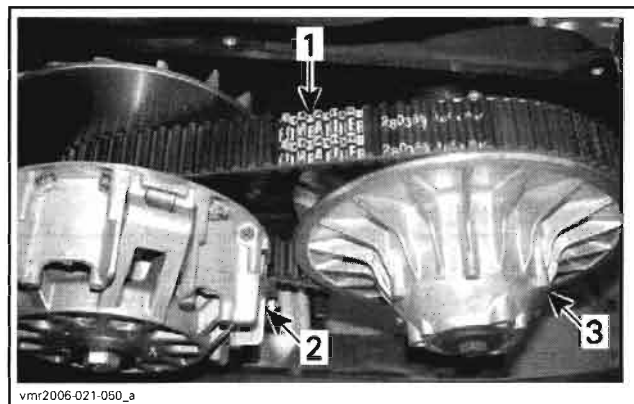
Install the center top screw of cover in first.

Tighten the CVT cover screws as per following sequence.



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#### DRIVE PULLEY



vmr2006-021-050\_a

1. Belt
2. Drive pulley
3. Driven pulley



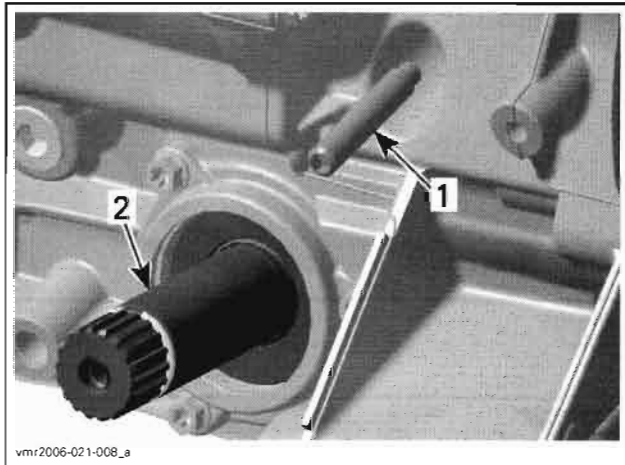
**Removal**

Remove belt no. 1.

Block the drive pulley. To do this, two procedures can be followed.

**First Possible Procedure:**

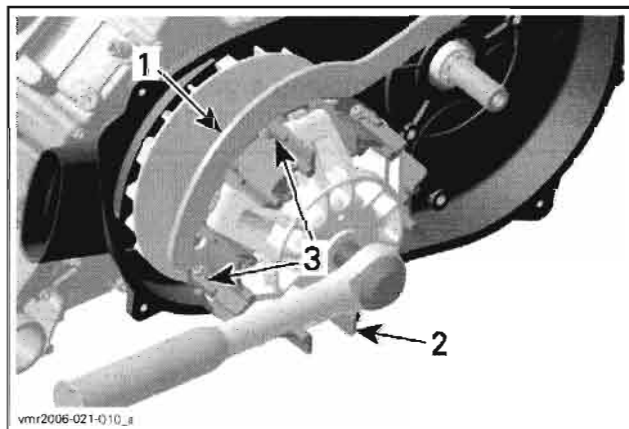
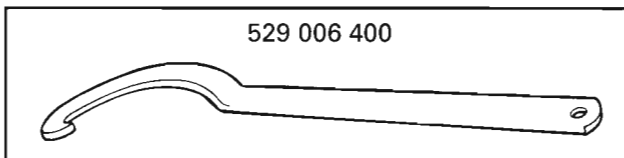
- Remove spark plugs.
- Lock crankshaft at TDC position. Refer to *BOTTOM END* section.



1. Crankshaft locking bolt
2. Engine drive shaft (front side)

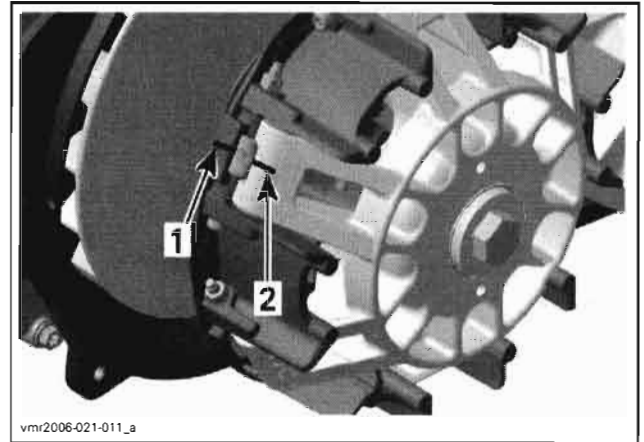
**Second Possible Procedure:**

- Block drive pulley with the pulley holding tool (P/N 529 006 400).



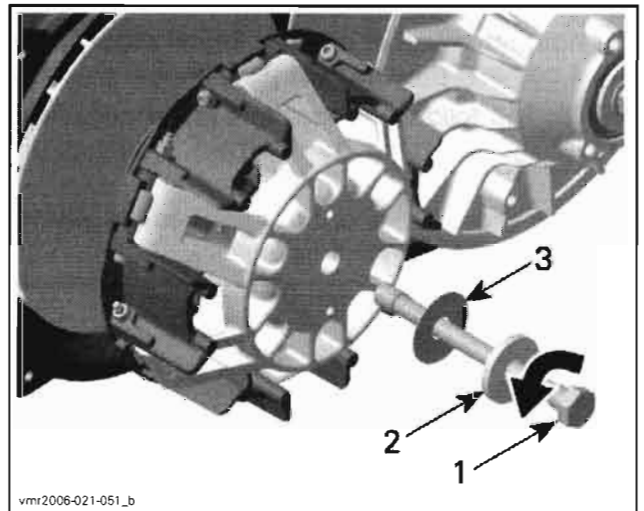
1. Pulley holding tool
2. Drive pulley sliding sheave
3. Area to place holding tool hook

When the drive pulley is blocked, mark sliding sheave and governor cup to ensure correct reinstallation.



1. Mark on drive pulley sliding sheave
2. Mark on governor cup

Unscrew the drive pulley screw (right hand thread), then remove it as well as the conical spring washer and thrust washer.



1. Drive pulley screw
2. Conical spring washer
3. Thrust washer

**WARNING**  
Sliding sheave of drive pulley is spring loaded.

Push with your hand the sliding sheave no. 2 of the drive pulley then remove the screw completely.

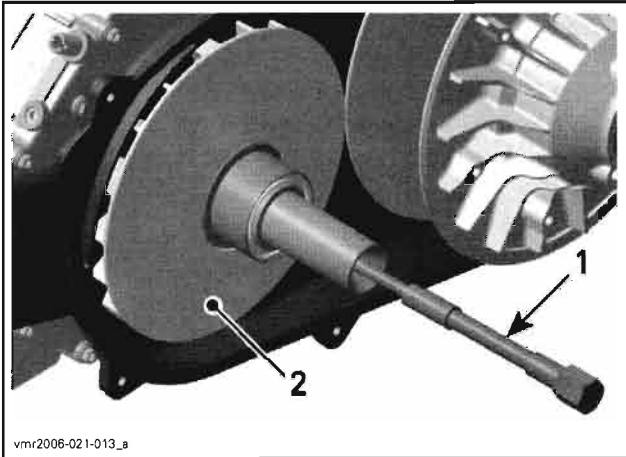
Slowly release sliding sheave.

Screw drive pulley puller (P/N 529 035 746) in fixed sheave and remove fixed pulley.



## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



1. Drive pulley puller
2. Fixed sheave

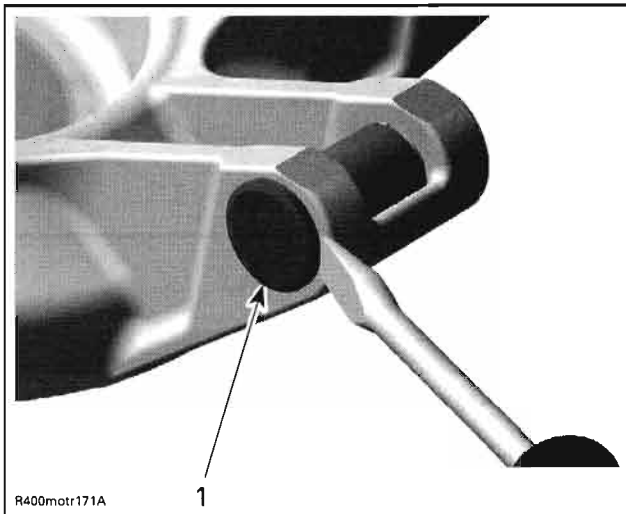
## Disassembly

### Governor Cup

Carefully lift governor cup no. 3 until slider shoes no. 4 come at their highest position into guides.

**NOTE:** The following procedure is not necessary except if roller must be removed. Refer to *INSPECTION* before proceeding.

Remove slider shoes out of each bearing sleeve. Use a flat screwdriver if necessary.



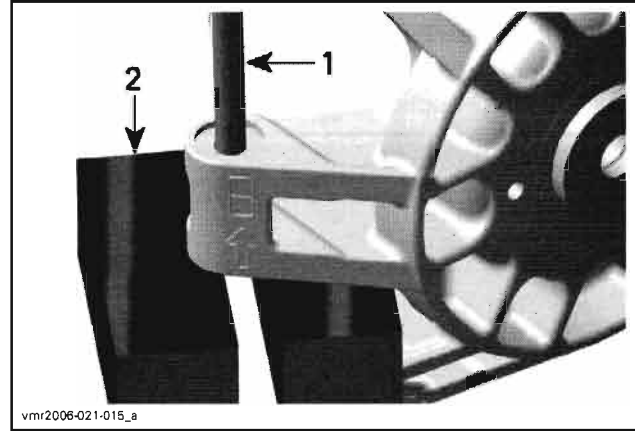
1. Slider shoe

Put governor cup on a vice to push out bearing sleeve of roller in the foreseen direction (against arrow). Use an appropriate punch (diameter of punch must be smaller than the bearing sleeve diameter).

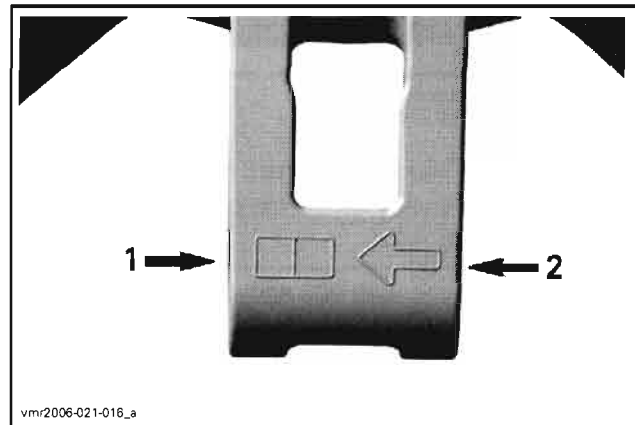
**CAUTION:** Do not clamp the governor cup in the vice to push out bearing sleeve. Governor cup will be damaged.

**NOTE:** Use protection plates to avoid marks and/or damages to the governor cup.

**CAUTION:** Always replace all rollers at the same time. Partly worn rollers may cause damage to the CVT system.

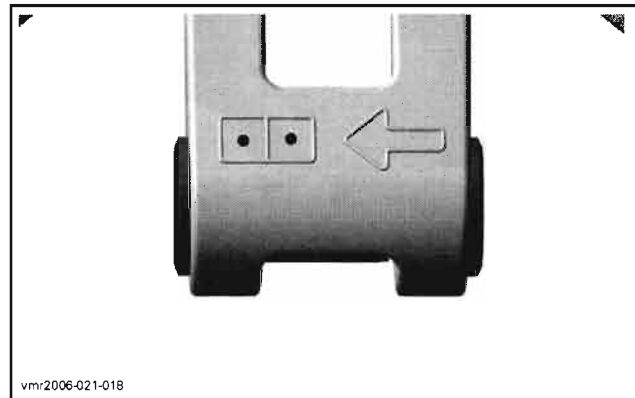


1. Punch
2. Vice



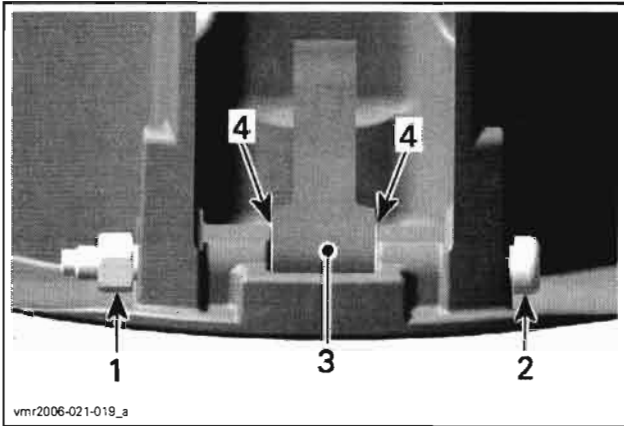
1. Removal direction
2. Assembly direction

**NOTE:** Whenever removing a governor cup with already two marked boxes replace it by a new one.



**Sliding Sheave**

Unscrew lock nut and remove centrifugal lever pivot bolt. This drive pulley is equipped with 6 levers. Remove centrifugal lever no. 7 and both thrust washers no. 8.



- 1. Lock nut
- 2. Centrifugal lever pivot bolt
- 3. Centrifugal lever
- 4. Thrust washers

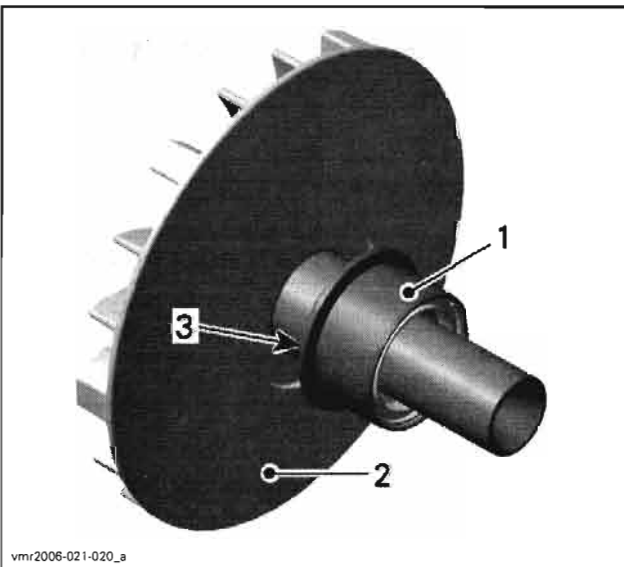
**Fixed Sheave**

Remove friction washer no. 12.

**⚠ WARNING**

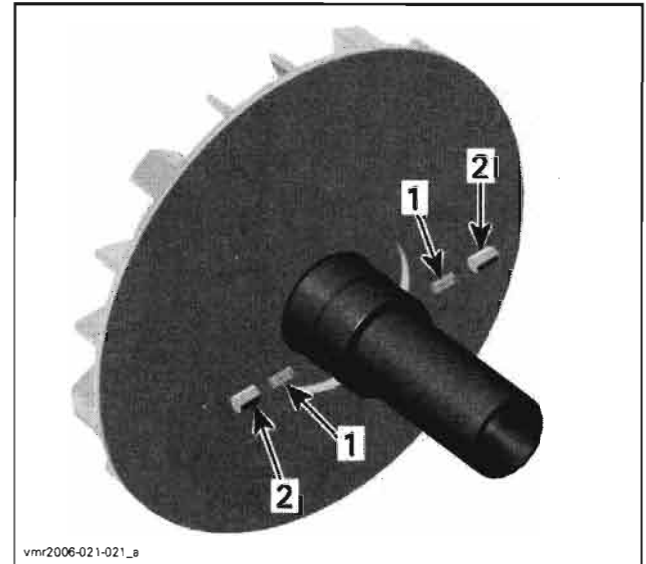
**Always wear safety glasses to remove spring sleeves.**

Pull and rotate one-way clutch slowly until the sheave of spring sleeves are visible.



- 1. One-way clutch
- 2. Fixed sheave
- 3. Spring sleeve area

Hold both spring sleeves with fingers and release when one-way clutch is disengaged.



- 1. Springs
- 2. Spring sleeves

**Cleaning**

Clean pulley faces and shaft with fine steel wool and dry cloth.

Using a paper towel with pulley flange cleaner (P/N 413 711 809) cleaning solvent, clean crankshaft tapered end and the taper inside the fixed sheave of the drive pulley, crankshaft threads and threads of drive pulley screw no. 15.

**CAUTION:** 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.

**CAUTION:** Do not use any other type of abrasive.

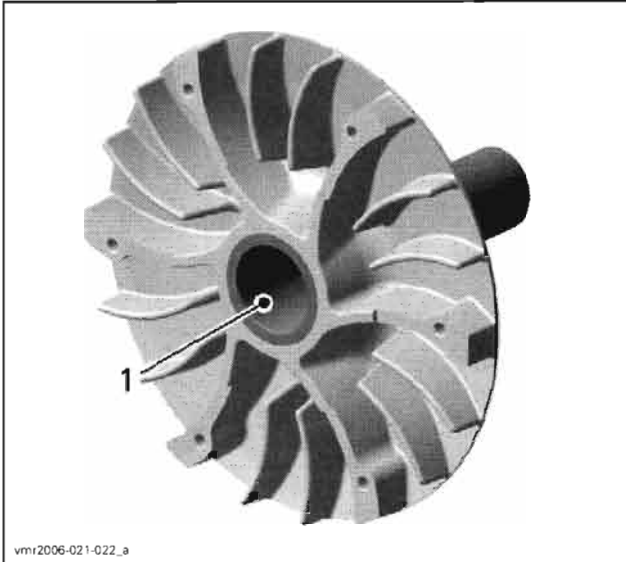
Reclean mounting surfaces with paper towel and pulley flange cleaner (P/N 413 711 809).

Wipe off the mounting surfaces with a clean, dry paper towel.

**CAUTION:** Mounting surfaces must be free of any oil, cleaner or towel residue.

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



1. Taper of fixed sheave

Only use petrol base cleaner when cleaning bushings no. 10 and no. 11.

**CAUTION:** Do not use acetone to clean bushing.

### Inspection

#### Drive Pulley

Drive pulley should be inspected annually.

#### Governor Cup

Check governor cup for cracks or other visible damages. Replace if necessary.

#### Roller and Slider Shoe

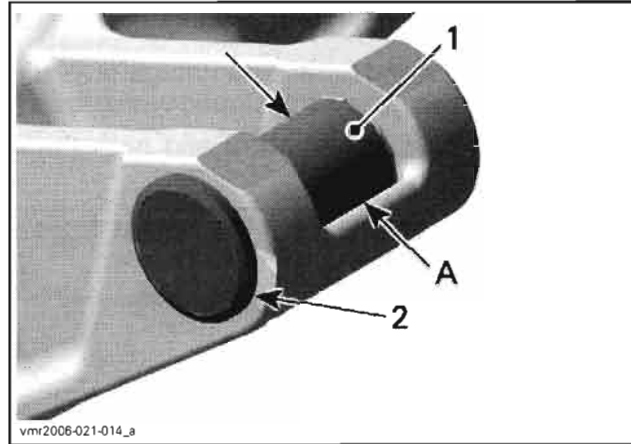
Check each roller for roundness of external diameter.

Check if rollers move freely.

**CAUTION:** Whenever replacing rollers and slider shoes, always replace all rollers and slider shoes at the same time.

Check slider shoes for visible wear and replace if damaged.

**NOTE:** If necessary, use a screwdriver to remove slider shoes.

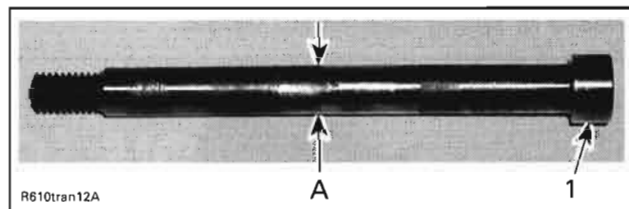


1. Roller  
2. Slider shoe  
A. Roller outer diameter

ROLLER OUTER DIAMETER	
NEW	13.70 to 13.80 mm (.539 to .543 in)
SERVICE LIMIT	13.20 mm (.519 in)
ROLLER INNER DIAMETER	
NEW	8.05 to 8.15 mm (.317 to .321 in)
SERVICE LIMIT	9.00 mm (.354 in)

#### Centrifugal Lever Pivot Bolt

Measure diameter of centrifugal lever pivot bolt no. 9, replace if it is out of specification.



1. Centrifugal lever pivot bolt  
A. Measure diameter here

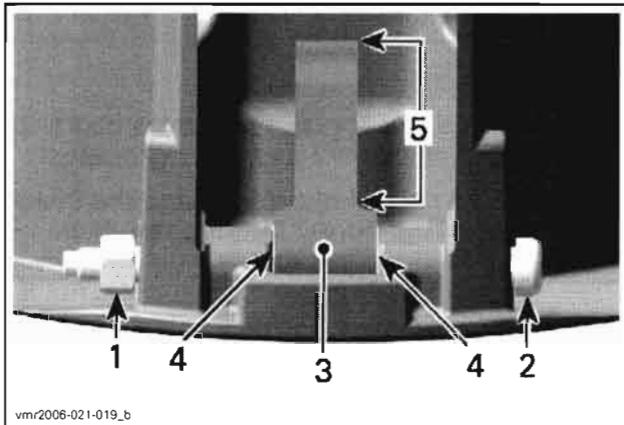
CENTRIFUGAL LEVER PIVOT BOLT DIAMETER	
NOMINAL	6.078 to 6.100 mm (.239 to .240 in)
SERVICE LIMIT	6.00 mm (.236 in)

#### Centrifugal Lever

Check bushing diameter in the centrifugal lever no. 7 for wear. Replace centrifugal lever if necessary.

<b>CENTRIFUGAL LEVER BORE DIAMETER</b>	
<b>NOMINAL</b>	6.035 to 6.078 mm (.238 to .239 in)
<b>SERVICE LIMIT</b>	6.200 mm (.244 in)

Replace centrifugal lever, thrust washers, centrifugal lever pivot bolts and lock nuts if the contact surfaces show heavy visible wear.



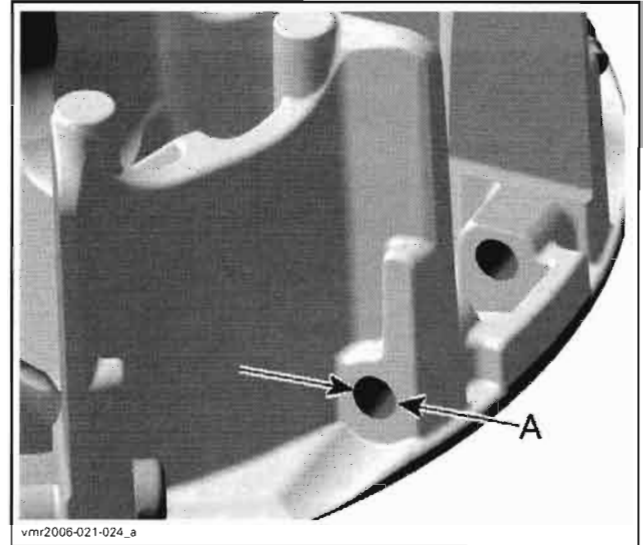
1. Lock nut
2. Centrifugal lever pivot bolt
3. Centrifugal lever
4. Thrust washers
5. Contact surface to the roller

**⚠ WARNING**  
Whenever replacing centrifugal levers, always replace all lever at the same time. Otherwise, unbalanced drive pulley will occur because of levers difference.

**Sliding Sheave**

Check sliding sheave for cracks and sliding contact surface for excessive wear. Replace sliding sheave if necessary.

Measure centrifugal lever pivot bolt bores. Replace sliding sheave if bores are out of specification or otherwise damaged.

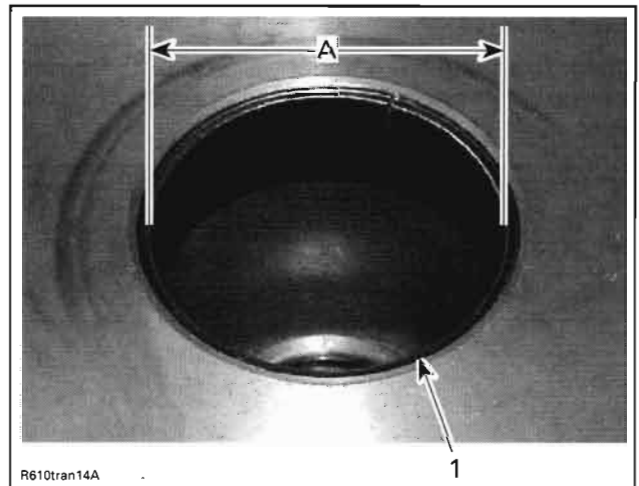


A. Centrifugal lever pivot bolt bore diameter

<b>CENTRIFUGAL LEVER PIVOT BOLT BORE DIAMETER</b>	
<b>NOMINAL</b>	6.113 to 6.171 mm (.241 to .243 in)
<b>SERVICE LIMIT</b>	6.300 mm (.248 in)

Measure bushing diameters of sliding sheave.

Use a dial bore gauge to measure bushing diameter. Measuring point must be at least 5 mm (1/4 in) from bushing edge.

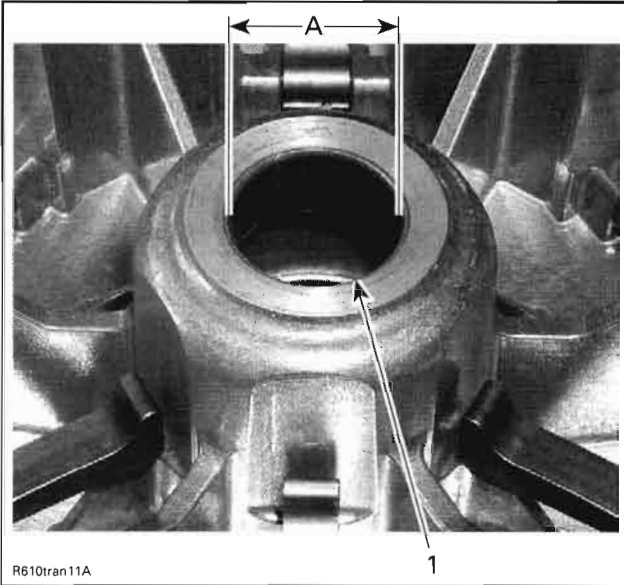


1. Bushing on fixed sheave side  
A. Bore diameter of bushing

<b>SLIDING SHEAVE LARGE BUSHING</b>	
<b>NOMINAL</b>	55.000 to 55.040 mm (2.165 to 2.167 in)
<b>SERVICE LIMIT</b>	55.200 mm (2.173 in)

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



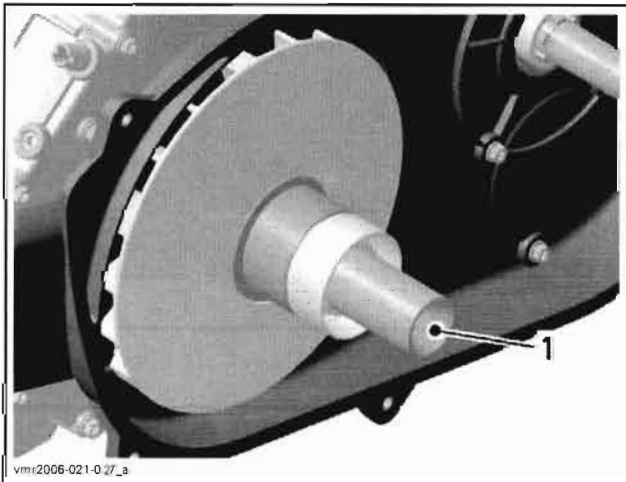
1. Bushing on governor cup side  
A. Bore diameter of bushing

SLIDING SHEAVE SMALL BUSHING	
NOMINAL	32.000 to 32.040 mm (1.260 to 1.261 in)
SERVICE LIMIT	32.200 mm (1.268 in)

Replace sliding sheave if bushings **no. 10** and/or **no. 11** is (are) out of specification. Visually inspect coatings.

#### Fixed Sheave

Check fixed sheave contact surface to the governor cup for scratches or other damages. If so, replace fixed sheave.



1. Visually check here

Check for any marks on fixed sheave plate. Replace if necessary.

#### Spring

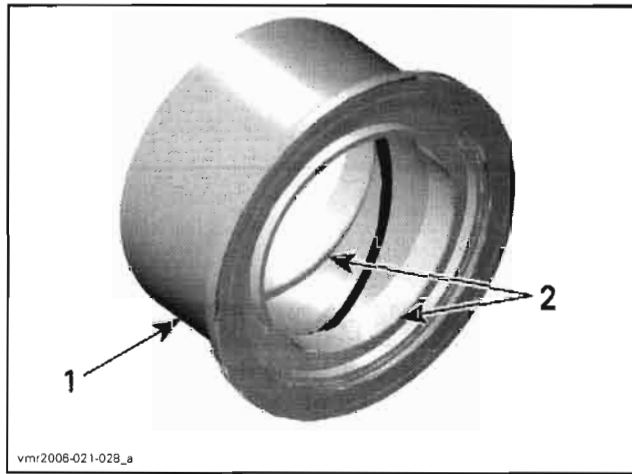
Measure spring free length and squareness. If spring is out of specification, replace by a new one.

SPRING FREE LENGTH	
SERVICE LIMIT	85 mm (3.347 in)
CLUTCH SPRING SQUARENESS	
SERVICE LIMIT	4 mm (.157 in)

#### One-Way Clutch

Check bearings for excessive play and smooth operation. Replace one-way clutch if necessary.

**CAUTION:** Be careful not to damage the inside of one-way clutch during bearing removal.



1. One-way clutch  
2. Bearings

Measure length of spring sleeve **no. 14** and check if edges on top of the spring sleeve are excessively worn. If they out of specifications, replace both spring sleeve at the same time.

SPRING SLEEVE LENGTH	
NOMINAL	9.2 to 9.4 mm (.362 to .370 in)
SERVICE LIMIT	9 mm (.276 in)

#### Assembly

For assembly, reverse the disassembly procedure. Pay attention to following details.

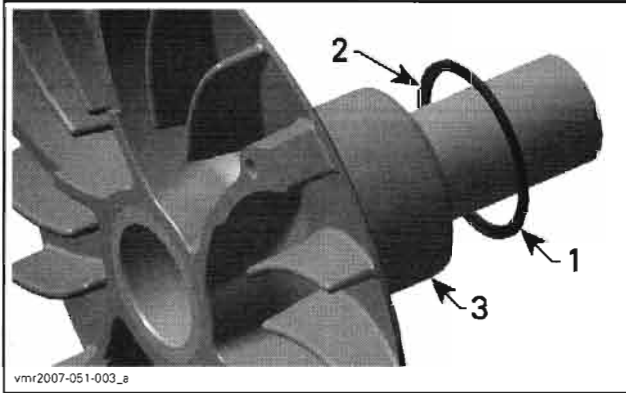
#### One-Way Clutch

**NOTE:** Using Isoflex grease Topas NB 52 (P/N 293 550 021), lubricate spring and spring sleeve **no. 14** and between one way clutch bearings **no. 13**.

**Friction Washer**

**NOTE:** Apply Isoflex grease Topas NB 52 (P/N 293 550 021) on both sides of friction washer no. 12.

**NOTE:** Friction washer has to be assembled with collar towards to the one way clutch.



- 1. Friction washer
- 2. Collar
- 3. One way clutch

**Sliding Sheave**

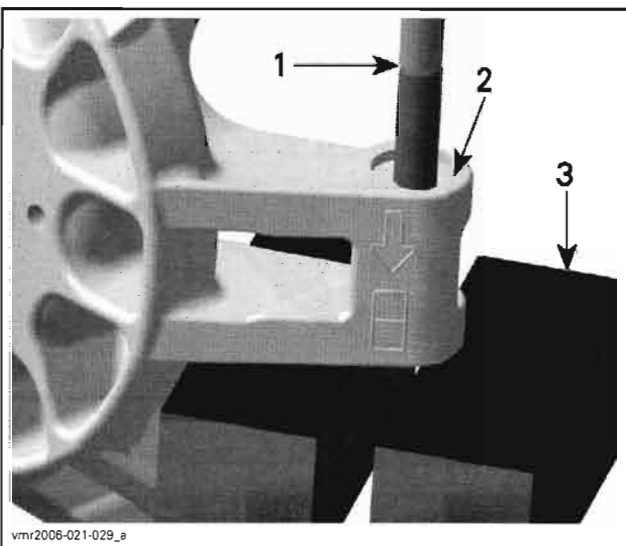
Install centrifugal levers no. 7 with their thrust washers no. 8.

**CAUTION:** Centrifugal levers must move easily after installation.

**Governor Cup**

Rebuild governor cup with new bearing sleeves, thrust washers no. 6, rollers and slider shoes.

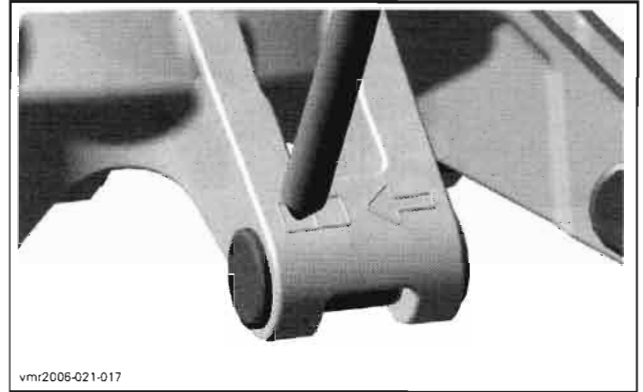
**CAUTION:** Final position has to be aligned with the contact surface of the slider shoes (no protrusion).



- 1. Top edge of bearing sleeve
- 2. Mating surface of slider shoes
- 3. Vice

Each time when replacing the bearing sleeves sign the foreseen box with a punch.

**CAUTION:** Do not tap too hard. Violent damage of the governor cup may appear.



**CAUTION:** Rollers must move easily after installation.

Insert slider shoes into governor cup to properly slide in guides.

**Installation**

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

**WARNING**

Do not apply antiseize or any lubricant on crankshaft and drive pulley tapers.

**CAUTION:** Never use any type of impact wrench at drive pulley removal and installation.

Clean mounting surfaces as described in *CLEANING* above.

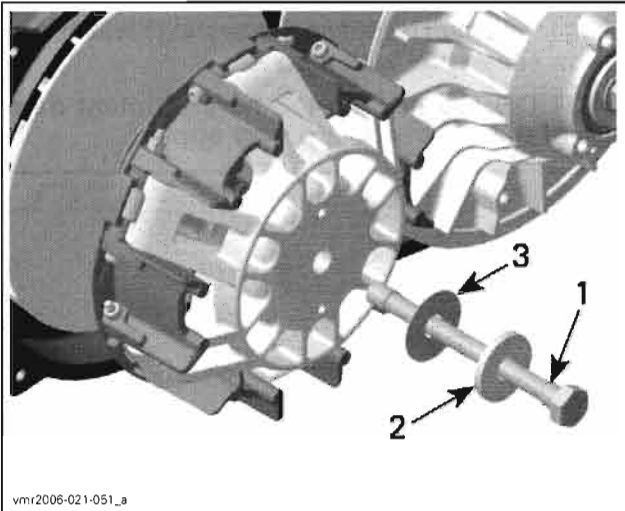
Install drive pulley on crankshaft extension.

**CAUTION:** Do not forget to place thrust washer prior to install conical spring washer.

Install conical spring washer with its concave side towards drive pulley then install drive pulley screw.

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



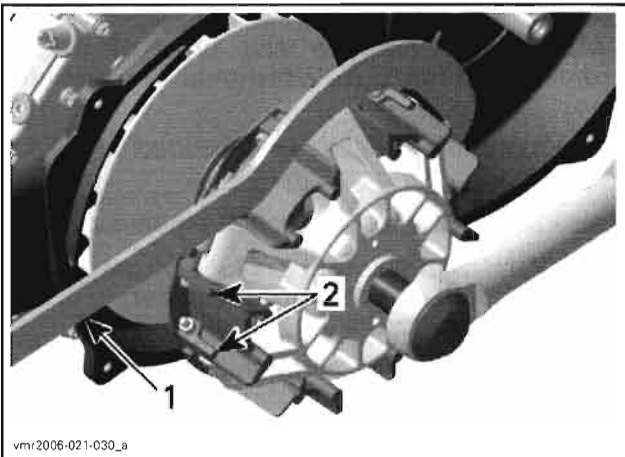
1. Drive pulley screw
2. Conical spring washer
3. Thrust washer

#### **⚠ WARNING**

Never substitute conical spring washer and/or screw with jobber ones. Always use BRP genuine parts for this particular case.

To torque the drive pulley screw, block the drive pulley. Refer at the beginning of this section for the two possible procedures.

When the drive pulley is blocked, torque screw to 100 N•m (74 lbf•ft).



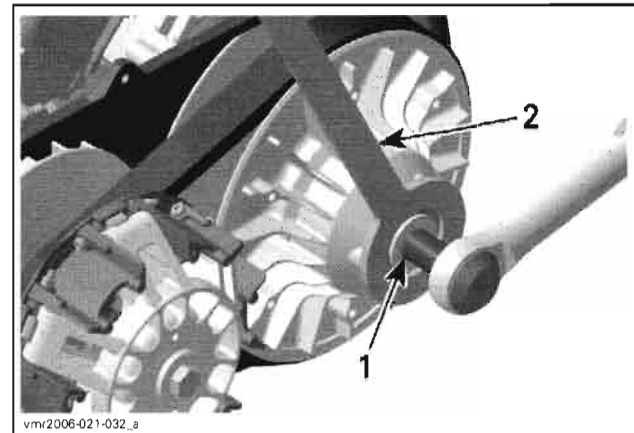
1. Pulley holding tool (P/N 529 006 400)
2. Drive pulley removal/installation area

## DRIVEN PULLEY

### Removal

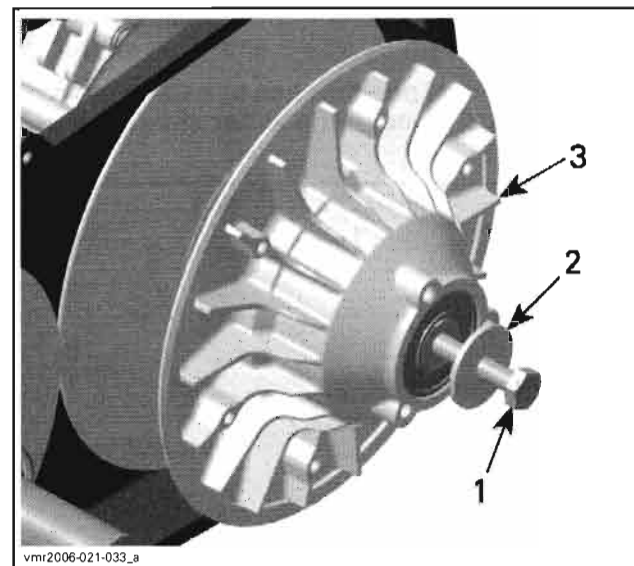
Remove drive belt (see *DRIVE BELT* above).

Using the pulley holding tool (P/N 529 035 771), hold the driven pulley during the removal of the driven pulley screw. Do not remove screw completely.



1. Driven pulley screw
2. Pulley holding tool

Push the driven pulley and maintain it in this position during the removal of screw. Remove driven pulley screw and washer.



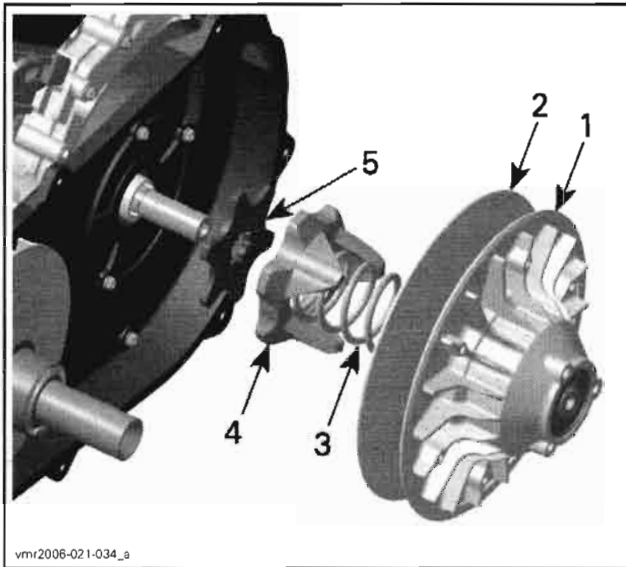
1. Driven pulley screw
2. Thrust washer
3. Driven pulley fixed sheave

#### **⚠ WARNING**

Driven pulley is spring loaded. Hold driven clutch pulley tight and slowly remove the driven pulley screw to release spring tension.



Remove the driven pulley with the spring, cam and the plate.



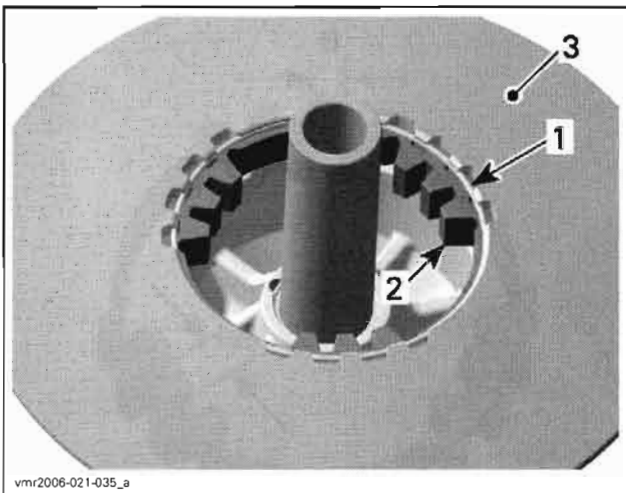
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1. Fixed sheave of driven pulley
2. Sliding sheave of driven pulley
3. Spring
4. Cam
5. Plate

**Disassembly**

**Fixed Sheave**

Remove retaining ring and lift torque gear.



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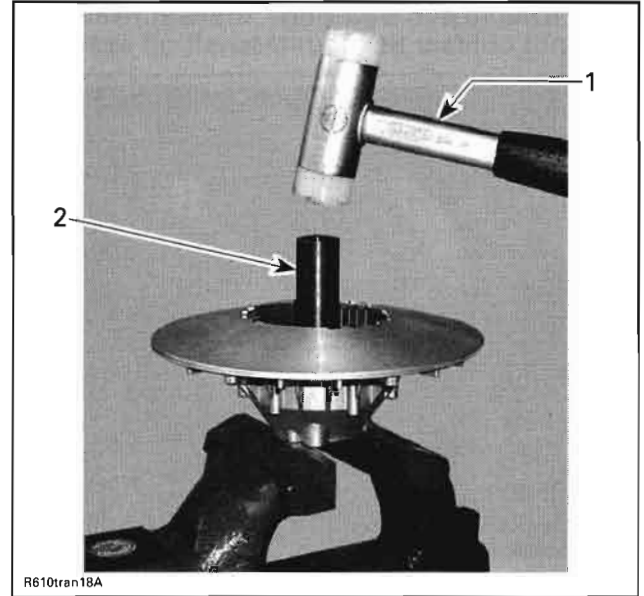
1. Retaining ring
2. Torque gear
3. Fixed sheave of driven pulley

**NOTE:** The following procedure is not necessary except if ball bearing or shaft must be removed. Refer to *INSPECTION* before proceeding.

Heat ball bearing area up to 100°C (212°F) before removing ball bearing.

Use a soft hammer to push shaft with bearing no. 17 out of fixed sheave.

vmr2008-065



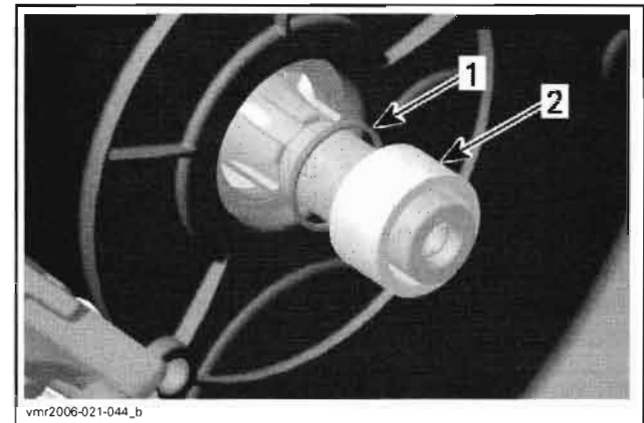
R610tran18A

1. Soft hammer
2. Shaft

Remove shaft from ball bearing.

Remove distance sleeve and O-ring no. 26 from countershaft.

Replace O-ring if brittle, hard or damaged.



vmr2006-021-044\_b

1. O-ring
2. Distance sleeve

**Cleaning**

When a dust deposit has to be removed from the cam or the shaft, use dry cloth.

Clean pulley faces and shaft with fine steel wool and dry cloth.

Use pulley flange cleaner (P/N 413 711 809) to clean driven pulley.

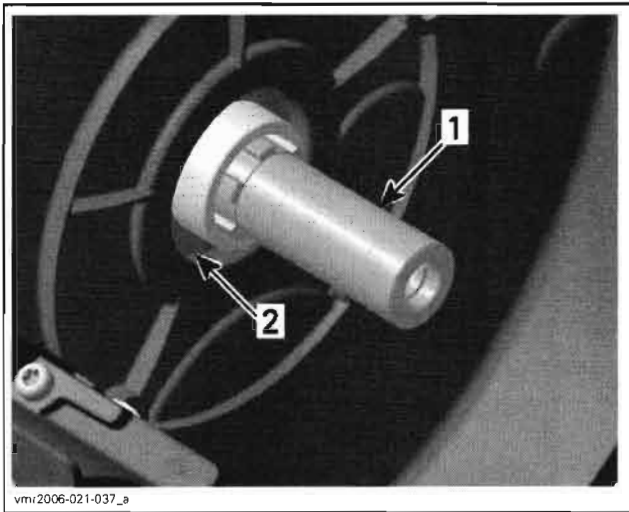
Clean the CVT air guide area from contamination.

Using a paper towel with pulley flange cleaner (P/N 413 711 809) to clean countershaft end and the inside of the shaft no. 23.

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

**CAUTION:** To avoid damage, make sure cleaner does not contact the countershaft oil seal.



vmr2006-021-037\_a

1. Countershaft support
2. Countershaft oil seal

## Inspection

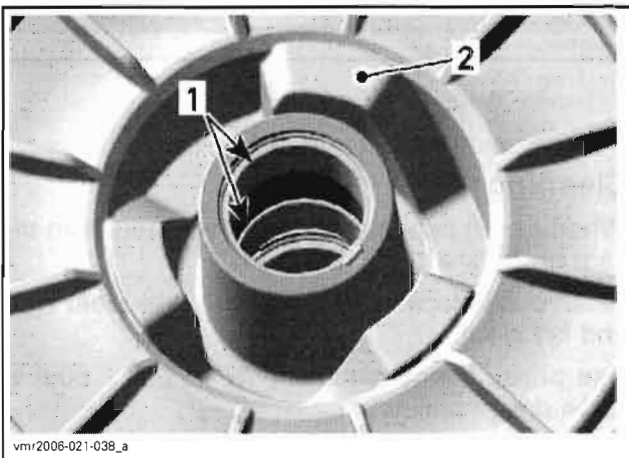
### Sliding Sheave

Check sliding sheave for cracks and sliding contact surface for excessive wear. Replace sliding sheave if necessary.

Check bushings no. 22 for cracks, scratch and for free movement when assembled to sliding sheave.

Using a dial bore gauge measure bushing diameter. Measuring point must be at least 5 mm (1/4 in) from bushing edge.

This bushing can not be replaced. Replace sliding sheave if bushings no. 22 are out of specification. Visually inspect coatings.



vmr2006-021-038\_a

1. Bushings
2. Backside of sliding sheave of driven pulley

### BUSHINGS BORE DIAMETER

NOMINAL	30.060 to 30.100 mm (1.183 to 1.185 in)
SERVICE LIMIT	30.200 mm (1.189 in)

### Fixed Sheave

Check fixed sheave for cracks and excessive wear. Replace fixed sheave if necessary.

Check ball bearing for free play and smooth operation. Replace if necessary.

Check shaft for heavy wear or visible damage. Replace if necessary.

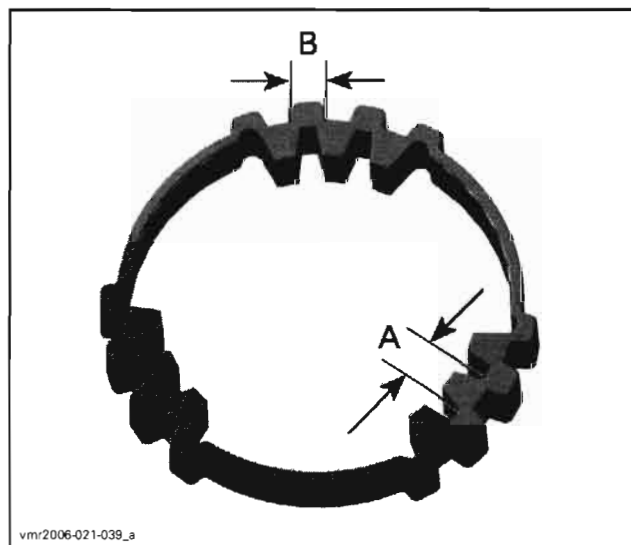
If the shaft is removed, using a dial bore gauge, measure bushing diameter. Measuring point must be at least 5 mm (1/4 in) from bushing edge.

This bushing can not be replaced. Replace fixed sheave if bushing no. 18 is out of specification. Visually inspect coatings.

### BUSHING BORE DIAMETER

NOMINAL	30.060 to 30.100 mm (1.183 to 1.185 in)
SERVICE LIMIT	30.200 mm (1.189 in)

Check torque gear for visible damage and cracks. Measure wear limit with a caliper.



vmr2006-021-039\_a

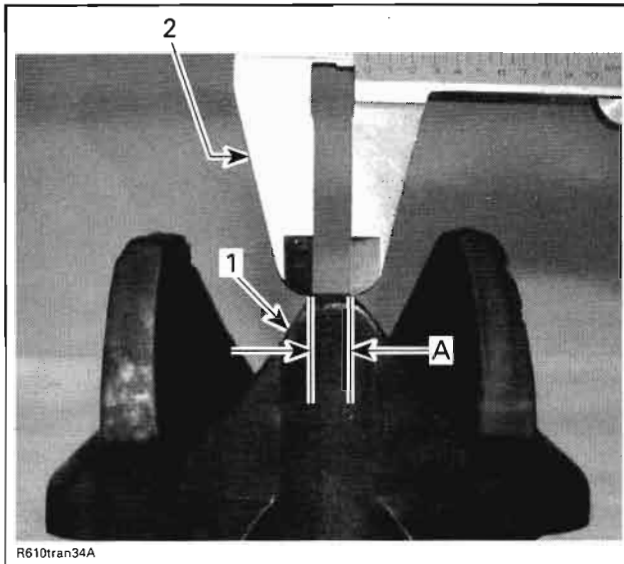
- A. Measurement inside
- B. Measurement outside

### WEAR ON TEETH BOTH SIDES

SERVICE LIMIT	7.500 mm (.295 in)
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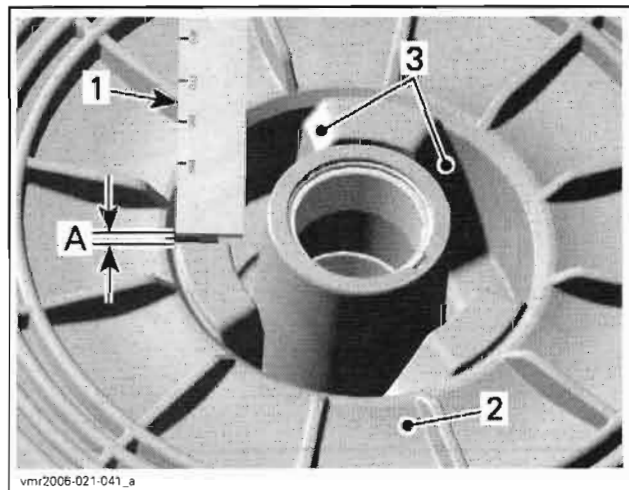
**Cam**

Check cam for visible damage and wear limit with a caliper.



- 1. Contact surface
- 2. Caliper
- A. Width to be measured due to wear on contact surface

WIDTH ON TOP SURFACE	
SERVICE LIMIT	9.00 mm (.354 in)



- 1. Caliper
- 2. Sliding sheave
- 3. Contact surface
- A. Wear to be measured

WEAR ON CONTACT SURFACE	
SERVICE LIMIT	1.00 mm (.039 in)

**Spring**

Measure spring free length and squareness. If spring is out of specification, replace by a new.

SPRING FREE LENGTH	
SERVICE LIMIT	125 mm (4.921 in)
CLUTCH SPRING SQUARENESS	
SERVICE LIMIT	3.8 mm (.150 in)

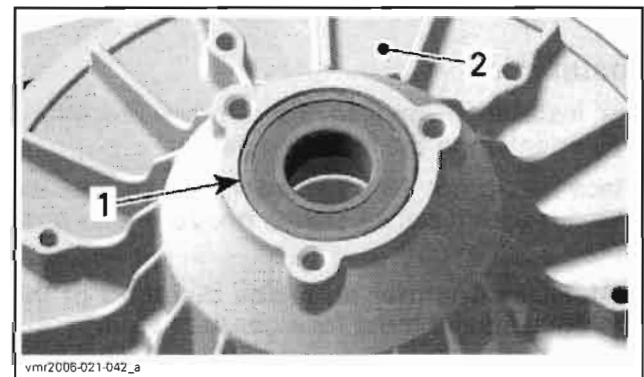
**Assembly**

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

Heat ball bearing area up to 100°C (212°F) before ball bearing installation.

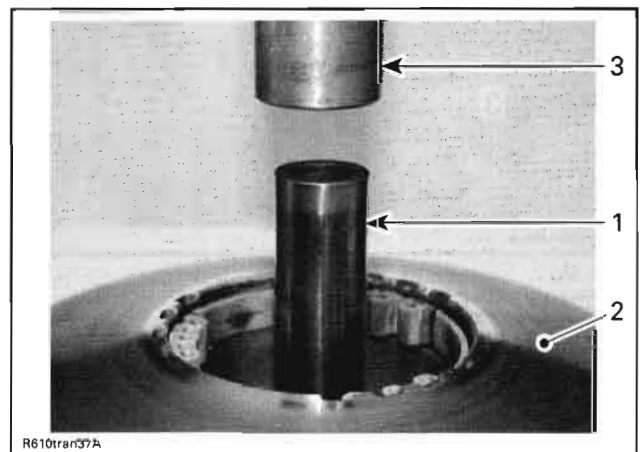
**NOTE:** Place new ball bearing in a freezer for 10 minutes before installation.

Install ball bearing with the writing on top and push only on the outer ring.



- 1. Ball bearing
- 2. Fixed sheave of driven pulley

**CAUTION:** Do not use hammer, use press machine only.

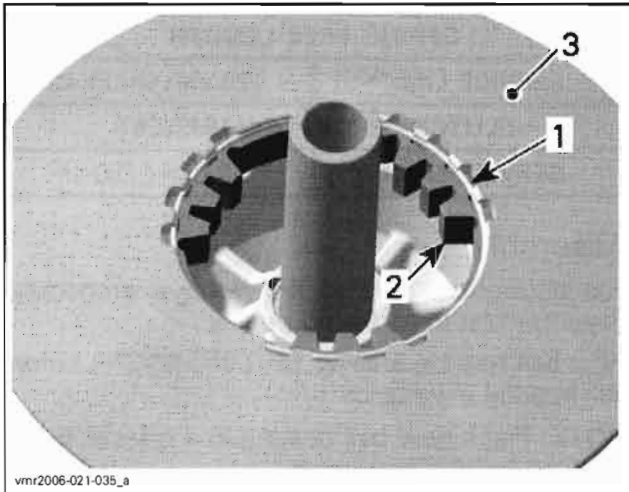


- 1. Shaft
- 2. Fixed sheave
- 3. Press machine

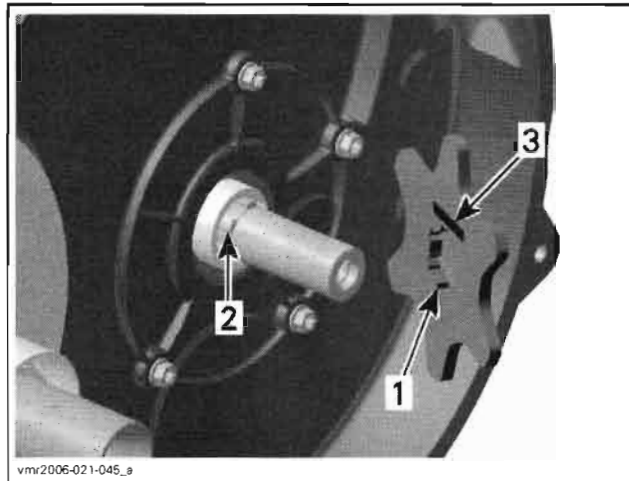
Install torque gear then secure it with retaining ring.

## Section 07 TRANSMISSION

### Subsection 01 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



1. Retaining ring
2. Torque gear
3. Fixed sheave of driven pulley



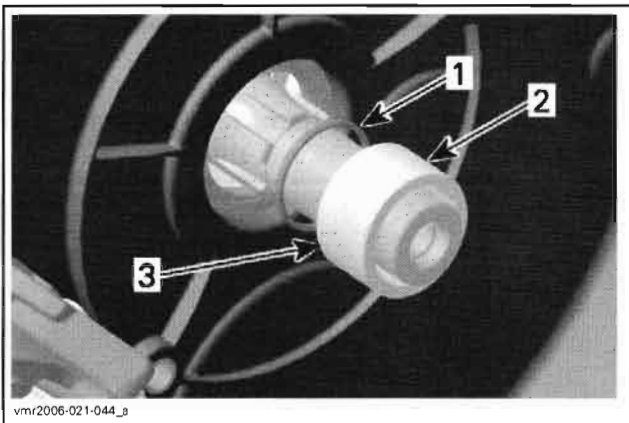
1. Sharp edge of cam retainer to engine side
2. Countershaft spline
3. Inscription

### Installation

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

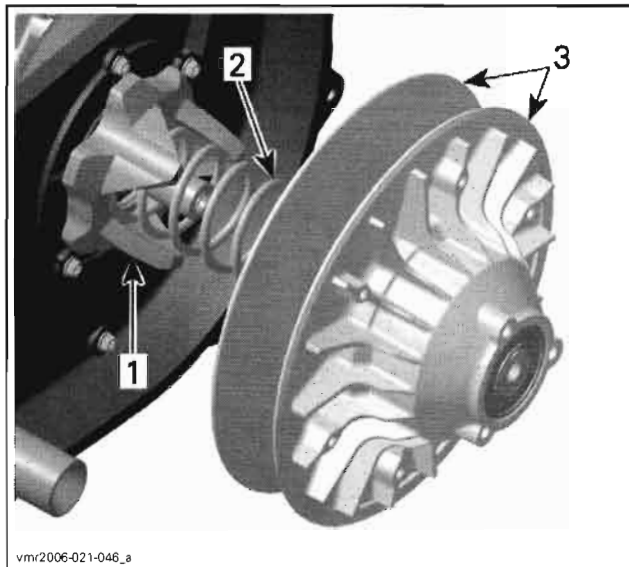
Place O-ring no. 26 on countershaft splines and move it with distance sleeve no. 25 in end position.

**CAUTION:** Chamfer on inside diameter of the distance sleeve must face gearbox side.



1. O-ring
2. Distance sleeve
3. Chamfered area of distance sleeve

Install cam retainer on countershaft end the right way.

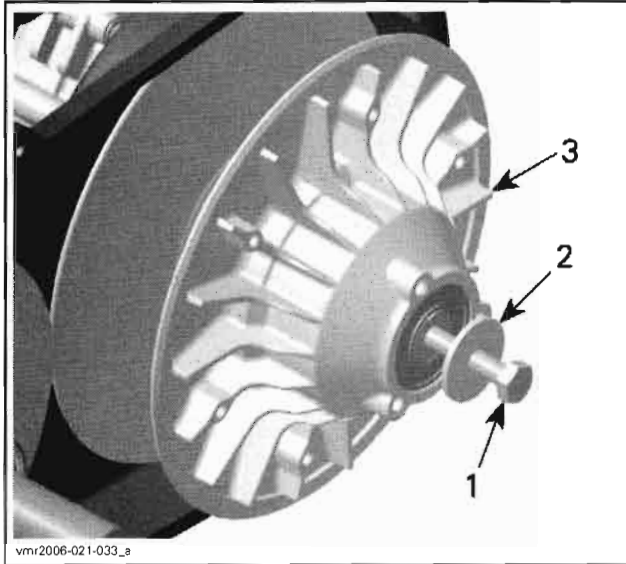


1. Cam
2. Spring
3. Driven pulley

With your hand, push the driven pulley on the shaft to compress the spring. Install the driven pulley screw and thrust washer.

### WARNING

Driven pulley is a spring loaded system.



- 1. Driven pulley screw
- 2. Thrust washer
- 3. Driven pulley fixed sheave

**NOTE:** Driven pulley end-play is 0 (zero).  
Torque driven pulley screw.

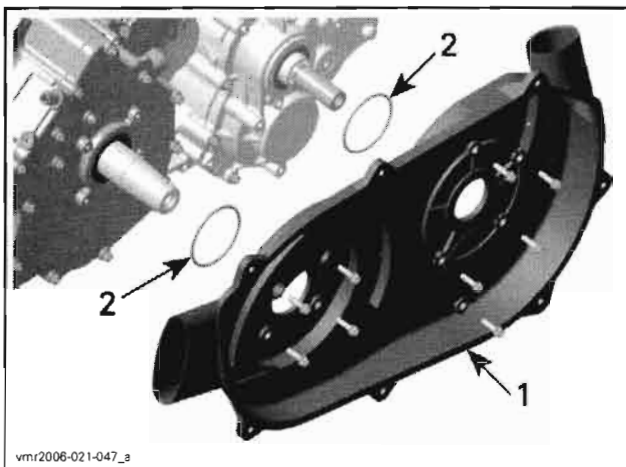
## CVT AIR GUIDE

### Removal

Remove the drive pulley and the driven pulley.  
Unscrew the clamps retaining the CVT air hoses.  
Remove CVT air guide.

### Inspection

Clean CVT air guide from contamination  
Check O-rings if brittle, hard or damaged. Replace if necessary.



- 1. CVT air guide
- 2. O-rings



---

# FRONT DRIVE

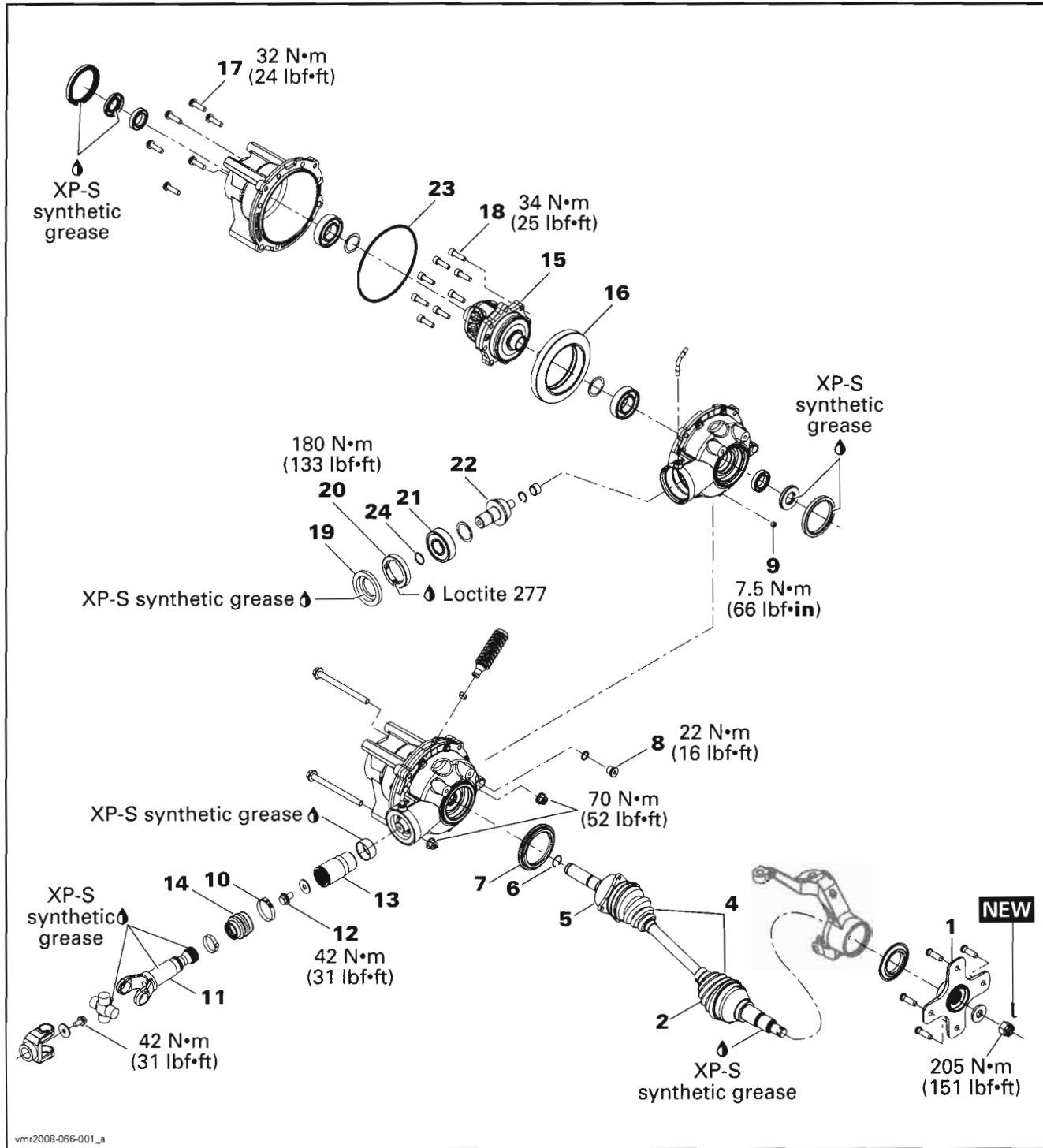
## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
CV boot clamp pliers.....	295 000 069 .....	312
pliers Oetiker 1099 .....	295 000 070 .....	312
differential spanner socket .....	529 035 649 .....	314
backlash measurement tool .....	529 035 665 .....	315
joint extractor tool.....	529 036 005 .....	312

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
XP-S synthetic grease.....	293 550 010 .....	311, 316, 318
XP-S synthetic gear oil.....	293 600 043 .....	313
Loctite 277.....	293 800 073 .....	316

**Section 08 DRIVETRAIN**  
**Subsection 01 (FRONT DRIVE)**





## GENERAL

The procedure explained below is the same for the RH and LH sides unless otherwise instructed.

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

Clean threads before applying 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 pins, etc.) must be replaced with new ones.

## PROCEDURES

### TIRES AND WHEELS

### **⚠ WARNING**

When the tires are replaced, never install a bias tire with a radial tire. Such a combination could create handling and/or stability problems.

Do not mix tires of different size and/or design on the same axle.

Front and rear tire pairs must be the identical model and manufacturer.

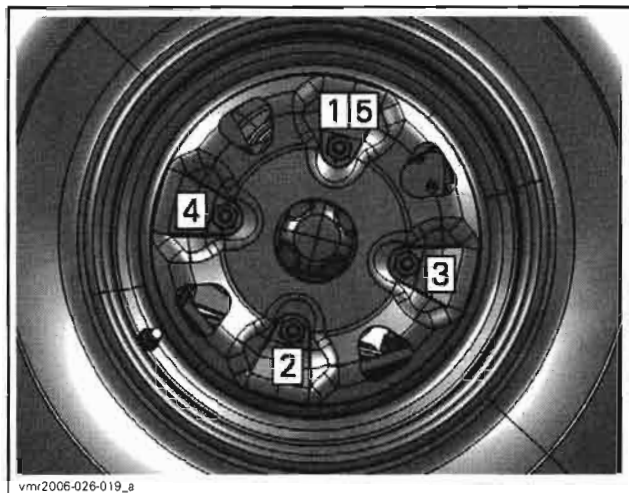
For unidirectional tread pattern, ensure that the tires are installed in the correct direction of rotation.

The radial tires must be installed as a complete set.

Severe injury or death can result if these instructions are not followed.

The tires are directional and their rotation must be kept in a specific direction for proper operation.

Using the next table, torque wheel nuts in accordance with the following illustration.



**CAUTION:** Always use the recommended wheel nuts. Using a different nut could cause damages to the rim.

WHEEL NUT TORQUE	
All steel wheels	70 N•m (52 lbf•ft)
All aluminum wheels (except for Outlander MAX 800 Ltd)	100 N•m (74 lbf•ft)
Outlander MAX 800 Ltd (BLACK aluminum wheels)	70 N•m (52 lbf•ft)

### **Outlander 650 and 800 Series and Renegade Models**

On these models, wheel balancing is necessary. To perform this operation, use a wheel balancer and adhesive weights.

## WHEEL HUB

### Wheel Hub Removal

Raise the front of vehicle, support it securely on jack stands and remove front wheel.

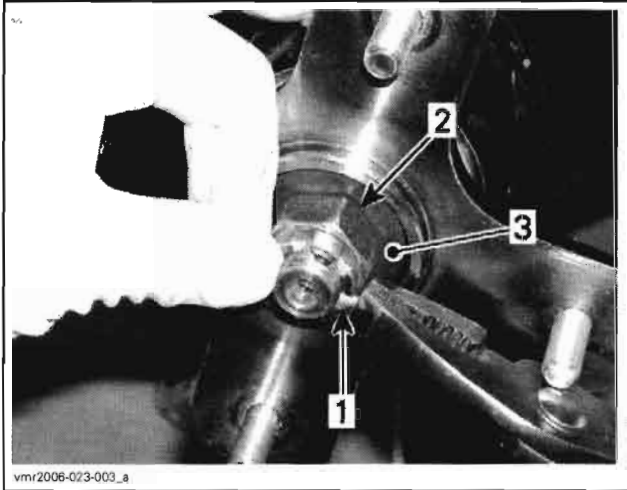
Apply parking brake or select 4WD position and place transmission lever on P.

Remove cotter pin and discard it.

Unscrew the castellated nut.

Remove the Belleville washer.

**Section 08 DRIVETRAIN**  
Subsection 01 (FRONT DRIVE)



**TYPICAL**  
1. Cotter pin  
2. Castellated nut  
3. Belleville washer

**Renegade Models**

Remove caliper from knuckle. Refer to *BRAKES*.

**All Models**

Pull wheel hub no. 1 to remove it.

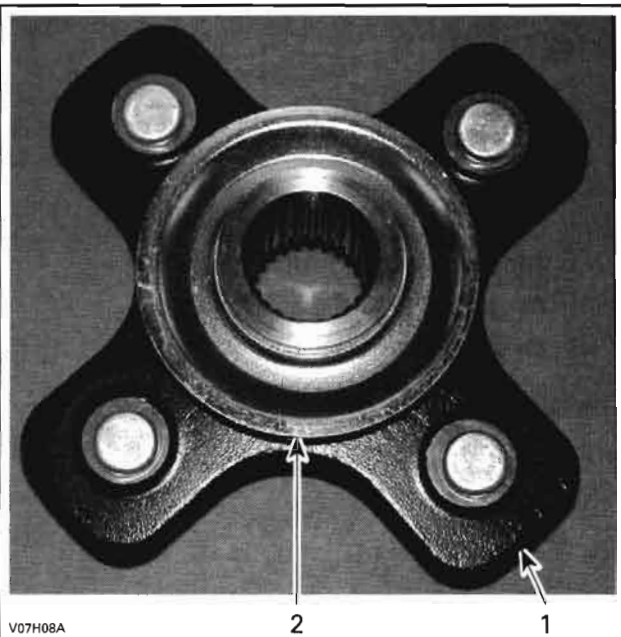
**Wheel Hub Inspection**

Check wheel hub for cracks or other damages.

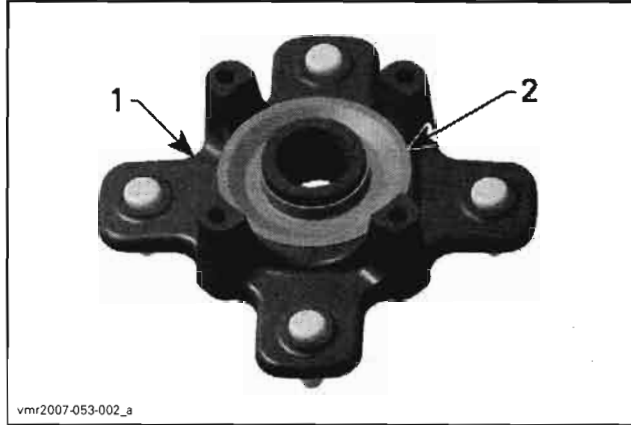
Check inner splines for wear or other damages.

If any damage is detected on wheel hub, replace it with a new one.

Check wear ring. If damage is apparent, replace the wear ring.



**TYPICAL — FOR ALL OUTLANDER**  
1. Wheel hub  
2. Wear ring



**RENEGADE MODELS**

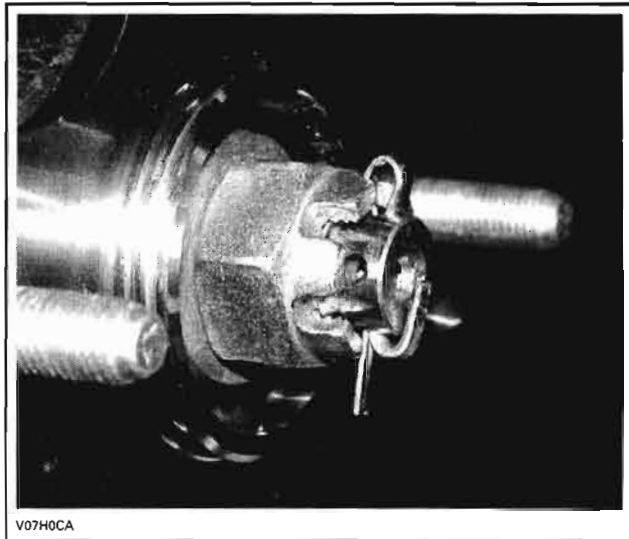
1. Wheel hub  
2. Wear ring

**Wheel Hub Installation**

The installation is the reverse of removal procedure.

Install Belleville washer so that the inside diameter protrudes outward and contacts the nut.

Tighten the castellated nut on the drive shaft end to 205 N•m (151 lbf•ft) and further tighten until one of its grooves is aligned with a cotter pin hole. Install a **NEW** cotter pin and the wheel cap. Fold one pin of cotter pin over drive shaft end.



**FRONT DRIVE SHAFT**

**Drive Shaft Removal**

Remove the appropriate wheel hub no. 1, see above.

**Outlander 500 Series**

Unscrew bolts holding strut to knuckle.

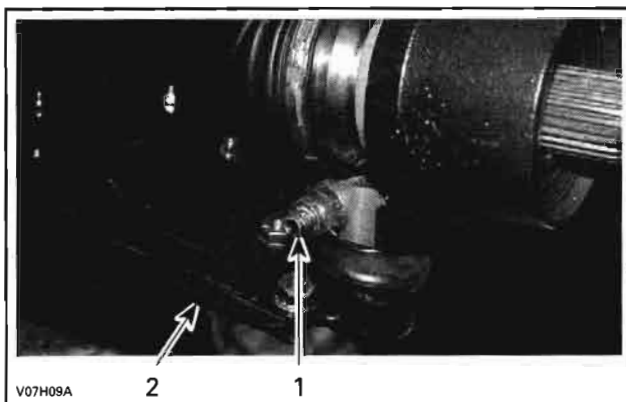
**Outlander 650/800 Series and Renegade Models**

Remove bolt that attach the shock absorber to the upper suspension arm.

Detach upper suspension arm from knuckle.

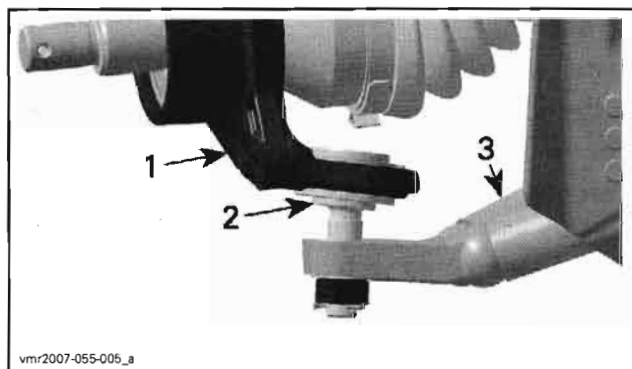
**All Models**

Remove ball joint retaining bolt or ball joint nut from knuckle.



**ALL OUTLANDER MODELS**

1. Ball joint retaining bolt
2. Lower suspension arm



**RENEGADE MODELS**

1. Knuckle
2. Lower ball joint
3. Lower suspension arm

Separate knuckle from lower suspension arm.

Move CV joint no. 2 out of knuckle then place the knuckle and the tie-rod out of way.

**All Outlander Models**

Remove caliper. Refer to *BRAKES*.

**All Models**

Pull drive shaft out of differential no. 3.

**NOTE:** Pull drive shaft strongly.

**Drive Shaft Inspection**

Inspect the condition of boots no. 4. If there is any damage or evidence of leaking lubricant, replace them. Refer to *DRIVE SHAFT BOOT* further.

Check splines for excessive wear. Replace if necessary.

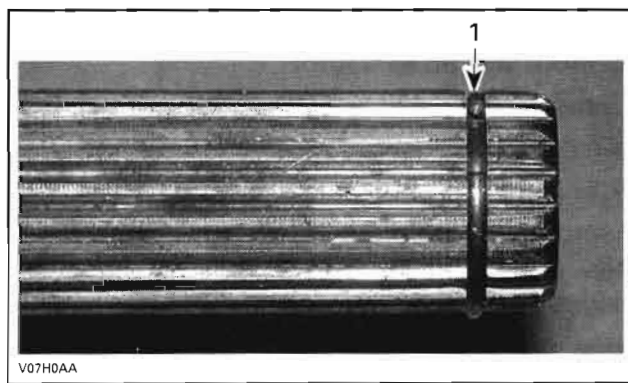
**NOTE:** If the splines on plunging joint no. 5 are worn, a check of differential inner splines should be done.

Check the stop ring no. 6 at the end of drive shaft. If wear is apparent, replace the wear ring no. 7.

Check if the bearings in knuckle move freely and smoothly. If not, replace them. Refer to *STEERING SYSTEM*.

