



# 2011

# Side-by-side Vehicles Shop Manual

# COMMANDER<sup>®</sup> 800R/1000

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# 2011 Shop Manual

Commander™ 800R/1000 Series



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# SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair the 2011 Can-Am<sup>™</sup> Commander SSV as described 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 BRPTI.

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

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

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

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

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

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

### 

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

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

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

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

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

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

BRP disclaims liability for all damages and/or injuries resulting from the improper use of the contents of this publication. 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.

This shop manual covers the following BRP made 2011 Can-Am side by side vehicles.

MODEL	ENGINE TYPE	MODEL NUMBER
Commander 800R	810	6CBA, 6CBC, 6DBA, 6DBD
Commander 1000	1010	6ABA, 6ABC, 6BBA, 6BBB, 6BBC, 6BBD, 6BBE, 6BBF, 6EBA, 6EBC, 6CBA, 6CBC

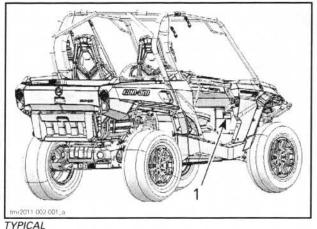
The information and component/system descriptions contained in this manual are correct at time of writing. BRP however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured.

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

# VEHICLE IDENTIFICATION NUMBER (VIN)



1. VIN (Vehicle Identification Number) location

The VIN (Vehicle Identification Number) decal is located under the glove box on the passenger side.

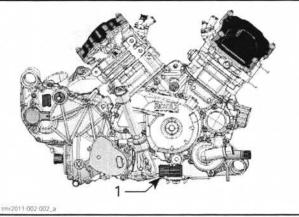
# **VIN Decal Description**



- TYPICAL VEHICLE IDENTIFICATION NUMBER LABEL
- VIN (Vehicle Identification Number)
   Model number

3. Manufacturing date

# ENGINE IDENTIFICATION NUMBER (EIN)



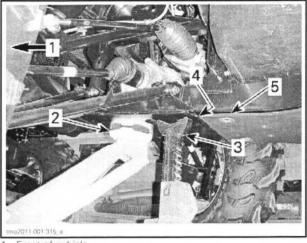
TYPICAL - RH SIDE OF ENGINE

1. Engine Identification Number (EIN)

# LIFTING AND SUPPORTING THE VEHICLE

# Front of Vehicle

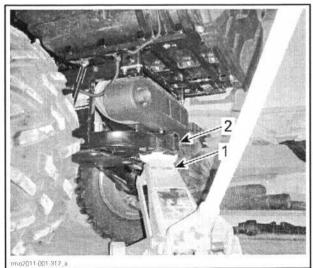
- 1. Place vehicle on a flat non slippery ground.
- 2. Ensure vehicle shift lever is set to PARK.
- 3. Install an hydraulic jack under front skid plate.
- 4. Lift front of vehicle and install a jack stand on each side under frame section in front of the lip for center skid plate.



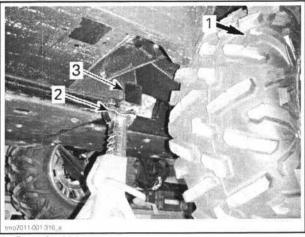
- 1. Front of vehicle
- Hydraulic jack
   Jack stand
- 4. Lip for center skid plate
- 5. Center skid plate
- 5. Lower hydraulic lift and ensure vehicle is supported safely onto both jack stands.

# **Rear of Vehicle**

- 1. Place vehicle on a flat non slippery ground.
- 2. Activate 4WD mode.
- 3. Ensure vehicle shift lever is set to PARK.
- 4. Install a hydraulic jack under the trailer hitch.



- 1. Hydraulic jack
- 2. Trailer hitch
- Lift rear of vehicle and install a jack stand on each side under frame section in front of rear wheel.



1. Rear of vehicle

2. Jack stand 3. Frame section

Lower hydraulic lift and ensure vehicle is supported safely onto both jack stands.

# HOISTING THE VEHICLE

The vehicle may be lifted off the ground by the cage using a hoist and a lifting strap.

**NOTICE** The lifting strap must be wrapped around the horizontal side tubes at the top of the cage, NOT fore and aft. Lifting vehicle by the fore and aft tubes of the cage can cause damage.



Lifting strap around horizontal side tubes (top)
 Hoist hook

# A WARNING

- Ensure hoist and lifting strap are rated for lifting the total vehicle weight. Refer to applicable manufactures instructions.
- Ensure lifting strap is in good condition before lifting vehicle.
- Do not allow anyone in the vehicle or under any portion of the vehicle while it is suspended by a hoist.
- Do not perform any work on the vehicle while it is suspended by a hoist.

# TRANSPORTING THE VEHICLE

If the vehicle needs to be transported, it should be carried inside a full size pick-up box or on a flatbed trailer of the appropriate size and capacity.

# **NOTICE** Do not tow this vehicle - towing can seriously damage the vehicle's drive system.

When contacting a towing or transporting service, be sure to ask for tie-down straps, a flatbed trailer, loading ramp or power ramp to safely lift and secure the vehicle. Ensure the vehicle is properly transported as specified in this section.

**NOTICE** Avoid using chains to tie down the vehicle - they may damage the surface finish or plastic components.

To load the vehicle for transport, proceed as follows:

- 1. Set gear shift lever to NEUTRAL (N).
- 2. Remove the key from the ignition switch.
- If the vehicle is equipped with a winch, use the winch to roll the vehicle onto the transport vehicle.
- 4. If the vehicle is not equipped with a winch, proceed as follows:
  - 4.1 Put a strap around the lower arm of each front suspension.
  - 4.2 Attach the straps to the winch cable of the towing vehicle.
  - 4.3 Pull the vehicle on the flatbed trailer with the winch.

NOTE: Be sure to leave the gear shift lever in NEUTRAL (N).

- 5. Tie down the front wheels to the front of the trailer using tire towing straps.
- 6. Pass a tie-down strap inside each rear wheel.

- 7. Firmly attach the rear wheels tie-down straps to both sides of the rear of the trailer with ratchets.
- 8. Ensure that both the front and rear wheels are firmly secured to the trailer.

# ENGINE EMISSIONS INFORMATION

# MANUFACTURER'S RESPONSIBILITY

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

# DEALER RESPONSIBILITY

When servicing any vehicle that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

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

# OWNER RESPONSIBILITY

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

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

# EPA EMISSION REGULATIONS

Vehicles manufactured by BRP are certified to the EPA standards as conforming to the requirements of the regulations for the control of air pollution emitted from new vehicle engines. This certifica-

tion 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 more detailed information on this subject, you may contact the following locations:

### FOR ALL COURIER SERVICES:

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

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

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

E-MAIL: otaqpublicweb@epa.gov

# MANUAL INFORMATION

# MANUAL PROCEDURES

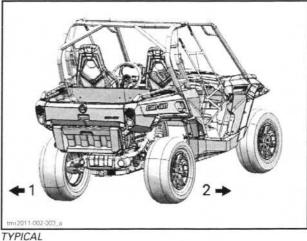
Many of the procedures in this manual are interrelated. Before undertaking any task, you should read and thoroughly understand the entire section or subsection in which the procedure is contained.

## WARNING

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

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 their approved equivalents.

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



1. Left 2. Right

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*.

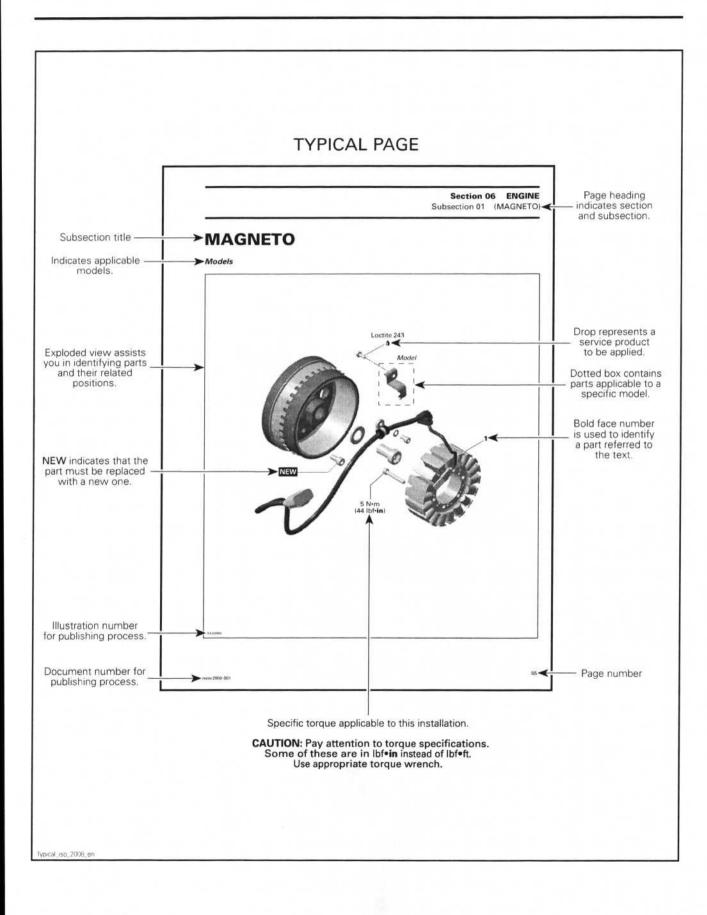
**NOTICE** Most fasteners are metric, and most components are built with parts dimensioned using the metric system. Consult the appropriate *PARTS CATALOG* to obtain and use the correct parts and fasteners. Mismatched or incorrect fasteners could cause damage to the vehicle.

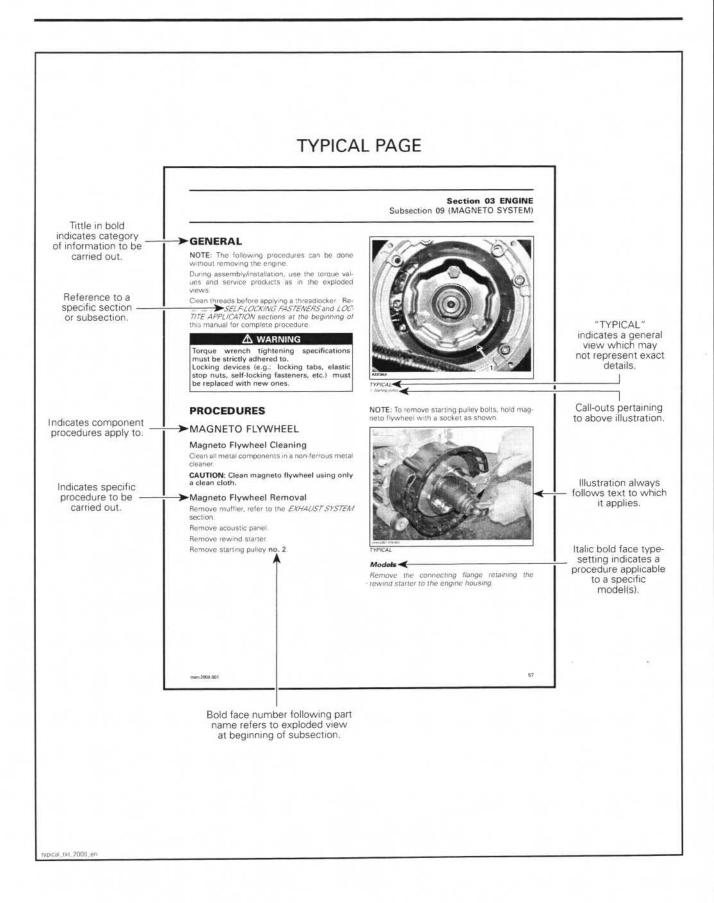
# MANUAL LAYOUT

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

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

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





# TIGHTENING TORQUE

Tighten fasteners to the torque specified in the exploded view(s) and/or in the written procedure. When a torque is not specified, refer to the following table.

# A WARNING

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

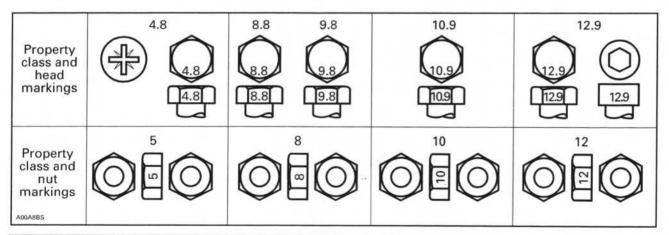
In order to avoid a poor assembly, tighten screws, bolts, or nuts in accordance with the following procedure:

- 1. Manually screw all screws, bolts and/or nuts.
- 2. Apply half the recommended torque value.
- 3. Tighten fastener to the recommended torque value.

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

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

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

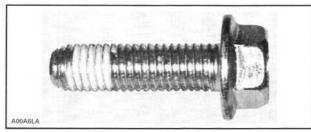


FASTENER	FASTENER GRADE/TORQUE			
SIZE	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 – 2 N∙m (13 – 18 lbf <b>∙in</b> )	2.5 – 3 N∙m (22 – 27 lbf <b>∙in</b> )	3.5 – 4 №m (31 – 35 lbf•ft)	4 – 5 №m (35 – 44 lbf•ft)
M5	3 – 3.5 N•m (27 – 31 lbf•ft)	4.5 – 5.5 N∙m (40 – 47 lbf∙ft)	7 – 8.5 N∙m (62 – 75 lbf∙ft)	8 – 10 N∙m (71 – 89 lbf∙ft)
M6	6.5 – 8.5 N∙m (58 – 75 lbf∙ft)	8 – 12 N∙m (71 – 106 lbf∙ft)	10.5 – 15 N∙m (93 – 133 lbf•in)	16 N∙m (142 lbf•in)
M8	15 N•m (133 lbf•in)	25 N•m (18 lbf•ft)	32 N•m (24 lbf•ft)	40 N•m (30 lbf•ft)
M10	29 N•m (21 lbf•ft)	48 N•m (35 lbf•ft)	61 N•m (45 lbf•ft)	73 N•m (54 lbf•ft)
M12	52 N•m (38 lbf•ft)	85 N•m (63 lbf•ft)	105 N•m (77 lbf•ft)	128 N•m (94 lbf•ft)
M14	85 N•m (63 lbf•ft)	135 N•m (100 lbf•ft)	170 N•m (125 lbf•ft)	200 N•m (148 lbf•ft)

# FASTENER INFORMATION

**NOTICE** 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.

# SELF-LOCKING FASTENERS PROCEDURE



TYPICAL - SELF-LOCKING FASTENER

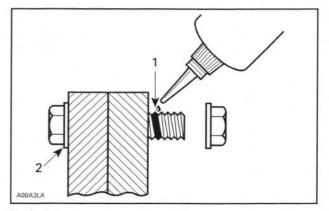
The following describes common procedures used when working with self-locking fasteners.

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

# LOCTITE® APPLICATION PROCEDURE

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

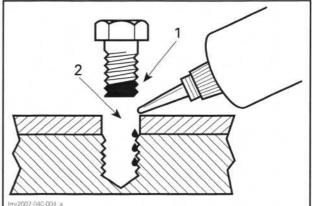
**NOTE:** Always use proper strength Loctite product as recommended in this shop manual. Threadlocker Application for Uncovered Holes (Bolts and Nuts)



1. Apply here 2. Do not apply

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

# Threadlocker Application for Blind Holes

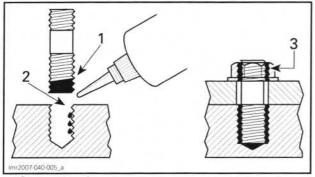


1. On fastener threads

- 2. On threads and at the bottom of hole
- 1. Clean threads (bolt and hole) with solvent.
- 2. Apply LOCTITE PRIMER N (P/N 293 800 041) on threads (bolt and nut) and allow to dry for 30 seconds.
- 3. Choose proper strength Loctite threadlocker.

- 4. Apply several drops along the threaded hole and at the bottom of the hole.
- 5. Apply several drops on bolt threads.
- 6. Tighten as required.

# Threadlocker Application for Stud Installation in Blind Holes



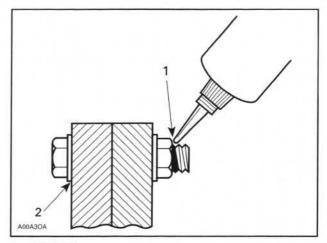
On stud threads 1

- On threads and in the hole 3 On retaining nut threads
- 1. Clean threads (stud and hole) with solvent.
- 2. Apply LOCTITE PRIMER N (P/N 293 800 041) on threads and allow to dry.
- 3. Put 2 or 3 drops of proper strength Loctite threadlocker on female threads and in hole.

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

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

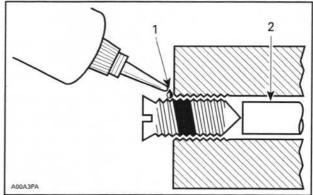
# Threadlocker Application for Pre-Assembled Parts



- Apply here 1 2
- Do not apply
- 1. Clean bolts and nuts with solvent.
- 2. Assemble components.
- 3. Tighten nuts.
- 4. Apply a few drops of proper strength Loctite on bolt/nut contact surfaces.
- 5. Avoid touching metal with tip of flask.

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

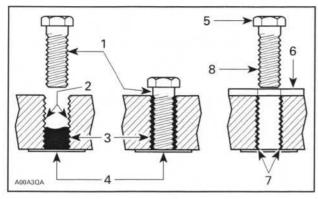
### Threadlocker Application for an Adjustment Screw



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

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

# Application for Stripped Thread Repair



1. Release agent

- Stripped threads
   Form-A-Thread
- 4. Tapes
- 5. Cleaned bolt
- Plate
   New threads
- 8. Threadlocker

### Standard Thread Repair

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

- If a plate is used to align bolt:
- 1. Apply release agent on mating surfaces.
- 2. Put waxed paper or similar film on the surfaces.
- 3. Twist bolt when inserting it to improve thread conformation.

NOTE: NOT intended for engine stud repairs.

### Repair of Small Holes/Fine Threads

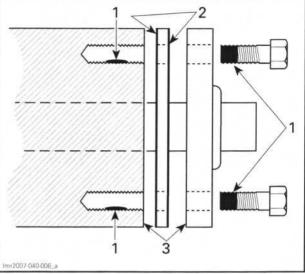
Option 1: Enlarge damaged hole, then follow *STANDARD THREAD REPAIR* procedure.

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

### Permanent Stud Installation (Light Duty)

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

# Gasket Compound Application



1. Proper strength Loctite

2. Locitie Primer N (P/N 293 800 041) and Gasket Eliminator 518 (P/N 293 800 038) on both sides of gasket

3. Loctite Primer N only

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

NOTE: Avoid grinding.

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

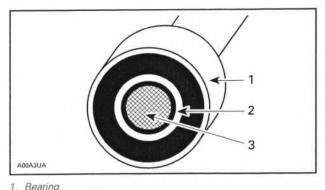
**NOTE:** If the cover is bolted to blind holes, apply proper strength Loctite in the hole and on threads. Tighten fastener.

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

6. Tighten as usual.

# Threadlocker Application for Mounting on a Shaft

Mounting with a Press



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

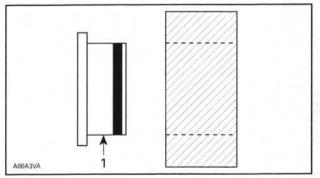
**NOTE:** Retaining compound is always forced out when applied on shaft.

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

### Mounting in Tandem

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

# Threadlocker Application for Case-In Components (Metallic Gaskets)



1. Proper strength Loctite

- 1. Clean inner housing diameter and outer gasket diameter.
- 2. Spray housing and gasket with LOCTITE PRIMER N (P/N 293 800 041).

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

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

- 4. Install according to standard procedure.
- 5. Wipe off excess product.

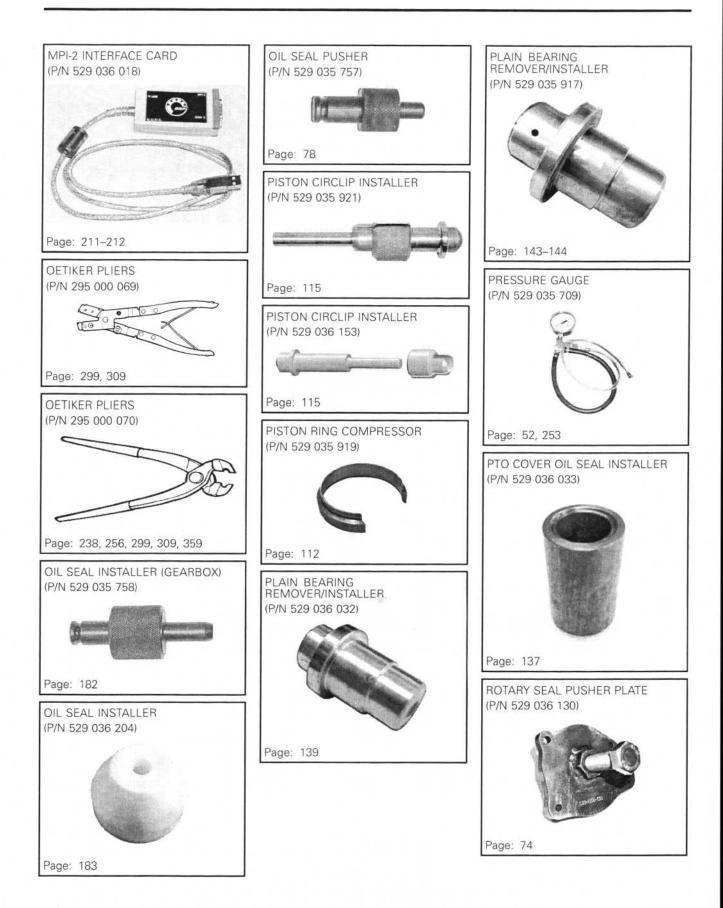
6. Allow 30 minutes for product to cure.

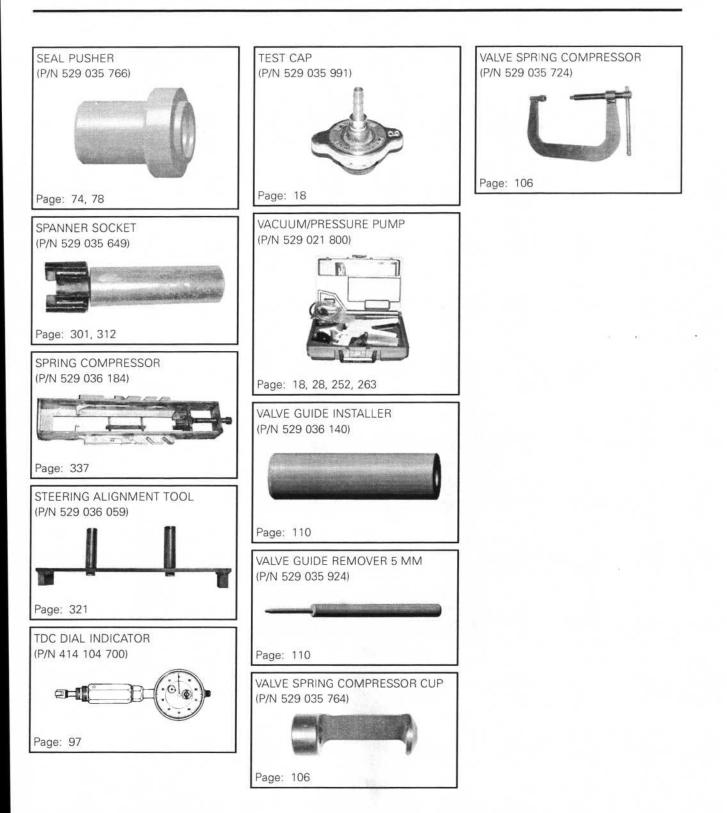
NOTE: Normally used on worn-out housings to prevent leaking or sliding.

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









# **BREAK-IN INSPECTION**

This vehicle should be serviced after the first 10 hours or 300 km (200 mi) of operation, whichever comes first, by an authorized Can-Am dealer. The break-in inspection is very important and must not be neglected.

The following message will appear in the cluster as a reminder of when the break-in inspection is due: **MAINTENANCE SOON**. The message can be cancelled by alternately pressing the override button and the brake pedal 3 times, or by using B.U.D.S. software.