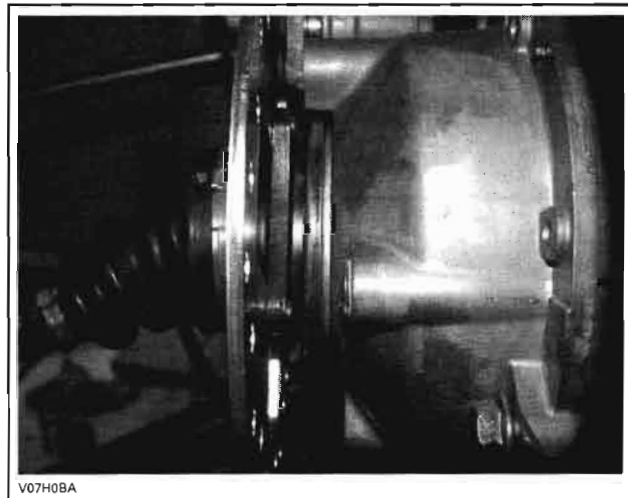
**Drive Shaft Installation**

Apply XP-S synthetic grease (P/N 293 550 010) to the splines and insert the end of drive shaft in differential and pull joint a little to make sure that the stop ring is locked in differential side gear groove.



1. Stop ring

The wear ring should be closed to the differential.



**TYPICAL**

## Section 08 DRIVETRAIN

### Subsection 01 (FRONT DRIVE)

Insert the other end of drive shaft in the knuckle and install the knuckle to the lower suspension arm. Install and torque the ball joint retaining bolts to 45 N•m (33 lbf•ft).

Install all other removed parts.

## DRIVE SHAFT BOOT

### Boot Inspection

Check bearing in plunging joint no. 5 or CV joint no. 2. If bearing is hard to move, change plunging joint or CV joint.

Check circlip for damage, change as necessary.

### Boot Removal

Remove clamps from rubber boot using CV boot clamp pliers (P/N 295 000 069) and pliers Oetiker 1099 (P/N 295 000 070).

Remove the large end of the boot from plunging joint no. 5 or CV joint no. 2.

Separate the joint from the shaft. Two procedures can be done.

#### Without the Special Tool

Clamp joint housing in a vise.

Align shaft with joint.

Pull hard on shaft to remove from joint.

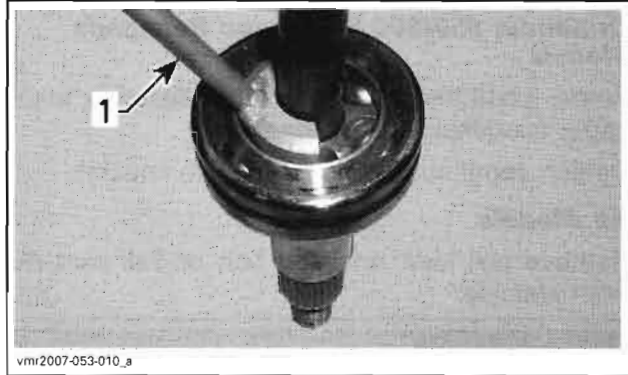
Remove boot from drive shaft.

Remove and discard the circlip. A new one is included in the boot kit.

#### With the Special Tool

Place drive shaft in vice with the joint downward.

Install the joint extractor tool (P/N 529 036 005) on bearing.



TYPICAL — CV JOINT SHOWN  
1. Joint extractor tool

With an hammer, hit on the tool to separate joint from shaft.

When joint and shaft are separated, remove boot from drive shaft.

Remove and discard the circlip. A new one is included in the boot kit.

### Boot Installation

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

Insert the small clamp and the small end of boot on shaft.

Install the **NEW** circlip.

Install the joint in a vise (joint facing up).

Center circlip on shaft.

Carefully insert shaft into joint and push hard to engage circlip.

Pack bearing area with grease (included with the new boot kit).

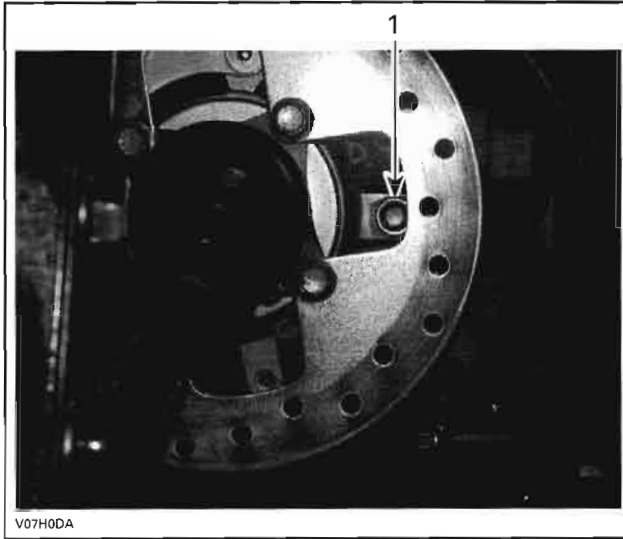
**NOTE:** Do not use or add other grease.

Install all other removed parts.

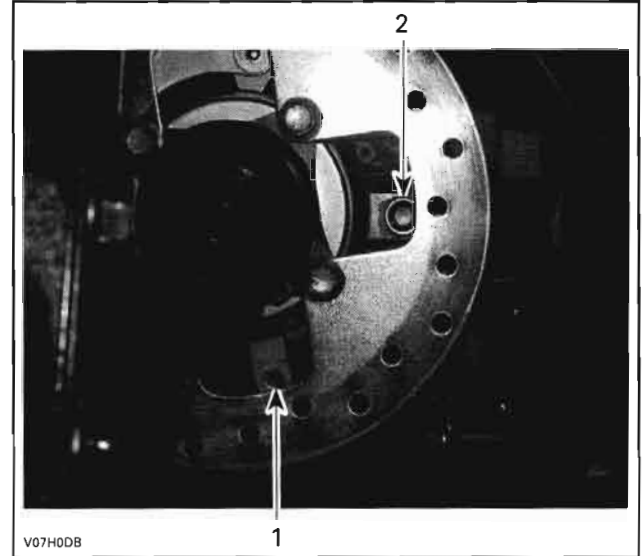
## FRONT DIFFERENTIAL

### Oil Level

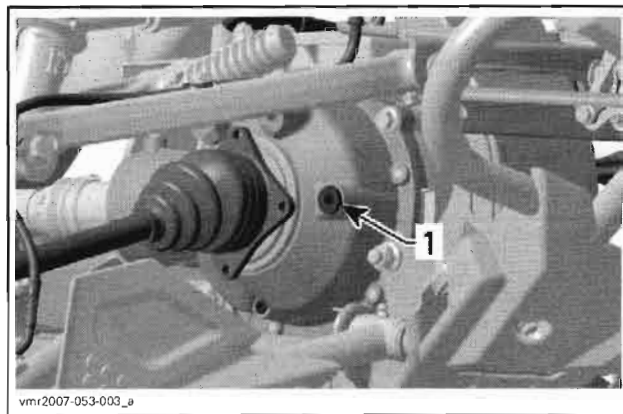
Clean filler plug prior to checking oil level.



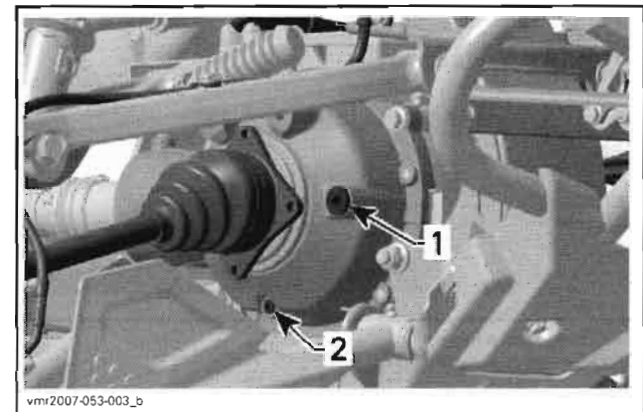
**ALL MODELS EXCEPT RENEGADE**  
1. Filler plug



**ALL MODELS EXCEPT RENEGADE**  
1. Drain plug  
2. Filler plug



**RENEGADE MODELS**  
1. Filler plug



**RENEGADE MODELS**  
1. Filler plug  
2. Drain plug

With vehicle on a level surface, check oil level by removing filler plug no. 8. Oil level must reach the lower edge.

Add oil if necessary. Use XP-S synthetic gear oil (P/N 293 600 043) or a 75W90 synthetic oil (API GL-5).

### Oil Change

Place vehicle on a level surface. Set transmission in park position.

Lift LH side of vehicle.

Clean drain plug area.

Place a drain pan under differential drain plug area.

Remove drain plug no. 9.

Unscrew filler plug.

Clean drain plug area then reinstall plug.

Lower vehicle.

Use a funnel and refill front differential with 500 mL (17 oz. US) of XP-S synthetic gear oil (P/N 293 600 043). If the XP-S synthetic gear oil is not available, use a 75W90 synthetic oil (API GL-5).

Reinstall filler plug.

### Removal

Drain the differential.

Raise front of vehicle, support it securely on jack stands and remove front wheels.

On both sides, remove the drive shafts (refer to *FRONT DRIVE SHAFT* above).

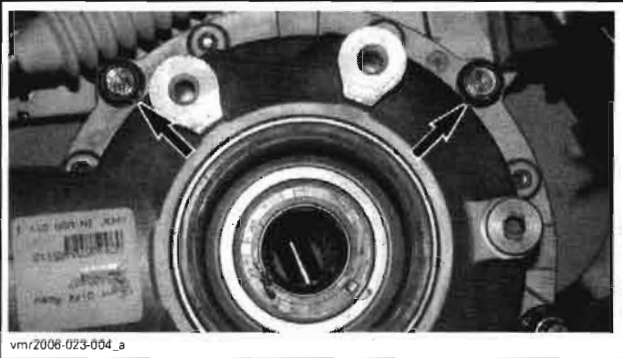
Remove both upper suspension arms.

## Section 08 DRIVETRAIN

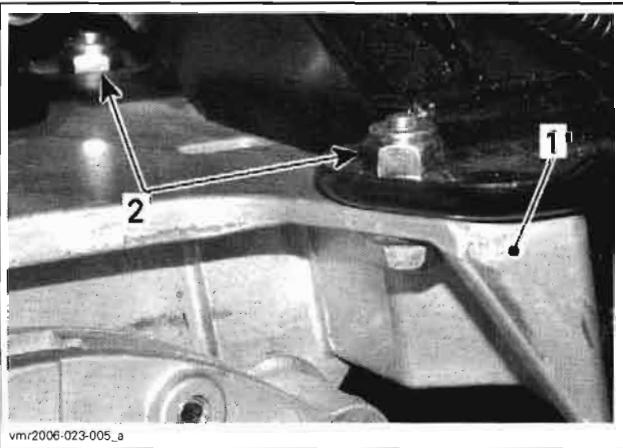
### Subsection 01 (FRONT DRIVE)

Remove bolts that attach winch bracket to the frame (XT models).

Remove the upper differential bolts.



Remove the differential support bolts.



1. Differential support
2. Differential support bolts

Remove the lower differential bolts.



Remove the differential support, by the left side.  
Remove the Oetiker clamp no. 10 that attach propeller shaft bellows no. 14 to the propeller shaft adaptor no. 13.



Remove the differential no. 3 from the right side of vehicle.

### Inspection

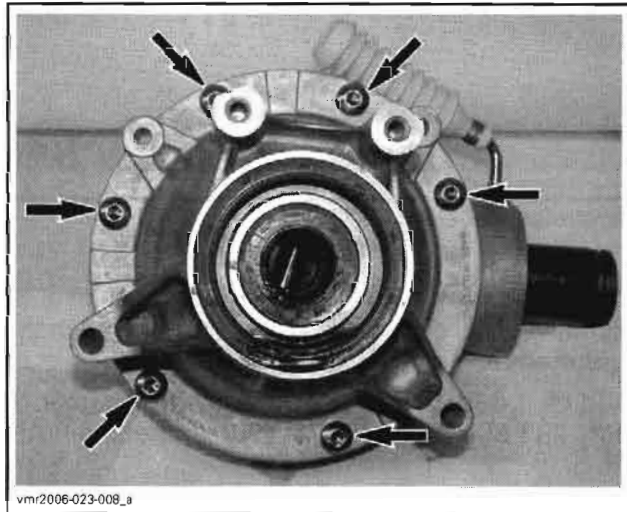
Check backlash and drag torque, see *ADJUSTMENT* further in this section.

Check if oil seals are brittle, hard or damaged. Replace if necessary.

### Disassembly

#### Ring Gear Carrier/Ring Gear

Unscrew the TORX screws no. 17, then separate half housings.



**NOTE:** Be careful to keep track of shims on each end of ring gear carrier.

Extract ring gear carrier no. 15 with ring gear no. 16 out of half housing.

Unscrew Allen socket screws no. 18 then separate ring gear from ring gear carrier.

#### Pinion Gear

Remove oil seal no. 19.

Unscrew the pinion nut no. 20. Use the differential spanner socket (P/N 529 035 649).



Remove the bearing no. 21 at the same time as the pinion gear no. 22. Be careful to keep track of shims.

**NOTE:** The pinion gear and bearing can be easily removed using the following suggested tool:

- pipe 3-1/2 in diameter x 5 in (1)
- screwed rod M10 x 1.25, 7 in length (1)
- nut M10 x 1.25 (3)
- flat bar (1).

**Adjustment**

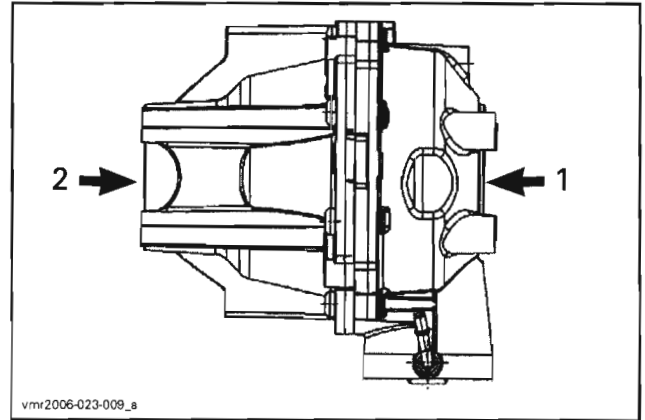
A shimming procedure must be done when ring gear carrier, pinion gear, ring gear or housing is (are) changed.

Measure the old pinion shim stack. If the shims measure over 1 mm (.039 in), install shim stacks on the differential components as per CHART "A".

If the old pinion shim stack measurement is under 1 mm (.039 in), install a .5 mm (.02 in) shim on the differential components as per CHART "B".

CHART "A"		CHART "B"	
PINION	1.85 mm (.073 in)	PINION	.5 mm (.02 in)
BACKLASH	1 mm (.039 in)	BACKLASH	
PRELOAD		PRELOAD	

**NOTE:** The procedure above sets the pinion shim thickness and should not be modified thereafter. Any changes should be done on the preload and/or backlash side(s).



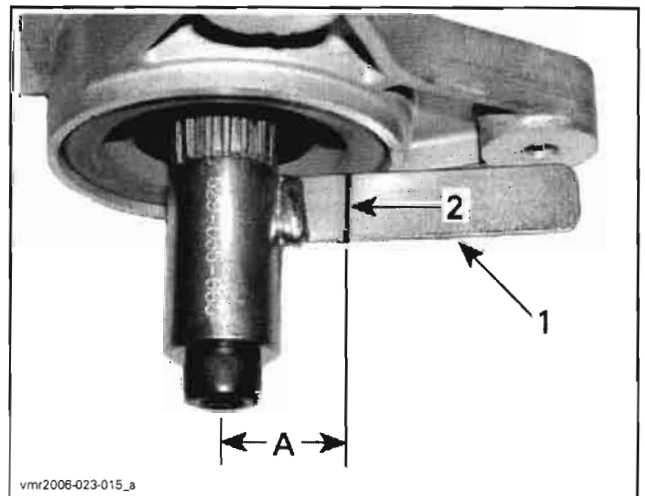
- 1. Backlash side
- 2. Preload side

Assemble the differential and check backlash as well as preload.

**Backlash**

Using a dial indicator and the backlash measurement tool (P/N 529 035 665), measure the backlash. Place the backlash measurement tool at the end of pinion gear.

From center of bolt, measure 25.4 mm (1 in) and scribe a mark on the tab.

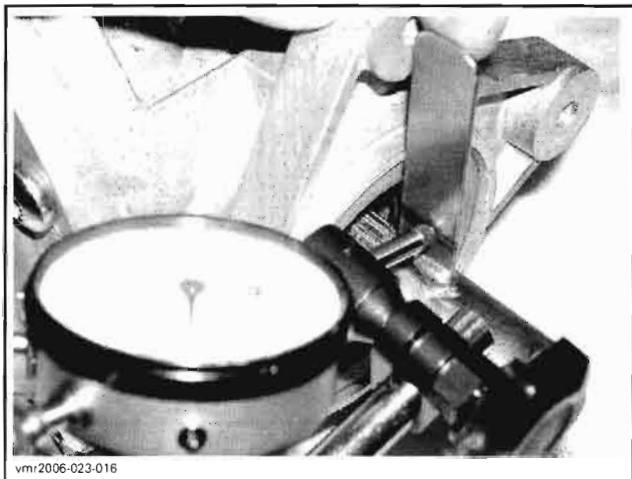


- 1. Tab of backlash measurement tool
- 2. Mark on tab
- A. 25.4 mm (1 in)

Position the dial indicator tip against the tab at a 90° angle and right on the previously scribed mark. Gently, move the tab back and forth. Note the result.

## Section 08 DRIVETRAIN

### Subsection 01 (FRONT DRIVE)



Rotate pinion gear 1/2 turn and check backlash again. Note the result.

Rotate pinion gear 1 turn and check backlash again.

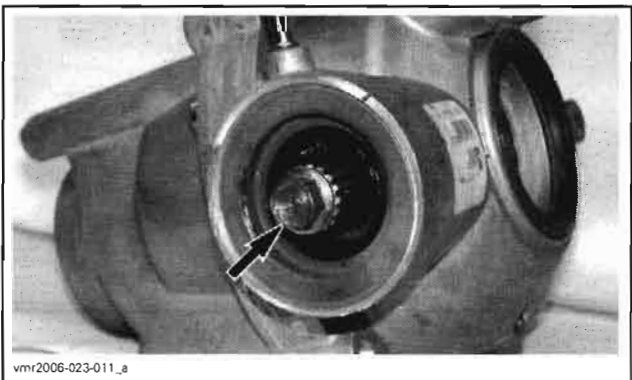
If backlash is below 0.05 mm (.002 in), increase backlash shim by 0.05 mm (.002 in) and check the backlash again.

If backlash is greater than 0.356 mm (.014 in), decrease backlash shim by 0.05 mm (.002 in) and check the backlash again.

Measure preload.

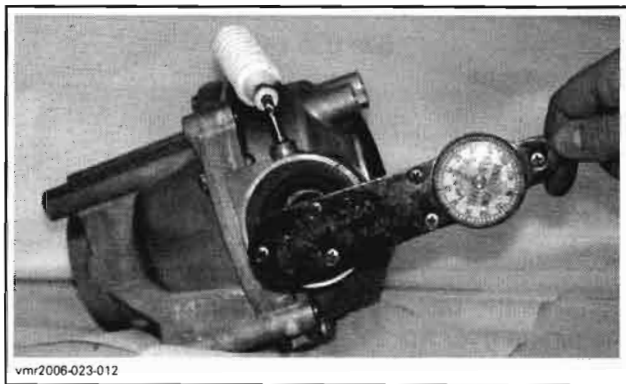
#### Preload

Screw the propeller shaft adaptor bolt no. 12 in pinion gear.



TYPICAL

Using a needle torque wrench, measure the drag torque.



TYPICAL

If the drag torque is greater than 0.7 N•m (6 lbf•in), reduce preload shim by 0.05 mm (.002 in) and check drag torque again.

If the drag torque is less than 0.06 N•m (.5 lbf•in), increase preload shim by 0.05 mm (.002 in) and check drag torque again.

## Assembly

### Ring Gear Carrier/Ring Gear

To assemble, reverse the removal procedure. Pay attention to the following details.

Verify condition of half housing seal no. 23. Change seal if necessary.

Check all bearings and all oil seals. Change them if necessary.

### Pinion Gear

To install, reverse the removal procedure. Pay attention to the following details.

Check O-ring no. 24 for damage. If so, change it.

Install the shim(s) then the ball bearing.

Install the nut no. 20. Apply Loctite 277 (P/N 293 800 073) on threads nut then torque it to 180 N•m (133 lbf•ft).

Apply XP-S synthetic grease (P/N 293 550 010) in the lips of the new oil seal no. 19 and install it.

## Installation

The installation is the reverse of the removal procedure.

## FRONT PROPELLER SHAFT

### Removal

Place vehicle on PARK position and select 4WD.

Remove the RH footrest.

Unscrew propeller shaft bolt on engine side.





Remove the Oetiker clamp no. 10 that attach propeller shaft bellows no. 14 to the propeller shaft adaptor no. 13. Discard clamp.



Remove LH drive shaft.  
Unscrew lower and upper differential bolts.  
Remove them and move the differential forwards.  
Remove front propeller shaft no. 11.

### Inspection

Check:

- splines for wear or damage
- if U-joint moves freely in all direction
- bellows for holes or brittleness.

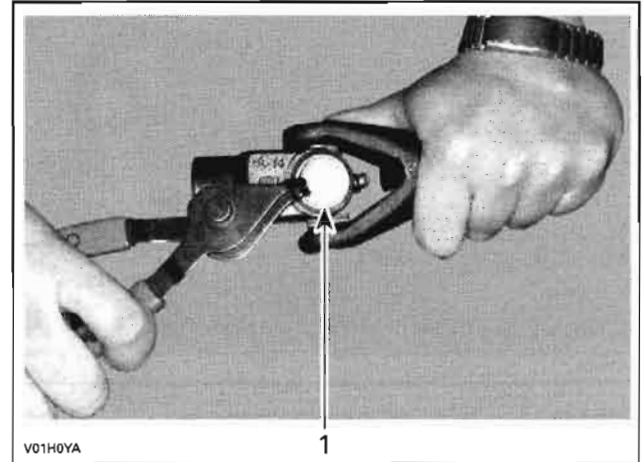
### Installation

Installation is the reverse of removal procedure.

## PROPELLER SHAFT U-JOINT

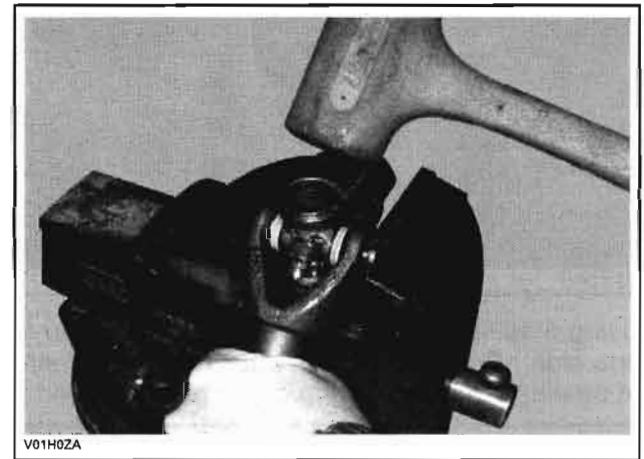
### Removal

Remove internal snap ring from bearing caps.



1. Snap ring

Support inner yoke in vice and drive other yoke down with a soft hammer.



Support U-joint in vice and drive inner yoke down to remove remaining bearing caps.

Remove U-joint cross.

### Installation

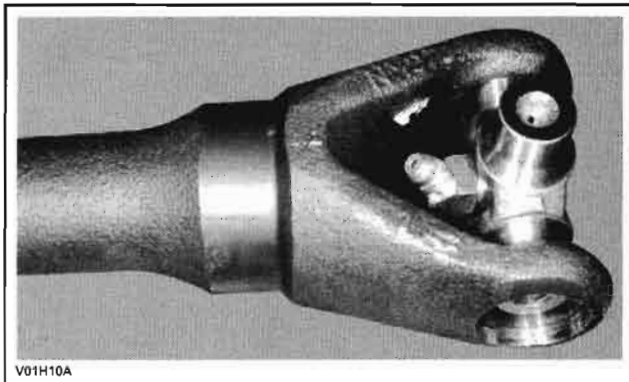
Install new U-joint cross in inner yoke.

Install new bearing cap by hand.

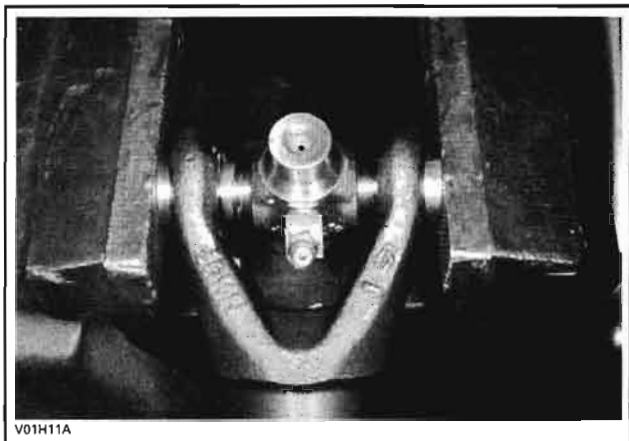
**NOTE:** Carefully install U-joint cross with grease fitting properly positioned.

## Section 08 DRIVETRAIN

### Subsection 01 (FRONT DRIVE)



Tighten vise to force bearing caps in.



Using a suitable tappet, fully seat bearing cap in one side. Continually, check for free movement of bearing cross as bearing caps are assembled.



Install snap ring.

Repeat procedure for other sides.

Grease U-joint, using a grease gun with XP-S synthetic grease (P/N 293 550 010).

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# REAR DRIVE

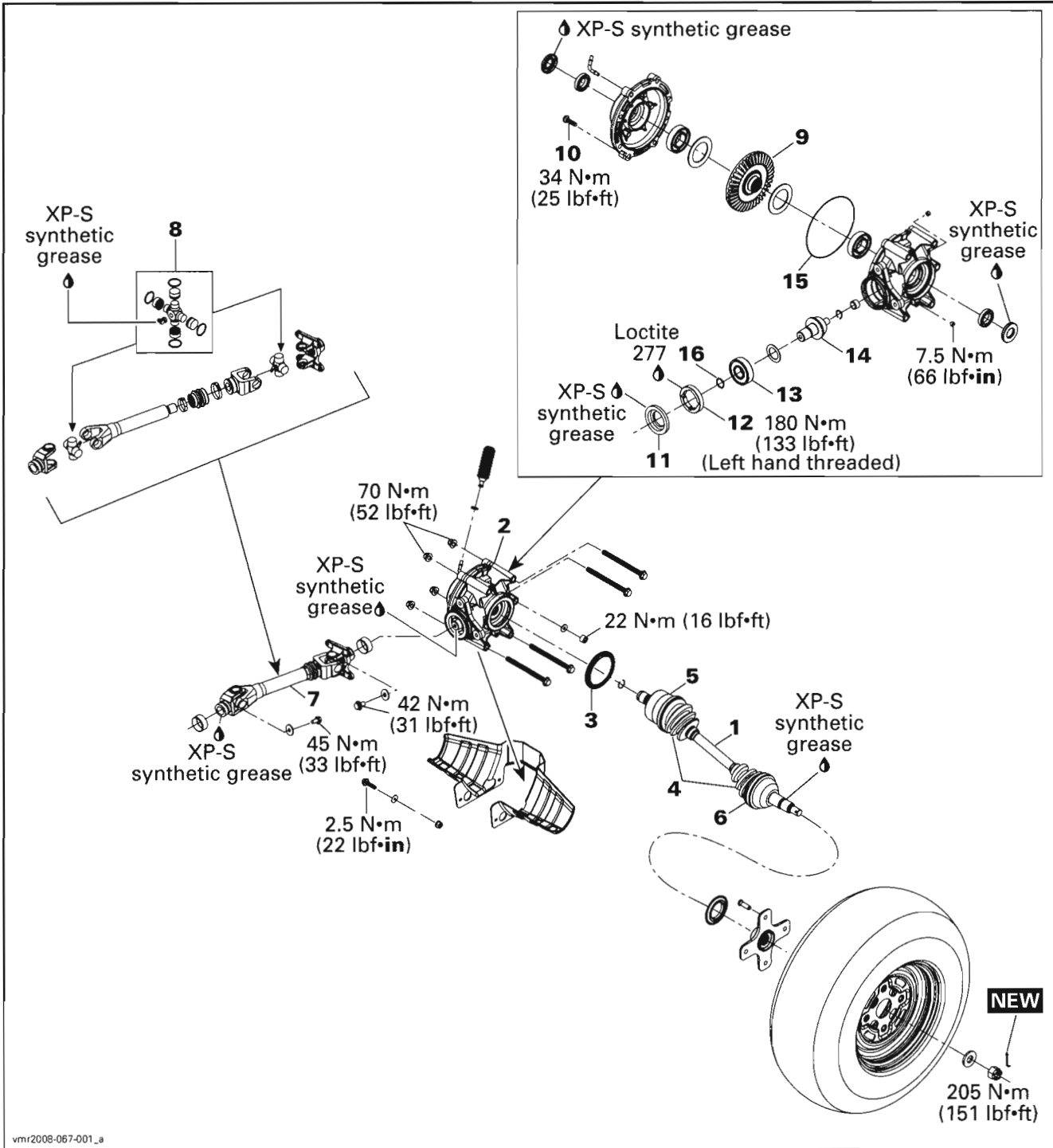
## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
CV boot clamp pliers.....	295 000 069 .....	323
pliers Oetiker 1099 .....	295 000 070 .....	323
differential spanner socket .....	529 035 649 .....	327
backlash measurement tool .....	529 035 665 .....	328

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
XP-S synthetic grease.....	293 550 010 .....	322, 325–326, 329
XP-S synthetic gear oil.....	293 600 043 .....	326
Loctite 277.....	293 800 073 .....	329

**Section 08 DRIVETRAIN**  
**Subsection 02 (REAR DRIVE)**



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## GENERAL

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

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

### **⚠ WARNING**

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

## PROCEDURES

### TIRES AND WHEELS

### **⚠ WARNING**

When the tires are replaced, never install a bias tire with a radial tire. Such a combination could create handling and/or stability problems.

Do not mix tires of different size and/or design on the same axle.

Front and rear tire pairs must be the identical model and manufacturer.

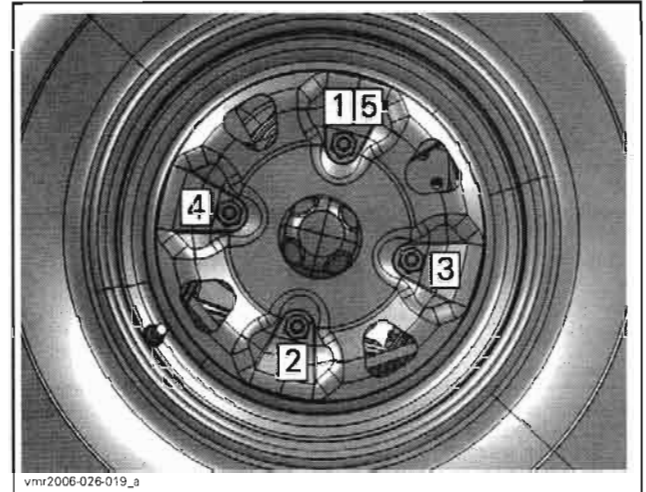
For unidirectional tread pattern, ensure that the tires are installed in the correct direction of rotation.

The radial tires must be installed as a complete set.

Severe injury or death can result if these instructions are not followed.

The tires are directional and their rotation must be kept in a specific direction for proper operation.

Using the next table, torque wheel nuts in accordance with the following illustration.



**CAUTION:** Always use the recommended wheel nuts. Using a different nut could cause damages to the rim.

WHEEL NUT TORQUE	
All steel wheels	70 N•m (52 lbf•ft)
All aluminum wheels (except for Outlander MAX 800 Ltd)	100 N•m (74 lbf•ft)
Outlander MAX 800 Ltd (BLACK aluminum wheels)	70 N•m (52 lbf•ft)

### **Outlander 650/800 Series and Renegade Models**

On these models, wheel balancing is necessary. To perform this operation, use a wheel balancer and adhesive weights.

## WHEEL HUB

### Wheel Hub Removal

Remove the appropriate wheel.

Remove and discard the cotter pin.

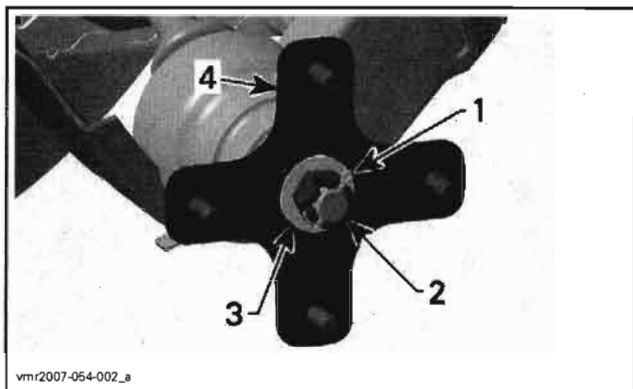
Unscrew the castellated nut.

Remove the Belleville washer.

Pull wheel hub to remove it.

## Section 08 DRIVETRAIN

### Subsection 02 (REAR DRIVE)



1. Cotter pin
2. Castellated nut
3. Belleville washer
4. Wheel hub

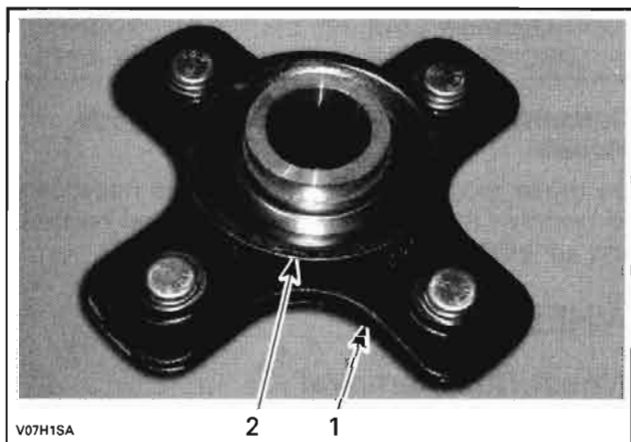
### Wheel Hub Inspection

Check wheel hub for cracks or other damages.

Check inner splines for wear or other damages.

If any damage is detected on wheel hub, replace it with a new one.

Check wear ring. If it is loose on hub, replace the wear ring.



1. Wheel hub
2. Wear ring

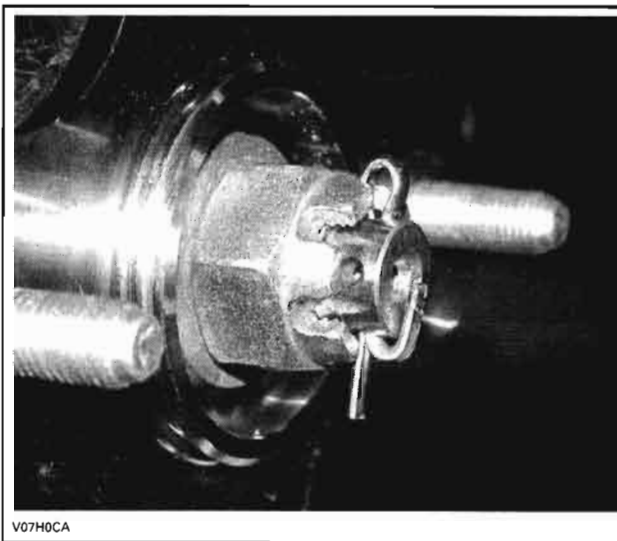
### Wheel Hub Installation

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

Apply XP-S synthetic grease (P/N 293 550 010) on drive shaft splines.

Install Belleville washer in correct orientation. Inside diameter must protrude outward.

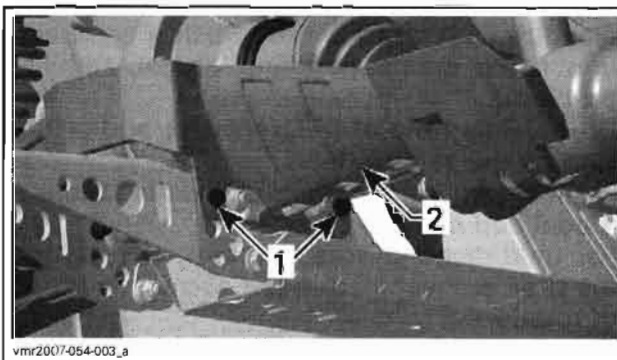
Torque castellated nut to 205 N•m (151 lbf•ft) and further tighten until one of its grooves is aligned with a cotter pin hole. Install a **NEW** cotter pin. Fold one pin of cotter pin over drive shaft end.



## DIFFERENTIAL PROTECTOR

### Differential Protector Removal

Remove bolts retaining the protector to the frame.



1. Protector bolts
2. Differential protector

### Differential Protector Installation

The installation is the reverse of removal procedure.

## DRIVE SHAFT

### Drive Shaft Removal

Remove the appropriate wheel hub and the footrest on this side.

Remove the lower shock absorber bolt.

Remove trailing arm. Refer to *REAR SUSPENSION*.

Pull drive shaft no. 1 out of differential no. 2.

**NOTE:** Pull drive shaft strongly.

## Drive Shaft Inspection

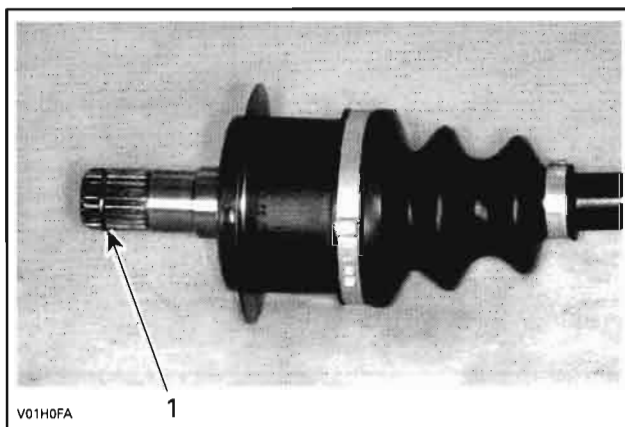
Inspect the condition of boots. If there is any damage or evidence of leaking lubricant, replace them. Refer to *DRIVE SHAFT BOOT*.

Check shaft splines. Replace drive shaft if necessary.

Check wear ring no. 3 on drive shaft end. Replace if necessary.

## Drive Shaft Installation

Insert the end of drive shaft in differential and pull joint a little to make sure that the stop ring is locked in differential gear groove.



1. Stop ring

**NOTE:** Make sure do not interchange LH and RH drive shafts. The shafts are different lengths.

Install the other parts in the reverse order of removal procedure. Refer to the appropriate sections to apply the proper torque.

## DRIVE SHAFT BOOT

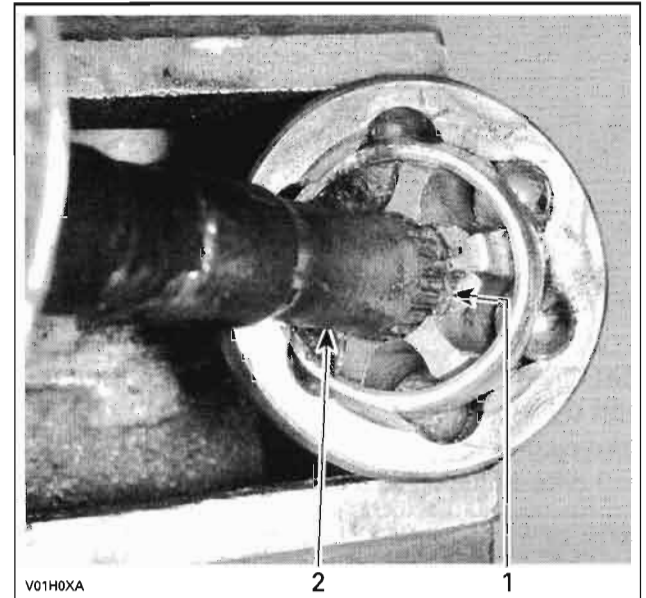
### Boot Removal

Remove the drive shaft from vehicle.

Remove the clamps from rubber boot no. 4 using CV boot clamp pliers (P/N 295 000 069) and pliers Oetiker 1099 (P/N 295 000 070).

Remove the large end of the boot from plunging joint no. 5 or CV joint no. 6.

Move apart circlip and pull out the shaft from bearing. Do not remove circlip.



1. Circlip  
2. Shaft

Remove boot from drive shaft.

### Boot Inspection

Check bearing in plunging joint no. 5 or CV joint no. 6. If bearing is hard to move, change plunging joint or CV joint.

Check circlip for damage, change as necessary.

### Boot Installation

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

Insert boot, do not forget the small clamp.

Insert shaft and push firmly.

Pack bearing area with grease (including with the new boot kit).

**NOTE:** Do not use any other grease.

Install all other removed parts.

## REAR PROPELLER SHAFT

### Propeller Shaft Removal

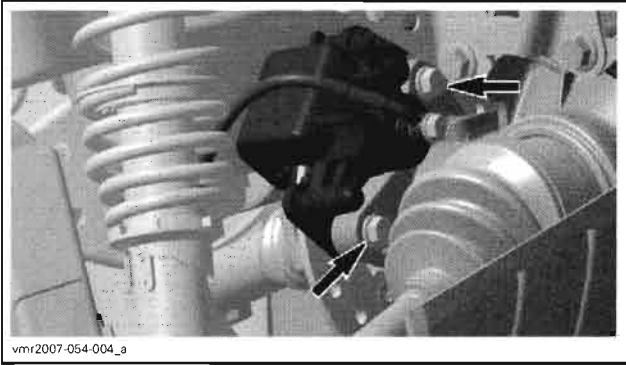
Install a jack stand to support the vehicle during the procedure.

Remove rear wheels.

Remove caliper screws and suspend caliper out of the way.

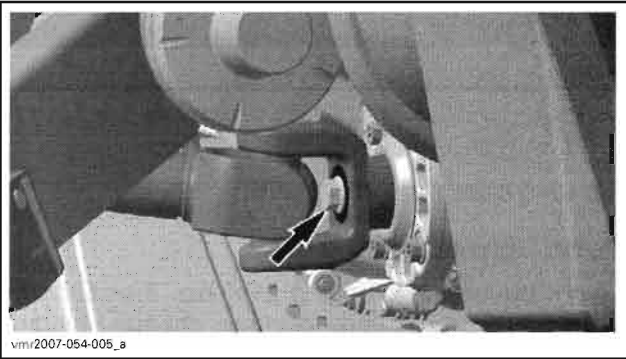
## Section 08 DRIVETRAIN

### Subsection 02 (REAR DRIVE)

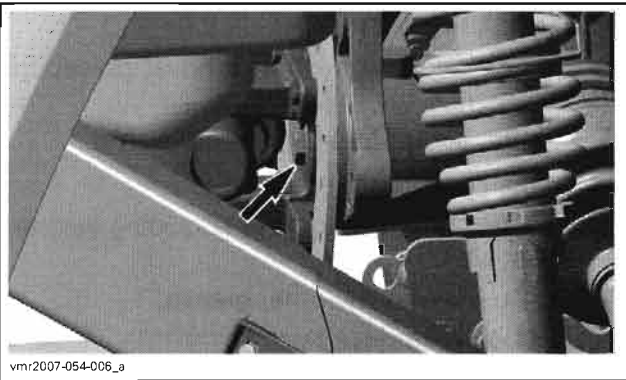


**CAUTION:** Do not let caliper hang by the hose and do not stretch or twist hose.

Unscrew the rear propeller shaft screws (engine and differential sides).



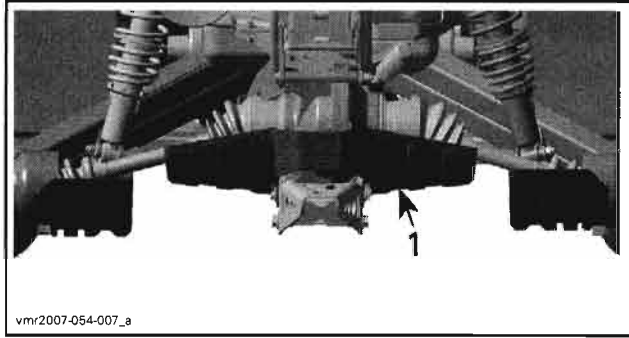
ENGINE SIDE



DIFFERENTIAL SIDE

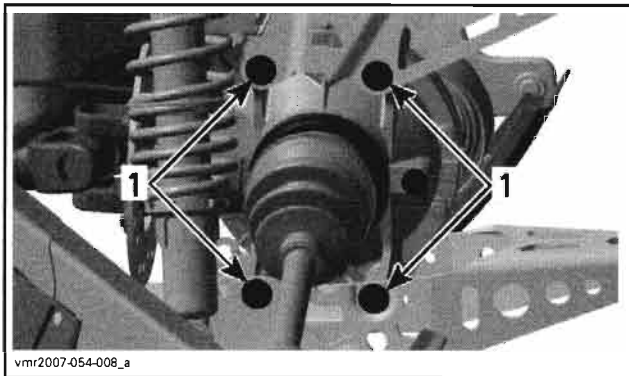
**NOTE:** The propeller shaft bolts are different, they must be reinstalled in same location.

Remove the differential protector.



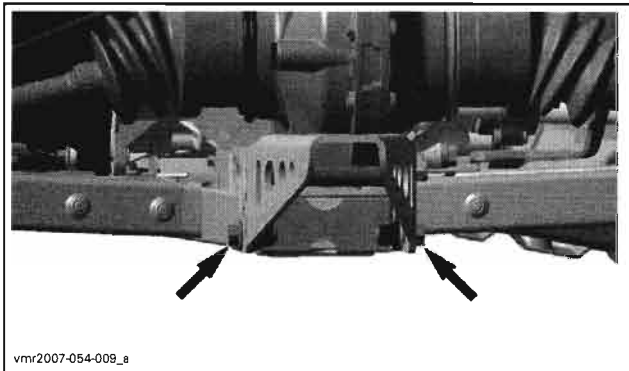
1. Differential protector

Unscrew and remove lower and upper differential bolts.



1. Differential bolts

Loosen hitch plate bolts.



Move the differential no. 2 backward.

Unplug the propeller shaft no. 7 from the differential then remove it from vehicle.

### Propeller Shaft Inspection

Check yoke U-joint no. 8 for wear, backlash or axial play, replace if necessary.

Inspect engine seal for damage or leaks. Replace if necessary.

Inspect brake disc (refer to *HYDRAULIC BRAKES*).



### Propeller Shaft Installation

Installation is essentially the reverse of removal procedure. Pay attention to the following details.

Apply XP-S synthetic grease (P/N 293 550 010) on engine drive shaft splines.

Install the propeller shaft screw (engine side) and torque it to 45 N•m (33 lbf•ft).

Apply XP-S synthetic grease (P/N 293 550 010) to splines before insert the end of the propeller shaft into differential. Torque propeller shaft screw to 34 N•m (25 lbf•ft).

Reinstall all other removed parts.

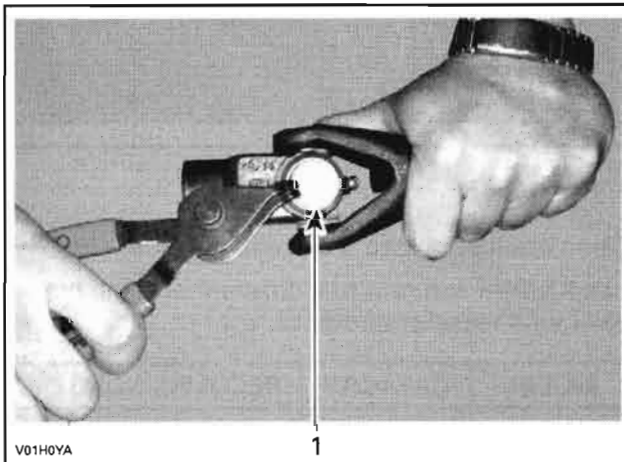
Grease U-joint from rear propeller shaft. Use a grease gun with XP-S synthetic grease (P/N 293 550 010).

### REAR PROPELLER SHAFT U-JOINT

Remove the brake disc before working on differential side of propeller shaft.

#### U-Joint Removal

Remove internal snap ring from bearing caps.



1. Snap ring

Support inner yoke in vice and drive other yoke down with a soft hammer.



Support U-joint in vice and drive inner yoke down to remove remaining bearing caps.

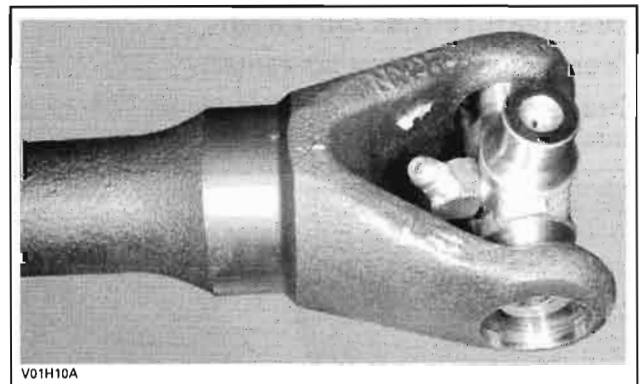
Remove U-joint cross.

#### U-Joint Installation

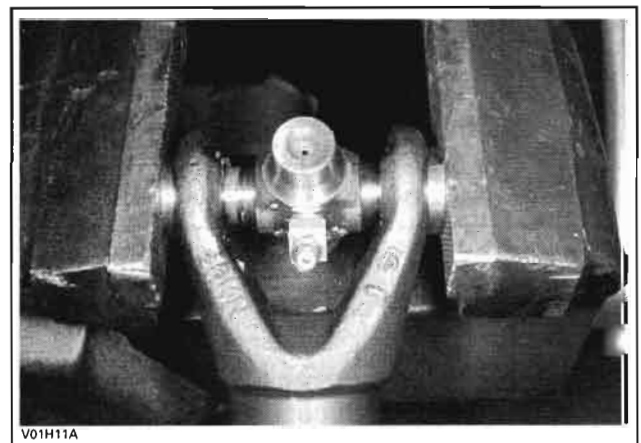
Install new U-joint cross in inner yoke.

Install new bearing cap by hand.

**NOTE:** Carefully install U-joint cross with grease fitting properly positioned.

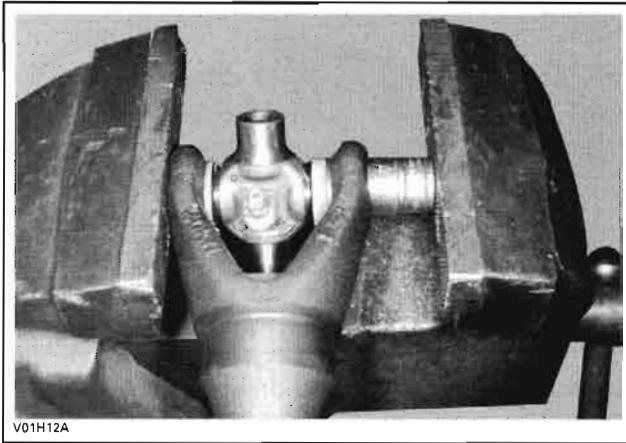


Tighten vise to force bearing caps in.



**Section 08 DRIVETRAIN**  
**Subsection 02 (REAR DRIVE)**

Using a suitable tappet, fully seat bearing cap in one side. Continually, check for free movement of bearing cross as bearing caps are assembled.



Install snap ring.

Repeat procedure for other sides.

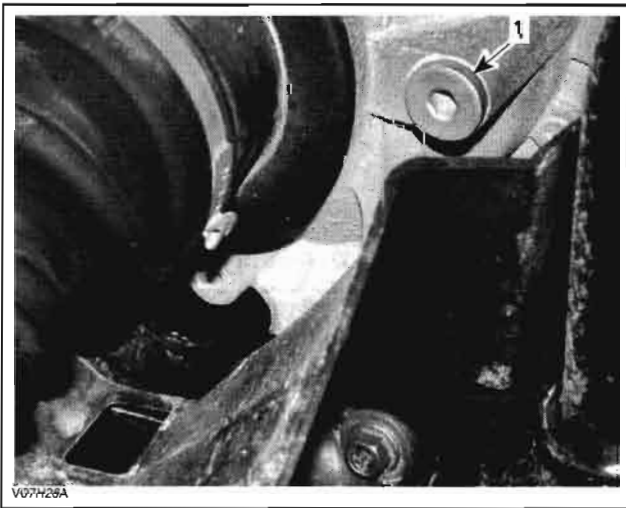
Grease U-joint, using a grease gun with XP-S synthetic grease (P/N 293 550 010).

**REAR DIFFERENTIAL**

**Rear Differential Oil Level**

Place bottom of frame horizontally.

Clean filler plug prior to check oil level. Check oil level by removing filler plug.



1. Filler plug

The rear differential oil is not level with the filler plug threads.

It is possible to verify the oil level by inserting a wire with a 90° bend through the oil filler hole.

Oil level is between 25 to 32 mm (1 to 1-1/4 in) from the bottom of oil filler plug threads when the vehicle is level on ground.

When replacing the oil in the differential, it is easier to measure the right quantity of oil to add in order to reach the proper level. Refer to *OIL REPLACEMENT*.

Add oil if necessary.

**Rear Differential Oil Replacement**

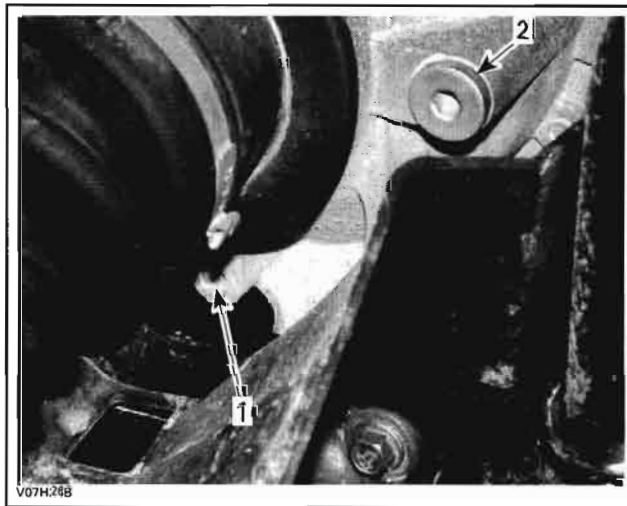
Ensure vehicle is on a level surface.

Clean drain plug area.

Place a drain pan under rear differential drain plug area.

Unscrew filler plug.

Remove drain plug.



1. Drain plug  
 2. Filler plug

Clean drain plug area then reinstall drain plug.

Use a funnel and refill rear differential at the proper level with recommended oil.

MODEL	CAPACITY	RECOMMENDED OIL
All models	250 mL (8.5 U.S. oz)	XP-S synthetic gear oil (P/N 293 600 043) or REDLINE pump oil 75W90 (API GL5)

Reinstall filler plug.

**Rear Differential Removal**

Install a jack stand under differential to support the vehicle during the following procedure.

Remove rear wheels.

Remove both trailing arms. Refer to *REAR SUSPENSION*.

Remove both drive shafts.

Remove the differential protector.

Unscrew and remove lower and upper differential bolts.

Remove the propeller shaft screw and its washer (differential side).

Remove the differential no. 2.

### Rear Differential Inspection

Turn rear differential gear with a finger; it should turn smoothly. Replace if necessary.

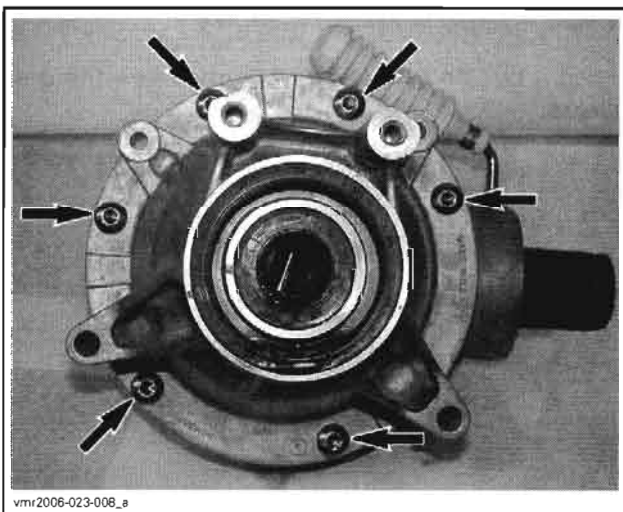
Check backlash and drag torque, see *ADJUSTMENT* further in this section.

Check if oil seals are brittle, hard or damaged. Replace if necessary.

### Rear Differential Disassembly

#### Ring Gear

Unscrew the TORX screws no. 10, then separate half housings.



TYPICAL — FRONT DIFFERENTIAL SHOWN

**NOTE:** Be careful to keep track of shims on each end of ring gear no. 9.

Extract ring gear out of half housing.

#### Pinion Gear

Remove oil seal no. 11.

Unscrew the pinion nut no. 12. Use the differential spanner socket (P/N 529 035 649).



vmr2008-067

**CAUTION:** The pinion nut is left hand threaded. Unscrew by turning clockwise.

Remove the bearing no. 13 at the same time as the pinion gear no. 14. Be careful to keep track of shims.

**NOTE:** The pinion gear and bearing can be easily removed using the following suggested tool:

- pipe 3-1/2 in diameter x 5 in (1)
- screwed rod M10 x 1.25, 7 in length (1)
- nut M10 x 1.25 (3)
- flat bar (1).

### Rear Differential Adjustment

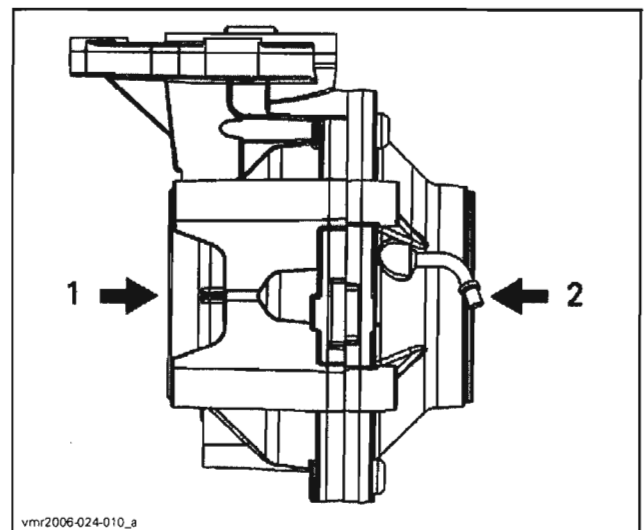
A shimming procedure must be done when pinion gear, ring gear or housing is (are) changed.

Measure the old pinion shim stack. If the shims measure over 1 mm (.039 in), install shim stacks on the differential components as per CHART "A".

If the old pinion shim stack measurement is under 1 mm (.039 in), install a .5 mm (.02 in) shim on the differential components as per CHART "B".

CHART "A"		CHART "B"	
PINION	2.18 mm (.086 in)	PINION	.5 mm (.02 in)
BACKLASH	.94 mm (.037 in)	BACKLASH	
PRELOAD	1.37 mm (.054 in)	PRELOAD	

**NOTE:** The procedure above sets the pinion shim thickness and should not be modified thereafter. Any changes should be done on preload and/or backlash side(s).



1. Backlash side
2. Preload side

## Section 08 DRIVETRAIN

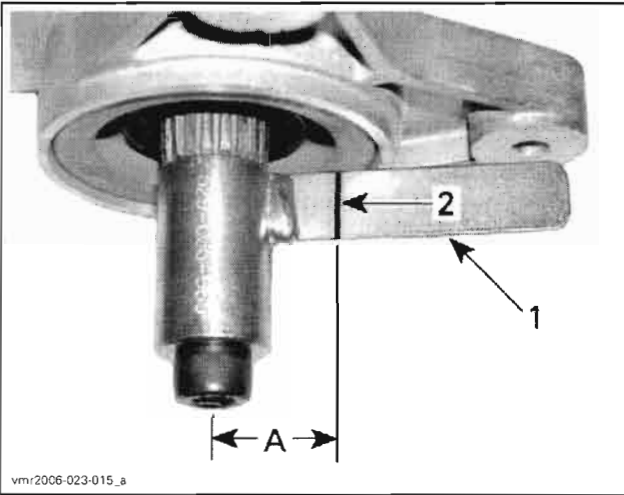
### Subsection 02 (REAR DRIVE)

Assemble the differential.

#### Backlash

Using a dial indicator and the backlash measurement tool (P/N 529 035 665), measure the backlash. Place the backlash measurement tool at the end of pinion gear.

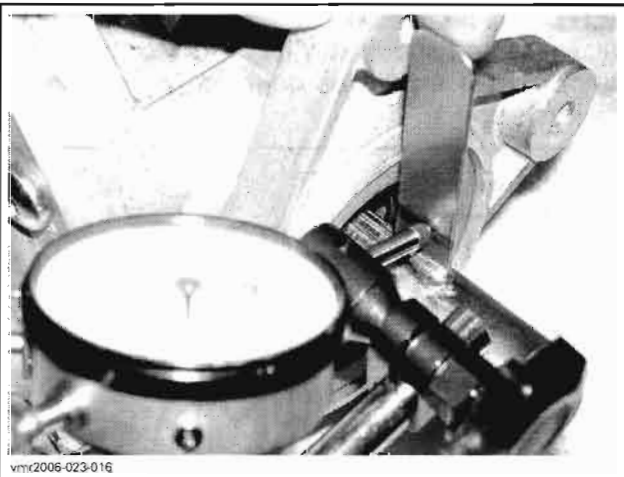
From center of bolt, measure 25.4 mm (1 in) and scribe a mark on the tab.



1. Tab of backlash measurement tool
2. Mark on tab
- A. 25.4 mm (1 in)

Position the dial indicator tip against the tab at a 90° angle and right on the previously scribed mark.

Gently, move the tab back and forth. Note the result.



Rotate pinion gear 1/2 turn and check backlash again. Note the result.

Rotate pinion gear 1 turn and check backlash again.

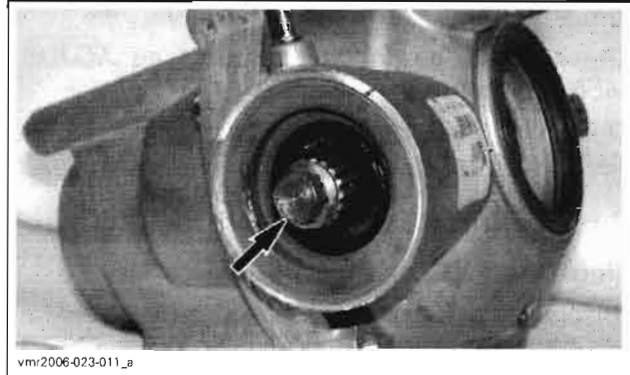
If backlash is below 0.05 mm (.002 in), increase backlash shim by 0.05 mm (.002 in) and check the backlash again.

If backlash is greater than 0.356 mm (.014 in), decrease backlash shim by 0.05 mm (.002 in) and check the backlash again.

Measure preload.

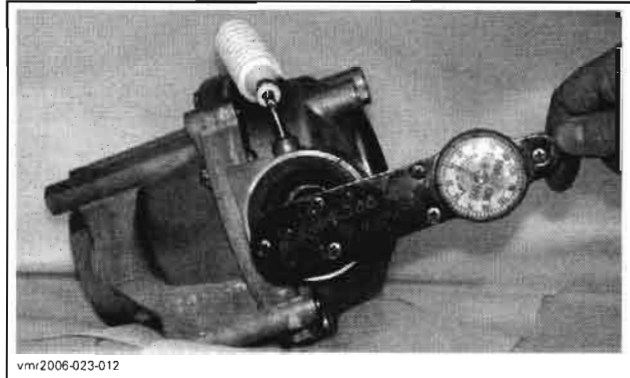
#### Preload

Screw the propeller shaft adaptor bolt in pinion gear.



TYPICAL — FRONT DIFFERENTIAL SHOWN

Using a needle torque wrench, measure the drag torque.



TYPICAL — FRONT DIFFERENTIAL SHOWN

If the drag torque is greater than 0.7 N•m (6 lbf•in), reduce preload shim by 0.05 mm (.002 in) and check drag torque again.

If the drag torque is less than 0.06 N•m (.5 lbf•in), increase preload shim by 0.05 mm (.002 in) and check drag torque again.

#### Rear Differential Assembly

##### Ring Gear

To assemble, reverse the removal procedure. Pay attention to the following details.

Verify condition of half housing seal **no. 15**. Change seal if necessary.

Check all bearings and all oil seals. Change them if necessary.

### **Pinion Gear**

To install, reverse the removal procedure. Pay attention to the following details.

Check O-ring **no. 16** for damage. If so, change it.

Install the shim then the ball bearing.

Install the nut **no. 12**. Apply Loctite 277 (P/N 293 800 073) on threads nut then torque it to 180 N•m (133 lbf•ft).

Apply XP-S synthetic grease (P/N 293 550 010) in the lips of the new oil seal **no. 11** and install it.

### **Rear Differential Installation**

The installation is the reverse of the removal procedure.



*Midwest Manuals*

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# STEERING SYSTEM

## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
steering alignment tool.....	529 036 059 .....	340

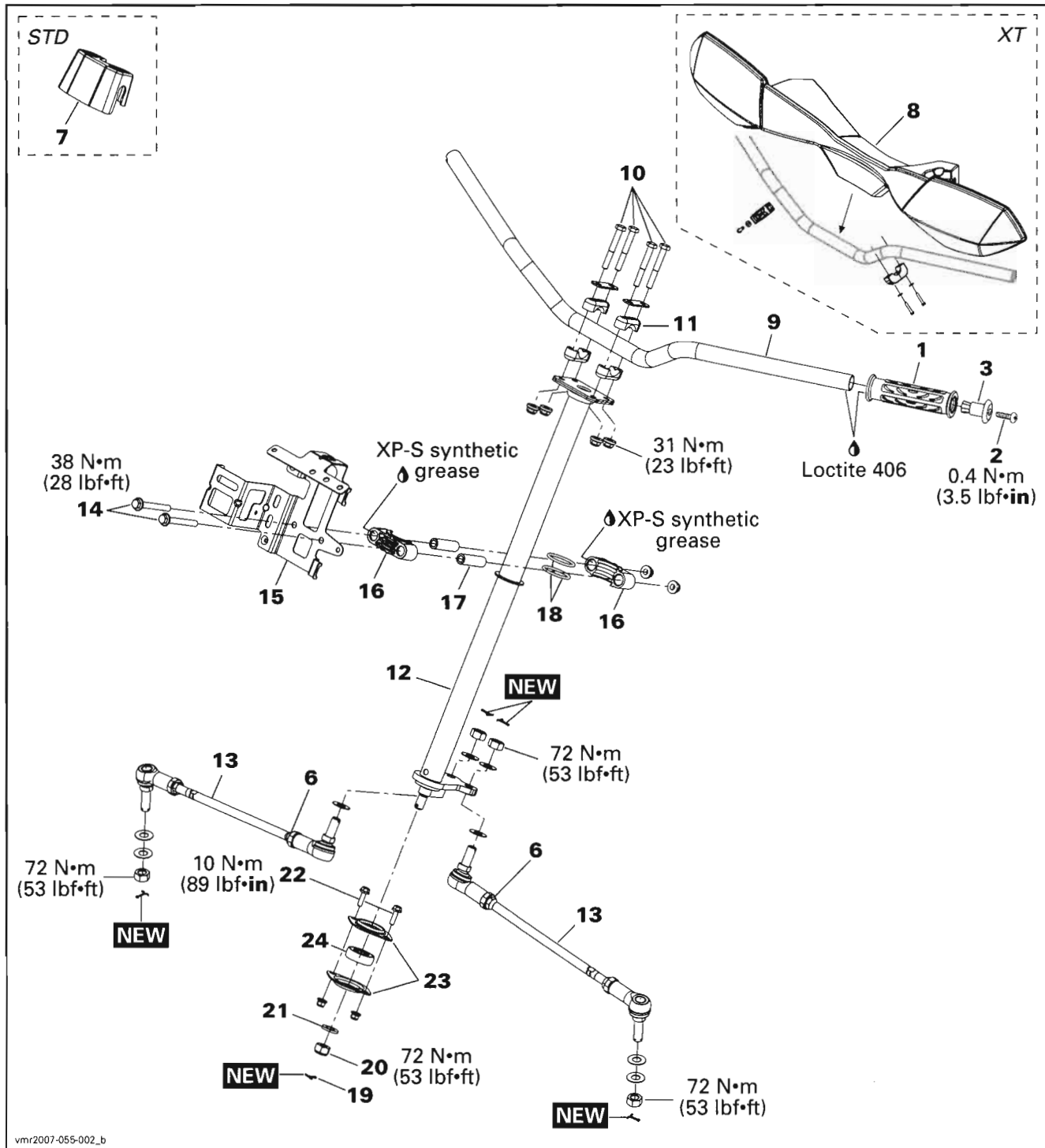
## SERVICE TOOLS – OTHER SUPPLIER

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Smoothflow™ tapered tip .....	16 ga .....	333
	#511 rtt-b .....	

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Loctite 406 (glue).....	293 800 100 .....	333
pulley flange cleaner.....	413 711 809 .....	333
XP-S synthetic grease.....	529 550 010 .....	335

**Section 09 STEERING SYSTEM**  
**Subsection 01 (STEERING SYSTEM)**





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

## PROCEDURES

### HANDLEBAR GRIP

#### Removal

Loosen the screw **no. 2** at the end of handlebar grip **no. 1**.

Remove the handlebar grip cap **no. 3**.

Cut and remove the handlebar grip.

#### Installation

Remove all rubber residues of the old grip before installing the new.

Clean the handlebar with pulley flange cleaner (P/N 413 711 809) or alcohol to remove any greasy matter on it.

Install handlebar grip by blowing compressed air between handle grip and handlebar.

Install a Smoothflow™ tapered tip (P/N 16 ga #511 rtt-b) from EFD Inc on a bottle of Loctite 406 (glue) (P/N 293 800 100).

Lift a part of the grip using a small screwdriver and inject glue (about 4 spots per side).

**NOTE:** The glue dries quickly. Do not apply it before installing grip.

Apply pressure on the grip for approximately 30 seconds to set the glue.

Install the handlebar grip cap and torque screw 0.4 N•m (3.5 lbf•in).

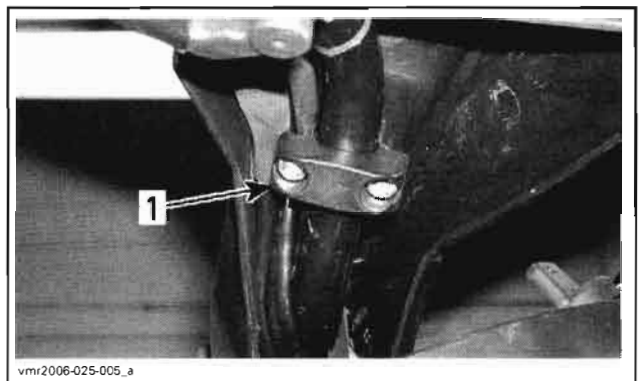
### HANDLEBAR COVER

#### Removal

On models without XT package, just pull the handlebar cover **no. 7** to remove it.



On XT models, unscrew both plastic U-clamps that attach handlebar cover **no. 8** to the handlebar **no. 9**.



1. Plastic U-clamp

#### Inspection

Check covers for cracks or other damages. Replace if necessary.

#### Installation

The installation is the reverse of removal procedure.

### HANDLEBAR

#### Removal

**All Models except Renegade**

Remove handlebar cover.

Remove handlebar grips **no. 1**.

Remove throttle and brake handles as well as multifunction switch (see below in this section).

## Section 09 STEERING SYSTEM

### Subsection 01 (STEERING SYSTEM)

**NOTE:** Remove handlebar grips, throttle handle, brake handle and multifunction switch only if the handlebar is defective and replace with a new.

Remove steering clamp mounting bolts no. 10 and steering clamps no. 11.



TYPICAL — OUTLANDER 800 SHOWN

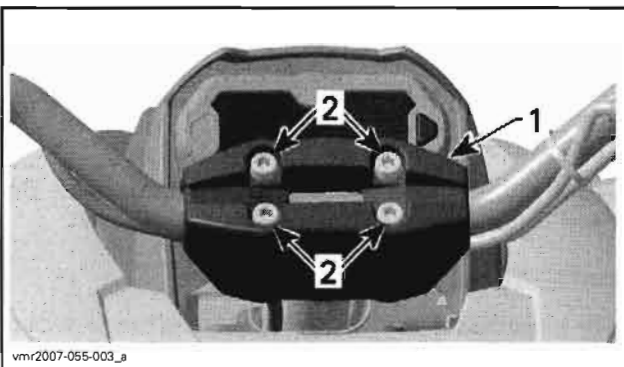
Remove the handlebar no. 9.

#### Renegade Model

Remove handlebar grips, throttle and brake handles as well as multifunction switch.

**NOTE:** These items should be removed only if the handlebar is defective and/or replaced with a new.

Unscrew the four socket screws securing the moulded handlebar support.



1. Moulded handlebar support
2. Socket screws

Remove handlebar.

#### Inspection

Inspect the handlebar for damage, cracks or bending, replace if any of these problems is detected.

#### Installation

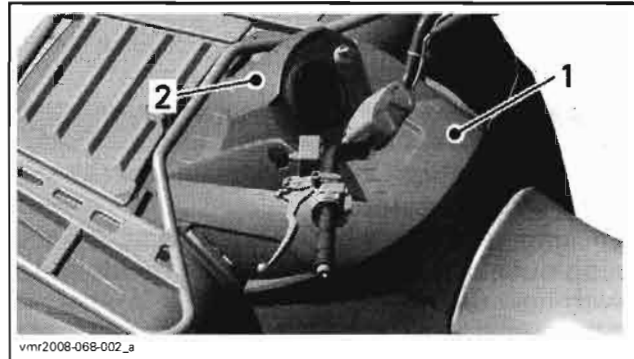
For the installation, reverse the removal procedure.

## STEERING COLUMN

### Removal

Remove both footrests.

Remove central panel and dash board.

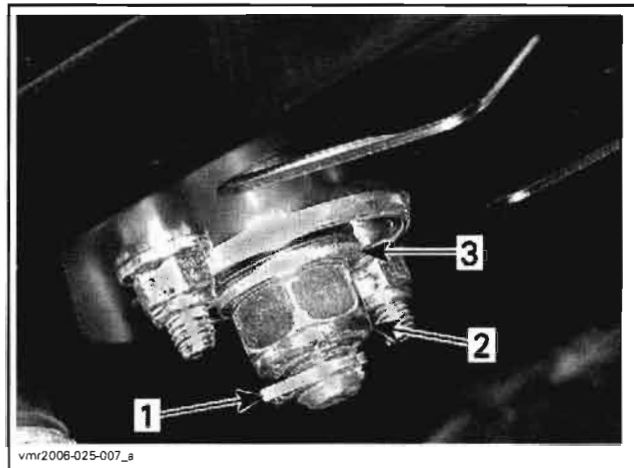


1. Central panel
2. Dash board

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

Remove handlebar.

Remove the cotter pin (discard it), the elastic stop nut and the washer to bottom end of steering column.



- TYPICAL
1. Cotter pin
  2. Elastic nut
  3. Washer

Separate steering column no. 12 and tie-rods no. 13. Refer to *TIE-ROD*, further in this section.

Remove half bushing bolts no. 14, stopping plate or module support no. 15, half bushing no. 16 and bushings no. 17.

Pull out steering column.

### Inspection

Inspect steering column for wear, cracks or bending, replace if any of these problems is detected.

Check if steering column O-rings **no. 18** are brittle, hard or otherwise damaged. Replace if necessary.

At the same time, check steering column bearing condition. It must turn smoothly and freely. If not, refer to *STEERING COLUMN BEARING* for replacement procedure.

### Installation

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

Apply XP-S synthetic grease (P/N 529 550 010) on O-rings and on bushings.

Install **NEW** cotter pins. Both ends of cotter pins must be folded.

## STEERING COLUMN BEARING

### Removal

Place vehicle on jack stands and remove one wheel.

Remove both footrests, central panel and dashboard (refer to *BODY*).

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

Separate tie-rods **no. 13** from steering column **no. 12**. Refer to *TIE-ROD* section.



TYPICAL

Remove cotter pin **no. 19** (discard it), elastic nut **no. 20** and flat washer **no. 21** to bottom end of steering column **no. 12**.



TYPICAL

Pull up steering column.

Remove bolts **no. 22** and bearing flanges **no. 23**.

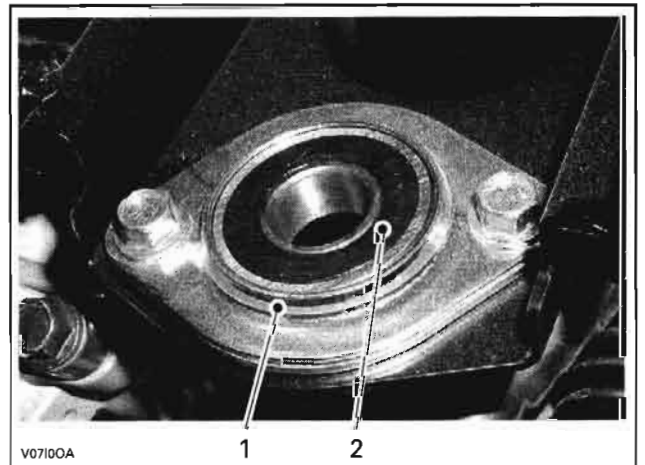
Remove bearing **no. 24**.

### Installation

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

Place bearing flanges collars outward.

**NOTE:** Install both bearing flanges on top of frame support.



TYPICAL

1. Bearing flange
2. Bearing

Install bearing flange bolts **no. 22**.

Install the steering column, flat washer, elastic nut and a **NEW** cotter pin. Both ends of cotter pin must be folded.

## TIE-ROD

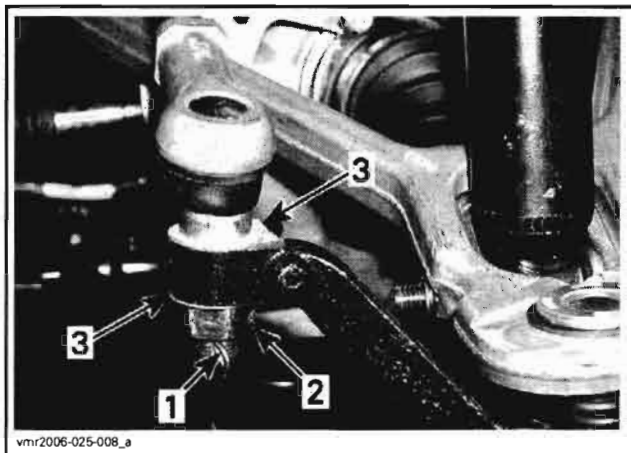
**NOTE:** Use the same procedure for RH and LH side.

**Section 09 STEERING SYSTEM**  
**Subsection 01 (STEERING SYSTEM)**

**Removal**

Place the vehicle on jack stands and remove the appropriate wheel.

Remove cotter pin (discard it), elastic nut and hardened washers from steering column and knuckle.



**TYPICAL**  
 1. Cotter pin  
 2. Elastic nut  
 3. Hardened washers

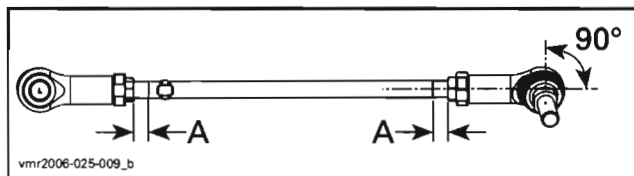
**Inspection**

Inspect ball joint ends for wear or looseness, if excessive, replace.

**Installation**

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

When installing a tie-rod, screw threaded end of tie-rod into ball joint. The maximum length for tie-rod groove to ball joint end must match value "A" in the following chart:



MODEL		"A"
ALL	mm	17.5 ± 5
	in	11/16 ± 3/16

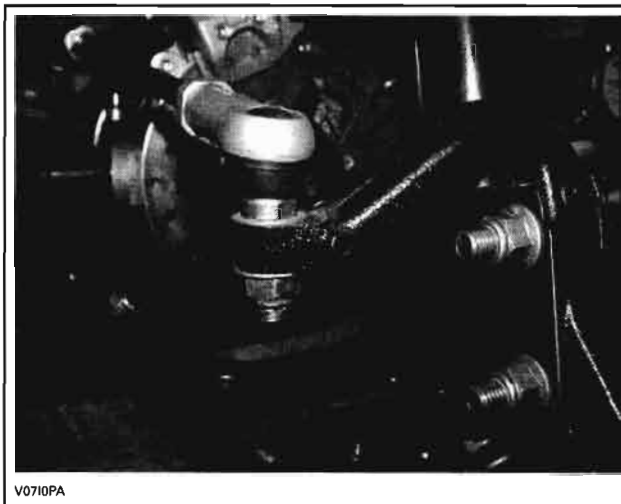
**NOTE:** Torque the ball joint lock nut no. 6.  
 Install **NEW** cotter pins. Both ends of cotter pins must be folded.

**KNUCKLE**

**Removal**

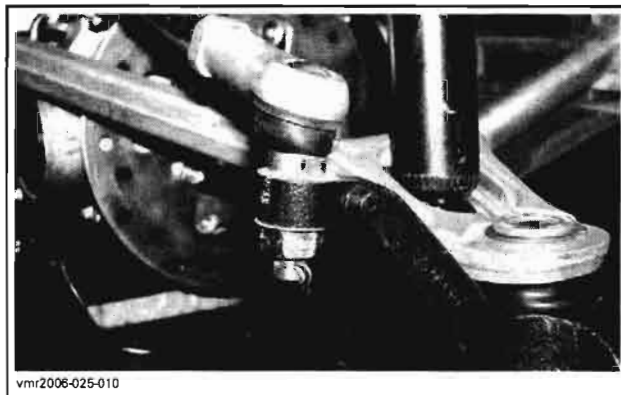
Place vehicle on jack stands and remove the appropriate wheel.

Separate tie-rod no. 13 from knuckle.



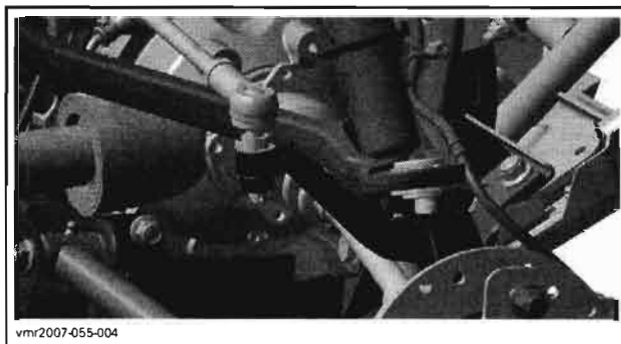
V0710PA

**OUTLANDER 500**



vmr2006-025-010

**OUTLANDER 650 AND 800**



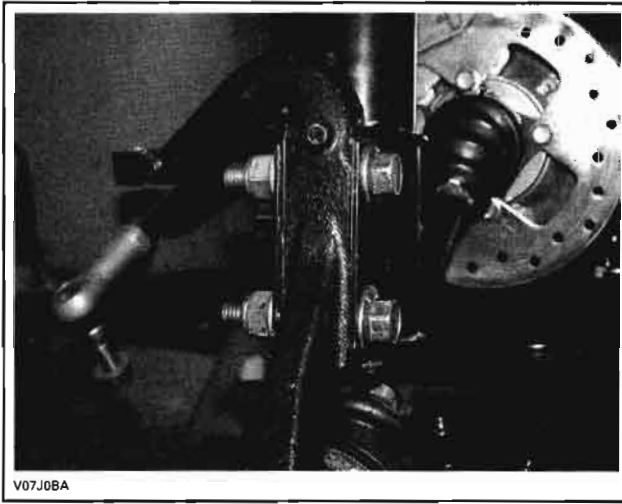
vmr2007-055-004

**RENEGADE**

Remove wheel hub. Refer to **FRONT SUSPENSION**.

**Outlander 500**

Remove strut bolts.



TYPICAL

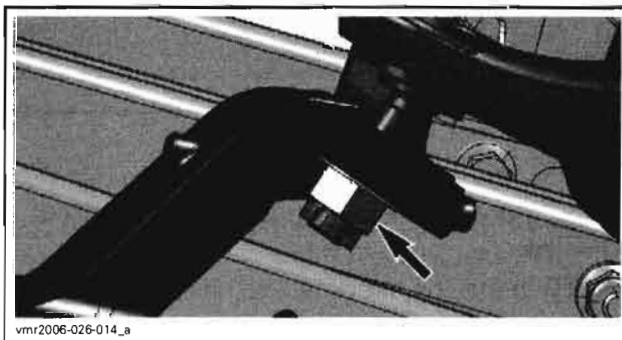
Remove bolt that attaches lower ball joint to knuckle.



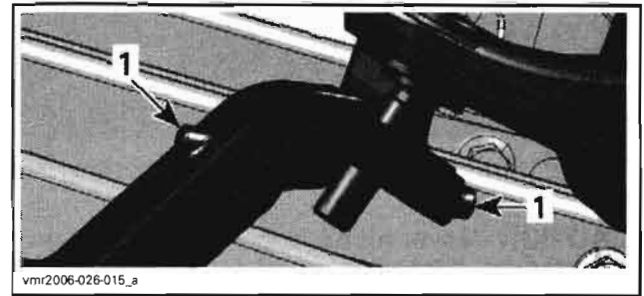
Remove knuckle.

**Outlander 650 and 800**

Unscrew the upper ball joint nut and separate upper ball joint to knuckle.



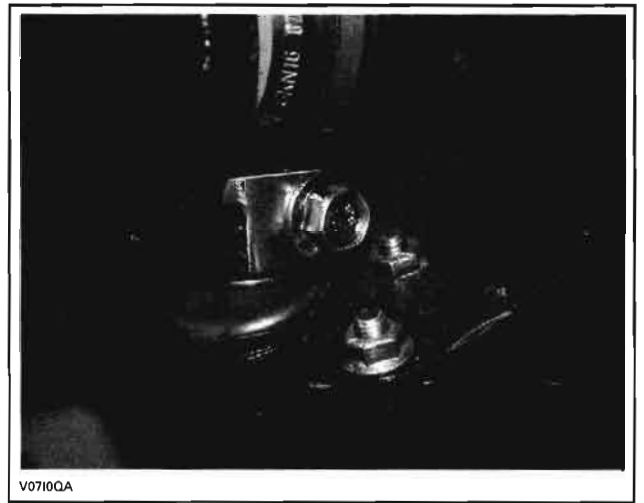
Using a hammer, hit on the knuckle tip to separate ball joint from knuckle. A ball joint remover can be used if the ball joint is jammed into knuckle.



1. Hit here

**CAUTION:** Never hit on upper suspension arm. Permanent damages could be caused to arm and its replacement would be necessary.

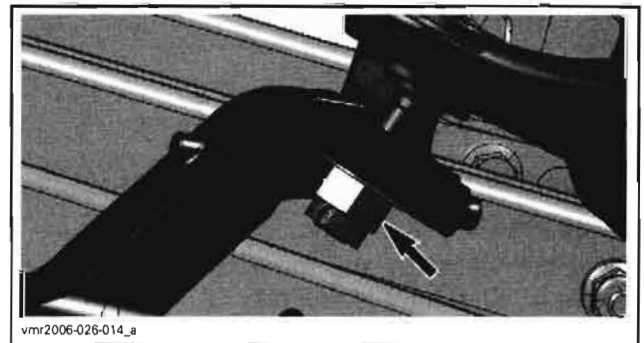
Remove bolt that attaches lower ball joint to knuckle.



Remove knuckle.

**Renegade**

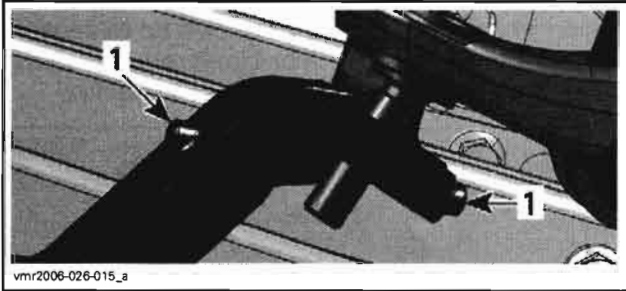
Unscrew the upper ball joint nut and separate upper ball joint to knuckle.



Using a hammer, hit on the knuckle tip to separate ball joint from knuckle. A ball joint remover can be used if the ball joint is jammed into knuckle.

## Section 09 STEERING SYSTEM

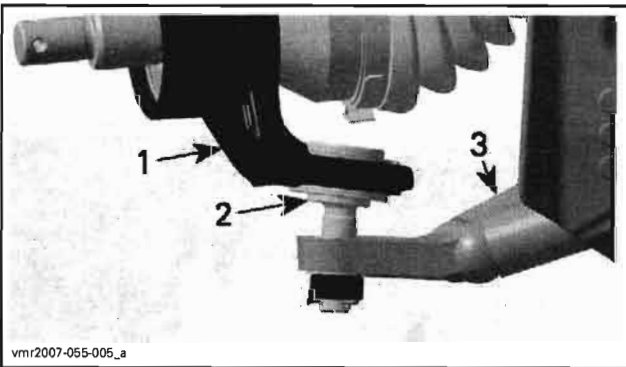
### Subsection 01 (STEERING SYSTEM)



1. Hit here

**CAUTION:** Never hit on upper suspension arm. Permanent damages could be caused to arm and its replacement would be necessary.

Remove nut that attaches lower ball joint to lower suspension arm.



1. Knuckle
2. Lower ball joint
3. Lower suspension arm

Remove knuckle.

### Inspection

Check knuckle for cracks or other damages. Replace if necessary.

Check if wheel bearing turns freely and smoothly. See *WHEEL BEARING* below if the replacement is necessary.

### Installation

The installation is the reverse of removal procedure.

## WHEEL BEARING

### Inspection

Raise the front of vehicle.

Hold the wheel by the top and the bottom and move it. Check for lateral play.

If there is any loose, replace the wheel bearing.

**NOTE:** First, check if ball joint is loose. If necessary repair all defective parts before checking the wheel bearing condition. Be careful not to misjudge loose in the ball joint and loose in the wheel bearing.

### Removal

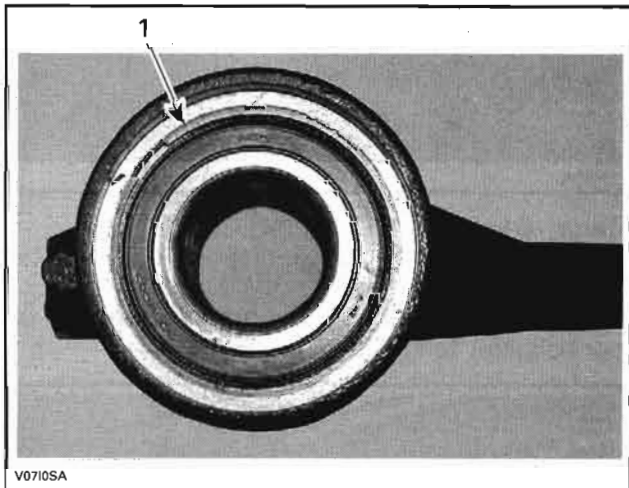
Remove knuckle from vehicle, (see above).

Remove and discard knuckle seal.



TYPICAL

Remove the circlip.



TYPICAL

1. Circlip

Using a press machine, push the bearing out of knuckle.

**NOTE:** It may be necessary to heat the knuckle to remove the bearing.

**⚠ WARNING**

Clean all grease, outside and inside, from knuckle before heating it.

### Installation

Place the bearing in a freezer for 10 minutes before installing.

Place the knuckle in oven to 100°C (212°F) for 30 minutes maximum to ease bearing installation.

When knuckle is cold, install the circlip and the **NEW** seal.

Install the other parts in the reverse order of removal procedure.

## MULTIFUNCTION SWITCH

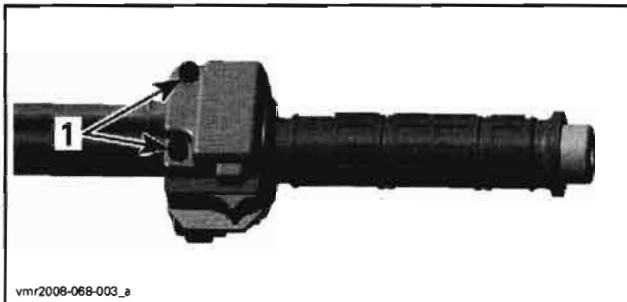
### Test

Refer to *LIGHTS, GAUGE AND ACCESSORIES* for Hi-Lo Beam button.

Refer to *IGNITION SYSTEM* for engine run/stop switch and start button.

### Removal

Remove multifunction switch screws.



*TYPICAL*  
1. Remove the screws

Separate multifunction switch from handlebar no. 9.

Remove central panel. Refer to *BODY*.

Unplug multifunction switch connector. The connector is located under central panel.

### Installation

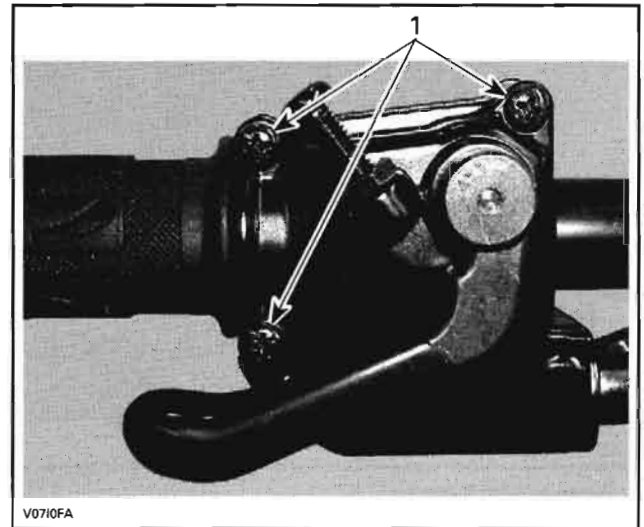
For installation, reverse the removal procedure.

## THROTTLE HANDLE

### Removal

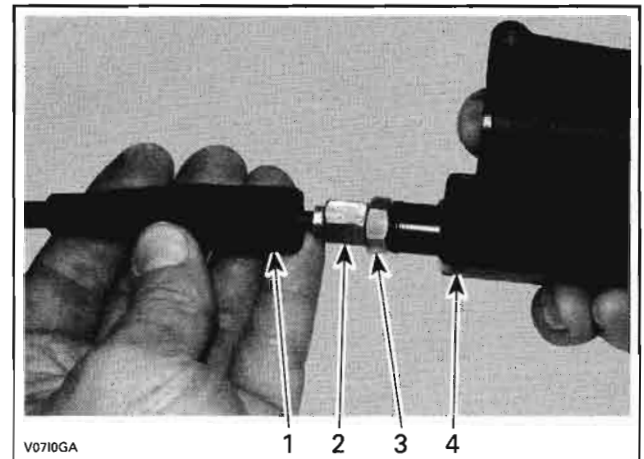
Remove central panel and unplug the 2/4WD switch connector (except on CE models).

Remove screws.



*TYPICAL*  
1. Remove screws

Separate throttle handle from handlebar no. 9. Slide rubber protector back to expose throttle cable adjuster.



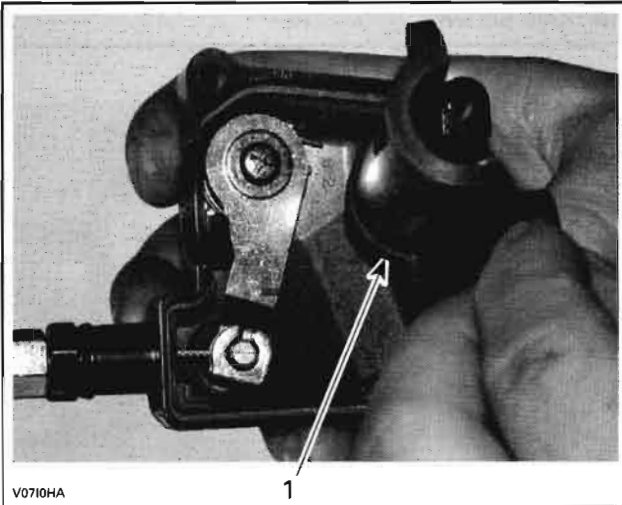
1. Cable protector  
2. Throttle cable adjuster  
3. Lock nut  
4. Throttle lever housing

Loosen lock nut and screw in the throttle cable adjuster.

Remove inner housing protector.

## Section 09 STEERING SYSTEM

### Subsection 01 (STEERING SYSTEM)



1. Inner housing protector

Slide cable in clip slot and remove the end of the cable from clip.



Remove throttle cable from housing.

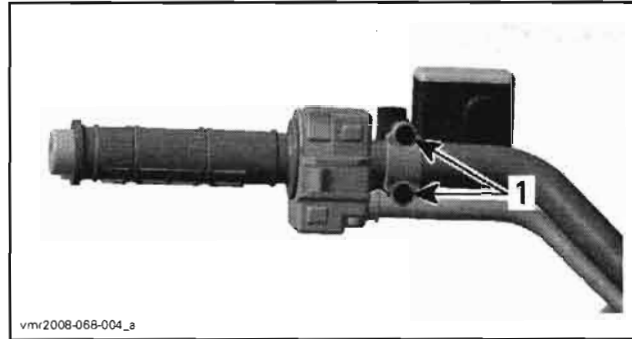
### Installation

For installation, reverse the removal procedure. After throttle cable installation, the reset of TPS must be performed. Refer to *ENGINE MANAGEMENT*.

## HANDLE BRAKE

### Removal

Remove screws.



### TYPICAL

1. Remove the screws

Separate handle brake from handlebar no. 9.

### Hose Removal

Refer to *HYDRAULIC BRAKES* for specifics instructions.

### Installation

For installation, reverse the removal procedure.

## ADJUSTMENT

### STEERING ALIGNMENT

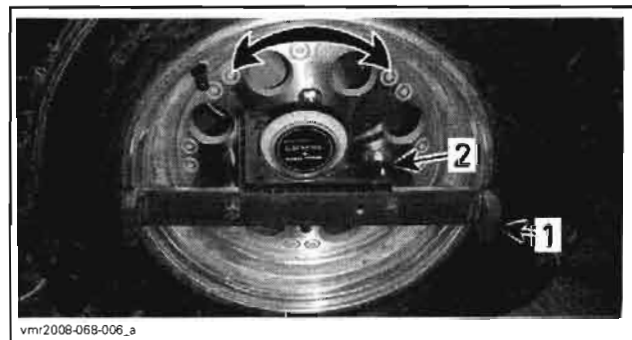
Place vehicle on level surface.

Check that handlebar is straight.

Check pressure in each tires. Always follow recommended pressure.

Remove two wheel nuts and install the steering alignment tool (P/N 529 036 059).

Move the vehicle to place the tool on a level with the ground.



1. Steering adjustment tool  
2. Angle gauge or level

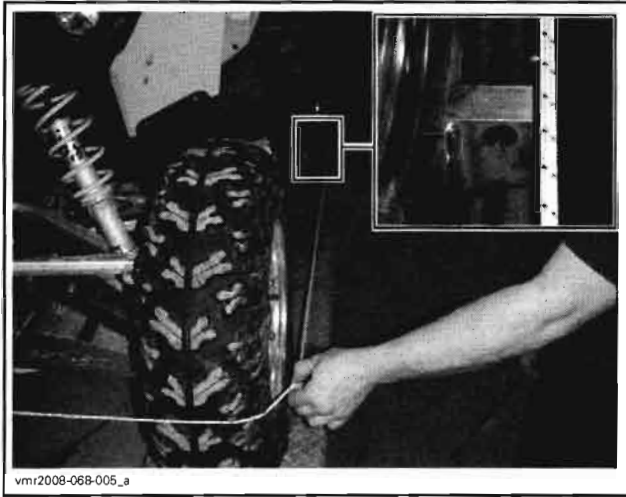
Place a rope around the vehicle and using an elastic, link both ends together.

The rope must be place at the center of the wheels.



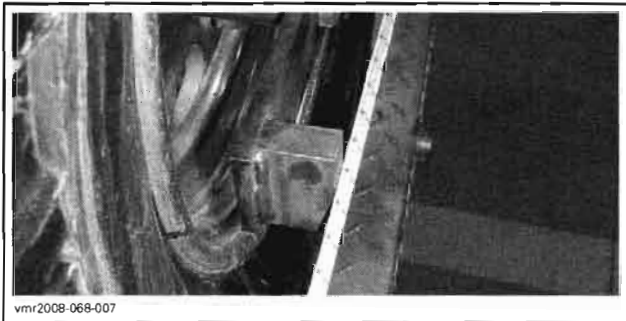
**Section 09 STEERING SYSTEM**  
**Subsection 01 (STEERING SYSTEM)**

From the front of vehicle, near the front of rim, move rope so that it does not touch the first spacer of tool.



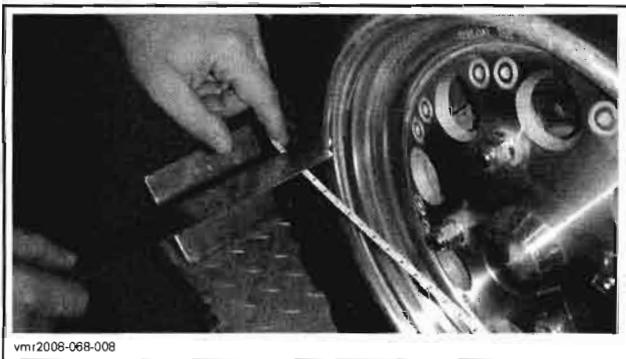
TYPICAL

Then, bring the rope back until it touches the spacer.



TYPICAL

Keep this position and measure the distance between the rope and the rim, to the front and to the rear of wheel.



TYPICAL — FRONT OF WHEEL



TYPICAL — REAR OF WHEEL

Refer to the following chart to know the difference between the rear and the front measurement.

MODELS	TOE-OUT
ALL OUTLANDER	0 mm $\pm$ 4 mm (0 in $\pm$ .157 in)
RENEGADE	2 mm (.79 in)

Set alignment of wheel by adjusting tie-rod.  
 Repeat the procedure for the other side of vehicle.



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# FRONT SUSPENSION

## SERVICE TOOLS

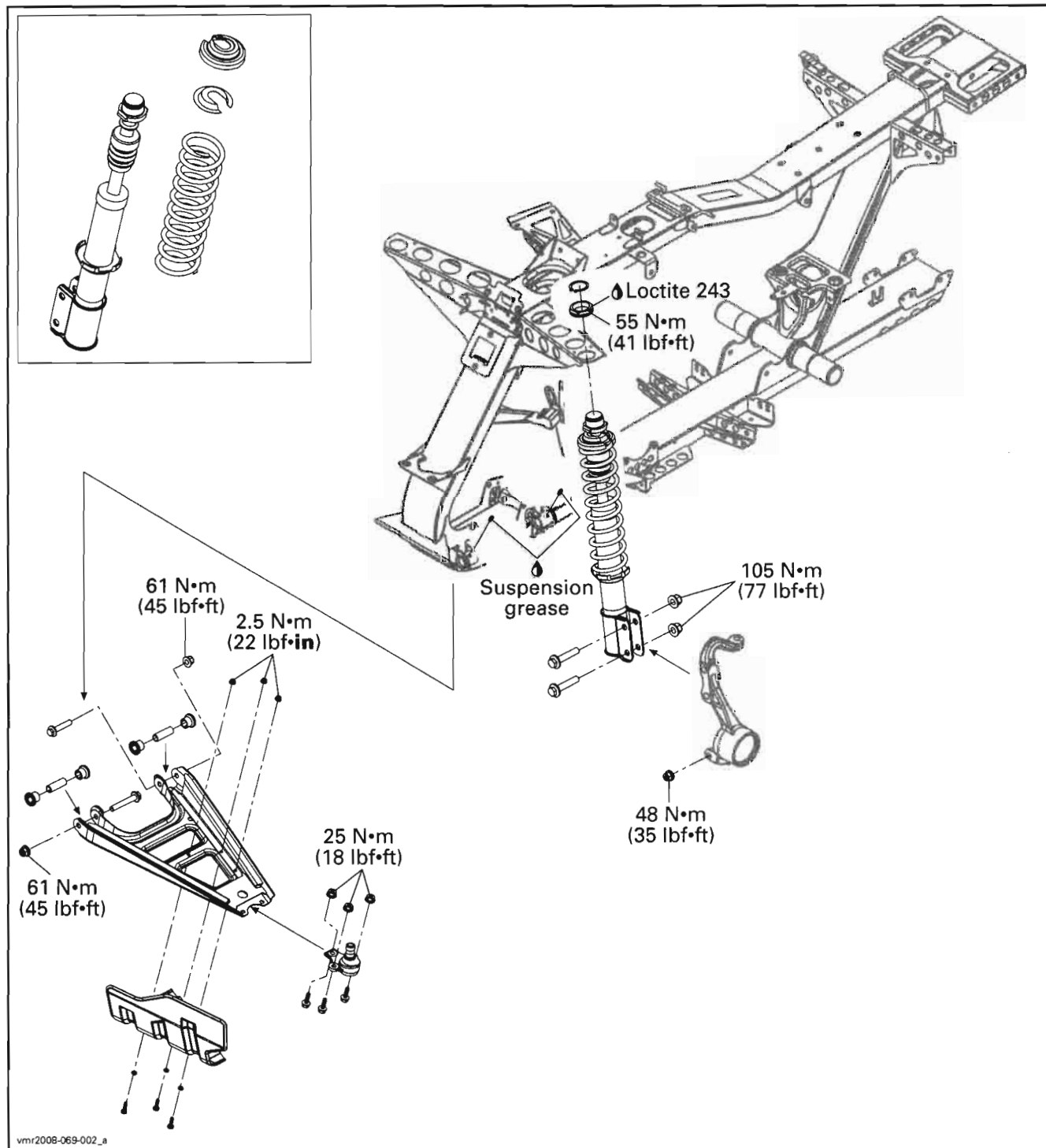
<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Supertanium drill bit.....	529 031 800 .....	349
shock/spring remover.....	529 036 007 .....	348
ball joint installer.....	529 036 020 .....	351, 355

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
suspension grease.....	293 550 033 .....	351-352
Loctite 243 (blue).....	293 800 060 .....	349

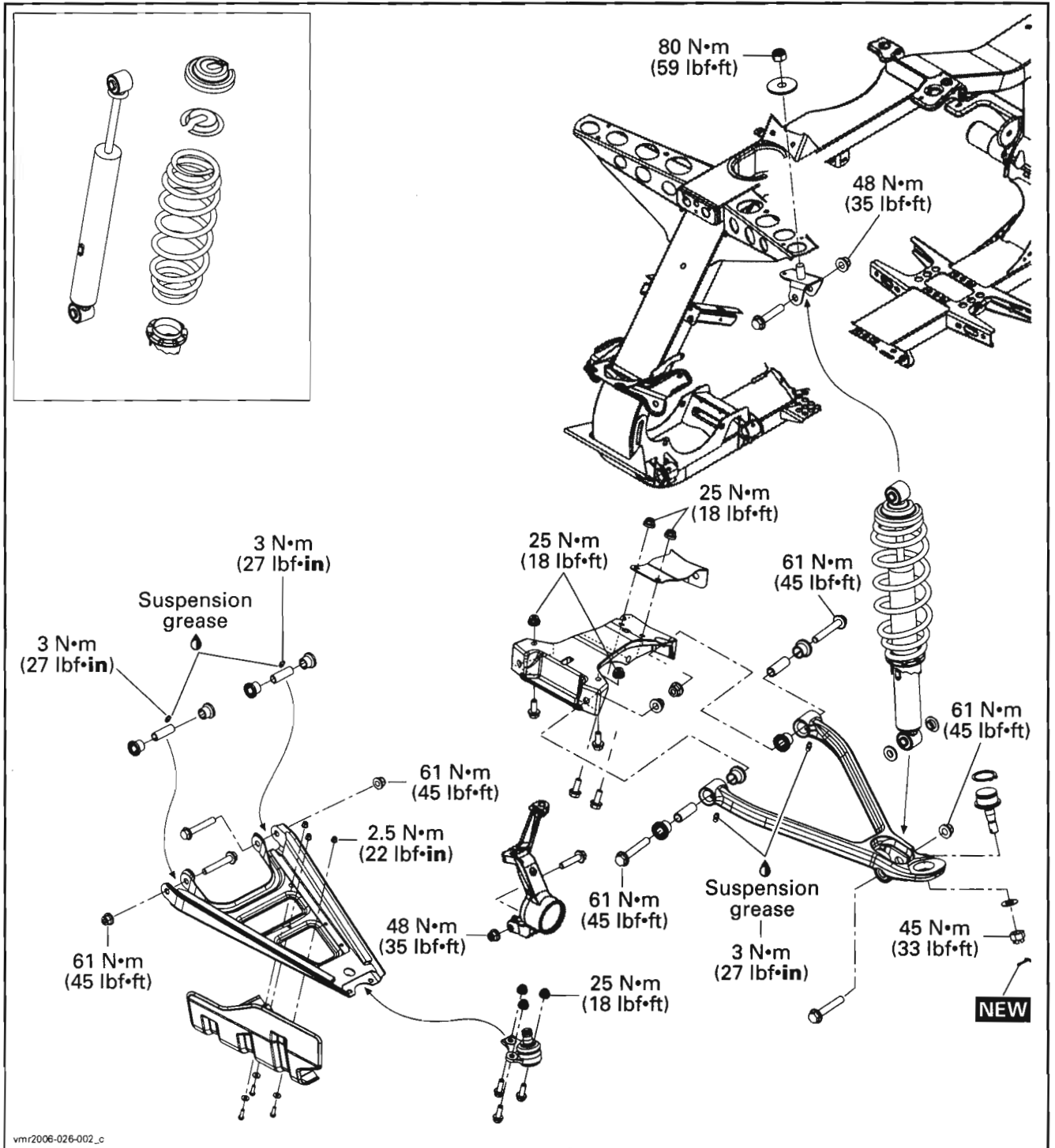
**Section 10 SUSPENSION**  
Subsection 01 (FRONT SUSPENSION)

**Outlander 500 Series**



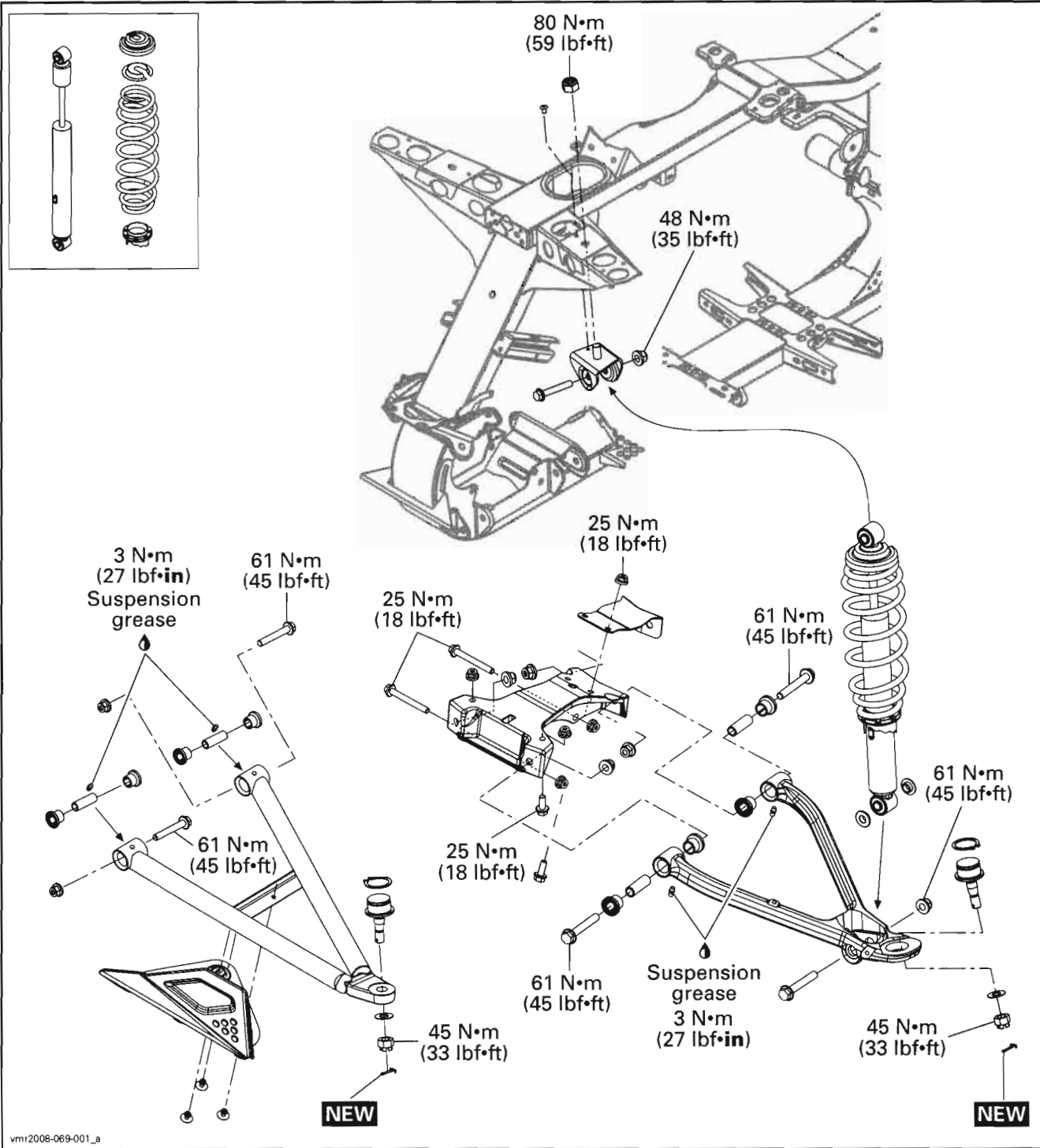
**Section 10 SUSPENSION**  
**Subsection 01 (FRONT SUSPENSION)**

**Outlander 650/800 Series**



**Section 10 SUSPENSION**  
**Subsection 01 (FRONT SUSPENSION)**

**Renegade Models**



## GENERAL

The procedure explained below is the same for the RH and LH sides unless otherwise noted.

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

## PROCEDURES

### TIRES AND WHEELS

### **⚠ WARNING**

When the tires are replaced, never install a bias tire with a radial tire. Such a combination could create handling and/or stability problems.

Do not mix tires of different size and/or design on the same axle.

Front and rear tire pairs must be the identical model and manufacturer.

For unidirectional tread pattern, ensure that the tires are installed in the correct direction of rotation.

The radial tires must be installed as a complete set.

Severe injury or death can result if these instructions are not followed.

The tires are directional and their rotation must be kept in a specific direction for proper operation.

## SHOCK ABSORBER AND SPRING

### Removal

#### **Outlander 500 Series**

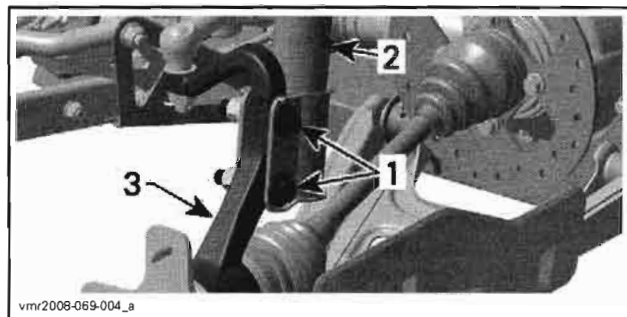
Loosen wheel nuts of the appropriate wheel.

Lift front of vehicle until front struts are fully extended then install a jack stand under the frame to support the vehicle off the ground.

Remove wheel.

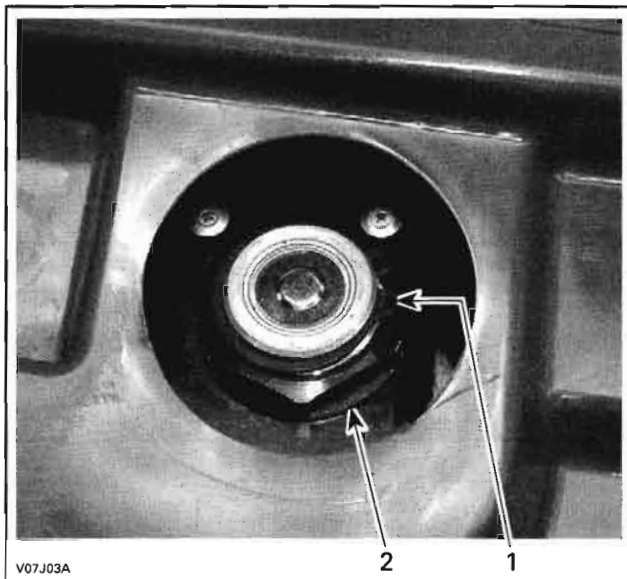
Remove the front rack and the cap on the top of the front fender.

Unscrew bolts retaining strut to the knuckle.



1. Strut bolts
2. Strut
3. Knuckle

Remove the circlip and unscrew the strut nut.



1. Circlip
2. Strut nut

Remove strut from vehicle.

#### **Outlander 650/800 Series and Renegade Models**

Loosen wheel nuts of the appropriate wheel.

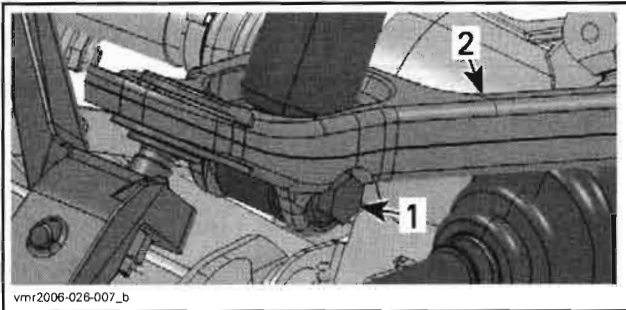
Lift the front of the vehicle until shock absorber is fully extended then install a jack stand under the frame to support the vehicle off the ground.

Remove wheel.

Remove lower bolt securing shock absorber to upper suspension arm.

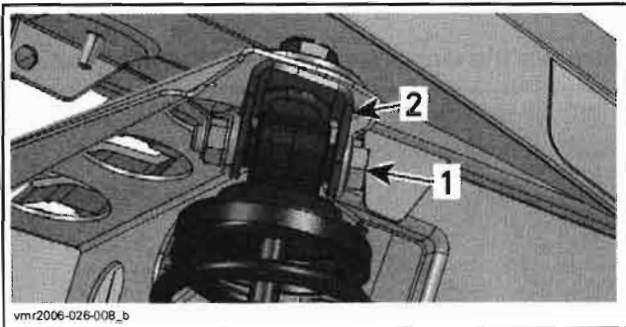
## Section 10 SUSPENSION

### Subsection 01 (FRONT SUSPENSION)



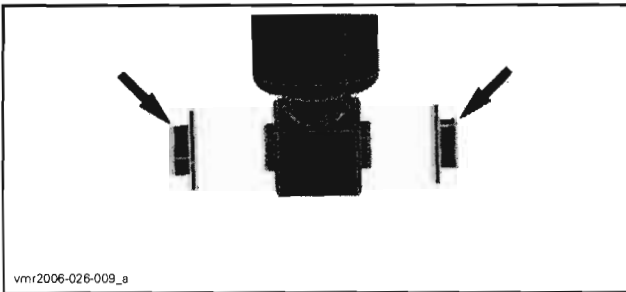
1. Shock absorber's lower bolt
2. Upper suspension arm

Then the upper bolt from shock absorber support.



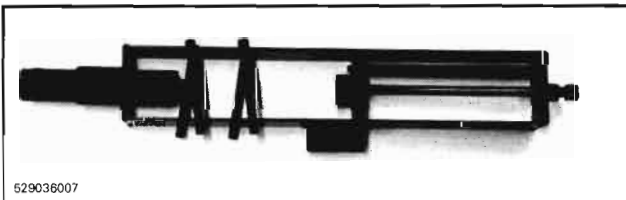
1. Shock absorber's upper bolt
2. Shock absorber support

When the shock absorber is removed from upper arm, pay attention not to mislay the both metallic bushings.

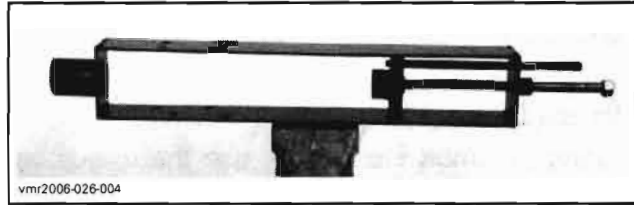


### Disassembly

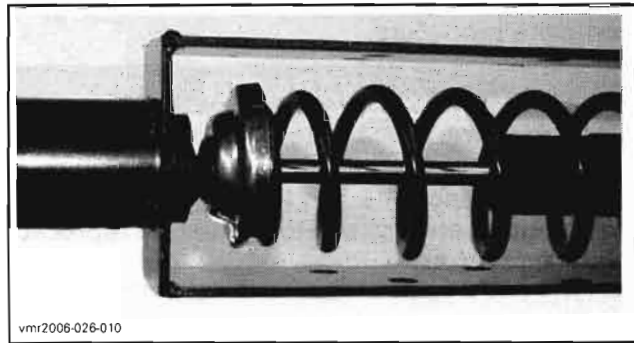
To remove spring from the shock absorber, use the shock/spring remover (P/N 529 036 007).



Place the tool in a vise.

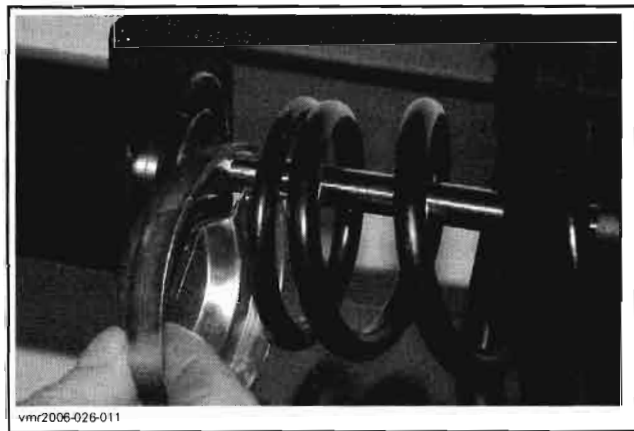


Position the shock absorber in the tool and install the spring compressor pins.



Tighten the shock spring remover screw until the spring is sufficiently compressed to remove spring locking devices.

Remove spring stopper and its cap then release the shock spring remover screw.



### Inspection

Inspect the spring for damage. Replace if necessary.

Inspect shock for oil leakage. Extend and compress the piston several times over its entire stroke. Check that it moves smoothly and with uniform resistance with rod up. Any of the following conditions will denote a defective shock:

- A skip or hang up when reversing stroke at mid travel.
- Seizing or binding conditions except at extreme end of either stroke.
- A gurgling noise after completing one full compression and extension stroke.



Replace shock if any of these conditions are found.

### Assembly and Installation

For assembly and installation, reverse the disassembly and removal procedures.

#### **Outlander 500 Series**

Apply Loctite 243 (blue) (P/N 293 800 060) on threads of strut nut and tighten it to 55 N•m (41 lbf•ft).

## LOWER SUSPENSION ARM PROTECTOR

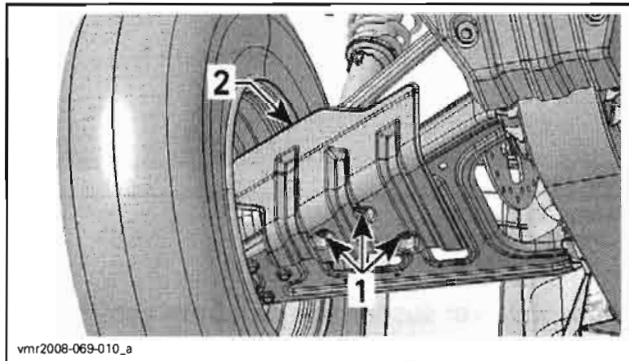
### Inspection

Check protector for cracks or other damages. Replace if necessary.

### Removal

#### **Outlander Models**

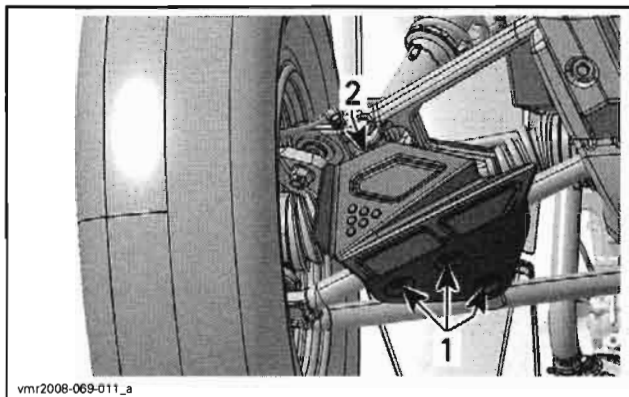
Remove bolts then the protector.



1. Bolts
2. Protector

#### **Renegade Models**

Using a Supertanium drill bit (P/N 529 031 800), drill rivets securing protector to lower suspension arm.



1. Rivets
2. Protector

vmr2008-069

Remove the protector.

### Installation

The installation is the reverse of removal procedure.

## LOWER SUSPENSION ARM

### Inspection

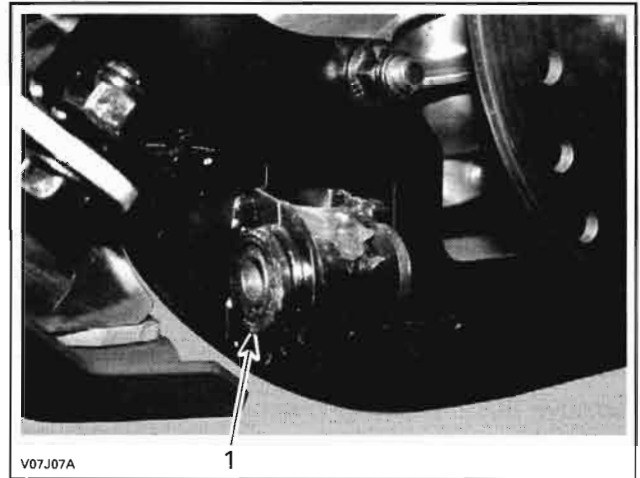
Check lower suspension arms for distortion or damage. Replace suspension arms if necessary.

Move lower suspension arm from side to side. There should be no noticeable loose. Replace bushings if necessary.

Move lower suspension arm up and down. There should be no noticeable loose. Replace bushings if necessary.

The following items are performed when the lower suspension arm is removed.

Inspect pivot bushings and cushions for wear or damages. Replace bushings and/or cushions if necessary.



**TYPICAL**  
1. Pivot bushing

Check ball joint bellows on lower suspension arm for cracks or any other damage. Inspect ball joint end for damage. Ensure it's moving freely. Replace ball joints as required, see below for procedure.

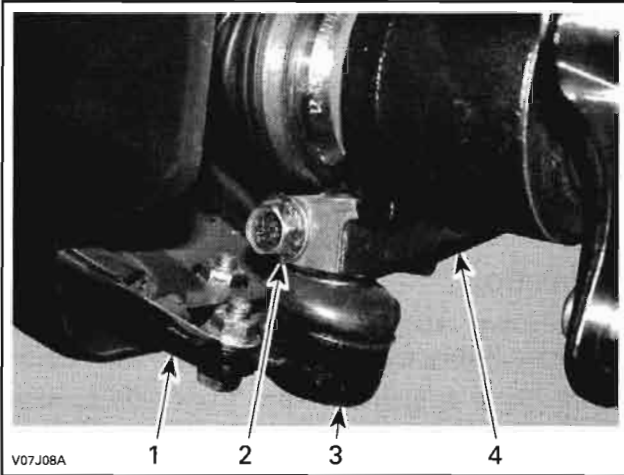
### Removal

Remove wheel.

Remove bolt or nut retaining ball joint to the knuckle.

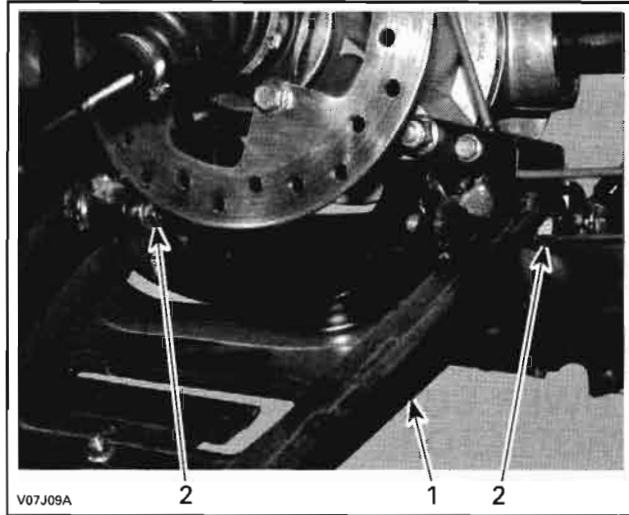
## Section 10 SUSPENSION

### Subsection 01 (FRONT SUSPENSION)



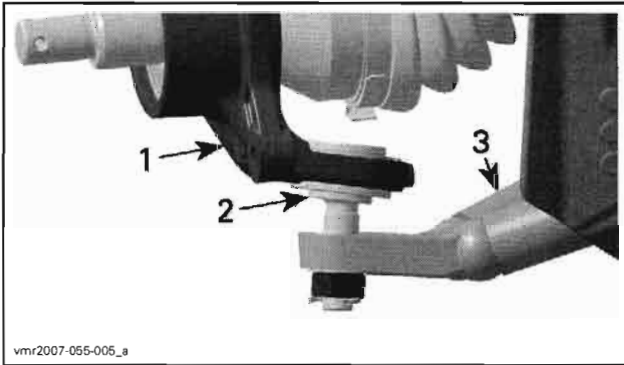
#### TYPICAL — OUTLANDER MODELS

1. Lower suspension arm
2. Ball joint bolt
3. Ball joint
4. Knuckle



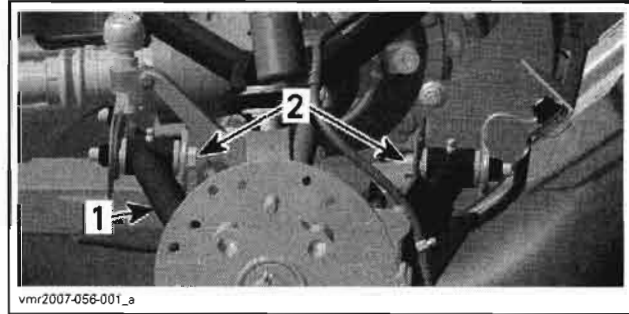
#### TYPICAL — ALL OUTLANDER MODELS

1. Lower suspension arm
2. Remove bolts



#### RENEGADE MODELS

1. Knuckle
2. Lower ball joint
3. Lower suspension arm



#### RENEGADE MODELS

1. Lower suspension arm
2. Lower suspension arm bolts

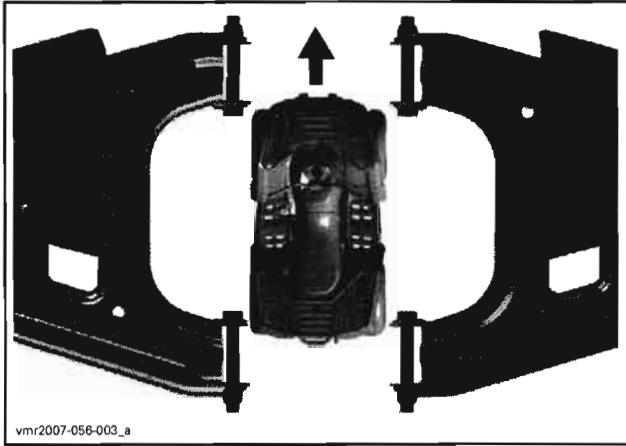
Remove lower suspension arm from vehicle.

### Installation

For assembly, reverse the disassembly procedure. However, pay attention to the following.

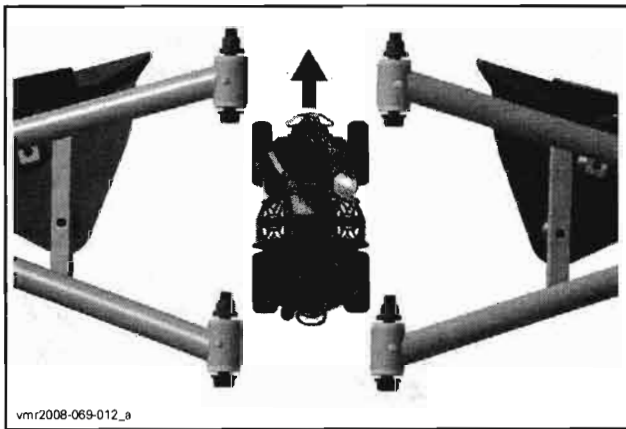
Install lower suspension arm to frame.

Install lower suspension arm bolts as per following illustration.



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**OUTLANDER SERIES**



vmr2008-069-012\_a

**RENEGADE MODELS**

Torque lower suspension arm bolts to 61 N•m (45 lbf•ft).

Use suspension grease (P/N 293 550 033) to lubricate both lower suspension arms. There are two grease fittings on each arm.

Attach lower suspension arm to knuckle.

Install wheel. Refer to *STEERING SYSTEM* for proper torque.

## LOWER BALL JOINT

### Inspection

Check lower ball joint for damage, pitting, looseness and roughness. If so, replace it.

Check ball joint bellows for cracks. Change if necessary.

### Removal

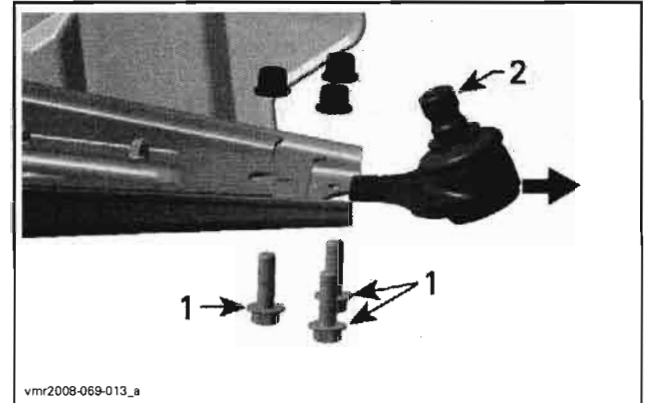
#### **Outlander Series**

Remove appropriate wheel.

Remove bolt securing ball joint to knuckle.

Unscrew bolts retaining ball joint to lower suspension arm.

Extract the ball joint by pulling it out of lower suspension arm.



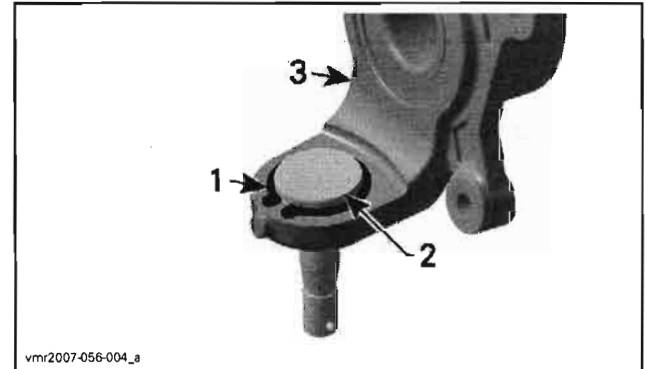
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1. Bolts securing ball joint
2. Ball joint

#### **Renegade Models**

Remove knuckle from vehicle. Refer to *STEERING SYSTEM*.

Remove the circlip.



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1. Circlip
2. Ball joint
3. Knuckle

Using a press and a small piece of pipe, extract the ball joint. Support the knuckle properly to avoid damaging ball joint location.

### Installation

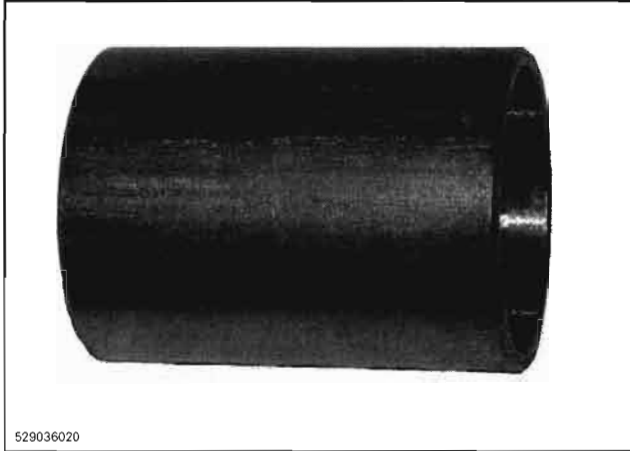
The installation is the reverse of removal procedure.

#### **Renegade Models**

To install the ball joint properly, use the ball joint installer (P/N 529 036 020).

## Section 10 SUSPENSION

### Subsection 01 (FRONT SUSPENSION)



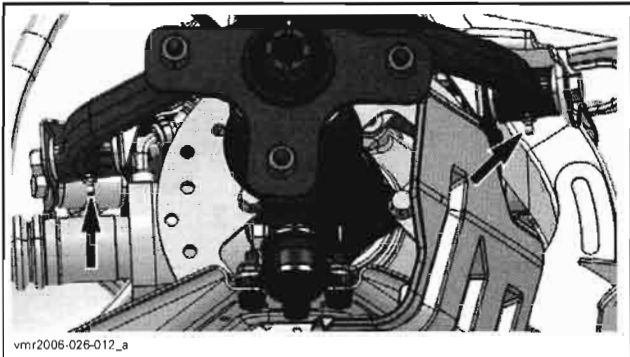
Support the knuckle before pressing the ball joint into its location.

## UPPER SUSPENSION ARM

### **Outlander 650/800 Series and Renegade Models**

#### Lubrication

Use suspension grease (P/N 293 550 033) to lubricate both upper suspension arms. There are two grease fittings on each arm.



TYPICAL — OUTLANDER SERIES SHOWN, SAME ON RENEGADE

#### Inspection

Check upper suspension arm for cracks, pitting, distortion or other damages. Replace as required.

Near upper suspension arm bracket, move upper suspension arm up and down then from side to side. There should be no noticeable play. Replace pivot bushings and/or cushions if necessary.

The following items are performed when the upper suspension arm is removed.

- Inspect pivot bushings and cushions for wear.
- Check ball joint bellows for crack or wear.
- Inspect ball joint end for damages. Ensure it is moved freely.

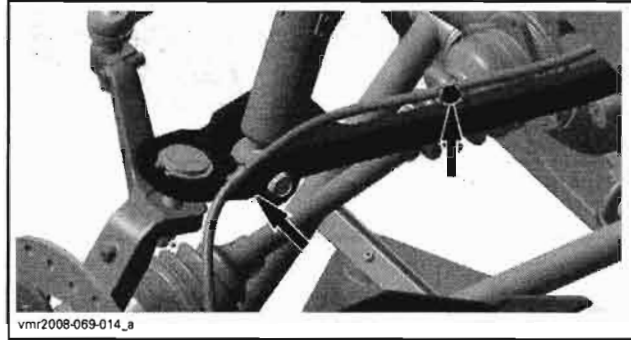
Replace all defective parts.

#### Removal

Remove appropriate wheel.

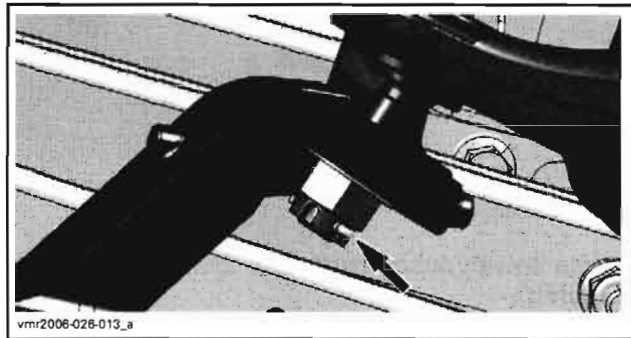
#### **Renegade Models**

Unscrew bolts securing brake hose on the suspension arm.

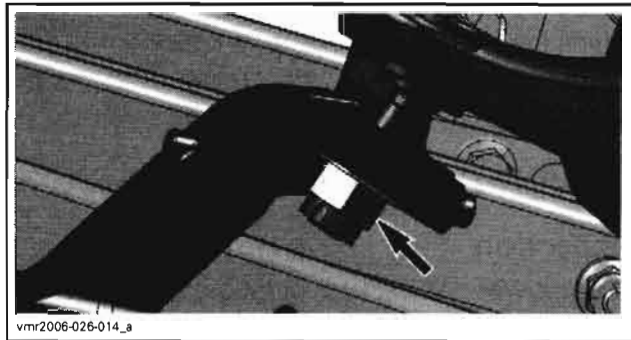


#### **All Models**

Remove cotter pin retaining upper ball joint nut. Discard cotter pin.

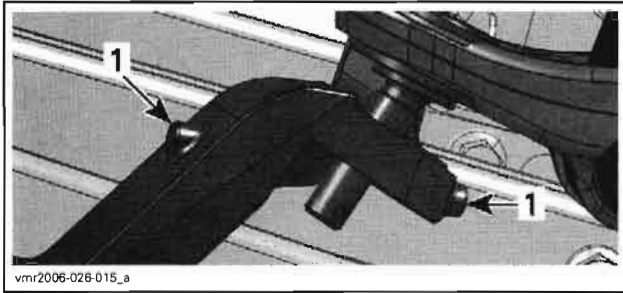


Unscrew upper ball joint nut.



Using a hammer, hit on the knuckle tip to separate ball joint from knuckle.

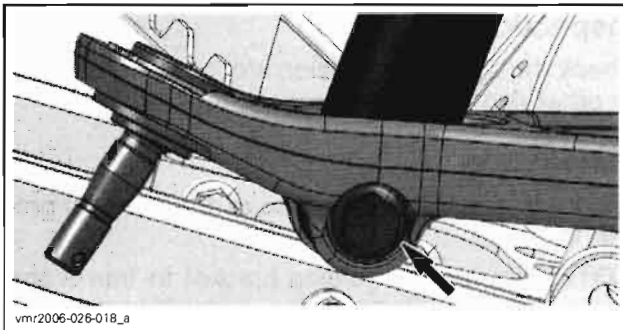
**NOTE:** A ball joint remover can be used if the ball joint is jammed into knuckle.



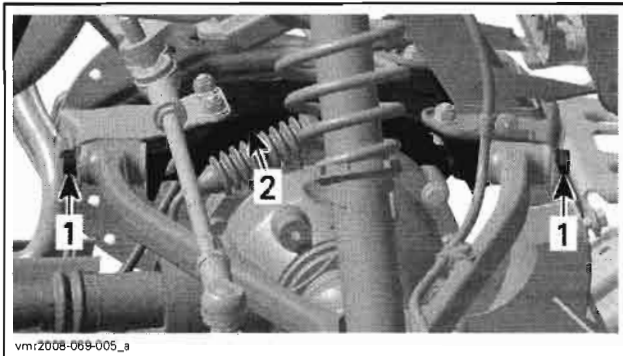
1. Hit here

**CAUTION:** Never hit on upper suspension arm. Permanent damages could be caused on arm and its replacement will be necessary.

Remove shock absorber lower bolt from upper suspension arm.



Unscrew bolts that attach upper suspension arm to upper suspension arm bracket.

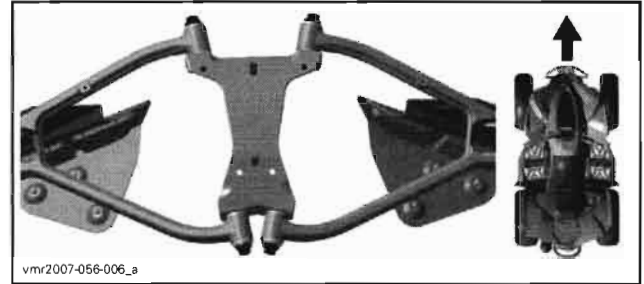


1. Upper suspension arm bolts  
 2. Suspension arm bracket

Remove upper suspension arm from vehicle.

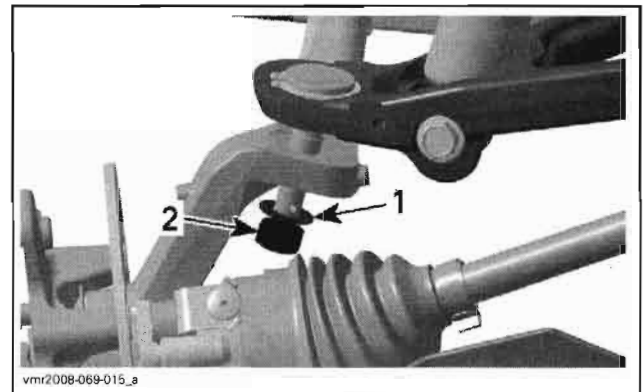
**Installation**

Position the upper suspension arm and install its bolts. Torque to 61 N•m (45 lbf•ft).



TYPICAL — RENEGADE SHOWN

Attach the upper suspension arm to knuckle. When hardened washer and upper ball joint nut are installed, tighten nut to 45 N•m (33 lbf•ft).



1. Hardened washer  
 2. Ball joint nut

Install a **NEW** cotter pin. Both end of cotter pin must be folded.

Install the shock absorber lower bolt and torque it to 61 N•m (45 lbf•ft).

Install wheel.

**UPPER SUSPENSION ARM BRACKET**

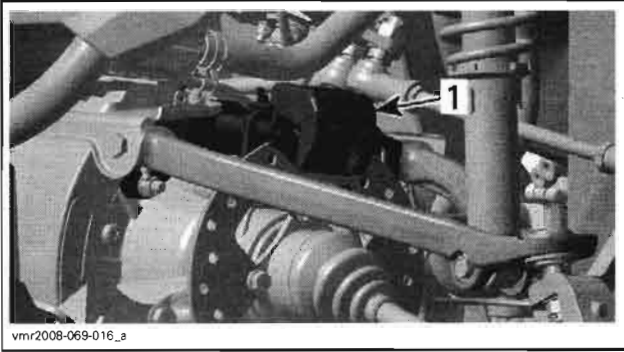
**Removal**

Remove both front wheels.

**Outlander 650/800 Series**

Unscrew the left caliper and attach it out of way.

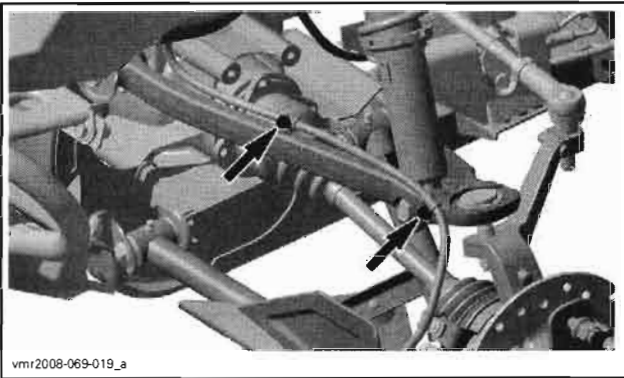
**Section 10 SUSPENSION**  
**Subsection 01 (FRONT SUSPENSION)**



1. Left caliper

**Renegade Models**

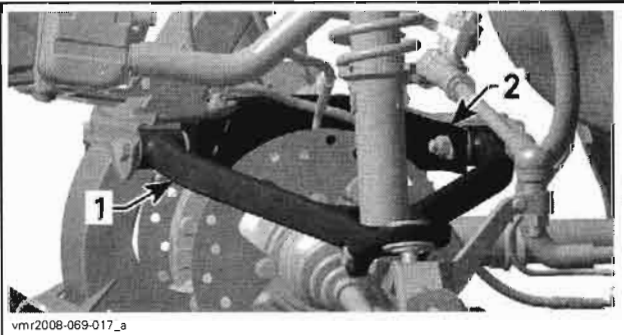
Unscrew bolts securing brake hose on the upper suspension arm.



vmr2008-069-019\_a

**All Models**

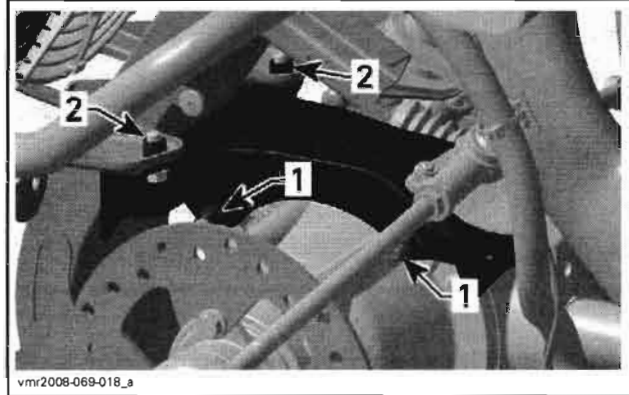
Unscrew upper suspension arms from the upper suspension arm bracket.



vmr2008-069-017\_a

- 1. LH upper suspension arm
- 2. Upper suspension arm bracket

Remove differential upper bolts.  
 Remove front bolts that attach the upper suspension arm bracket to frame.



vmr2008-069-018\_a

- 1. Upper differential bolts
- 2. Front bracket retaining bolts

Slide bracket backward then pull it by the left side.

**Inspection**

Check the upper suspension arm bracket for crack or other damages. Replace as required.

**Installation**

The installation is the reverse of the removal procedure.

**NOTE:** Install bolts holding bracket to frame and upper differential bolts before tightening them.

**UPPER BALL JOINT**

**Outlander 650/800 Series and Renegade Models**

**Inspection**

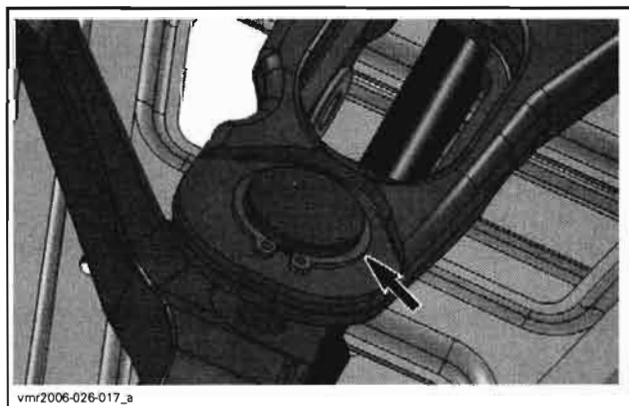
Check upper ball joint for damage, pitting, looseness and roughness. If so, replace it.

Check ball joint bellows for cracks. Replace as required.

**Removal**

Remove upper suspension arm.

Remove the circlip.



vmr2006-026-017\_a

Using a press and a piece of pipe, remove the ball joint.

**CAUTION:** Support upper suspension arm properly to avoid damaging ball joint location.

### Installation

To install the upper ball joint properly, use the ball joint installer (P/N 529 036 020).



Support the upper suspension arm before pressing the ball joint into its location.

Install the upper suspension arm.

Install wheel.



*Midwest Manuals*

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# REAR SUSPENSION

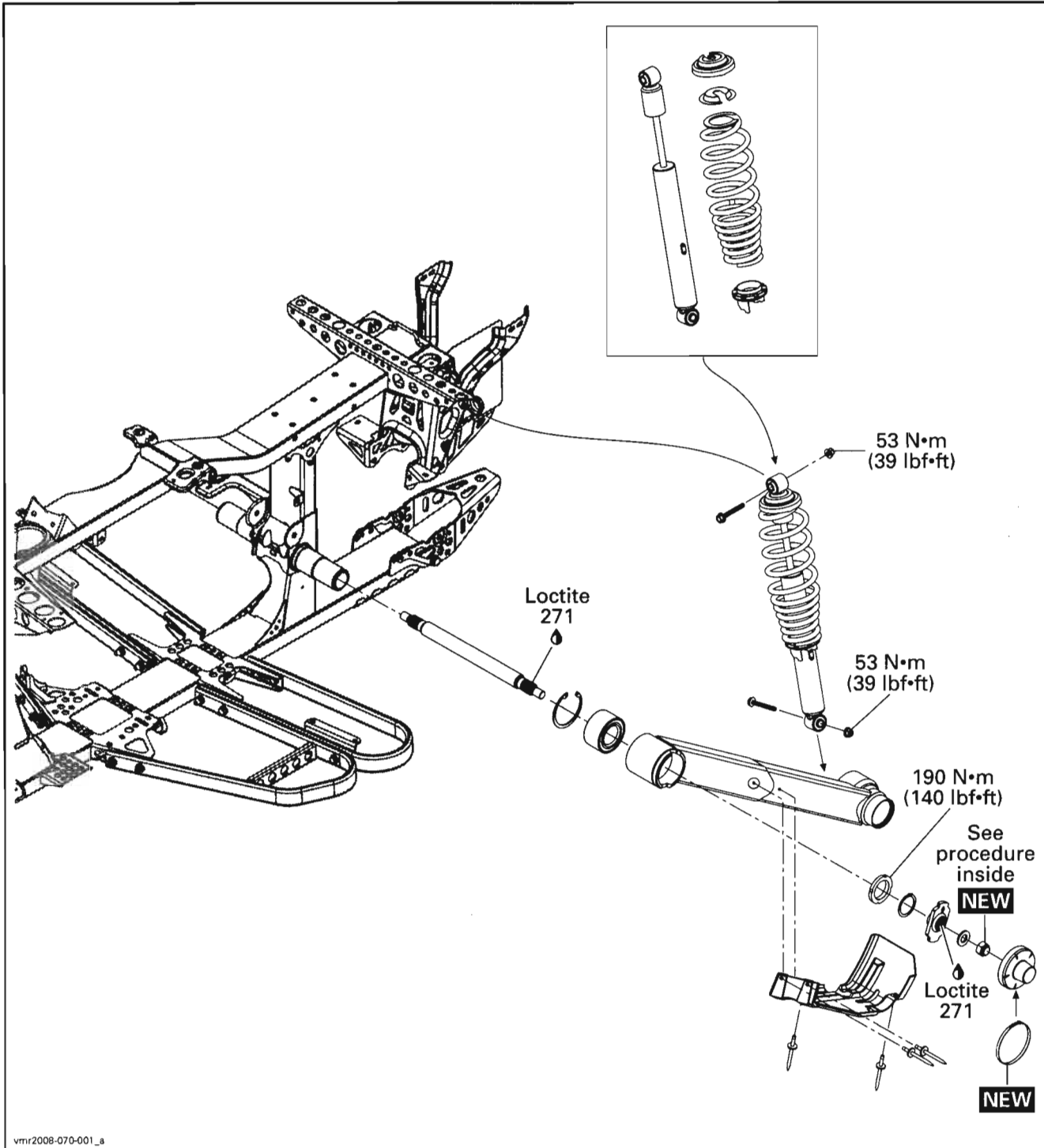
## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Bearing extractor/installer .....	529 035 918 .....	363
Bearing extractor/installer .....	529 035 920 .....	363
trailing arm support.....	529 035 922 .....	363
spanner wrench.....	529 035 925 .....	362
shock spring remover .....	529 036 007 .....	359

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Loctite 243 (blue) .....	293 800 060 .....	362

**Section 10 SUSPENSION**  
Subsection 02 (REAR SUSPENSION)



## GENERAL

The procedure described below is the same for the RH and LH sides, unless otherwise instructed.

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 pins, etc.) must be replaced with new ones.

## PROCEDURES

### TIRES AND WHEELS

#### WARNING

When the tires are replaced, never install a bias tire with a radial tire. Such a combination could create handling and/or stability problems.

Do not mix tires of different size and/or design on the same axle.

Front and rear tire pairs must be the identical model and manufacturer.

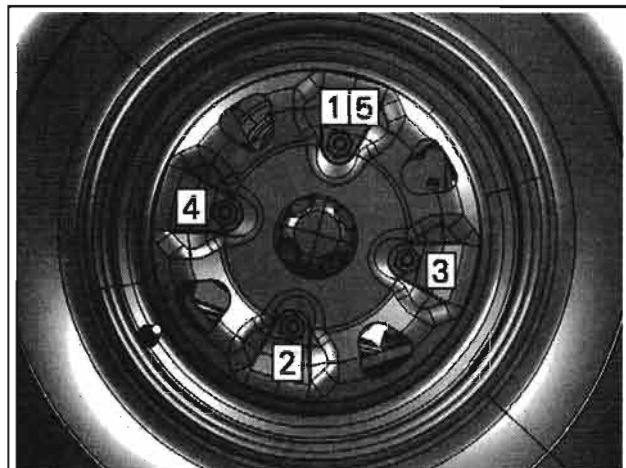
For unidirectional tread pattern, ensure that the tires are installed in the correct direction of rotation.

The radial tires must be installed as a complete set.

Severe injury or death can result if these instructions are not followed.

The tires are directional and their rotation must be kept in a specific direction for proper operation.

Torque wheel nuts in accordance with the following illustration.



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**CAUTION:** Always use the recommended wheel nuts. Using a different nut could cause damages to the rim.

## REAR SHOCK

### Removal

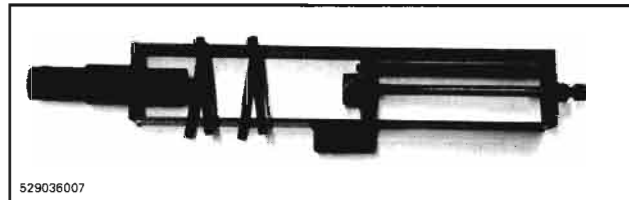
Lift rear of vehicle until rear shock absorbers are fully extended.

Install jack stands or blocks under the frame to support the vehicle.

Remove upper and lower bolts retaining shock absorbers.

### Disassembly

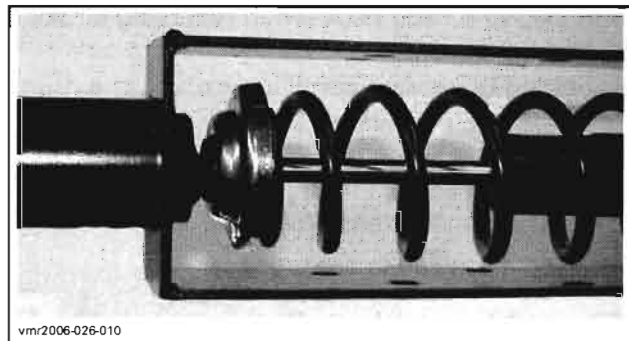
Use the shock spring remover (P/N 529 036 007).