		Replac			1		
	Adjust					2	
BREAK-IN INSPECTION CHART	Tighten					1	
BREAK-IN INSPECTION CHART		Lubricate Clean			9.0		
				]			
	Inspect						
ENGINE		5.6					
Engine oil and filter			17				X
Valve clearance		Х				Х	
Cylinder head screws					Х		
Air filter		X	1.00		0		
Engine seals		Х					
Engine mounting fasteners		Х					
Exhaust system		Х	1				
COOLING SYSTEM	and the stand of the second					110.61	
Radiator/cooling system leak (leak test)		Х			20		
FUEL SYSTEM					643		
Throttle body							
Fuel lines, fuel rails, connections, check valves and fuel tank leak test					34		
ELECTRICAL SYSTEM			11.3	*		11.11	
Spark plugs ···	1	X	0.0				-
Battery connections			6.4		len:		
CVT TRANSMISSION					_	_	
CVT air inlet/outlet		Х	1.5		1 a		
CVT air filter		X			dist.		
GEARBOX	Helman I. T. S		96-		_		1
Gearbox oil			X				Х
Vehicle speed sensor					1		1
DRIVE SYSTEM							_
Front differential/rear final drive oil					-		X
Front differential/rear final drive (seals and vents)			1				
Front and rear propeller shaft joints		Х		Х			
WHEEL							
Wheel nuts/studs		X			Х		
Wheel beadlock (X model)					Х		

Section 01 MAINTENANCE Subsection 01 (BREAK-IN INSPECTION)

	Re			
	Adjust			
BREAK-IN INSPECTION CHART	Tighten			
	Lubricate Clean Inspect			
STEERING SYSTEM		1.		
Steering system (column, bearing, etc.)	X			
Front wheel alignment	X			
BRAKES	AND AND AND A DESCRIPTION OF	1.1846		
Brake fluid	X			
OCCUPANT RESTRAINT SYSTEM	the set is the set of the set of the set			
Seat belts	X			
Side nets				
BODY/CHASSIS	X			
Cage fasteners X				
Upper and lower tailgates latches X				
Seats latch	X			

### Section 01 MAINTENANCE Subsection 02 (PERIODIC MAINTENANCE SCHEDULE)

# PERIODIC MAINTENANCE SCHEDULE

Maintenance is very important for keeping the vehicle in a safe operating condition. Proper maintenance is the owner's responsibility. The vehicle should be serviced as per the maintenance schedule.

The following message will appear in the cluster after the first 10 hours of operation and then at every 50 hours that follow as a reminder of when an inspection is due: **MAINTENANCE SOON**. The message can be cancelled by alternately pressing the override button and the brake pedal 3 times, or by using B.U.D.S. software.

# 

Failure to properly maintain the vehicle according to the maintenance schedule and procedures can make it unsafe to operate.

EVERY 750 KM (500 MI) OR 25 HOURS OF OPERATION (whichever comes first)

Clean the CVT air inlet/outlet

Inspect and clean the CVT air filter

Inspect the brake pads

Tighten the wheel lug nuts

Inspect the drive shaft boots and protectors

Inspect passenger grab handles condition

Inspect hitch condition

Inspect driver and passenger seat latch operation

Inspect tailgates latch operation

EVERY 1 500 KM (1,000 MI) OR 50 HOURS OF OPERATION (whichever comes first)

Replace the air filter

Verify battery condition

Inspect the front differential/rear final drive oil level

Inspect the drive shaft joints condition

Inspect the front/rear propeller shaft joint condition

Grease the front/rear propeller shaft joints

Inspect the tie rod ends

Inspect shock absorbers for any leaks

Lubricate shock absorber spherical bearings (X model)

Inspect and lubricate front suspension arms

EVERY 3 000 KM (2,000 MI) OR 100 HOURS OF OPERATION

OR 1 YEAR (whichever comes first)

Inspect seat belts (check for any damages and proper operation)

Inspect side nets (check for any damages and ensure they buckle properly)

Replace the engine oil and filter

Inspect and adjust the valve clearance

Inspect and clean the muffler spark arrester

Check engine coolant strength

Inspect throttle body

Clean the fuel pump pre-filter

Inspect the fuel pump pressure

Replace fuel vent breather filter

Inspect the drive belt

Inspect, clean and lubricate the drive and driven pulleys (including the one-way bearing)

Inspect the gearbox oil level and condition

Inspect wheel bearings

Inspect the steering system (column, bearing, etc.)

Inspect and clean the brake system

Inspect frame for any damage

Replace rear final drive oil

### EVERY 6 000 KM (4,000 MI) OR 200 HOURS OF OPERATION OR 2 YEARS (whichever comes first)

Replace the engine coolant

Verify the cooling system and perform a pressure test on pressure cap and cooling system

Verify the fuel system and perform a fuel system leak test

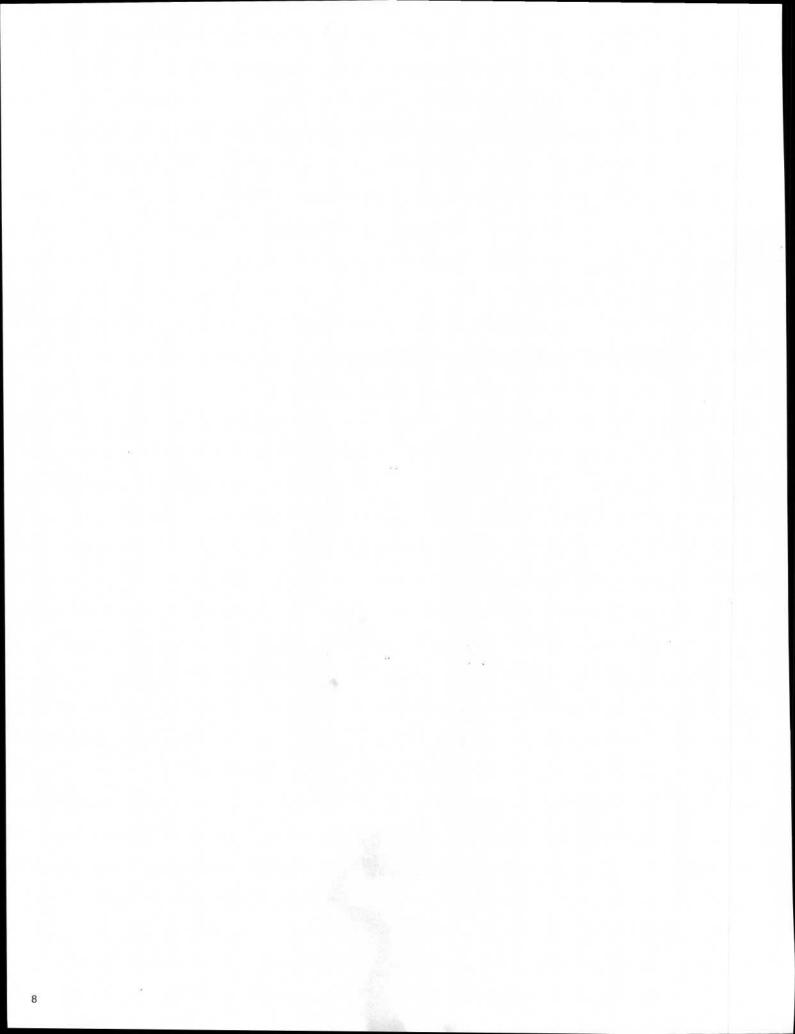
Replace spark plugs

Replace the front differential oil

Replace gearbox oil

Clean the vehicle speed sensor

Replace the brake fluid



# PERIODIC MAINTENANCE PROCEDURES

# SERVICE TOOLS

Description	Part Number	Page
TEST CAP	529 035 991	
VACUUM/PRESSURE PUMP	529 021 800	

# SERVICE PRODUCTS

Description	Part Number	Page
BRAKE FLUID	293 600 131	
BRP PREMIXED COOLANT		
COSMO RUBBER GREASE		
SUSPENSION GREASE		
XPS PARTS AND BRAKES CLEANER	219 701 705	
XPS SYNTHETIC BLEND OIL (SUMMER GRADE)	293 600 121	
XPS SYNTHETIC GEAR OIL (75W 140)	293 600 140	
XPS SYNTHETIC GEAR OIL (75W 90)	293 600 043	
XPS SYNTHETIC GREASE	293 550 010	
XPS SYNTHETIC OIL (WINTER GRADE)	293 600 112	

# GENERAL

This subsection provides:

- Fluid level vérifications
- Maintenance procedures.

The following systems should be serviced according to the *PERIODIC MAINTENANCE SCHED-ULE*.

# PROCEDURES

# AIR FILTER REPLACEMENT

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

# Air Filter Replacement Guideline

Air filter replacement should be adjusted according to riding conditions as it is critical to ensure proper engine performance and life span.

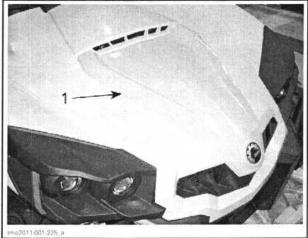
Air filter replacement frequency must be increased for the following dusty conditions:

- Riding on dry sand
- Riding on dry dirt covered surfaces
- Riding on dry gravel roads or similar conditions.

**NOTE:** Riding in a group in these conditions would increase even more the air filter replacement requirement.

# Air Filter Removal

Remove service cover.

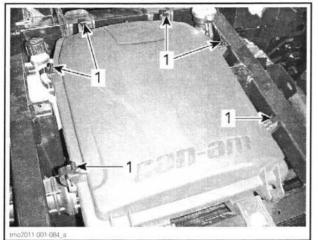


1. Service cover

Release clamps and remove air filter housing cover.

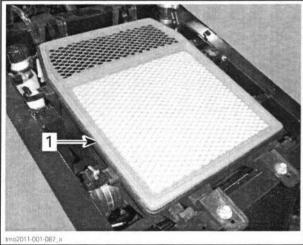
# Section 01 MAINTENANCE

Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



1. Release clamps

Remove air filter.





Replace air filter if clogged. Always use the recommended air filter or an equivalent.

## Air Filter Installation

Inspect air filter housing for cleanliness.

**NOTICE** If any sands or other particles are found in air filter housing, clean it using a vacuum cleaner.

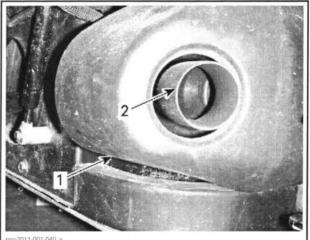
Install air filter.

Install air filter housing cover and latch all clamps. Install service cover.

# MUFFLER SPARK ARRESTER CLEANING AND INSPECTION

**CAUTION** Never perform this operation immediately after the engine has been running as exhaust system is very hot.

Remove the muffler cover.

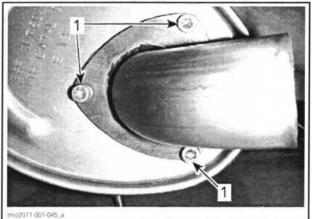


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1. Muffler cover

2. Exhaust tail pipe

Remove and discard the tail pipe retaining screws.



1. Retaining screws

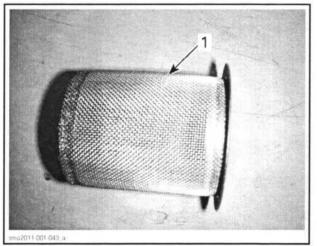
Remove exhaust tail pipe, gasket (discard) and spark arrester.



- Spark arrester
- Gasket
- 2.3. Exhaust tail pipe

Remove carbon deposits from the spark arrester using a brush.

NOTICE Use a soft brush and be careful to avoid damaging spark arrester mesh.



Clean spark arrester

Inspect mesh of spark arrester for any damage. Replace as required.

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

Install new gasket and retaining screws.

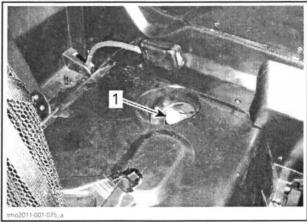
PART	TORQUE	
Tail pipe retaining screws	11 N∙m ± 1 N∙m (97 lbf•in ± 9 lbf•in)	

# ENGINE OIL LEVEL VERIFICATION

NOTICE Operating the engine with an improper level may severely damage engine.

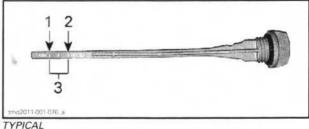
With vehicle on a level surface and engine cold, check the oil level as follows:

- 1. Remove passenger seat.
- 2. Unscrew dipstick then remove it and wipe clean.



Dipstick

- 3. Reinstall dipstick, screw in it completely.
- 4. Remove dipstick and check oil level. It should be near or equal to the upper mark.



- MIN. MAX
- MAX.
   Operating range

To add oil, remove the dipstick. Place a funnel into the dipstick tube.

Add a small amount of recommended oil and recheck oil level.

Repeat the above procedures until oil level reaches the dipstick's upper mark.

NOTE: Do not overfill. Wipe off any spillage.

Properly tighten dipstick.

Install passenger seat.

# Section 01 MAINTENANCE

Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

# **ENGINE OIL CHANGE**

Place vehicle on a level surface.

Oil change and oil filter replacement should be done with a warm engine.

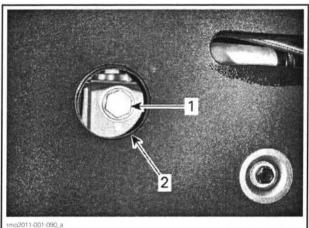
# **A** CAUTION The engine oil can be very hot. Wait until engine oil is warm.

Ensure vehicle is on a level surface.

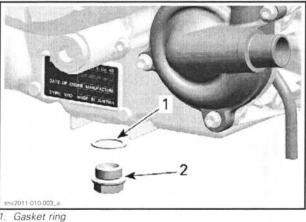
Remove dipstick.

Place a drain pan under the engine drain plug area. Clean the drain plug area.

Unscrew drain plug and discard the gasket ring.



DRAIN PLUG ACCESS 1. Oil drain plug 2. Skid plate



1. Gasket ring 2. Drain plug

Allow oil to drain completely from the crankcase.

Clean the magnetic drain plug from metal shavings and residue. Presence of debris gives an indication of internal engine damage.

Install a NEW gasket ring on the drain plug.

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

Install and tighten drain plug to the recommended torque.

DRAIN PLUG TIGHTENING TORQUE
30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

Replace oil filter. Refer to ENGINE OIL FILTER RE-PLACEMENT in this subsection.

Refill engine with recommended engine oil.

ENGINE OIL CAPACITY		
2	.2 L (23.25 qt (U.S. liq.))	
RECO	DMMENDED ENGINE OIL	
SEASON	TYPE	
Summer	XPS SYNTHETIC BLEND OIL (SUMMER GRADE) (P/N 293 600 121)	
Winter	XPS SYNTHETIC OIL (WINTER GRADE) (P/N 293 600 112)	

If recommended XPS oil is not available, use a 4-stroke SAE 5W 40 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.

After filling, check the oil level, refer to ENGINE OIL LEVEL VERIFICATION in this subsection.

Start engine and let it idle for a few minutes.

Ensure oil filter and drain plug areas are not leaking.

Stop engine.

Wait a while to allow oil to flow down to crankcase, then check oil level again.

Dispose oil and filter as per your local environmental regulations.

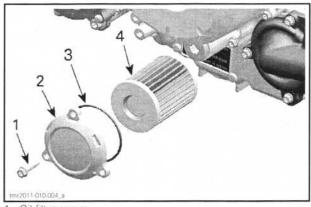
# ENGINE OIL FILTER REPLACEMENT

# **Oil Filter Removal**

Clean oil filter area. Remove oil filter cover screws. Remove oil filter cover. Remove oil filter.

### Section 01 MAINTENANCE

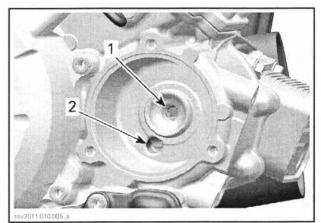
Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



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

# **Oil Filter Installation**

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

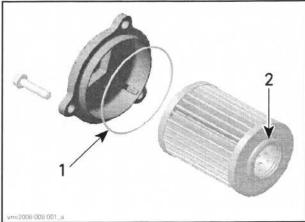


Outlet bore to the engine oil providing system Inlet bore from the oil pump to the oil filter

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.



Slightly oil

2. Slightly oil

Install the cover on the engine.

Tighten oil filter cover screws to recommended torque.

OIL	FILTER	COVER	SCREWS	TIGHTENING
		TC	DRQUE	

10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

# **RECOMMENDED ENGINE** COOLANT

COOLANT			
BRP RECOMMENDED PRODUCT	BRP PREMIXED COOLANT (P/N 219 700 362)		
ALTERNATIVE, OR IF NOT AVAILABLE	Distilled water and antifreeze solution (50% demineralized water, 50% antifreeze)		

NOTICE Always use ethylene-glycol antifreeze containing corrosion inhibitors specifically formulated for internal combustion aluminum engines.

# ENGINE COOLANT LEVEL VERIFICATION

### WARNING A

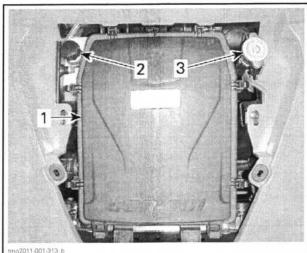
Check coolant level with engine cold.

- 1. Place vehicle on a level surface.
- 2. Open service cover.
- 3. Remove the pressure cap.

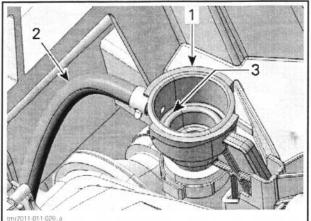
Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

### WARNING

In order to avoid potential burns, do not remove the pressure cap if the engine is hot.

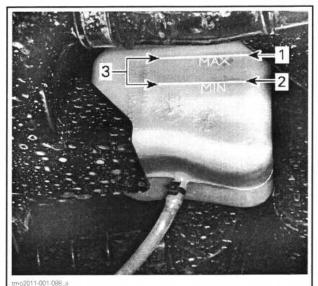


- Air filter housing cover Coolant expansion tank cap
- 3. Pressure cap
- 4. Ensure cooling system is full up to the pressure cap seat.



- Cooling system refill adapter Expansion tank hose
- Coolant system full level (pressure cap seat)
- 5. Add coolant in system as necessary.
- 6. Properly reinstall pressure cap on refill adapter.
- 7. Check coolant level in expansion tank.

NOTE: Coolant level can be checked by looking at the side of the coolant expansion tank under the RH front fender.



COOLANT EXPANSION TANK

- MAX. level MIN. level
- 2 3. Operating range
- 8. Add coolant if level is below MIN. mark. Use a funnel to avoid spillage. Do not overfill.
- 9. Properly reinstall coolant expansion tank cap.
- 10. Reinstall service cover.

**NOTE:** A cooling system that frequently requires addition of coolant is an indication of leaks or engine problems.

### ENGINE COOLANT SPECIFIC GRAVITY CHECK

Remove pressure cap.

Use an antifreeze tester to test coolant strength.

MINIMUM RECOMMENDED COOLANT STRENGTH

-30°C (-22°F)

# ENGINE COOLANT REPLACEMENT

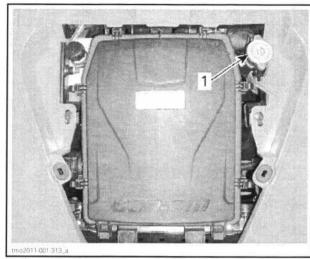
**Cooling System Draining** 

#### 

In order to avoid potential burns, do not remove the pressure cap or loosen the coolant drain plug if the engine is hot.

- 1. Remove service cover.
- 2. Remove the cooling system pressure cap.

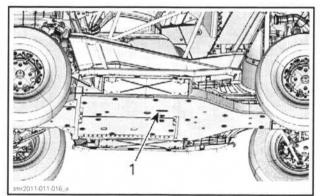
#### Section 01 MAINTENANCE Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



<sup>1.</sup> Pressure cap

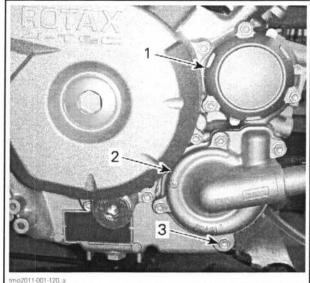
3. Unscrew coolant drain plug and drain the coolant into a suitable container.

NOTE: The drain plug is accessible from underneath the vehicle.



Cooling system drain plug access 1

NOTE: Do not unscrew the coolant drain plug completely.



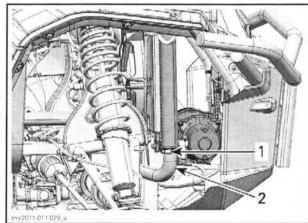
Oil filter cover

1.

2. Water pump cover 3. Coolant drain plug

4. Disconnect the lower radiator hose and drain the remaining coolant into a suitable container.

NOTE: Take note of the position of the hose clamp on the lower radiator hose at the radiator.



- Hose clamp position to note Lower radiator hose to remove 2
- 5. Drain cooling system completely.
- 6. Reinstall cooling system drain plug.

COOLING SYSTEM DRAIN PLUG TORQUE

9 Nom to 11 Nom (80 lbfoin to 97 lbfoin)

7. Reinstall radiator hose as noted prior to removal.

#### RADIATOR HOSE CLAMP

2.5 N•m to 3.5 N•m (22 lbf•in to 31 lbf•in)

8. Siphon the cooling system expansion tank.

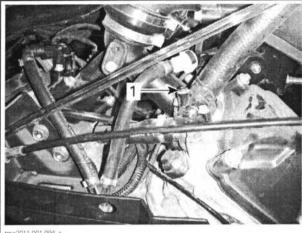
#### Section 01 MAINTENANCE Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

9. Fill cooling system with coolant, refer to COOL-ING SYSTEM BLEEDING procedure.

#### **Cooling System Bleeding**

#### 800R Models

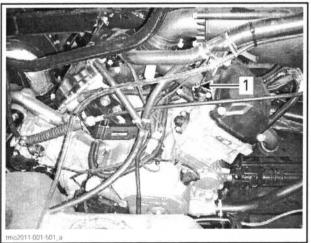
1. Unscrew bleed screw on thermostat housing cover of front cylinder.



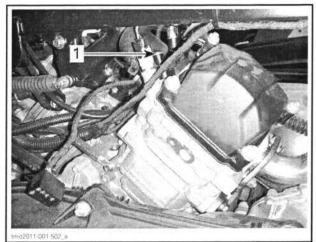
TYPICAL 1. Bleed screw

#### 1000 Models

2. Unscrew bleed screws on thermostat housing covers of both front and rear cylinders.



1. Front cylinder bleed screw



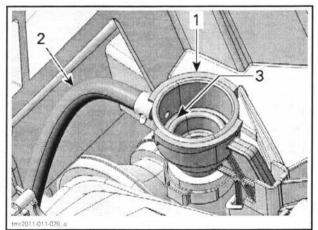
. Rear cylinder bleed screw

#### All Models

- 3. Remove the pressure cap.
- 4. Fill the cooling system until coolant comes out of the bleed screw(s).
- 5. Install the bleed screw(s) using NEW gasket ring(s) and torque as per following chart.

<b>BLEED SCREW INSTALLATION</b>		
GASKET RING	TORQUE	
New	4.4 N•m to 5.6 N•m (39 lbf•in to 50 lbf•in)	

6. Continue adding coolant until system is full up to the pressure cap seat in the refill adapter.

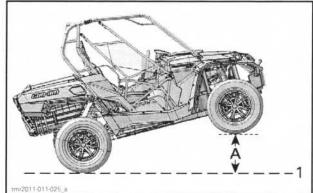


- 1. Cooling system refill adapter
- 2. Expansion tank hose
- 3. Coolant system full level (pressure cap seat)
- 7. Install pressure cap.

**NOTICE** The following steps must be carried out as specified to ensure proper cooling system bleeding in addition to the previous steps.

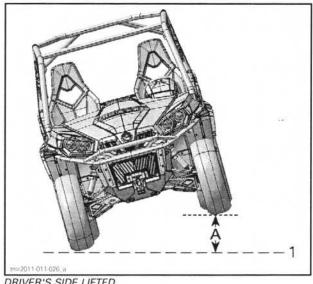
# Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

8. Lift the entire front end of the vehicle so the front tires are 60 cm (2 ft) above the ground for at least 1 minute.



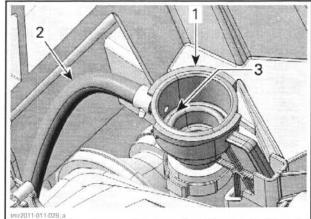
ENTIRE FRONT END LIFTED

- 1. Ground level
- A. 60 cm (24 in)
- 9. Lower vehicle to the ground.
- Remove pressure cap and add coolant as required.
- 11. Install pressure cap.
- 12. Lift driver's side of vehicle 60 cm (2 ft) above it's horizontal position for at least 1 minute.



DRIVER'S SIDE LIFTED 1. Ground level A. 60 cm (24 in)

- 13. Lower vehicle to the ground.
- Remove pressure cap and add coolant as required up to the pressure cap seat in the refill adapter.