529036007

Place the tool in a vise.

Position the shock absorber in the tool and install the spring compressor pins.



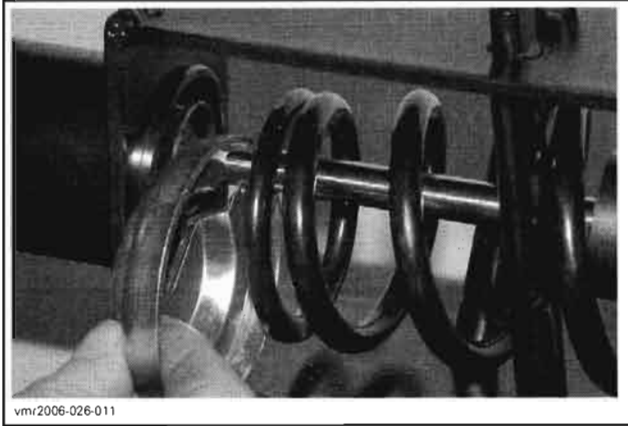
vmr2006-026-010

## Section 10 SUSPENSION

### Subsection 02 (REAR SUSPENSION)

Tighten the shock spring remover screw until the spring is sufficiently compressed to remove spring locking devices.

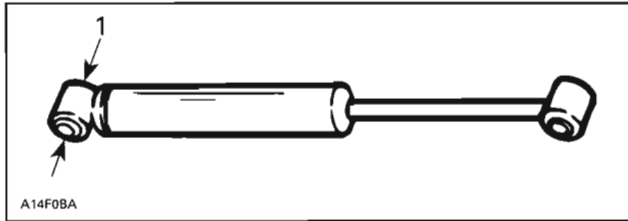
Remove spring stopper and its cap then release the shock spring remover screw.



Remove spring from shock.

### Inspection

Secure the end of shock body in a vise with its rod upward.



**TYPICAL**  
1. Clamp here

**CAUTION:** Do not clamp directly on shock body.

Examine each shock for leaks. Extend and compress the piston several times over its entire stroke. Check that it moves smoothly and with uniform resistance with its rod upward.

Pay attention to 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 stroke.

Replace if any faults are present.

### Assembly and Installation

Assembly and installation are essentially the reverse of disassembly and removal procedures.

**NOTE:** Install cap opening at 180° from spring stopper opening.

## TORSION BAR

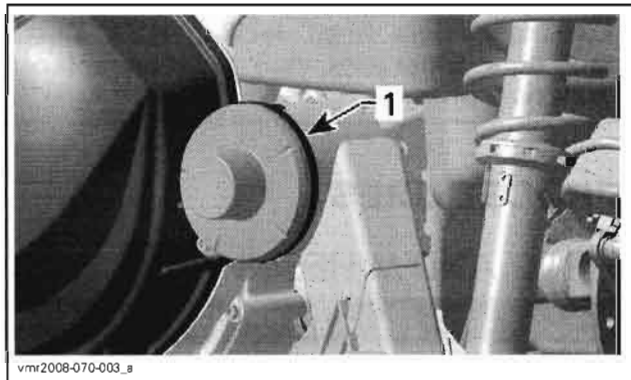
### Removal

Apply parking brake and lift rear of vehicle until rear shock absorbers are fully extended.

Install a jack stand or blocks under the frame to safely support the vehicle.

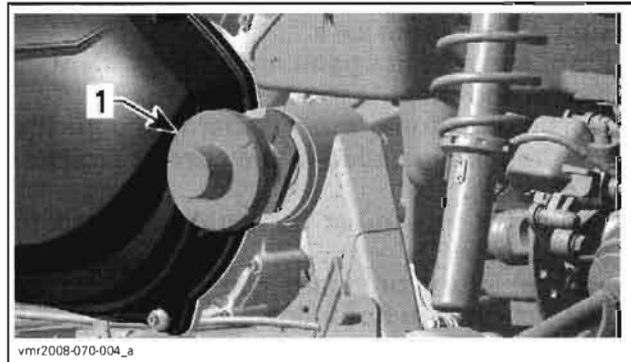
Remove both footrests.

Remove and discard both protective cover clamps.



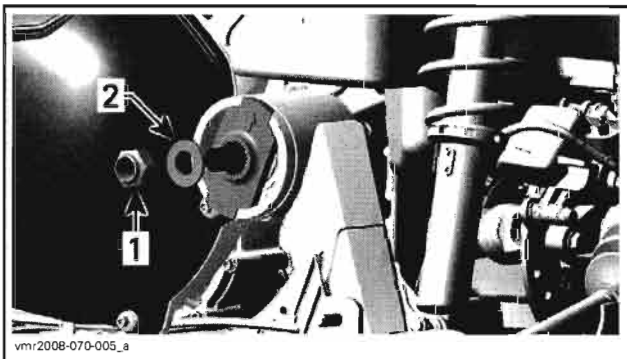
1. LH protective cover clamp

Remove protective covers.



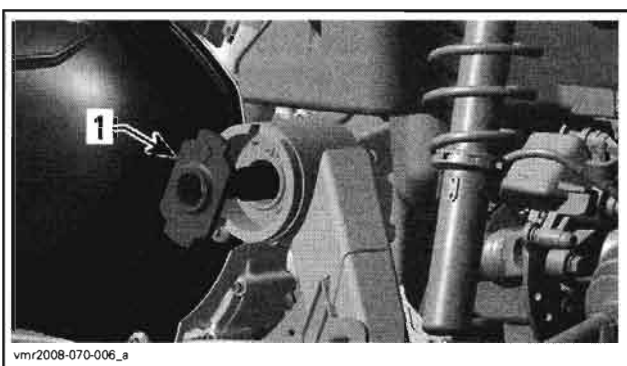
1. Protective cover

Remove both elastic nuts (discard them) and both flat washers.



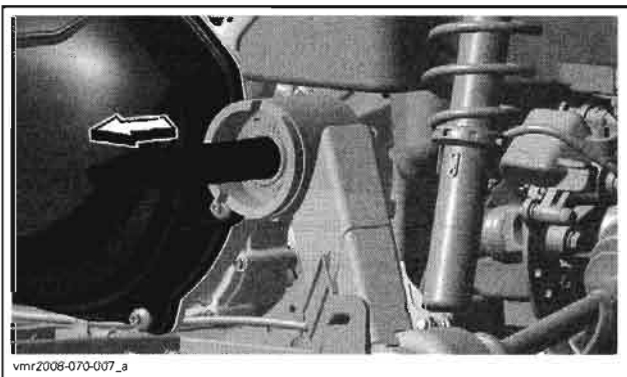
- 1. Elastic nut
- 2. Flat washer

Remove torsion bar levers.



- 1. Torsion bar lever

Remove the torsion bar.



### Inspection

Check torsion bar for cracks, bending or other damages.

Verify splines for damages (torsion bar and torsion bar lever).

Check torsion bar lever tabs for racking, cracks or other damages.

**NOTE:** If a tab is damaged, check the trailing arm for damages.

Replace all damaged parts.

### Installation

Insert the torsion bar into the frame and install the torsion bar lever (one on each side).

**NOTE:** Ensure torsion bar lever is aligned with the cut-outs on the swing arm and arrow is pointing up.



Install the flat washer and a **NEW** elastic nut.

First torque the right hand side elastic nut to 55 N•m (41 lbf•ft), then the left hand side to 120 N•m (89 lbf•ft).

Reinstall both torsion bar covers with **NEW** clamps.

### TRAILING ARM

#### Removal

Apply parking brake and lift rear of vehicle until rear shock absorbers are fully extended.

Install a jack stands or a blocks under the frame to safely support the vehicle.

Remove wheel hub (refer to *REAR DRIVE*).

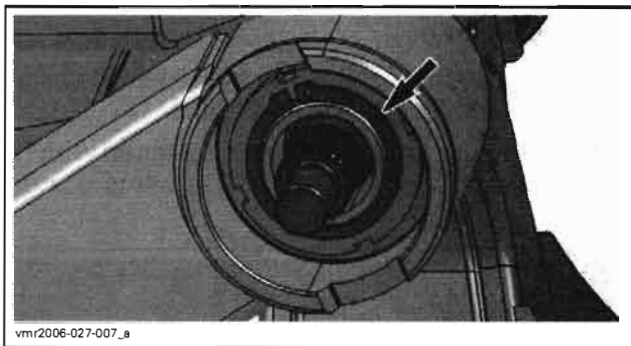
Remove the protective cover, the elastic nut and the flat washer.

Remove the torsion bar lever.

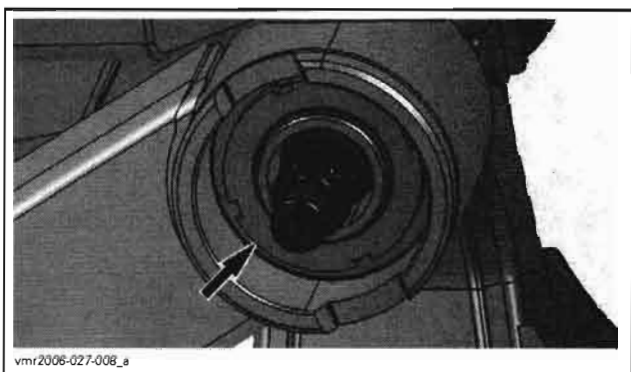
Remove the circlip securing the trailing arm.

## Section 10 SUSPENSION

### Subsection 02 (REAR SUSPENSION)



Unscrew the trailing arm nut.



To do this, use the spanner wrench (P/N 529 035 925).



Unscrew lower bolt of shock absorber.  
Remove trailing arm.

#### Inspection

Check trailing arms for cracks, bending or other damages.

Verify bearings for smooth and free operation.

Replace all damaged parts.

#### Installation

Insert drive shaft end into trailing arm.

Install the trailing arm on frame.

Install the lower shock absorber bolt to support the trailing arm. Do not torque yet.

#### Frame Side

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

Install the trailing arm nut and torque it to 190 N•m (140 lbf•ft).

Install circlip, torsion bar lever, washer and a **NEW** elastic nut. Torque the left elastic nut to 120 N•m (89 lbf•ft) and the right elastic nut to 55 N•m (41 lbf•ft).

Install protective cover.

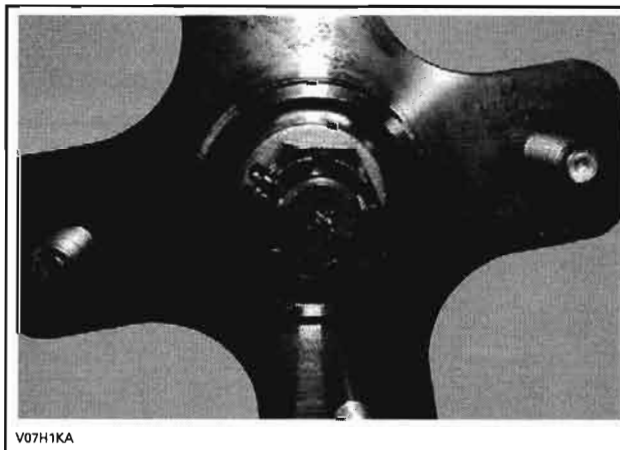
#### Wheel Side

Install wheel hub, Belleville washer and castellated nut.

Torque castellated nut to 205 N•m (151 lbf•ft) and further tighten until its grooves align with the next cotter pin hole.

Install a **NEW** cotter pin then the wheel cap.

**NOTE:** The longer end of cotter pin must be folded over shaft end.



Torque the shock absorber bolt to 53 N•m (39 lbf•ft).

Install wheel.

## TRAILING ARM BEARINGS

Remove trailing arm. Refer to procedure above.

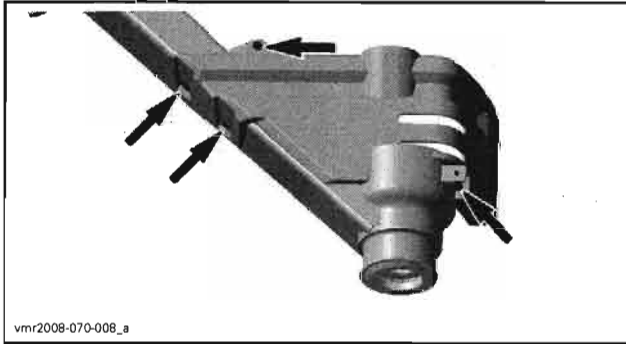
#### Inspection

Check inner race of each trailing arm bearing with your finger. The bearings should turn smoothly and quietly. Remove and discard bearings if race does not turn smoothly or quietly.

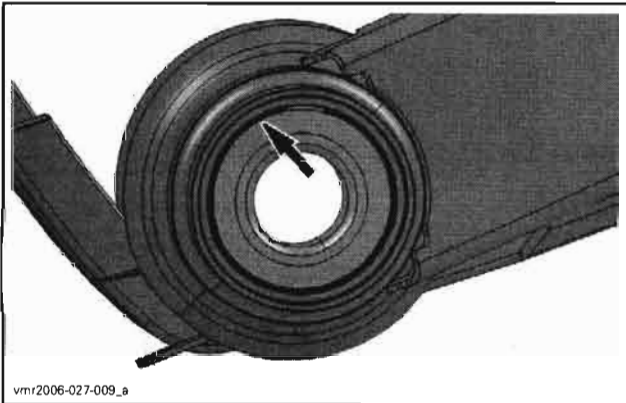
#### Removal

The same procedure can be used for both bearings.

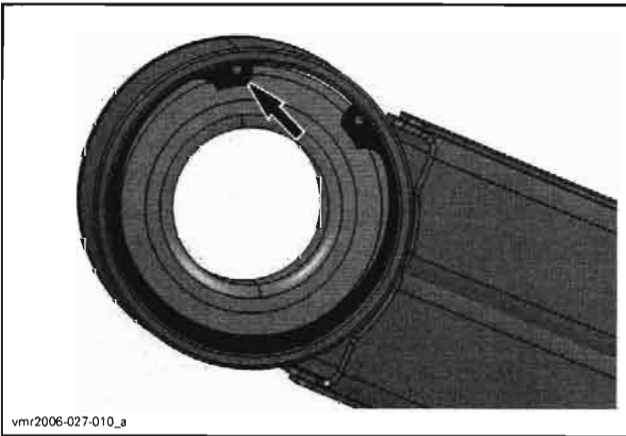
**NOTE:** Before extracting the bearing on wheel side, remove the protector by drilling the pop rivets with a 3/16" drill.



Remove the circlip.

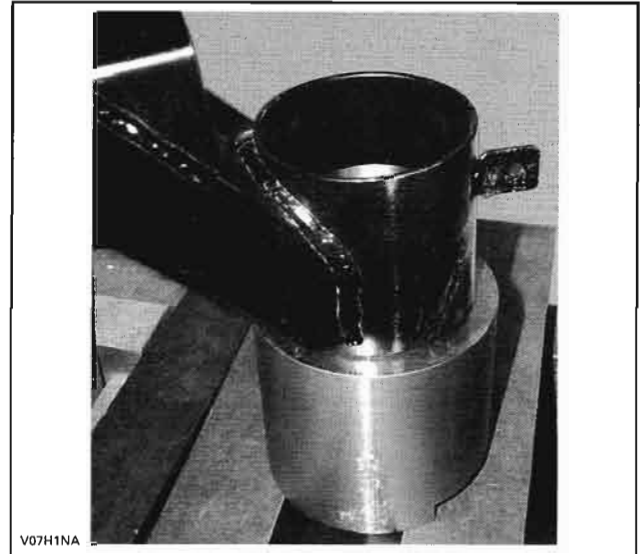


*WHEEL SIDE*

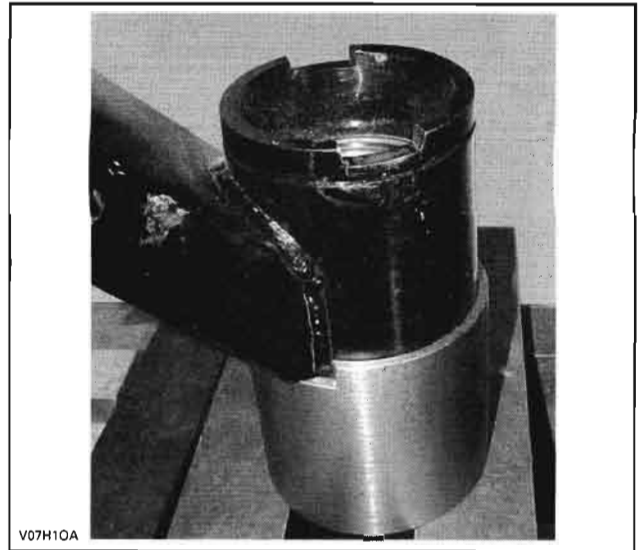


*FRAME SIDE*

Place the trailing arm support (P/N 529 035 922) on the end of trailing arm.



*WHEEL SIDE*

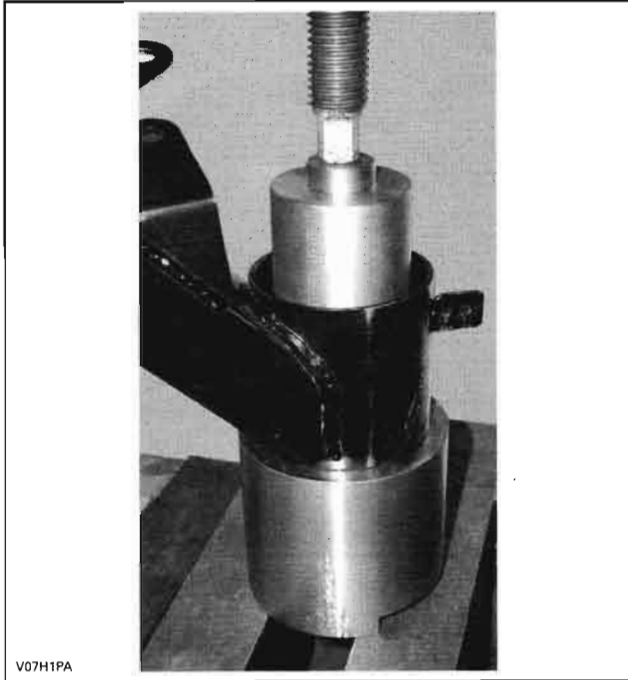


*FRAME SIDE*

Using a press and the proper bearing extractor/installer, remove the bearing.

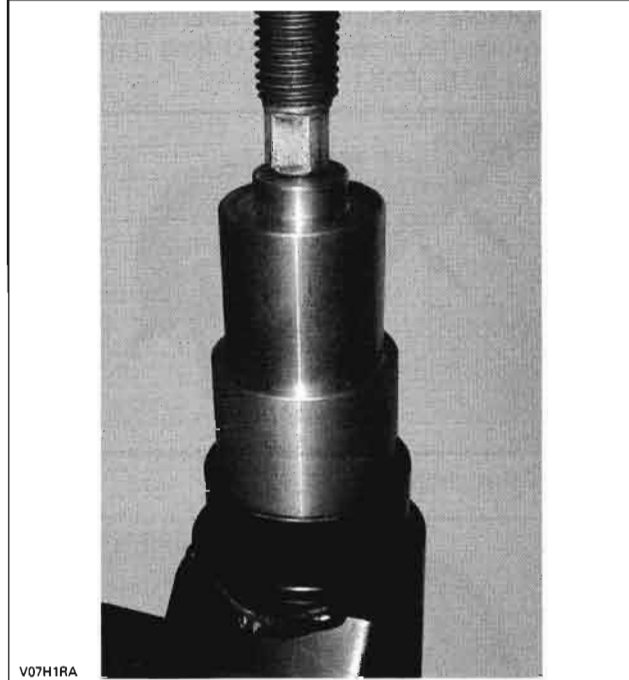
LOCATION	TOOL
WHEEL SIDE	Bearing extractor/installer (P/N 529 035 918)
FRAME SIDE	Bearing extractor/installer (P/N 529 035 920)

**Section 10 SUSPENSION**  
Subsection 02 (REAR SUSPENSION)



V07H1PA

*WHEEL SIDE*



V07H1RA

*WHEEL SIDE*



V07H1QA

*FRAME SIDE*



V07H1HA

*FRAME SIDE*

**Installation**

Clean the bearing housing.

To install the bearing in its location, use the same tool as per removal procedure.

Install the circlip. If the circlip is slacked, replace it with a new.

Install all other removed parts.



---

# FRONT AND REAR BRAKES

## SERVICE TOOLS

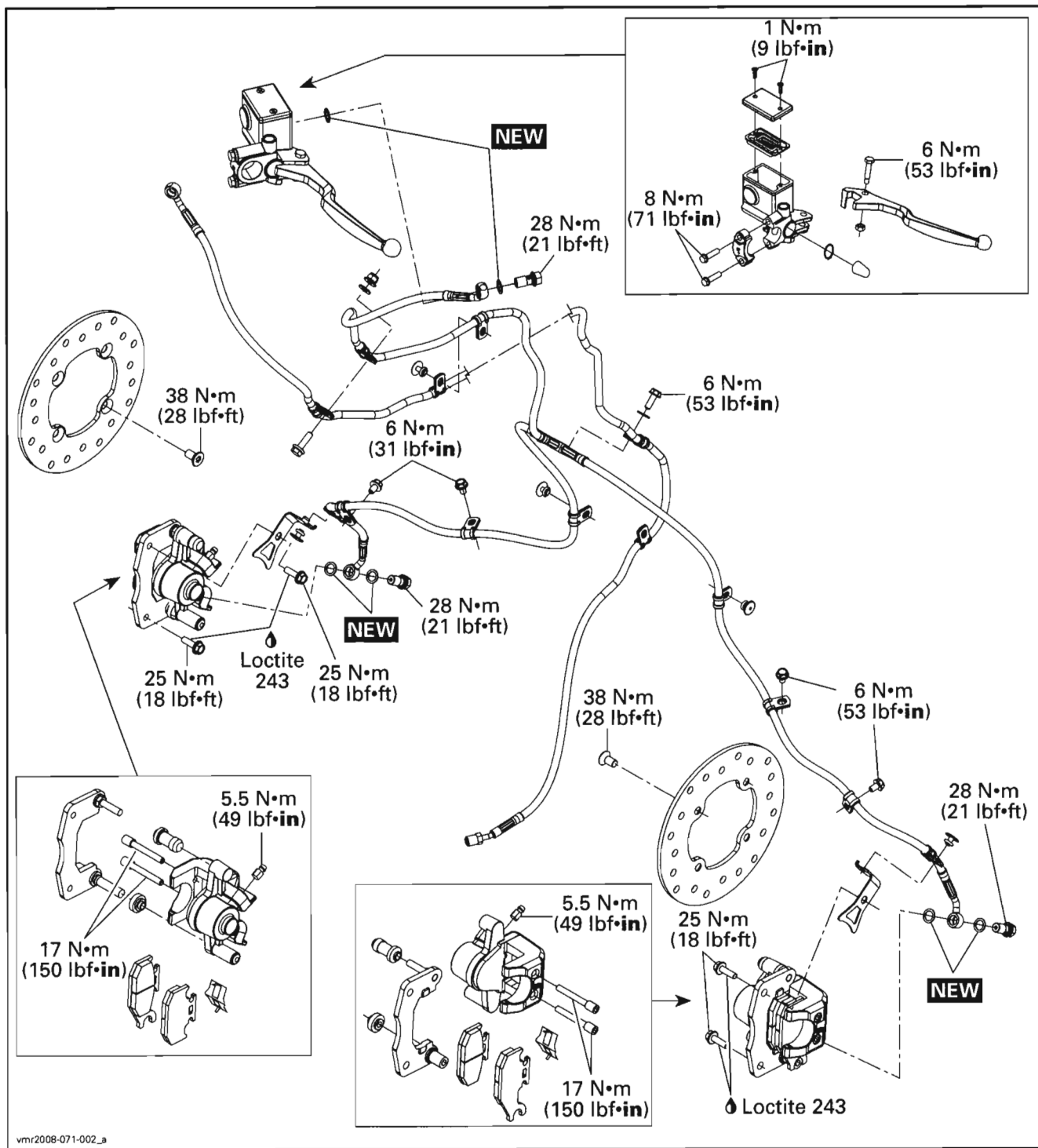
<b>Description</b>	<b>Part Number</b>	<b>Page</b>
vacuum/pressure pump.....	529 021 800 .....	370

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
dielectric grease .....	293 550 004 .....	374, 377
XP-S synthetic grease.....	293 550 010 .....	375, 380
GTLMA brake fluid.....	293 600 062 .....	369



Renegade Models (Front Brakes)

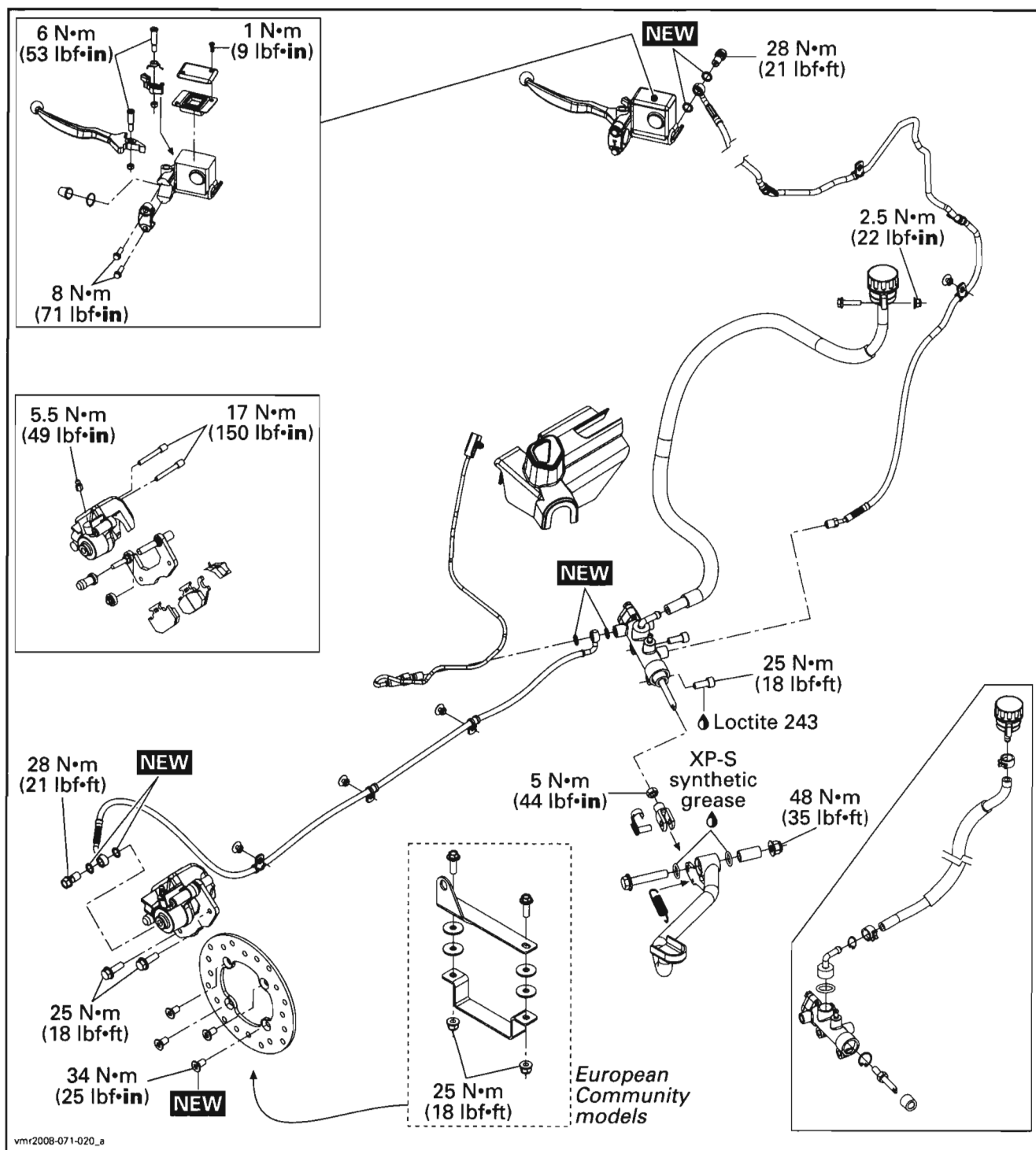


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# Section 11 BRAKES

## Subsection 01 (FRONT AND REAR BRAKES)

### Renegade Models (Rear Brake)



## GENERAL

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

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 pins, etc.) must be replaced with new ones.

**CAUTION:** Avoid spilling brake fluid on plastic, rubber or painted parts. Protect these parts with a rag when servicing brake system.

**CAUTION:** 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.

**CAUTION:** Sealing washers must be discarded and replaced with new ones every time a Banjo fitting is unscrewed.

## Hydraulic Brakes System

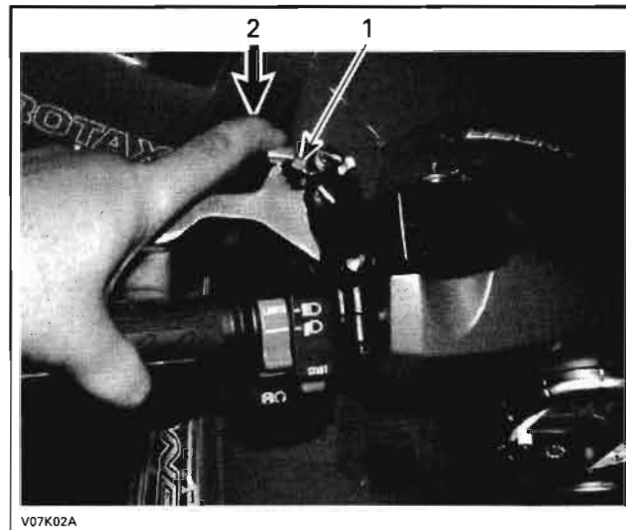
The brake system consists of two circuits. Each system has its own master cylinder and reservoir. Both front and rear brakes are disc type.

### WARNING

Periodically check the brake hoses for damages or leaks. Repair any damage before operating the vehicle.

## Parking Brake

The parking brake operates all brakes. It is activated by a locking mechanism on LH brake lever.



TYPICAL

1. LH brake lever
2. Press lever to activate parking brake

## MAINTENANCE

### BRAKE FLUID

#### Recommended Fluid

Always use brake fluid meeting the specification DOT 4 only such as GTLMA brake fluid (P/N 293 600 062) sold by BRP.

#### Fluid Level

With vehicle on a level surface, check brake fluid in reservoir for proper level. It should be above MIN. mark.

Clean filler cap before removing.

Add fluid as required. Do not overfill.

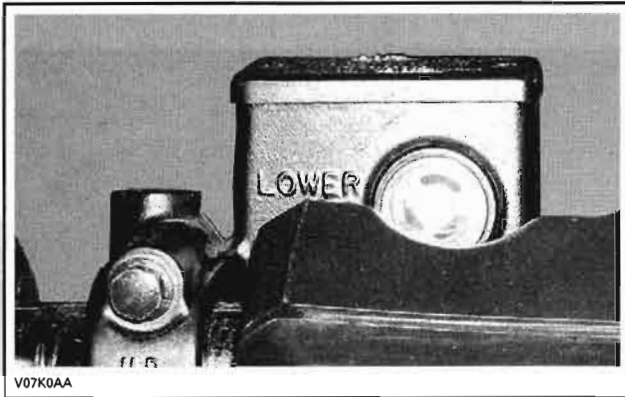
**NOTE:** A low level may indicate leaks or worn brake pads.

#### Front Brake Fluid Reservoir

Turn steering in the straight-ahead position to ensure reservoir is level. Check the brake fluid level, the reservoir is full when the fluid reaches the top of window.

## Section 11 BRAKES

### Subsection 01 (FRONT AND REAR BRAKES)



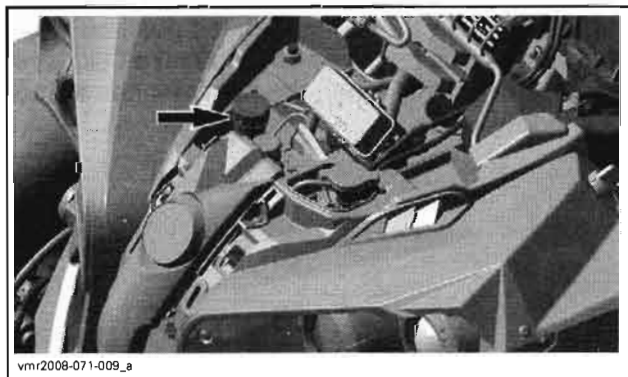
Visually inspect lever boot condition. Check for cracks, tears, etc. Replace if damaged.

#### Rear Brake Fluid Reservoir *Outlander Series*



UNDER FRONT ACCESS PANEL

#### *Renegade Models*



UNDER CONSOLE

## Brake Fluid Replacement

### **⚠ WARNING**

A contaminated brake disc or pad reduces stopping power. Discard contaminated pads and clean a contaminated disc with a high quality brake degreasing agent.

#### Brake Fluid Draining

Remove reservoir cover with its diaphragm.

Connect a clear hose to bleeding screw.

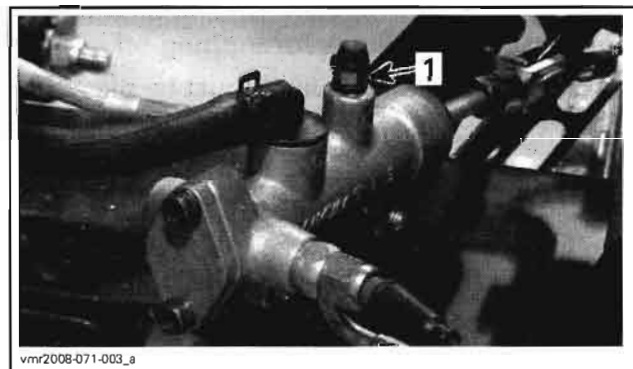
Loosen bleeding screw and pump brake lever(s) or brake pedal until no more fluid flows out of bleeding screw.

#### Brake Fluid Filling and Bleeding

Close bleeding screws.

Fill reservoirs with DOT 4 brake fluid.

Unscrew the bleeding screw on the top of rear master cylinder until brake fluid comes out then close it.



1. Bleeding screw

On each caliper, unscrew the bleeding screw until the brake fluid comes out then close it.

Bleed system as per the following procedure.

#### With a Vacuum Pump

Using a clear hose, install the vacuum/pressure pump (P/N 529 021 800) to bleeding screw. Place the pump in vacuum position. See the manufacturer's operating instructions.

Pump vacuum pump loosen bleeding screw. Close bleeding screw and refill reservoir when the fluid level is low.

**NOTE:** Check fluid level often to prevent air from being pumped into the system.

Repeat the procedure until no more air bubbles appear in hose.

**NOTE:** For the front brake system, switch to LH and RH caliper. Turn handlebar to full RH side when bleeding right caliper and turn to the LH side for the left caliper. This helps to reach air into the caliper. On **Outlander series**, the front and the rear brakes must be bled at the same time.

Close bleeding screw and operate brake lever or brake pedal. If it still feels spongy, bleed system again.

Repeat the procedures until air bubbles do not appear in hose and lever or pedal is stiff.

Fill reservoirs to the upper level with DOT 4 brake fluid.

Install diaphragms and covers on reservoirs.

**Without a Vacuum Pump**

If vacuum pump is not available, use the following procedure.

Install a clear hose to bleeding screw.

Open bleeding screw. Fill reservoirs and pump brake lever or brake pedal until fluid freely flows out of the hose.

Close bleeding screw.

Pump up system pressure with brake lever or brake pedal until lever or pedal resistance is felt.

Squeeze brake lever or depress brake pedal, open bleeding screw and then close it.

**NOTE:** Do not release brake lever or brake pedal until bleeding screw has been closed. For the front brake system, switch to LH and RH caliper. Turn handlebar to full RH side when bleeding right caliper and turn to the LH side for the left caliper. This helps to reach air into the caliper. On **Outlander series**, the front and the rear brakes must be bled at the same time.

Release brake lever or brake pedal slowly.

Repeat the procedure until no more air bubbles appear in hose and lever or pedal is stiff.

**PROCEDURES**

**REAR BRAKE LIGHT SWITCH**

**Inspection**

First ensure brake light is good.

Check brake light switch for dirt or corrosion. Make sure it is operating properly.

Depress brake pedal and check for brake light to turn on. Repeat with the brake lever(s).

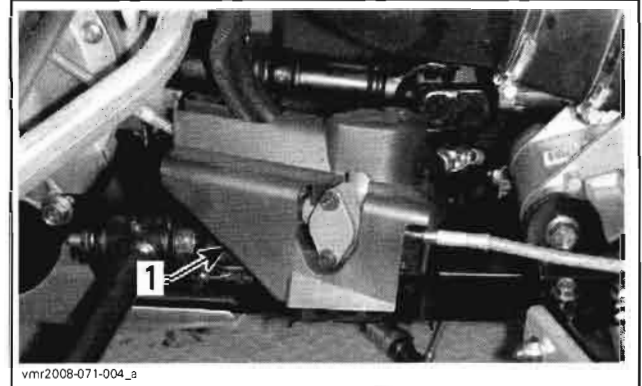
**Test**

**Outlander Series**

Remove the LH footrest.

**Renegade Models**

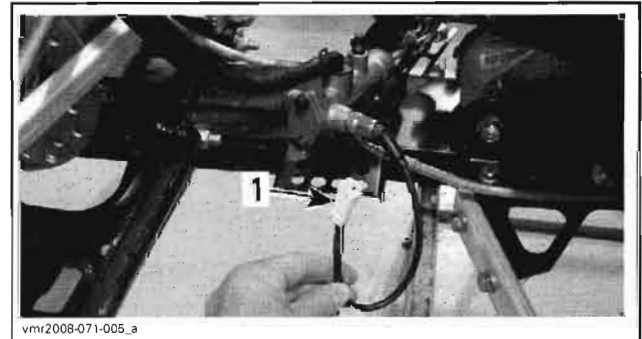
Remove the master cylinder cover.



1. Master cylinder cover

**All Models**

Disconnect switch connector.



1. Switch connector

Check switch operation as follows.

OUTLANDER SERIES			
BRAKE LIGHT SWITCH POSITION	PIN		RESISTANCE
Firmly pushed	1	2	0.2 Ω max.
Released			Infinite (OL)
RENEGADE MODELS			
BRAKE LIGHT SWITCH POSITION	PIN		RESISTANCE
Firmly pushed	1	3	0.2 Ω max.
Released			Infinite (OL)

If switch is defective, replace with a new one.

If the switch tests good, verify wire continuity between harness connector and ECM.

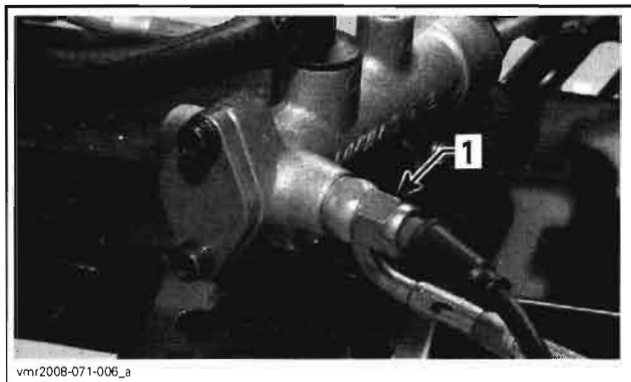
## Section 11 BRAKES

### Subsection 01 (FRONT AND REAR BRAKES)

ECM CONNECTOR PIN	HARNESS CONNECTOR WIRES	RESISTANCE
B-23	RED/ORANGE	Close to 0 $\Omega$

#### Removal

The rear brake light switch is located on the rear master cylinder and it cannot be adjusted.



1. Brake light switch

Disconnect switch connector.

Drain brake system.

Unscrew brake light switch from master cylinder. Catch spilled fluid with a rag.

Discard sealing washers.

#### Installation

For installation, reverse the removal procedure.

Install two **NEW** sealing washers.

## FRONT BRAKE LIGHT SWITCH

### **Renegade Models**

#### Inspection

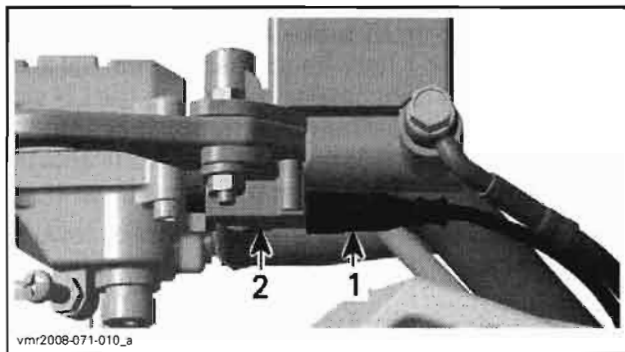
First, ensure bulb is not burnt.

Check brake light switch for dirt or corrosion. Make sure it is operating properly.

Depress front brake lever and check for brake light to turn on.

#### Test

Disconnect switch connectors.



UNDERNEATH RH BRAKE LEVER

1. Switch connectors
2. Brake light switch

Check switch operation as follows.

BRAKE LIGHT SWITCH POSITION	PIN	RESISTANCE
Firmly pushed	Switch pins	0.2 $\Omega$ max.
Released		Infinite (0L)

If switch is defective, replace with a new one.

If the switch test good, verify wire continuity between brake light switch and ECM.

ECM CONNECTOR PIN	BRAKE LIGHT SWITCH PIN	RESISTANCE
B-23	RED/ORANGE	Close to 0 $\Omega$

#### Removal

The front brake light switch is located underneath the RH brake lever and it cannot be adjusted.

Disconnect switch connectors.

Unscrew brake light switch from brake lever then remove it.

#### Installation

For installation, reverse the removal procedure.

Tighten switch screw to 1 N•m (9 lbf•in).

## PARKING BRAKE MECHANISM

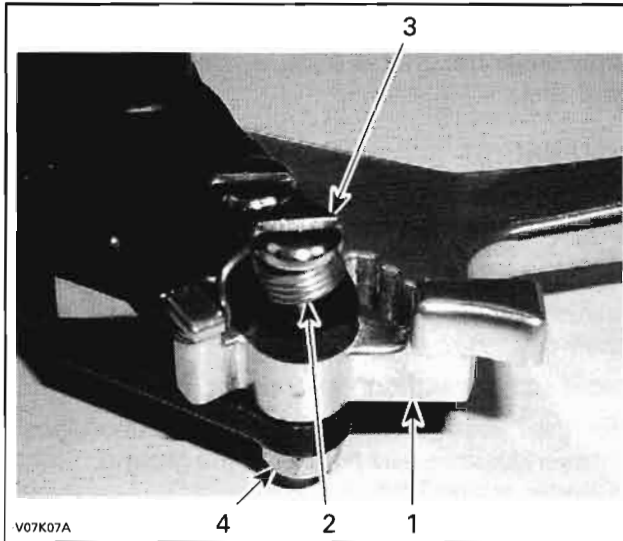
#### Removal

**NOTE:** The parking brake mechanism is located on the LH brake handle.

Unscrew nut under LH brake lever.

Remove screw, spring and brake lever lock.

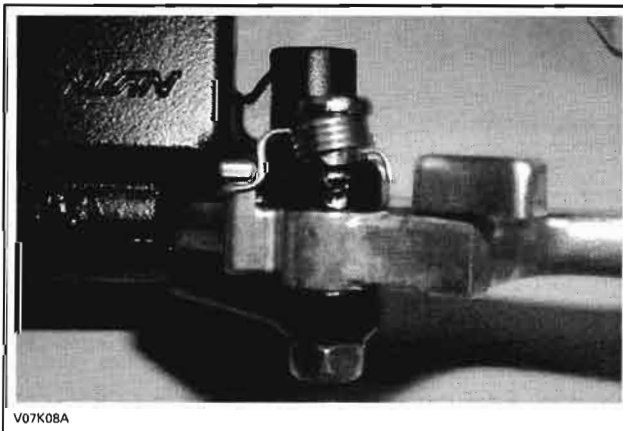




- 1. Brake lever lock
- 2. Spring
- 3. Screw
- 4. Nut

**Installation**

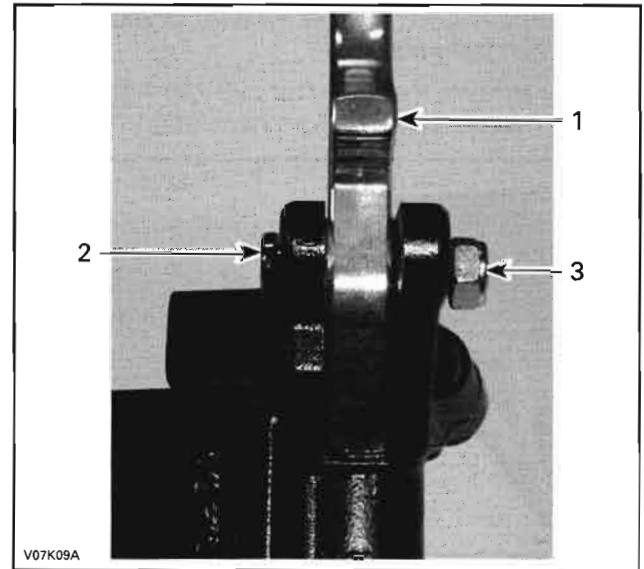
For installation, reverse the removal procedure. See the following illustration to install the spring properly.



**BRAKE LEVER**

**Removal**

Remove the parking brake mechanism (LH brake handle only).  
 Unscrew the brake lever nut.  
 Remove the screw and the brake lever.



- 1. Brake lever
- 2. Screw
- 3. Nut

**Inspection**

Check brake lever for bending, cracks or other damages. Replace if necessary.

**Installation**

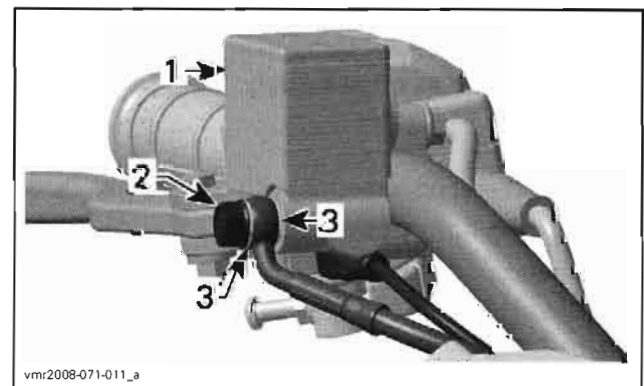
For installation, reverse the removal procedure.

**FRONT MASTER CYLINDER**

**Removal**

Remove master cylinder cover and its diaphragm then drain brake fluid until front master cylinder reservoir is empty.

Remove banjo fitting and sealing washers retaining brake hose to front master cylinder. Discard the sealing washers.



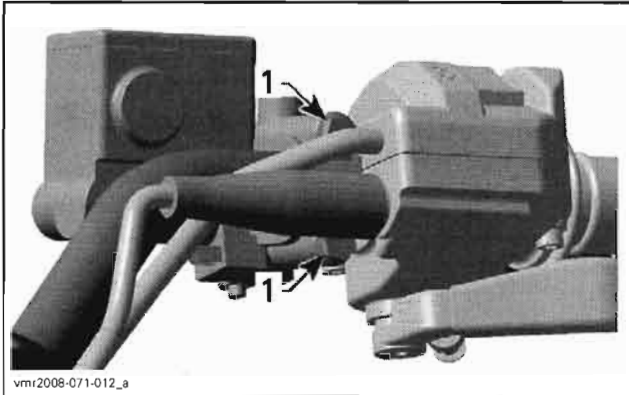
TYPICAL — RH MASTER CYLINDER SHOWN  
 1. Front master cylinder  
 2. Banjo fitting  
 3. Sealing washers

## Section 11 BRAKES

### Subsection 01 (FRONT AND REAR BRAKES)

When removing RH master cylinder, unplug brake light switch connectors.

Remove screws from master cylinder holder and remove master cylinder from handlebar.



TYPICAL — RH MASTER CYLINDER SHOWN  
1. Holder screws

### Disassembly

Remove brake lever.

Remove piston boot, snap ring, piston and spring.

### Inspection and Lubrication

Discard any remaining fluid inside reservoir.

Clean reservoir, piston and master cylinder thoroughly with clean brake fluid.

Check:

- boot for crack
- spring for damage
- piston cup for wear, deterioration or damages
- master cylinder and piston for scoring, scratches or other damages.

Change part(s) if necessary.

Check if the end cap O-ring is brittle, hard or damaged.

**NOTE:** If master cylinder housing is damaged or leaking, replace as an assembly.

### Assembly

Coat piston and piston cups with clean brake fluid.

Install spring onto piston.

Install piston into master cylinder.

Install the snap ring into groove in the master cylinder.

Install boot into master cylinder and the groove in piston.

Apply dielectric grease (P/N 293 550 004) to the brake lever contacting surface of the piston.

Install brake lever and locking mechanism.

Apply dielectric grease (P/N 293 550 004) on lever pivot bolt.

### Installation

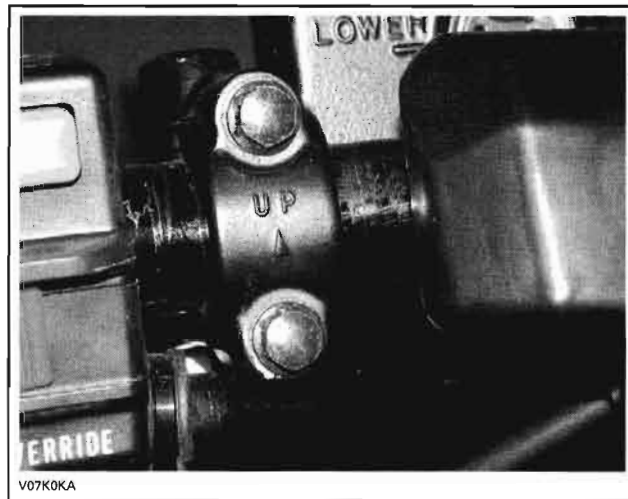
For the installation, reverse the removal procedure, pay attention to the following details.

Place the brake lever assembly on the handlebar.

Position cylinder holding bracket with the UP mark upward.

Install screws and tighten loosely.

With the handlebar in straight ahead position, position cylinder reservoir parallel to the ground. Tighten upper screw first.



Connect brake hose to master cylinder with a Banjo fitting and **NEW** sealing washers.

Bleed brake system.

Check for leaks and make sure the brakes operate normally before driving.

## REAR MASTER CYLINDER

### Removal

Drain brake fluid.

#### **Outlander Series**

Remove LH and RH footrests.

#### **Renegade Models**

Remove the master cylinder cover.

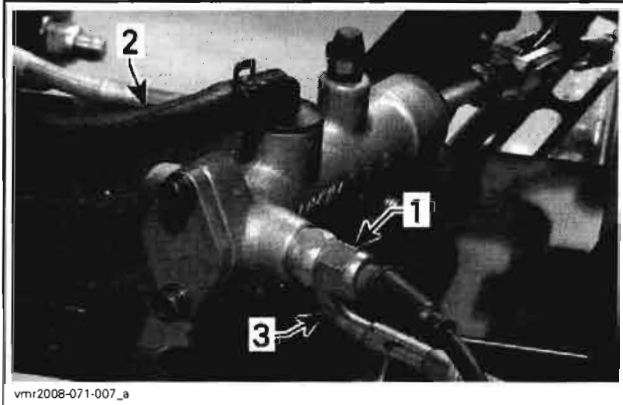
#### **All Models**

Unplug brake switch connector.

**NOTE:** At this time, check hoses and fittings for damages or leaks.

Disconnect reservoir flexible hose and plug the end to avoid brake fluid spillage.

Unscrew brake light switch from master cylinder. Discard sealing washers.

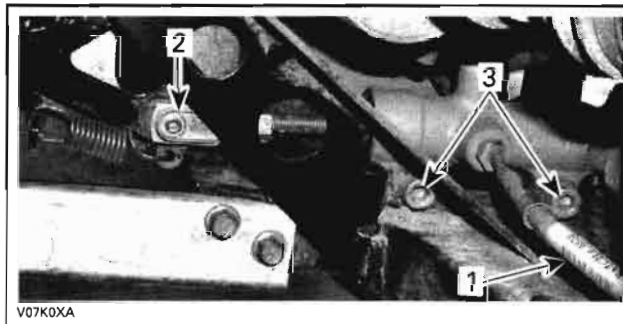


1. Brake switch
2. Reservoir hose
3. Rear hose

Unscrew front hose from master cylinder.

Unhook push rod from brake pedal.

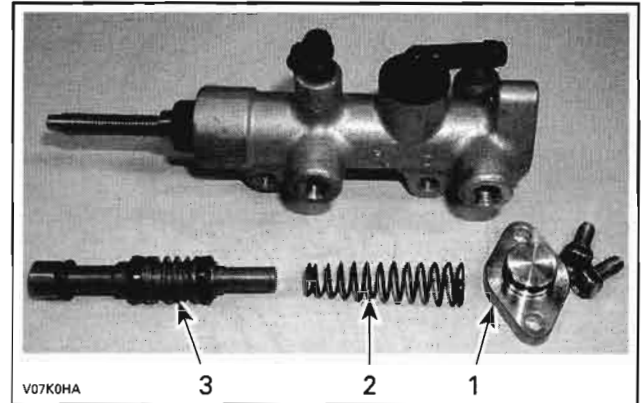
Remove bolts retaining master cylinder to the frame.



1. Front hose
2. Push rod lock
3. Master cylinder bolts

**Disassembly**

Remove the end cap, the spring and the piston.



1. End cap
2. Spring
3. Piston

Remove the boot, the snap ring and the push rod.

**Inspection and Lubrication**

Discard any remaining fluid inside reservoirs.

Clean reservoirs, pistons and master cylinders thoroughly with clean brake fluid.

Check:

- boots for crack
- springs for damage
- piston cups for wear, deterioration or damages
- master cylinders and pistons for scoring, scratches or other damages.

Change part(s) if necessary.

Check the push rod lock for excessive wear, replace if necessary.

Check if the end cap O-ring is brittle, hard or damaged.

**NOTE:** If master cylinder housing is damaged or leaking, replace as an assembly.

**Assembly**

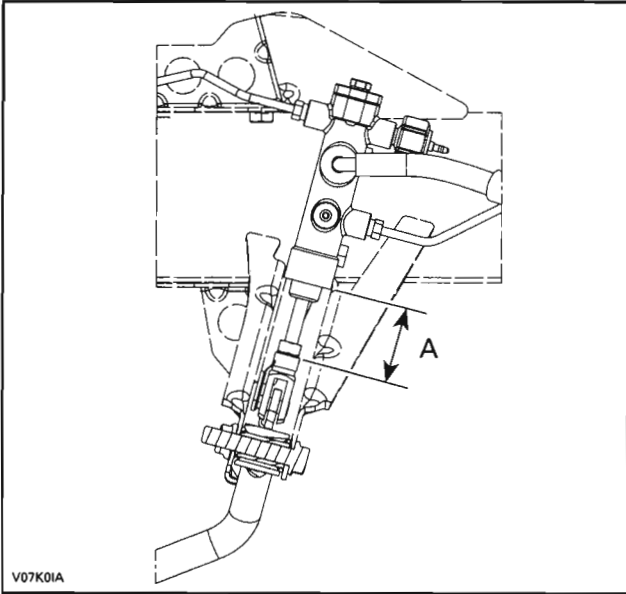
Apply XP-S synthetic grease (P/N 293 550 010) on both ends of push rod.

Install the push rod, the snap ring and the boot.

If push rod yoke has been removed, reinstall it then adjust push rod length, see the following illustration.

## Section 11 BRAKES

### Subsection 01 (FRONT AND REAR BRAKES)

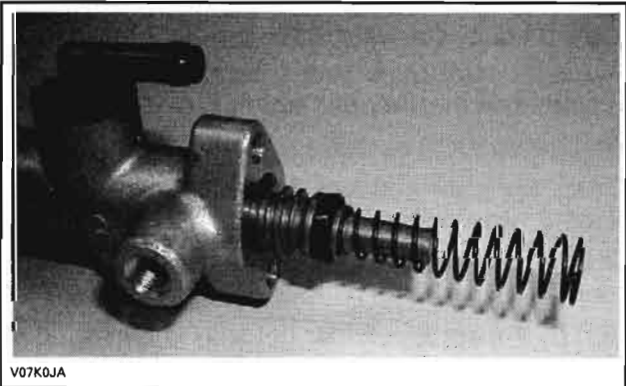


V07K01A

A.  $44 \pm 1 \text{ mm}$  ( $1.732 \pm .039 \text{ in}$ )

Coat piston and piston cups with clean brake fluid. The spring is conical. Install the smaller end on piston.

Insert piston in the master cylinder.



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Install the end cap. Do not forget the O-ring.

### Installation

Install master cylinder to frame.

Hook push rod on brake pedal.

Connect front hose on master cylinder.

Connect reservoir flexible hose.

Install the rear hose and the brake light switch with two **NEW** sealing washers.

Connect brake light switch connector.

Fill up reservoir with clean brake fluid.

Bleed brake system.

Check for leaks and make sure the brakes operate normally before driving.

## CALIPER

### Removal

Loosen wheel nuts.

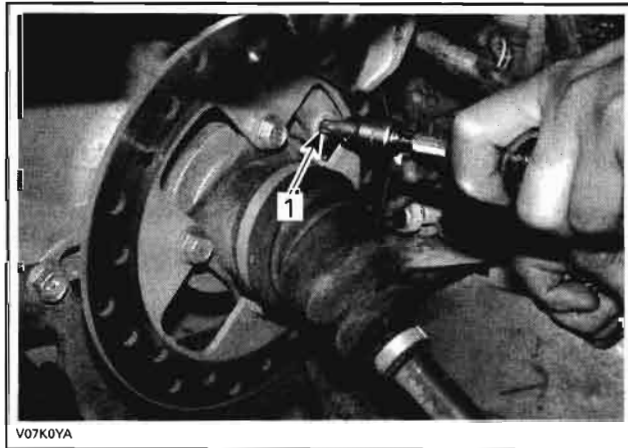
Raise vehicle and support it securely.

Remove appropriate wheel.

Remove the caliper screws then the caliper. If the caliper is not being removed from the vehicle as during brake pad replacement, simply hang the caliper with a piece of wire to take the weight off the brake hose.

**CAUTION:** Do not let caliper hangs by the hose and do not stretch or twist the hose.

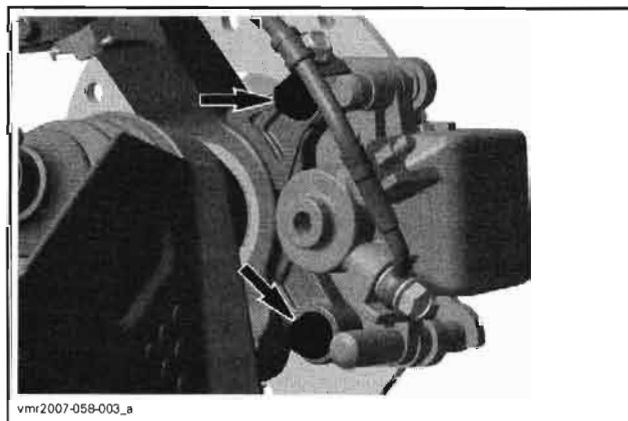
If the caliper is being removed for replacement, drain brake system before removing the Banjo fitting and its sealing washers. Remove the caliper from the vehicle.



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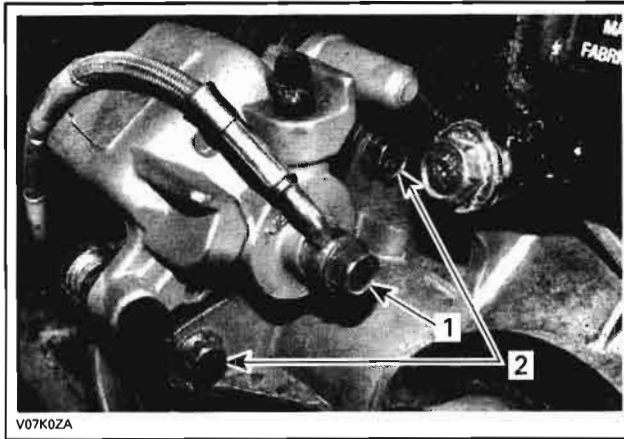
FRONT CALIPER — OUTLANDER SERIES

1. Retaining screw



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FRONT CALIPER — RENEGADE MODELS



**REAR CALIPER — ALL MODELS**  
 1. Remove banjo fitting and sealing washers  
 2. Unscrew bolts

Catch spilled fluid with a rag. Attach the brake hose in a position to prevent the fluid from flowing out.

Discard all sealing washers.

**Disassembly**

- Remove brake pads, see further in this section.
- Remove slide caliper support and pad spring.
- Place rag over piston.
- Place caliper body with piston down and apply small squirts of air pressure to the fluid inlet to remove piston.

**⚠ WARNING**

**Do not use high pressure air or bring nozzle too close to inlet.**

Remove piston seal.

**CAUTION:** Be careful not to damage piston sliding surface.

- Clean piston grooves, caliper cylinder and piston with clean brake fluid.
- Clean slide pins with brake cleaner and a rag.

**Inspection**

- If boots are deteriorated or hard, replace the caliper.
- Check caliper cylinder for scratches, rust or other damages. If so, replace caliper.
- Check piston for scratches, rust or other damages. If so, replace caliper.

**Assembly**

Coat piston seal with clean brake fluid and install it into piston grooves in caliper.

Coat piston with clean brake fluid and install into cylinder with the closing toward caliper body.

Apply dielectric grease (P/N 293 550 004) into sliding bores and install slide pins.

**NOTE:** Make sure that rubber boots are correctly installed in slide pins grooves.

Install pad spring, caliper bracket and pads.

**Installation**

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

Use **NEW** sealing washers when installing banjo fitting retaining brake hose to caliper.

Install caliper in its original position.

Torque screws in accordance with the following table.

MODELS	TORQUE
OUTLANDER SERIES	34 N•m (25 lbf•ft)
RENEGADE MODELS	24 N•m (17 lbf•ft)

Bleed the brake system.

Check for leaks and make sure the brakes operate normally before driving.

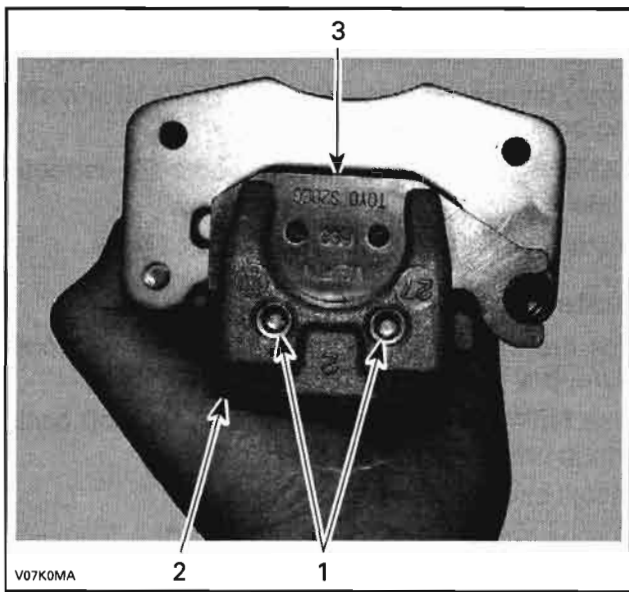
**BRAKE PADS**

**Removal**

- Raise vehicle and support it securely.
- Remove appropriate wheel.
- Loosen pad pins.

## Section 11 BRAKES

### Subsection 01 (FRONT AND REAR BRAKES)



1. Pad pins
2. Caliper
3. Pad

Remove caliper from its support or from knuckle. Unscrew pad pins then remove pads. Discard pad pins.

**CAUTION:** Do not let the caliper hang by the hose and do not stretch or twist the hose.

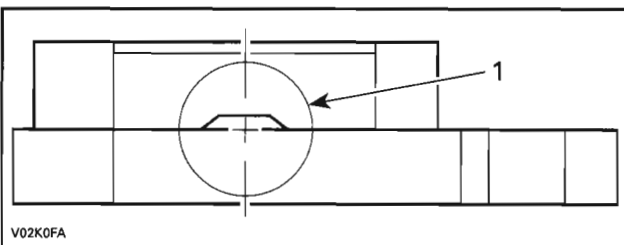
### Inspection

**CAUTION:** Do not clean brake pads in petroleum based solvent. Use brake system cleaner only. Soiled brake pads must be replaced with new ones.

Measure brake pad lining thickness.

Brake pads must be replaced when lining is 1 mm (1/32 in) thick or less, or look the hollow places on both sides on the pad lining.

There are four hollow places on one set of brake pads. When the pad wear reaches one of the hollow places, the pad must be changed even if the pad wear does not reach another hollow place.



1. Hollow place

**BRAKE PAD MINIMUM THICKNESS**

1 mm (1/32 in)

### **⚠ WARNING**

Avoid getting oil or grease on brake pads. Contaminated brake pads can affect stopping capacities.

**CAUTION:** Brake pads must always be replaced in pairs.

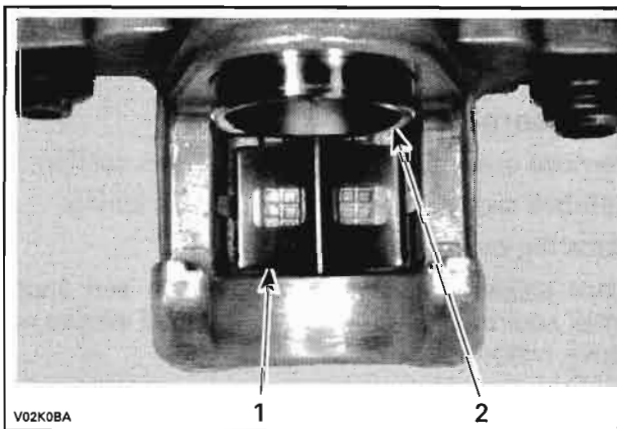
### Installation

Clean the visible portion of piston with clean brake fluid.

Push caliper pistons inward before installing brake pads.

**NOTE:** Use a C-clamp or another suitable tool. To avoid damaging the piston, use an old pad to push it into the caliper.

Make sure that pad spring is in position.



1. Pad spring
2. Piston

Install new brake pads.

Install **NEW** pad pins by pushing in the pads against pad spring to align pad slots in the pads and caliper body.

Install brake caliper so the disc is positioned between pads.

**NOTE:** Be careful not to damage pads and make sure pads are correctly inserted in their location.

After the job is completed, firmly depress the brake lever a few times to bring the pads in contact with the disc.

Check for leaks and make sure the brakes operate normally before driving. The pads must rest flat on the disk.

## BRAKE DISC

### Inspection

Brake discs can be inspected without removing them from the vehicle.

Raise vehicle and support it securely. Remove wheels and visually inspect disc surfaces for scratches or grooves. Make sure to check both sides of disc.

Measure thickness of the disc.

DISC MINIMUM THICKNESS	
FRONT	3.5 mm (.138 in)
REAR	4.3 mm (.170 in)

Replace disc if not within specifications.

**CAUTION:** Brake discs should never be machined.

Turn the disc by hand and check warpage.

MAXIMUM DISC WARPAGE	
FRONT	0.2 mm (.01 in)
REAR	

### Removal

#### Front Brake Disc

##### **Outlander Series**

Apply parking brake and raise the front of the vehicle.

Remove the appropriate wheel.

Remove wheel hub. Refer to *FRONT DRIVE*.

On **Outlander 650 and 800 series**, remove the shock absorber.

Separate knuckle from lower A-arm.

Remove drive shaft from knuckle.

Attach upper A-arm or strut out of way.

Unscrew brake disc screws.

Keep the Belleville washers.

Release parking brake and remove caliper. Suspend caliper out of the way.

**CAUTION:** Do not let the caliper hang by the hose and do not stretch or twist the hose.

Remove brake disc. Pay attention not to cut the CV boot.

##### **Renegade Models**

Remove appropriate wheel.

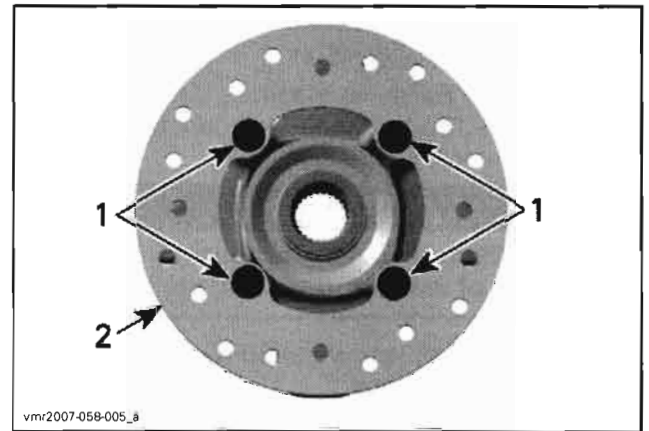
Remove caliper as described previously. Do not disconnect brake hose from caliper.

After removing the caliper, suspend it out of the way.

**CAUTION:** Do not let the caliper hang by the hose and do not stretch or twist the hose.

Remove wheel hub with brake disc. Refer to *FRONT DRIVE*.

Heat up brake disc around screw to break the threadlocker. Remove and discard brake disc screws.



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1. Brake disc screws
2. Brake disc

#### Rear Brake Disc

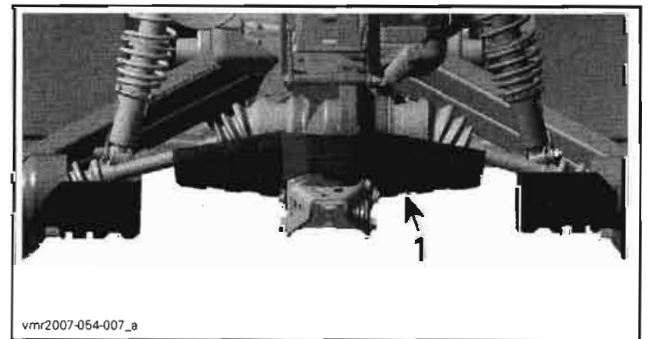
Remove rear wheels.

Remove the caliper and suspend it out of the way.

**CAUTION:** Do not let the caliper hang by the hose and do not stretch or twist the hose.

Unscrew and remove the rear propeller shaft screw from differential.

Remove the differential protector.



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1. Differential protector

Remove the differential bolts.

Loosen hitch plate bolts.

Move the differential backward.

Disconnect propeller shaft from differential.

## Section 11 BRAKES

### Subsection 01 (FRONT AND REAR BRAKES)

Unscrew brake disc screws. Heat up brake disc around screws to facilitate removal. Discard brake disc screws.

#### Installation

##### Front Brake Disc

###### **Renegade Models**

The installation is the reverse of the removal procedure.

###### **Outlander Series**

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

Do not forget Belleville washers when installing brake disc screws. Place the concave side of washers towards brake disc.

#### **⚠ WARNING**

Never substitute Belleville washer with another type of washer (flat, lock, etc.).

Tighten brake disc screws to 38 N•m (28 lbf•ft) in a criss-cross sequence.

##### Rear Brake Disc

###### **All Models**

Install brake disc on propeller shaft and tighten **NEW** screws to 34 N•m (25 lbf•ft) in a criss-cross sequence.

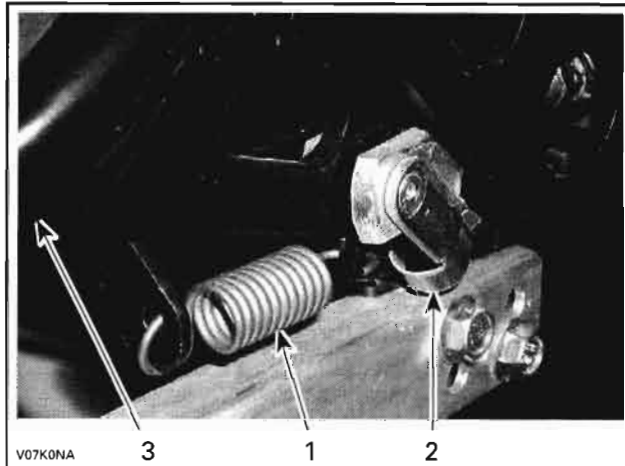
## BRAKE PEDAL

#### Removal

Remove RH footwell.

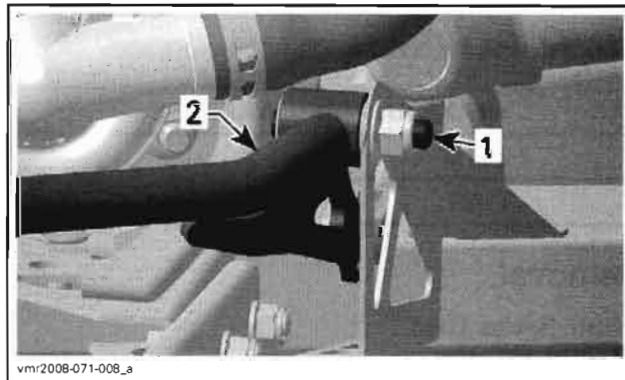
Detach the return spring from the brake pedal.

Open the master cylinder push rod hook.



1. Return spring
2. Push rod hook
3. Brake pedal

Remove bolt retaining the brake pedal to frame.



1. Brake pedal bolt
2. Brake pedal

#### Inspection

Check brake pedal for cracks or distortion.

Check if O-rings are brittle, hard or otherwise damaged.

Replace any defective parts.

#### Installation

For installation, reverse the removal procedure.

Apply XP-S synthetic grease (P/N 293 550 010) on both O-rings and into brake pedal.

## BRAKE HOSES

#### Inspection

Brake hoses should be inspected frequently for leaks and damages.

Check if the hoses are crushed or damaged. Any deformation can restrict the proper flow of fluid and cause braking problems.



Check hoses for cracking or scrapes. This damage can cause hose failure under pressure.

When hoses are removed or disconnected, cleanliness must be observed. Clean all joints and connections before disassembly. New hoses should be cleaned with brake fluid before installation to remove any contamination.

Replace any defective parts.

### Removal

**NOTE:** Before removing any hoses, drain brake system.

Remove all necessary parts to reach the hoses.

Thoroughly clean the area around the joints that will be disconnected.

Place a drain pan under the joint that will be disconnected.

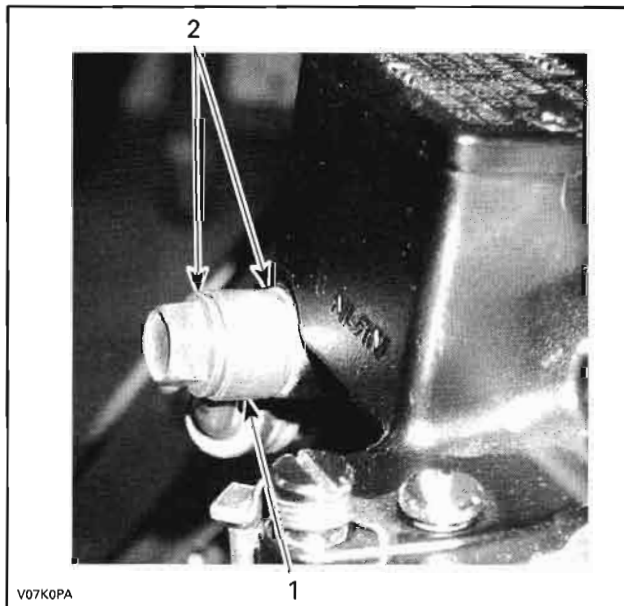
Disconnect any retaining clips or brackets holding the hose and remove the defective part(s).

### Installation

Install the new hose.

Make sure the piece will not rub against any other part.

When there is a banjo fitting securing the hose to the caliper or to the master cylinder, always replace the sealing washers with new ones.



**FRONT MASTER CYLINDER SHOWN**

1. Banjo fitting
2. Sealing washers

Install any retaining clips or brackets.

Refill and bleed the system.



# BODY

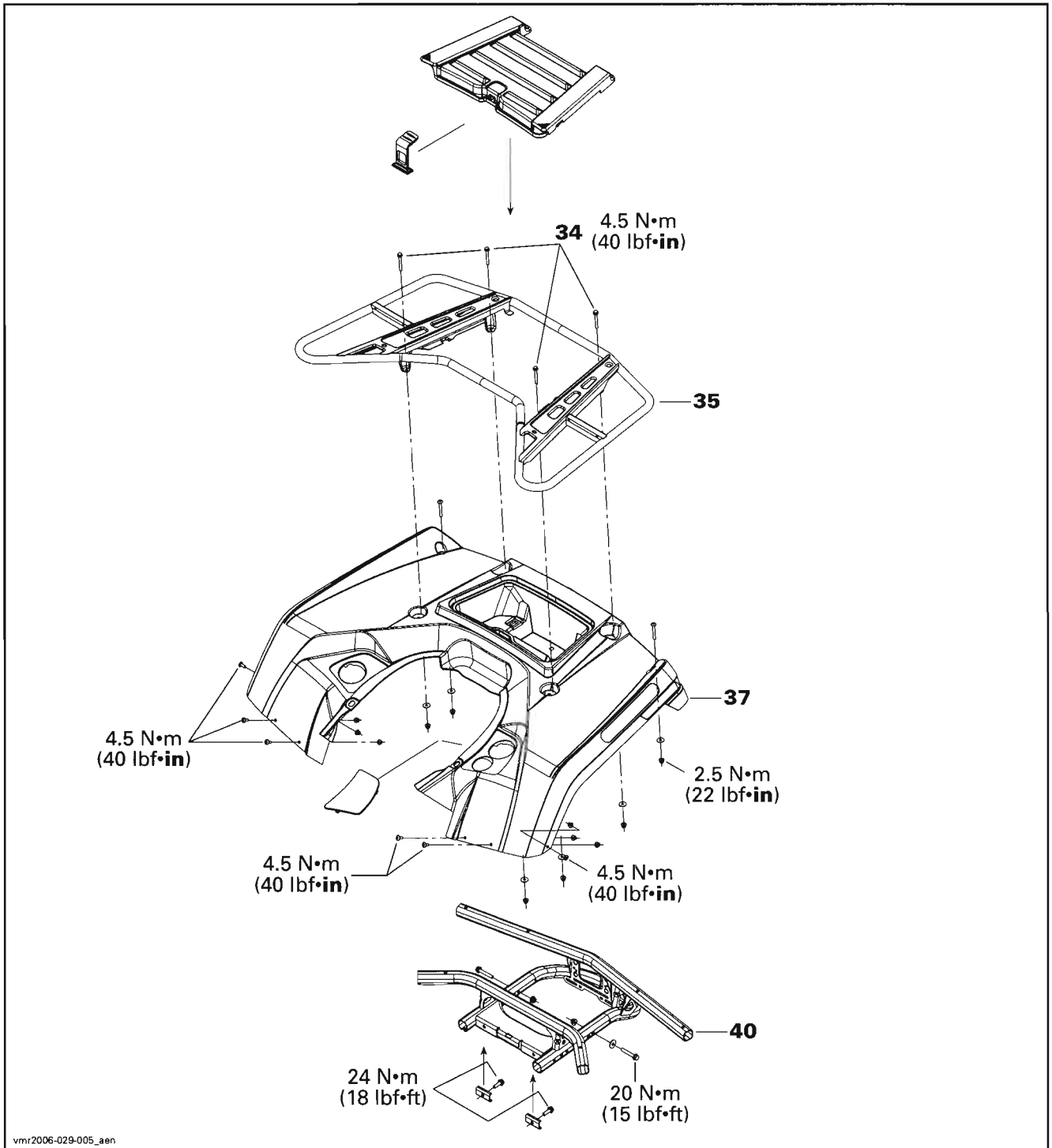
## SERVICE TOOLS

Description	Part Number	Page
pliers Oetiker 1099 .....	295 000 070 .....	393





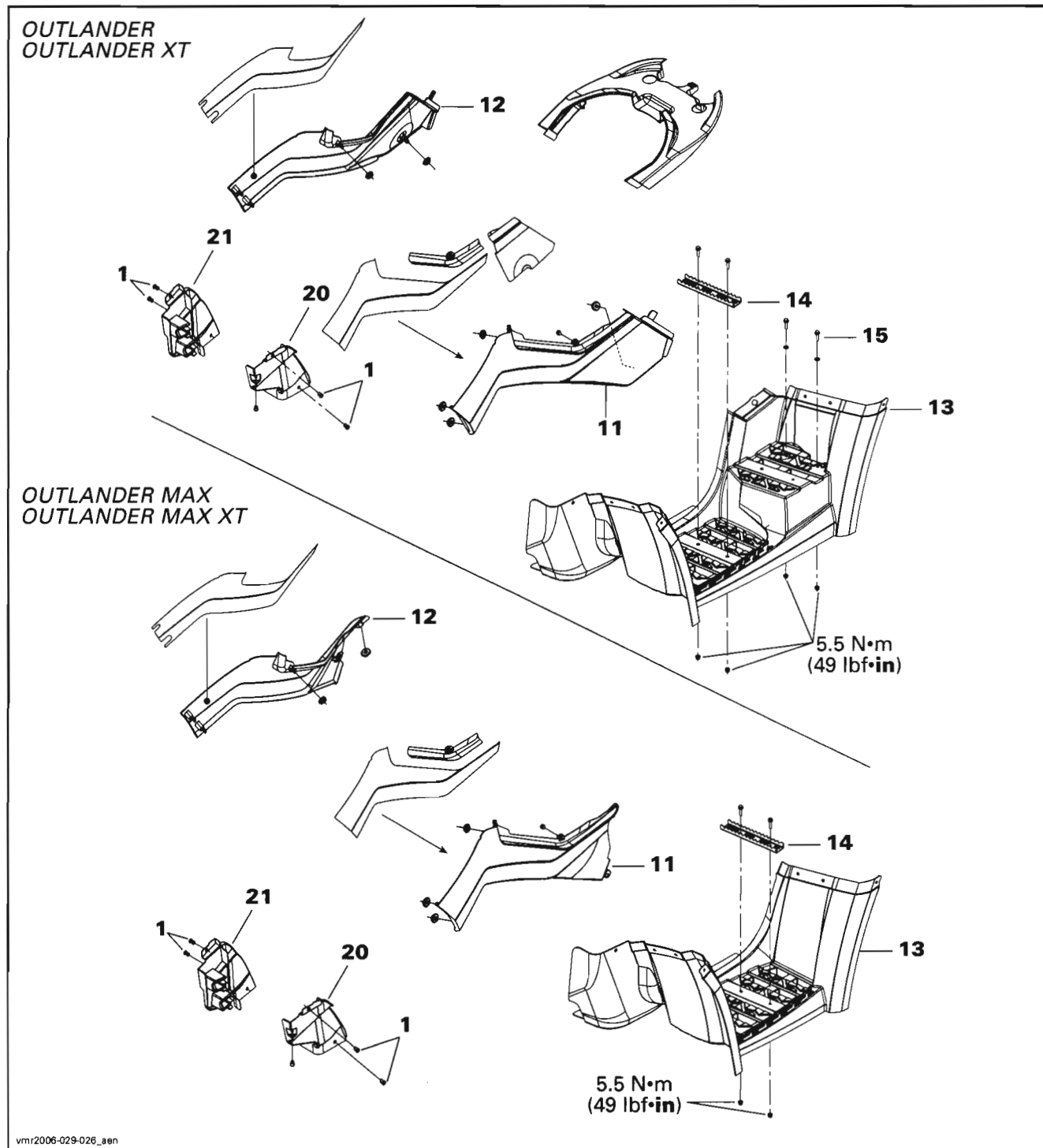
Body Parts (Rear View)



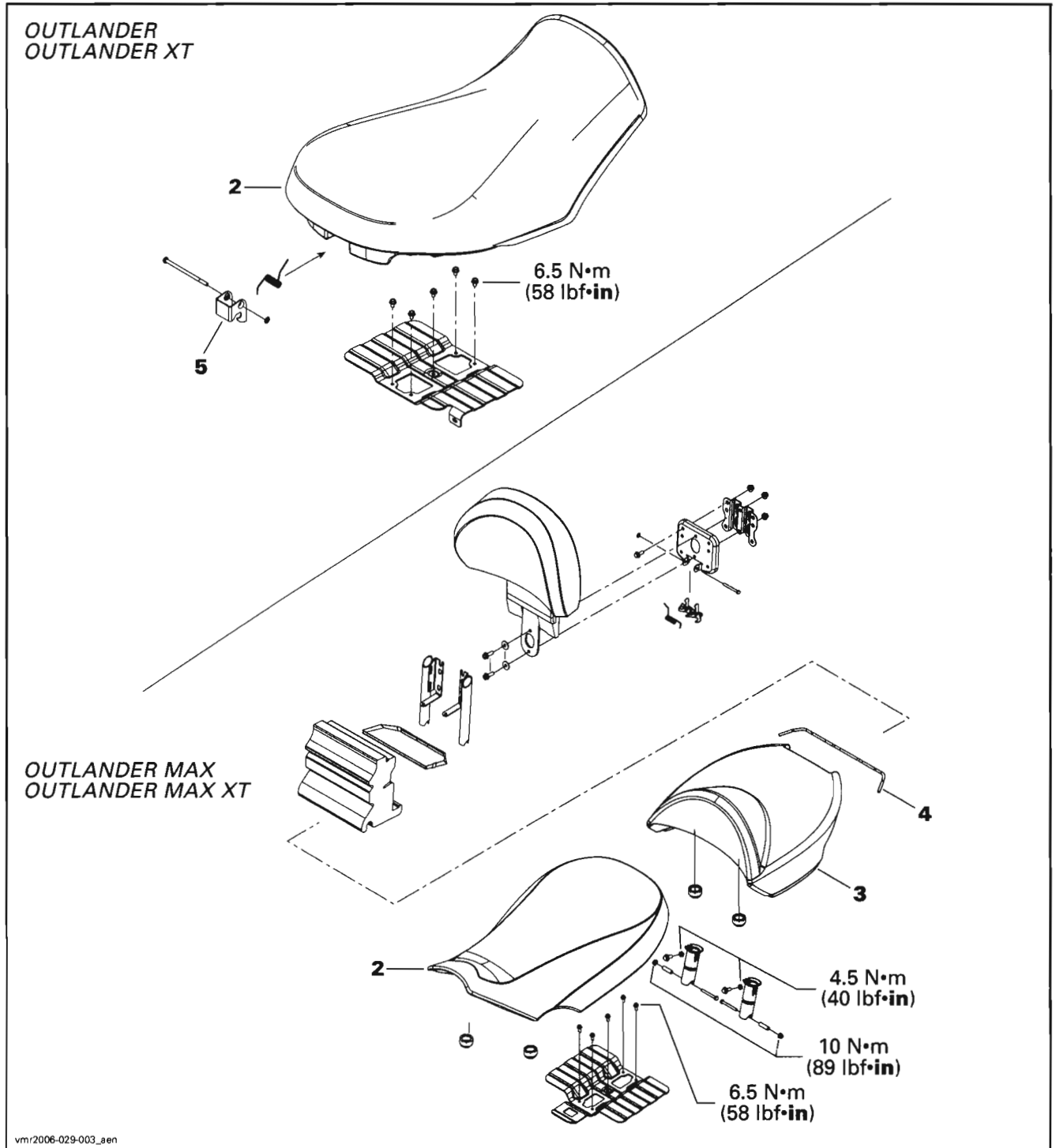
# Section 12 BODY/FRAME

## Subsection 01 (BODY)

### Body Parts (Side View)



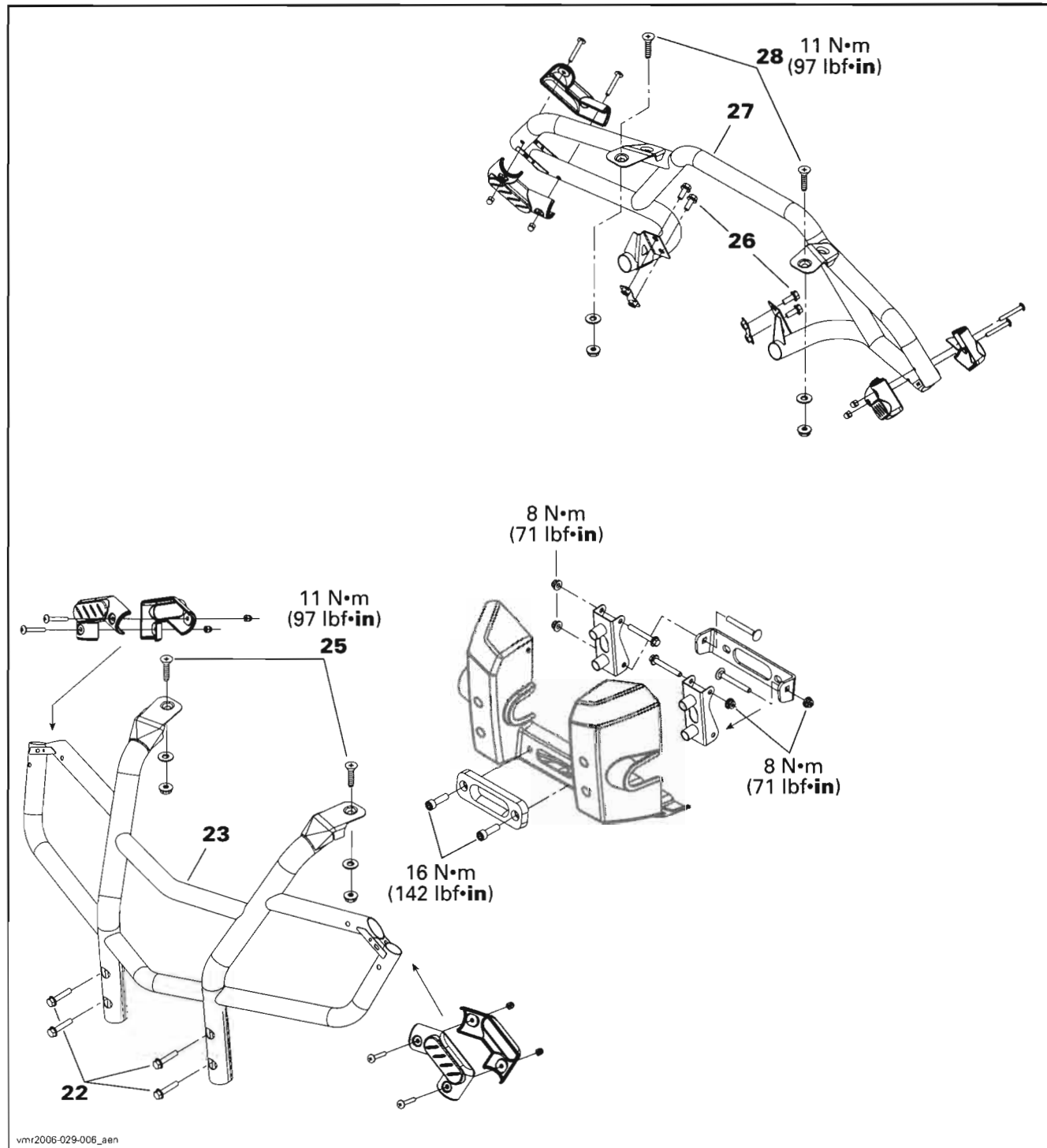
Seat



# Section 12 BODY/FRAME

## Subsection 01 (BODY)

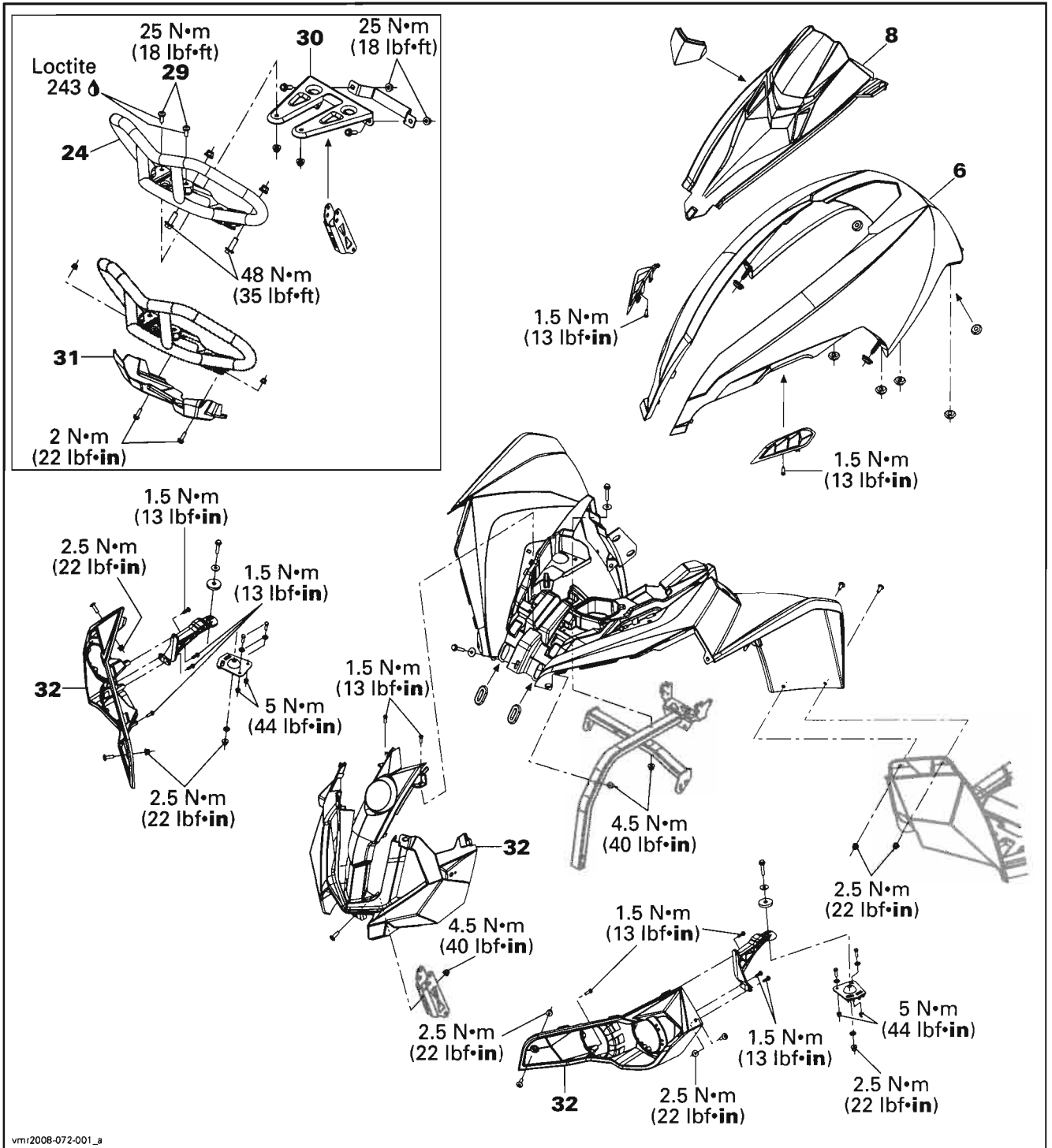
### XT Package





# RENEGADE MODELS

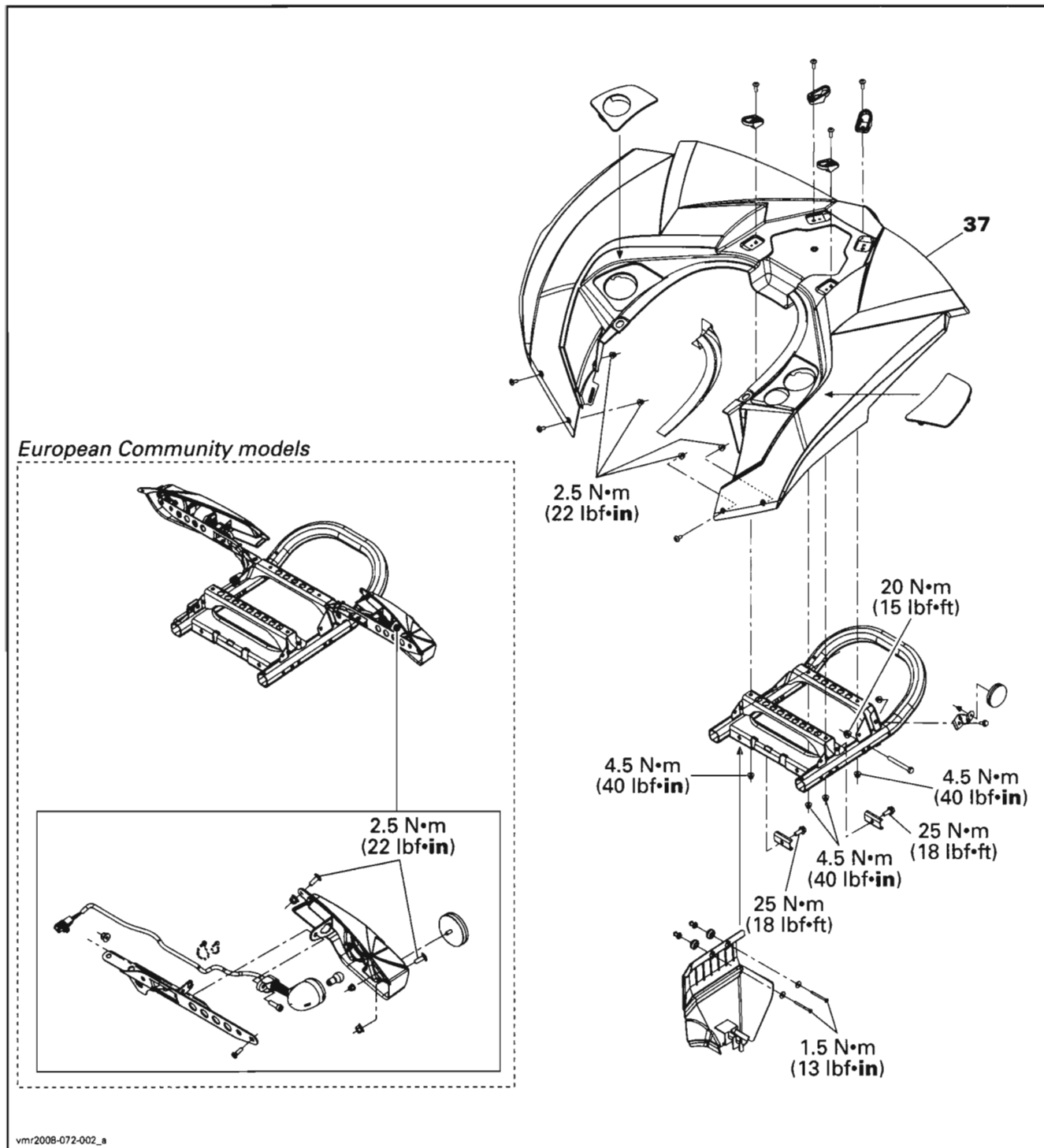
## Body Parts (Front View)



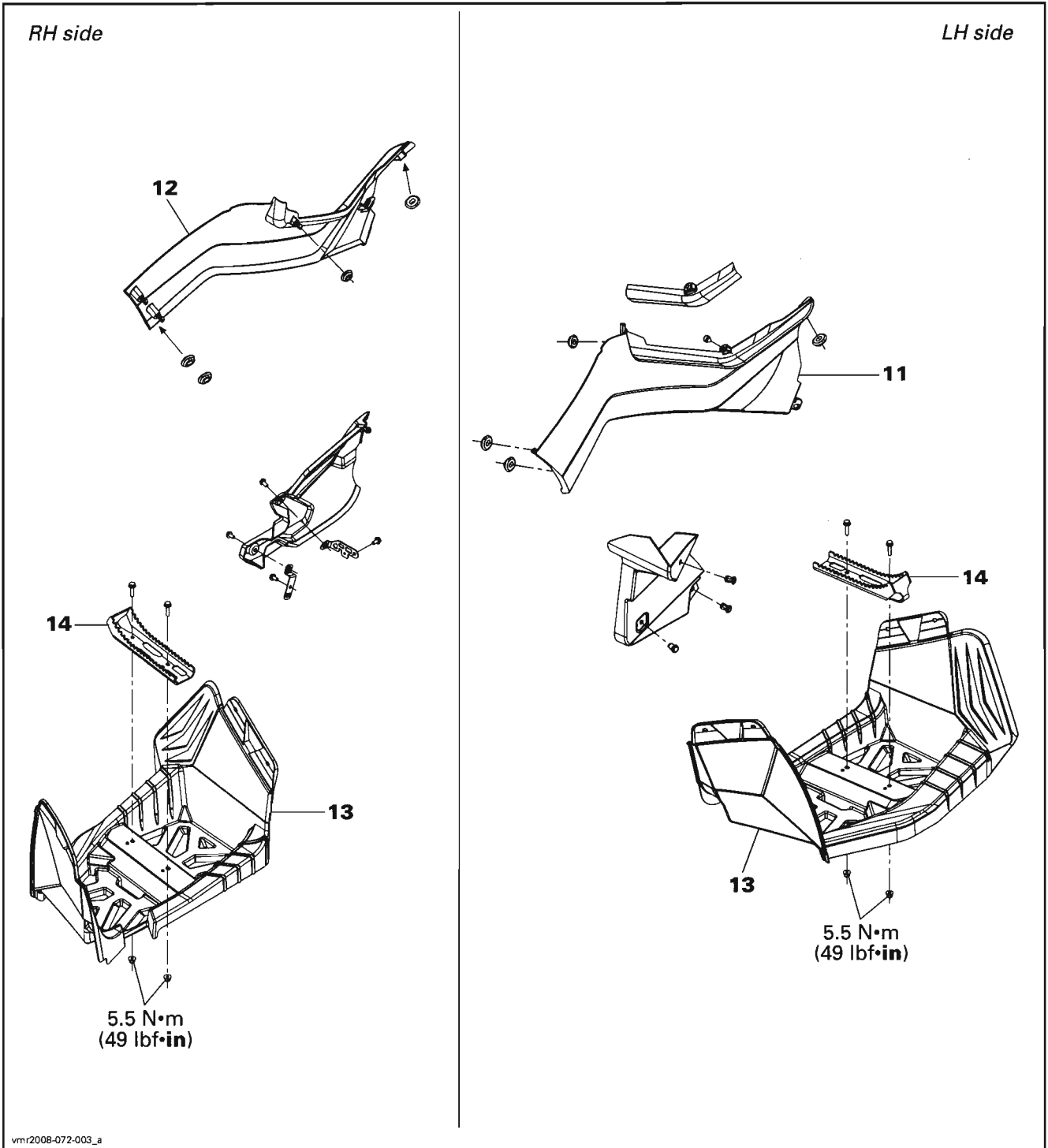
# Section 12 BODY/FRAME

## Subsection 01 (BODY)

### Body Parts (Rear View)



Body Parts (Side View)

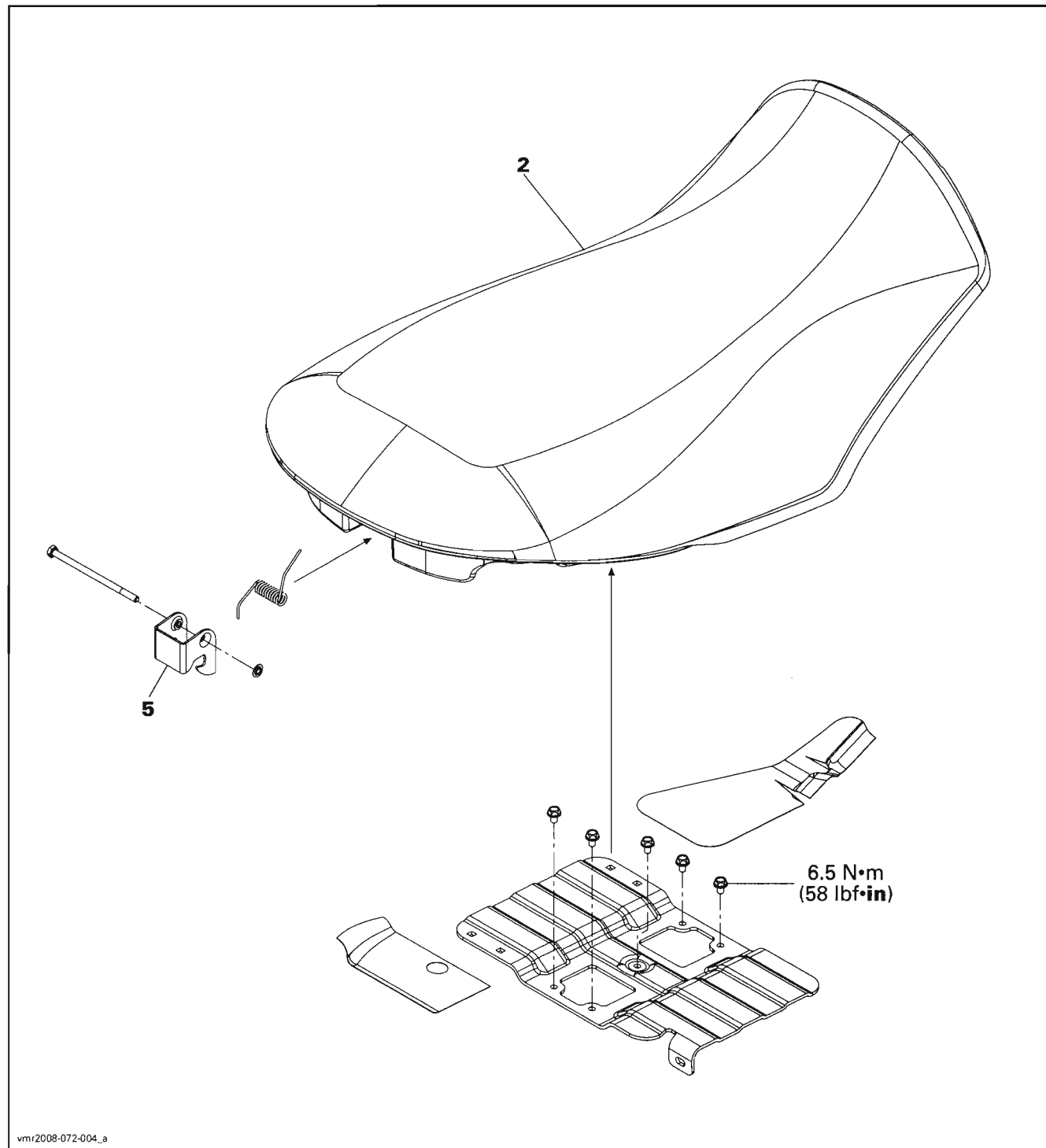


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# Section 12 BODY/FRAME

## Subsection 01 (BODY)

### Seat



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## 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 strictly be adhered to.

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

## Vehicle Care

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.

**CAUTION:** Do not apply isopropyl alcohol or acetone directly on decals.

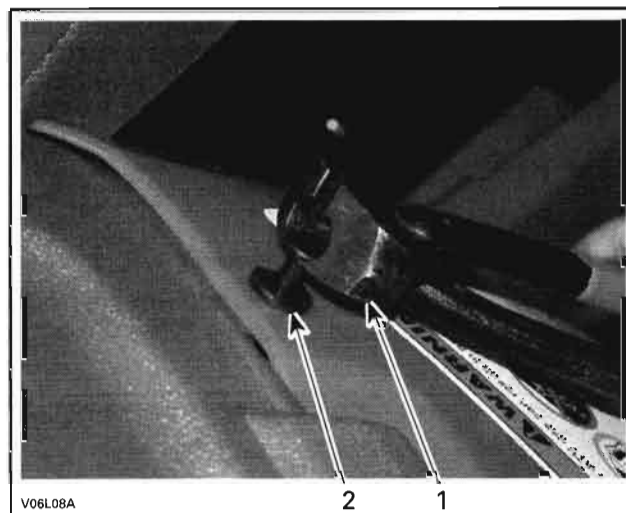
The following products must not be used to clean or wax any of the plastic components used on the vehicles:

- 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.

## Plastic Rivet

Plastic rivets no. 1 are used in the riveting of the various body parts. Plastic rivets can be removed carefully with pliers Oetiker 1099 (P/N 295 000 070).

**NOTE:** Reuse the plastic rivets.



TYPICAL  
1. Pliers  
2. Plastic rivet

## PROCEDURES

### DECALS

#### Decal Removal

Using a heat gun warm up one end of decal for a few seconds until decal can roll off when rubbing with your finger.

Pull decal slowly and when necessary apply more heat to ease removal on the area that has to be peeled off.

If decal tears while pulling off, it has to be heated for a few seconds longer. If decal tends to stretch while pulling off, stop heating and wait a few seconds to let it cool, then peel it off.

#### Decal Installation

Using isopropyl alcohol, clean the surface and dry thoroughly.

Apply liquid soap to new decal and carefully position it. Using a sponge or a squeegee, remove the air bubbles and surplus water working from the center toward the edges. Allow to air dry.

**CAUTION:** Do not apply isopropyl alcohol or solvent directly on decals. Use these products in a well ventilated area.

## SEAT

### Seat Cleaning

It is recommended to clean seat(s) with a solution of warm soapy water, using a soft clean cloth.

## Section 12 BODY/FRAME

### Subsection 01 (BODY)

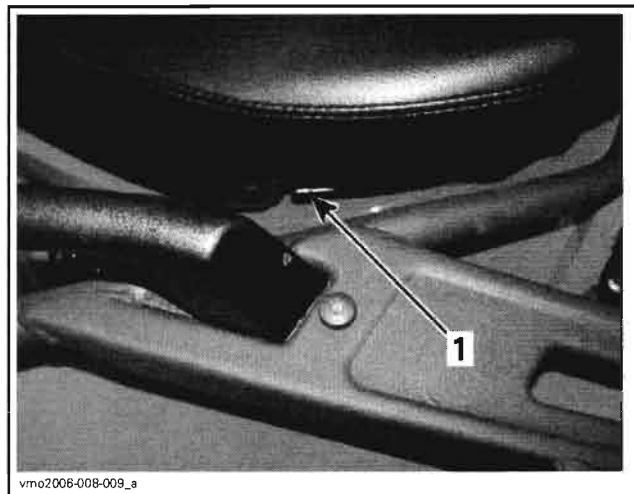
**CAUTION:** Avoid use of harsh detergents such as strong soaps, degreasing solvents, abrasive cleaners, paint thinners, etc. that may cause damage to the seat cover.

### Seat Removal

#### Passenger's Seat

##### **Outlander MAX/MAX XT Models**

Pull one of the passenger's seat latch levers **no. 4**. Those levers are located underneath the RH or LH rear end of seat.



*TYPICAL — LH SIDE*  
1. Seat latch lever

Gently lift the rear of seat **no. 3**.

Pull seat rearwards.

Continue lifting movement until you can release the front retaining device then completely remove passenger's seat.

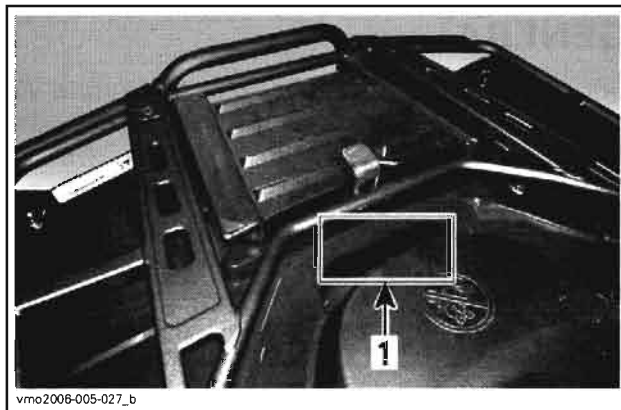
#### Operator's Seat

##### **Outlander MAX/MAX XT Models**

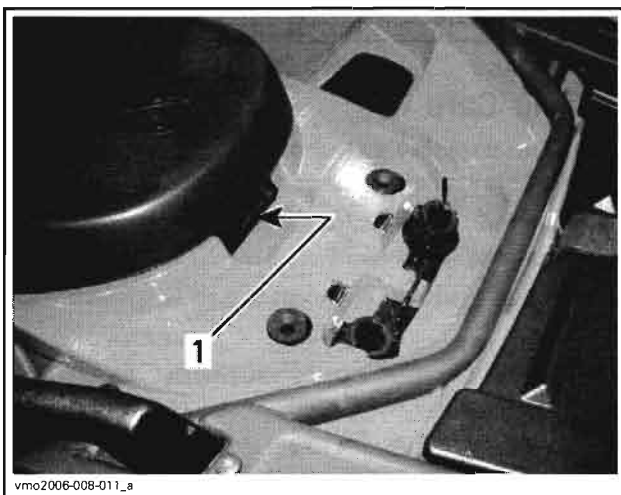
Remove passenger's seat **no. 3** as mentioned above.

##### **All Models**

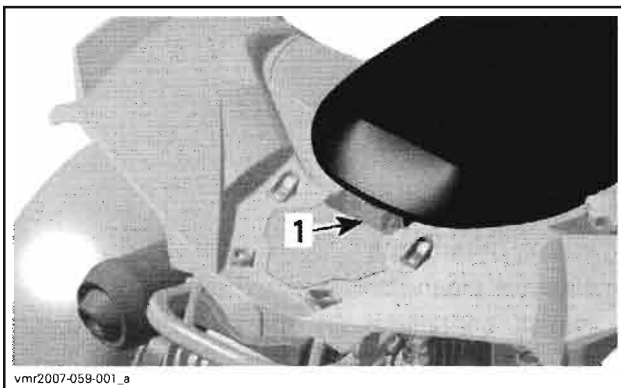
To remove seat **no. 2**, move latch lever **no. 5** upward while gently lifting rear of seat.



*OUTLANDER/OUTLANDER XT*  
1. Seat latch



*OUTLANDER MAX/OUTLANDER MAX XT*  
1. Seat latch

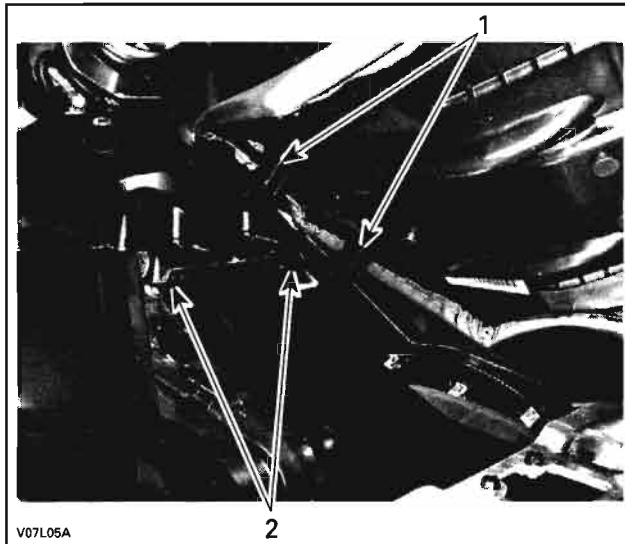


*RENEGADE MODELS*  
1. Seat latch

Pull seat rearward. Continue lifting movement until you can release the front retaining device then completely remove seat.

## Seat Installation

Insert front tabs of seat into frame hooks. When seat rests in its position, firmly push seat down to latch.



1. Insert these tabs in hooks
2. Hooks

**NOTE:** A distinctive snap will be felt. Double check that the seat is secure by giving it a tug to confirm proper latching.

### WARNING

Make sure seat is securely latched before riding.

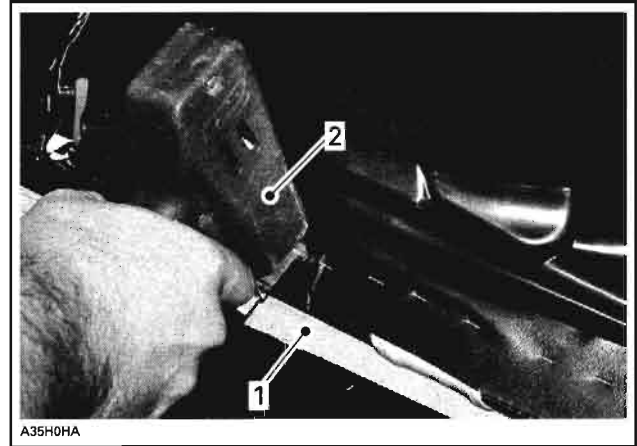
## Seat Cover Replacement

Remove the old seat cover. Check the foam and replace if necessary.

Install staples with an electric tacker such as Arrow tacker no. ETN-50 or with a manual tacker such as Arrow tacker no. T-50.

**NOTE:** For an easier installation, it's highly recommended to use an electric tacker.

Ensure that the seat rest firmly against a hard surface such as a piece of wood. This is done to get the staples completely pushed in place.



### TYPICAL

1. Piece of wood
2. ETN-50 (electric)

After cover installation cut all around the excess of material.

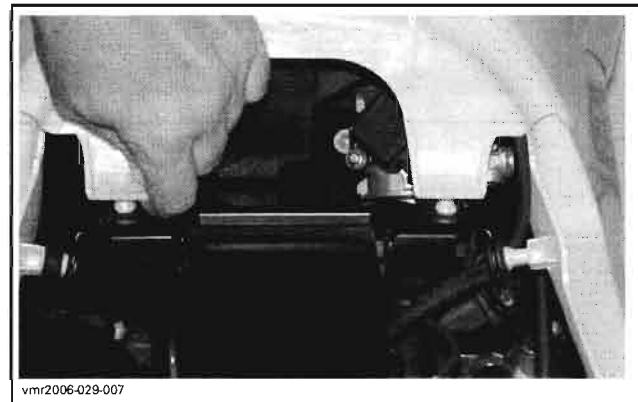
## CENTRAL PANEL

### Central Panel Removal

#### **Outlander Series**

Remove seat(s).

Come off the plastic studs from the grommets.



Pull central panel no. 6 to separate its tabs from front fender no. 7.

## Section 12 BODY/FRAME

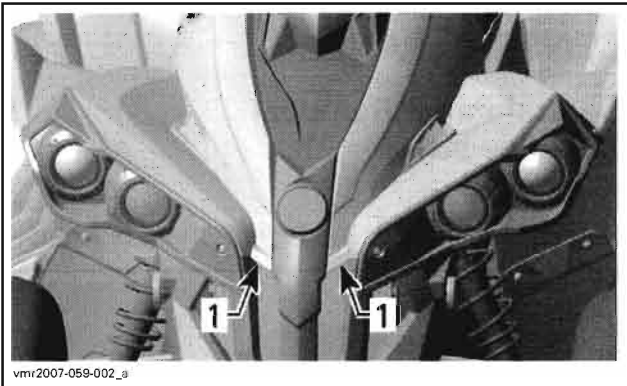
### Subsection 01 (BODY)



#### **Renegade Models**

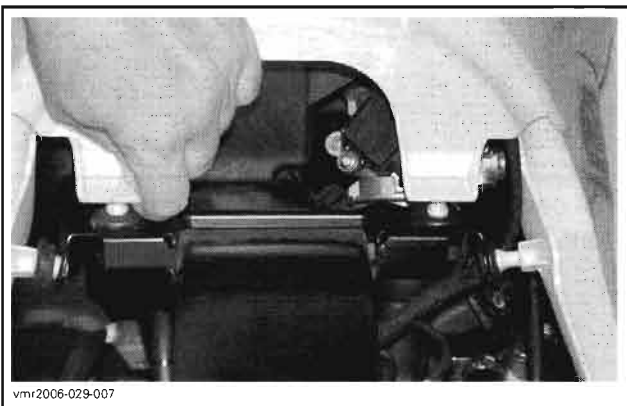
Remove seat.

Lift the front part of the central panel no. 6.



1. Lift here

Come off the plastic studs from the grommets.



Remove central panel.

#### **Central Panel Installation**

The installation is the reverse of the removal procedure.

## DASH BOARD

### **Dash Board Removal**

Remove central panel.

Lift up dash board no. 8.

Disconnect speedometer, 12-volt power outlet and ignition switch (Outlander Series).

### **Dash Board Installation**

For installation, reverse the removal procedure.

## SIDE PANEL

### **Side Panel Removal**

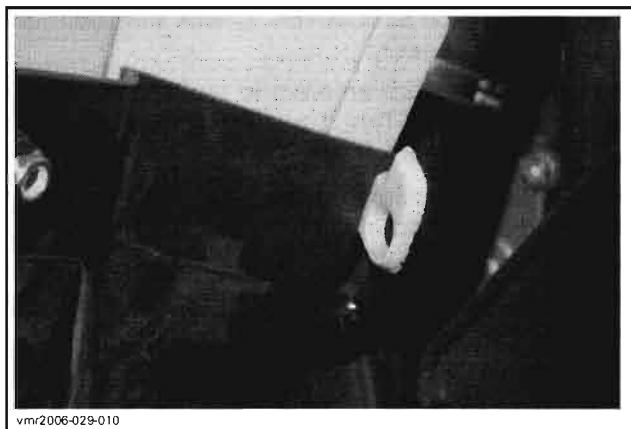
NOTE: Use the same procedure for the LH and RH side panels no. 11 and no. 12.

Remove seat(s) and central panel no. 6.

Come off the plastic studs from the grommets.



Unhook the side panel from footrest.



Remove side panel from vehicle.

### **Side Panel Installation**

The installation is the reverse of removal procedure.

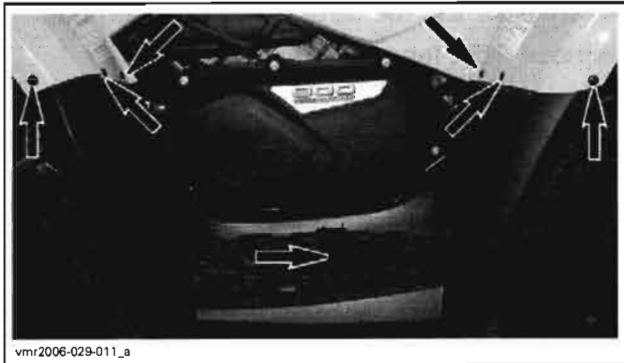


## FOOTREST

### Footrest Removal

#### **Outlander Series**

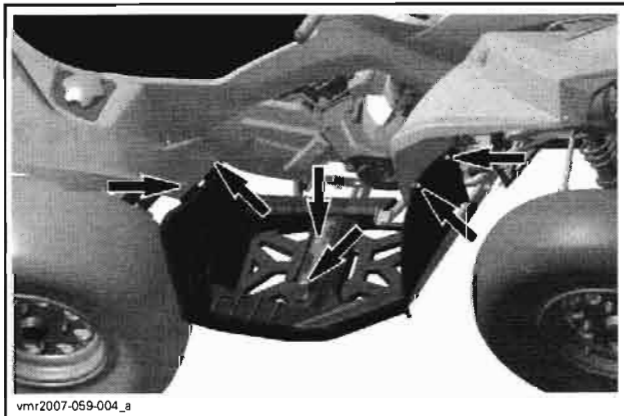
Remove footpeg(s) no. 14 and all bolts that attach the footrest no. 13 to fenders.



On MAX and MAX XT models, remove the footrest support retaining screws no. 15.

#### **Renegade Models**

Remove the footpeg and all bolts securing footrest to front and rear fender.



### Footrest Installation

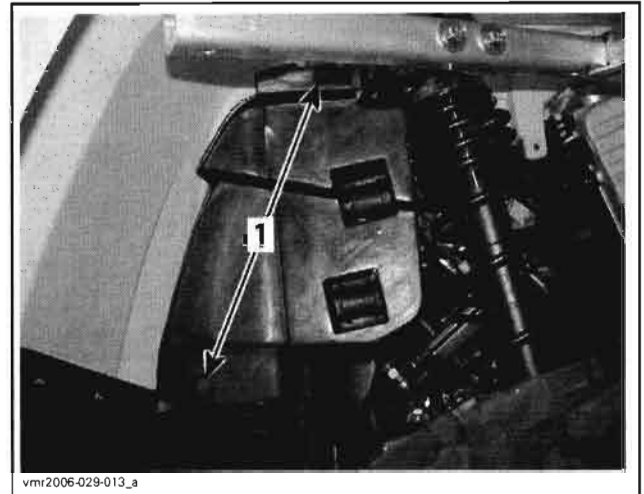
The installation is the reverse of removal procedure.

## INNER FENDER

### Inner Fender Removal

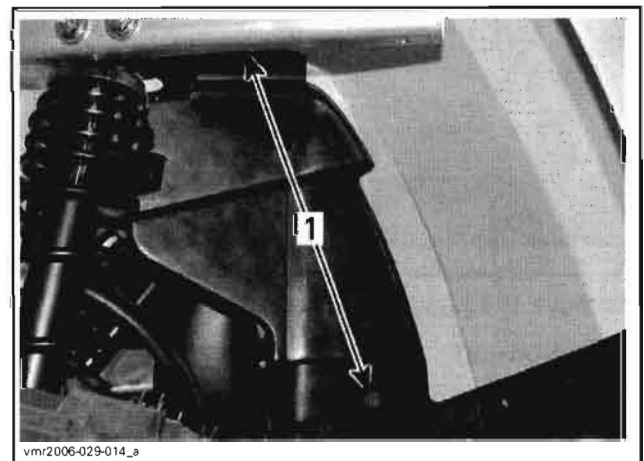
#### **Outlander Series**

Remove the plastic rivets that attach inner fenders no. 20 and no. 21 to footrest and frame.



INNER FENDER ON RH SIDE

1. Plastic rivets



INNER FENDER ON LH SIDE

1. Plastic rivets

On the RH side, detach coolant hoses from inner fender no. 21.

### Inner Fender Installation

The installation is the reverse of removal procedure.

## HEAVY DUTY BUMPER

#### **Outlander XT Package**

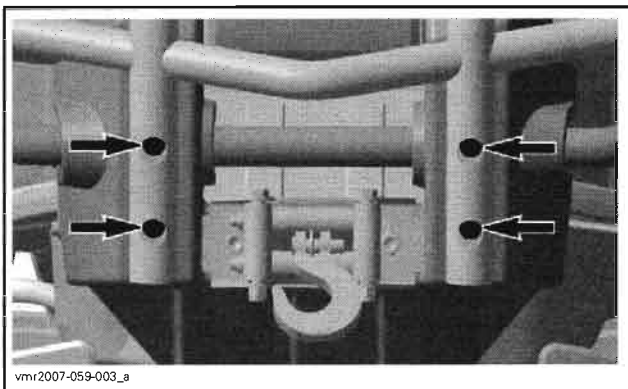
### Bumper Removal

#### Front Bumper

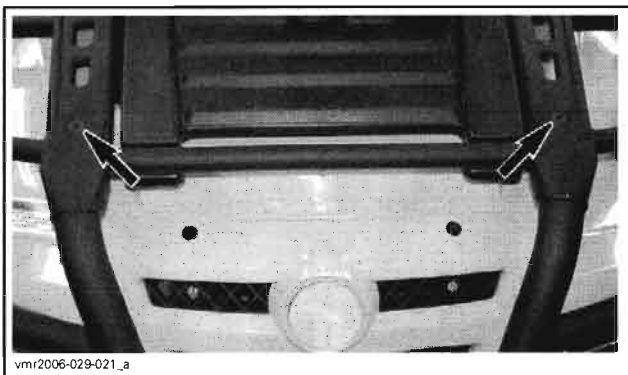
Remove bolts no. 22 retaining the heavy duty bumper no. 23 to the front bumper no. 24.

## Section 12 BODY/FRAME

### Subsection 01 (BODY)



Remove screws no. 25 that attach the heavy duty bumper to the rack.

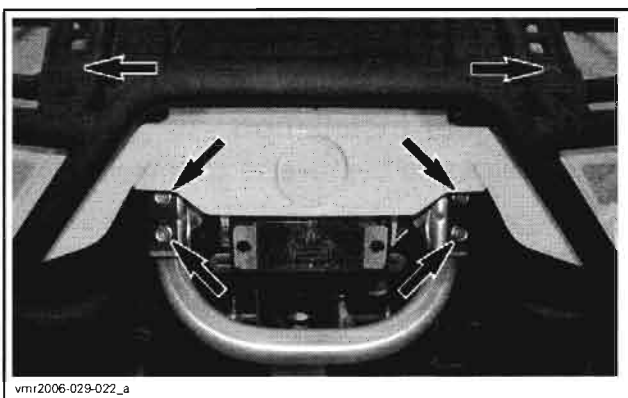


Remove the heavy duty bumper.

#### Rear Bumper

Unscrew bolts no. 26 retaining the rear heavy duty bumper no. 27 to the rear bumper.

Remove screws no. 28 that attach the heavy duty bumper to the rack.



#### Bumper Installation

The installation is the reverse of the removal procedure.

## FRONT BUMPER/FRONT SKID PLATE/FRONT FASCIA

### Removal

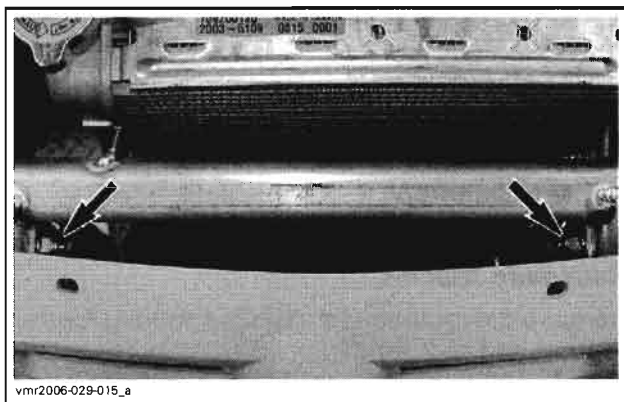
#### *Outlander Series*

**NOTE:** On XT models, remove hook at the end of winch cable and the front heavy duty bumper.

Remove front fender.

Unplug headlamps connectors.

Unscrew bolts no. 29 that attach front bumper no. 24 to fender support no. 30.



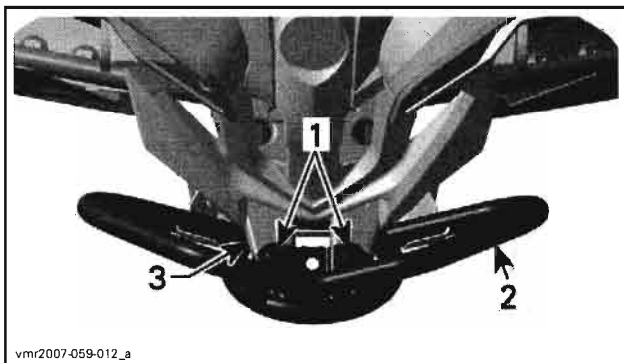
Unscrew bolts retaining the bottom of bumper to frame.

Remove front bumper with front skid plate no. 31 and front fascia no. 32 assembly.

Disassemble all parts if necessary.

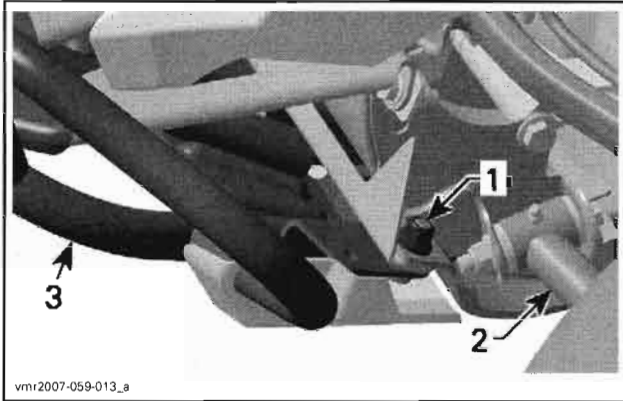
#### *Renegade Models*

Unscrew bolts no. 29 securing the front bumper no. 24 to the bumper bracket no. 30.



1. Upper bumper bolts
2. Front bumper
3. Bumper bracket

Unscrew bolts retaining the bottom of front bumper to frame.



1. Lower bumper bolt
2. LH lower suspension arm
3. Front bumper

Remove front bumper.

### Installation

The installation is the reverse of removal procedure.

#### **Outlander Series**

Install a washer no. 33 under each plastic rivet located at the both ends of fascia.



## LUGGAGE RACK

#### **Outlander Series**

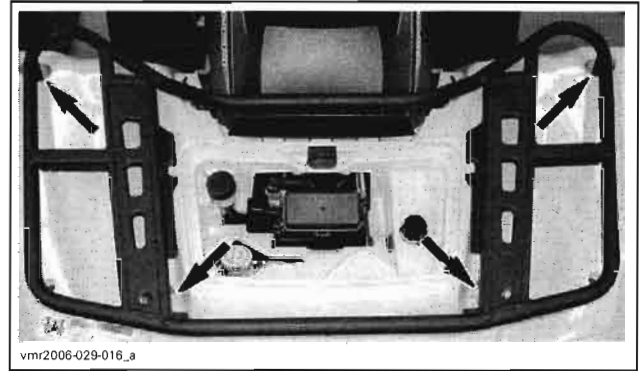
**NOTE:** Use the same procedure for front or rear luggage racks.

### Rack Removal

**NOTE:** On XT models, heavy duty bumpers (front and rear) must be removed to allow luggage racks removal.

Remove storage or service compartment cover.

Unscrew the four (4) bolts no. 34 retaining the rack no. 35.



Remove luggage rack.

### Rack Installation

The installation is the reverse of removal procedure.

## FENDER

### Fender Removal

#### Front Fender

#### **Outlander Series**

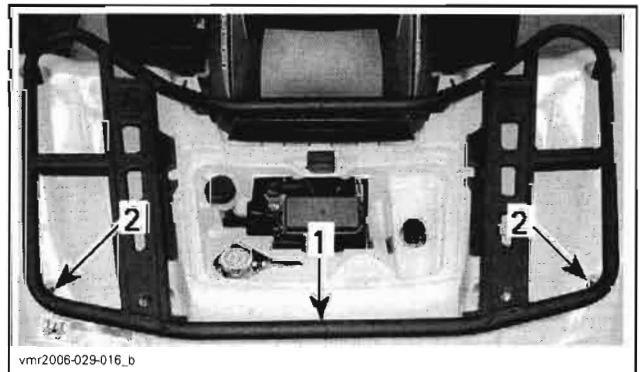
Remove both side panels no. 11 and no. 12.

Remove bolts that attach both footrests to the fender.

Remove plastic rivets retaining front fender no. 7 to front fascia.

Remove luggage rack.

Unscrew and remove fender bolts no. 36.



1. Luggage rack
2. Fender bolts

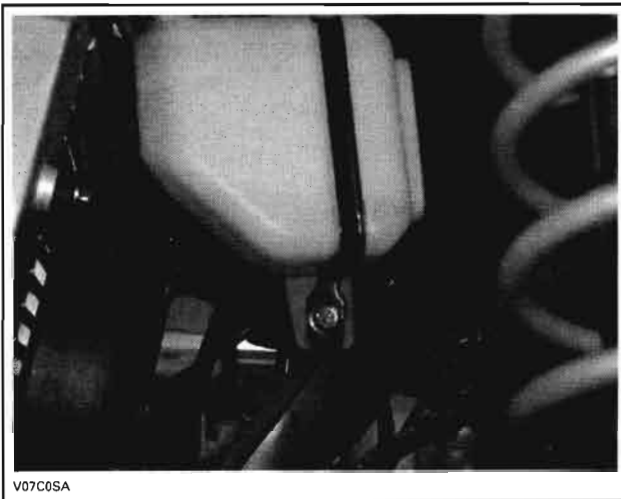
Unscrew the brake fluid reservoir bolt.

## Section 12 BODY/FRAME

### Subsection 01 (BODY)



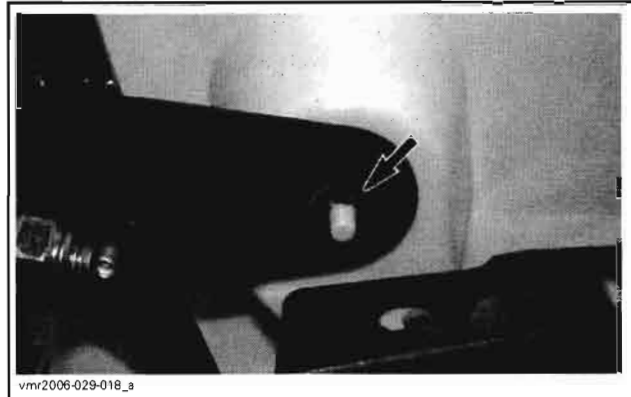
Remove the coolant reservoir support bolt.



Remove both inner fenders.  
Detach dash board no. 8 from fender.



Remove push nuts retaining fender to frame.

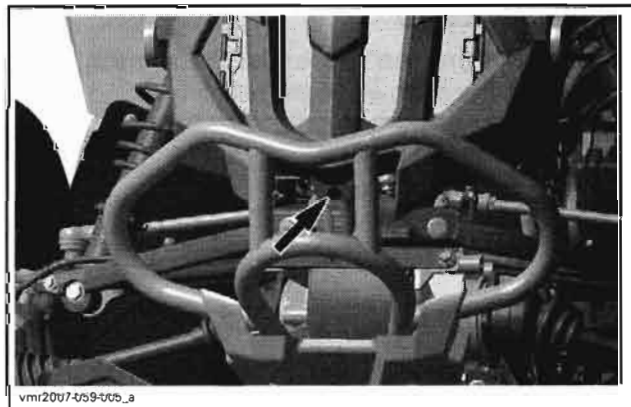


Lift up fender and place it in a safe place to avoid scratches.

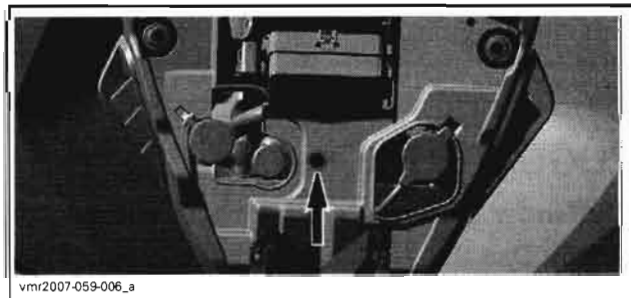
#### **Renegade Models**

Remove central panel, dash board and both side panels.

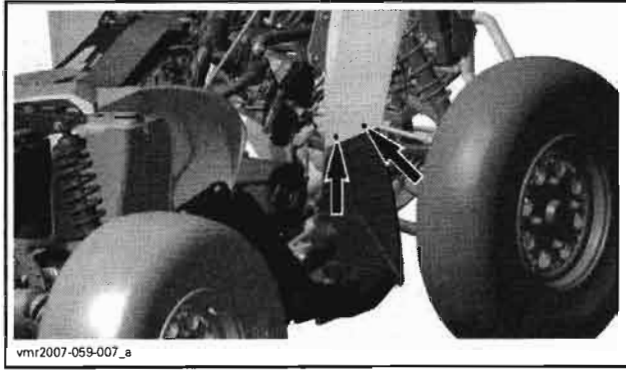
Remove the screw at the bottom of the front plastic grid.



Remove the screw located between radiator cap and coolant tank.



Remove screws attaching front fender to both footrests.



Unplug all headlamps.

Remove fender and store it safely to avoid scratches.

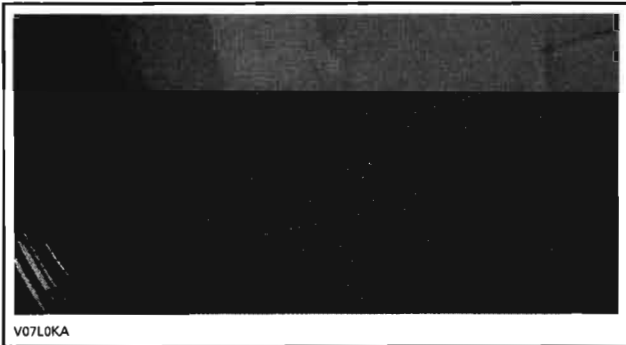
**Rear Fender**  
**Outlander Series**

Remove seat(s).

Remove both side panels.

Remove luggage rack no. 35.

Remove all screws retaining the footrests to rear fender no. 37.



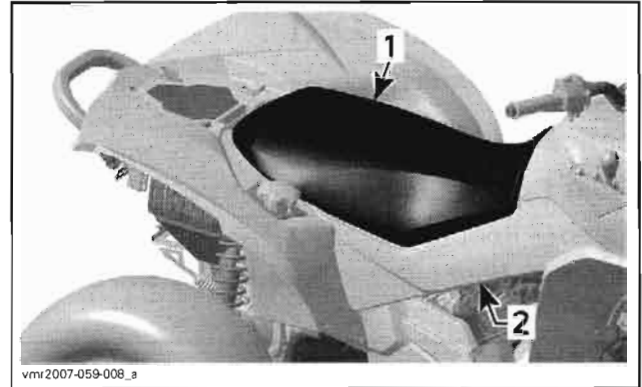
Unscrew the fuel tank cap.

Lift and remove fender. Place it in a place to avoid scratches.

Reinstall the fuel tank cap.

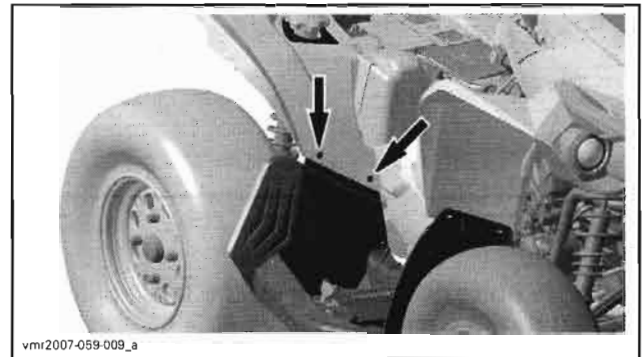
**Renegade Models**

Remove seat and both side panels.

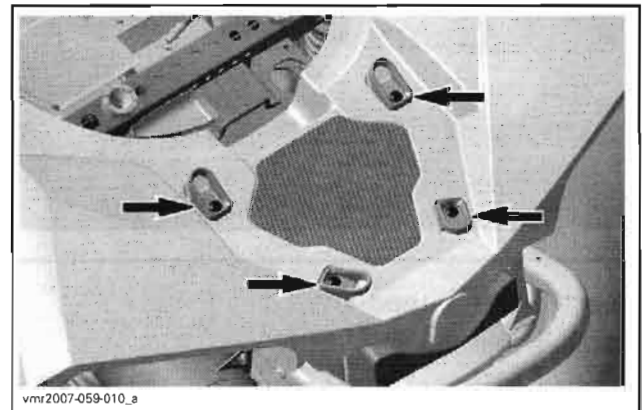


1. Seat
2. RH side panel

Remove screws attaching the bottom of rear fender no. 37 to both footrests.



Remove anchorage hooks on the top of rear fender.



Remove fuel tank cap.

Lift and remove fender. Store it safely to avoid scratches.

Reinstall the fuel tank cap.

**Fender Installation**

The installation is the reverse of removal procedure.

## Section 12 BODY/FRAME

### Subsection 01 (BODY)

## FENDER SUPPORT

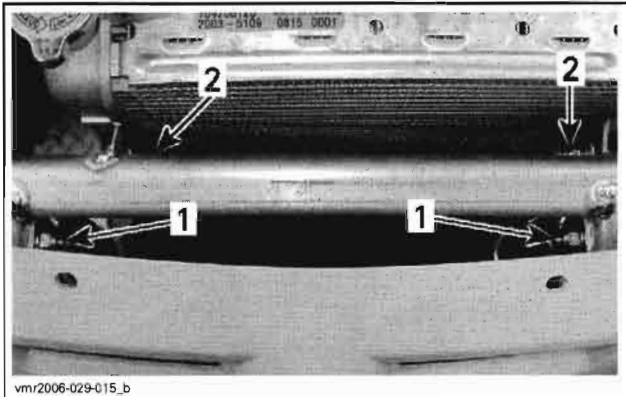
### *Outlander Series*

### Fender Support Removal

#### Front Fender Support

Remove front fender.

Unscrew front bumper bolts **no. 29** and radiator mounting bolts.



1. Radiator bolts
2. Bumper bolts

Remove bolts **no. 39** retaining the fender support **no. 30** to the frame.

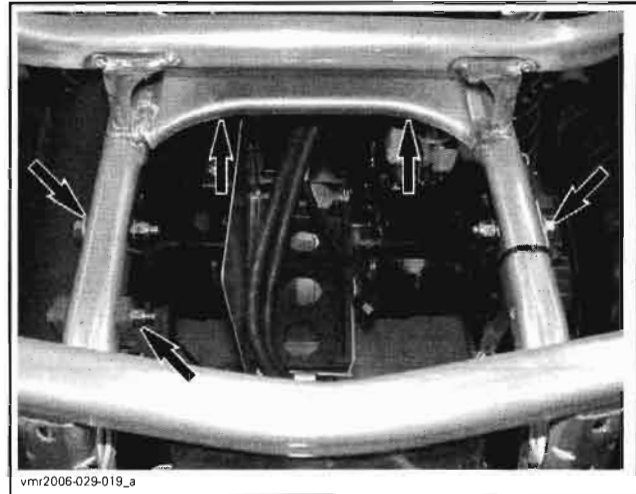


#### Rear Fender Support

Remove rear fender.

Remove bolts that attach fender support **no. 40** to frame.

Unscrew the exhaust support bolt.

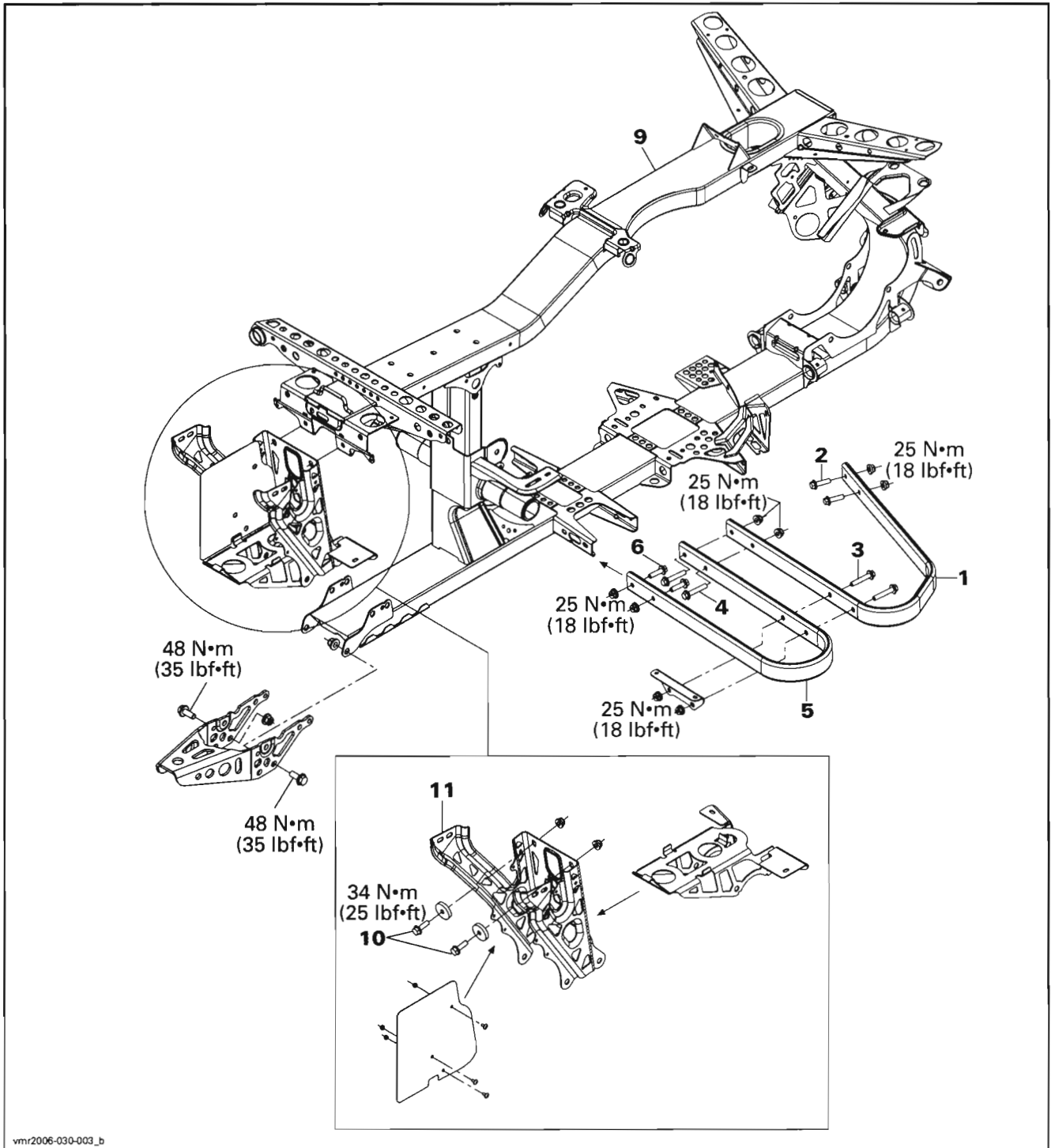


### Fender Support Installation

The installation is the reverse of removal procedure.

# FRAME

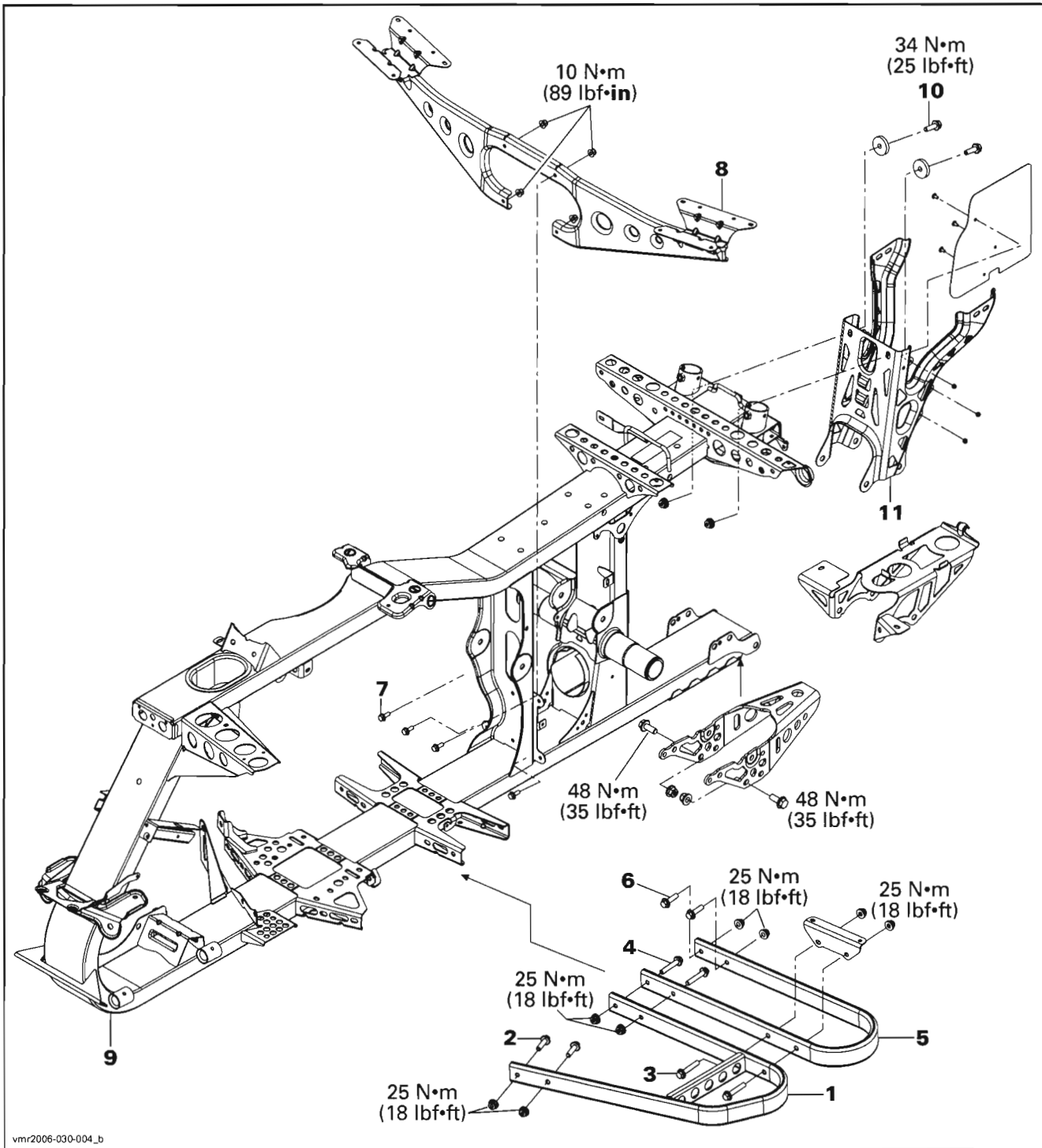
Outlander 500/650/800 Series and Renegade Models



# Section 12 BODY/FRAME

## Subsection 02 (FRAME)

### Outlander MAX 500/650/800 Series





## 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 strictly be adhered to.

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

## PROCEDURES

### FOOTREST SUPPORT

**NOTE:** Use the same procedure for RH or LH footrest supports.

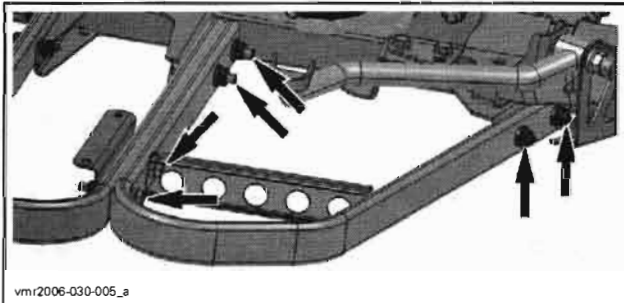
#### Footrest Support Removal

##### Front Footrest Support

To remove the front support no. 1, do the following.

Remove the appropriate footrest.

Unscrew bolts no. 2, no. 3 and no. 4.



Remove the front footrest support.

##### Rear Footrest Support

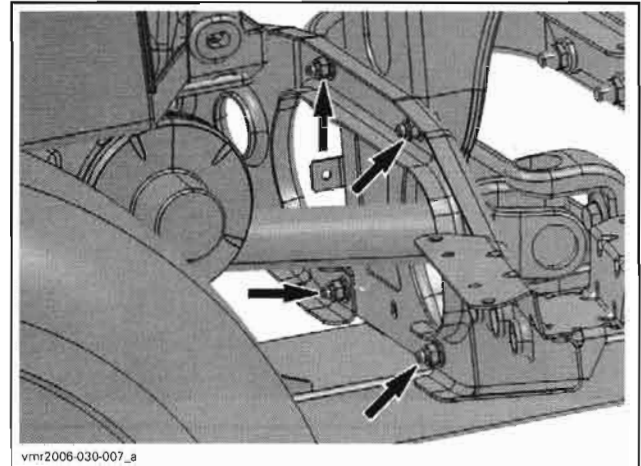
To remove the rear footrest support no. 5, use same procedure than front footrest support but remove bolts no. 6 instead of bolts no. 2.

##### Passenger Footrest Support

##### **All MAX/MAX XT Models**

Remove both footrests.

Unscrew bolts no. 7 then remove passenger footrest support(s) no. 8.



OUTLANDER MAX

#### Footrest Support Inspection

Check footrest support(s) for cracks, bending or other damages. Replace if necessary.

#### Footrest Support Installation

The installation is the reverse of removal procedure.

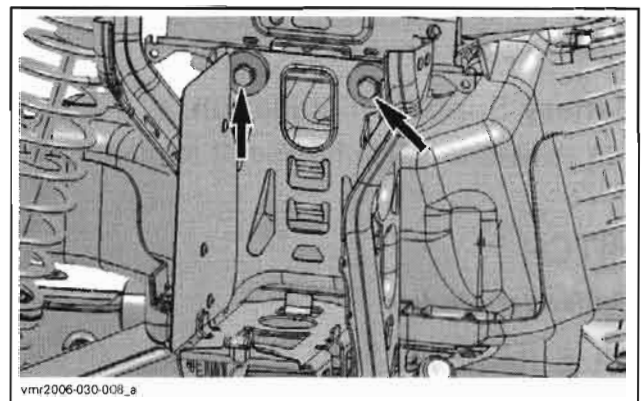
**NOTE:** Install all bolts before tightening.

## BATTERY SUPPORT

### Battery Support Removal

Remove battery (refer to *STARTING SYSTEM*).

Remove bolts no. 10 retaining the battery support no. 11 to frame no. 9.

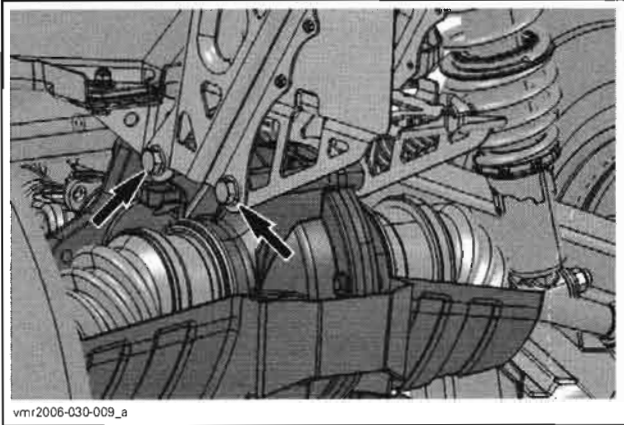


TYPICAL

Remove upper differential bolts.

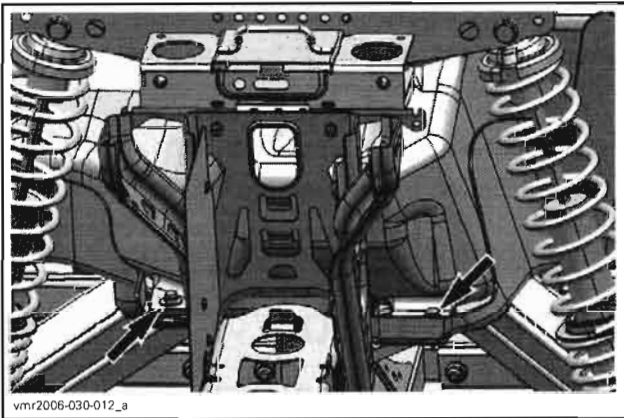
## Section 12 BODY/FRAME

### Subsection 02 (FRAME)



TYPICAL

Remove bolts that attach fuel tank and its protector to frame.