- . Cooling system refill adapter
- 2. Expansion tank hose
- 3. Coolant system full level (pressure cap seat)
- 15. Install the pressure cap.
- 16. Check coolant level in the coolant expansion tank and fill to the MIN. level (as required).
- 17. Run engine at idle with the pressure cap **ON** until the cooling fan cycles on for a second time.
- 18. Stop the engine and let it cool down.

#### A WARNING

In order to avoid potential burns, do not remove the pressure cap if the engine is hot.

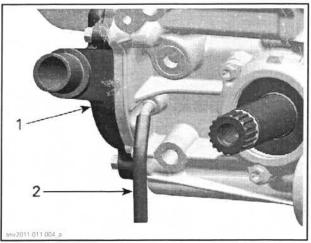
- 19. When the engine is cool, remove pressure cap and add coolant if required.
- 20. Install pressure cap.
- 21. Check coolant level in the expansion tank. Add coolant as required. Refer to *ENGINE COOLANT LEVEL VERIFICATION* in this subsection.

# COOLING SYSTEM INSPECTION

- Check general condition of hoses and clamps for tightness.
- 2. Check the leak indicator hose for oil or coolant.

**NOTE:** Leaking coolant indicates a defective rotary seal. Leaking oil indicates a defective 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 subsection.

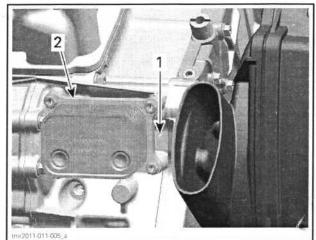
Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



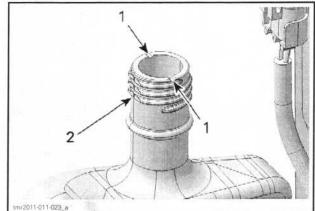
1. Water pump

2. Leak indicator hose

**NOTE:** Another leak indicator hole is visible on the PTO side. It provides an indication of the PTO gasket condition. If a liquid leaks from this hole, PTO gasket replacement is necessary.



- 1. Leak indicator hole
- 2. Oil cooler
- 3. Ensure vents on coolant expansion tank neck are not obstructed (see following illustration).



COOLANT EXPANSION TANK VENTS 1. Slots atop neck 2. Flat threadless portion on tank neck

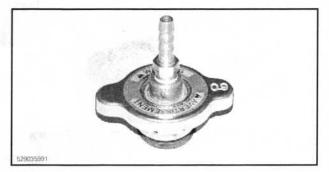
- 4. Carry out an ENGINE COOLANT SPECIFIC GRAVITY CHECK as detailed in this subsection.
- 5. Carry out a *PRESSURE CAP TEST* as detailed in this subsection.
- 6. Replace engine coolant if contaminated.

**NOTE:** Engine coolant should be replaced every 2 years or if contaminated.

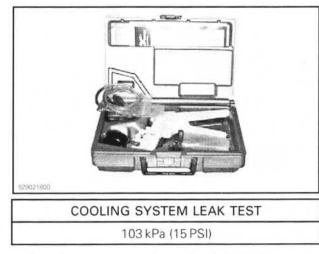
# COOLING SYSTEM LEAK TEST

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

- 1. Open service cover.
- 2. Remove cooling system pressure cap.
- 3. Install TEST CAP (P/N 529 035 991) on filler neck.



4. Using the VACUUM/PRESSURE PUMP (P/N 529 021 800), pressurize cooling system.



If there is no pressure drop after 10 minutes, there is no leak in the cooling system.

If the pressure drops, check all hoses, radiator, cylinders and engine base for coolant leaks or air bubbles.

# PRESSURE CAP TEST

Test the pressure cap using a cooling system tester.

Replace the cap if it does not hold the pressure, or if it opens at a relief pressure that is too low or too high.

#### PRESSURE CAP RELIEF PRESSURE

Approximately 110 kPa (16 PSI)

#### ENGINE VALVE CLEARANCE ADJUSTMENT

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

Remove valve covers, refer to *TOP END* subsection.

Before checking or adjusting the valve clearance, turn crankshaft to TDC ignition of the respective cylinder, refer to *CAMSHAFT TIMING GEAR* in the *TIMING CHAIN* subsection.

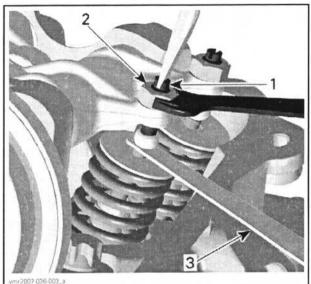
Using feeler gauge, check the valve clearance.

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



<sup>1.</sup> Adjustment screw

2. Locking nut

3. Feeler gauge

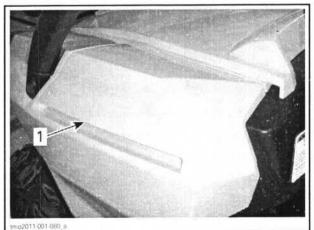
Repeat the procedure for each valve.

Before installing valve covers, recheck valve clearance.

# CVT AIR FILTER CLEANING CVT Air Filter

#### CVT Air Filter Removal

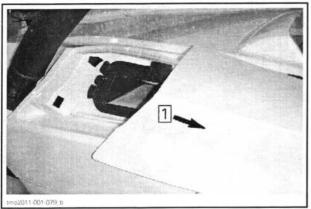
1. Remove the CVT air filter plastic cover located on LH side of hood near driver.



1. CVT air filter plastic cover

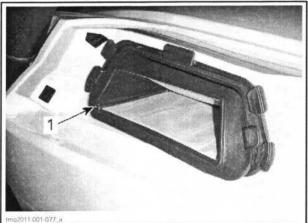
2. Slide the cover rearward.

Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



Step 1: Slide cover rearward

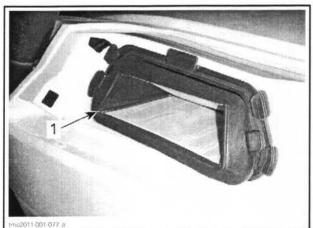
3. Pull CVT air filter out.



1. CVT air filter

CVT Air Filter Cleaning

1. Remove CVT air filter.



1. CVT air filter

- 2. Inspect filter and replace if damaged.
- 3. Gently clean using a solution of soft soap and water, then rinse filter.

- 4. Dry filter completely.
- 5. Clean inside the CVT air inlet end.

#### CVT Air Filter Installation

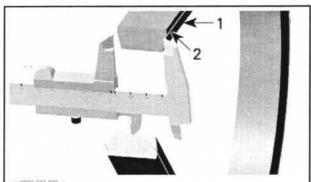
- 1. Install air filter on CVT inlet using retaining tabs.
- 2. Install CVT air filter cover by sliding in place toward front of vehicle.

# DRIVE BELT 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 mm (1.181 in)



1. Drive belt

2. Cord in drive belt

#### DRIVE PULLEY, DRIVEN PULLEY AND ONE-WAY BEARING MAINTENANCE

Refer to *CONTINUOUSLY VARIABLE TRANSMIS-SION (CVT)* subsection.

# CVT AIR INLET/OUTLET CLEANING

- 1. Remove CVT cover, refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) subsection.
- 2. Inspect and clean the air inlet and outlet openings from inside the inner CVT cover.
- 3. Inspect and clean the aft end of air outlet duct at rear of the vehicle.

**NOTE:** If a lot of debris or grime are found in the CVT system, it may be necessary to remove the ducts and thoroughly clean them.

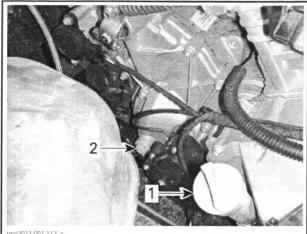
4. Reinstall CVT cover.

#### Section 01 MAINTENANCE Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

#### GEARBOX OIL LEVEL VERIFICATION

Remove the RH lateral console panel and the fuel tank cover.

Check the gearbox oil level by removing the gearbox oil level plug.



Engine oil dipstick

Gearbox oil level plug

The oil should be level with the bottom of the oil level hole.

NOTICE Operating the gearbox with an improper oil level may severely damage gearbox.

# GEARBOX OIL REPLACEMENT

#### Draining Procedure

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

Oil change should be done with a warm engine.

#### WARNING<sup>®</sup>

The gearbox oil can be very hot.

Place a drain pan under the gearbox drain plug area.

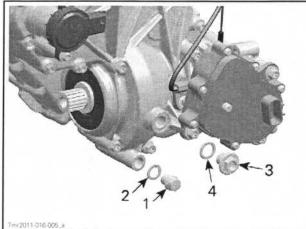
Clean drain plug area and remove magnetic drain plug with its sealing ring to drain gearbox oil.

Discard sealing ring. Always install a NEW one.

Remove oil filler screw including its O-ring.

**NOTICE** Pay attention not to loose O-ring on oil filler screw.

Wait a while to allow oil flow out of gearbox.



Magnetic drain plug 1.

- Sealing ring Oil filler screw
- 3 4. O-ring

Dispose gearbox oil as per your local environmental regulations.

#### Inspection

Oil condition gives information about the teeth condition inside the gearbox. See TROU-BLESHOOTING in this subsection.

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.

Replace O-ring of oil filler screw if brittle, hard or otherwise damaged.

### Filling Procedure

Make sure that magnetic drain plug is reinstalled and tight.

Always install	а	NEW	sea	ling	ring.	
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PART	TORQUE	
Magnetic drain plug	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)	

With the vehicle on a level surface, fill the gearbox through the oil filler hole with XPS SYNTHE-TIC GEAR OIL (75W 140) (P/N 293 600 140) until the oil reaches the lower threads of the oil filler hole (around 450 ml (15.22 U.S. oz)).

However, if the XPS synthetic gear oil is not available use a gearbox oil that meets the requirements of 75W 140 API GL-5 synthetic gear oil.

Install the oil filler screw with its O-ring. Tighten oil filler screw to recommended torque.

Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

PART	TORQUE
Oil filler screw	5 N•m ± 0.6 N•m (44 lbf•in ± 5 lbf•in)

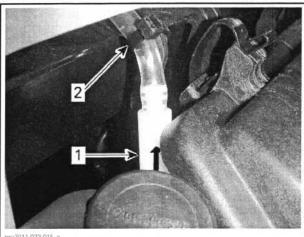
# THROTTLE BODY INSPECTION

- 1. Refer to AIR INTAKE SYSTEM subsection and remove the following:
  - Air filter housing
  - Adapter hose between air filter housing and throttle body.
- 2. Visually inspect throttle plate and throttle body venturi for cleanliness.
- 3. Clean inside throttle body using a common throttle body cleaner if necessary.

# FUEL TANK VENT BREATHER FILTER REPLACEMENT

Ensure breather filter is installed with the flow arrow pointing towards the vent hose.

Secure the vent hose using a locking tie as illustrated.



FUEL TANK VENT BREATHER FILTER

Direction arrow on breather filter pointing towards vent hose Vent hose secured with a locking tie

# FUEL SYSTEM INSPECTION

- 1. Visually inspect fuel tank for cracks, wear marks, signs of leakage or any other damages.
- 2. Visually inspect fuel system hoses for proper rooting, cracking, wear marks, signs of leakage or any other damages.
- 3. Carry out a FUEL TANK LEAK TEST, refer to FUEL TANK AND FUEL PUMP subsection.

### A WARNING

All fuel system leaks must be repaired. Damaged, worn or leaking fuel system components should be replaced to ensure fuel system tightness.

# FUEL PUMP PRESSURE TEST

Refer to FUEL TANK AND FUEL PUMP subsection for procedure.

### FUEL PUMP PREFILTER CLEANING

- 1. Remove fuel pump from fuel tank, refer to FUEL PUMP REMOVAL in FUEL TANK AND FUEL PUMP subsection.
- 2. Clean the fuel pump prefilter (strainer) using XPS PARTS AND BRAKES CLEANER (P/N 219 701 705) and low pressure air.
- 3. If the fuel pump prefilter is heavily soiled, cloaged or damaged:
  - Replace it with a new one. Refer to FUEL PUMP STRAINER REPLACEMENT in the FUEL TANK AND FUEL PUMP subsection.
  - Inspect inside of fuel tank for contaminants.
  - Clean fuel tank as required.
  - Inspect fuel tank vent breather filter. Replace as necessary. Refer to FUEL TANK VENT BREATHER FILTER in FUEL TANK AND FUEL PUMP subsection.

# 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.

For battery testing, refer to CHARGING SYSTEM subsection.

# SPARK PLUG REPLACEMENT

#### Spark Plug Removal

Unplug the spark plug cable.

Clean the spark plug area with pressurized air. Unscrew spark plug.

# Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

#### Spark Plug Installation

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

- 1. Using a wire feeler gauge, set electrode gap as specified in *TECHNICAL SPECIFICATIONS*.
- 2. Apply antiseize lubricant over the spark plug threads to prevent possible seizure.
- Hand screw spark plug into cylinder head, then tighten with a torque wrench and an appropriate socket.

#### SPARK PLUG TORQUE

20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)

#### VEHICLE SPEED SENSOR (VSS) CLEANING

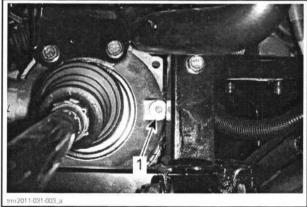
Remove the VSS. Refer to VSS REMOVAL in GEARBOX AND 4X4 COUPLING UNIT subsection.

Remove all metal particles and oil from the VSS magnet.

**NOTE:** A dirty VSS will cause erratic speedometer readings.

# FRONT DIFFERENTIAL OIL LEVEL VERIFICATION

Clean filler plug prior to checking oil level.



FRONT RIGHT SIDE OF VEHICLE 1. Filler plug

With vehicle on a level surface, check oil level by removing filler plug. Oil level must reach the lower edge.

Reinstall filler plug with a NEW sealing ring.

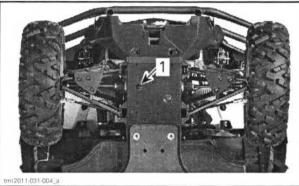
FILLER PLUG

 $22.5 \text{ N} \cdot \text{m} \pm 2.5 \text{ N} \cdot \text{m}$ (17 lbf  $\cdot$  ft  $\pm 2 \text{ lbf} \cdot \text{ft}$ )

### FRONT DIFFERENTIAL OIL REPLACEMENT

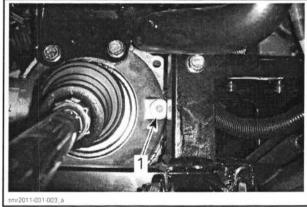
Place vehicle on a level surface. Set transmission in park position.

From underneath of vehicle, clean drain plug area.



1. Drain plug access hole

Place a drain pan under the front differential. Remove drain plug. Unscrew filler plug.



FRONT RIGHT SIDE OF VEHICLE 1. Filler plug

Install drain plug.

	TORQUE
DRAIN PLUG	7.5 N∙m ± 0.5 N∙m (66 lbf•in ± 4 lbf•in)

Refill front differential with recommended oil.

Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

CAPACITY	RECOMMENDED OIL
500 ml (17 U.S. oz)	XPS SYNTHETIC GEAR OIL (75W 90) (P/N 293 600 043) or a 75W 90 (API GL-5) gear oil

Reinstall filler plug with a NEW sealing ring.

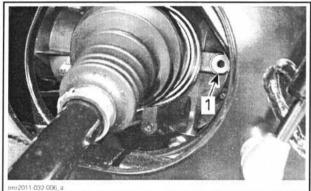
	TORQUE	
FILLER PLUG	22.5 N•m ± 2.5 N•m (17 lbf•ft ± 2 lbf•ft)	

# REAR FINAL DRIVE OIL LEVEL VERIFICATION

Ensure vehicle is on a level surface.

Clean filler plug area.

Remove filler plug.



LH REAR SIDE OF VEHICLE 1. Filler plug

It is possible to verify the oil level by inserting a wire with a 90° bend through the oil filler hole.

Oil level is within the following distance from the bottom of oil filler plug threads when the vehicle is level on ground.

OIL LEVEL	
20  mm + 5  mm (9/16  in + 3/16  in)	)

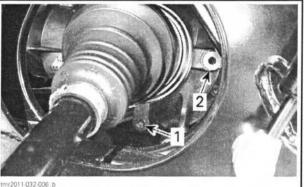
Reinstall filler plug with a NEW sealing ring.

	TORQUE
FILLER PLUG	22.5 N•m ± 2.5 N•m (17 lbf•ft ± 2 lbf•ft)

# REAR FINAL DRIVE OIL REPLACEMENT

Ensure vehicle is on a level surface. Remove the rear skid plate. Clean filler and drain plug areas.

Place a drain pan under rear final drive. Unscrew filler plug. Remove drain plug.



LH REAR SIDE OF VEHICLE Drain plug Filler plug

2

Install drain plug.

	TORQUE
DRAIN PLUG	7.5 N∙m ± 0.5 N∙m (66 lbf•in ± 4 lbf•in)

Refill the rear final drive.

RECOMMENDED OIL	QUANTITY
XPS SYNTHETIC GEAR OIL (75W 140) (P/N 293 600 140) or a 75W 140 (API GL-5) gear oil	350 ml (12 U.S. oz)

Reinstall filler plug with a NEW sealing ring.

TORQUE	
FILLER PLUG	22.5 N•m ± 2.5 N•m (17 lbf•ft ± 2 lbf•ft)

#### DRIVE SHAFT BOOT AND PROTECTOR (VISUAL INSPECTION)

Visually inspect each drive shaft boot for grease leak, cracks or opening.

Check if the drive shaft boot protector are fixed firmly, not torn or otherwise damaged.

Replace if necessary.

#### DRIVE SHAFT JOINT INSPECTION

Turn and move drive shaft to detect excessive play.

#### PROPELLER SHAFT U-JOINT CONDITION

Check yoke U-joints for wear, backlash or axial play, replace if necessary.

### PROPELLER SHAFT U-JOINT LUBRICATION

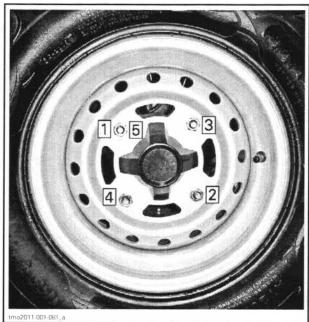
PROPELLER SHAFT U-JOINT LUBRICATION

Use Hi-temp bearing grease NLGI-2 or an equivalent

### WHEEL LUG NUT TORQUE CHECK

Tighten wheel lug nuts to the specified torque using the illustrated sequence.

WH	EEL LUG NUTS
TORQUE	100 N∙m ± 10 N∙m (74 lbf∙ft ± 7 lbf∙ft)



TIGHTENING SEQUENCE

# WHEEL BEARING INSPECTION

1. Safely lift and support the front of vehicle. Refer to *INTRODUCTION* subsection.

- 2. Hold wheel by the top and the bottom and move it. Check for any play.
- 3. If there is any loose, replace wheel bearing, refer to *STEERING SYSTEM* subsection.

**NOTE:** To properly locate play during this inspection, be sure to check other components for wear or loose (ball joints, suspension pivots, etc). If necessary repair or replace 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.

# STEERING SYSTEM INSPECTION

#### Steering Column

Turn and move steering column to detect any play.

#### **Rack and Pinion**

Check rack and pinion boots for:

- Damage
- Cracks.

Replace if necessary.

#### Tie-Rod End

Check tie-rod end ball joint for:

- Damage
- Pitting
- Play.

Replace if necessary.

# SHOCK ABSORBER INSPECTION

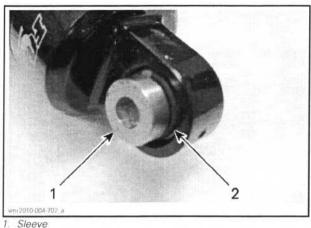
Check shock absorber for any leaks, replace if necessary.

# SHOCK ABSORBER SPHERICAL BEARING LUBRICATION

#### HPG Shock Absorber with Remote Reservoir

- 1. Remove shock absorber from vehicle.
- 2. Remove shock sleeves then O-rings from shock absorber.

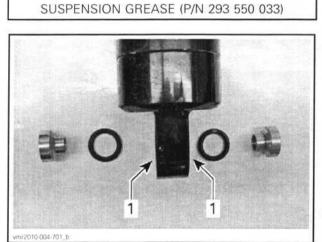
Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



- 2. O-ring
- 3. Clean spherical bearing using a shop rag to remove any dirt and debris.

SPHERICAL BEARING LUBRICATION

4. Lubricate spherical bearing as illustrated.



1. Apply grease here

- 5. Install O-rings then shock sleeves.
- 6. Install shock absorber.

# FRONT SUSPENSION ARM LUBRICATION

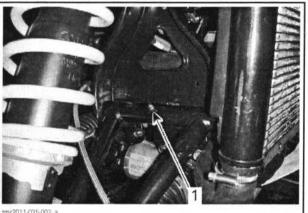
Lubricate suspension arm at grease fittings.

SUSPENSION ARM LUBRICATION

SUSPENSION GREASE (P/N 293 550 033)



LOWER SUSPENSION ARM 1. Grease fittings



UPPER SUSPENSION ARM 1. Grease fitting

# FRONT SUSPENSION ARM INSPECTION

Check suspension arm for:

- Cracks
- Pitting
- Bending
- Distortion.

Check suspension arm for abnormal play:

- Side to side
- Up and down.
- If any play is detected, inspect:
- Bushings
- Cushions
- Wear plates.

Check ball joint for:

- Damage
- Pitting
- Play.

Check ball joint bellows for:

- Damage
- Cracks.

#### BRAKE SYSTEM INSPECTION AND CLEANING

**NOTICE** Do not clean brake components in petroleum based solvent. Use brake system cleaner only. Soiled brake pads must be replaced with new ones.

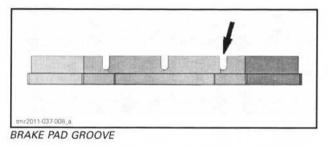
#### **Brake Pads**

1. Measure brake pad lining thickness.

#### BRAKE PAD MINIMUM THICKNESS

1 mm (1/32 in)

NOTE: The brake pad grooves are wear indicators.



#### A WARNING

Brake pads must always be replaced in pairs.

#### Brake Caliper

- 1. Remove calipers then check the following components:
  - Check brake pad pins
  - Check caliper boot for cracks
  - Check caliper movement on its support
  - Check pistons movement
  - Check pistons for scratches, rust or other damages.
- 2. Clean the following components using XPS PARTS AND BRAKES CLEANER (P/N 219 701 705):
  - Brake pads
  - Caliper support and slider
  - Caliper pistons, spring and pins.

NOTE: Do not remove pistons from caliper for cleaning them.

3. Lubricate caliper sliders and pins using an appropriate *BRAKE CALIPER SYNTHETIC GREASE*.

#### Brake Disc

- 1. Check brake disc as follows:
  - Check disc thickness
  - Check disc surfaces
  - Check disc warpage.

**NOTE:** Refer to *BRAKE DISC INSPECTION* in *BRAKES* subsection for details.

2. Clean brake disc using XPS PARTS AND BRAKES CLEANER (P/N 219 701 705).

#### Master Cylinder

- 1. Check master cylinder as follows:
  - Check cleanliness of master cylinder rod and boot.
  - Check master cylinder boot for cracks or damage.
- 2. If required, clean then lubricate master cylinder rod and boot using COSMO RUBBER GREASE (P/N 293 550 055).

#### Brake Pedal

- 1. Check brake pedal as follows:
  - Brake pedal pivot movement
  - Brake pedal pivot cleanliness.
- 2. If required, clean then lubricate brake pedal pivot using XPS SYNTHETIC GREASE (P/N 293 550 010).

#### **Brake Hoses**

1. Check hoses for leaks, crushed, deformations, cracking or scrapes.

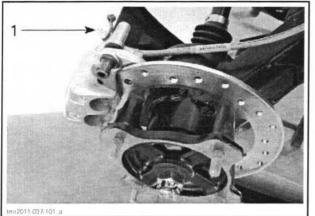
**NOTE:** Any deformation can restrict the proper flow of fluid and cause braking problems.

# BRAKE FLUID REPLACEMENT

#### **Brake Fluid Draining**

- 1. Clean and remove reservoir cover with its diaphragm.
- 2. Connect a clear hose into caliper bleeder.

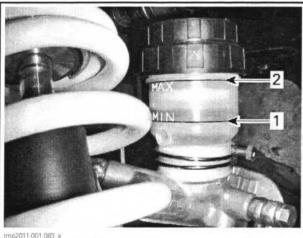
Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)



- Caliper bleeder 1.
- 3. Loosen caliper bleeder.
- 4. Pump brake pedal until no more fluid flows out.
- 5. Repeat draining procedure for the other caliper bleeders.