Remove battery support from vehicle.

#### Battery Support Inspection

Check battery support for cracks or other damages. Replace if necessary.

#### Battery Support Installation

The installation is the reverse of removal procedure.

## HITCH

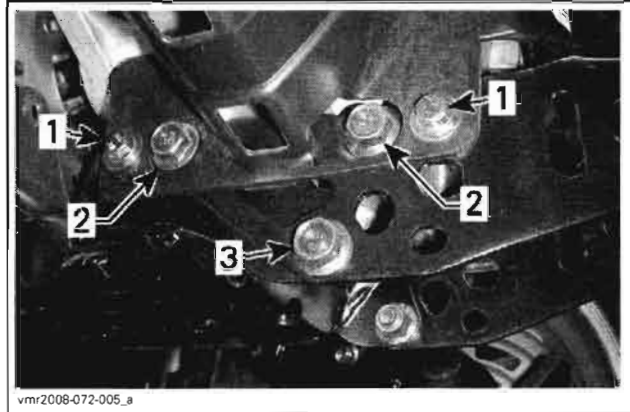
### **Outlander Models**

#### Hitch Removal

Remove the differential protector.

Unscrew bolts retaining the hitch to frame.

Remove lower differential bolts.



1. Differential protector bolts
2. Lower differential bolts
3. Hitch bolt

Remove hitch from vehicle.

#### Hitch Inspection

Check hitch for cracks, bending or other damages. Replace if necessary.

#### Hitch Installation

The installation is the reverse of removal procedure.

## RECOVERY HOOK

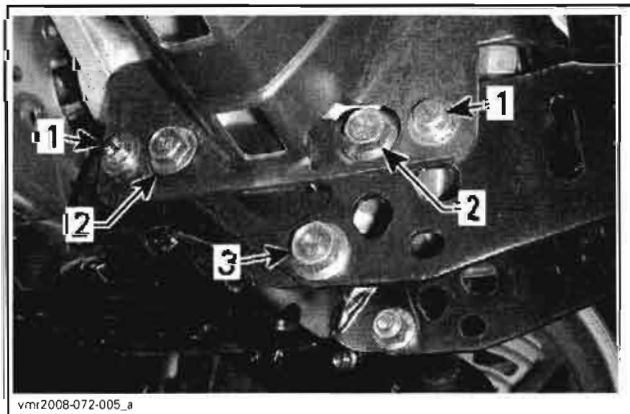
### **Renegade Models**

#### Hook Removal

Remove the differential protector.

Unscrew bolts retaining the recovery hook to frame.

Remove lower differential bolts.



TYPICAL

1. Differential protector bolts
2. Lower differential bolts
3. Hitch bolt

Remove recovery hook from vehicle.

### Hook Inspection

Check hitch for cracks, bending or other damages. Replace if necessary.

### Hook Installation

The installation is the reverse of removal procedure.

## FRAME

### Frame Cleaning

Clean frame no. 9 with appropriate cleaners and rinse with high pressure hose.

**NOTE:** Clean the draining holes under frame. The drain holes are located at the rear of bottom side of frame.

Touch up all metal spots where paint has been scratched off. Spray all bare metal parts of vehicle with metal protector.

### Frame Welding

**CAUTION:** Before performing electrical welding anywhere on the vehicle, unplug the multiple connector at the electronic module connector. Also unplug the negative cable and the voltage regulator. This will protect the electronic module and battery against damage caused by flowing current when welding.

Use the following specifications for electric welding:

- amperage: 70 - 110 A
- voltage: 20 - 24 V
- rod: E-7014 (3/32 in).

**NOTE:** Install the ground as close as possible from the reparation area.

**CAUTION:** If welding is to be done near plastic material, it is recommended to either remove the part from the area or to protect it with aluminum foil to prevent damage.



# OUTLANDER SERIES

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>ENGINE</b>				
Engine type		ROTAX® V490	ROTAX® V660	ROTAX® V810
		4-stroke, Single Over Head Camshaft (SOHC), liquid cooled		
Number of cylinders		2		
Number of valves		8 valves (mechanical adjustment)		
Bore	mm (in)	82.03 (3.23)		91 (3.58)
Stroke	mm (in)	47.3 (1.86)	61.5 (2.42)	
Displacement	cm <sup>3</sup> (in <sup>3</sup> )	500 (30.51)	650 (39.67)	800 (48.82)
Compression ratio		10.7:1	10.3:1	10.3:1
Decompressor type		N.A.		
Maximum HP RPM		7250		6750
Lubrication	Type	Wet sump. Replaceable oil filter		
	Oil filter	BRP Rotax paper type, replaceable		
	Engine oil pressure	Minimum	350 kPa (51 PSI) at 6000 RPM	
	Engine oil	Capacity (oil change with filter)	2 L (2.11 quarts)	
Recommended		SAE 5W30 API classification SM, SL or SJ see <i>OIL VISCOSITY CHART</i> in <i>LUBRICATION SYSTEM</i>		
Intake valve opening		3° BTDC	5° BTDC	
Intake valve closing		34° ABDC	45° ABDC	
Exhaust valve opening		39° BBDC	50° BBDC	
Exhaust valve closing		2° ATDC	0° ATDC	
Chain tensioner plunger protrusion		Service limit	mm (in) 20.0 (.7874)	
Valve clearance	Intake	mm (in)	0.06 to 0.14 (.0024 to .0055)	
	Exhaust	mm (in)	0.11 to 0.19 (.0043 to .0075)	
Valve stem diameter	Intake	New	mm (in) 4.966 to 4.980 (.1955 to .1960)	
		Service limit	mm (in) 4.930 (.1941)	
	Exhaust	New	mm (in) 4.956 to 4.970 (.1951 to .1957)	
		Service limit	mm (in) 4.930 (.1941)	
Valve out of round	Intake and exhaust	New	mm (in) 0.005 (.0002)	
		Service limit	mm (in) 0.06 (.0024)	
Valve guide diameter		New	mm (in) 4.998 to 5.018 (.1968 to .1976)	
		Service limit	mm (in) 5.050 (.1988)	
Valve spring free length		New	mm (in) 40.81 (1.607)	
		Service limit	mm (in) 39.00 (1.535)	
Valve seat contact width	Intake	New	mm (in) 1.05 to 1.35 (.041 to .053)	
		Service limit	mm (in) 1.8 (.070)	
	Exhaust	New	mm (in) 1.25 to 1.55 (.049 to .061)	
		Service limit	mm (in) 2 (.078)	

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 01 (OUTLANDER SERIES)

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800	
<b>ENGINE (cont'd)</b>					
Rocker arm bore diameter	New	mm (in)	12.036 to 12.050 (.4739 to .4744)		
	Service limit	mm (in)	12.060 (.4748)		
Rocker arm shaft diameter	New	mm (in)	12.000 to 12.018 (.4724 to .4731)		
	Service limit	mm (in)	11.990 (.4720)		
Piston measurement	New	mm (in)	81.950 to 81.966 (3.2264 to 3.2270)	90.950 to 90.966 (3.5807 to 3.5813)	
	Service limit	mm (in)	81.850 (3.2224)	90.850 (3.577)	
Piston/cylinder clearance	New	mm (in)	0.057 (.0022)	0.027 (.0011)	
	Service limit	mm (in)	0.130 (.0051)	0.100 (.0040)	
Piston ring type	1 <sup>st</sup>		Upper compression ring, rectangular		
	2 <sup>nd</sup>		Lower compression ring, tapered face		
	3 <sup>rd</sup>		Oil scraper ring		
Ring end gap	Rectangular	New	mm (in)	0.20 to 0.40 (.008 to .016)	
	Tapered face			0.20 to 0.40 (.008 to .016)	
	Oil scraper ring	Service limit	mm (in)	0.20 to 0.70 (.008 to .028)	
	All			1.5 (.059)	
Ring/piston groove clearance	Rectangular	New	mm (in)	0.03 to 0.070 (.0012 to .0028)	
	Tapered face			0.02 to 0.060 (.0008 to .0024)	
	Oil scraper ring			0.01 to 0.018 (.0004 to .0007)	
	Rectangular	Service limit	mm (in)	0.15 (.0059)	
	Tapered face			0.15 (.0059)	
	Oil scraper ring			0.25 (.0098)	
Cylinder bore	New	mm (in)	82.023 to 82.037 (3.2292 to 3.2298)	90.993 to 91.007 (3.5823 to 3.5829)	
Cylinder taper	Maximum New	mm (in)	0.038 (.0015)		
	Service limit	mm (in)	0.090 (.0035)		
Cylinder out of round	Maximum New	mm (in)	0.015 (.0006)		
	Service limit	mm (in)	0.020 (.0008)		
Camshaft main bearing journal	Timing chain side	New	mm (in)	34.959 to 34.975 (1.3763 to 1.3770)	
		Service limit	mm (in)	34.950 (1.3760)	
	Spark plug side	New	mm (in)	21.959 to 21.980 (.8645 to .8654)	
		Service limit	mm (in)	21.950 (.8642)	
Camshaft main bearing journal bore	Timing chain side	New	mm (in)	35.000 to 35.025 (1.3780 to 1.3789)	
		Service limit	mm (in)	35.040 (1.3795)	
	Spark plug side	New	mm (in)	22.000 to 22.021 (.8661 to .8670)	
		Wear limit	mm (in)	22.040 (.8677)	
Camshaft lobe	Intake valve	New	mm (in)	31.830 to 32.030 (1.2531 to 1.2610)	
		Service limit	mm (in)	31.810 (1.2524)	
	Exhaust valve	New	mm (in)	31.730 to 31.930 (1.2492 to 1.2571)	31.94 to 32.14 (1.2575 to 1.2654)
		Service limit	mm (in)	31.710 (1.2484)	31.92 (1.2567)

**Section 13 TECHNICAL SPECIFICATIONS**  
Subsection 01 (OUTLANDER SERIES)

MODEL			OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>ENGINE (cont'd)</b>					
Crankshaft main journal diameter MAG/PTO side	New	mm (in)	42.024 to 42.040 (1.6545 to 1.6551)		
	Service limit	mm (in)	42.000 (1.6535)		
Crankshaft radial play MAG/PTO side	Service limit	mm (in)	0.07 (.0031)		
Crankshaft main journal diameter PTO support bearing	New	mm (in)	34.024 to 34.040 (1.3395 to 1.3402)		
	Service limit	mm (in)	34.010 (1.3390)		
Crankshaft radial play PTO support bearing	Service limit	mm (in)	0.10 (.0039)		
Crankshaft pin diameter	New	mm (in)	35.064 to 35.080 (1.3805 to 1.3811)	40.009 to 40.025 (1.5752 to 1.5758)	
	Service limit	mm (in)	35.050 (1.3800)	39.990 (1.5744)	
Crankshaft deflection	MAG/PTO side	New	mm (in)	0.050 (.002)	
Crankcase plain bearing	MAG/PTO side	Service limit	mm (in)	42.100 (1.6575)	
PTO cover plain bearing		Service limit	mm (in)	34.120 (1.3433)	
Connecting rod big end diameter		Service limit	mm (in)	35.150 (1.3839)	40.100 (1.579)
Connecting rod big end radial play		Service limit	mm (in)	0.09 (.0035)	
Connecting rod big end axial play	New	mm (in)	0.200 to 0.500 (.008 to .020)		
	Service limit	mm (in)	0.600 (.024)		
Connecting rod small end diameter	New	mm (in)	18.010 to 18.020 (.7091 to .7095)	20.010 to 20.020 (.7878 to .7882)	
	Service limit	mm (in)	18.060 (.7110)	20.060 (.7898)	
Piston pin diameter	New	mm (in)	17.996 to 18.000 (.7085 to .7087)	19.996 to 20.000 (.7872 to .7874)	
	Service limit	mm (in)	17.980 (.7079)	19.980 (.7866)	
Connecting rod/piston pin clearance (radial play)		Service limit	mm (in)	0.080 (.0035)	
<b>GEARBOX</b>					
Type	Dual range (HI-LO) with park, neutral and reverse				
Gearbox oil	Capacity	400 mL (14 U.S. oz)			
	Recommended	XP-S chaincase oil			
Output shaft backlash	New	mm (in)	0.10 to 0.20 (.0039 to .0079)		
	Service limit	mm (in)	0.25 (.0098)		
Bevel gear axial play	New	mm (in)	0.02 to 0.15 (.0008 to .0059)		
	Service limit	mm (in)	0.19 (.0075)		
Shifting sleeve groove width	New	mm (in)	5.25 to 5.35 (.207 to .211)		
	Service limit	mm (in)	5.50 (.217)		
Shifting fork claw thickness	New	mm (in)	4.95 to 5.05 (.195 to .199)		
	Service limit	mm (in)	4.80 (.189)		
Shift fork claw thickness (for high gear shifting)	New	mm (in)	4.80 to 4.90 (.189 to .193)		
	Service limit	mm (in)	4.70 (.185)		
Shift fork claw thickness (for low/reverse gear shifting)	New	mm (in)	5.10 to 5.20 (.201 to .205)		
	Service limit	mm (in)	5.00 (.197)		
Shift fork pin diameter	New	mm (in)	6.920 to 6.970 (.272 to .274)		
	Service limit	mm (in)	6.850 (.270)		

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 01 (OUTLANDER SERIES)

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>ENGINE (cont'd)</b>				
Gap of shift fork engagement groove (high gear shifting)	New	mm (in)	5.00 to 5.10 (.197 to .201)	
	Service limit	mm (in)	5.20 (.205)	
Gap of shift fork engagement groove (low/reverse gear shifting)	New	mm (in)	5.30 to 5.40 (.209 to .213)	
	Service limit	mm (in)	5.50 (.217)	
Diameter free pinions	New	mm (in)	29.000 to 29.013 (1.1417 to 1.1422)	
	Service limit	mm (in)	29.015 (1.1422)	
Intermediate gear shaft	New	mm (in)	24.979 to 25.000 (.983 to .984)	
	Service limit	mm (in)	24.977 (.983)	
Countershaft	Right side		17.990 (.708)	
	Free pinion bearing	Service limit	mm (in)	24.970 (.983)
	CVT side		24.970 (.983)	
Bevel gear shaft	Free pinion bearing	Service limit	mm (in)	24.984 (.984)
<b>COOLING SYSTEM</b>				
Coolant	Type	Ethyl glycol/water mix (50% coolant, 50% water). Use premixed coolant sold by BRP (P/N 219 700 362) or coolant specifically designed for aluminum engines		
	Capacity	2.5 L (2.65 quarts)		
Thermostat	Opening temperature	65°C (149°F)		
<b>ELECTRICAL SYSTEM</b>				
Magneto generator output		400 W @ 6000 RPM		
Ignition system type		IDI (Inductive Discharge Ignition)		
Ignition timing		Not adjustable		
Spark plug	Quantity	2		
	Make and type	NGK DCPR8E		
	Gap	mm (in)	0.6 to 0.7 (.024 to .027)	
Crankshaft position sensor (CPS)		Ω	774 to 946 @ 20 °C (68 °F)	
Engine RPM limiter setting	Forward	RPM	8000	
	Reverse	RPM	3200	
Battery	Type	Dry battery type		
	Voltage	12 volts		
	Nominal rating	18 A•h		
	Power starter output	0.7 KW		
Headlamp	W	2 x 35		
Taillight	W	7/29		
Director indicator (European Community models)	W	10		
Indicator lights		LEDS, 0.7 V approximately (each)		



**Section 13 TECHNICAL SPECIFICATIONS**  
Subsection 01 (OUTLANDER SERIES)

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>ELECTRICAL SYSTEM (cont'd)</b>				
Fuses	Accessories		20 A	
	Fan		20 A	
	Main		30 A	
	Ignition coils		5 A	
	Fuel injectors		5 A	
	Speedometer/speed sensor/tail lamp		7.5 A	
	Fuel pump		7.5 A	
	Engine control module (ECM)		5 A	
Main accessories		30 A		
<b>FUEL SYSTEM</b>				
Fuel delivery		Type	Electronic Fuel Injection (EFI), DeLorto 46 mm throttle body, 1 injector per cylinder	
Fuel pump		Type	Bosch	
		Model	Electrical (in fuel tank)	
Idle speed		RPM ± 50	1250 (not adjustable)	
Fuel	Type		Regular unleaded gasoline	
	Octane no.	Inside North America (R+M)/2	87 or higher	
		Outside North America RON	92 or higher	
Fuel tank capacity		20 L (5.3 U.S. gal)		
Remaining fuel in fuel tank when display light turns ON		± 6 L (1.6 U.S. gal)		
<b>DRIVE TRAIN</b>				
Front drive		Shaft driven/Auto-lock differential (shear pump)		
Front drive ratio		3.6:1		
Rear drive		Shaft driven/locked differential		
Rear drive ratio		3.6:1		
Differential oil	Capacity	Front	500 mL (17 U.S. oz)	
		Rear	250 mL (8.5 U.S. oz)	
	Recommended	BRP differential oil (P/N 293 600 043) or synthetic oil 75W90 (API GL5)		
CV joint grease		CV joint grease (P/N 293 550 019)		
Propeller shaft grease		XP-S synthetic grease (P/N 293 550 010)		

**Section 13 TECHNICAL SPECIFICATIONS**  
**Subsection 01 (OUTLANDER SERIES)**

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>TRANSMISSION</b>				
Type	CVT (Continuously Variable Transmission)			
Engagement RPM	± 100 RPM	1750		
CVT				
Drive belt width	Service limit mm (in)	30.00 (1.181)		
Governor cup roller outer diameter	New mm (in)	13.70 to 13.80 (.539 to .543)		
	Service limit mm (in)	13.20 (.519)		
Governor cup roller inner diameter	New mm (in)	8.05 to 8.15 (.317 to .321)		
	Service limit mm (in)	9.00 (.354)		
Centrifugal lever pivot bolt diameter	New mm (in)	6.078 to 6.100 (.239 to .240)		
	Service limit mm (in)	6.000 (.236)		
Centrifugal lever bore diameter	Service limit mm (in)	6.200 (.244)		
Drive pulley sliding half centrifugal lever pivot bolt bore diameter	New mm (in)	6.113 to 6.171 (.241 to .243)		
	Service limit mm (in)	6.300 (.248)		
Drive pulley sliding half large bushing	New mm (in)	55.000 to 55.040 (2.165 to 2.167)		
	Service limit mm (in)	55.200 (2.173)		
Drive pulley sliding half small bushing	New mm (in)	32.000 to 32.040 (1.260 to 1.261)		
	Service limit mm (in)	32.200 (1.268)		
Driven pulley sliding half bushing	New mm (in)	30.060 to 30.100 (1.183 to 1.185)		
	Service limit mm (in)	30.200 (1.189)		
Driven pulley sliding fixed bushing	New mm (in)	30.060 to 30.100 (1.183 to 1.185)		
	Service limit mm (in)	30.200 (1.189)		
Torque gear on driven pulley	Service limit mm (in)	7.500 (.295)		
<b>STEERING</b>				
Turning radius	Standard	2.16 m (7 ft)		
	MAX	4.80 m (7 ft 9 in)		
Total toe (vehicle on ground)	mm (in)	0 (0)		
Camber angle		0°		
Tie-rod maximum length unengaged	mm (in)	17.5 ± 5 (11/16 ± 3/16)		
<b>SUSPENSION</b>				
<i>FRONT</i>				
Suspension type		MacPherson	Double A-Arm	
Suspension travel	mm (in)	178 (7)	203 (8)	
Shock absorber	Qty	2		
	Type	Oil		
Spring free length	Standard mm (in)	372 (14-5/8)	349 (13-3/4)	
	XT mm (in)	387 (15-1/4)	359 (14-1/8)	
	MAX mm (in)	372 (14-21/32)	358 (14-3/32)	
	MAX XT mm (in)	387 (15-15/64)	369 (14-17/32)	
	LTD mm (in)	—	—	369 (14-17/32)

**Section 13 TECHNICAL SPECIFICATIONS**  
Subsection 01 (OUTLANDER SERIES)

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>SUSPENSION (cont'd)</b>				
Spring color code	Standard	Silver/Blue/Gold	Green/Gold/Green	
	XT	White/Blue/Gold	White/Red/Gold	
	MAX	Silver/Blue/Gold	Gold/Yellow/Blue	
	MAX XT	White/Blue/Gold	Silver/Red/Gold	
	LTD	—	—	Silver/Red/Gold
Front preload adjustment		N.A.	5 settings	
<b>REAR</b>				
Suspension type		TTI™ independent		
Suspension travel		mm (in)	229 (9)	
Shock absorber	Qty	2		
	Type	Oil		
Spring free length	Standard and XT	mm (in)	354 (13-15/16)	
	MAX and MAX XT	mm (in)	364 (14-21/64)	
	LTD	mm (in)	—	—
Spring color code	Standard and XT	Gold/Blue/Gold		
	MAX and MAX XT	Gold/Green/Gold		
	LTD	—	—	Gold/Green/Gold
Rear preload adjustment		5 settings		
<b>BRAKES</b>				
Front brake	Qty	2		
	Type	Hydraulic, discs		
Rear brake	Qty	1		
	Type	Hydraulic, disc		
Brake fluid	Capacity	180 mL (6.1 U.S. oz)		
	Type	DOT 4		
Parking brake		Hydraulic lock-4 wheels		
Caliper		Floating		
Brake pad material	Front	Organic		
	Rear	Metallic		
Minimum brake pad thickness		mm (in)	1 (.04)	
Minimum brake disc thickness	Front	mm (in)	3.5 (.138)	
	Rear	mm (in)	4.3 (.17)	
Maximum brake disc warpage		mm (in)	0.2 (.01)	

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 01 (OUTLANDER SERIES)

MODEL			OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>TIRES AND WHEELS</b>					
<i>TIRES</i>					
Pressure	1-UP Models	Front	kPa (PSI)	Maximum: 34.5 (5) Minimum: 31 (4.5)	Maximum: 48 (7) Minimum: 31 (4.5)
		Rear	kPa (PSI)	Maximum: 34.5 (5) Minimum: 31 (4.5)	Maximum: 48 (7) Minimum: 31 (4.5)
	2-UP Models	Front	kPa (PSI)	Maximum: 34.5 (5) Minimum: 31 (4.5)	Maximum: 48 (7) Minimum: 31 (4.5)
		Rear	kPa (PSI)	Maximum: 34.5 (5) Minimum: 31 (4.5)	Maximum: 48 (7) Minimum: 31 (4.5)
Minimum tire thread depth			mm (in)	3 (0.118)	
Size	Front		25 x 8 x 12	26 x 8 x 12	
	Rear		25 x 10 x 12 XT: 25 x 11 x 12	26 x 10 x 12	
<i>WHEELS</i>					
Size	Front		12 x 6		
	Rear		12 x 7.5		
<b>DIMENSION</b>					
Overall length	Standard	m (in)	2.18 (86)		
	MAX	m (in)	2.39 (94)		
Overall width	m (in)		1.17 (46)		
Overall height	m (in)		1.14 (45)		
Dry weight	Standard	kg (lb)	287 (634)	295 (649)	290 (639)
	MAX	kg (lb)	310 (684)	318 (699)	313 (689)
Wheel base	Standard	m (in)	1.30 (51)		
	MAX	m (in)	1.50 (59)		
Wheel track	Front	mm (in)	965 (38)		
	Rear	mm (in)	914 (36)		
Ground clearance	mm (in)		279 (11)		
<b>LOADING CAPACITY</b>					
Weight distribution	Front/rear	%	51/49 MAX: 48/52		
Rear storage box (included with rear rack weight)	kg (lb)		10 (22)		
Rack	Front	kg (lb)	45 (100)		
	Rear	kg (lb)	90 (200) (including rear storage box and tongue weight)		
Total vehicle load allowed (including driver, all other loads and added accessories)	Standard	kg (lb)	235 (517)		
	MAX	kg (lb)	272 (600)		
Gross vehicle weight rating	Standard	kg (lb)	553 (1220) XT: 584 (1287)	584 (1287)	
	MAX	kg (lb)	558 (1228)	649 (1430)	
Towing capacity	kg (lb)		591 (1300)		
Tongue capacity (included with rear rack weight)	kg (lb)		23 (50)		

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 01 (OUTLANDER SERIES)

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>MATERIAL</b>				
Frame	Material	Steel		
	Color	Black		
Wheel	Material	All except Camo	Aluminum	
		Camo/Camo XT	Steel	
	Color	All except Camo	Aluminum	
		Camo/Camo XT	Black	
Front/rear rack	Material	Steel		
	Color	Black		
Front bumper	Material	Aluminum		
	Color	Aluminum		
Front/rear fender	Material	High density polyethylene		
	Color	Yellow/Laurentian green/Viper red/Camo/Steel grey metallic		
Fuel tank protector(s)	Material	High density polyethylene		
	Color	Black		
Steering cover	Material	High density polyethylene		
	Color	Black		
Storage compartment cover	Material	Polypropylene (glass fiber-reinforced)		
	Color	Black		
Front fascia	Material	High density polyethylene		
	Color	Yellow/Laurentian green/Viper red/Camo/Steel grey metallic		
Front skid plate	Material	High density polyethylene		
	Color	Black		
Side panel	Material	High density polyethylene		
	Color	Yellow/Laurentian green/Viper red/Camo/Steel grey metallic		
Foot rest	Material	High density polyethylene		
	Color	Black		
Central panel	Material	High density polyethylene		
	Color	Yellow/Laurentian green/Viper red/Camo/Steel grey metallic		
Air filter housing cover	Material	Polypropylene (glass fiber-reinforced)		
	Color	Black		
Air filter housing	Material	Polypropylene (glass fiber-reinforced)		
	Color	Black		
Transmission lever locator	Material	Polypropylene (glass fiber-reinforced)		
	Color	Black		
A-arm protector	Material	Polypropylene		
	Color	Black		

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 01 (OUTLANDER SERIES)

MODEL		OUTLANDER™ 500	OUTLANDER™ 650	OUTLANDER™ 800
<b>MATERIAL (cont'd)</b>				
Engine cover	Material	High density polyethylene		
	Color	Black		
Seat base	Material	Polypropylene		
	Color	Black		
Seat cover	Material	Thermoformed vinyl		
	Color	Black LTD models: Steel grey metallic and Black		



# RENEGADE MODELS

MODEL			RENEGADE™ 500	RENEGADE™ 800
<b>ENGINE</b>				
Engine type			ROTAX® V490	ROTAX® V810
			4-stroke, Single Over Head Camshaft (SOHC), liquid cooled	
Number of cylinders			2	
Number of valves			8 valves (mechanical adjustment)	
Bore	mm (in)		82.03 (3.23)	91 (3.58)
Stroke	mm (in)		47.3 (1.86)	61.5 (2.42)
Displacement	cm <sup>3</sup> (in <sup>3</sup> )		500 (30.51)	800 (48.82)
Compression ratio			10.7:1	10.3:1
Decompressor type			N.A.	
Maximum HP RPM			7250	6750
Lubrication	Type		Wet sump. Replaceable oil filter	
	Oil filter		BRP Rotax paper type, replaceable	
	Engine oil pressure	Minimum	350 kPa (51 PSI) at 6000 RPM	
	Engine oil	Capacity (oil change with filter)	2 L (2.11 quarts)	
		Recommended	SAE 5W30 API classification SM, SL or SJ see <i>OIL VISCOSITY CHART</i> in <i>LUBRICATION SYSTEM</i>	
Intake valve opening			3° BTDC	5° BTDC
Intake valve closing			34° ABDC	45° ABDC
Exhaust valve opening			39° BBDC	50° BBDC
Exhaust valve closing			2° ATDC	0° ATDC
Chain tensioner plunger protrusion		Service limit mm (in)	20.0 (.7874)	
Valve clearance	Intake	mm (in)	0.06 to 0.14 (.0024 to .0055)	
	Exhaust	mm (in)	0.11 to 0.19 (.0043 to .0075)	
Valve stem diameter	Intake	New mm (in)	4.966 to 4.980 (.1955 to .1960)	
		Service limit mm (in)	4.930 (.1941)	
	Exhaust	New mm (in)	4.956 to 4.970 (.1951 to .1957)	
		Service limit mm (in)	4.930 (.1941)	
Valve out of round	Intake and exhaust	New mm (in)	0.005 (.0002)	
		Service limit mm (in)	0.06 (.0024)	
Valve guide diameter		New mm (in)	5.006 to 5.018 (.1971 to .1976)	
		Service limit mm (in)	5.050 (.1988)	
Valve spring free length		New mm (in)	40.81 (1.607)	
		Service limit mm (in)	39.00 (1.535)	
Valve seat contact width	Intake	New mm (in)	1.05 to 1.35 (.041 to .053)	
		Service limit mm (in)	1.8 (.070)	
	Exhaust	New mm (in)	1.25 to 1.55 (.049 to .061)	
		Service limit mm (in)	2 (.078)	

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 02 (RENEGADE MODELS)

MODEL		RENEGADE™ 500	RENEGADE™ 800	
<b>ENGINE (cont'd)</b>				
Rocker arm bore diameter	New	mm (in)	12.036 to 12.050 (.4739 to .4744)	
	Service limit	mm (in)	12.060 (.4748)	
Rocker arm shaft diameter	New	mm (in)	12.000 to 12.018 (.4724 to .4731)	
	Service limit	mm (in)	11.990 (.4720)	
Piston measurement	New	mm (in)	81.950 to 81.966 (3.2264 to 3.2270)	
	Service limit	mm (in)	81.850 (3.2224)	
Piston/cylinder clearance	New	mm (in)	0.057 (.0022)	
	Service limit	mm (in)	0.130 (.0051)	
Piston ring type	1 <sup>st</sup>		Upper compression ring, rectangular	
	2 <sup>nd</sup>		Lower compression ring, tapered face	
	3 <sup>rd</sup>		Oil scraper ring	
Ring end gap	Rectangular	New	mm (in)	
	Taper-face			0.20 to 0.40 (.008 to .016)
	Oil scraper ring		0.20 to 0.40 (.008 to .016)	
	All	Service limit	mm (in)	0.20 to 0.70 (.008 to .028)
Ring/piston groove clearance	Rectangular	New	mm (in)	
	Taper-face			0.03 to 0.070 (.0012 to .0028)
	Oil scraper ring			0.02 to 0.060 (.0008 to .0024)
	Rectangular	Service limit	mm (in)	0.01 to 0.018 (.0004 to .0007)
	Taper-face			0.15 (.0059)
	Oil scraper ring			0.15 (.0059)
Cylinder bore	New	mm (in)	82.023 to 82.037 (3.2292 to 3.2298)	
			90.993 to 91.007 (3.5823 to 3.5829)	
Cylinder taper	Maximum New	mm (in)	0.038 (.0015)	
	Service limit	mm (in)	0.090 (.0035)	
Cylinder out of round	Maximum New	mm (in)	0.015 (.0006)	
	Service limit	mm (in)	0.020 (.0008)	
Camshaft main bearing journal	Timing chain side	New	mm (in)	34.959 to 34.975 (1.3763 to 1.3770)
		Service limit	mm (in)	34.950 (1.3760)
	Spark plug side	New	mm (in)	21.959 to 21.980 (.8645 to .8654)
		Service limit	mm (in)	21.950 (.8642)
Camshaft main bearing journal bore	Timing chain side	New	mm (in)	35.000 to 35.025 (1.3780 to 1.3789)
		Service limit	mm (in)	35.040 (1.3795)
	Spark plug side	New	mm (in)	22.000 to 22.021 (.8661 to .8670)
		Wear limit	mm (in)	22.040 (.8677)
Camshaft lobe	Intake valve	New	mm (in)	31.830 to 32.030 (1.2531 to 1.2610)
		Service limit	mm (in)	32.11 to 32.31 (1.2642 to 1.2721)
	Exhaust valve	New	mm (in)	31.810 (1.2524)
		Service limit	mm (in)	32.09 (1.2634)
Camshaft lobe	Exhaust valve	New	mm (in)	31.730 to 31.930 (1.2492 to 1.2571)
		Service limit	mm (in)	31.94 to 32.14 (1.2575 to 1.2654)
Camshaft lobe	Exhaust valve	New	mm (in)	31.710 (1.2484)
		Service limit	mm (in)	31.92 (1.2567)



**Section 13 TECHNICAL SPECIFICATIONS**  
Subsection 02 (RENEGADE MODELS)

MODEL		RENEGADE™ 500	RENEGADE™ 800	
<b>ENGINE (cont'd)</b>				
Crankshaft main journal diameter MAG/PTO side	New	mm (in)	42.024 to 42.040 (1.6545 to 1.6551)	
	Service limit	mm (in)	42.000 (1.6535)	
Crankshaft radial play MAG/PTO side	Service limit	mm (in)	0.07 (.0031)	
Crankshaft main journal diameter PTO support bearing	New	mm (in)	34.024 to 34.040 (1.3395 to 1.3402)	
	Service limit	mm (in)	34.010 (1.3390)	
Crankshaft radial play PTO support bearing	Service limit	mm (in)	0.10 (.0039)	
Crankshaft pin diameter	New	mm (in)	35.064 to 35.080 (1.3805 to 1.3811)	
	Service limit	mm (in)	35.050 (1.3800)	
Crankshaft deflection	MAG/PTO side	New	mm (in)	0.050 (.002)
Crankcase plain bearing	MAG/PTO side	Service limit	mm (in)	42.100 (1.6575)
PTO cover plain bearing	Service limit	mm (in)	34.120 (1.3433)	
Connecting rod big end diameter	Service limit	mm (in)	35.150 (1.3839)	
Connecting rod big end radial play	Service limit	mm (in)	0.09 (.0035)	
Connecting rod big end axial play	New	mm (in)	0.200 to 0.500 (.008 to .020)	
	Service limit	mm (in)	0.600 (.024)	
Connecting rod small end diameter	New	mm (in)	18.010 to 18.020 (.7091 to .7095)	
	Service limit	mm (in)	18.060 (.7110)	
Piston pin diameter	New	mm (in)	17.996 to 18.000 (.7085 to .7087)	
	Service limit	mm (in)	17.980 (.7079)	
Connecting rod/piston pin clearance (radial play)	Service limit	mm (in)	0.080 (.0035)	
<b>GEARBOX</b>				
Type	Dual range (HI-LO) with park, neutral and reverse			
Gearbox oil	Capacity	400 mL (14 U.S. oz)		
	Recommended	XP-S chaincase oil		
Output shaft backlash	New	mm (in)	0.10 to 0.20 (.0039 to .0079)	
	Service limit	mm (in)	0.25 (.0098)	
Bevel gear axial play	New	mm (in)	0.02 to 0.15 (.0008 to .0059)	
	Service limit	mm (in)	0.19 (.0075)	
Shifting sleeve groove width	New	mm (in)	5.25 to 5.35 (.207 to .211)	
	Service limit	mm (in)	5.50 (.217)	
Shifting fork claw thickness	New	mm (in)	4.95 to 5.05 (.195 to .199)	
	Service limit	mm (in)	4.80 (.189)	
Shift fork claw thickness (for high gear shifting)	New	mm (in)	4.80 to 4.90 (.189 to .193)	
	Service limit	mm (in)	4.70 (.185)	
Shift fork claw thickness (for low/reverse gear shifting)	New	mm (in)	5.10 to 5.20 (.201 to .205)	
	Service limit	mm (in)	5.00 (.197)	
Shift fork pin diameter	New	mm (in)	6.920 to 6.970 (.272 to .274)	
	Service limit	mm (in)	6.850 (.270)	

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 02 (RENEGADE MODELS)

MODEL		RENEGADE™ 500	RENEGADE™ 800
<b>ENGINE (cont'd)</b>			
Gap of shift fork engagement groove (high gear shifting)	New	mm (in)	5.00 to 5.10 (.197 to .201)
	Service limit	mm (in)	5.20 (.205)
Gap of shift fork engagement groove (low/reverse gear shifting)	New	mm (in)	5.30 to 5.40 (.209 to .213)
	Service limit	mm (in)	5.50 (.217)
Diameter free pinions	New	mm (in)	29.000 to 29.013 (1.1417 to 1.1422)
	Service limit	mm (in)	29.015 (1.1422)
Intermediate gear shaft	New	mm (in)	24.979 to 25.000 (.983 to .984)
	Service limit	mm (in)	24.977 (.983)
Countershaft	Right side		17.990 (.708)
	Free pinion bearing	Service limit	mm (in) 24.970 (.983)
	CVT side		24.970 (.983)
Bevel gear shaft	Free pinion bearing	Service limit	mm (in) 24.984 (.984)
<b>COOLING SYSTEM</b>			
Coolant	Type	Ethyl glycol/water mix (50% coolant, 50% water). Use premixed coolant sold by BRP (P/N 219 700 362) or coolant specifically designed for aluminum engines	
	Capacity	2.5 L (2.65 quarts)	
Thermostat	Opening temperature	65°C (149°F)	
<b>ELECTRICAL SYSTEM</b>			
Magneto generator output		400 W @ 6000 RPM	
Ignition system type		IDI (Inductive Discharge Ignition)	
Ignition timing		Not adjustable	
Spark plug	Quantity	2	
	Make and type	NGK DCPR8E	
	Gap	mm (in)	0.6 to 0.7 (.024 to .027)
Crankshaft position sensor (CPS)		Ω	774 to 946 @ 20 °C (68 °F)
Engine RPM limiter setting	Forward	RPM	8000
	Reverse	RPM	3200
Battery	Type	Dry battery type	
	Voltage	12 volts	
	Nominal rating	18 A•h	
	Power starter output	0.7 KW	
Headlamp		W	2 x 35
Taillight		W	7/29
Director indicator (European Community models)		W	10
Indicator lights		LEDS, 0.7 V approximately (each)	

**Section 13 TECHNICAL SPECIFICATIONS**  
**Subsection 02 (RENEGADE MODELS)**

MODEL		RENEGADE™ 500	RENEGADE™ 800
<b>ELECTRICAL SYSTEM (cont'd)</b>			
Fuses	Accessories		20 A
	Fan		20 A
	Main		30 A
	Ignition coils		5 A
	Fuel injectors		5 A
	Speedometer/speed sensor/tail lamp		7.5 A
	Fuel pump		7.5 A
	Engine control module (ECM)		5 A
Main accessories		30 A	
<b>FUEL SYSTEM</b>			
Fuel delivery		Type	Electronic Fuel Injection (EFI), DeLorto 46 mm throttle body, 1 injector per cylinder
Fuel pump		Type	Bosch
		Model	Electrical (in fuel tank)
Idle speed		RPM ± 50	1250 (not adjustable)
Fuel	Type		Regular unleaded gasoline
	Octane no.	Inside North America (R+M)/2	87 or higher
		Outside North America RON	92 or higher
Fuel tank capacity			20 L (5.3 U.S. gal)
Remaining fuel in fuel tank when display light turns ON			± 6 L (1.6 U.S. gal)
<b>DRIVE TRAIN</b>			
Front drive			Shaft driven/Auto-lock differential (shear pump)
Front drive ratio			3.6:1
Rear drive			Shaft driven/locked differential
Rear drive ratio			3.6:1
Differential oil	Capacity	Front	500 mL (17 U.S. oz)
		Rear	250 mL (8.5 U.S. oz)
	Recommended		
CV joint grease			CV joint grease (P/N 293 550 019)
Propeller shaft grease			XP-S synthetic grease (P/N 293 550 010)

## Section 13 TECHNICAL SPECIFICATIONS

### Subsection 02 (RENEGADE MODELS)

MODEL		RENEGADE™ 500	RENEGADE™ 800
<b>TRANSMISSION</b>			
Type		CVT (Continuously Variable Transmission)	
Engagement RPM	± 100 RPM	1750	
CVT			
Drive belt width	Service limit mm (in)	30.00 (1.181)	
Governor cup roller outer diameter	New mm (in)	13.70 to 13.80 (.539 to .543)	
	Service limit mm (in)	13.20 (.519)	
Governor cup roller inner diameter	New mm (in)	8.05 to 8.15 (.317 to .321)	
	Service limit mm (in)	9.00 (.354)	
Centrifugal lever pivot bolt diameter	New mm (in)	6.078 to 6.100 (.239 to .240)	
	Service limit mm (in)	6.000 (.236)	
Centrifugal lever bore diameter	Service limit mm (in)	6.200 (.244)	
Drive pulley sliding half centrifugal lever pivot bolt bore diameter	New mm (in)	6.113 to 6.171 (.241 to .243)	
	Service limit mm (in)	6.300 (.248)	
Drive pulley sliding half large bushing	New mm (in)	55.000 to 55.040 (2.165 to 2.167)	
	Service limit mm (in)	55.200 (2.173)	
Drive pulley sliding half small bushing	New mm (in)	32.000 to 32.040 (1.260 to 1.261)	
	Service limit mm (in)	32.200 (1.268)	
Driven pulley sliding half bushing	New mm (in)	30.060 to 30.100 (1.183 to 1.185)	
	Service limit mm (in)	30.200 (1.189)	
Driven pulley sliding fixed bushing	New mm (in)	30.060 to 30.100 (1.183 to 1.185)	
	Service limit mm (in)	30.200 (1.189)	
Torque gear on driven pulley	Service limit mm (in)	7.500 (.295)	
<b>STEERING</b>			
Turning radius	Standard	2.16 m (7 ft)	
Total toe (vehicle on ground)	mm (in)	0 (0)	
Camber angle		0°	
Tie-rod maximum length unengaged	mm (in)	17.5 ± 5 (11/16 ± 3/16)	
<b>SUSPENSION</b>			
<i>FRONT</i>			
Suspension type		Double A-Arm	
Suspension travel	mm (in)	229 (9)	
Shock absorber	Qty	2	
	Type	Oil	Gas
Spring free length	mm (in)	319 (12-9/16)	
Spring color code		Silver/White/Green	
Front preload adjustment		5 settings	
<i>REAR</i>			
Suspension type		TTI™ independent	
Suspension travel	mm (in)	254 (10)	

**Section 13 TECHNICAL SPECIFICATIONS**  
Subsection 02 (RENEGADE MODELS)

MODEL			RENEGADE™ 500	RENEGADE™ 800
<b>SUSPENSION (cont'd)</b>				
Shock absorber	Qty		2	
	Type		Oil	Gas
Spring free length	mm (in)		381 (15)	348 (13-45/64)
Spring color code			Silver/Red/White	Gold/Gold/Green
Rear preload adjustment			5 settings	
<b>BRAKES</b>				
Front brake	Qty		2	
	Type		Hydraulic, discs	
Rear brake	Qty		1	
	Type		Hydraulic, disc	
Brake fluid	Capacity		180 mL (6.1 U.S. oz)	
	Type		DOT 4	
Parking brake			Hydraulic lock-4 wheels	
Caliper			Floating	
Brake pad material	Front		Organic	
	Rear		Metallic	
Minimum brake pad thickness	mm (in)		1 (.04)	
Minimum brake disc thickness	Front	mm (in)	3.5 (.138)	
	Rear	mm (in)	4.3 (.17)	
Maximum brake disc warpage	mm (in)		0.2 (.01)	
<b>TIRES AND WHEELS</b>				
<i>TIRES</i>				
Pressure	Front		Maximum: 48 kPa (7 PSI) Minimum: 34.5 kPa (5 PSI)	
	Rear		Maximum: 48 kPa (7 PSI) Minimum: 38 kPa (5.5 PSI)	
Minimum tire thread depth	mm (in)		3 (0.118)	
Size	Front		25 x 8 x 12	
	Rear		25 x 10 x 12	
<i>WHEELS</i>				
Size	Front		12 x 6	
	Rear		12 x 7.5	
<b>DIMENSION</b>				
Overall length	m (in)		2.18 (86)	
Overall width	m (in)		1.17 (46)	
Overall height	m (in)		1.14 (45)	
Dry weight	kg (lb)		275 (607)	
Wheel base	m (in)		1.30 (51)	
Wheel track	Front	mm (in)	965 (38)	
	Rear	mm (in)	914 (36)	
Ground clearance	mm (in)		279 (11)	

**Section 13 TECHNICAL SPECIFICATIONS**  
**Subsection 02 (RENEGADE MODELS)**

MODEL		RENEGADE™ 500	RENEGADE™ 800
<b>LOADING CAPACITY</b>			
Weight distribution	Front/rear	%	51/49
Rear storage box		kg (lb)	3.7 (1)
Rack	Rear	kg (lb)	16 (35)
Total vehicle load allowed (including driver, all other loads and added accessories)		kg (lb)	141 (310)
Gross vehicle weight rating		kg (lb)	476 (1050)
Towing capacity		kg (lb)	591 (1300)
<b>MATERIAL</b>			
Frame	Material		Steel
	Color		Black
Wheel	Material		Aluminum
	Color		Aluminum
Front bumper	Material		Aluminum
	Color		Aluminum
Front/rear fender	Material		High density polyethylene
	Color		Yellow
Fuel tank protector(s)	Material		High density polyethylene
	Color		Black
Steering cover	Material		Aluminum
	Color		Aluminum
Rear storage compartment	Material		Polypropylene (glass fiber-reinforced)
	Color		Black
Front grid	Material		High density polyethylene
	Color		Black
Front skid plate	Material		High density polyethylene
	Color		Black
Side panel	Material		High density polyethylene
	Color		Black
Foot rest	Material		High density polyethylene
	Color		Black
Central panel	Material		High density polyethylene
	Color		Yellow
Air filter housing cover	Material		Polypropylene (glass fiber-reinforced)
	Color		Black
Air filter housing	Material		Polypropylene (glass fiber-reinforced)
	Color		Black
Transmission lever locator	Material		Polypropylene (glass fiber-reinforced)
	Color		Black
A-arm protector	Material		Polypropylene
	Color		Black

**Section 13 TECHNICAL SPECIFICATIONS**  
**Subsection 02 (RENEGADE MODELS)**

MODEL		RENEGADE™ 500	RENEGADE™ 800
<b>MATERIAL (cont'd)</b>			
Engine cover	Material	High density polyethylene	
	Color	Black	
Seat base	Material	Polypropylene	
	Color	Black	
Seat cover	Material	Thermoformed vinyl	
	Color	Black	



# *Midwest Manuals*

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# ELECTRICAL CONNECTORS

## SERVICE TOOLS

Description	Part Number	Page
crimping pliers .....	529 035 730 .....	435
crimper die.....	529 035 906 .....	432
crimping tool.....	529 035 909 .....	432

## SERVICE TOOLS – OTHER SUPPLIER

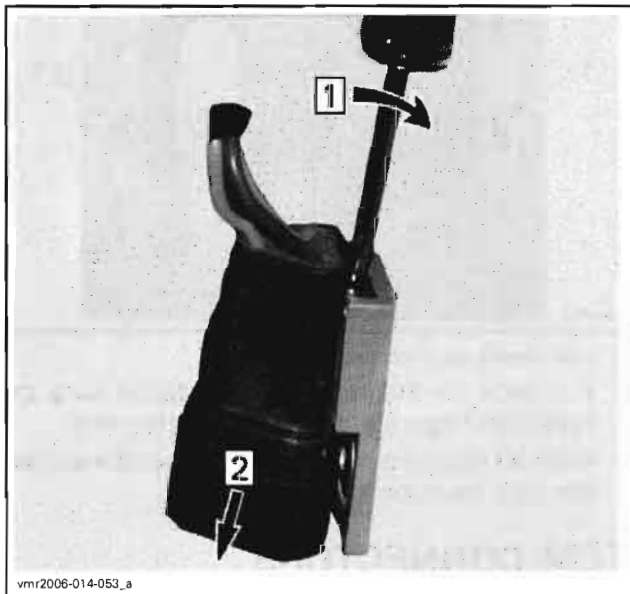
Description	Part Number	Page
Snap-on terminal remover .....	TT600-1 .....	432

## DEUTSCH CONNECTORS

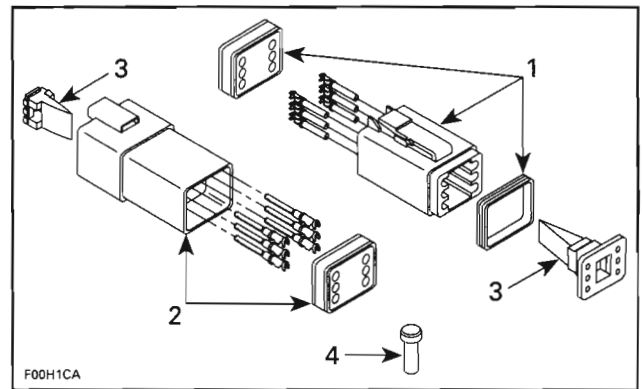
Deutsch connectors are used on some harnesses.

### Removal from Engine Connector Bracket

To remove Deutsch connectors from engine connector bracket, slide a flat screwdriver between the connector bracket and the Deutsch connector and push out connector.



### Connector Disassembly



1. Male connector
2. Female connector
3. Secondary locks
4. Sealing cap

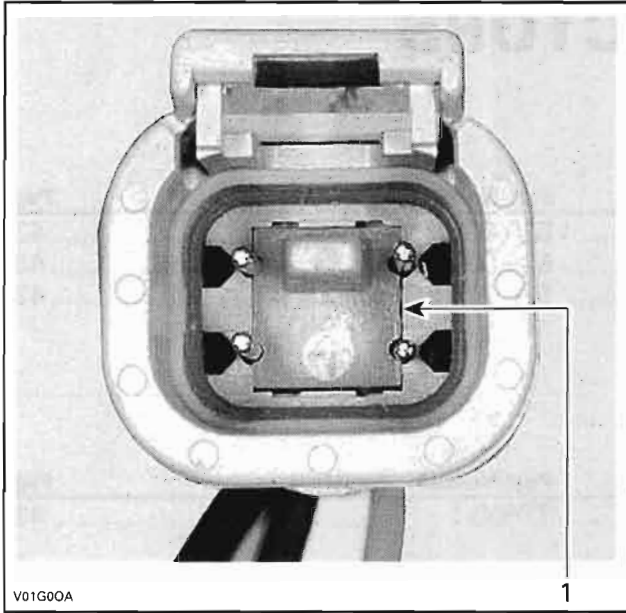
**CAUTION:** Do not apply dielectric grease on terminal inside connector.

To remove terminals from connector, proceed as follows:

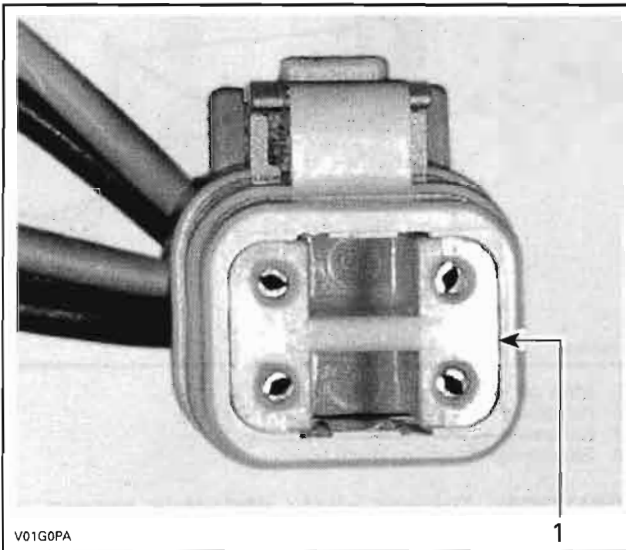
- Using a long nose pliers, pull out the lock.

## Section 14 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

### Subsection 01 (ELECTRICAL CONNECTORS)



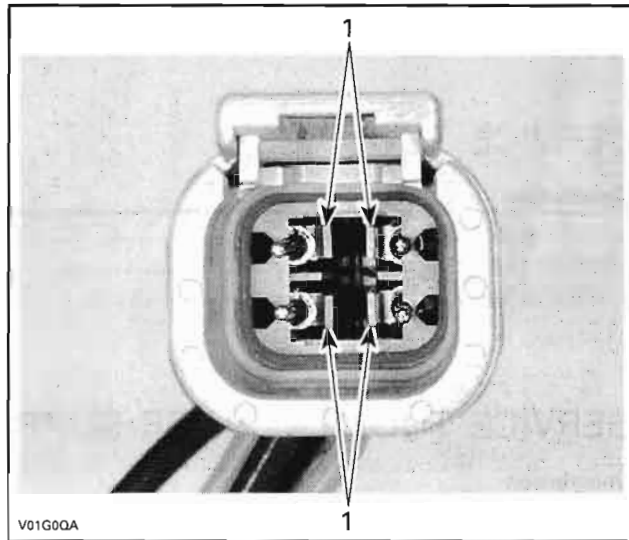
**FEMALE CONNECTOR**  
1. Female lock



**MALE CONNECTOR**  
1. Male lock

**NOTE:** Before extraction, push wire forward to relieve pressure on retaining tab.

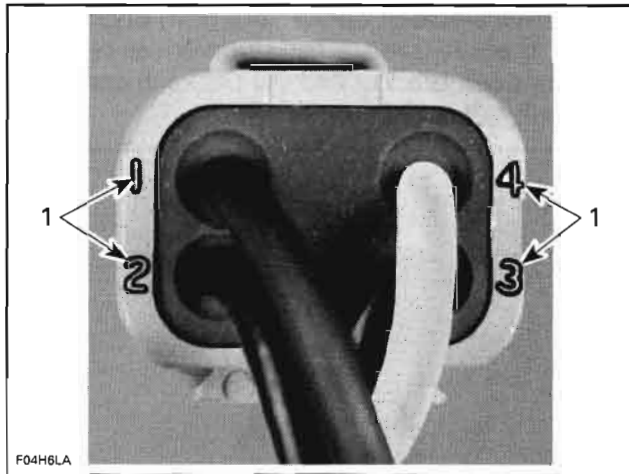
- Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
- Pry back the retaining tab while gently pulling wire back until terminal is removed.



**FEMALE CONNECTOR**  
1. Retaining tabs

To install:

- For insertion of a terminal, make sure the lock is removed.
- Insert terminal into appropriate cavity and push as far as it will go.

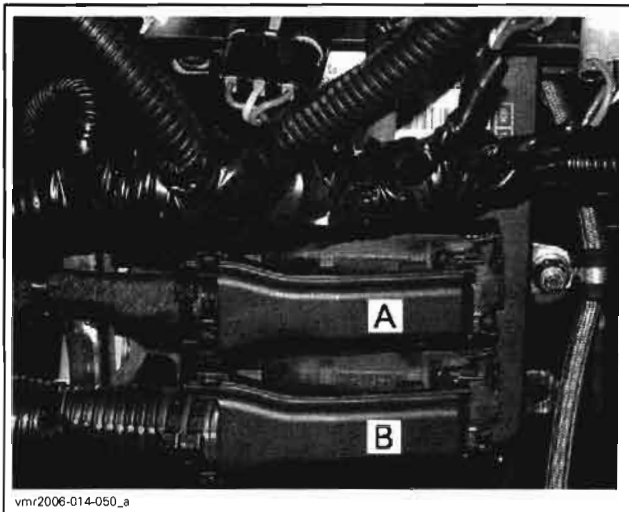


1. Wire identification numbers

- Pull back on the terminal wire to be sure the retention fingers are holding the terminal.
- After all required terminals have been inserted, the lock must be installed.

## ECM CONNECTORS

There are two ECM 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.

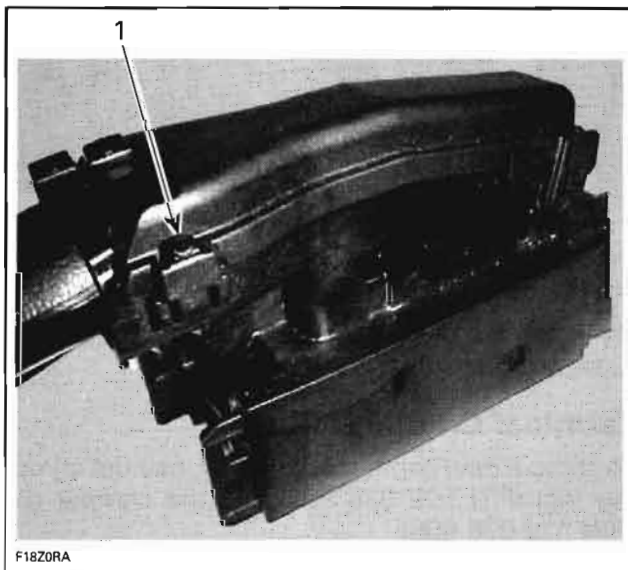


For probing techniques and tool, refer to *ENGINE MANAGEMENT*.

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

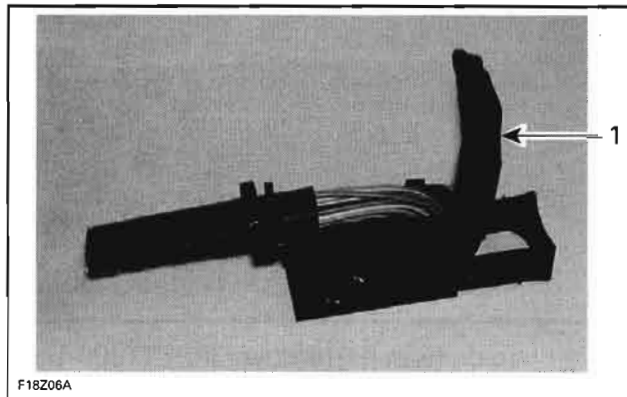
### Terminal Removal

Unlock the connector cover by pushing in the tabs on top of the connector with a flat screwdriver to be able to flip the top cover up.



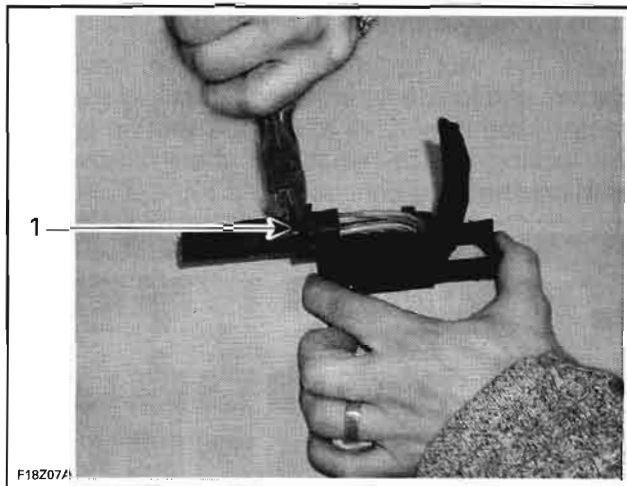
1. Push in tab

Lift the cover by pushing it forward.



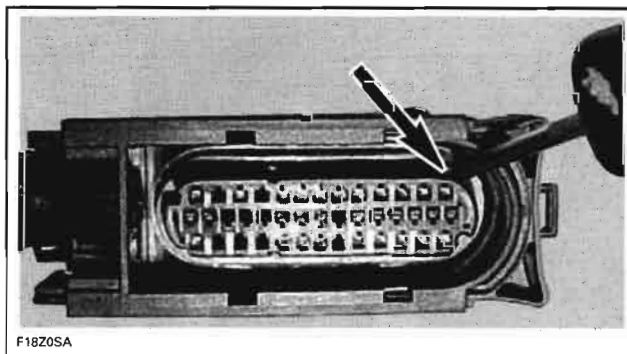
1. Cover

Cut both tie raps that secure the harness to the connector.



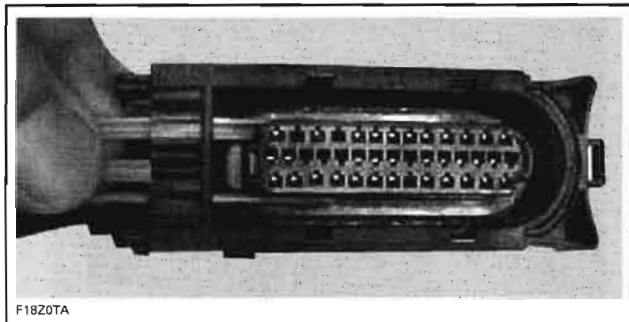
1. Tie raps

Turn the connector over and remove the orange locking tab by pushing and then pulling toward the wire harness.



## Section 14 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

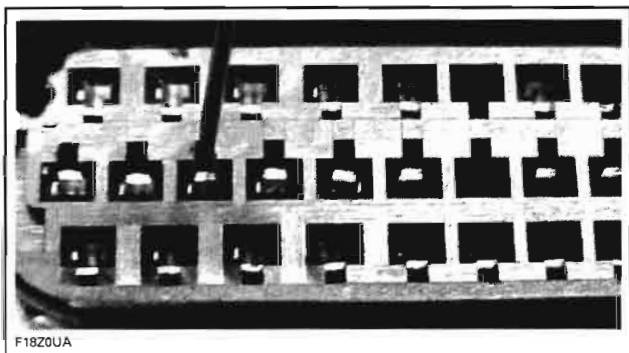
### Subsection 01 (ELECTRICAL CONNECTORS)



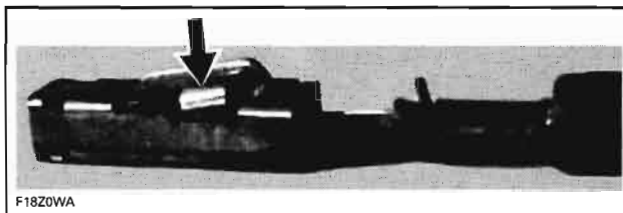
Use a Snap-on terminal remover (P/N TT600-1) (or a 0.76 mm (.030 in) oxyacetylene torch tip cleaner or a no. 68 drill bit) must be inserted into the terminal cavity to release the locking tab from the connector.

**CAUTION:** Using a tool tip larger than 0.76 mm (.030 in) may damage the terminal.

Insert the tool tip into the terminal cavity as shown, and locate its wire in the back of the connector. You may have to pry the tool tip against the locking tab to release it, then remove the terminal from the connector.



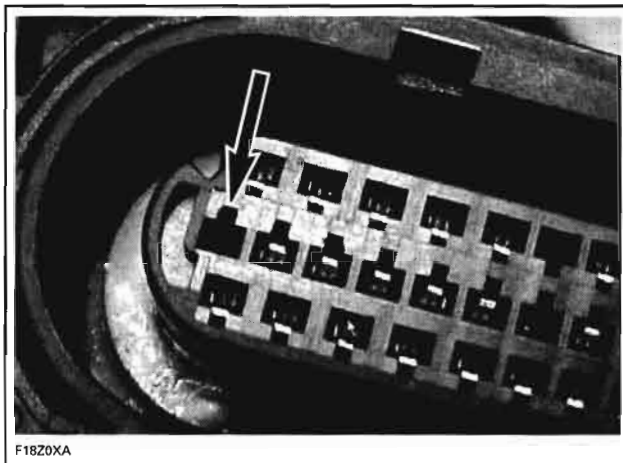
Check the locking tab on the terminal, it may have to be bent out a little so it will lock in its cavity when it is re-inserted.



If the wire is in good condition but the terminal is rusted or corroded, remove defective terminal and crimp a new one. If wire and terminal are defective, replace with a new genuine wire and new terminal and crimp them together as explained below.

**IMPORTANT:** Use genuine wires only. Otherwise wires will not fit properly.

When re-inserting the terminal, the locking tab must be installed facing the smaller cutout of the terminal cavity.

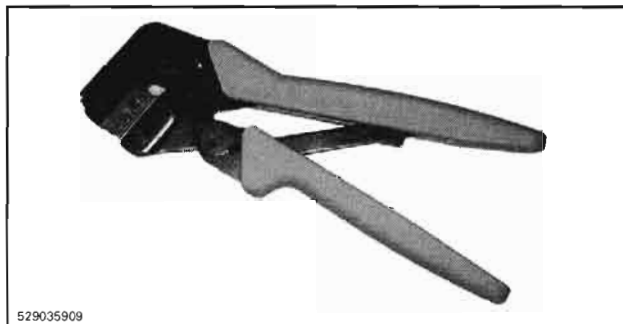


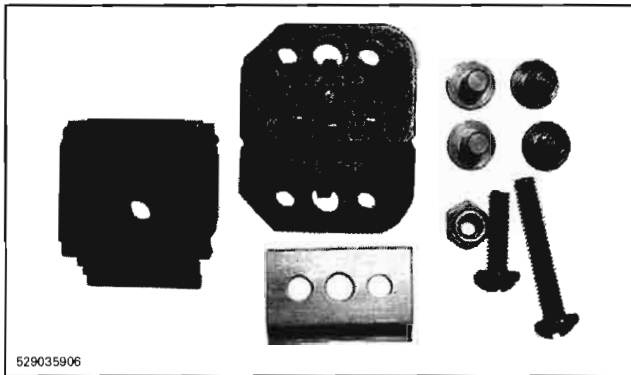
Insert the terminal, ensuring the locking tab snaps into its cavity.

Re-install the orange locking tab, attach the 2 tie raps, and close the connector cover.

#### Terminal Crimping (Kostal)

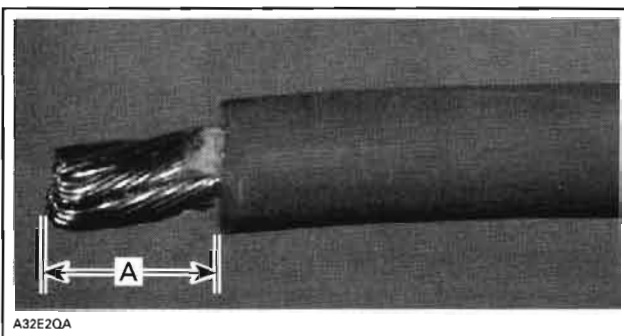
To crimp a new connector terminal, use the crimping tool (P/N 529 035 909) and the crimper die (P/N 529 035 906).





To properly crimp the wires, strictly follow this procedure.

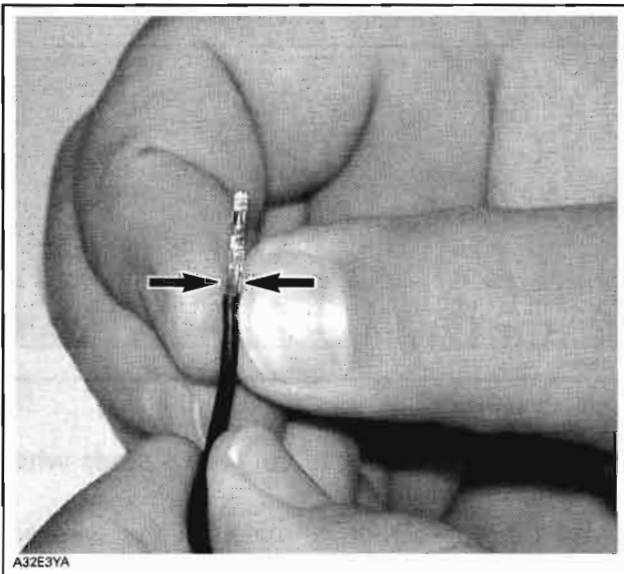
Strip the wire to a maximum of 3 mm (1/8 in).



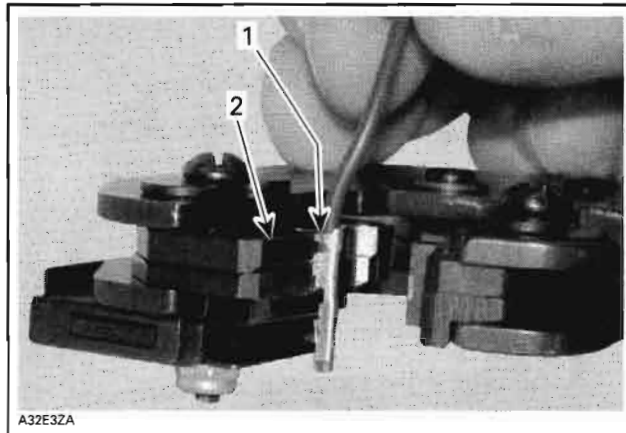
**TYPICAL**  
 A. 3 mm (1/8 in) max.

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

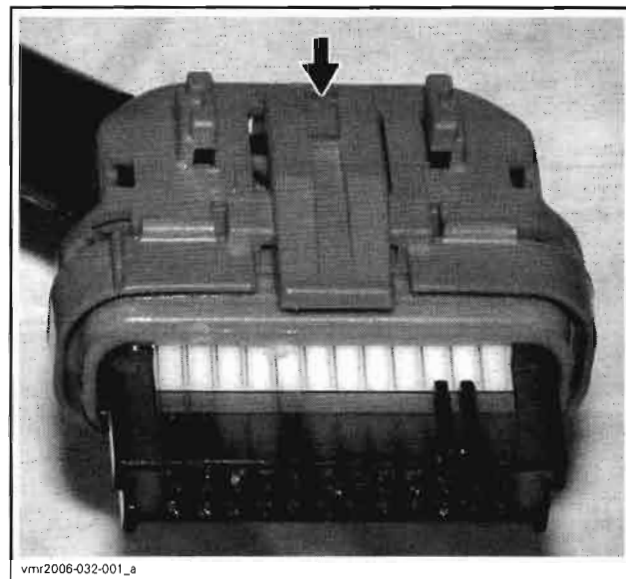
Crimp terminal. Ensure no tiny wire goes out of terminal. This might cause strange problems of the electrical system.

### Lubrication

Do not apply any product to the pins of the connector on the ECM.

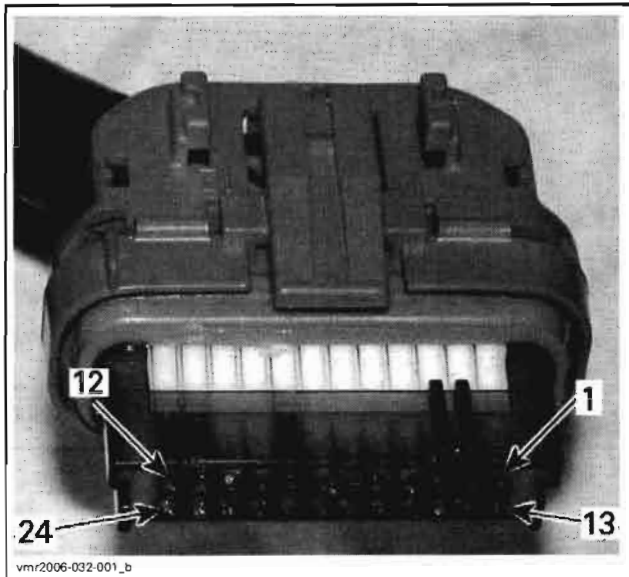
### MULTIFUNCTION SPEEDOMETER CONNECTOR

Firmly push down tab and hold to unlock connector while pulling it out.



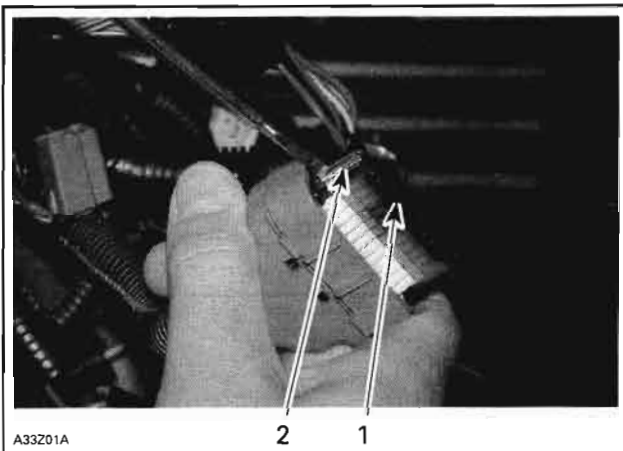
## Section 14 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

### Subsection 01 (ELECTRICAL CONNECTORS)



CONNECTOR PINOUT

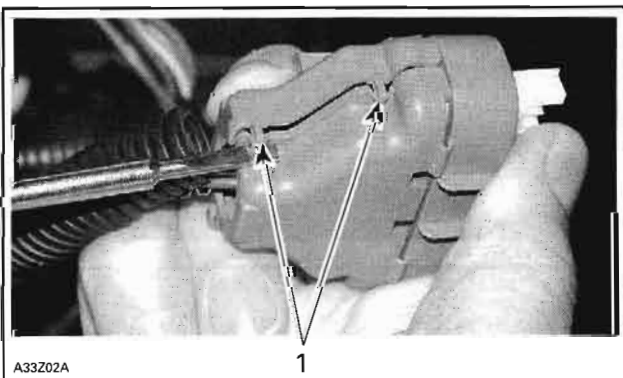
Push on both tabs to remove retainer.



TYPICAL

1. Retainer
2. Tab (one on each side)

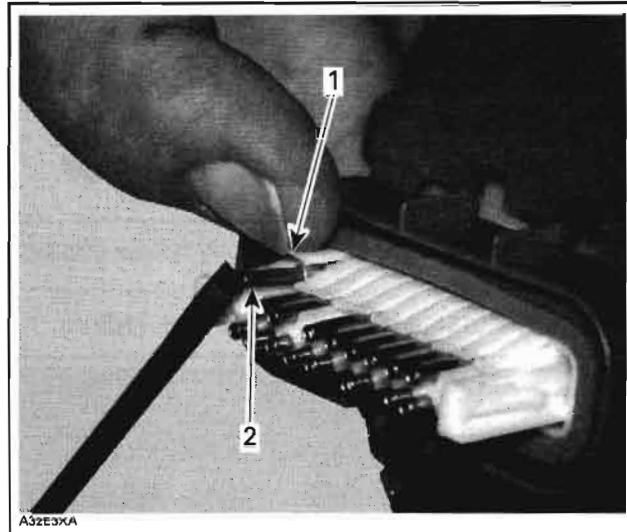
Open housing by lifting 4 tabs.



TYPICAL

1. Tabs (2 on each side)

Lift the top plastic lock of the female terminal to be removed and hold in position. Lift the female terminal to unlock from the housing and push out of housing.



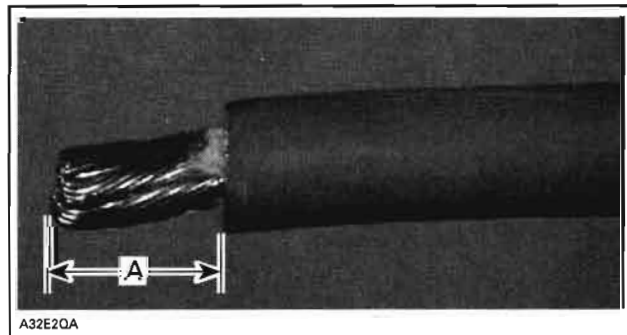
TYPICAL

1. Lift and hold plastic lock
2. Lift to unlock and push out

## BATTERY AND STARTER CABLE TERMINALS

### Crimping

Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.

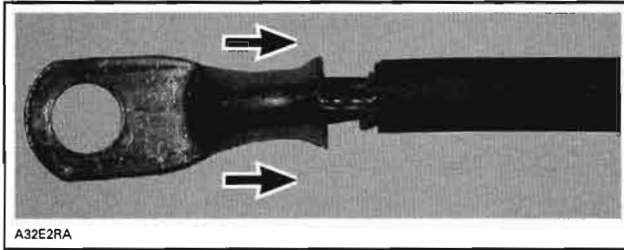


A. 10 mm (3/8 in)

**NOTE:** Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate *PARTS CATALOG*.

**Section 14 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS**  
Subsection 01 (ELECTRICAL CONNECTORS)

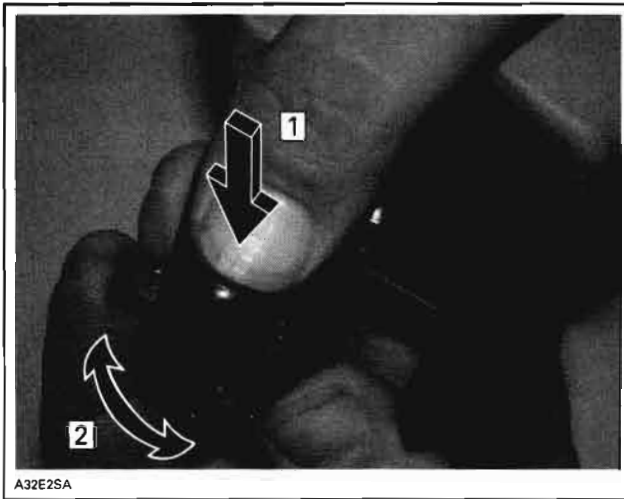


*INSTALLATION OF TERMINAL*

Follow the instructions provided with the crimping pliers (P/N 529 035 730) to select the proper position of the tool.



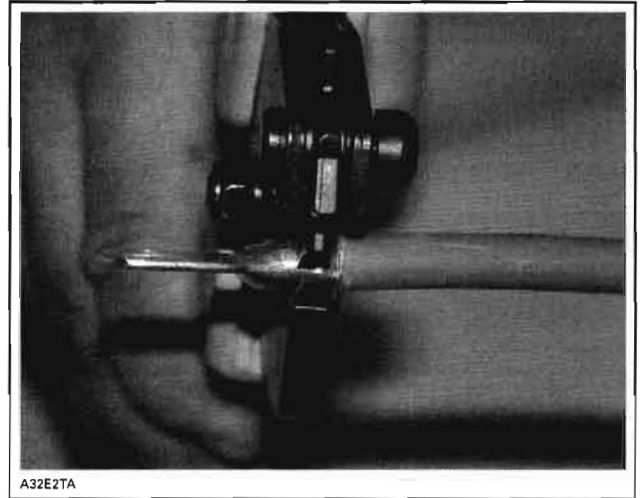
**NOTE:** Different wires require different crimping pliers settings, so make sure to follow the instruction supplied with the tool.



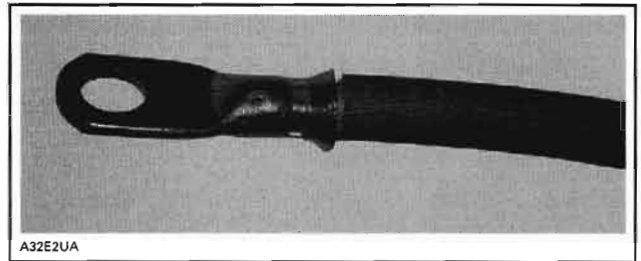
*POSITIONING THE CRIMPING PLIERS*

Step 1: Press  
Step 2: Rotate

After positioning the crimping pliers, crimp the terminal already installed on wire.



*CRIMPING OF WIRE*



*PROPERLY CRIMPED WIRE*

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

**CAUTION:** Never weld the wire to the terminal. Welding can change the property of the wire and it can become brittle and break.

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

**CAUTION:** Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.



*Midwest Manuals*

[sales@midwestmanuals.com](mailto:sales@midwestmanuals.com)

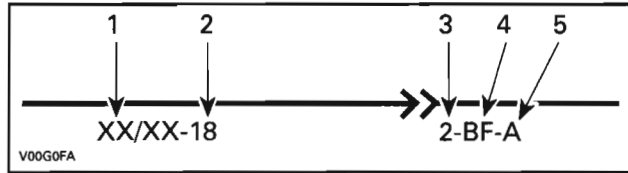
[www.midwestmanuals.com](http://www.midwestmanuals.com)

[www.midwestmanuals.com](http://www.midwestmanuals.com)  
[Sales@midwestmanuals.com](mailto:Sales@midwestmanuals.com)



# WIRING DIAGRAMS

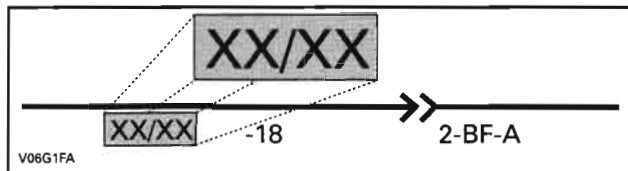
## WIRING CONNECTORS CODING



1. Wire colors
2. Wire gauge
3. Connector housing area
4. Connector identification
5. Wire location in connector

### Wire Colors

It identifies the color of a wire. When a 2-color scheme is used, the first color is the main color while the second color is the tracer color.

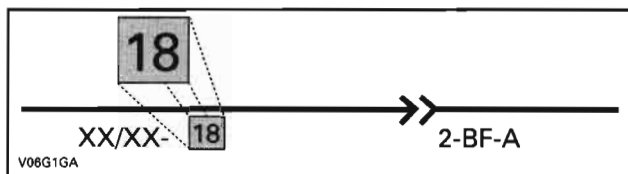


THE SHADED PART INDICATES THE WIRE COLOR

Example: YL/BK is a YELLOW wire with a BLACK stripe.

### Wire Gauge

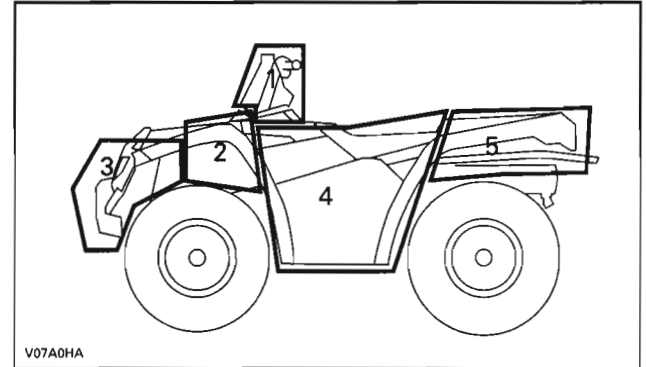
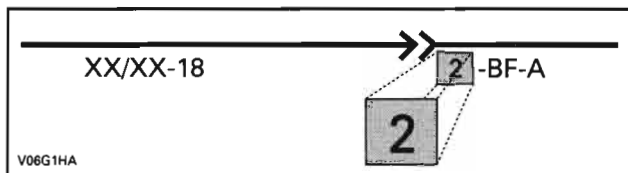
The number after wire color indicates the gauge of a wire.



THE SHADED PART INDICATES THE WIRE GAUGE

Example: YL/BK is a YELLOW wire with a BLACK stripe.

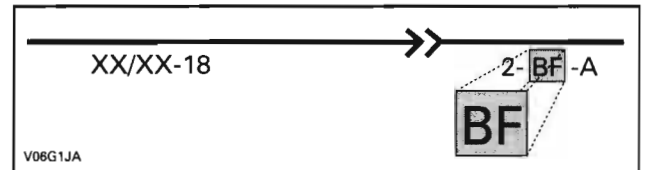
### Connector Housing Area



AREA	LOCATION
1	Steering area
2	Service compartment
3	Front of vehicle
4	Engine area
5	Rear of vehicle

### Connector Identification

Indicates the connector's function. If there are many connectors in the same area, this helps to identify which wire is in which connector.



THE SHADED PART INDICATES A CONNECTOR

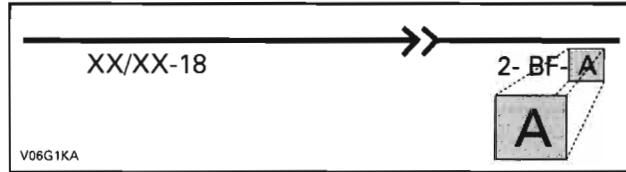
# Section 14 ELECTRICAL CONNECTORS AND WIRING DIAGRAMS

## Subsection 02 (WIRING DIAGRAMS)

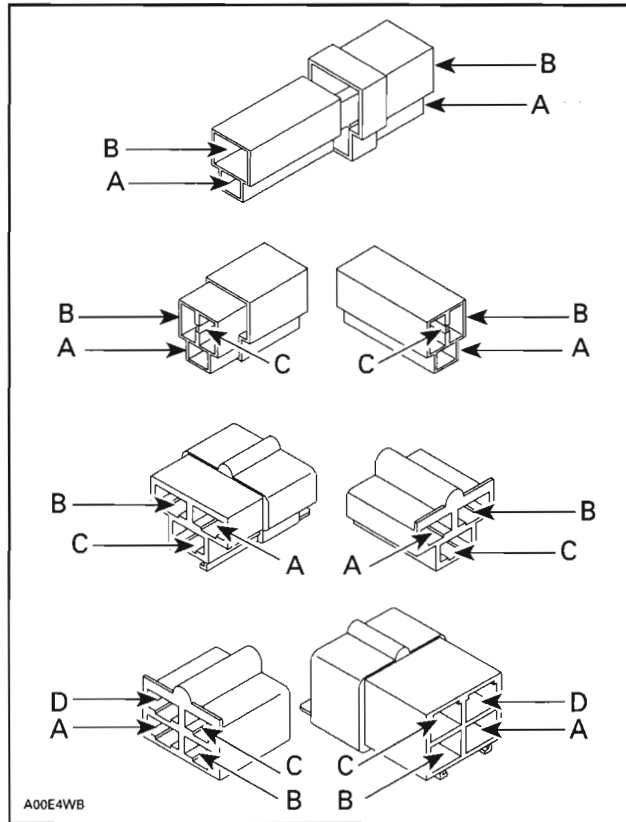
ABBREVIATION	DESCRIPTION
BA	Ignition coil
BAT	Battery
BD	2WD/4WD switch
CA	Magneto
CAPS	Camshaft position sensor
CC	Ignition switch
CI	Multifunction speedometer
CPS	Crankshaft position sensor
CTS	Coolant temperature sensor
CV	Speed sensor
DB	Diagnostic connector
DC	DC outlet
ECM	Engine control module
FP	Fuel pump
FRA	Brake light switch
FT	Cooling fan
HIC	Harness interconnector (engine/vehicle)
IDLE	Idle bypass valve
INJ1 and INJ2	Fuel injector
MAPTS	Manifold air pressure and temperature sensor
MD	2WD/4WD actuator
MG	multifunction switch
OPS	Oil pressure switch
PD	RH headlight
PF1	Fuse Holder (main)
PF2	Fuse Holder (near battery)
PG	LH headlight
PRN	Subtransmission switch
RD	Voltage regulator/rectifier
SD	2WD/4WD actuator switch
SM	Starter motor
SPK1 and SPK2	Spark plug
SS	Starter solenoid
SW	Winch relay
SWW	Winch switch
TPS	Throttle position sensor
WM	Winch motor

### Wire Location in Connector

This is the wire position in the connector. The number or letter given refers to the physical identification stamped on the connector.

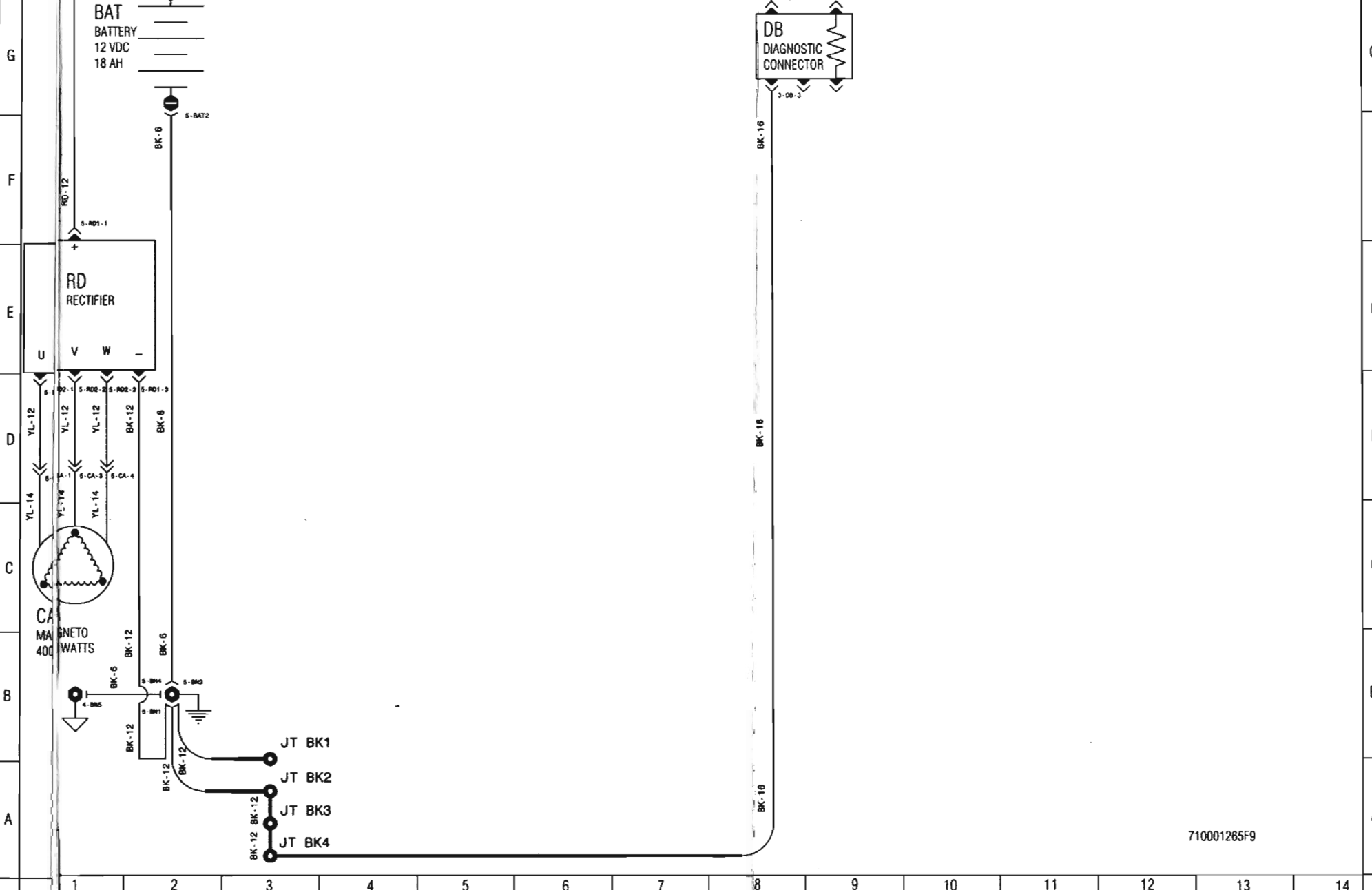


THE SHADED PART INDICATES THE CONNECTOR LOCATION IN HOUSING



TYPICAL

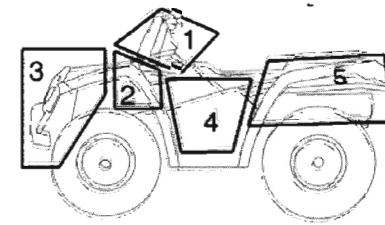




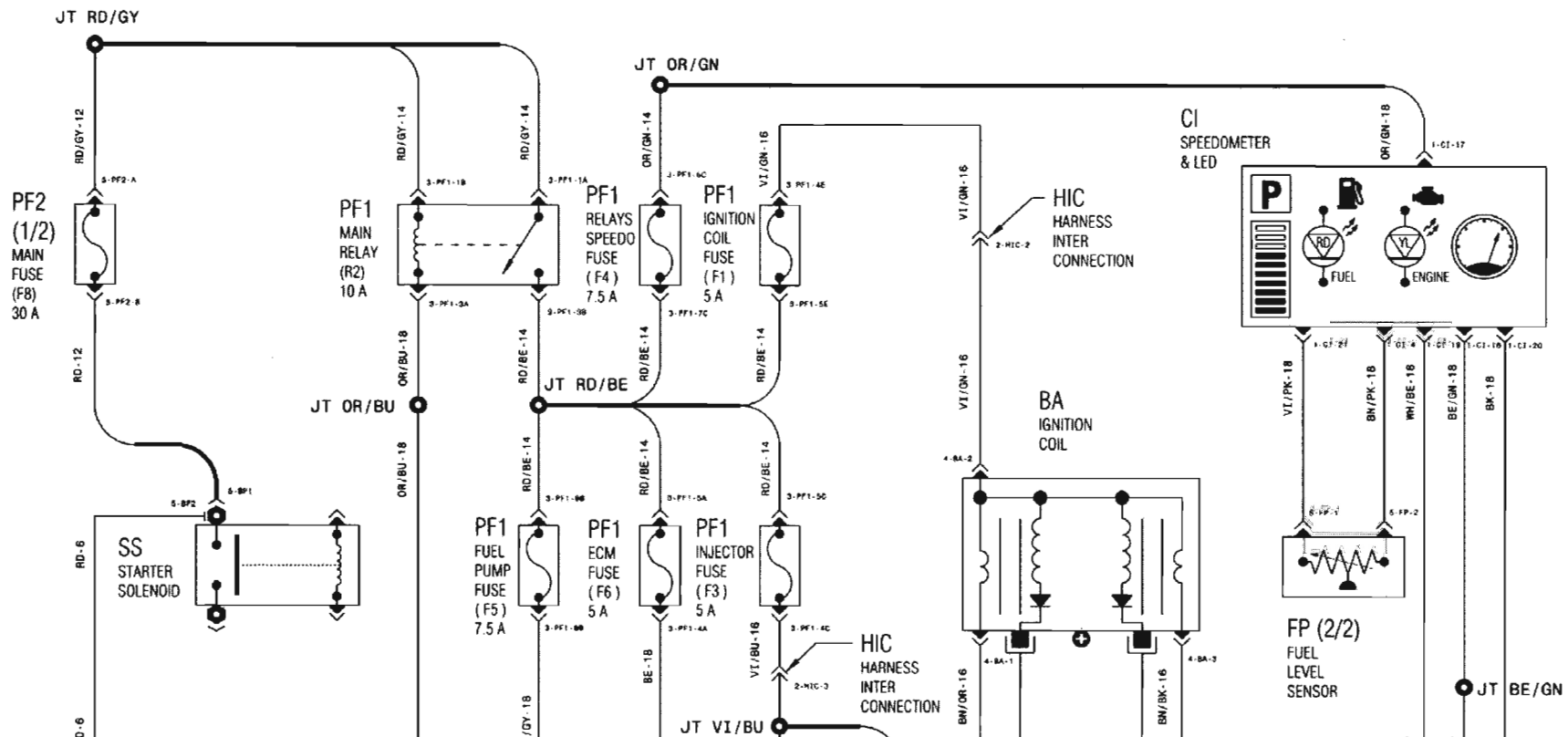
710001265F9

# 2008 RENEGADE 800

# INJECTION/IGNITION SYSTEM

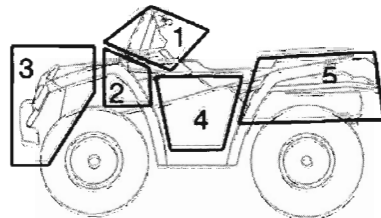


ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE

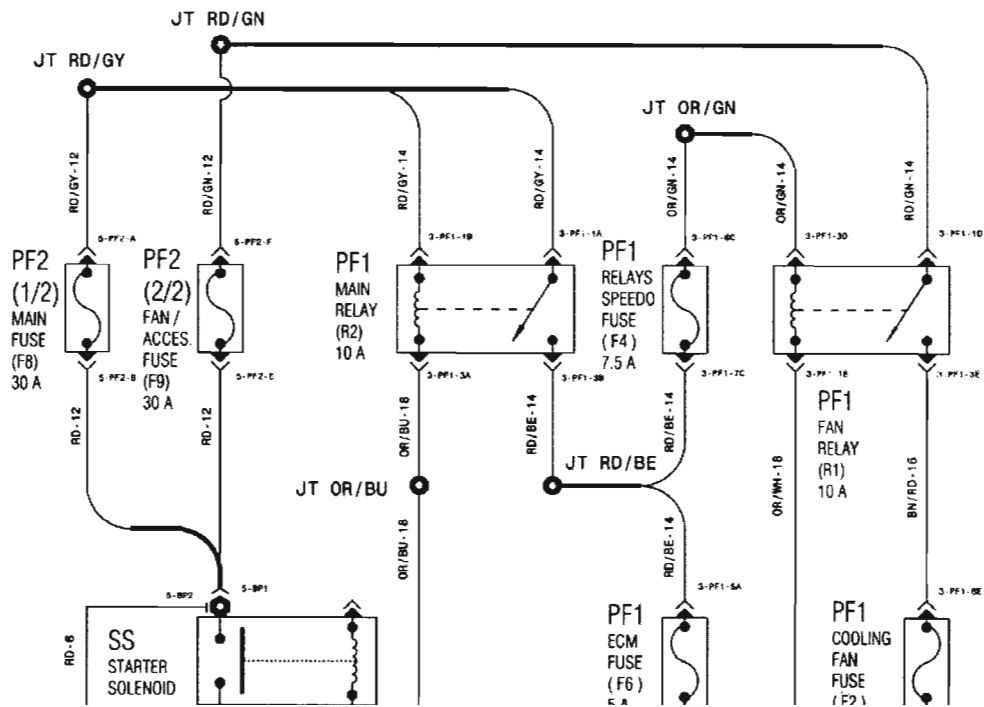


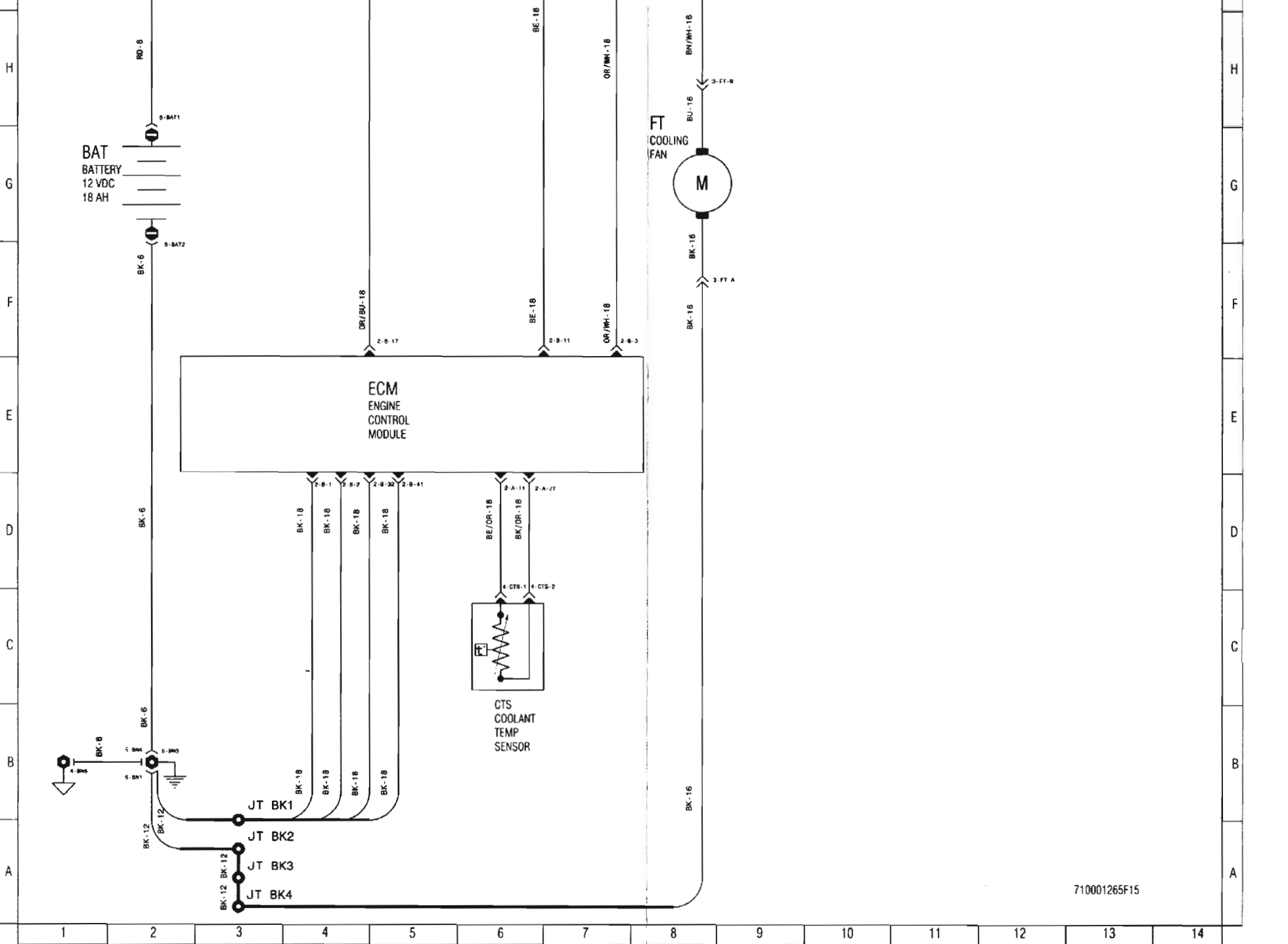


# 2008 RENEGADE 800 COOLING SYSTEM



ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



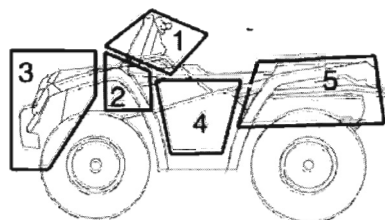


710001265F15

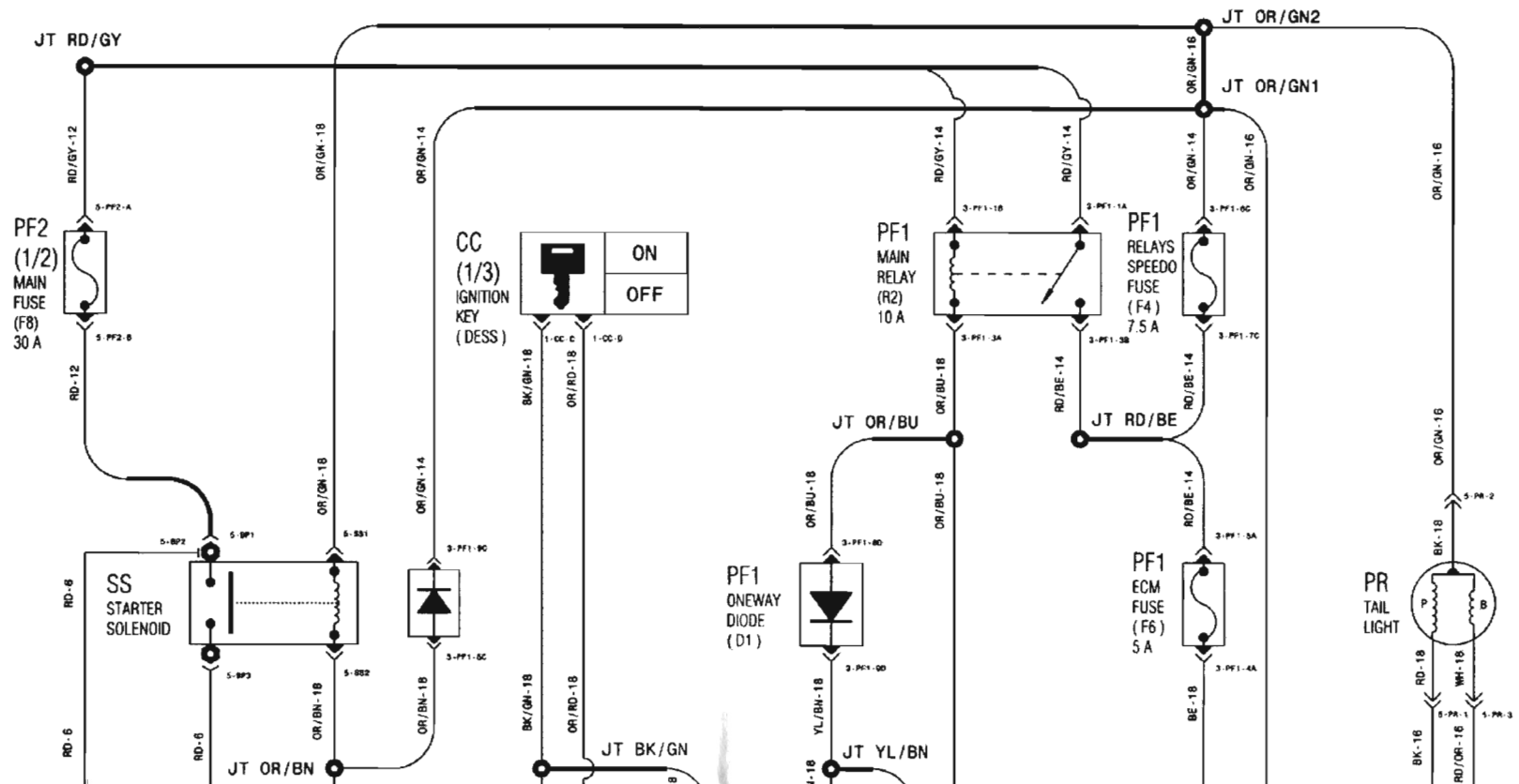


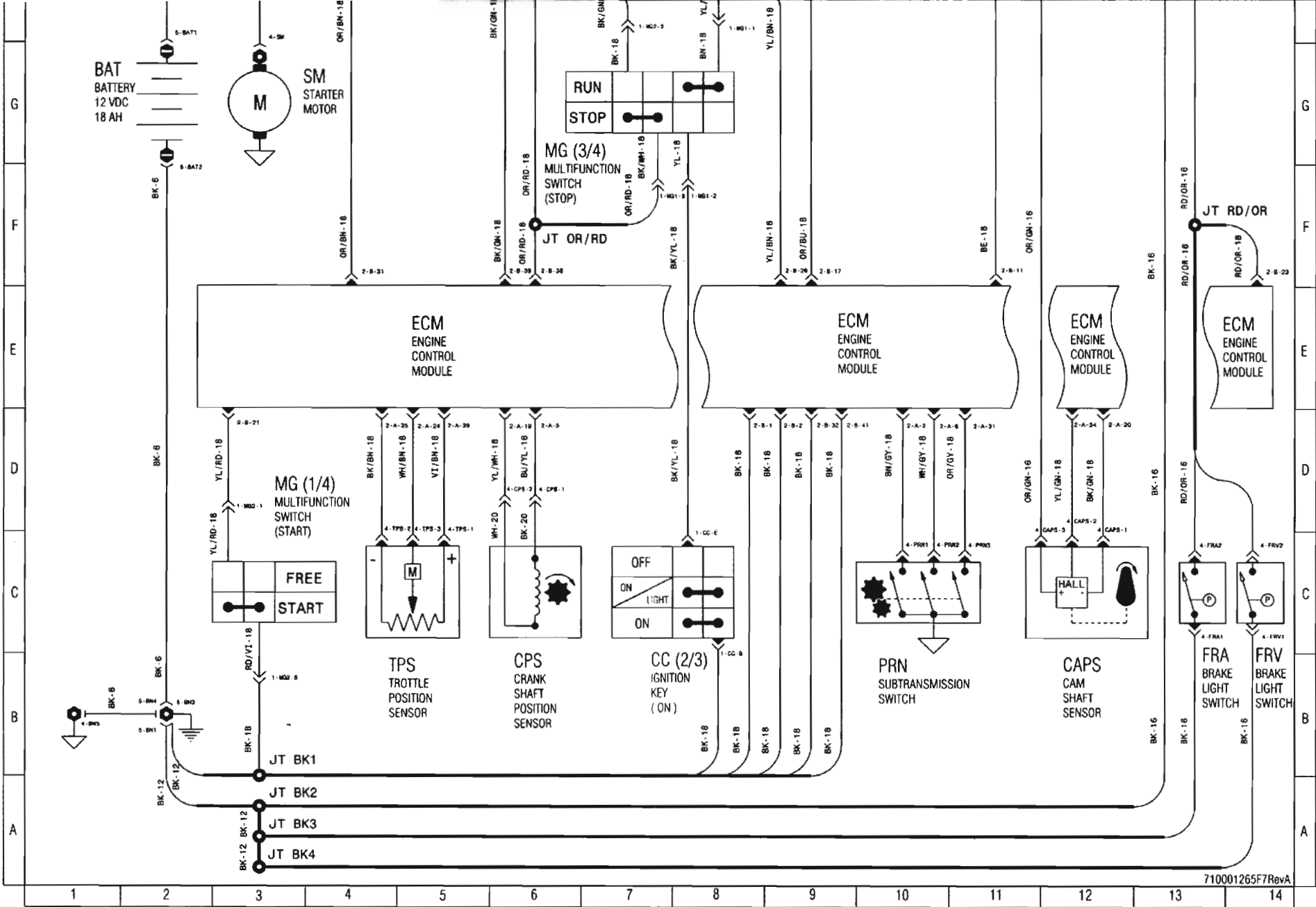
# 2008 RENEGADE 800

# STARTING SYSTEM



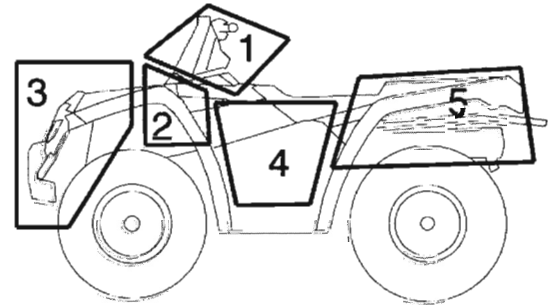
ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



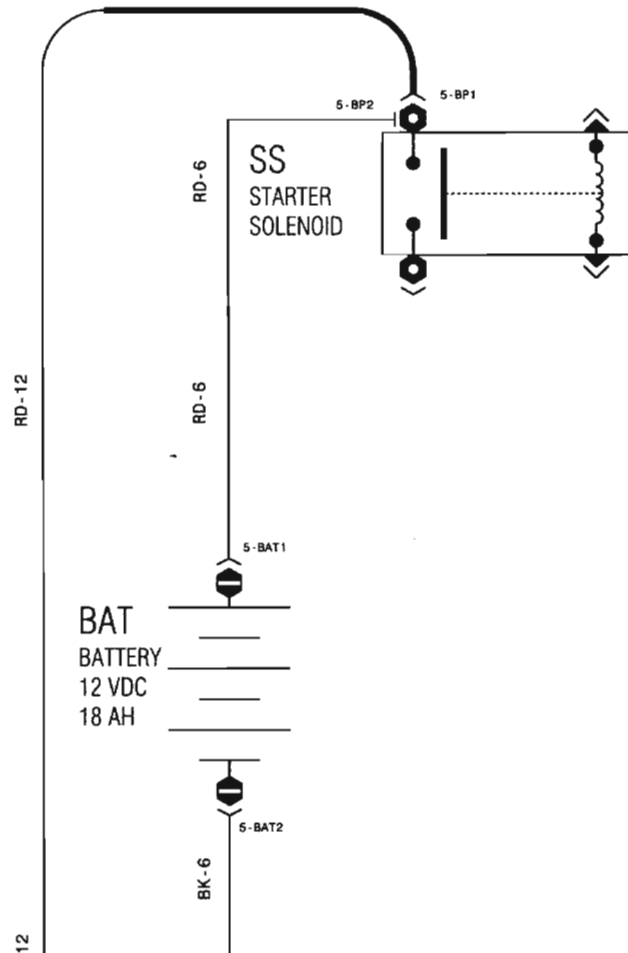


# 2008 RENEGADE 800

# CHARGING SYSTEM



ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



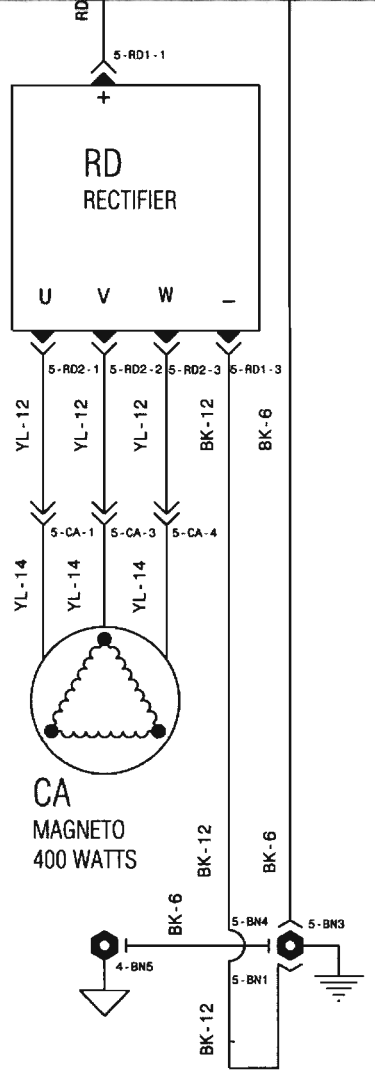
E

D

C

B

A



E

D

C

B

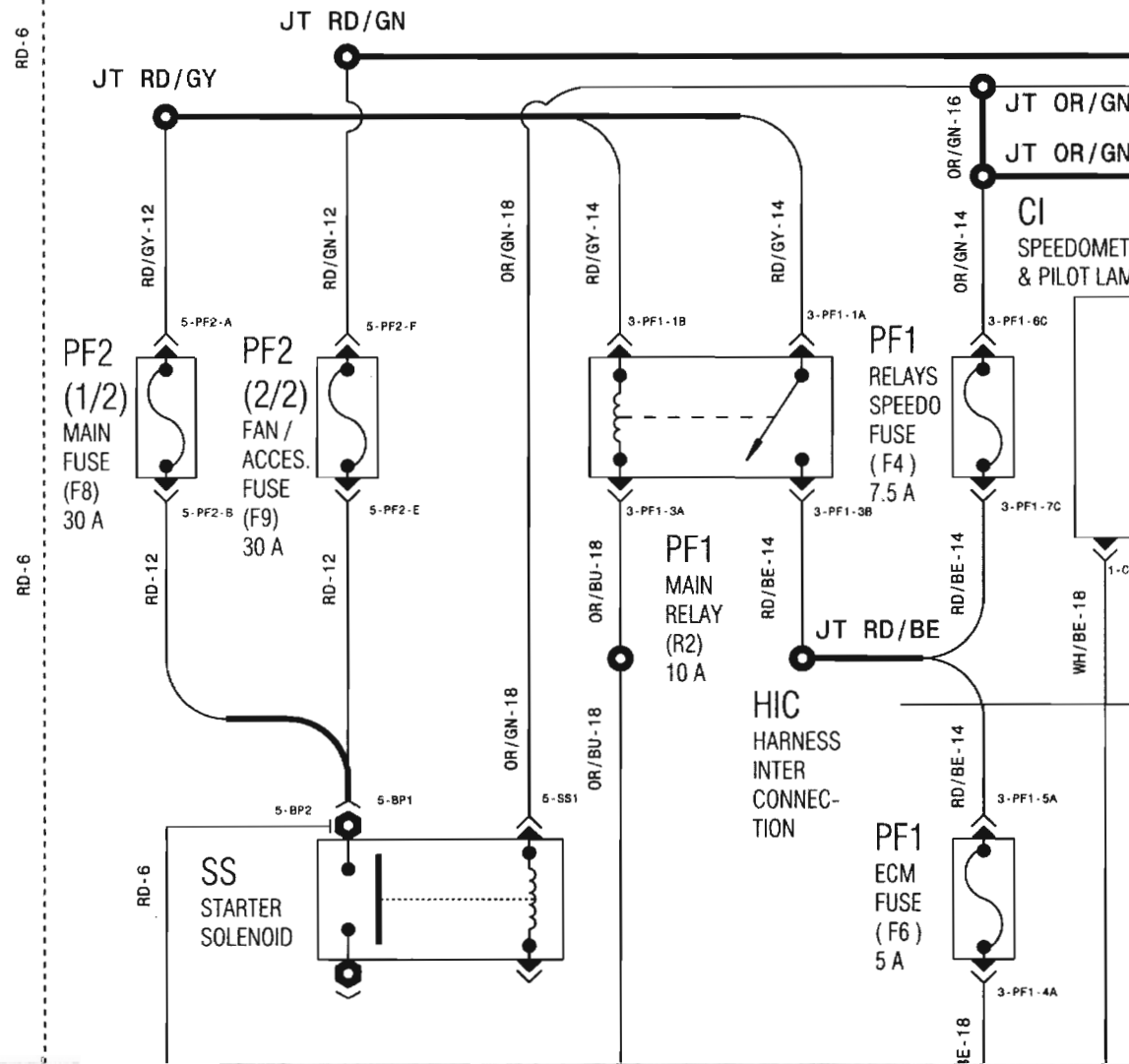
A

1      2      3      4      5      6      7      8      9

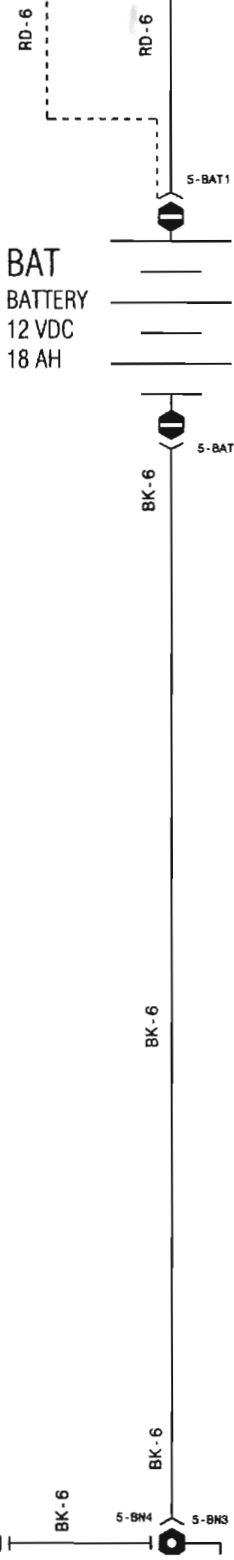
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2008 RENEGADE 800

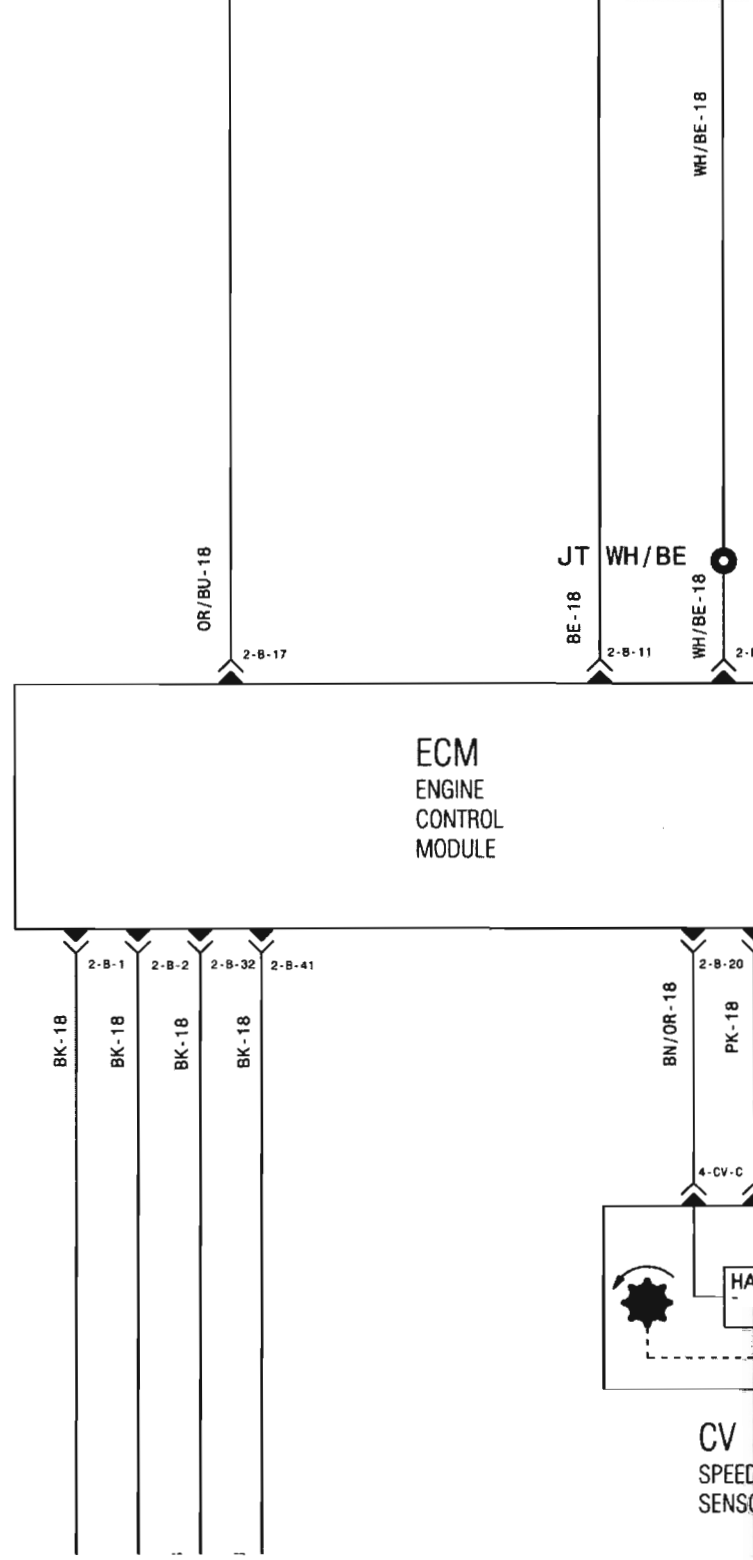
# ACCESSORIES SYSTEM



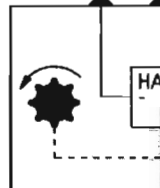
H  
G  
F  
E  
D  
C  
B



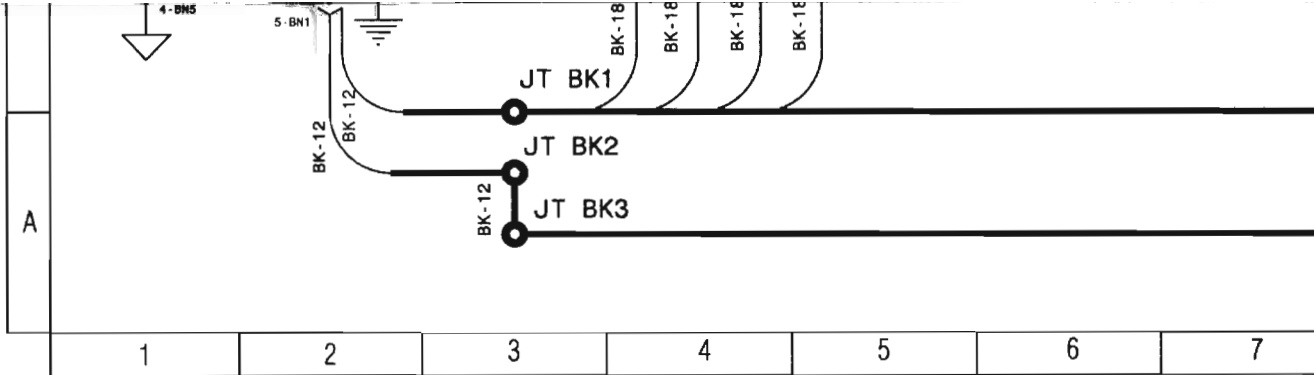
BAT  
BATTERY  
12 VDC  
18 AH



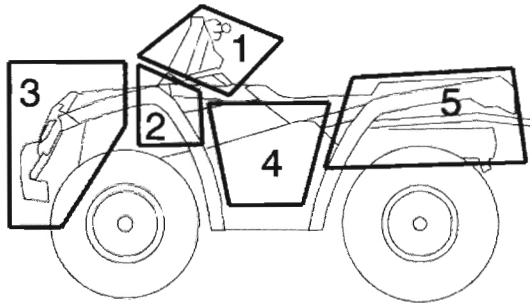
ECM  
ENGINE  
CONTROL  
MODULE



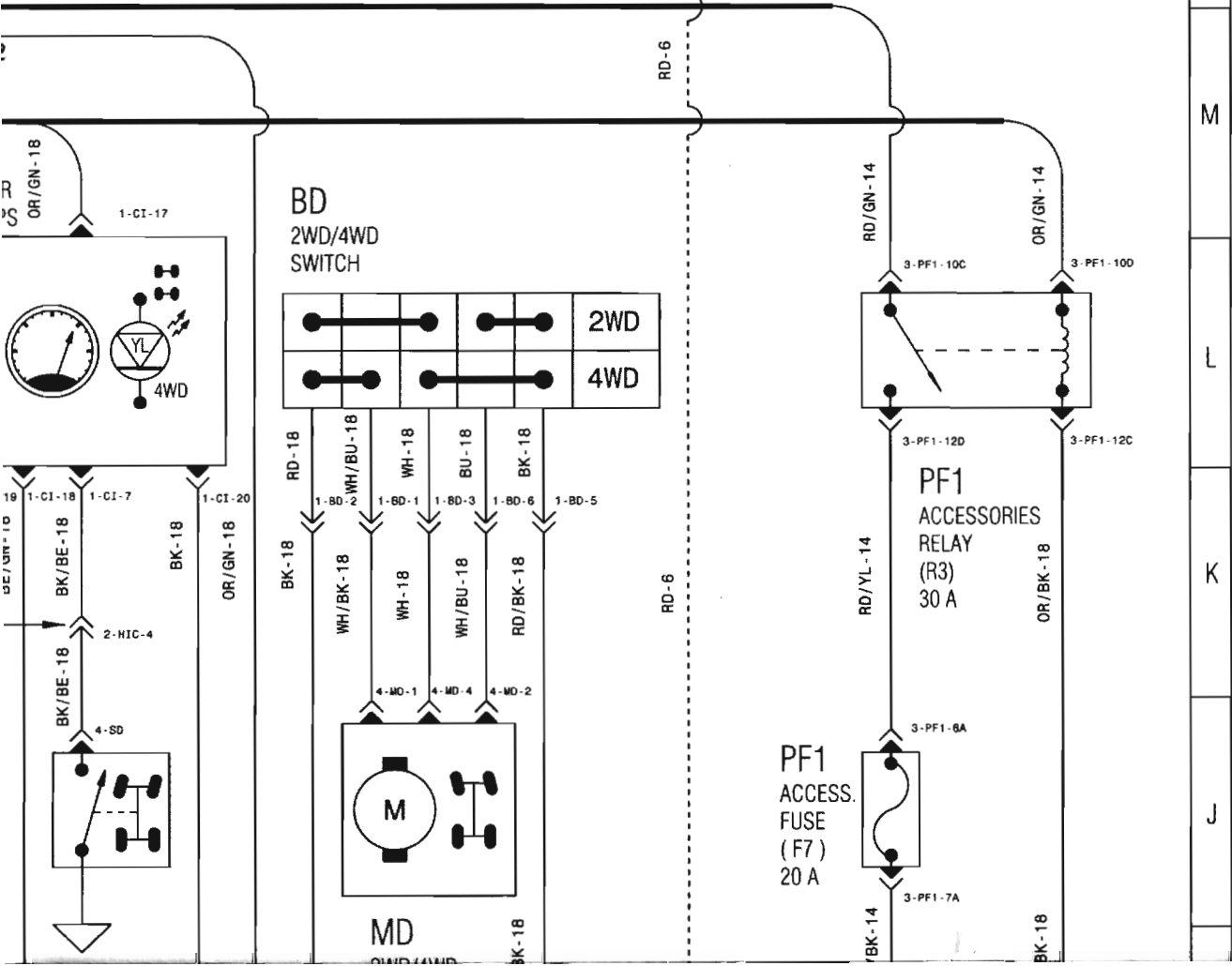
CV  
SPEED  
SENSOR



8 9 10 11 12 13 14



ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



P

N

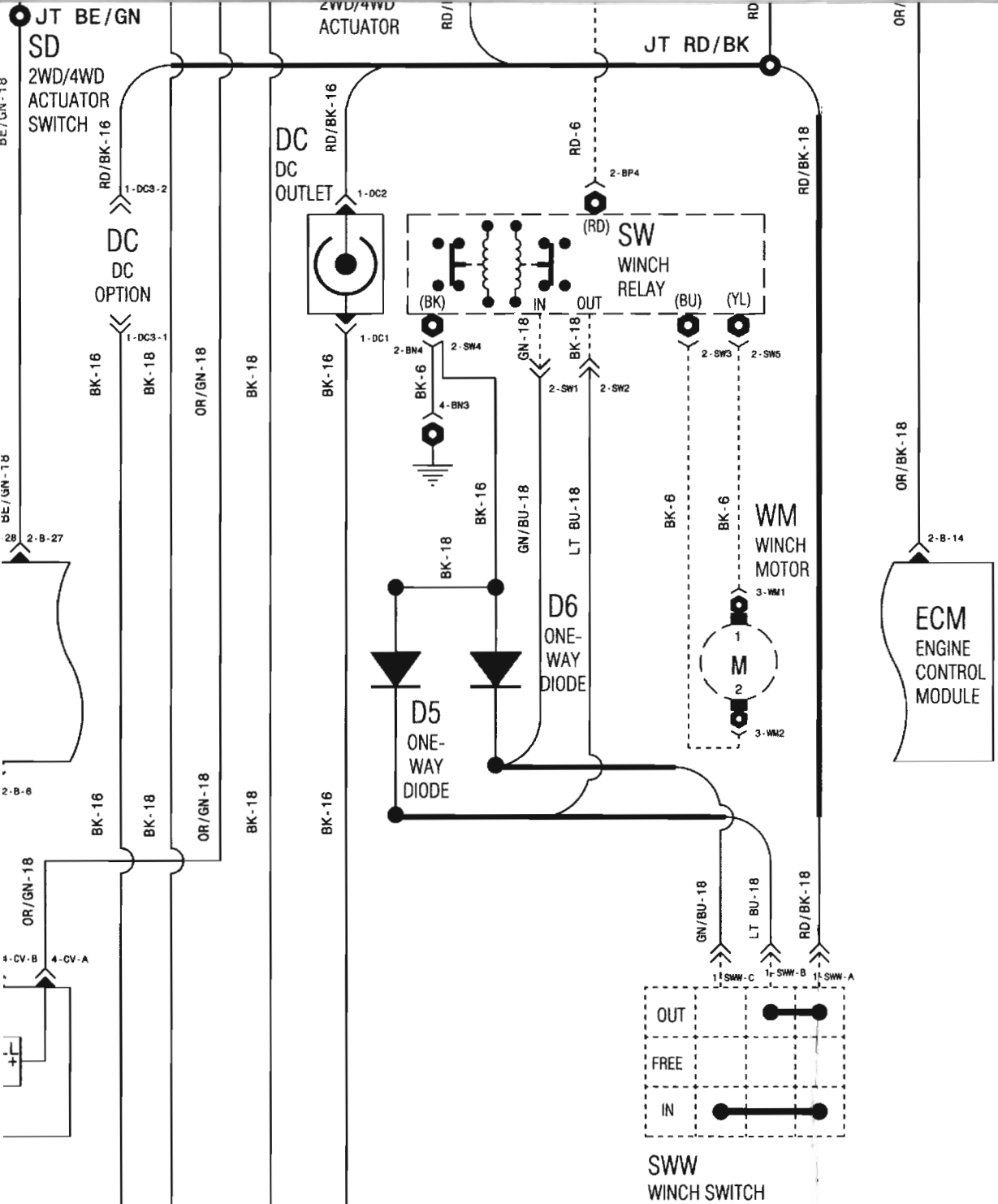
M

L

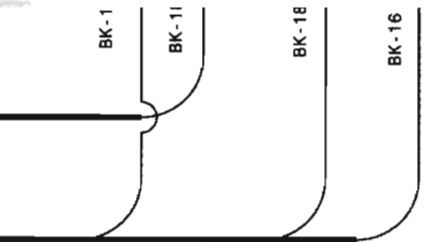
K

J





H  
G  
F  
E  
D  
C  
B



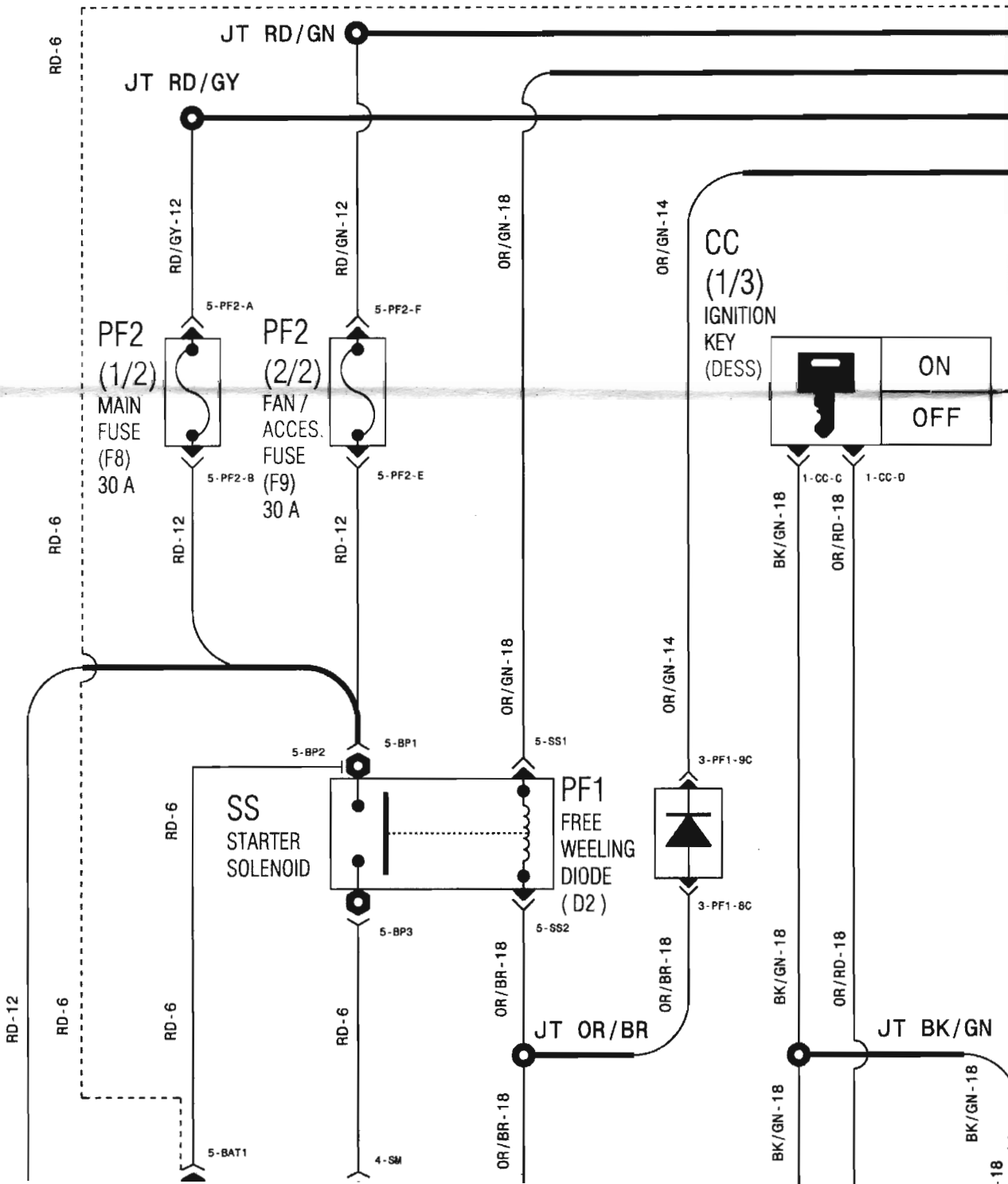
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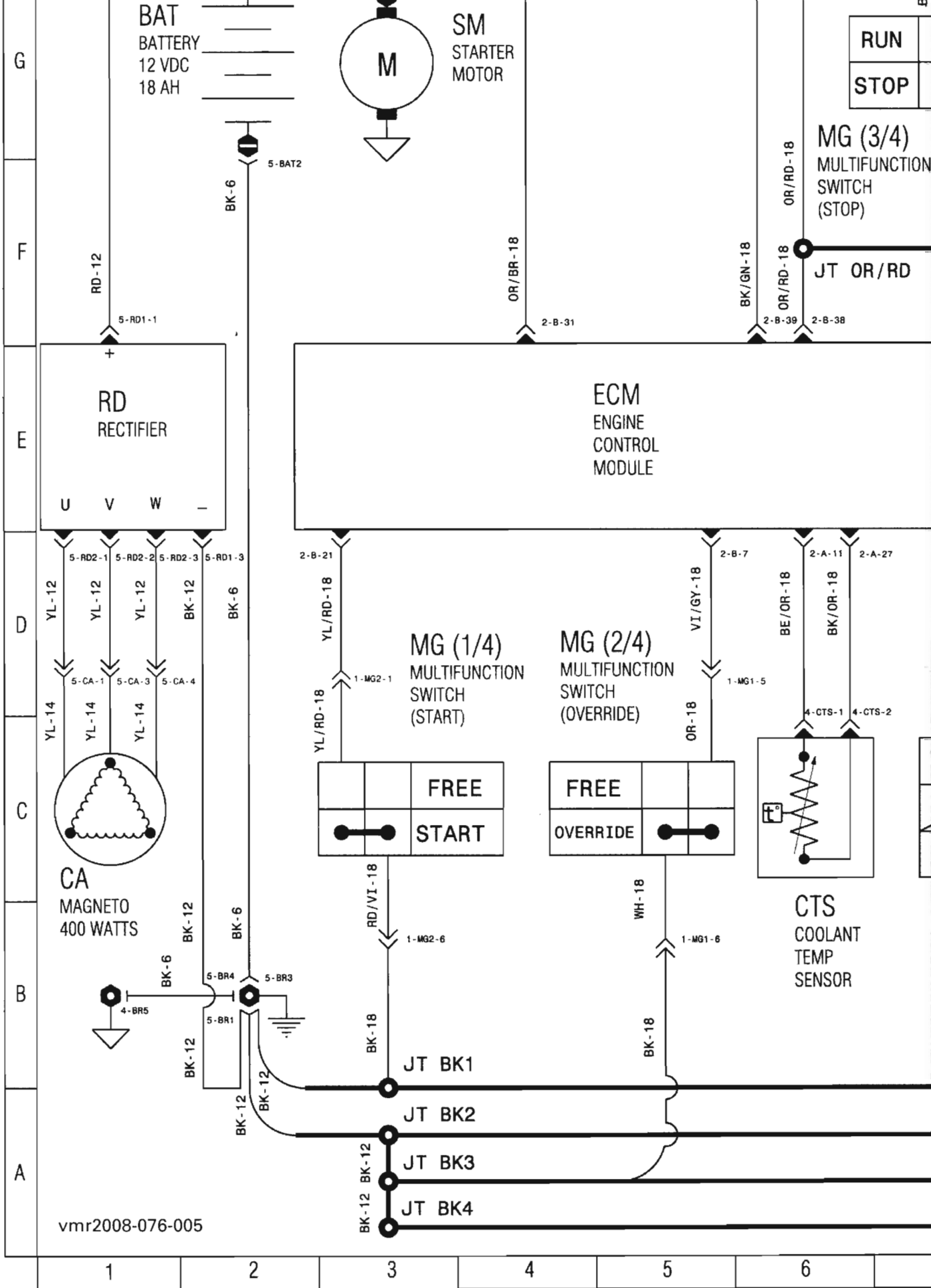
8	9	10	11	12	13	14
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A

2008 RENEGADE 800

# GENERAL SYSTEM



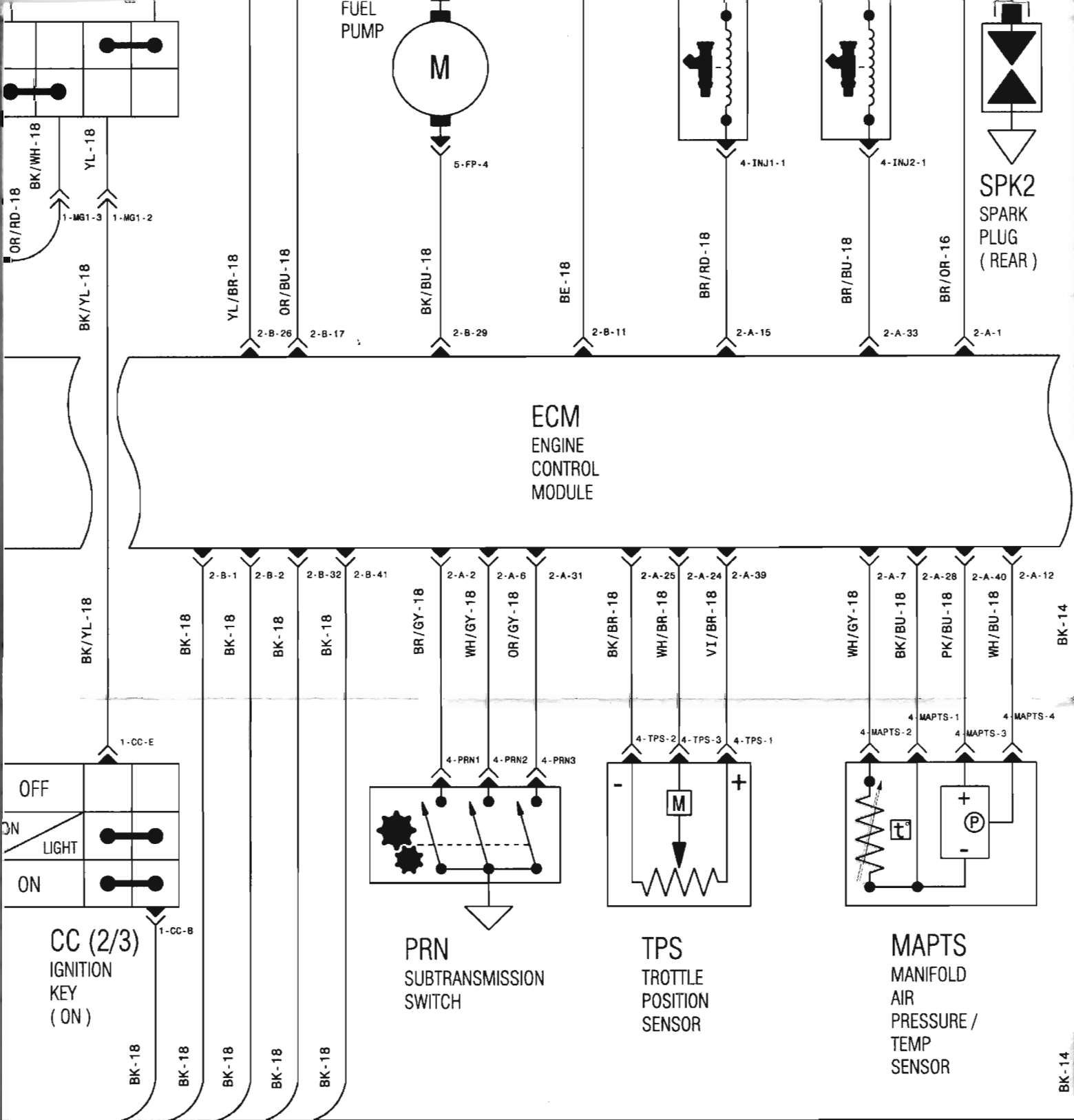


RUN
STOP

G  
F  
E  
D  
C  
B  
A

1 2 3 4 5 6



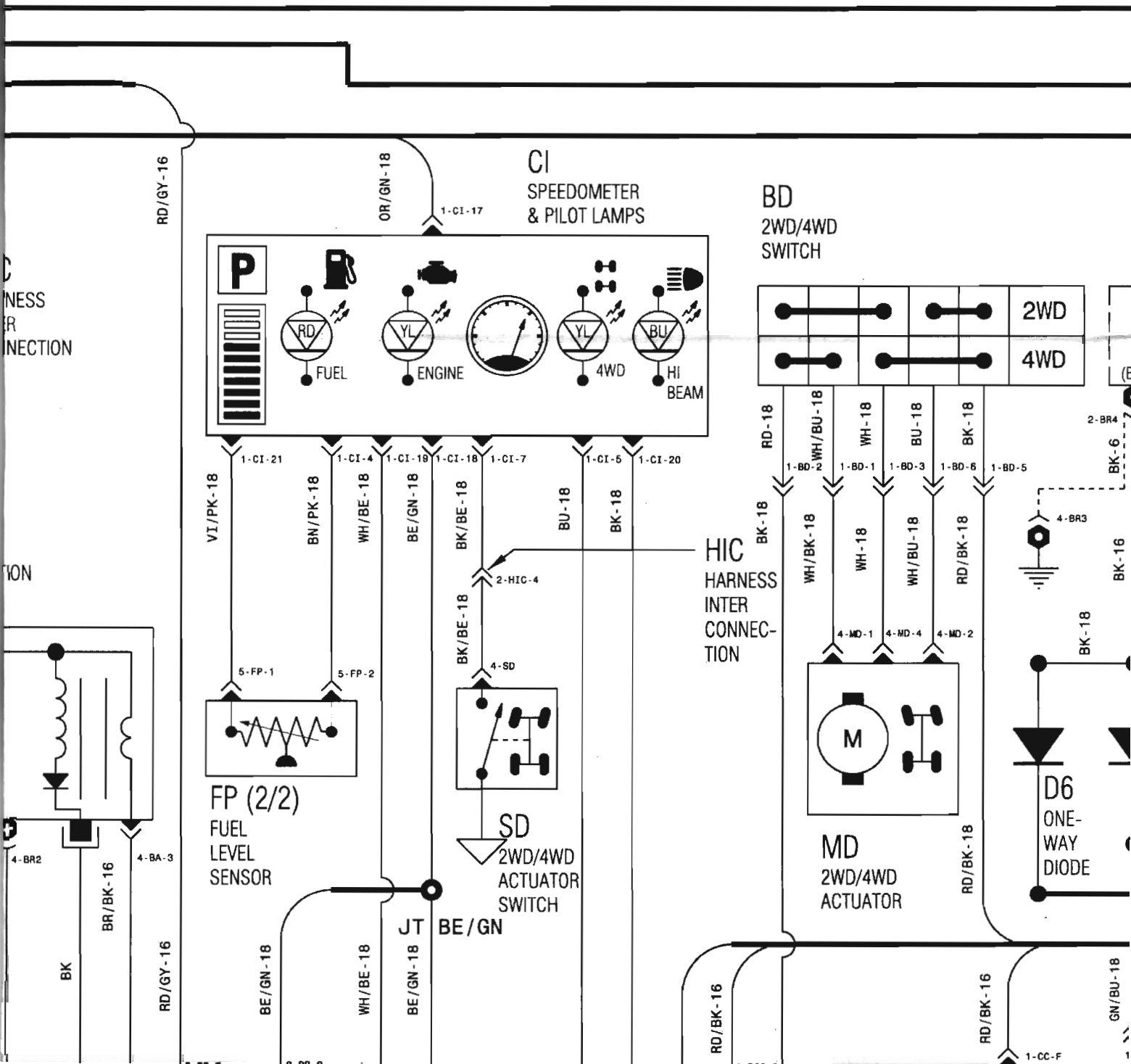


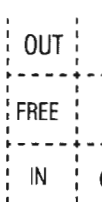
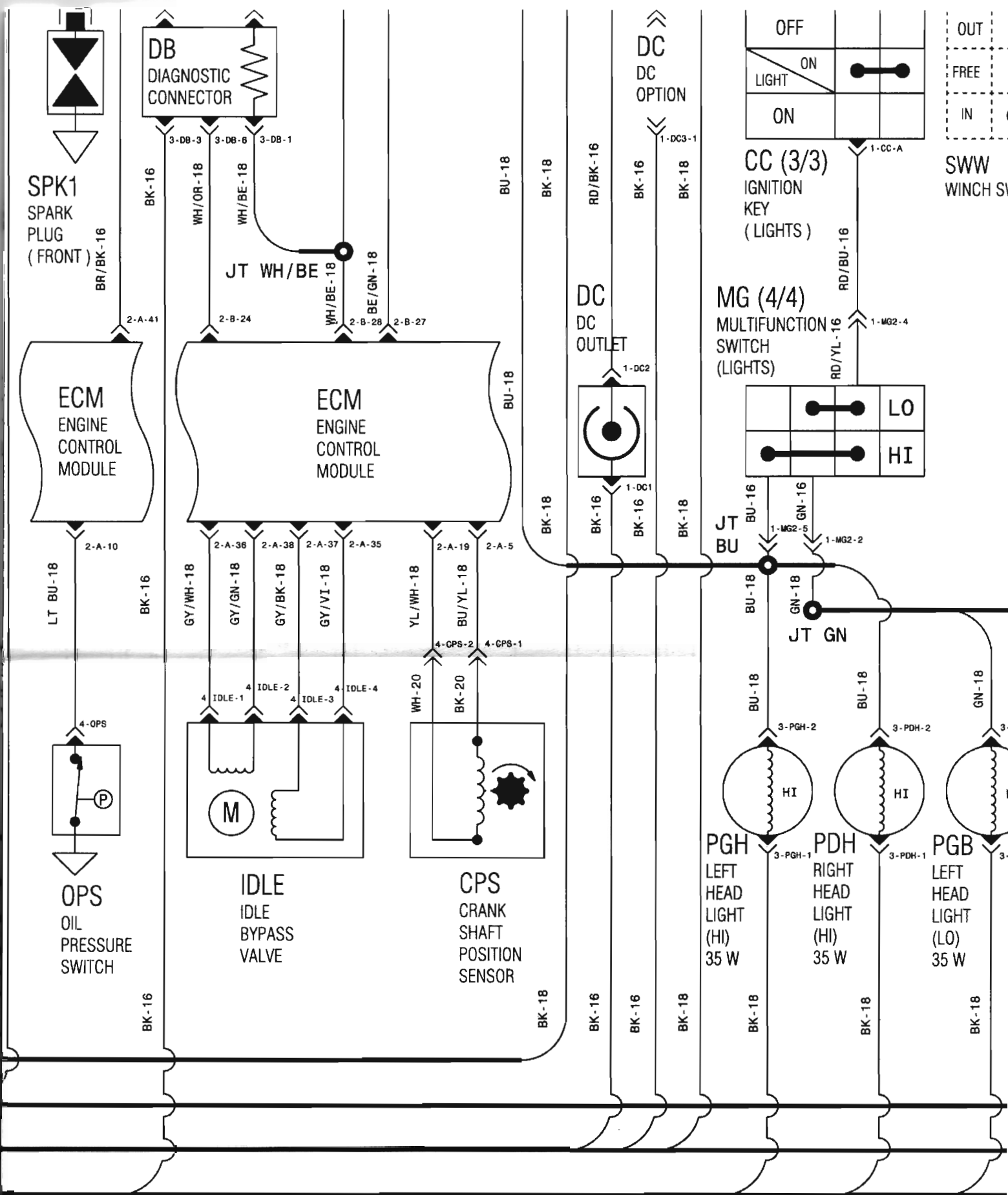
**TERMINAL IDENTIFICATION**

EX:	NAME	ZONE	-	CONNECTOR	-	TERMINAL #/A
EX:	CI	1	-	CI	-	15
EX:	CV	4	-	CV	-	A
EX:	ME	2	-	ME	-	

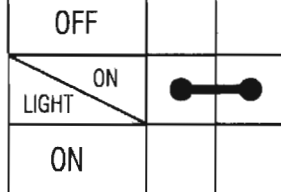
AWG	MAX. CURRENT	MAX. FUSE CURRENT	MAX. WATT
# 6	100 amps	125 amps	1450 watts
# 8	65 amps	80 amps	930 watts
# 10	40 amps	50 amps	580 watts
# 12	25 amps	30 amps	365 watts
# 14	16 amps	20 amps	230 watts
# 16	10 amps	15 amps	145 watts
# 18	6 amps	7.5 amps	85 watts
* AT	50°C MAX		

ZONE
1
2
3
4
5



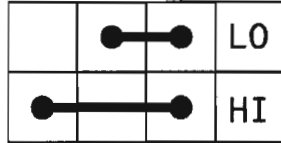


SWW WINCH SWITCH



CC (3/3) IGNITION KEY (LIGHTS)

MG (4/4) MULTIFUNCTION SWITCH (LIGHTS)



15

16

17

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19

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21



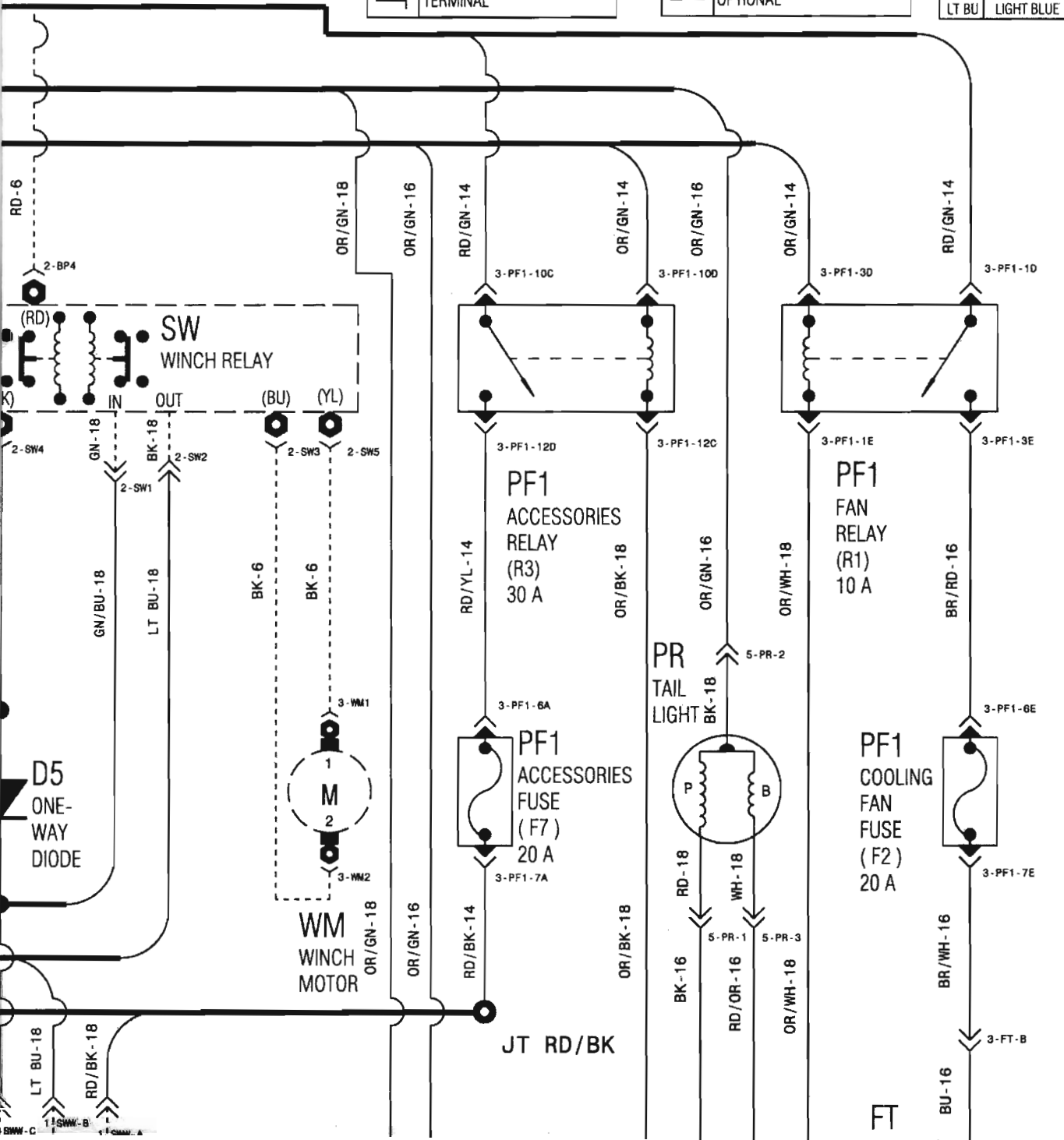
2      23      24      25      26      27      28

#	ZONE DESCRIPTION
	STEERING AREA
	MODULE AREA
	FRONT OF VEHICLE
	ENGINE AREA
	REAR OF VEHICLE

●	WELDED JOINT
—	SHRINKED JOINT
↔	CROSSED WIRE
—	WIRE BUS
—	SIMPLE CONDUCTOR WIRE
Y	FEMALE TERMINAL
→	MALE TERMINAL
—	STEEL LINK (FRAME)
—	TERMINAL

⏏	FRAME GROUND
⏏	ENGINE GROUND
⊕	PHILLIPS SCREW
⊕	NUT CONNECTION
⊕	SPLICE CONNECTION
⏏	COMPONENT CONNECTION
⏏	SECTION OF MODULE
⊕	SLOTTED SCREW
---	OPTIONAL

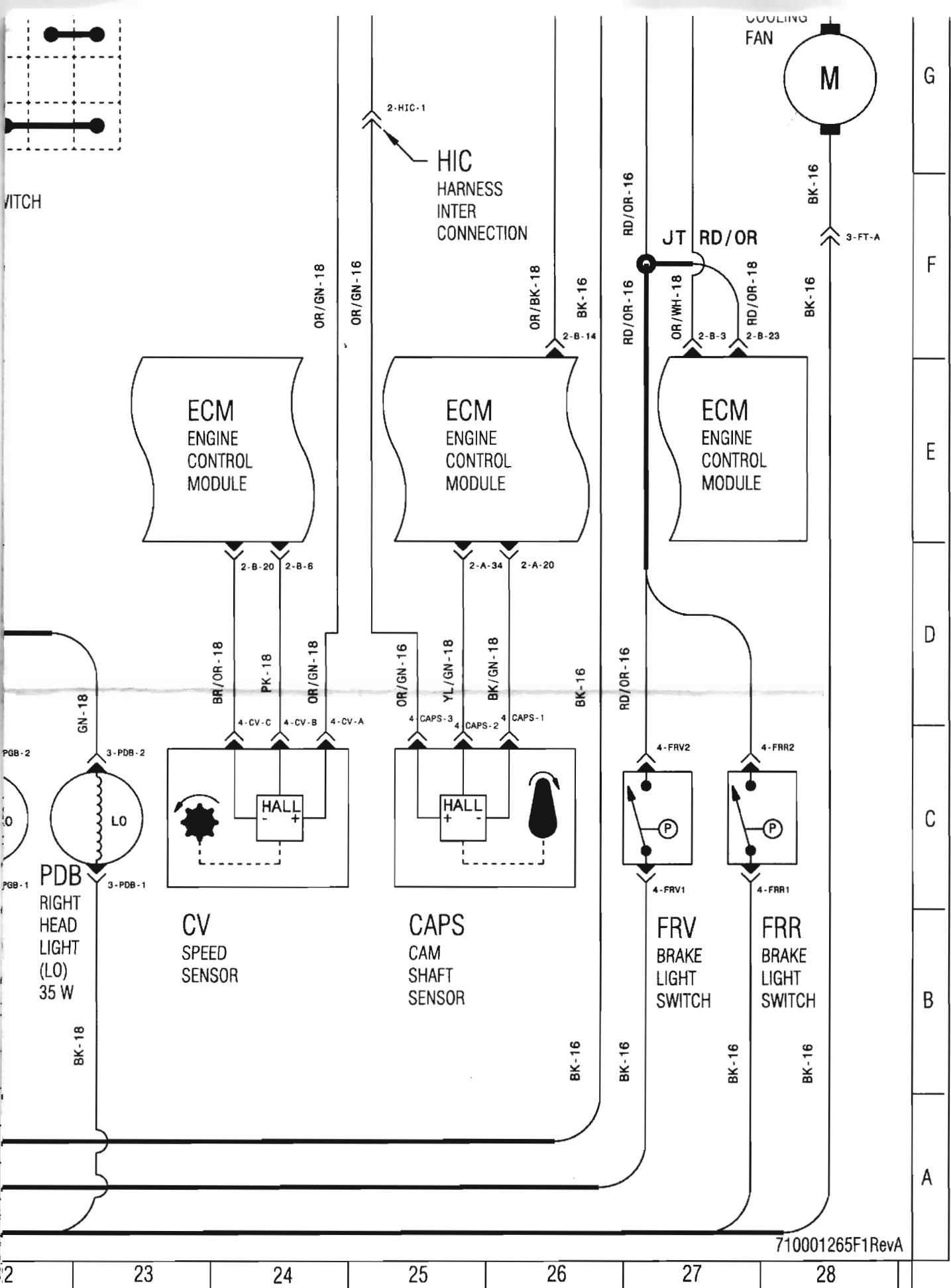
COLOR CODE	
BE	BEIGE
BK	BLACK
BU	BLUE
BN	BROWN
GN	GREEN
GY	GREY
OR	ORANGE
RD	RED
VI	VIOLET
WH	WHITE
YL	YELLOW
PK	PINK
LT BU	LIGHT BLUE