### Brake Fluid Filling

1. Add recommended brake fluid to MAX. mark. Do not overfill.



TYPICAL

MIN. MAX

#### **RECOMMENDED BRAKE FLUID**

DOT 4 BRAKE FLUID (P/N 293 600 131)

### A WARNING

- Use only DOT 4 brake fluid from a sealed container.
- Do not use brake fluid from an old or already opened container.

#### Brake Fluid Bleeding

#### Bleeding Procedure Using a Vacuum Pump

NOTE: Brake fluid reservoir must be kept full to prevent air from being pumped into the system.

- 1. On each caliper, unscrew bleeder until brake fluid comes out then close it.
- 2. Install the VACUUM/PRESSURE PUMP (P/N 529 021 800) onto caliper bleeder.



529021800

- 3. Place pump to vacuum position.
- 4. Pump vacuum pump a few times.
- 5. Loosen bleeder.
- 6. Continue to pump until no more air bubbles appear in clear hose.
- 7. Close then tighten bleeder.

#### BLEEDER TORQUE

5.5 N•m ± 1.5 N•m (49 lbf•in ± 13 lbf•in)

- 8. Add recommended brake fluid to MAX, mark, Do not overfill.
- 9. Perform bleeding procedure for the other caliper bleeders.
- 10. Check brake pedal operation:
  - If brake pedal feels spongy, bleed system again then carry out the BRAKE SYSTEM PRESSURE VALIDATION as detailed in BRAKES subsection.

#### Manual Bleeding Procedure

NOTE: Brake fluid reservoir must be kept full to prevent air from being pumped into the system.

- 1. Connect a clear hose onto caliper bleeder.
- 2. Pump up system pressure with brake pedal until pedal resistance is felt.
- 3. Depress and hold brake pedal.
- 4. Open bleeder and then close it.
- 5. Release brake pedal slowly.

# Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

NOTE: Do not release brake pedal until bleeder has been closed.

- 6. Repeat procedure until fluid flows out without any air bubbles.
- 7. Tighten bleeder.

BLEEDER TORQUE	
5.5 N•m ± 1.5 N•m (49 lbf•in ± 1	13 lbf•in

- 8. Perform bleeding procedure for the other caliper bleeders.
- 9. Check brake pedal operation:
  - If brake pedal feels spongy, bleed system again then carry out the BRAKE SYSTEM PRESSURE VALIDATION as detailed in BRAKES subsection.

#### PASSENGER HANDHOLD CONDITION

Check if the passenger handholds are fixed firmly, not bent or otherwise damaged.

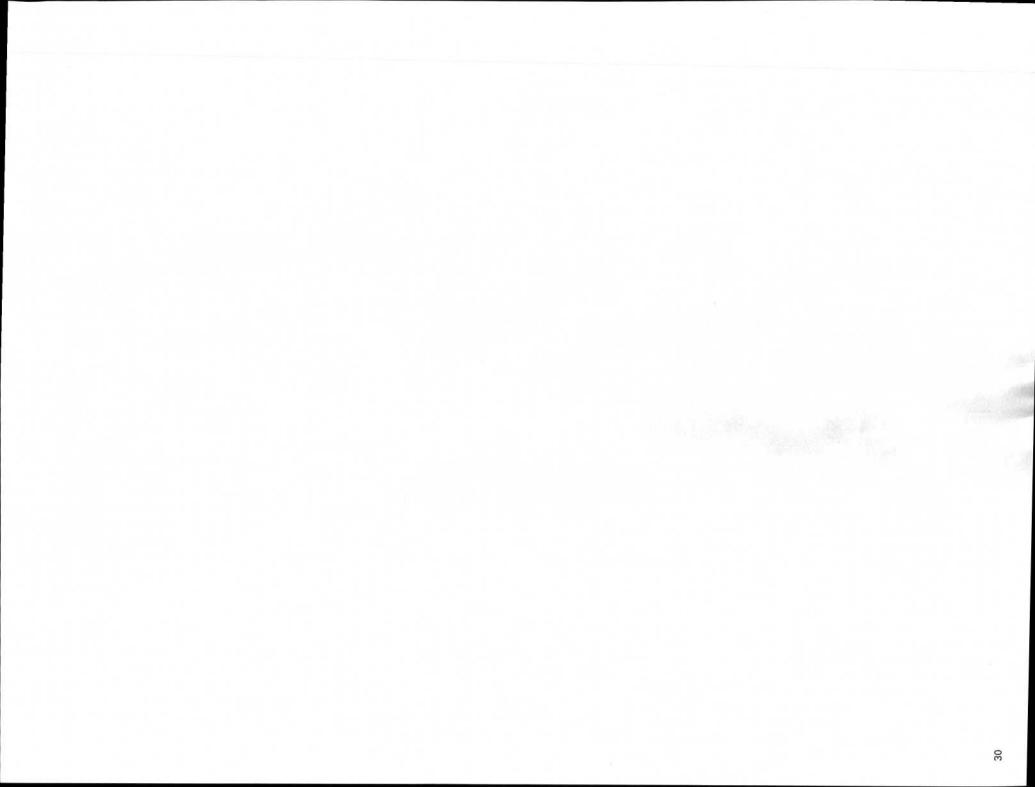
Replace if necessary.

#### TOW HITCH INSPECTION

Ensure tow hitch receptacle module is solidly mounted.

Inspect hitch for cracks and other damages.

Repair or replace as necessary.



# **PRESEASON PREPARATION**

Prior to using vehicle, proper vehicle preparation is required after a storage period.

If any worn, broken or damaged parts are found, replace them.

Remove rags that were installed for storage: CVT outlet hose and muffler.

Disconnect air inlet hose from the air filter housing and inspect for animal nests etc. Reinstall hose.

Drain fuel tank and fill with fresh fuel if a fuel stabilizer was not used for the storage.

Reinstall battery. Refer to CHARGING SYSTEM.

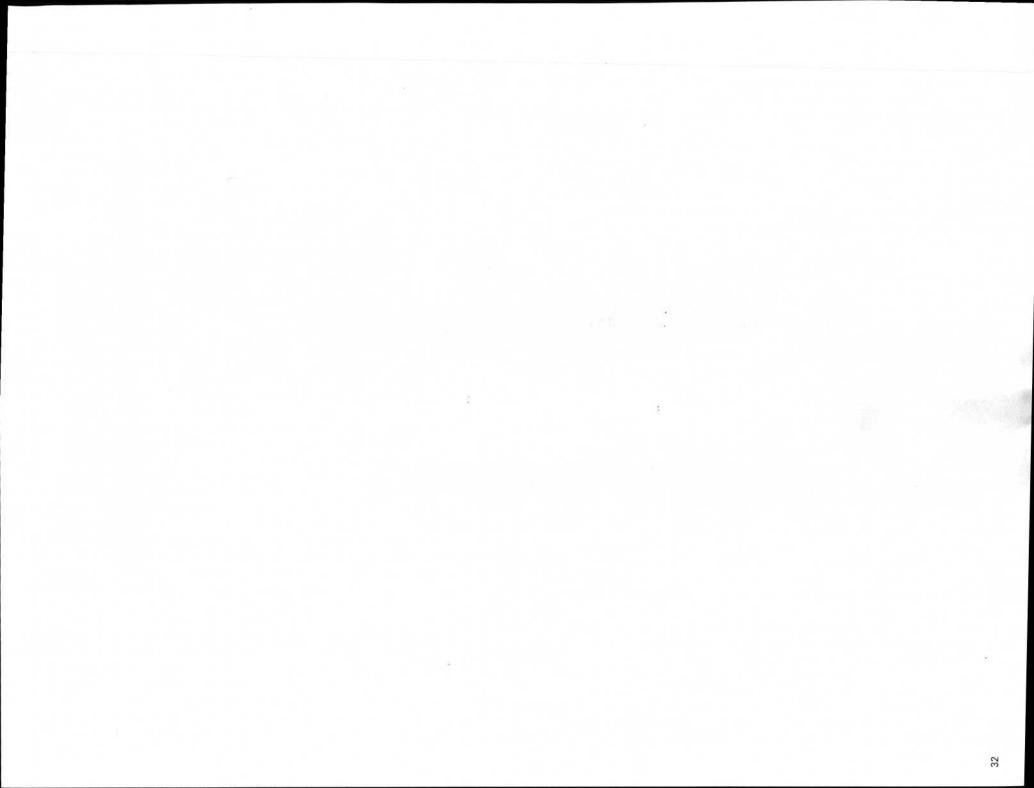
Using the maintenance chart, perform the items titled EVERY 3 000 km (2,000 mi) OR 100 HOURS OF OPERATION OR 1 YEAR.



1. Use this chart

**NOTE:** If the "every 6 000 km (4,000 mi) or 200 hours of operation or 2 years" maintenance service is due, also perform the related items as per the maintenance chart.

Test drive vehicle to confirm proper operation.



# **STORAGE PROCEDURE**

# SERVICE PRODUCTS

Description	Part Number	Page
BRP FUEL STABILIZER	413 408 600	
BRP HEAVY DUTY CLEANER	293 110 001	
XPS LUBE	293 600 016	
XPS MULTI-PURPOSE CLEANER	219 701 709	
XPS STORAGE OIL (EXCEPT U.S. COUNTRY)	413 711 600	
XPS STORAGE OIL (U.S. COUNTRY ONLY)	413 711 900 .	

# GENERAL

If the SSV 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.

Where applicable, refer to the appropriate subsections in this manual for the required tasks outlined in these procedures.

# PROCEDURES

**NOTE:** To facilitate the inspection and ensure adequate lubrication of components, it is recommended to clean the entire vehicle. Refer to *VEHICLE CLEANING* in this subsection.

# FUEL SYSTEM

#### **Fuel System Protection**

With the new fuel additives, it is critical to use the BRP FUEL STABILIZER (P/N 413 408 600) or an equivalent to prevent fuel deterioration and fuel system gumming. Follow the manufacturer's instructions for proper use.

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

Pour fuel stabilizer in fuel tank. Fill up fuel tank.

# ENGINE

#### **Engine Internal Lubrication**

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

Proceed as follows:

- 1. Remove lateral console panels.
- 2. Remove spark plugs.

3. Spray storage oil into each cylinder.

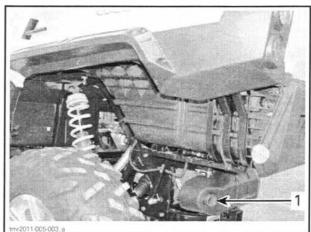
NOTE: Use the storage oil as per country availability.

	STORAGE OIL
XPS S	TORAGE OIL (EXCEPT U.S. COUNTRY) (P/N 413 711 600)
XPS S	STORAGE OIL (U.S. COUNTRY ONLY) (P/N 413 711 900)

4. Press start button, 1 or 2 seconds maximum, to lubricate cylinders.

5. Reinstall the spark plugs.

**NOTE:** Do not run engine during storage period. 6. Block muffler outlet with a rag.



1. Muffler outlet

#### **CVT** Protection

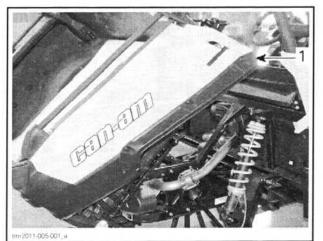
Remove drive belt. Refer to *ENGINE, CVT AND GEARBOX.* 

Close CVT cover.

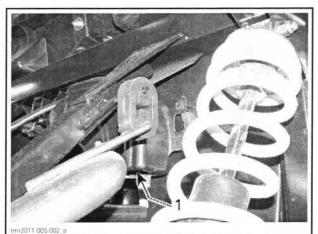
Block CVT outlet with a rag.

NOTE: To reach the CVT outlet, tilt the cargo box.

Subsection 05 (STORAGE PROCEDURE)



1. Tilted cargo box



1. CVT outlet

# ELECTRICAL SYSTEM

#### **Battery Removal**

Remove the battery. Charge and store battery.

# DRIVE SYSTEM

Lubricate front and rear propeller joints. Lubricate the engine output shaft with XPS LUBE (P/N 293 600 016).

# CHASSIS

#### Lubrication

Lubricate front suspension (no lube on rear).

#### **Tire Pressure**

Inflate tires to the recommended pressure.

#### Vehicle Cleaning

Wash and dry the vehicle.

**NOTICE** 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 XPS MULTI-PURPOSE CLEANER (P/N 219 701 709).

**NOTICE** 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 XPS LUBE (P/N 293 600 016).

#### Vehicle Protection

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

**NOTICE** 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
XPS LUBE	293 600 016	

# GENERAL

**NOTE:** Component failures resulting from these events are not warrantable.

Refer to the appropriate subsections in this manual for the required tasks outlined in these procedures.

# ROLLED OVER VEHICLE

In the event the vehicle was rolled over, check the following.

Inspect suspension components and steering system components.

Inspect body and chassis for damage (welded joints, bent or cracked parts).

Pay particular attention to the cage, shoulder protector, side nets, seat belts and their mechanisms.

#### 

Do not use vehicle if any of the safety devices are damaged or inoperative.

Check all fluids level before restarting engine.

**NOTICE** Check for oil accumulation in the air intake system. Check air filter.

After restarting engine, check multifunction gauge if any malfunction is detected.

Troubleshoot and repair as required before using vehicle.

### SUBMERGED VEHICLE

In the event the vehicle was submerged, proceed with the following.

**NOTICE** A submerged vehicle may cause several damages (short and long term) if not serviced adequately or soon enough. Do not crank or start engine.

Drain the entire air intake system. Inspect the throttle body. Remove parts as required.

Replace the air filter.

Drain, inspect and clean the CVT.

Empty muffler (removal required).

Unplug ECM connectors and open fuse boxes. Check for presence of water. Dry as necessary.

Replace the engine oil (without starting the engine).

Remove spark plugs. Crank engine in drowned mode to expel any water.

**A** CAUTION Keep away from spark plug holes to avoid to be splashed when cranking engine.

Add a small quantity of engine oil in cylinders (approximately 2 teaspoonfuls).

Install spark plugs (replace if required).

Replace gearbox oil.

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

Look for water in brake system. Replace brake fluid as required.

#### A WARNING

Before starting engine, use B.U.D.S. and check vehicle for fault codes.

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 whitish appearance in engine oil.

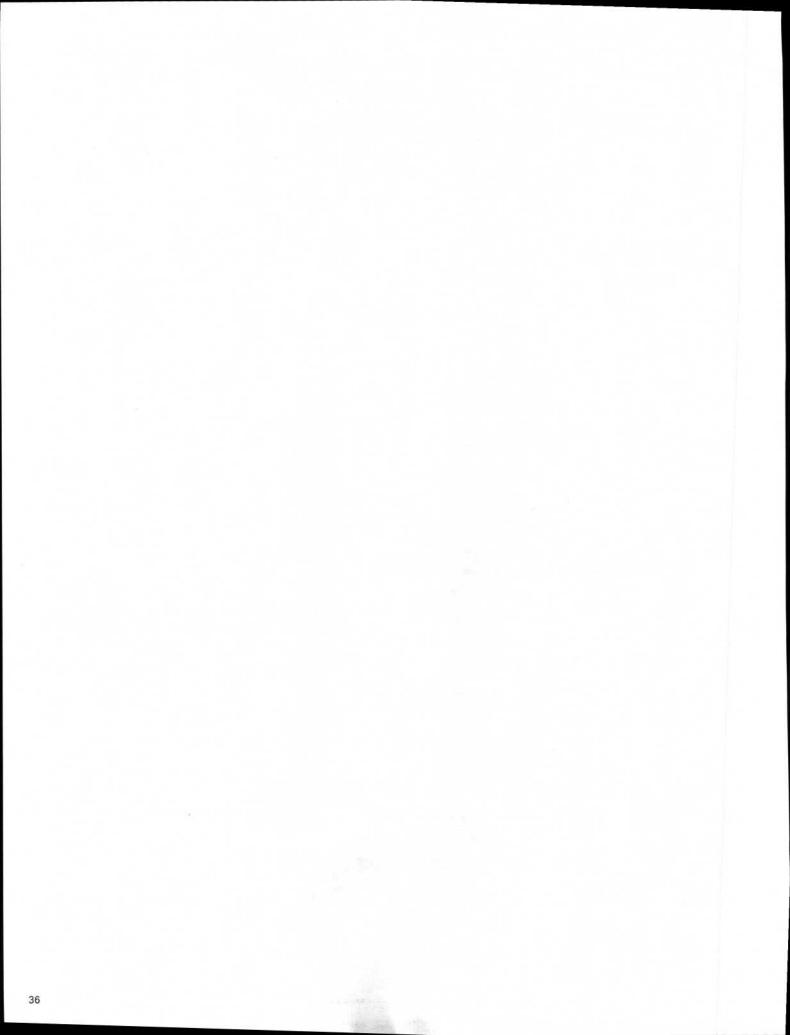
Check gearbox oil. Replace oil if contaminated with water.

Replace oil of front differential.

Replace oil of rear final drive.

Lubricate front and rear suspensions and propeller shaft joints. Refer to *FRONT AND REAR SUSPENSIONS*.

Spray all metal parts with XPS LUBE (P/N 293 600 016). Test drive to confirm proper operation.

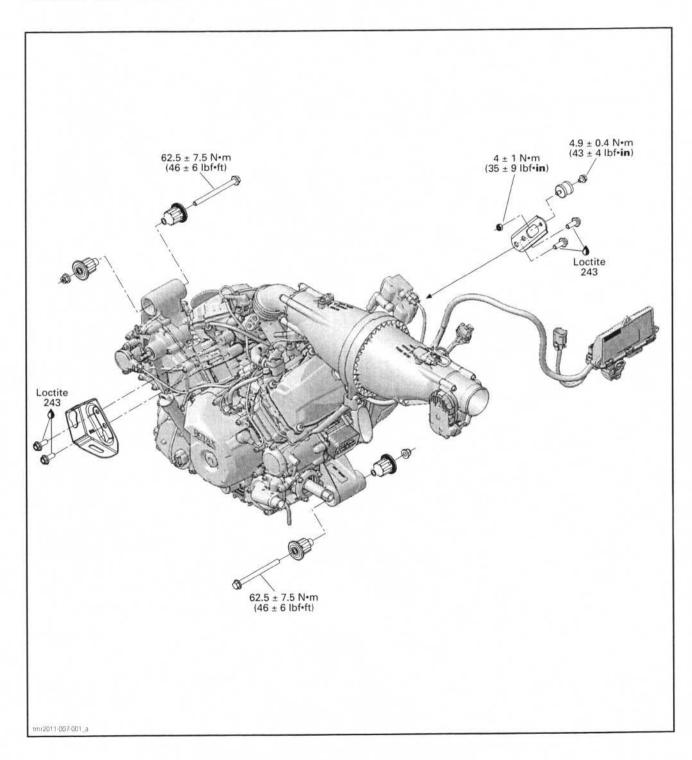


Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

# **ENGINE REMOVAL AND INSTALLATION**

# SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING TOOL	529 036 022	



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 when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pin, etc.) must be replaced.

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

# PROCEDURES

# ENGINE REMOVAL

#### Vehicle and Engine Preparation

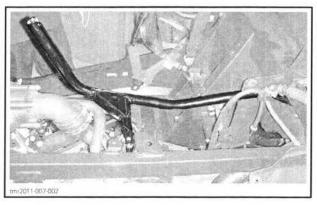
- 1. Place vehicle on a workstation that will have access to an engine-lifting hoist.
- 2. Safely lift and support the vehicle. Refer to *IN-TRODUCTION* subsection.
- 3. Unplug the BLACK (-) cable from battery, then the RED (+) cable.

# **NOTICE** Always unplug battery cables exactly in the specified order, the BLACK (-) cable first.

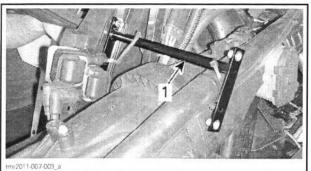
- 4. Remove the front section of the cage.
- 5. Remove seats.
- 6. Refer to *BODY* subsection and remove the following plastic parts:
  - Upper and lower consoles
  - LH and RH lateral console panels
  - Under seat storage compartment
  - Fuel tank cowl
  - Glove box
  - RH inner panel.
- 7. Drain engine oil. Refer to LUBRICATION SYS-TEM subsection.

**NOTE:** Drain engine oil only if engine overhaul is necessary.

- 8. Drain the engine coolant. Refer to *COOLING SYSTEM* subsection.
- 9. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
- 10. Remove the LH passenger handhold bar.



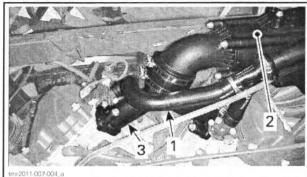
11. Remove the panel reinforcement support.



. Panel reinforcement support

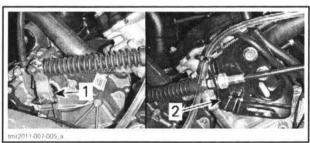
- 12. Disconnect both engine coolant hoses at cylinder heads.
- 13. Remove the plenumand the air intake manifold.
  - 13.1 Loosen clamp securing throttle body to plenum.
  - 13.2 Detach the plenum support from the front cylinder head.
  - 13.3 Unscrew air intake manifold from cylinder heads.
  - 13.4 Remove plenum and air intake manifold as an assembly.

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)



Engine coolant hoses

- Plenum 3. Air intake manifold
- 14. Remove the shift plate.
- 15. Remove the shifter cable bracket.



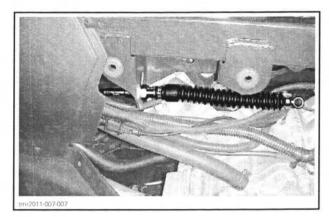
Shift plate

- 2. Shifter cable bracket
- 16. Remove the front and rear head pipes. Refer to EXHAUST SYSTEM subsection.
- 17. Disconnect the coolant hose at water pump.
- 18. Disconnect the gearbox vent hose.
- 19. Remove the CVT outlet duct.
- 20. Unplug and remove the CTS (coolant temperature sensor).
- 21. Remove the coolant plastic housing from the rear cylinder head.



1. CTS 2. Coolant plastic housing

22. Detach the shifter cable from its bracket and remove it.



23. Remove the upper engine support with its rubber isolator.



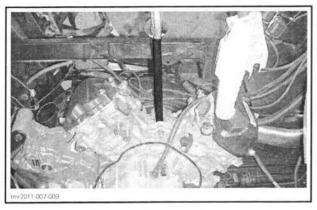
Rubber isolator is located between frame and engine support

- 24. Disconnect the CVT inlet duct from the CVT cover.
- 25. Disconnect the crankcase vent hose.
- 26. Unplug all remaining connectors and remove required cables from engine. Cut all necessary locking ties.
  - Spark plug cables
  - Starter cable (retaining nut on starter body)
  - GBPS (Gear Box Position Sensor)
  - Vehicle speed sensor
  - Actuator connector
  - Neutral switch
  - OPS (Oil Pressure Sensor)
  - CPS (Crankshaft Position Sensor)
  - Engine ground cable (screwed on LH side of the engine)
  - Magneto.

#### Lifting Engine

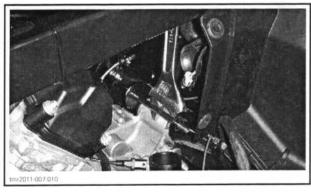
1. Install the ENGINE LIFTING TOOL (P/N 529 036 022).

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)



- 2. Remove retaining screws on front and rear propeller shafts.
- 3. Remove the front and rear engine support bolts.
- 4. Carefully lower the rear of the engine enough to reinstall temporally the engine support bolt.
- 5. Insert a spacer (± 9.5 mm (3/8 in) of thickness) between the engine support and the bolt.

**NOTE:** The spacer used in the following illustration is a monkey wrench of 25 cm (10 in).



6. Raise the front of engine to separate front propeller shaft from engine.

**NOTE:** If the propeller shaft cannot be removed easily, remove bolts retaining the front differential to create more space. Refer to *FRONT DRIVE* subsection.

- 7. Lower the front of engine to remove the rear engine support bolt and the spacer.
- 8. Remove engine from vehicle.

# ENGINE INSTALLATION

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

Prior to install engine, inspect condition of engine mounts.

Install the rear propeller shaft onto engine output shaft.

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

Install rear and front engine mounting bolts then torque all mounting bolts.

**NOTE:** Do not install plastic parts, seats and cage front portion prior to *FINAL ASSEMBLY*.

#### **Final Assembly Procedure**

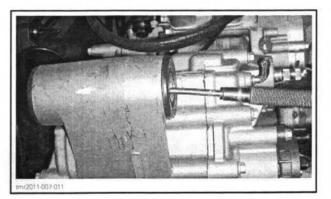
- 1. Fill engine with the recommended oil and quantity. Refer to *LUBRICATION SYSTEM* subsection.
- 2. Fill and bleed cooling system. Refer to *COOL-ING SYSTEM* subsection.
- 3. Check for any leaks.
- 4. Reinstall plastic parts, seats and the front portion of the cage.
- 5. Test drive vehicle to confirm proper operation.