P  
N  
M  
L  
K  
J  
H

JT RD/BK

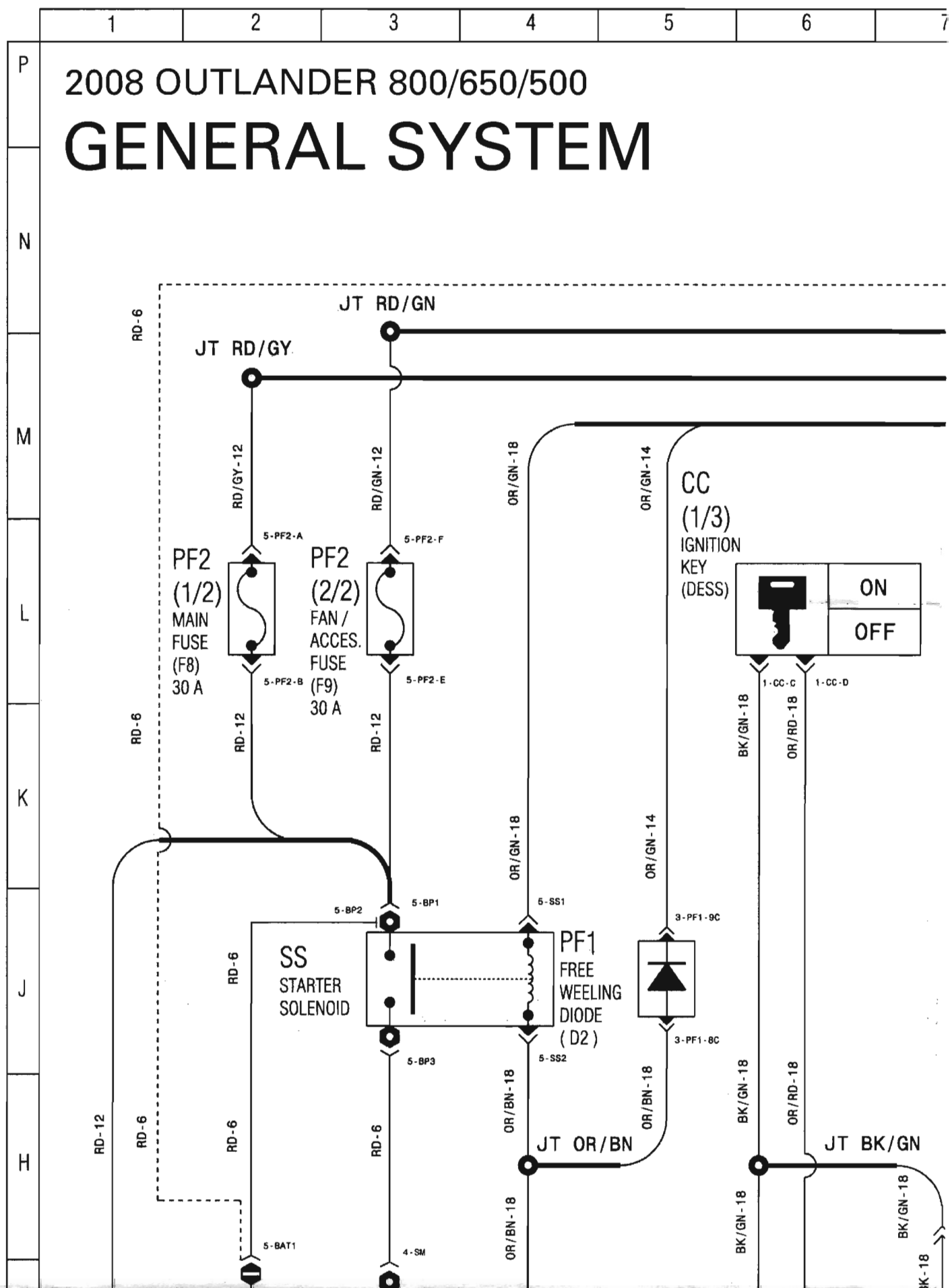
FT

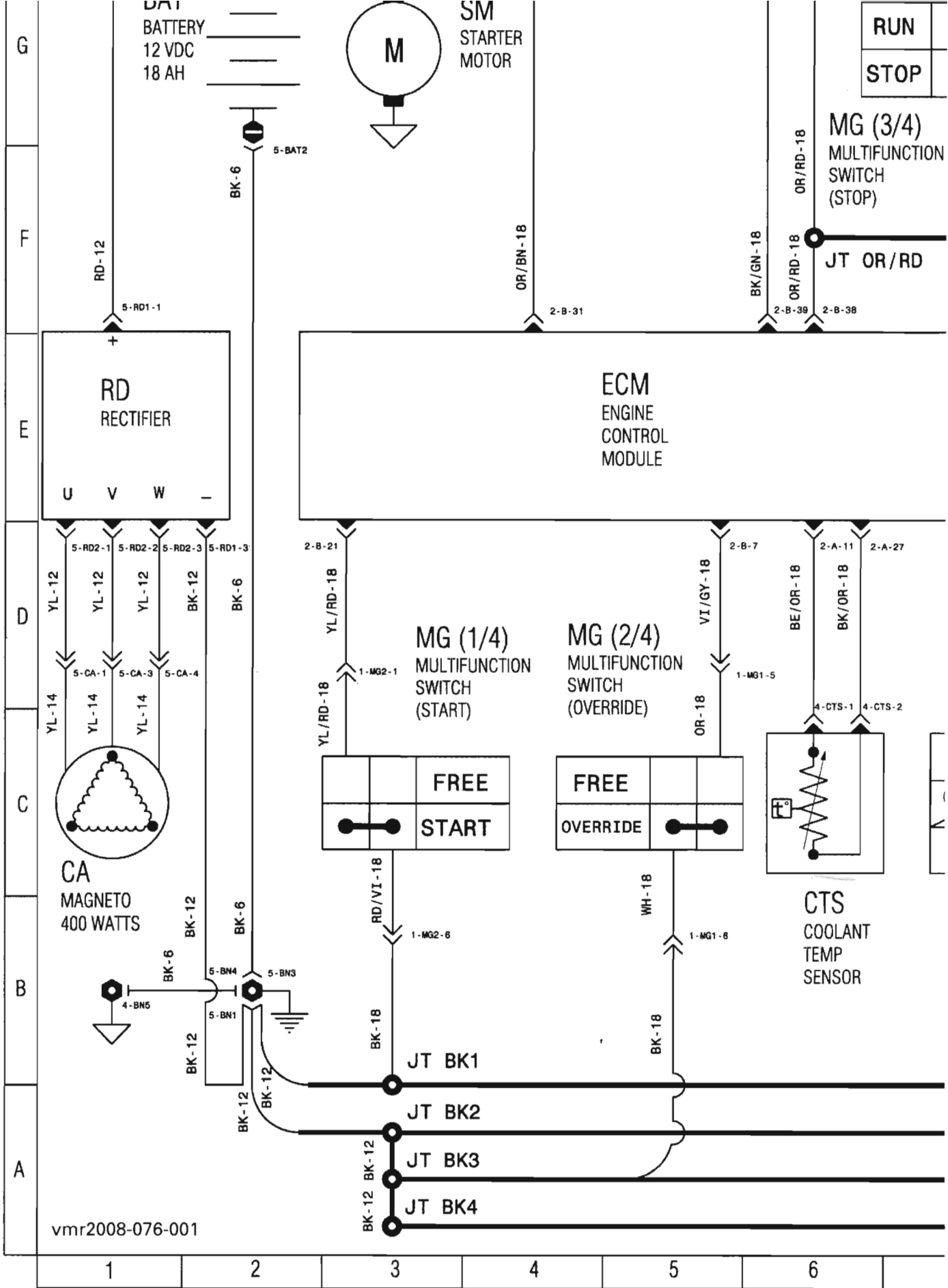


710001265F1RevA

2008 OUTLANDER 800/650/500

# GENERAL SYSTEM





vmr2008-076-001

- 1
- 2
- 3
- 4
- 5
- 6

8

9

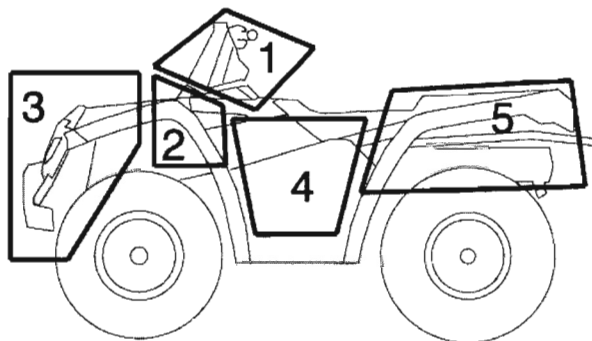
10

11

12

13

14



E  
E  
E

JT OR/GN

PF1  
MAIN  
RELAY  
(R2)  
10 A

PF1  
RELAYS  
SPEEDO  
FUSE  
(F4)  
7.5 A

PF1  
IGNITION  
COIL  
FUSE  
(F1)  
5 A

HIC  
HARN  
INTER  
CONN

JT OR/BU

JT RD/BE

BA  
IGNITIC  
COIL

PF1  
ONEWAY  
DIODE  
(D1)

PF1  
FUEL  
PUMP  
FUSE  
(F5)  
7.5 A

PF1  
ECM  
FUSE  
(F6)  
5 A

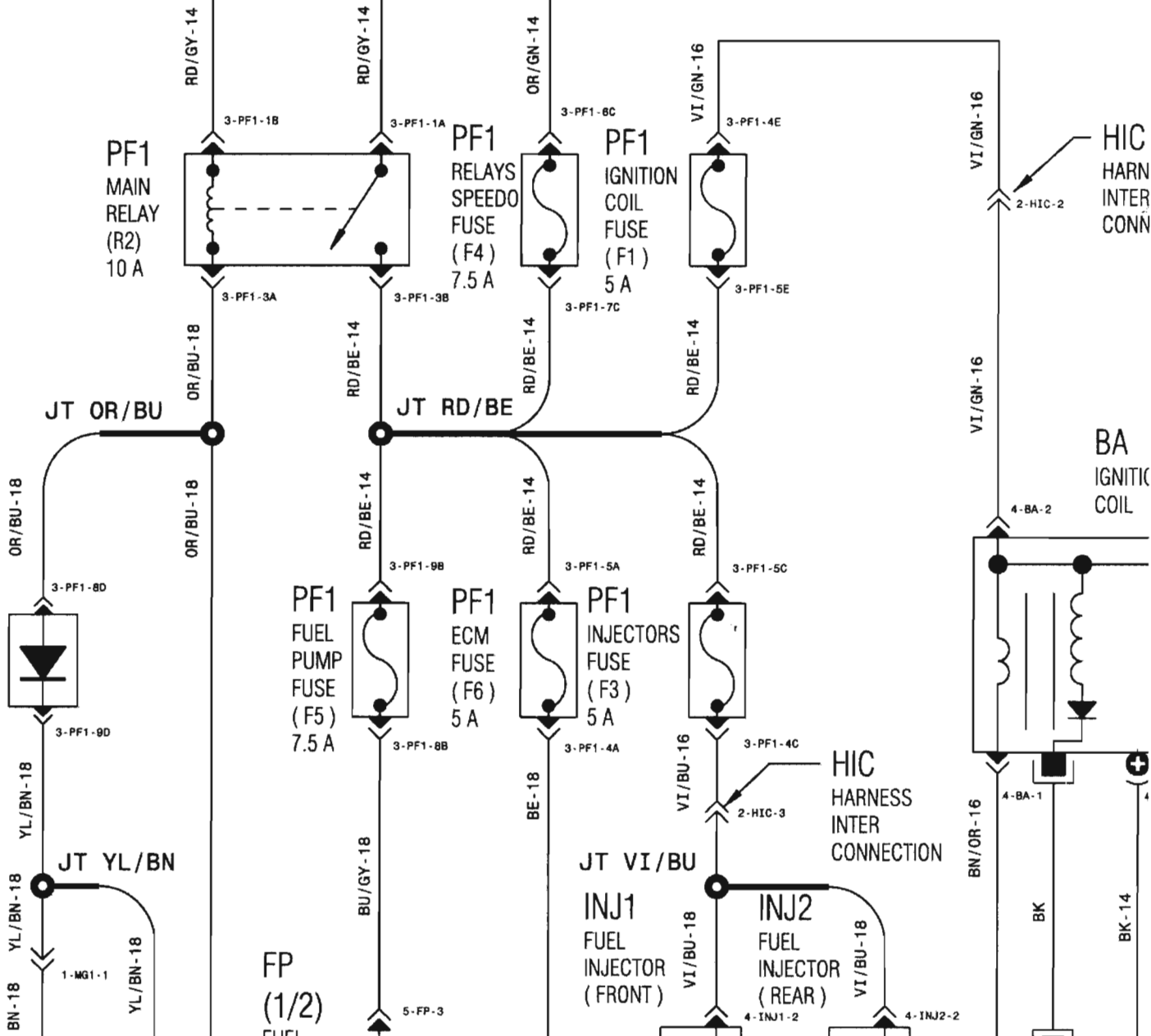
PF1  
INJECTORS  
FUSE  
(F3)  
5 A

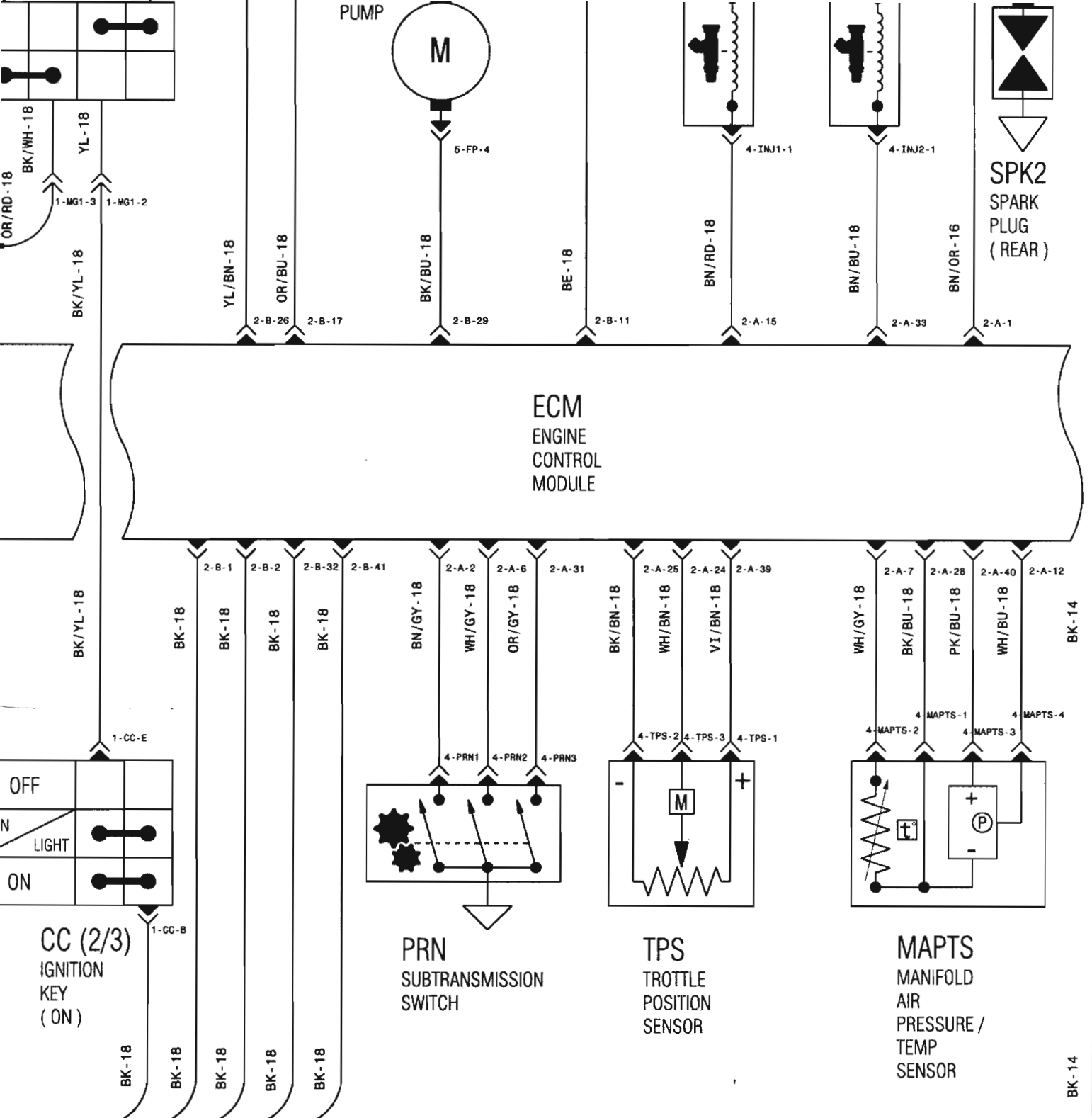
HIC  
HARNES  
INTER  
CONNECTION

FP  
(1/2)

INJ1  
FUEL  
INJECTOR  
(FRONT)

INJ2  
FUEL  
INJECTOR  
(REAR)



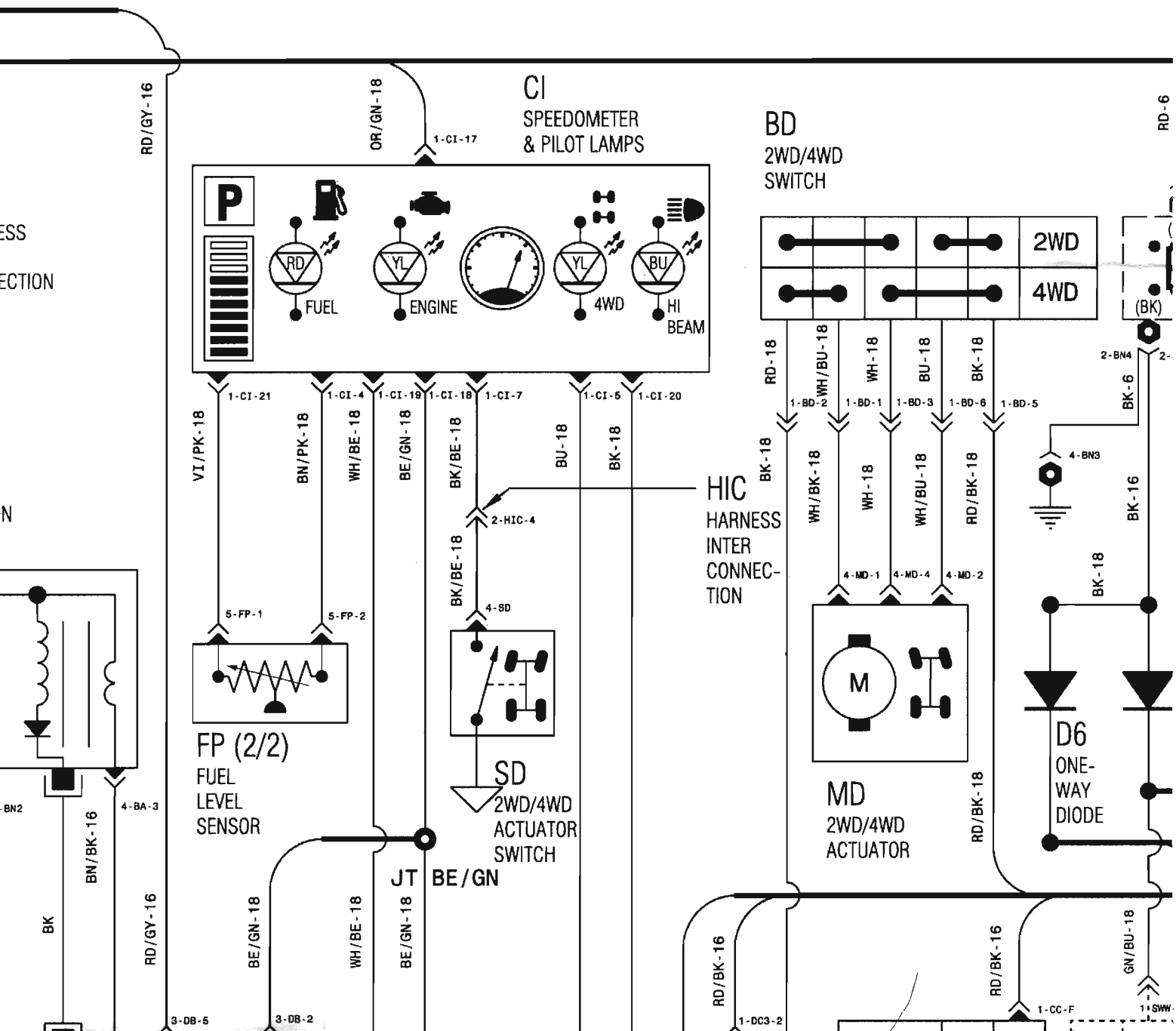


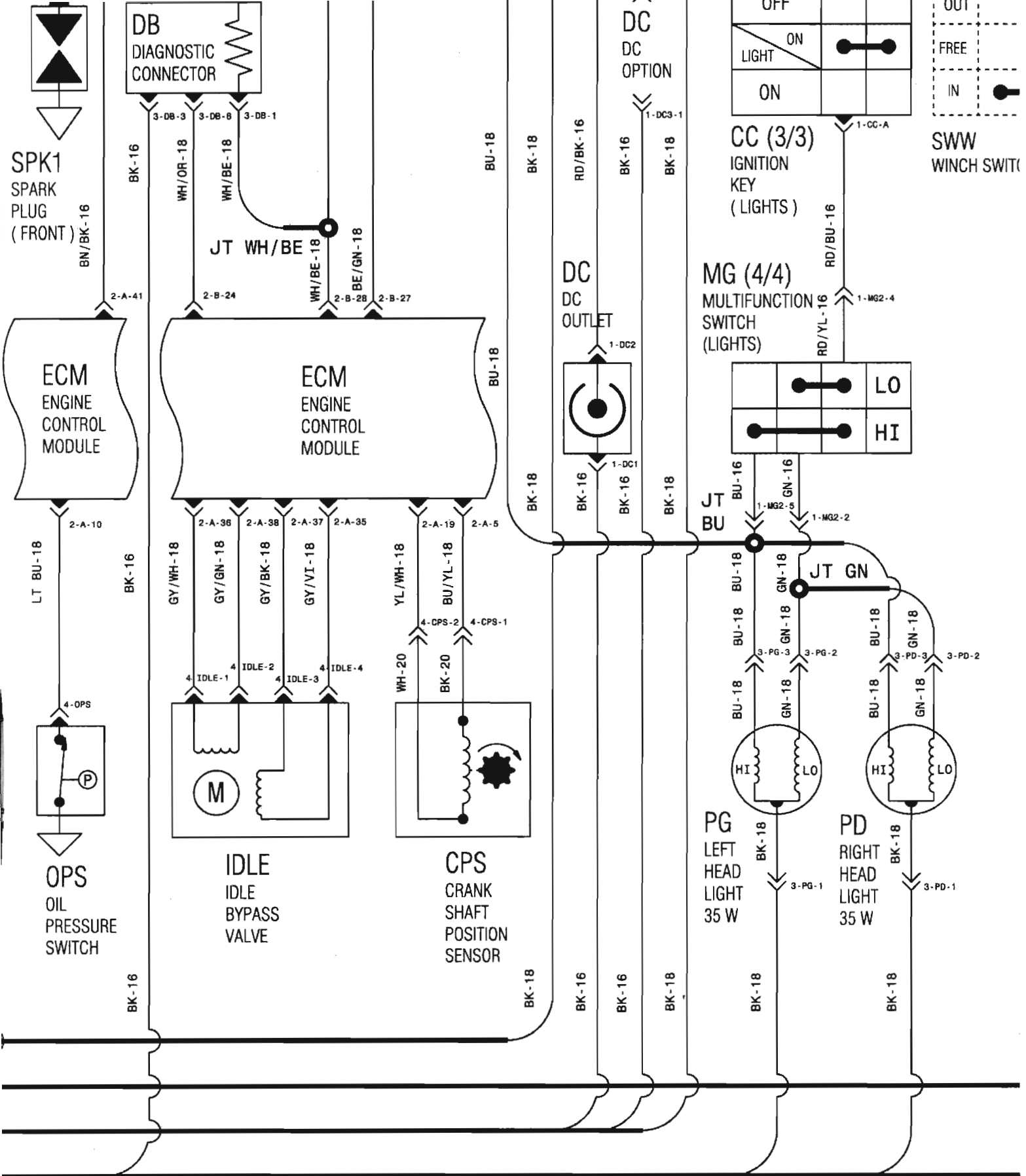
7	8	9	10	11	12	13	14
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TERMINAL IDENTIFICATION		
	NAME	ZONE-CONNECTOR NAME-TERMINAL #/A
X:	CI	1 - CI - 15
X:	CV	4 - CV - A
X:	ME	2 - ME

AWG	MAX. CURRENT	MAX. FUSE CURRENT	MAX. WATT
# 6	100 amps	125 amps	1450 watts
# 8	65 amps	80 amps	930 watts
# 10	40 amps	50 amps	580 watts
# 12	25 amps	30 amps	365 watts
# 14	16 amps	20 amps	230 watts
# 16	10 amps	15 amps	145 watts
# 18	6 amps	7.5 amps	85 watts
* AT	50°C MAX		

ZONE #
1
2
3
4
5





15

16

17

18

19

20

21

22



23

24

25

26

27

28

ZONE DESCRIPTION

STEERING AREA

MODULE AREA

FRONT OF VEHICLE

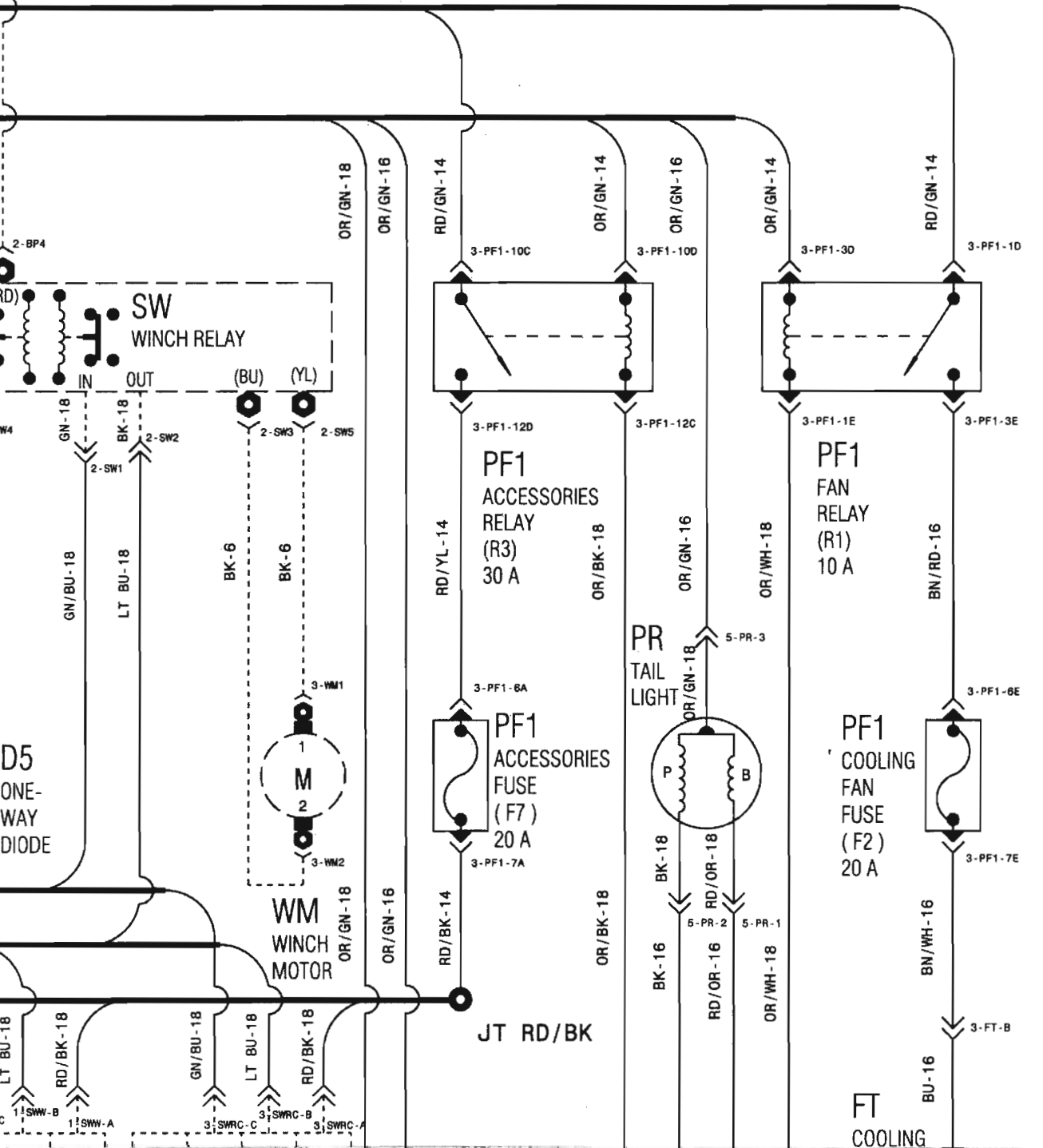
ENGINE AREA

REAR OF VEHICLE

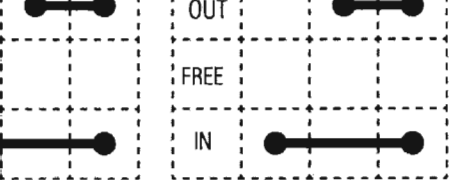
●	WELDED JOINT
—	SHRINKED JOINT
↔	CROSSED WIRE
—	WIRE BUS
—	SIMPLE CONDUCTOR WIRE
⌋	FEMALE TERMINAL
→	MALE TERMINAL
—○—	STEEL LINK (FRAME)
—	TERMINAL

⏏	FRAME GROUND
⏏	ENGINE GROUND
⊕	PHILLIPS SCREW
⊖	NUT CONNECTION
⊙	SPLICE CONNECTION
⏏	COMPONENT CONNECTION
⏏	SECTION OF MODULE
⊖	SLOTTED SCREW
---	OPTIONAL

COLOR CODE	
BE	BEIGE
BK	BLACK
BU	BLUE
BN	BROWN
GN	GREEN
GY	GREY
OR	ORANGE
RD	RED
VI	VIOLET
WH	WHITE
YL	YELLOW
PK	PINK
LT BU	LIGHT BLUE

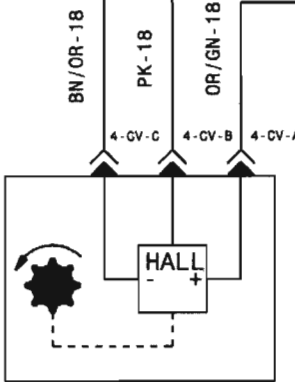
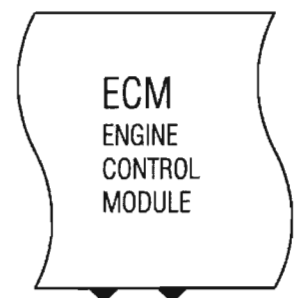


P  
N  
M  
L  
K  
J  
H

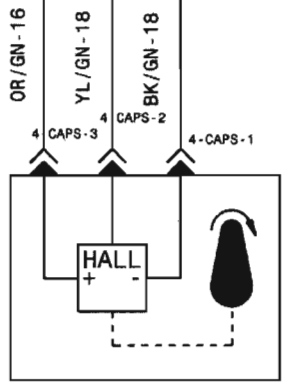
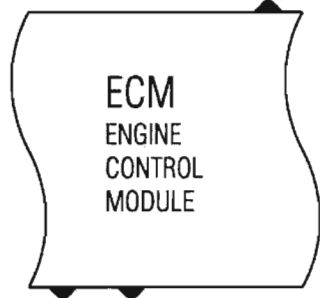


SWRC  
REMOTE  
WINCH SWITCH

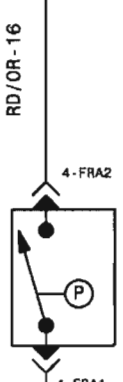
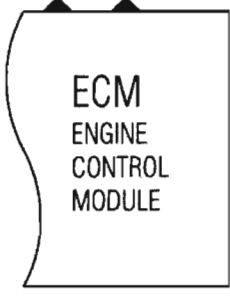
2-HIC-1  
HIC  
HARNESS  
INTER  
CONNECTION



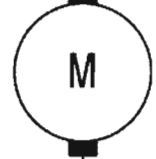
CV  
SPEED  
SENSOR



CAPS  
CAM  
SHAFT  
SENSOR



FRA  
BRAKE  
LIGHT  
SWITCH



G  
F  
E  
D  
C  
B  
A

710001317F1

23

24

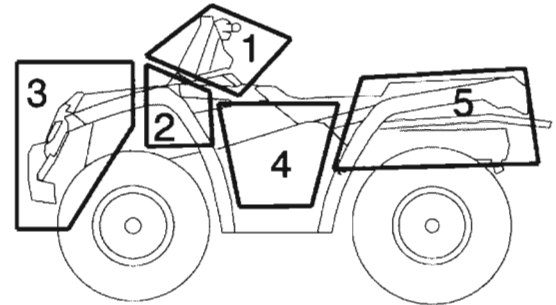
25

26

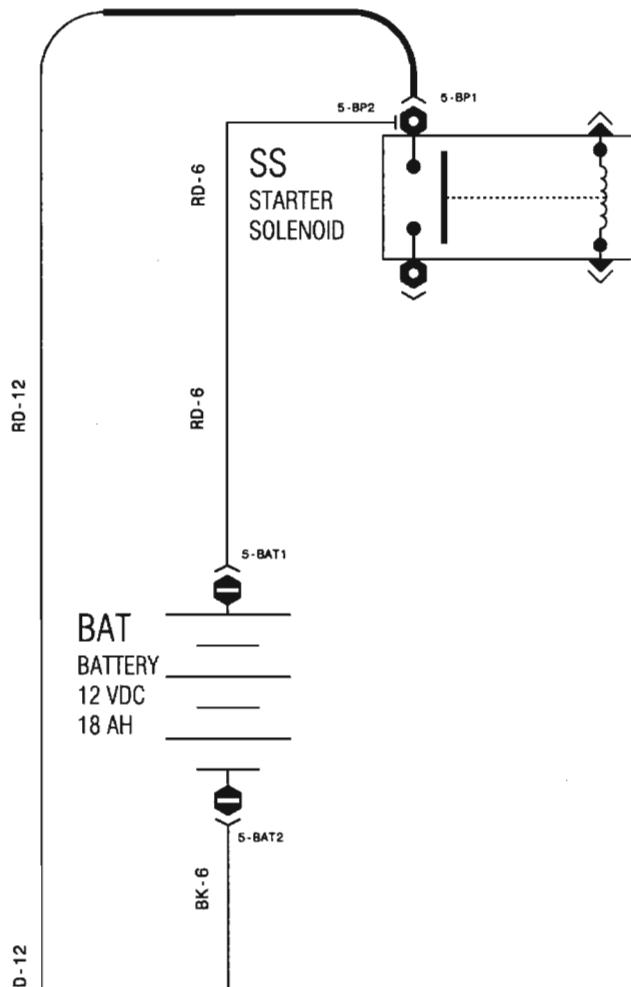
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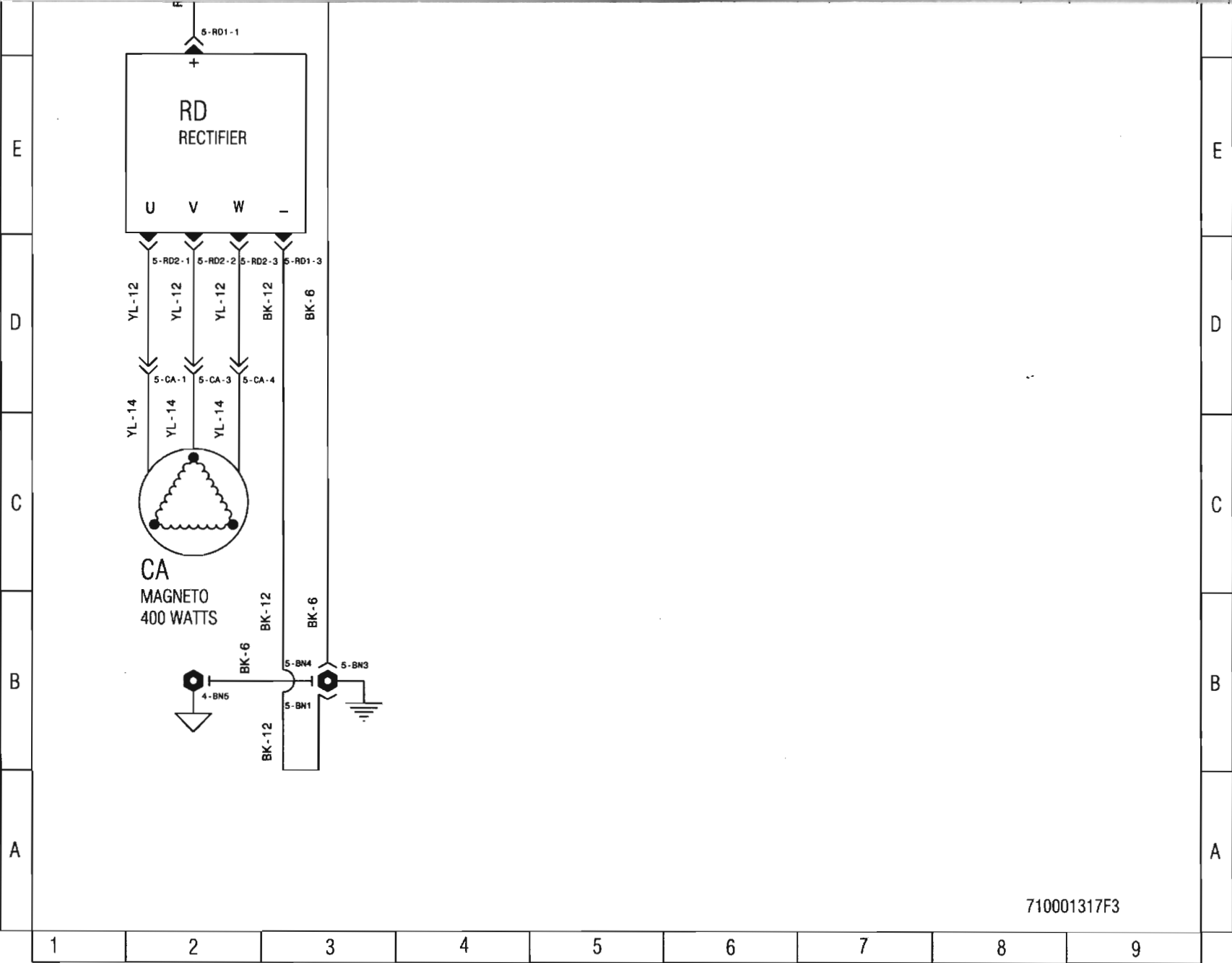
28

# 2008 OUTLANDER 800/650/500 CHARGING SYSTEM



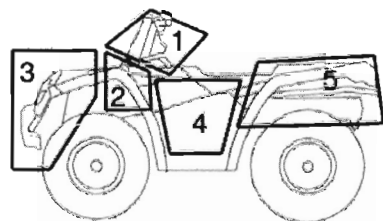
ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



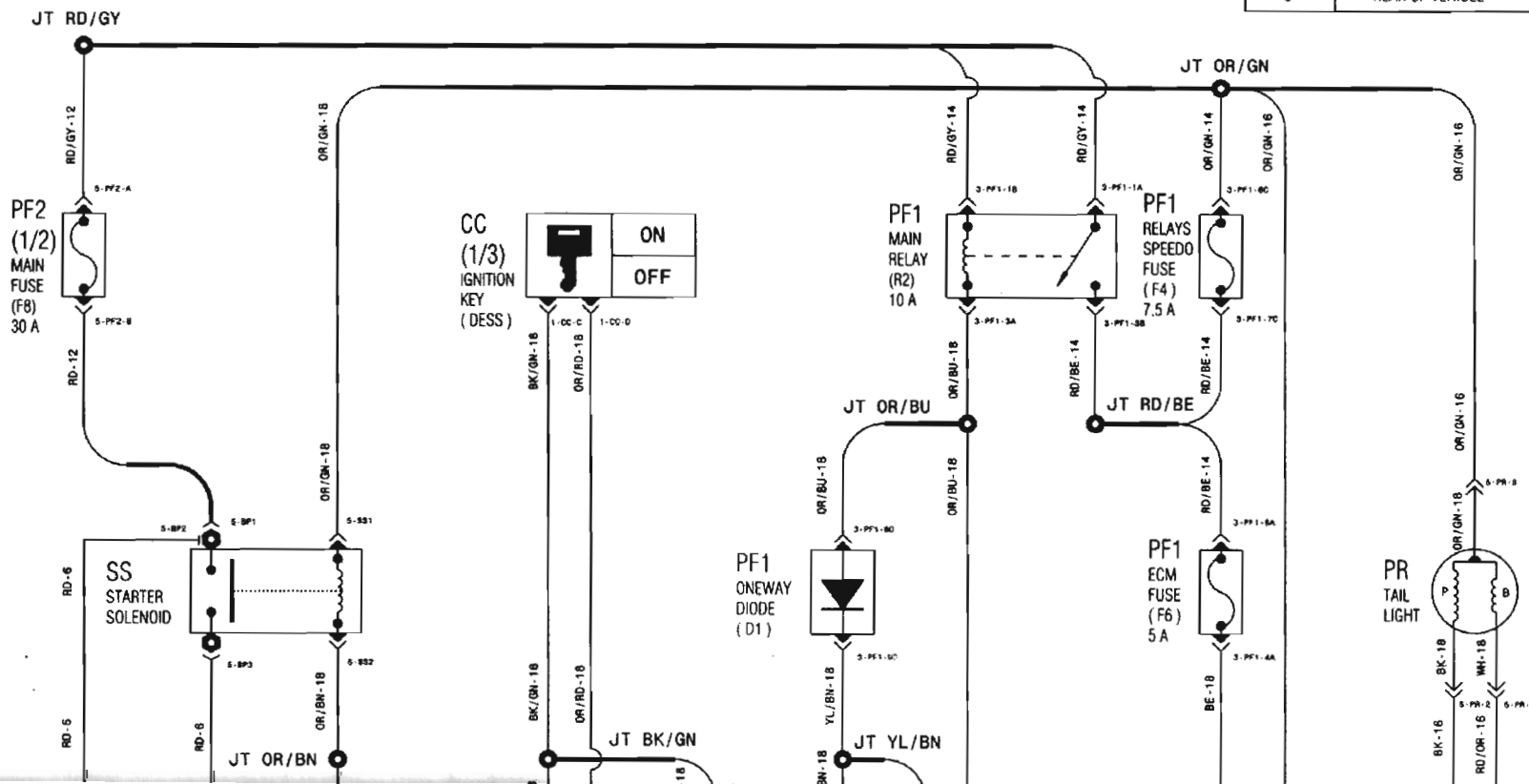


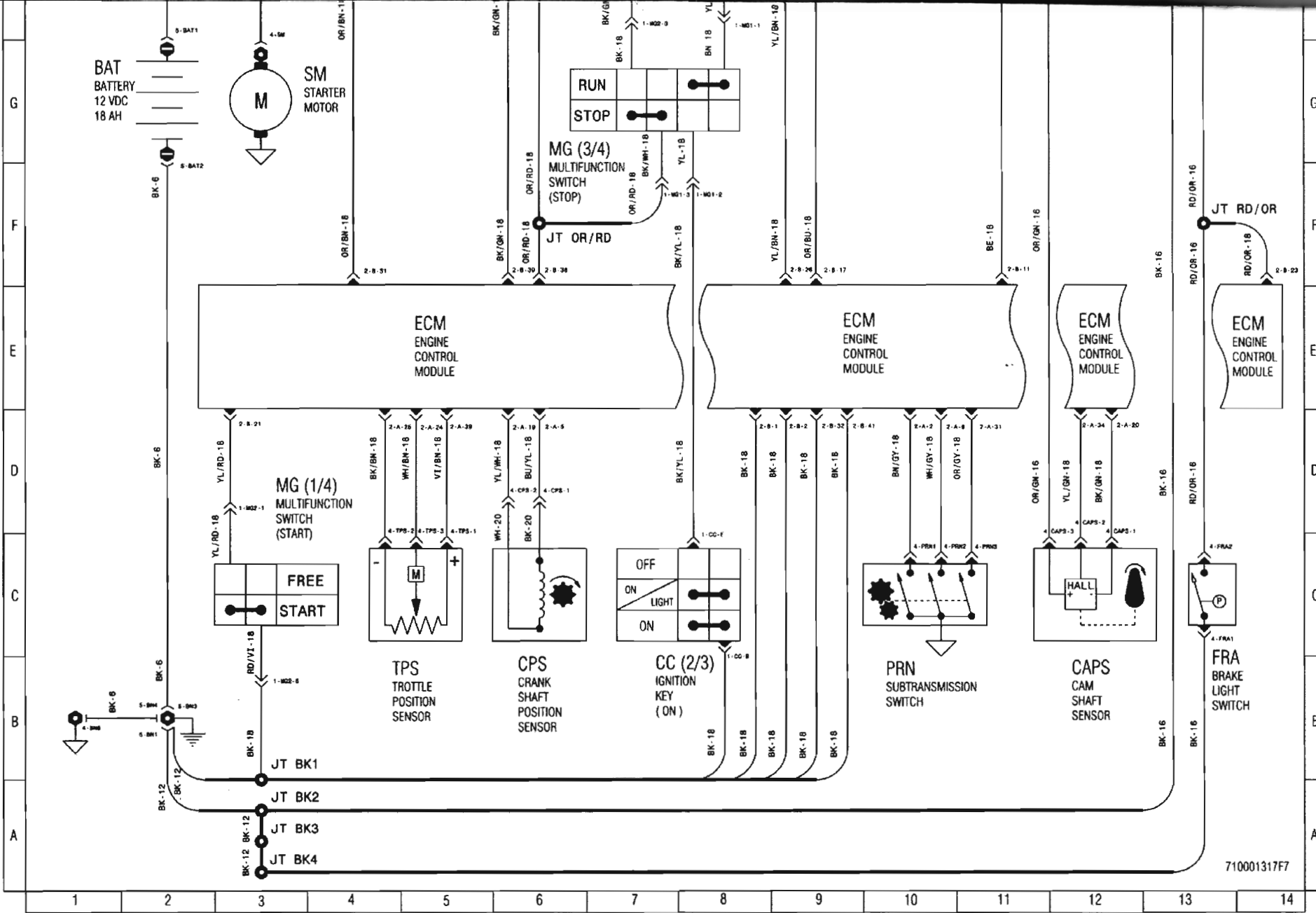
710001317F3

# 2008 OUTLANDER 800/650/500 STARTING SYSTEM



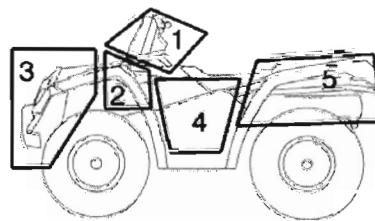
ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



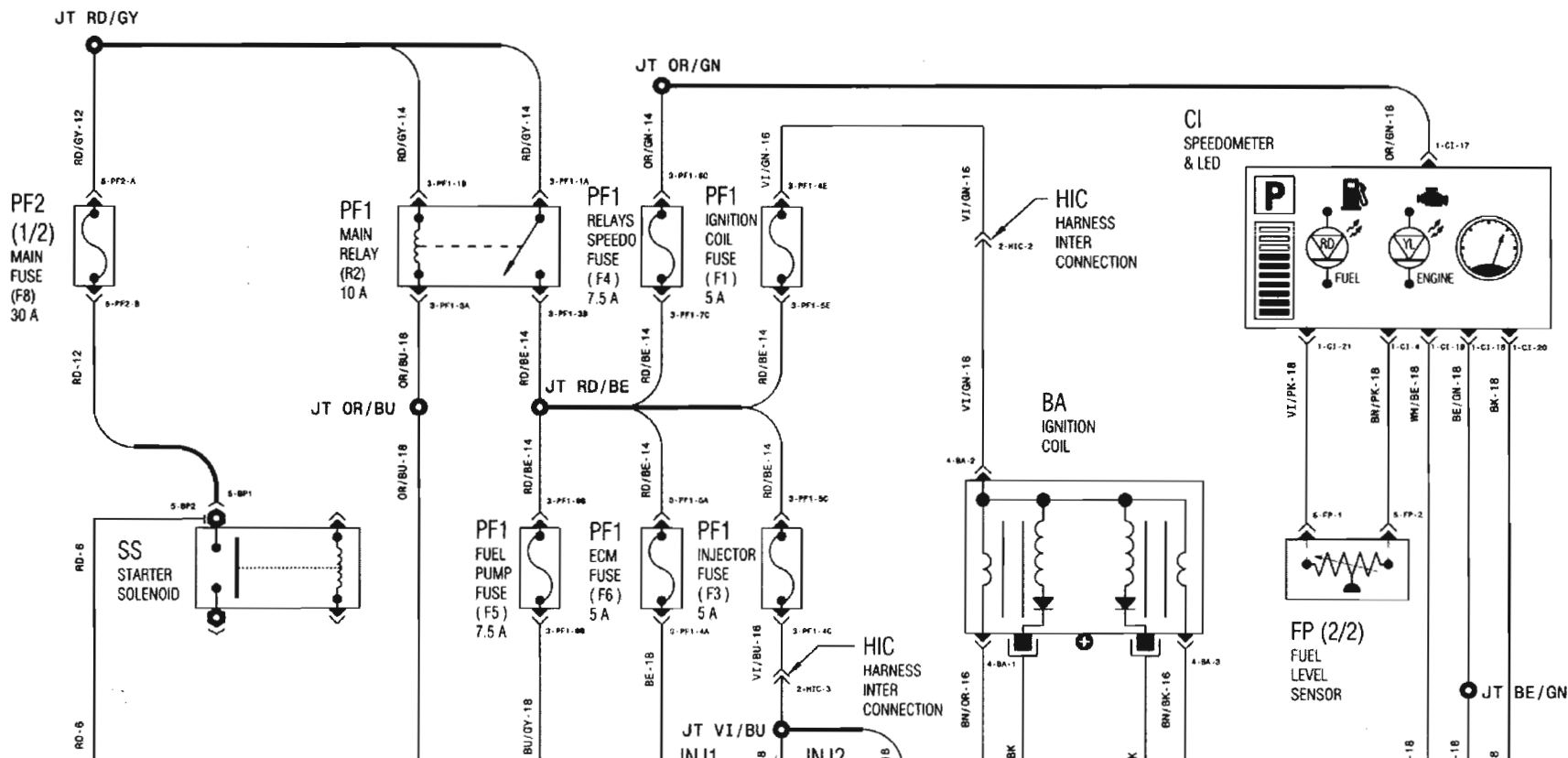


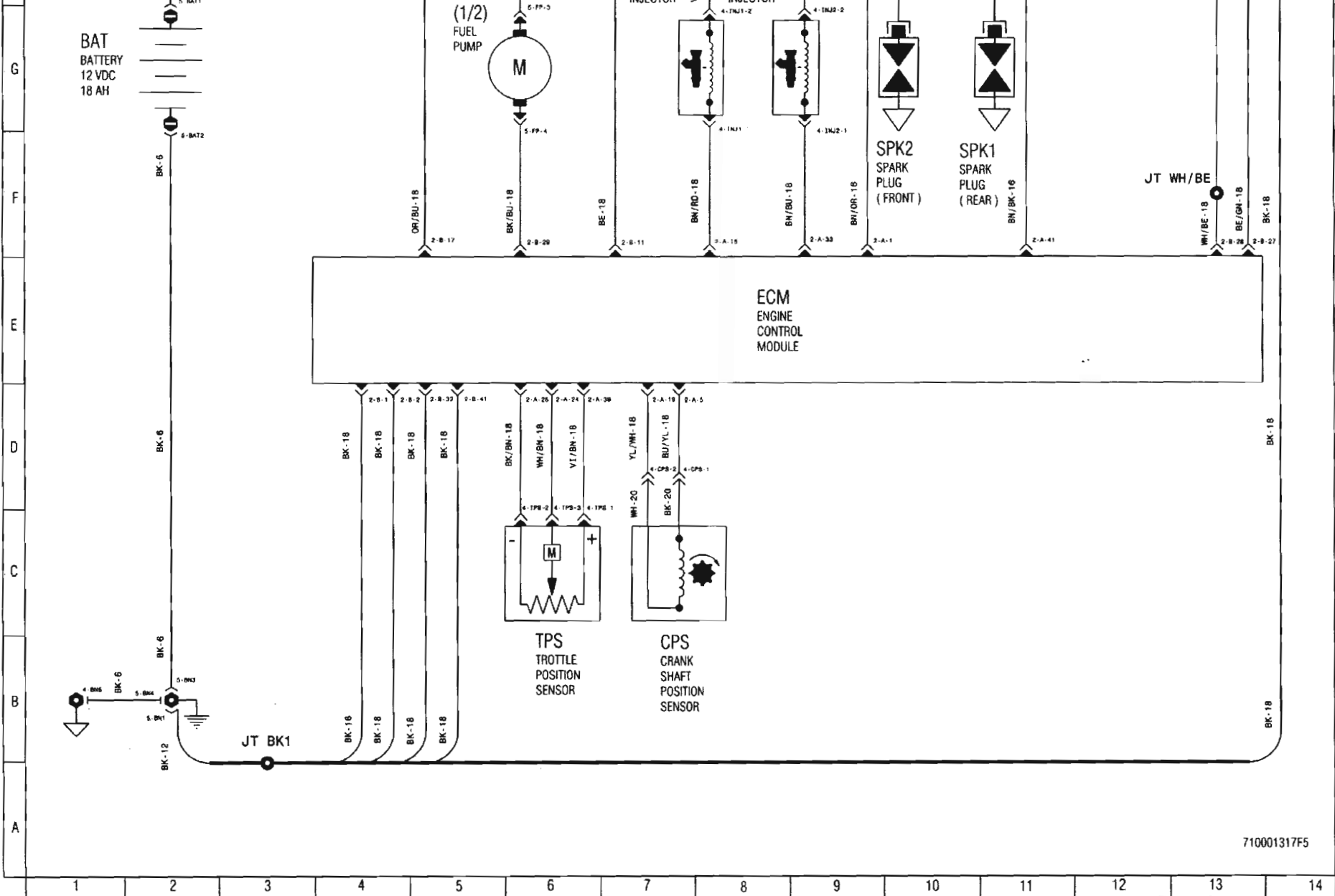
710001317F7

# 2008 OUTLANDER 800/650/500 INJECTION/IGNITION SYSTEM



ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE

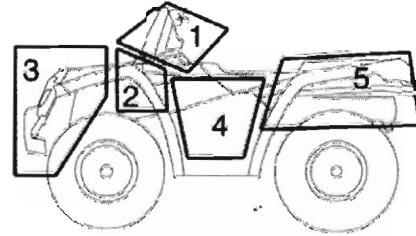




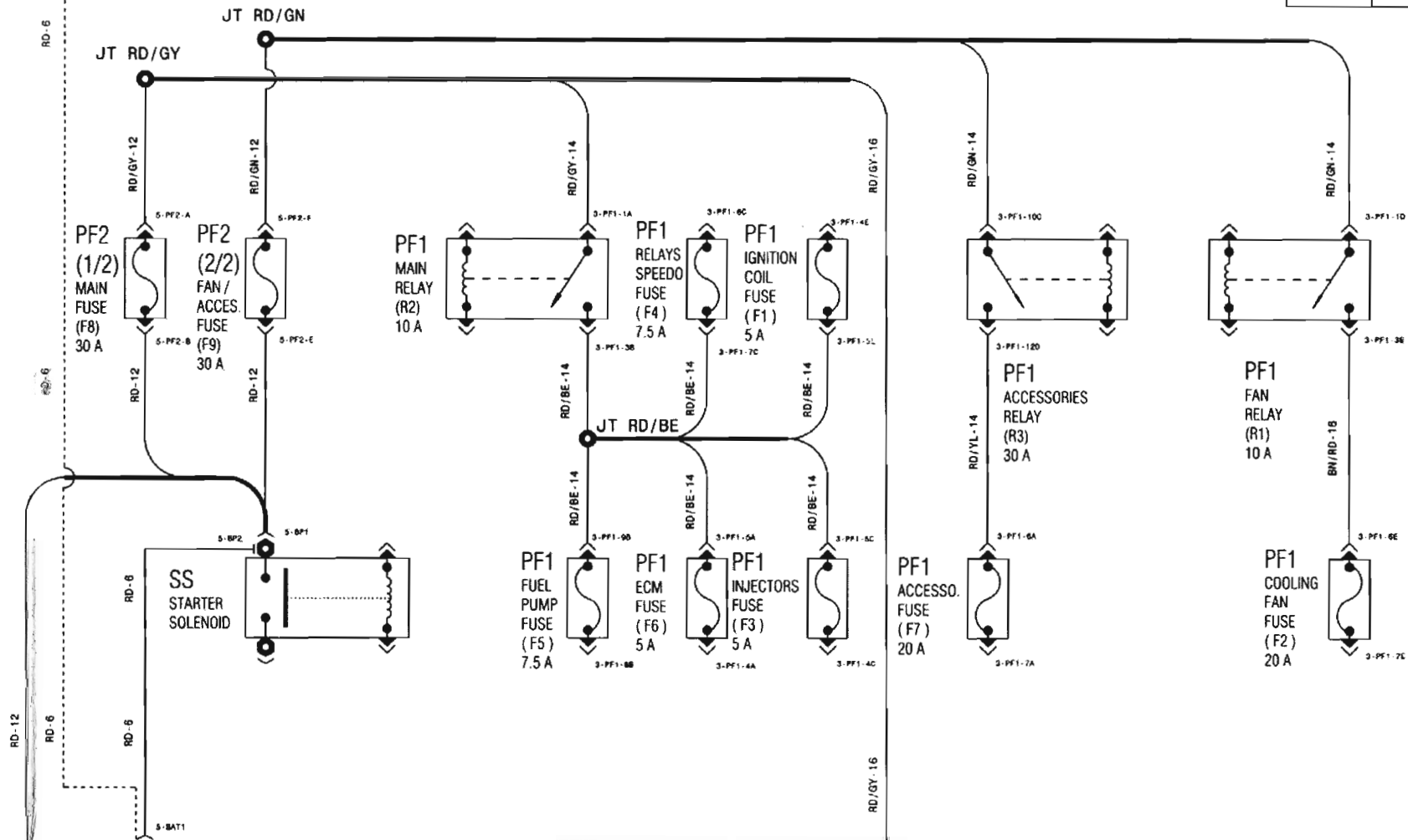
710001317F5

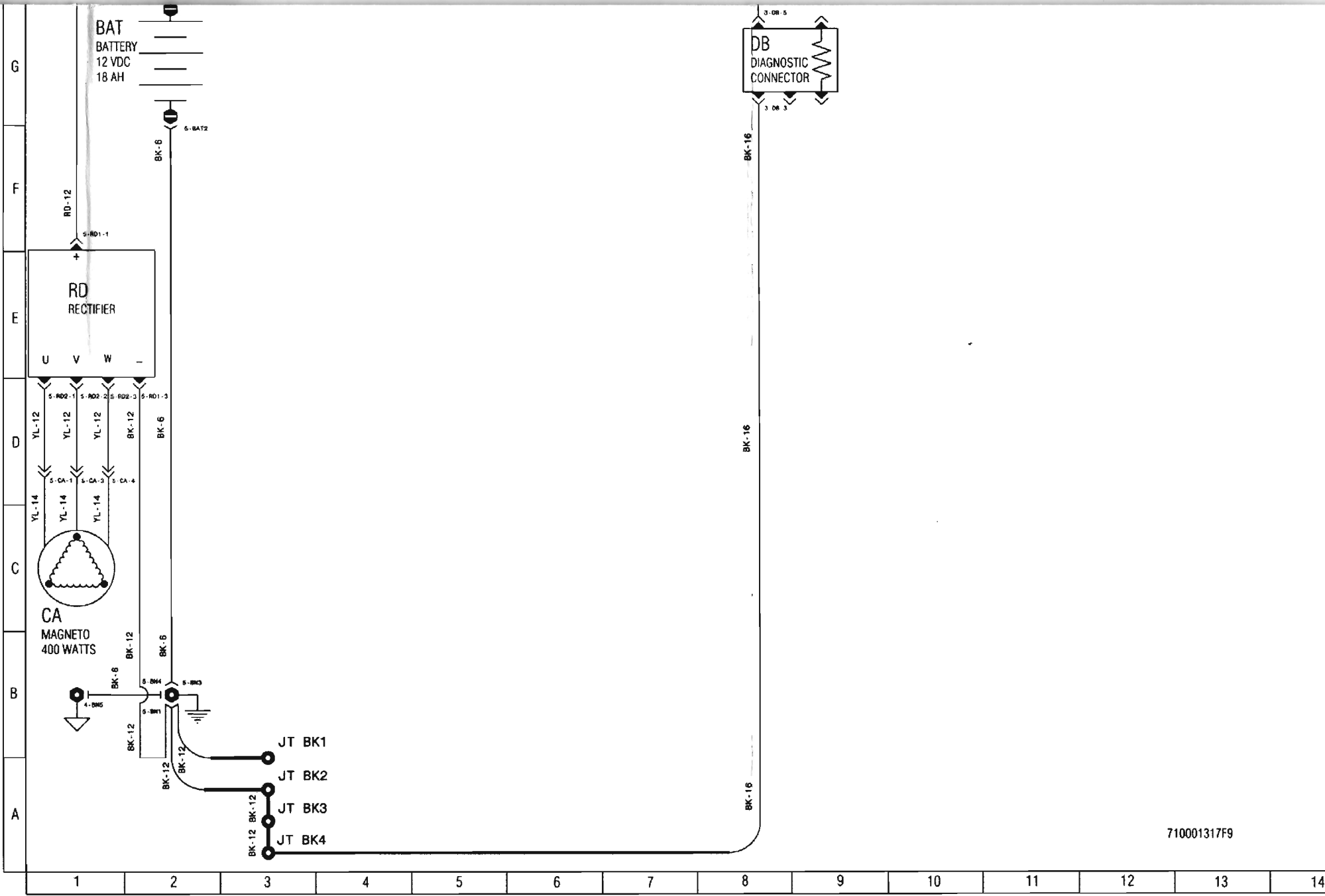


# 2008 OUTLANDER 800/650/500 DISTRIBUTION SYSTEM



ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE

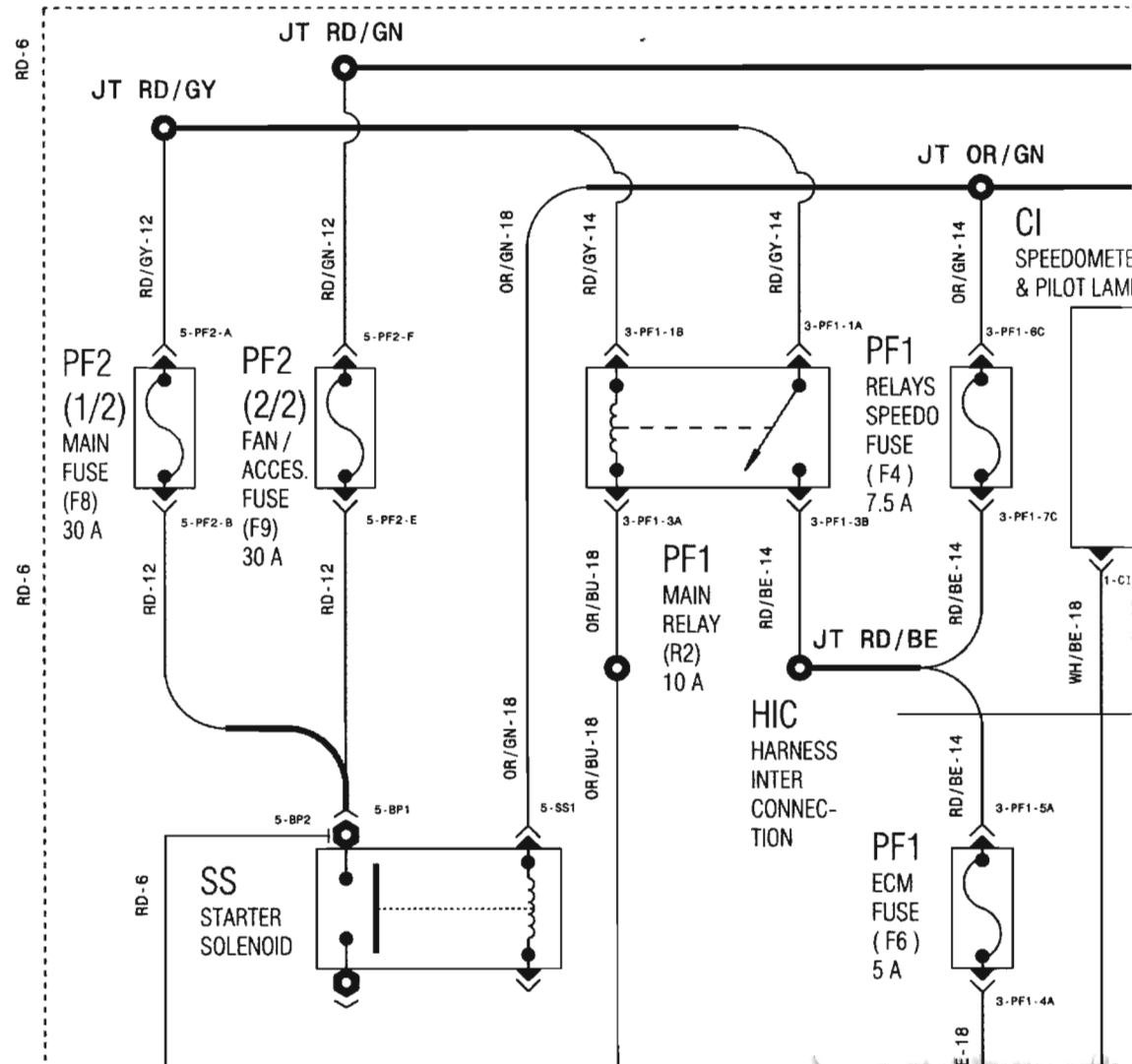




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2008 OUTLANDER 800/650/500

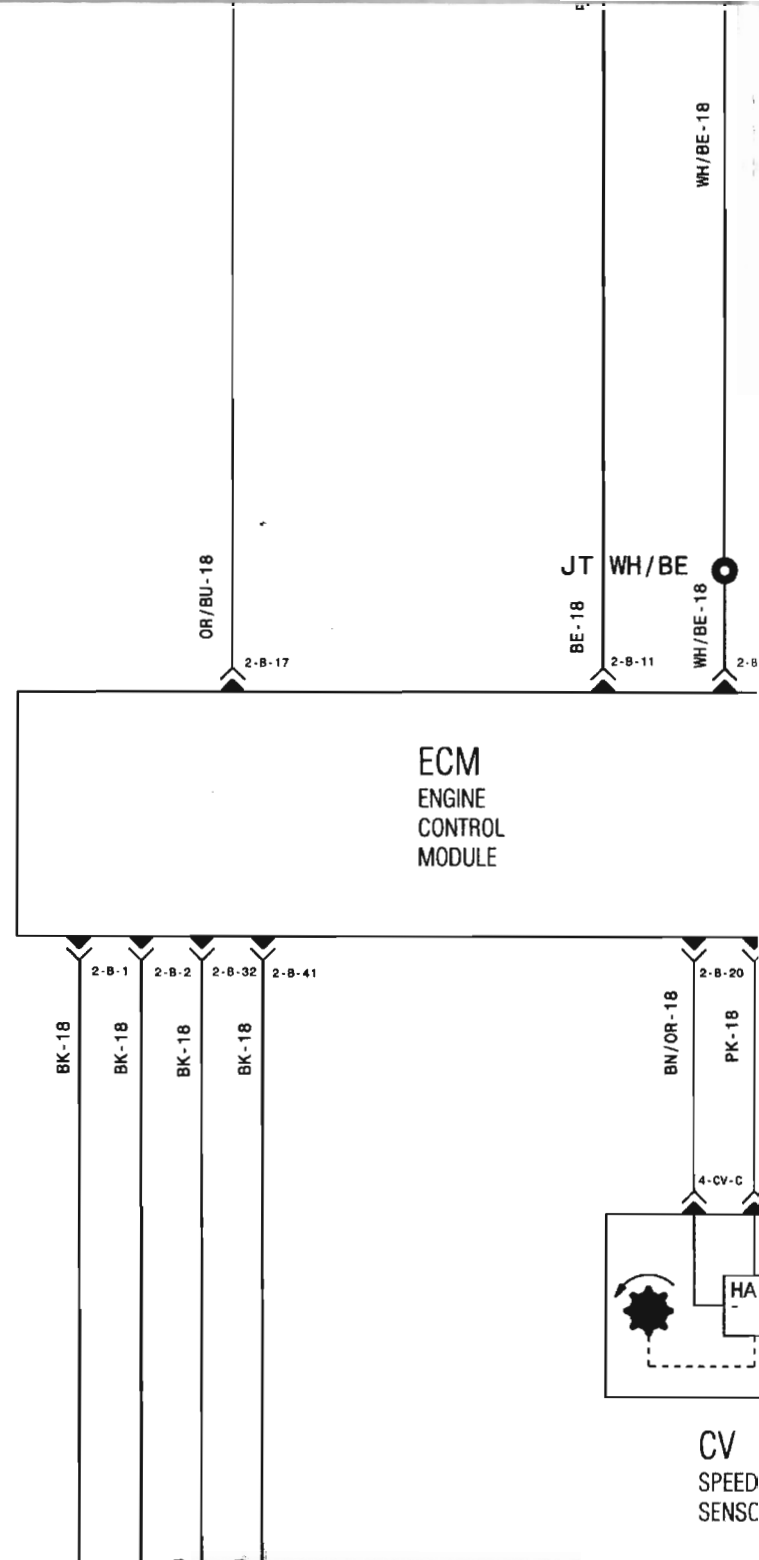
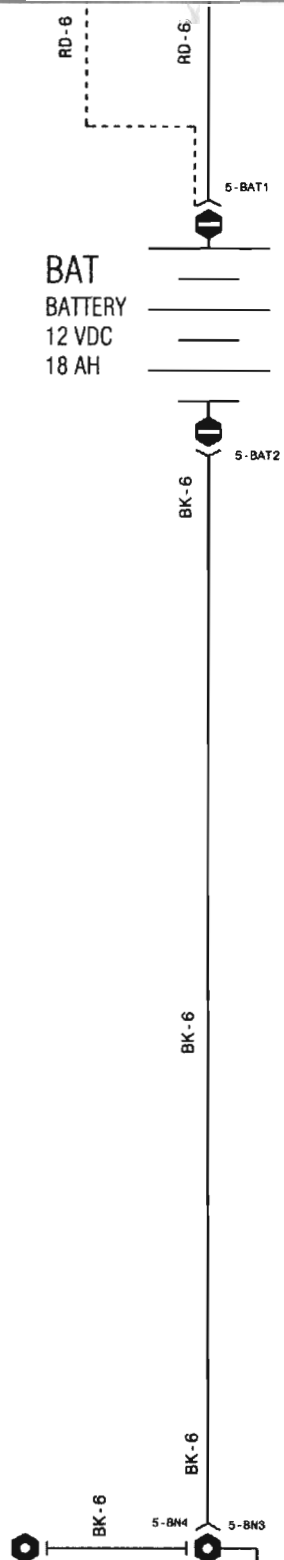
# ACCESSORIES SYSTEM

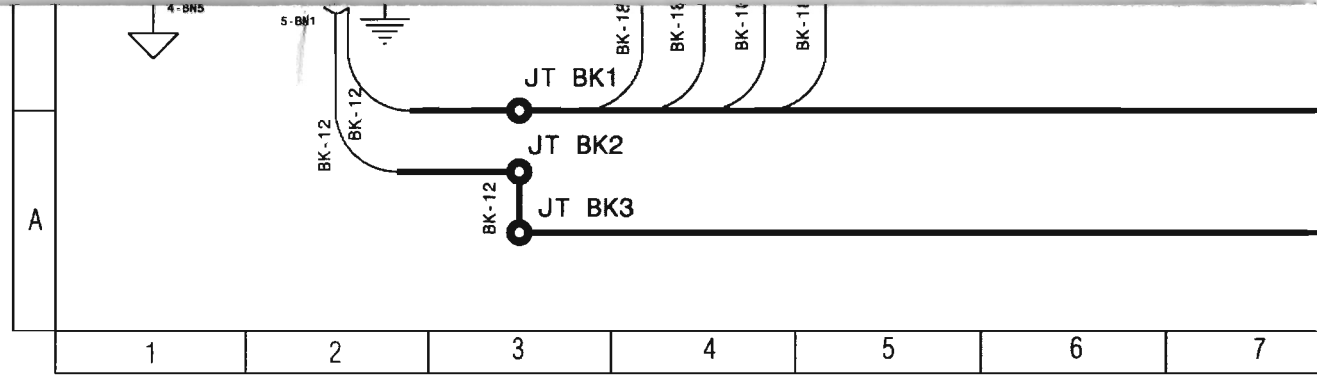


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K  
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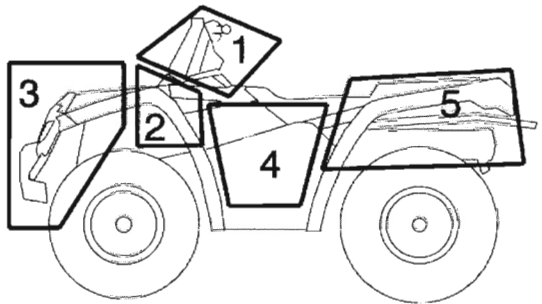
1 2 3 4 5 6 7

H  
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E  
D  
C  
B

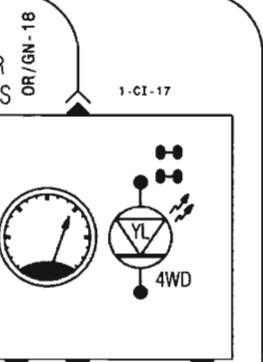




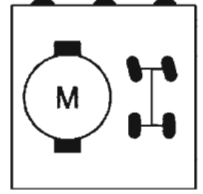
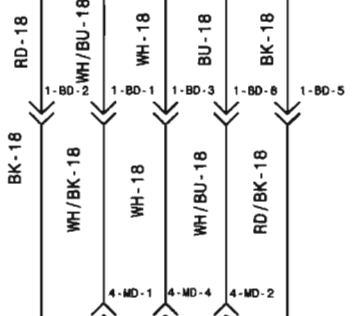
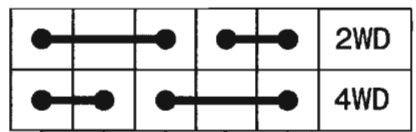
8      9      10      11      12      13      14



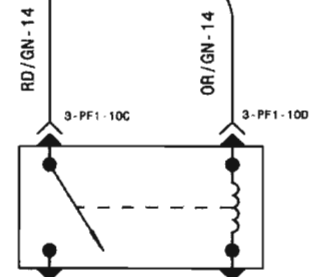
ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE



BD  
2WD/4WD  
SWITCH

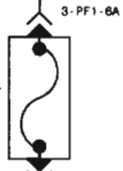


MD



PF1  
ACCESSORIES  
RELAY  
(R3)  
30 A

PF1  
ACCESS.  
FUSE  
(F7)  
20 A

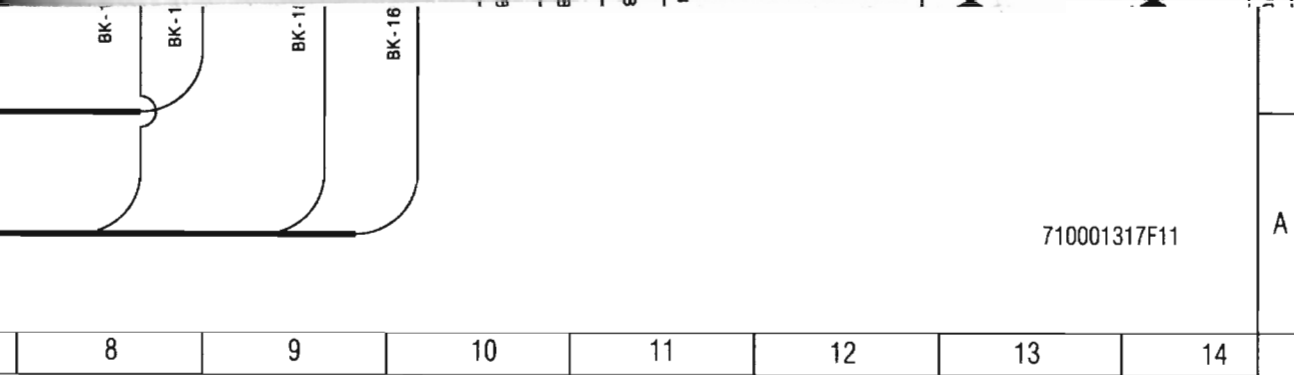


RD-6

RD-6

P  
N  
M  
L  
K  
J





BK-1

BK-1

BK-11

BK-16

8

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11

12

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14

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A