# ENGINE MOUNTS

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

# Engine Mount Removal

Insert a punch into engine mount bushing and push the opposite engine mount out.



# Engine Mount Installation

The installation is the reverse of the removal procedure.

Subsection 02 (AIR INTAKE SYSTEM)

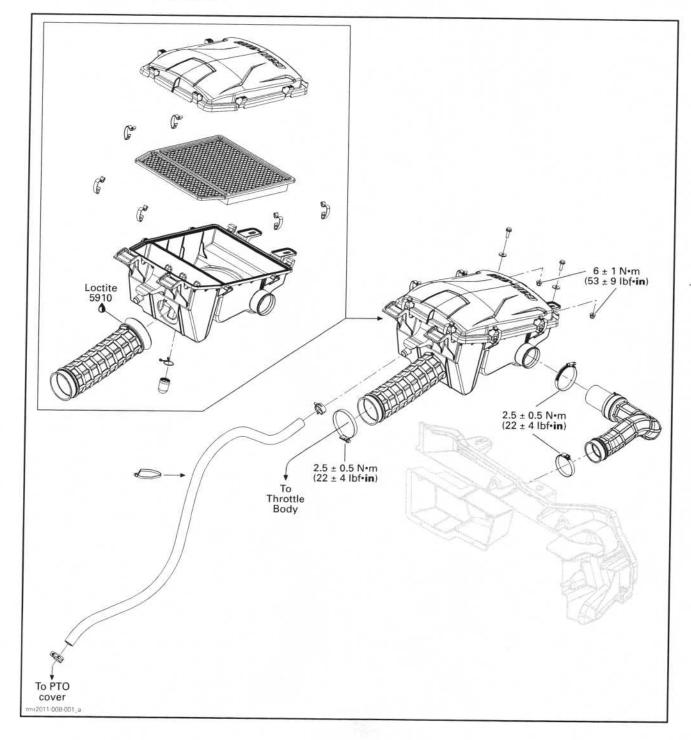
# **AIR INTAKE SYSTEM**

# SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	

Subsection 02 (AIR INTAKE SYSTEM)

# AIR FILTER HOUSING



Subsection 02 (AIR INTAKE 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 when removed (e.g.: locking tabs, elastic stop nuts, cotter pin, etc.) must be replaced.

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

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

### PROCEDURES

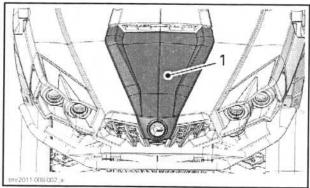
#### AIR FILTER

For air filter servicing, refer to *PERIODIC MAIN-TENANCE PROCEDURES* subsection.

# AIR FILTER HOUSING

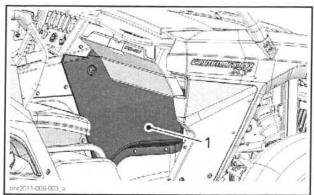
#### Air Filter Housing Removal

- 1. Remove the following parts:
  - 1.1 Service cover



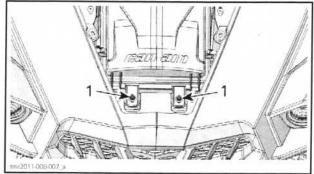
1. Service cover

1.2 RH inner panel.



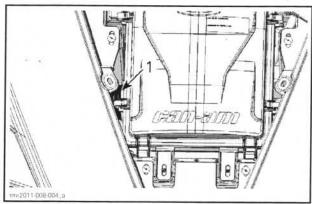
FROM INSIDE OF COCKPIT – PASSENGER SIDE 1. RH inner panel

2. Remove retaining bolts of air filter housing.



1. Air filter housing retaining bolts

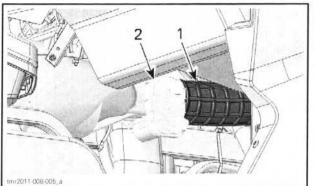
Disconnect air inlet hose from the LH side of air filter housing.



1. Air inlet hose

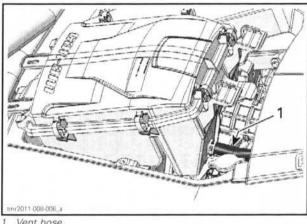
4. Disconnect intake adapter from throttle body.

Subsection 02 (AIR INTAKE SYSTEM)



FROM INSIDE OF COCKPIT – PASSENGER SIDE 1. Intake adapter

- Intake adapted
   Throttle body
- 5. Disconnect vent hose from the rear of air filter housing.

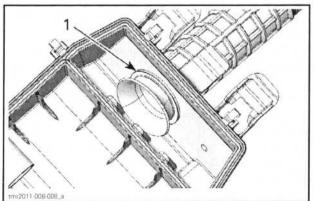


#### Vent hose 1.

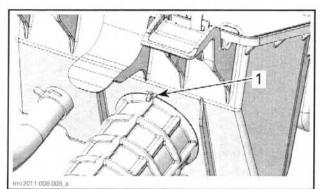
# Air Filter Housing Installation

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

If the intake adapter is removed, reseal it with LOCTITE 5910 (P/N 293 800 081) and align its recess with the notch on air filter housing.



Apply Loctite 5910 between intake adapter lips and housing wall 1

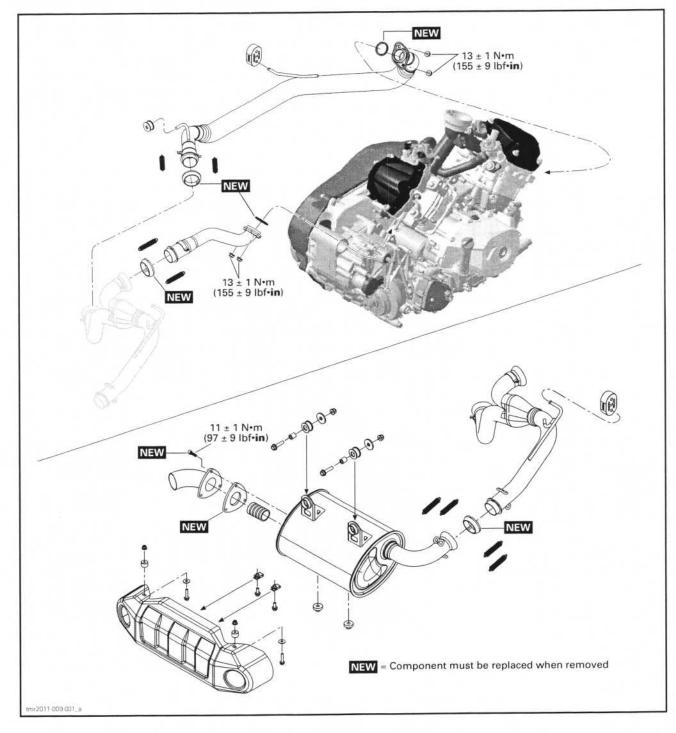


1. Intake adapter recess into air filter housing notch

TOR	QUE
Gear clamps	2.5N•m ± 0.5N•m (22 lbf•in ± 4 lbf•in)
Air filter housing nuts	6 N∙m ± 1 N∙m (53 lbf∙in ± 9 lbf∙in)

Subsection 03 (EXHAUST SYSTEM)

# **EXHAUST SYSTEM**



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.

### A WARNING

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

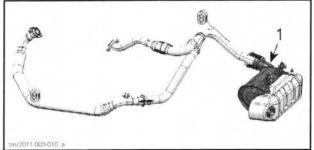
Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

# PROCEDURES

# SPARK ARRESTER

For spark arrester servicing, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

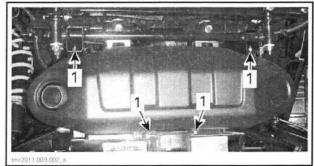
# MUFFLER



1. Muffler

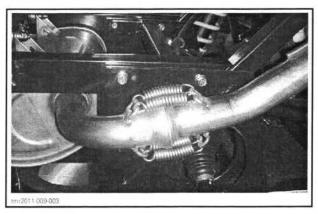
Muffler Removal

1. Remove the muffler cover.

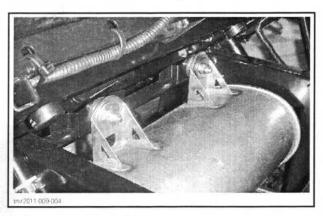


1. Muffler cover bolts

2. Open cargo box and detach springs from the "Y" exhaust pipe.



3. Remove muffler retaining bolts.



- 4. Remove the muffler.
- 5. Discard the gasket at the end of "Y" exhaust pipe.

### Muffler Inspection

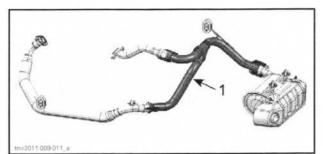
Check muffler for cracks or other damages. Replace if necessary.

### Muffler Installation

For the installation, reverse the removal procedure.

Subsection 03 (EXHAUST SYSTEM)

### "Y" EXHAUST PIPE



1. "Y" exhaust pipe

#### "Y" Exhaust Pipe Removal

- 1. Open the cargo box.
- 2. Remove the following parts:
  - Springs from head pipes
  - Muffler
  - "Y" exhaust pipe from vehicle.

#### "Y" Exhaust Pipe Inspection

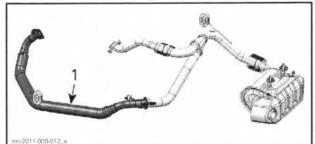
Check "Y" exhaust pipe for cracks, bending or other damages. Replace if need.

Check if the rubber support is brittle, hard or otherwise damage. Replace if need.

#### "Y" Exhaust Pipe Installation

The installation is the reverse of the removal procedure.

# HEAD PIPE (FRONT CYLINDER)



1. Front head pipe

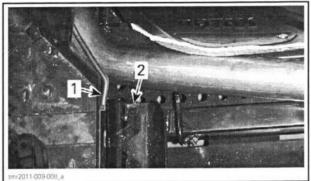
#### Front Head Pipe Removal

- 1. Refer to *BODY* subsection and remove the following plastic parts:
  - LH lateral console panel
  - Under seat storage compartment.
- 2. Remove the following parts:
  - Springs from "Y" exhaust pipe

- Rubber support
- Head pipe nuts.
- Remove front head pipe from vehicle according to following sub-steps:

**NOTE:** The space to remove the front head pipe is limited. When the head pipe is positioned correctly as shown, it can be removed easily without force.

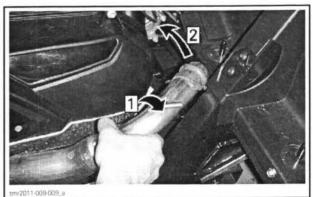
3.1 Position the rubber support rod near the front of the seat bracket.



. Rubber support rod

2. Seat bracket

3.2 Turn and lift the rear end of the head pipe.



Step 1: Turn outward Step 2: Lift

3.3 Remove head pipe from vehicle.

#### Front Head Pipe Inspection

Check head pipe for cracks, bending or other damages. Replace if need.

Check if the rubber support is brittle, hard or otherwise damage. Replace if need.

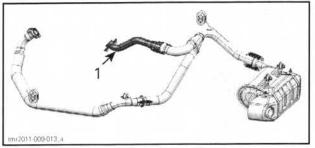
#### Front Head Pipe Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Install NEW exhaust gaskets.

Subsection 03 (EXHAUST SYSTEM)

то	RQUE
Head pipe nuts	13 N•m ± 1 N•m (115 lbf•in ± 9 lbf•in)

# HEAD PIPE (REAR CYLINDER)



1. Rear heap pipe

# Rear Head Pipe Removal

- 1. Remove the following parts:
  - Springs from "Y" exhaust pipe
  - LH lateral console panel, refer to *BODY* subsection
  - Head pipe nuts.
- 2. Remove head pipe from the vehicle.
- 3. Remove and discard exhaust gaskets.

### **Rear Head Pipe Inspection**

Check head pipe for cracks, bending or other damages. Replace if need.

Check if the rubber support is brittle, hard or otherwise damage. Replace if need.

### **Rear Head Pipe Installation**

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

Install NEW exhaust gaskets.

то	RQUE
Head pipe nuts	13 N•m ± 1 N•m (115 lbf•in ± 9 lbf•in)

Subsection 04 (LUBRICATION SYSTEM)

# **LUBRICATION SYSTEM**

# SERVICE TOOLS

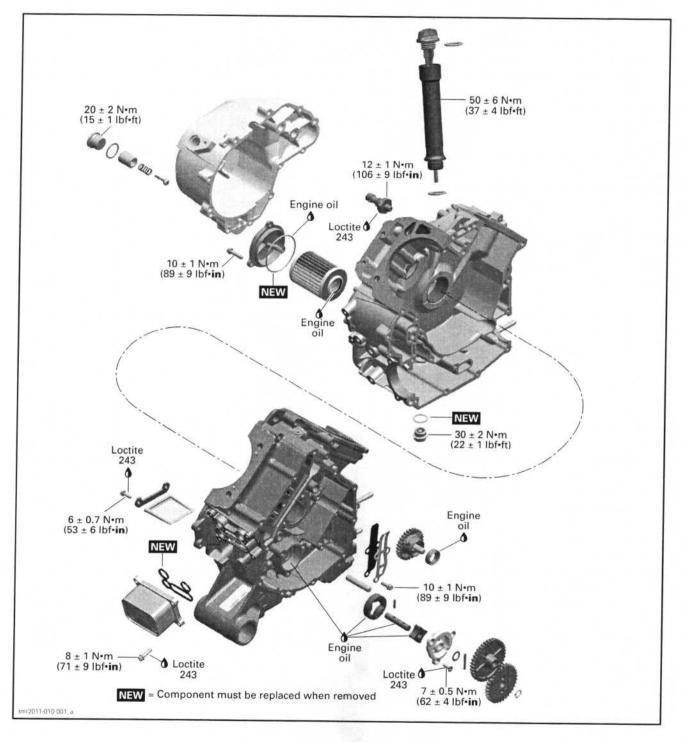
Description	Part Number	Page
ADAPTER HOSE	529 035 652	
DISCONNECT TOOL		
PRESSURE GAUGE	529 035 709	

# SERVICE PRODUCTS

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

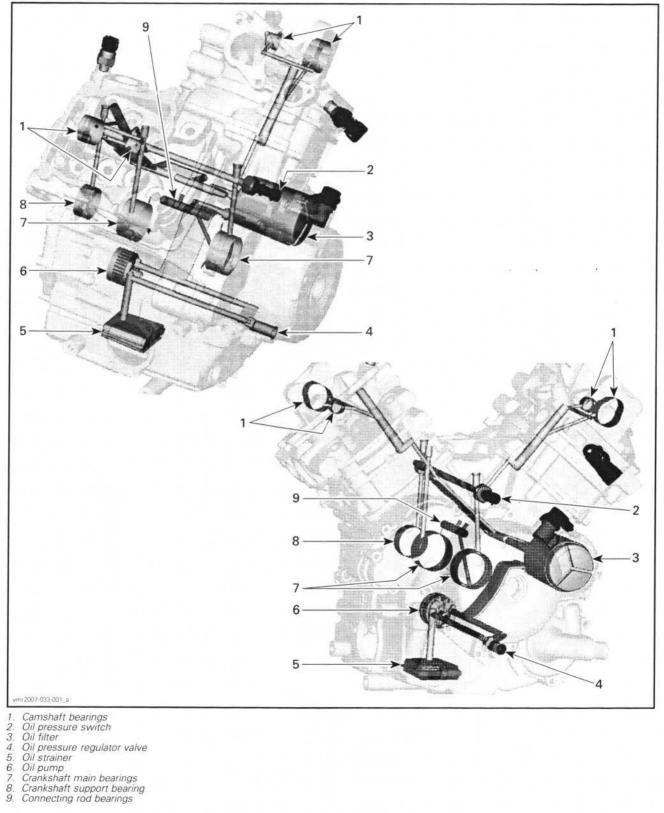
Subsection 04 (LUBRICATION SYSTEM)

## COMPONENTS



Subsection 04 (LUBRICATION SYSTEM)

## **ENGINE LUBRICATION CIRCUIT**



## 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.

### A WARNING

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

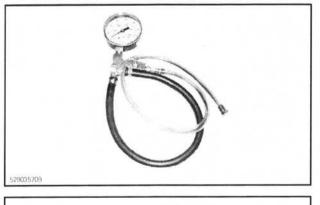
## INSPECTION

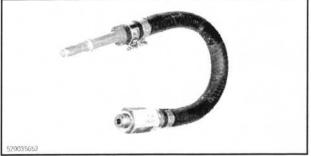
## ENGINE OIL PRESSURE

NOTE: The engine oil pressure test should be done with a warm engine 100°C (212°F) and the recommended oil.

Remove the oil pressure switch. Refer to *OIL PRESSURE SWITCH* in this subsection.

Install 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)	300 kPa (44 PSI)
NOMINAL	150 kPa (22 PSI)	350 kPa (51 PSI)
MAXIMAL	250 kPa (36 PSI)	450 kPa (65 PSI)

If the engine oil pressure is out of specifications, check the points described in *TROUBLESHOOT-ING* 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.

## TROUBLESHOOTING

#### LOW OR NO OIL PRESSURE

- 1. Oil level is too low.
  - Refill engine with recommended engine oil. Refer to OIL LEVEL VERIFICATION in the PERIODIC MAINTENANCE PROCEDURES subsection.
  - Check for high oil consumption, refer to HIGH OIL CONSUMPTION in the TROUBLESHOOT-ING subsection.
  - Check for engine oil leaks. For leak indicator holes, refer to COOLING SYSTEM subsection. Repair if necessary.
- 2. Use of unsuitable engine oil type.
  - Replace engine oil by the recommended engine oil.
- 3. Clogged oil filter.
  - Replace oil and oil filter at the same time.
- 4. Defective oil pressure switch.
  - Test oil pressure switch, see procedure in this subsection.
- 5. Defective or worn oil pump.
  - Check oil pump, see procedure in this subsection.
- 6. Defective engine oil pressure regulator.
  - Check engine oil pressure regulator, see procedure in this subsection.
- 7. Worn plain bearings in crankcase.
  - Check plain bearings clearance, refer to BOTTOM END subsection.
- 8. Clogged engine oil strainer.
  - Clean engine oil strainer, see procedure in this subsection.

Subsection 04 (LUBRICATION SYSTEM)

#### OIL CONTAMINATION

- 1. Defective water pump seal ring or rotary seal.
  - Check for oil or coolant leak from indicator hole near water pump, refer to COOLING SYSTEM subsection. Replace seal if necessary.
- 2. Cylinder head or cylinder base gasket leak.
  - Retighten cylinder head to specified torque, refer to TOP END subsection. Replace gasket if tightening does not solve the problem.
- 3. Engine internal damage.
  - Repair engine.
- 4. Oil cooler gasket leak. - Replace oil cooler gasket and change engine oil.

#### HIGH OIL CONSUMPTION

- 1. Leaking breather oil seal.
  - Check if the oil seal of the breather is brittle, hard or damaged. Refer to BOTTOM END subsection.
- 2. Valve stem seals worn or damaged. - Replace valve stem seals.
- 3. Worn piston rings (blue exhaust smoke). *Replace piston rings.*

## PROCEDURES

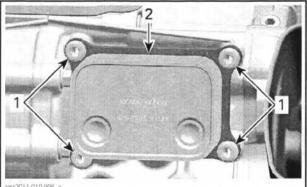
## **OIL COOLER**

#### **Oil Cooler Removal**

Drain engine oil. Refer to ENGINE OIL CHANGE in the PERIODIC MAINTENANCE PROCEDURES subsection.

Drain coolant. Refer to *COOLING SYSTEM* subsection.

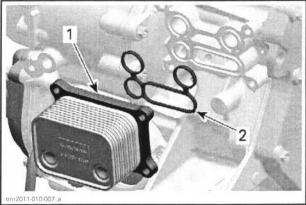
Remove oil cooler retaining screws.



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Place rags or towels under oil cooler to catch remaining oil and coolant.

Remove oil cooler and discard gasket.



1. Oil cooler 2. Gasket

## **Oil Cooler Inspection**

Check oil cooler for cracks or other damage. Replace if necessary.

### **Oil Cooler Installation**

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

Wipe off any oil and coolant spillage.

Install a NEW gasket.

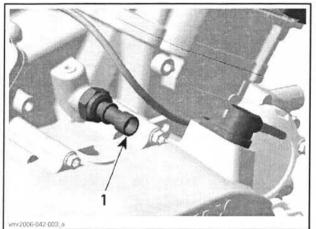
Refill engine oil with recommended oil and at the proper oil lever. Refer to *ENGINE OIL CHANGE* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.

Refill and bleed cooling system. Refer to *COOL-ING SYSTEM* subsection.

Retaining screws
 Oil cooler

Subsection 04 (LUBRICATION SYSTEM)

## OIL PRESSURE SWITCH (OPS)



1. Oil pressure switch

## Oil Pressure Switch Activation

Oil pressure switch works when engine oil pressure is 20 kPa to 40 kPa (2.9 PSI to 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* in this subsection.

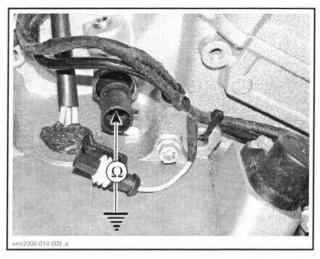
If the engine oil pressure is good, check the resistance of the oil pressure switch while engine is off and while engine is running.

## **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 (Ω)	
4	Engine ground	Close to 0 Ω (normally closed switch)	Infinite (open) when pressure reaches 20 kPa to 40 kPa (2.9 PSI to 5.8 PSI)



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

If the values are correct, check wiring.

## Oil Pressure Switch Removal

Unplug the oil pressure switch connector. Unscrew and remove oil pressure switch.

## Oil Pressure Switch Installation

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

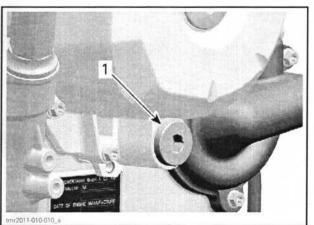
Tighten oil pressure switch to specified torque.

OIL PRESSURE SWITCH TIGHTENING TORQUE

12 N•m ± 1 N•m (106 lbf•in ± 9 lbf•in)

## ENGINE OIL PRESSURE REGULATOR

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



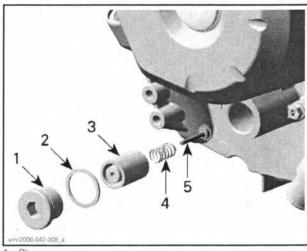
. Engine oil pressure regulator

Subsection 04 (LUBRICATION SYSTEM)

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

#### **Oil Pressure Regulator Removal**

Remove plug screw and pull oil pressure regulator out.



1. Plug screw

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

## Oil Pressure Regulator Inspection

Inspect pressure regulator housing and valve for scoring or other damages.

Check spring for free length.

SPRING FR	EE 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.

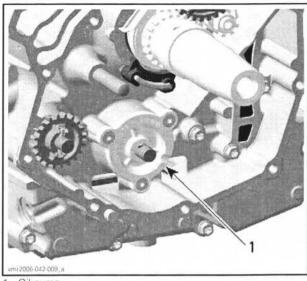
## Oil Pressure Regulator Installation

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

**NOTE:** At installation always replace the gasket ring of the plug screw by a new one.

## OIL PUMP

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

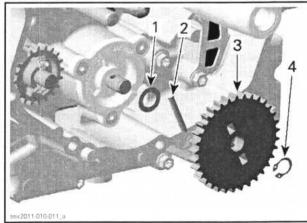


1. Oil pump

## Oil Pump Removal

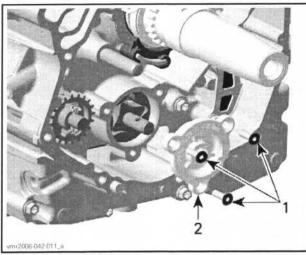
Remove the PTO cover. Refer to *PTO COVER* in the *BOTTOM END* subsection.

- 1. Remove:
  - Retaining ring
  - Oil pump gear
  - Needle pin
  - Thrust washer.



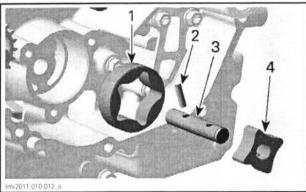
- 1. Thrust washer
- 2. Needle pin 3. Oil pump gea
- 3. Oil pump gear 4. Retaining ring
- 2. Remove oil pump cover screws and pull oil pump cover out.

Subsection 04 (LUBRICATION SYSTEM)



Retaining screws

- 2 Oil pump cover
- 3. Remove oil pump shaft with needle pin and inner rotor.
- 4. Remove outer rotor.

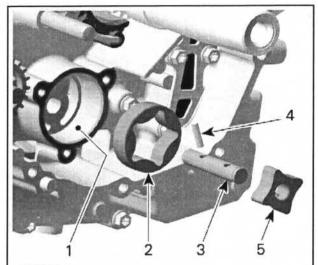


- Outer rotor Needle pin 2
- 3. Oil pump shaft Inner rotor

## **Oil Pump Inspection**

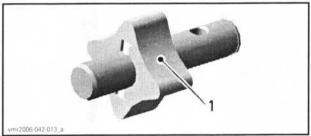
Inspect oil pump and oil pump cover bore for marks, scratches or other damages. Check for scratches in crankcase between outer rotor and oil pump bore. If so, replace damaged parts.

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



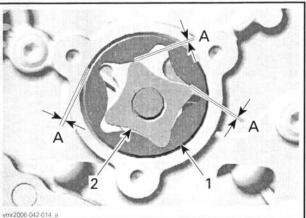
- 2006-042-012
- Oil pump bore
- 2.3.4. Outer rotor Oil pump shaft
- Needle pin
- 5. Inner rotor

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



Pittings on the teeth

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

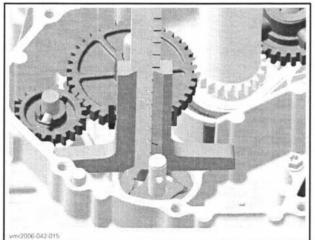


- Outer rotor
- 2. Inner rotor
- A. 0.25 mm (.0098 in)

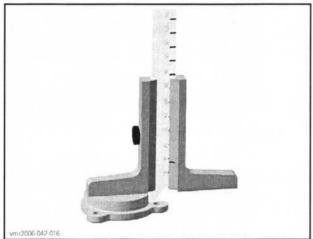
If clearance of inner and outer rotors exceeds the tolerance, replace oil pump shaft assembly. Ensure to also check oil pump cover. If damaged, replace the complete oil pump assembly.

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 A and B should not exceed specification. If so, replace the complete oil pump assembly.

OIL PUMP AXIAL CLEARANCE		
SERVICE LIMIT	0.2 mm (.008 in)	

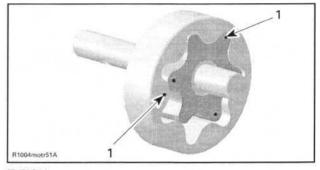
NOTE: When the axial clearance of the oil pump shaft assembly increases, the oil pressure decreases.

#### Oil Pump Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

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



TYPICAL 1. Markings

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

## **Oil Pump Final Test**

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

## ENGINE OIL STRAINER

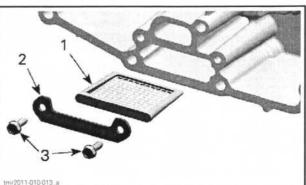
The engine oil strainer is located between both crankcase halves.

#### **Oil Strainer Removal**

Separate crankcase halves. Refer to *BOTTOM END* subsection.

Remove screws and retaining plate.

Pull out engine oil strainer.



1. Engine oil strainer 2. Retaining plate

3. Screws

Subsection 04 (LUBRICATION SYSTEM)

## **Oil Strainer Cleaning and Inspection**

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

#### A WARNING

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

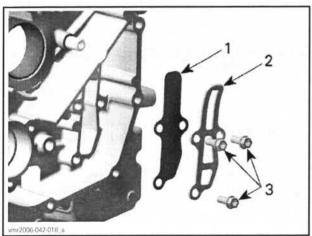
Check engine oil strainer for cracks or other damage. Replace if damaged.

#### **Oil Strainer Installation**

The installation is the reverse of the removal procedure.

## REED VALVE

The engine is equipped with a reed valve 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

#### **Reed Valve Removal**

Remove:

- PTO cover (refer to PTO COVER in the BOT-TOM END subsection)
- Reed valve retaining screws
- Stopper plate
- Reed valve.

#### **Reed Valve Inspection**

Check reed valve for cracks or other damage. Replace reed valve if damaged.

#### **Reed Valve Installation**

The installation is the reverse of the removal procedure.

Subsection 05 (COOLING SYSTEM)

# **COOLING SYSTEM**

## SERVICE TOOLS

Description	Part Number	Page
BLIND HOLE PULLER KIT		
FLUKE 115 MULTIMETER	529 035 868	
HANDLE	420 877 650	
LARGE HOSE PINCHER	529 032 500	
OIL SEAL PUSHER	529 035 757	
ROTARY SEAL PUSHER PLATE	529 036 130	74
SEAL PUSHER	529 035 766	

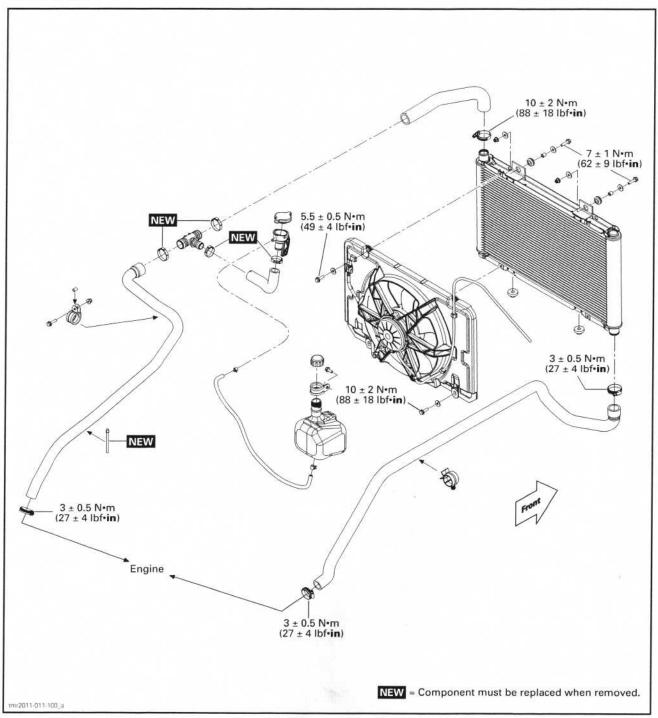
## SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	
LOCTITE 243 (BLUE)	293 800 060	

Subsection 05 (COOLING SYSTEM)

## RADIATOR

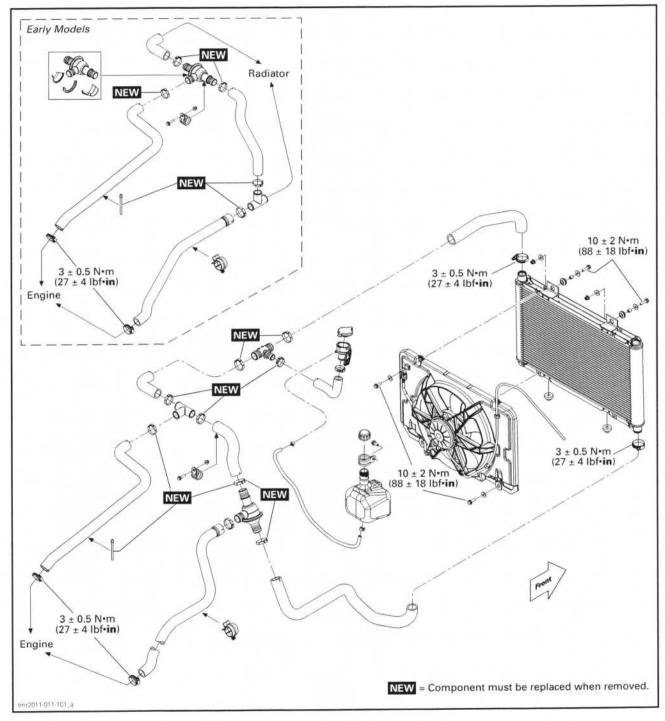
800R Engine



Subsection 05 (COOLING SYSTEM)

## RADIATOR

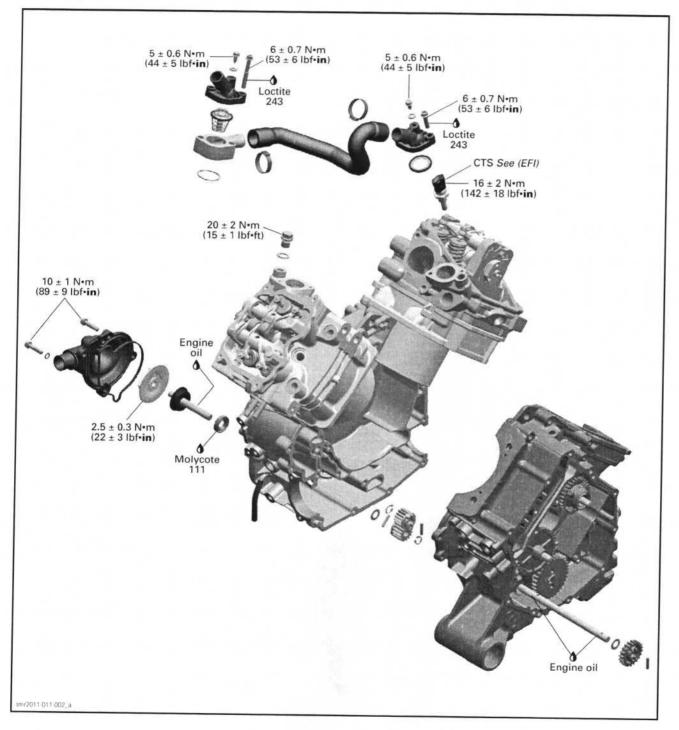
1000 Engine



Subsection 05 (COOLING SYSTEM)

## WATER PUMP

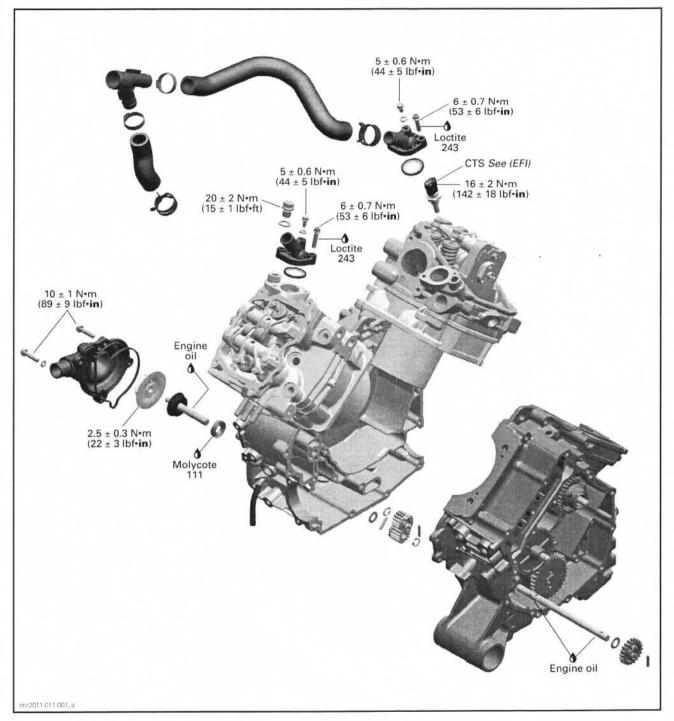
800R Engine



Subsection 05 (COOLING SYSTEM)

## WATER PUMP

1000 Engine



Subsection 05 (COOLING SYSTEM)

## GENERAL

#### 

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

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

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

## WARNING

Torque wrench tightening specifications must strictly be adhered to. Locking devices when removed must be re-

placed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, etc.).

## PROCEDURES

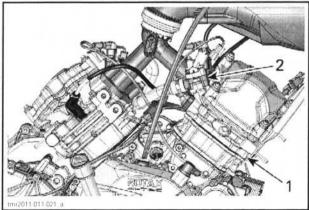
## THERMOSTAT

The thermostat is a single action type.

## Thermostat Location

#### 800R Models

The thermostat is located in the thermostat housing at the top of the front cylinder (RH side).



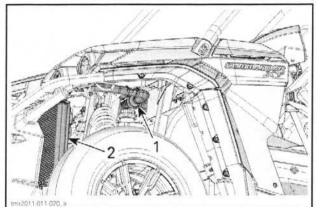
TYPICAL - THERMOSTAT LOCATION 800R MODELS 1. Front cylinder 2. Thermostat housing

#### z. memostat nousin

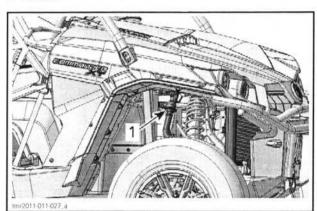
#### 1000 Models

The thermostat is mounted in-line in the cooling system circuit.

There are two possible locations (see illustrations).



THERMOSTAT LOCATION - LH FRONT WHEEL WELL ACCESS 1. In-line thermostat 2. Radiator



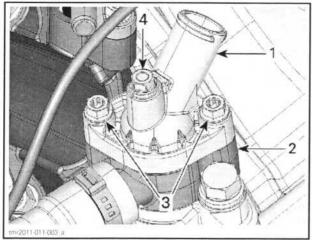
THERMOSTAT LOCATION - RH FRONT WHEEL WELL ACCESS 1. In-line thermostat

## Thermostat Removal

#### 800R Models

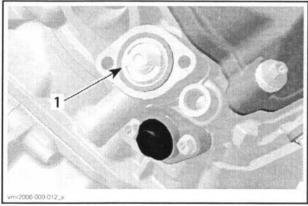
- 1. Install a LARGE HOSE PINCHER (P/N 529 032 500) on both radiator hoses.
- 2. Drain remainder of cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
- 3. Remove thermostat housing screws and remove thermostat cover.

Subsection 05 (COOLING SYSTEM)



THERMOSTAT LOCATION - FRONT CYLINDER HEAD

- 1. Thermostat cover
- 2. Thermostat housing 3. Cover screws
- 4. Bleed screw
- 4. Pull thermostat and gasket from thermostat housing.

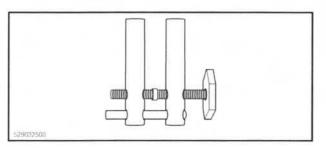


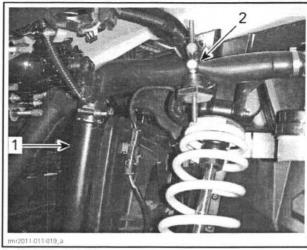
TYPICAL

1. Thermostat with gasket

#### 1000 Models

1. Install a LARGE HOSE PINCHER (P/N 529 032 500) on both radiator hoses.





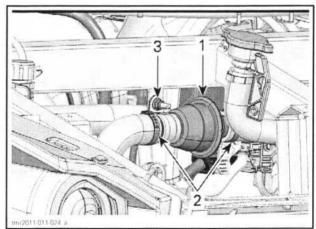
<sup>1.</sup> Radiator - LH side

2. Large hose clamp on upper hose (lower hose RH side similar)

2. Drain remainder of cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

## 1000 Models with Thermostat Access thru LH Front Wheel Well

- Remove service cover, refer to BODY subsection.
- 4. Remove air filter housing, refer to *AIR INTAKE SYSTEM* subsection.
- 5. Remove Oetiker clamps that secure hoses to thermostat.
- 6. Remove clamp that secures thermostat housing to frame.



THERMOSTAT EARLY 1000 PRODUCTION MODELS - AIR FILTER HOUSING REMOVED

- 1. Thermostat 2. Oetiker clamps (3)
- 3. Support clamp
- 7. Pull hoses from thermostat housing to remove thermostat.

Subsection 05 (COOLING SYSTEM)

#### 1000 Models with Thermostat Access thru RH Front Wheel Well

- Remove Oetiker clamps that secure hoses to thermostat.
- 9. Pull hoses from thermostat housing to remove thermostat.

## Thermostat Test

To check thermostat, put it in water and heat the water.

THERMOSTAT OPENING TEMPERATURE		
MODELS	STARTS TO OPEN	FULLY OPEN
800R	65°C (149°F)	75°C (167°F)
1000	65°C (149°F)	88°C (190°F)

Replace thermostat if it does not begin to open at specified temperature.

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

## Thermostat Installation

#### 800R Models

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

THERMOSTAT COVER INSTALLATION			
GASKET	PRODUCT	TORQUE	
New	LOCTITE 243 (BLUE) (P/N 293 800 060) on screws	6 N∙m ± 0.6 N∙m (53 lbf∙in ± 5 lbf∙in)	

## 1000 Models

Reverse removal procedures.

## All Models

Refill cooling system.

Bleed cooling system, refer to *PERIODIC MAIN-TENANCE PROCEDURES* subsection.

**NOTICE** The cooling system must be bled as specified.

Check for coolant leaks.

## RADIATOR

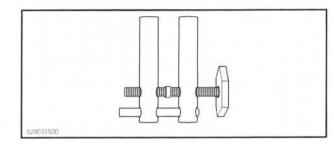
## Radiator Inspection

Check radiating fins for clogging or damage.

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

## Radiator Removal

1. Install a LARGE HOSE PINCHER (P/N 529 032 500) on both radiator hoses.



Pri2011-011-018 4

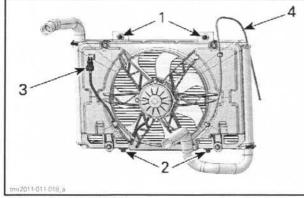
- 2. Lift front of vehicle to extend suspension.
- 3. Remove the following parts from the radiator:
  - Radiator inlet hose (LH upper)
  - Radiator outlet hose (RH lower)
  - Radiator mounting screws (2 at top of radiator).
- 4. Disconnect cooling fan electrical connector.
- 5. Remove cooling fan vent hose from frame.

**NOTE:** Take note of the rooting of the vent hose on the cooling fan motor. See following illustration.

<sup>1.</sup> Radiator - LH side

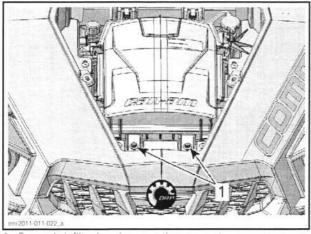
<sup>2.</sup> Large hose clamp on upper hose (lower hose RH side similar)

Subsection 05 (COOLING SYSTEM)



- RADIATOR REAR VIEW
- 1. Radiator mounting screws
- Lower mounting bushings
   Radiator fan electrical connector
- 4. Fan motor vent hose
- 6. Remove the 2 forward air filter housing mounting screws.

**NOTE:** This will make room for lifting the radiator off its lower mounting bushings.



1. Forward air filter housing mounting screws to remove

#### Models Equipped with a Winch

7. Remove the winch, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

#### All Models

8. Lift radiator t and tilt its lower end towards the front of the vehicle.

**NOTE:** Turning steering to LH stop or removing LH front wheel assembly provides greater access for radiator removal.

9. Carefully remove radiator through LH wheel well.

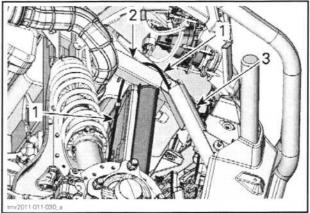
## **Radiator Installation**

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

- 2. Install the rubber bushings between bottom of radiator and radiator support.
- 3. Ensure the vent hose on the cooling fan motor is properly rooted as prior to removal.

**NOTE:** Cooling fan vent hose must pass over the top RH frame member, then be inserted down into the RH vertical bumper tube.

**NOTICE** If the vent hose on the cooling fan motor is not properly rooted, the fan motor may be damaged due to improper venting.



- 1. Cooling fan vent hose
- 2. RH top frame member
- 3. RH vertical bumper tube
- Fill radiator with the recommended coolant. Refer to *PERIODIC MAINTENANCE PROCE-DURES* subsection.
- 5. Bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

**NOTICE** The cooling system must be bled as specified.

6. Check for coolant leaks from radiator and hoses.

## COOLANT TEMPERATURE SENSOR (CTS)

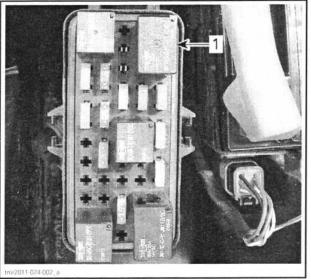
Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

# RADIATOR COOLING FAN RELAY (R1)

# Relay Installation (Radiator Cooling Fan)

**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.

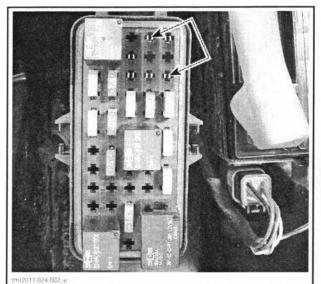
Subsection 05 (COOLING SYSTEM)



1. R1: Radiator cooling fan relay

# Relay Operation Test (Radiator Cooling Fan)

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

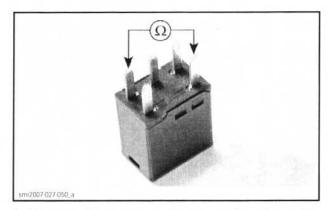


JUMPER RELAY R1 (RADIATOR FAN)

# Relay Continuity Test (Radiator Cooling Fan)

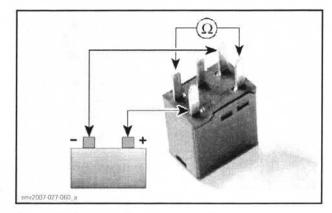
- 1. Remove relay.
- 2. Use the FLUKE 115 MULTIMETER (P/N 529 035 868), and select the  $\Omega$  position.
- 3. Probe relay as follows.

TERMINAL		RESISTANCE
30	87	Open circuit (OL)



4. Connect battery as shown and probe relay again as follows.

TERM	TERMINAL	
30	87	0.5 Ω max. (continuity)



If relay failed any test, replace it.

## RADIATOR COOLING FAN

## **Radiator Cooling Fan Operation**

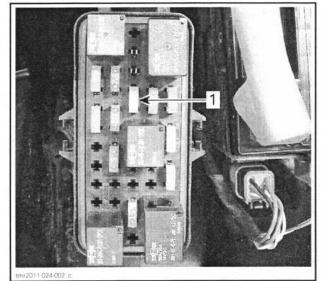
The ECM controls the radiator cooling fan via the input of the coolant temperature sensor (CTS) and the manifold air pressure and temperature sensor (MAPTS). Refer to the following table.

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	. <u> </u>	_	
96°C (205°F)		Turns ON	_	· · · · · · · · · · · · · · · · · · ·	-
92°C (198°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 Cooling Fan Fuse Location

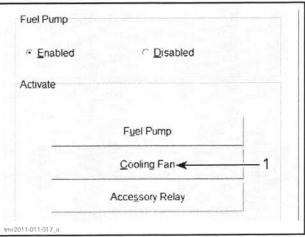
The fuse is located in the fuse box underneath the dashboard on the driver's side.





#### **Radiator Cooling Fan Test**

- 1. Connect the vehicle to B.U.D.S., refer to *COM-MUNICATION TOOLS AND B.U.D.S.* for procedure and connector location.
- 2. In B.U.D.S. software, select the following:
  - Read Data button
  - Activation page tab
  - ECM page
  - Cooling Fan button.



1. Cooling Fan activation button

If fan turns on, check CTS, wiring harness and connectors. If all parts are good, replace the ECM. If fan does not turn on when the **Cooling Fan** button is pressed, refer to the following troubleshooting chart.

Subsection 05 (COOLING SYSTEM)

Is fan working?	YES →	Everything is OK
NO 🗸		
Check "Relay driver" fuse (5A) and fan fuse (30A). Is fuse burnt?	YES →	Replace fuse Is fan working?
NO 🗸		
Bypass fan relay R1	]	
↓		
Fan turns?	YES →	Replace relay Is fan working?
NO 🗸		
Apply 12 Vdc to fan connector	]	
t		
Fan turns?	NO →	Replace fan Is fan working?
YES 🗸		
Check CTS	]	
Ť		
CTS works?	NO →	Replace CTS Is fan working?
YES 🗸		
Check wiring harness and connectors		
t		
Harness and connectors good?	NO →	Repair or replace defective part(s)
YES 🗸		
Try a new ECM	$\rightarrow$	Is fan working?

## Radiator Cooling Fan Removal

- 1. Disconnect fan motor electrical connector.
- 2. Remove fan motor vent tube from vehicle frame.
- 3. Remove 4 fan retaining screws.
- 4. Remove the radiator fan.

#### Radiator Cooling Fan Installation

For the installation, reverse the removal procedure.

## WATER PUMP HOUSING

It is located on the engine MAG side.

#### Water Pump Housing Removal

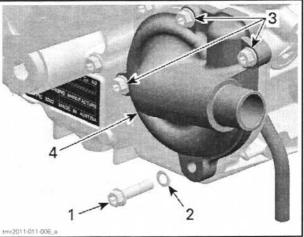
#### A WARNING

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

Drain cooling system.

Remove radiator outlet hose from water pump housing.

Remove screws retaining water pump housing.



. Coolant drain plug

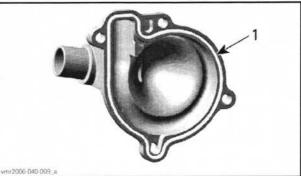
Sealing ring

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

Subsection 05 (COOLING SYSTEM)

#### Water Pump Housing Installation

The installation is the opposite of the removal procedure.

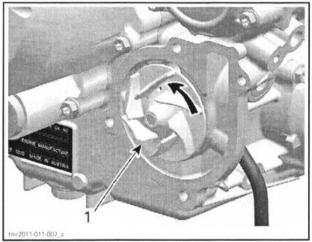
**NOTICE** To prevent leaking, take care that the gasket is exactly in groove when you reinstall the water pump housing.

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

## WATER PUMP IMPELLER

#### Water Pump Impeller Removal

Remove water pump housing. Unscrew impeller.



1. Turn counterclockwise to unscrew

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

#### Water Pump Impeller Inspection

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

#### Water Pump Impeller Installation

The installation is the opposite of the removal procedure.

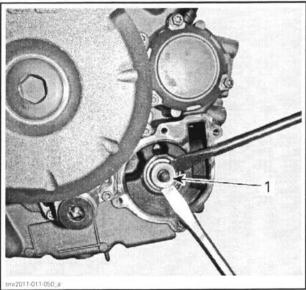
**NOTICE** Be careful not to damage impeller fins during installation.

# WATER PUMP SHAFT AND SEALS

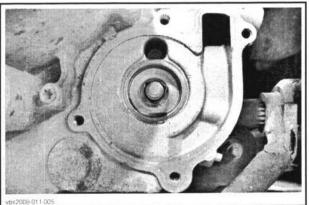
# Rotary Seal and Oil Seal Removal (Assembled Engine)

Remove water pump housing, refer to *WATER PUMP HOUSING* in this subsection.

1. Carefully pry out inner part of the rotary seal using 2 screwdrivers.



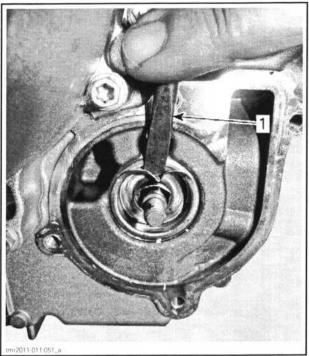
1. Inner part of rotary seal



TYPICAL - INNER PART OF ROTARY SEAL REMOVED

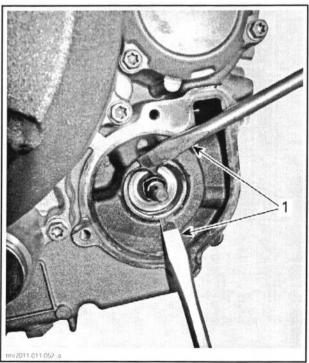
2. Carefully bend down the outer part of rotary seal lip using a small chisel.

Subsection 05 (COOLING SYSTEM)



Small chisel 1.

3. Use 2 screwdrivers and carefully remove the outer part of the rotary seal.

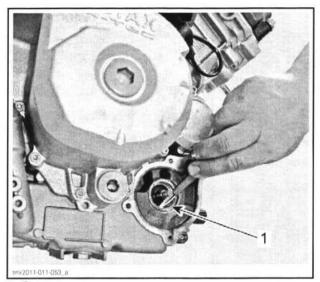


Screwdrivers

**NOTICE** Be careful not to damage the crankcase while removing outer part of the rotary seal.

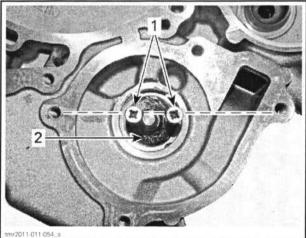
4. Thoroughly remove carefully sealing residue and burr of rotary seal using a scraper.

NOTICE Be careful not to damage water pump shaft.



Scraper

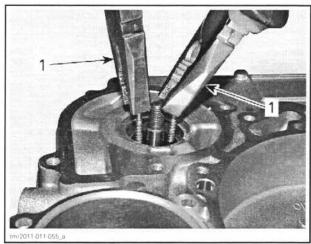
5. Install 2 wooden screws in the seal.



Wooden screws Oil seal 1.

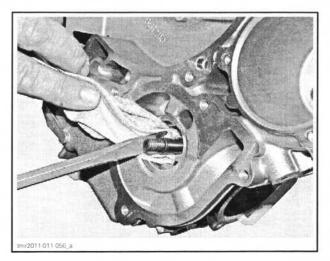
6. Remove oil seal from crankcase by puling screws with pliers.

Subsection 05 (COOLING SYSTEM)



1. Pull on screws to remove seal

- Check water pump shaft axial play. If not adequate, engine must be disassembled to replace the water pump shaft.
- 8. Clean oil seal seat.

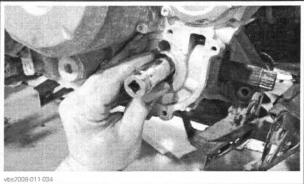


# Rotary Seal and Oil Seal Installation (Engine Assembled)

#### Oil Seal

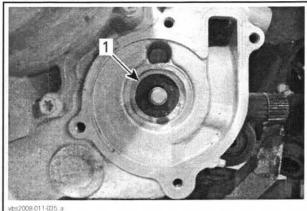
Apply engine oil on water pump shaft.

- 1. Apply grease to the lips of the oil seal.
- 2. Carefully install the oil seal over the water pump shaft.
- 3. Push the oil seal into the water pump cavity using a 17 mm (11/16 in) deep socket.



OIL SEAL INSTALLATION

Ensure that the oil seal is properly seated in water pump cavity.



TYPICAL

1. Oil seal properly seated

#### Rotary Seal

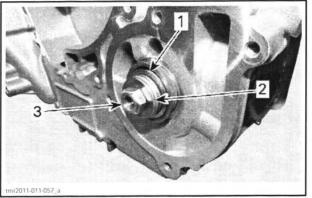
**NOTICE** Read and thoroughly understand the entire procedure of installing the rotary seal before starting it.

- 1. Apply engine oil on water pump shaft.
- 2. Place rotary seal onto water pump shaft and pull out water pump shaft by hand.

**NOTICE** Do not install the rotary seal completely into the crankcase to prevent the water pump shaft plastic gear from breaking. Push it partially in, then pull the shaft.

- 3. Place a robust M8 flat washer (P/N 420 227 935) onto water pump shaft.
- 4. Install a M8 x 1.25 nut onto water pump shaft by hand.
- 5. Then thread nut 1-1/2 turns to pull the shaft into rotary seal.

Subsection 05 (COOLING SYSTEM)



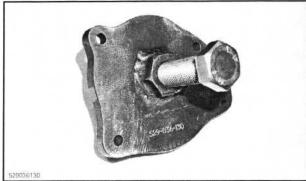
Rotary seal

- 1. M8 robust flat washer (P/N 420 227 935)
- 3. M8 x 1.25 nut (P/N 233 281 414)

#### 6. Remove M8 nut.

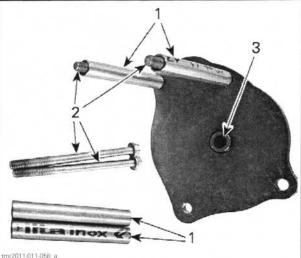
NOTE: The M8 flat washer remains on water pump shaft.

7. Use the ROTARY SEAL PUSHER PLATE (P/N 529 036 130) with M6 x 85 screws (P/N 420 440 347) and tubes (70 mm (2.75 in) length) to install rotary seal as follows.



ROTARY SEAL PUSHER PLATE (P/N 529 036 130)

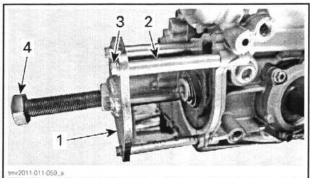
NOTE: Make sure the tool pusher bolt has a plane surface. If required, grind the pusher bolt.



4 x tubes (70 mm (2.75 in) length) 1. 2.

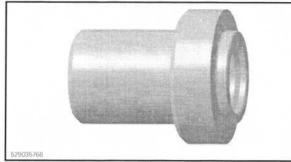
- 4 x screws M6 x 85
- 3. Plane surface on pusher bolt
- 8. Apply a little grease at the end of tool pusher bolt.
- 9. Ensure that the pusher bolt of rotary seal pusher plate is completely unscrewed.
- 10. Install rotary seal pusher plate on crankcase by torquing the M6 screws.

NOTICE Do not use pneumatic or electric tools for screwing the rotary seal pusher plate screws.

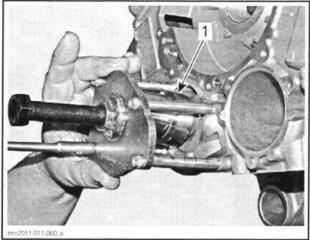


- ROTARY SEAL PUSHER PLATE INSTALLATION Rotary seal pusher plate Tube (70 mm (2.75 in) length) 2
- 3. M6 x 85 screw
- 4. Pusher bolt
- 11. Install SEAL PUSHER (P/N 529 035 766) between rotary seal pusher plate and water pump shaft.

Subsection 05 (COOLING SYSTEM)

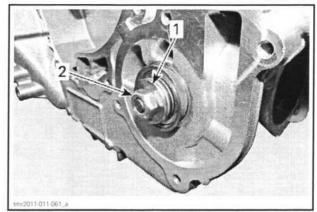


SEAL PUSHER (P/N 529 035 766)



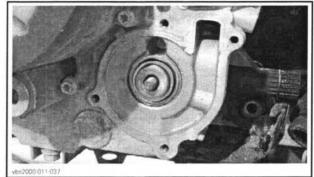
SEAL PUSHER INSTALLATION WITH ROTARY SEAL PUSHER 1. Seal pusher aligned with pusher bolt

- 12. Tighten the pusher bolt by hand until it stops against the seal pusher.
- 13. Carefully thread the pusher bolt 1-1/2 turns.
- 14. Ensure that the rotary seal is going straight into crankcase.
- 15. Remove tools from crankcase.
- Place a robust M8 flat washer (P/N 420 227 935) onto water pump shaft.
- 17. Install M8 x 1.25 nut (P/N 233 281 414) onto water pump shaft.



1. M8 robust flat washer (P/N 420 227 935) 2. M8 x 1.25 nut (P/N 233 281 414)

Repeat the steps 5 to 15 another 2 times until rotary seal is completely seated in the crankcase. 18. Remove tools from crankcase.

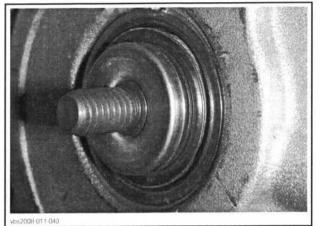


ROTARY SEAL PROPERLY SEATED ON CRANKCASE

- Place a robust M8 flat washer onto water pump shaft.
- 20. Pull water pump shaft in proper position until the rotary seal is flush with the end of water pump shaft threads.

**NOTICE** Ensure that the water pump shaft is properly adjusted with rotary seal.

Subsection 05 (COOLING SYSTEM)



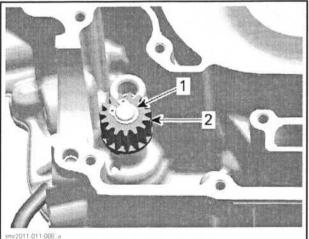
WATER PUMP SHAFT PROPERLY ADJUSTED WITH ROTARY SEAL

**NOTICE** Ensure that the water pump shaft moves freely while pushing it toward the crankcase.

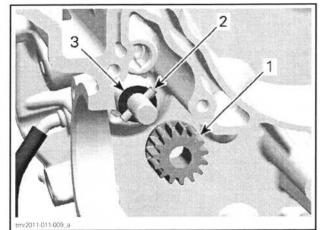
#### Water Pump Shaft/Seal Removal (Disassembled Engine)

1. Remove the following parts:

- Water pump housing
- Water pump impeller.
- 2. Remove the circlip retaining the intermediate driven gear on water pump shaft.



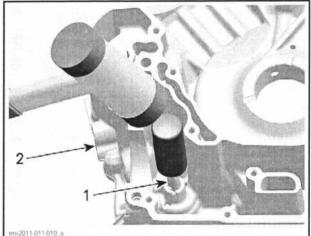
- 3. Remove the:
  - Water pump intermediate driven gear
  - Needle pin
  - Thrust washer.



Water pump intermediate driven gear (removed) Needle pin

2. Thrust washer

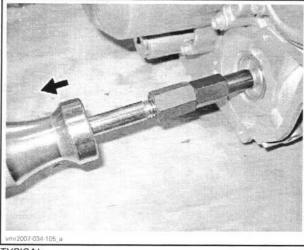
4. Using a soft hammer, push out water pump shaft with inner portion of rotary seal from inside of crankcase MAG side.



- 1. Water pump shaft 2. Crankcase MAG side
- 5. To remove outer part of rotary seal, use an expander from BLIND HOLE PULLER KIT (P/N 529 036 056).
- 6. Install expander snugly against outer part of rotary seal and pull seal out.

<sup>1.</sup> Circlip 2. Water pump gear

Subsection 05 (COOLING SYSTEM)

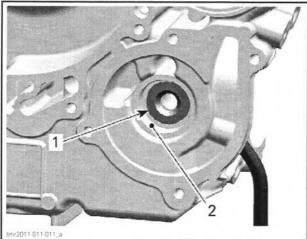


TYPICAL

**NOTICE** When removing water pump shaft, always replace rotary seal with water pump shaft. Also replace oil seal in crankcase (behind rotary seal).

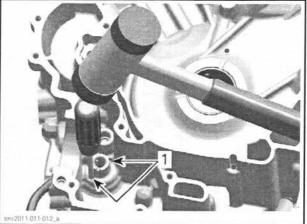
 Remove oil seal from inside of crankcase MAG side using a pusher tool.

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



1. Oil seal

2. Machined surface for rotary sea!



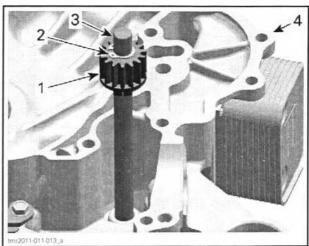
OIL SEAL REMOVAL - VIEW FROM INSIDE CRANKCASE MAG SIDE 1. Orifices for oil seal removal

# Water Pump Shaft/Seal Inspection (Disassembled Engine)

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

Check water pump intermediate drive gear for wear or broken teeth. Replace if damaged.

**NOTICE** Never use the circlip a second time. Always install a NEW one.



- 1. Water pump intermediate drive gear
- 2. Circlip
- 3. Intermediate shaft
- 4. Crankcase PTO side

# Water Pump Shaft/Seal Installation (Disassembled Engine)

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

**NOTE:** For installation use the torque values specified in the exploded view.

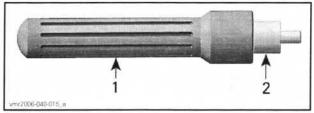
Subsection 05 (COOLING SYSTEM)

NOTICE Always replace rotary seal and water pump shaft together. Also, install a NEW oil seal (behind rotary seal) at the same time.

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

Clean rotary seal surface of any old sealant.

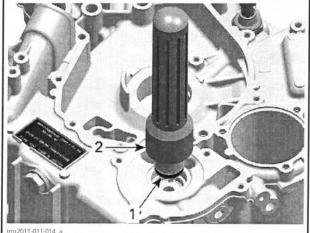
Use the OIL SEAL PUSHER (P/N 529 035 757) and the HANDLE (P/N 420 877 650) to install oil seal.



Handle 2. Pusher

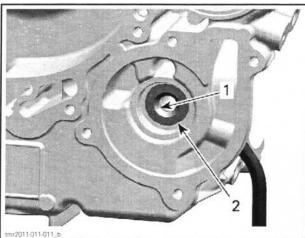
When installing the oil seal on the pusher, make sure the sealing lip points outwards.

Push NEW oil seal in place.



Oil seal 2. Installer handle with oil seal pusher

Apply DOW CORNING 111 (P/N 413 707 000) on sealing lip of the oil seal.

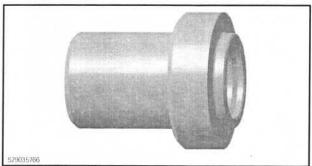


Sealing lip Oil seal properly installed 2

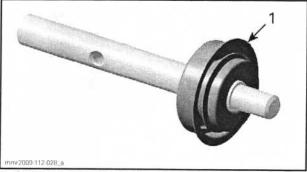
Apply engine oil on the water pump shaft and intermediate shaft.

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

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



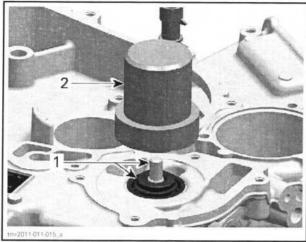
SEAL PUSHER (P/N 529 035 766)



Surface where rotary seal is pushed by tool

NOTICE Never use a hammer for rotary seal installation. Only use a press to avoid damaging the ceramic component.

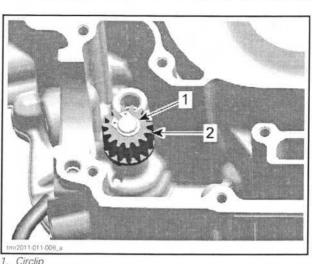
Subsection 05 (COOLING SYSTEM)



- Water pump shaft with rotary seal
- 2 Water pump seal installer

Install thrust washer and needle pin on water pump shaft.

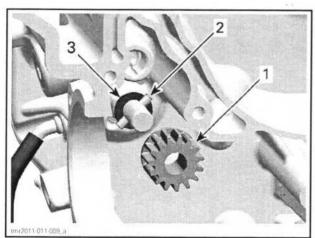
NOTICE A missing thrust washer will cause a leaking rotary seal.



1. Circlip 2. Water pump gear

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

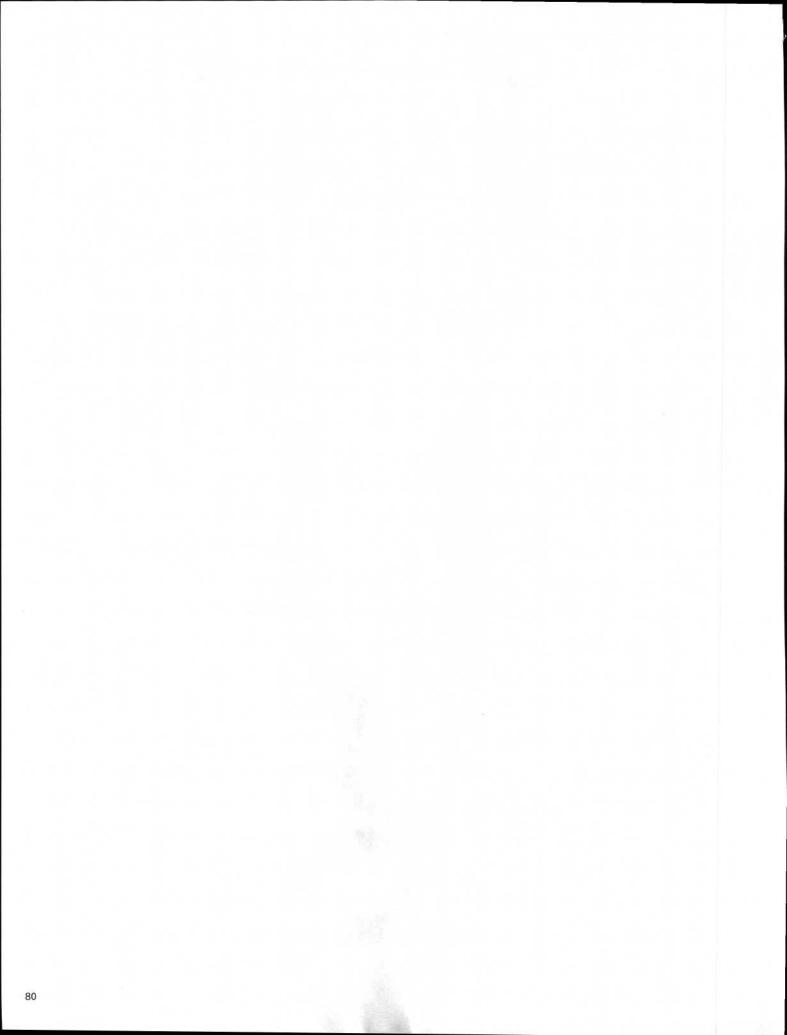
Tighten screws of the water pump housing crosswise.



- Water pump intermediate driven gear Needle pin Thrust washer 1
- 2. 3.

Ensure water pump intermediate driven gear snaps properly onto needle pin, then install the circlip to retain the gear onto the shaft.

**NOTICE** Never use the circlip a second time. Always install a NEW one.



Subsection 06 (MAGNETO SYSTEM)

# **MAGNETO SYSTEM**

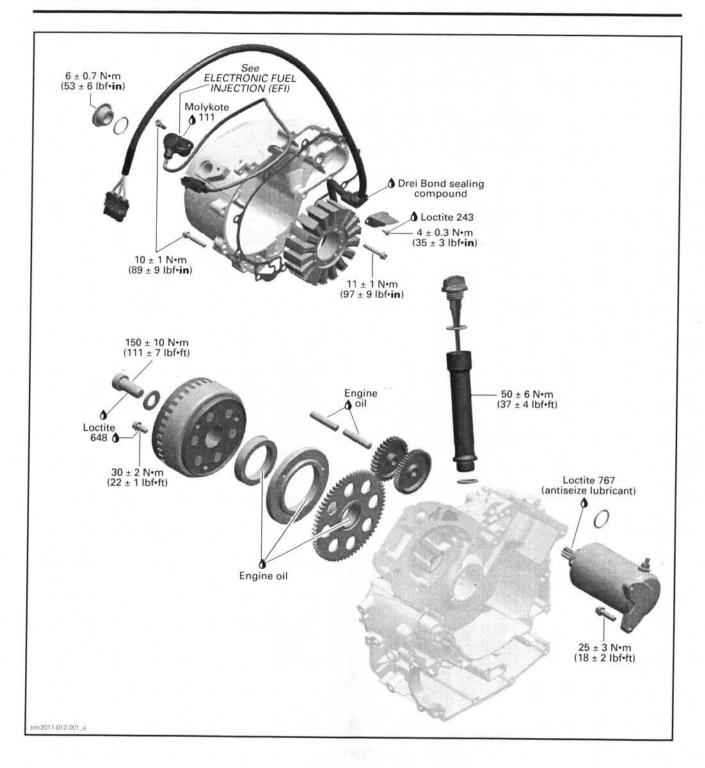
## SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT	529 035 617	
CRANKSHAFT PROTECTOR	529 036 034	
MAGNETO DIAGNOSTIC HARNESS	529 036 199	
MAGNETO PULLER	529 035 748	

## SERVICE PRODUCTS

Description	Part Number	Page
DREI BOND SEALING COMPOUND	420 297 906	
LOCTITE 648 (GREEN)	413 711 400	
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	
PULLEY FLANGE CLEANER	413 711 809	

Subsection 06 (MAGNETO SYSTEM)



Subsection 06 (MAGNETO SYSTEM)

## GENERAL

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

## PROCEDURES

## MAGNETO COVER

#### Magneto Cover Access in Vehicle

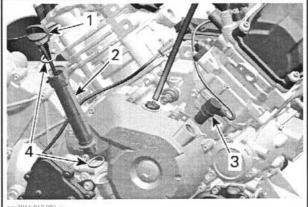
Remove fuel tank, refer to FUEL TANK AND FUEL PUMP.

#### Magneto Cover Removal

Drain engine oil (refer to *LUBRICATION SYSTEM*). Remove crankshaft position sensor (CPS) and cut tie raps.

Disconnect magneto connector.

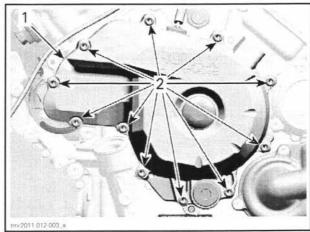
Remove dipstick and oil level tube with O-rings.



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- 1. Dipstick 2. Oil level tube
- 3. Crank position sensor (CPS)
- 4. O-rings

Remove magneto cover retaining screws.



1. Magneto cover 2. Retaining screws

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 nonferrous metal cleaner. Use LOCTITE CHISEL (GAS-KET REMOVER) (P/N 413 708 500), or suitable equivalent.

#### A 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.

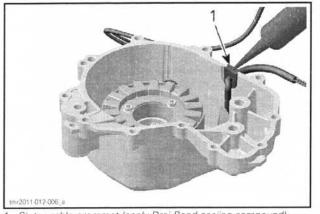
#### Magneto Cover Installation

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

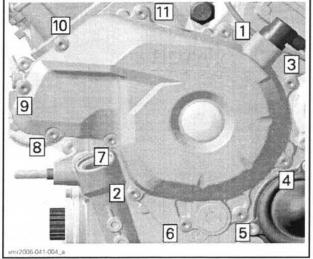
NOTE: At installation replace magneto cover gasket.

Apply DREI BOND SEALING COMPOUND (P/N 420 297 906) on stator cable grommet as shown in next illustration.

Subsection 06 (MAGNETO SYSTEM)



1. Stator cable grommet (apply Drei Bond sealing compound)



Tighten screws using the following sequence.

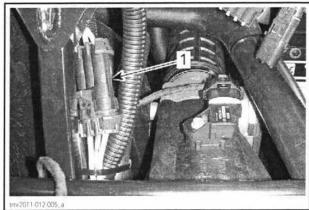
TIGHTENING SEQUENCE

Refill engine with recommended oil.

## STATOR

#### Stator Connector Access

Refer to BODY and remove upper console.

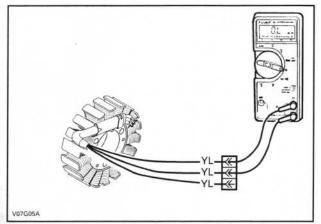


1. Magneto connector

#### Stator Static Test: Continuity

- 1. Disconnect the magneto connector.
- Install the MAGNETO DIAGNOSTIC HARNESS (P/N 529 036 199) on magneto connector (magneto side).
- 3. Set multimeter to  $\Omega$ .
- 4. Connect multimeter between YELLOW wires.
- 5. Read resistance.

TERMINAL	RESISTANCE @ 20°C (68°F)
1 and 2	
1 and 3	0.15 - 0.30 Ω
2 and 3	



TYPICAL

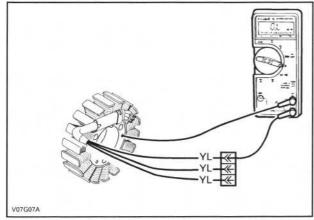
- 6. If any reading is out of specification, replace stator.
- 7. Re-plug connectors properly.

Subsection 06 (MAGNETO SYSTEM)

## Stator Static Test: Insulation

- 1. Install the MAGNETO DIAGNOSTIC HARNESS (P/N 529 036 199) on magneto connector (magneto side).
- 2. Set multimeter to  $\Omega$ .
- 3. Connect multimeter between any YELLOW wire and engine ground.
- 4. Read resistance.

TEST PROBES	RESISTANCE @ 20°C (68°F)	
Any YELLOW wire and engine ground	Infinite (open circuit)	



TYPICAL

- If there is a resistance or continuity, the stator coils and/or the wiring is shorted to ground and needs to be repaired or replaced.
- 6. Re-plug connectors properly.

#### Stator Dynamic Test: AC Voltage

- 1. Unplug magneto wiring harness connector.
- Install theMAGNETO DIAGNOSTIC HARNESS (P/N 529 036 199) between unplugged connectors.
- NOTE: Both connectors must be plugged.
- 3. Set multimeter to Vac.
- 4. Start engine.
- 5. Connect multimeter between YELLOW wires.
- 6. Read voltage as per following table.

TEST ENGINE SPEED	TERMINAL	VOLTAGE
	1 and 2	
4000 RPM	1 and 3	10 - 25 Vac
	2 and 3	

- 7. If voltage is lower than specification, replace stator.
- 8. Re-plug connectors properly.

## Stator Removal

Remove *MAGNETO COVER*. See procedure in this subsection.

Remove screws securing the wire holding strip.

Remove stator retaining screws then the stator.

#### Stator Inspection

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

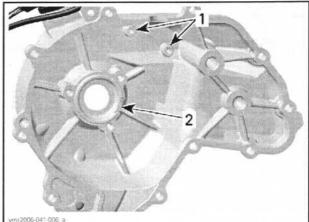
Check if stator wires are brittle, hard or otherwise damaged.

#### Stator Installation

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

**NOTICE** When installing the stator take care to route wires properly and install retaining strip.

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



. Threads for cable holding strip

2. Notch for stator

## ROTOR

## **Rotor Removal**

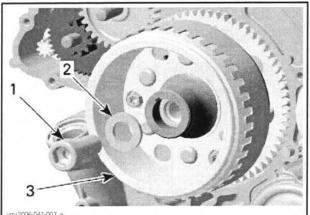
Remove *MAGNETO COVER*. See procedure in this subsection.

Lock crankshaft with CRANKSHAFT LOCKING BOLT (P/N 529 035 617) (refer to *BOTTOM END*).

Heat screw in order to break the Loctite.

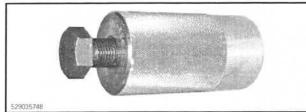
Subsection 06 (MAGNETO SYSTEM)

Remove screw and washer securing rotor to crankshaft.



- Screw M16 1 Washer
- 2. 3. Rotor

Install MAGNETO PULLER (P/N 529 035 748) and CRANKSHAFT PROTECTOR (P/N 529 036 034) then remove rotor.

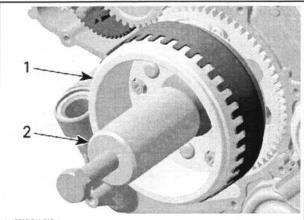


MAGNETO PULLER



CRANKSHAFT PROTECTOR

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



nr2006-041-010\_ Rotor

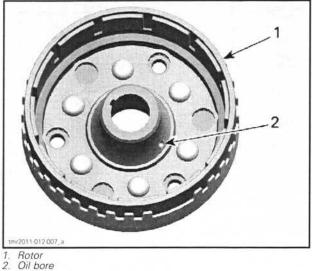
2. Magneto puller

Screw magneto puller bolt to remove rotor.

#### Rotor Inspection

Check inner side of rotor for scratches or other damage.

Blow pressurized air in the rotor oil bore and make sure it is not clogged.



Check keyway of the rotor for wear or damages.

Check if trigger wheel teeth are bent or otherwise damaged.

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.

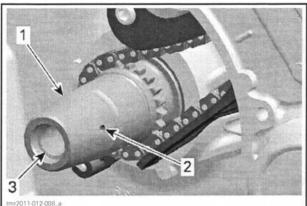
Subsection 06 (MAGNETO SYSTEM)

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

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

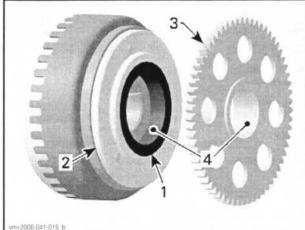
Blow pressurized air in the rotor oil bore.

Clean the crankshaft oil passage and threads using PULLEY FLANGE CLEANER (P/N 413 711 809).



- Crankshaft (MAG side)
- 2. Oil passage
- Threads

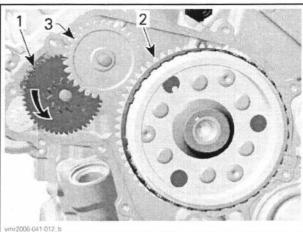
Oil sprag clutch and install sprag clutch gear.



- Sprag clutch Sprag clutch housing
- 3
- Sprag clutch gear Apply engine oil here 4

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.



Starter double gear Sprag clutch gear

3. Intermediate gear

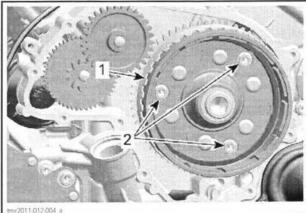
# SPRAG CLUTCH

## Sprag Clutch Removal

Remove MAGNETO COVER. See procedure in this subsection.

Heat screws in order to break the Loctite.

Loosen sprag clutch housing screws located inside rotor.



Rotor

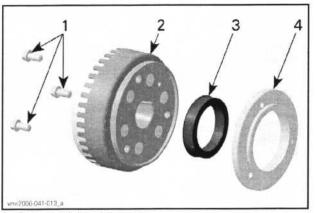
Rotor
 Sprag clutch housing screws

Remove rotor (refer to ROTOR above).

Remove sprag clutch gear.

Remove sprag clutch housing screws and sprag clutch housing.

Subsection 06 (MAGNETO SYSTEM)



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

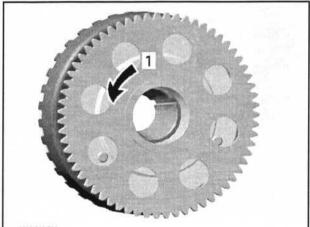
## Sprag Clutch Inspection

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.

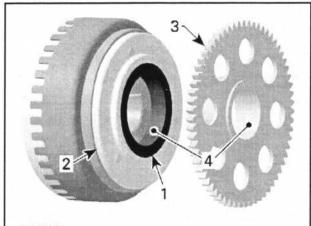
## Sprag Clutch Installation

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.



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- Sprag clutch
   Sprag clutch housing
- 2. Sprag clutch nousing 3. Sprag clutch gear

4. Apply engine oil here

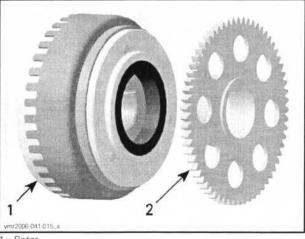
Install rotor then torque sprag clutch housing screws to 30 N•m (22 lbf•ft).

# SPRAG CLUTCH GEAR

#### Sprag Clutch Gear Removal

Remove *ROTOR*. See procedure in this subsection.

Pull sprag clutch gear out of the rotor.

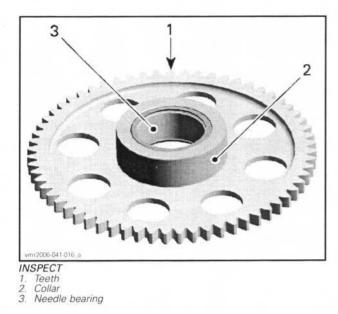


1. Rotor 2. Sprag clutch gear

## Sprag Clutch Gear Inspection

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

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



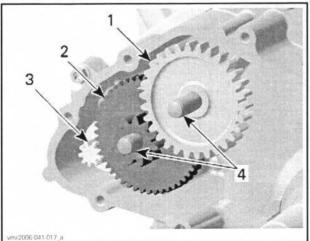
## Sprag Clutch Gear Installation

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

## Starter Drive Gear Removal

Remove *MAGNETO COVER*. See procedure in this subsection.

Remove location pins, starter double gear and intermediate gear.

## Starter Drive Gear Inspection

Inspect gears and location pins for wear and damage.

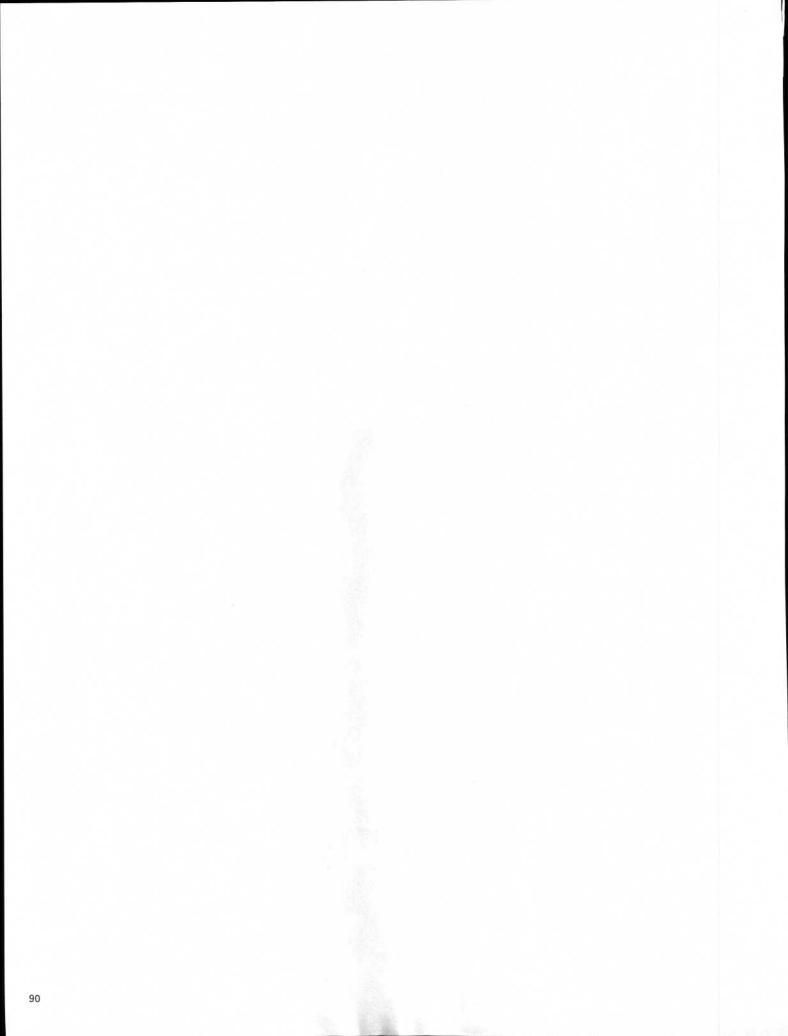
Replace parts as necessary.

#### Starter Drive Gear Installation

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



# **TOP END**

# SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT		
PISTON CIRCLIP INSTALLER	529 035 921	
PISTON CIRCLIP INSTALLER	529 036 153	
PISTON RING COMPRESSOR	529 035 919	
TDC DIAL INDICATOR	414 104 700	
VALVE GUIDE INSTALLER	529 036 140	
VALVE GUIDE REMOVER 5 MM	529 035 924	
VALVE SPRING COMPRESSOR CUP	529 035 764	
VALVE SPRING COMPRESSOR	529 035 724	

# SERVICE TOOLS - OTHER SUPPLIER

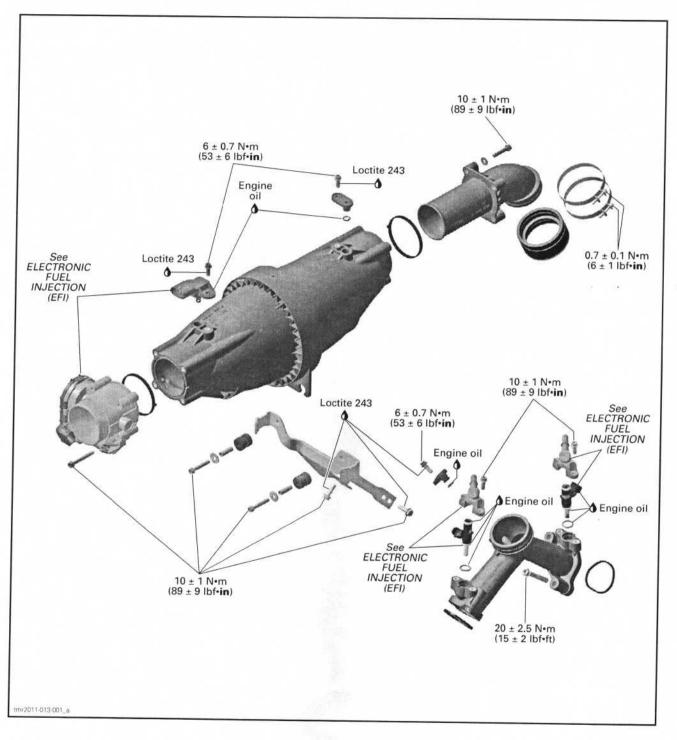
Description	Part Number	Page
SNAP-ON PLIERS	YA 8230	

# SERVICE PRODUCTS

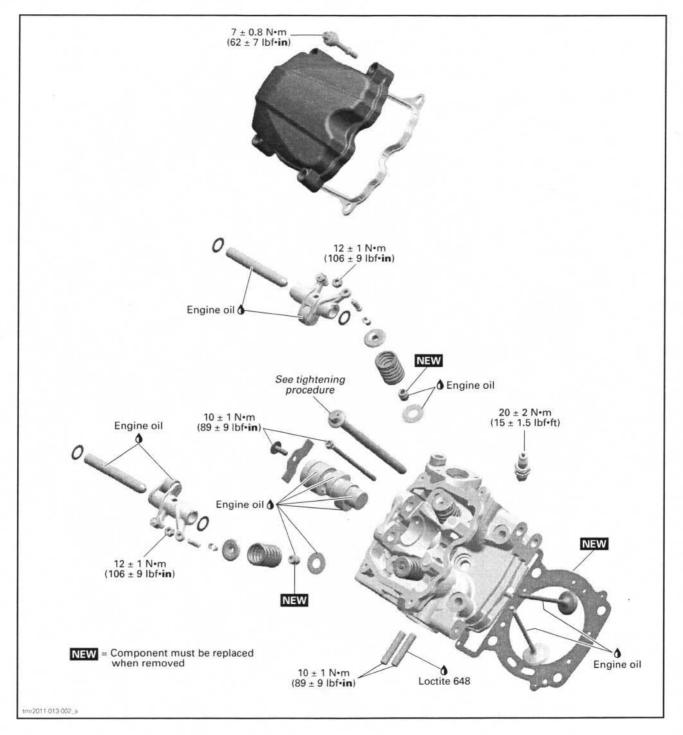
Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	

Subsection 07 (TOP END)

# INTAKE MANIFOLD

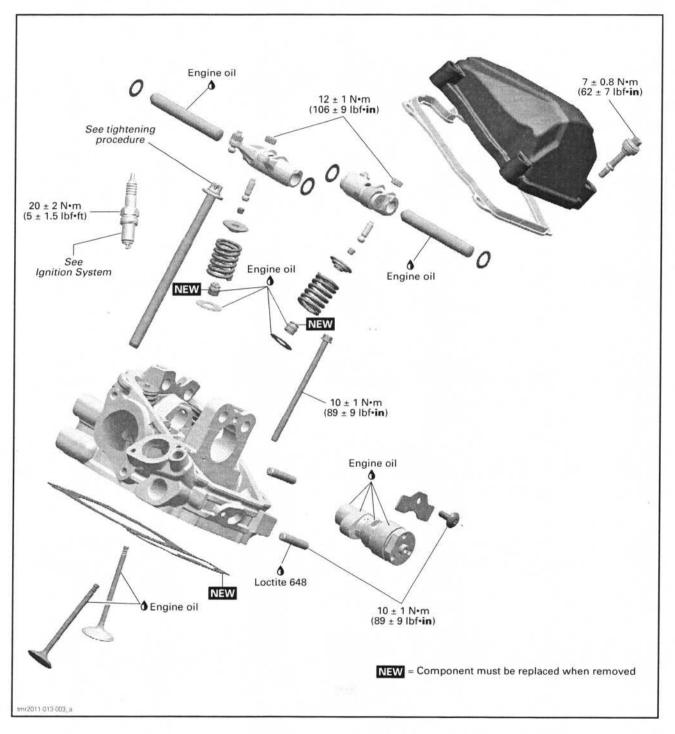


# CYLINDER HEAD NO. 1



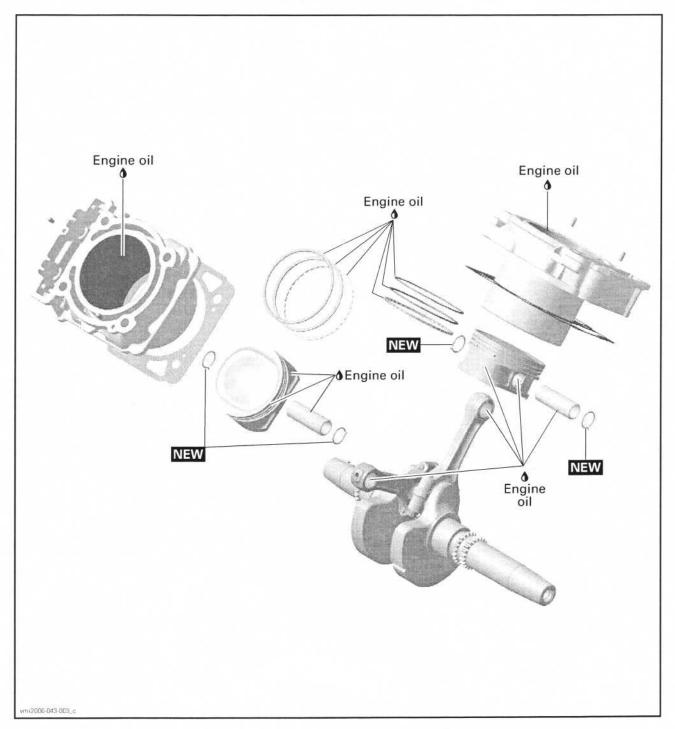
Subsection 07 (TOP END)

# CYLINDER HEAD NO. 2



## Section 02 ENGINE, CVT AND GEARBOX Subsection 07 (TOP END)

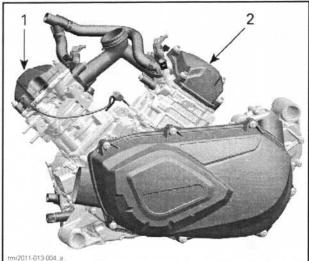
# CYLINDERS AND PISTONS



#### Section 02 ENGINE, CVT AND GEARBOX Subsection 07 (TOP END)

GENERAL

Special reference are made in the text for procedures which are different for cylinder no. 1 and cvlinder no. 2.



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

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

Always place the vehicle on level surface.

NOTE: Even though the following procedures do not require the engine removal, many illustrations show the engine out of the vehicle for more clarity.

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.

## A WARNING

Torque wrench tightening specifications must strictly be adhered to.

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

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".

# 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.

## A WARNING

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

Remove radiator cap.

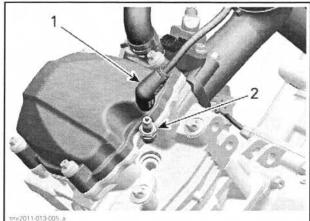
## A WARNING

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

Unplug spark plug cable.

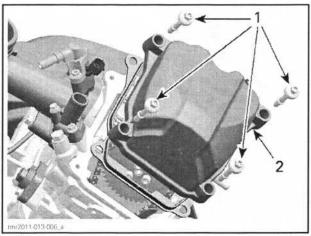
Clean spark plug area and remove spark plug from cylinder head.

Subsection 07 (TOP END)



- tmi2011-013-005\_a
- 1. Spark plug cable 2. Spark plug

Remove valve cover.



Valve cover screws
 Valve cover

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

#### **First Procedure**

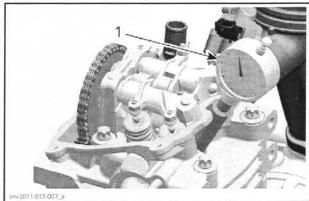
Turn the drive pulley.

#### Second Procedure

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

# **NOTICE** Turn only clockwise to avoid loosening of magneto flywheel Allen screw.

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

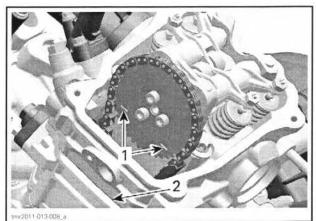


1. Dial gauge

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

**NOTICE** 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.



Marks on camshaft timing gear
 Cylinder head base

## Leak Test

Connect to adequate air supply.

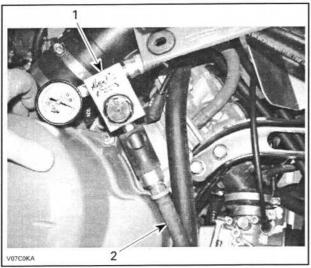
Set needle of measuring gauge to zero.

**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.

Subsection 07 (TOP END)



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

NOTE: To make sure there is no false reading due to a valves not perfectly seated, tap each valve adjustment screw (on the rocker) using a soft hammer.

## Diagnosis

Listen for air leaks.

- Air escaping in intake port/throttle body means leaking intake valve(s)
- Air escaping in exhaust port means leaking exhaust valve(s)
- Air bubbles in the coolant (radiator) means leaking cylinder head gasket
- Air/coolant escaping from cylinder/head means damaged gasket(s) and/or loosened screws
- Air escaping into crankcase area means excessively worn cylinder and/or broken piston rings
- Air/oil escaping from crankcase means damaged gasket and/or loosened screws (refer to BOTTOM END subsection).

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 torgue values and use of appropriate products/lubricants. Refer to exploded views in other sections of this manual as required.

# PROCEDURES

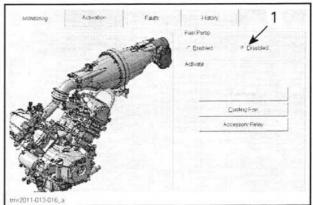
## INTAKE MANIFOLD

### Intake Manifold Access

Refer to BODY and remove the lower console.

### Intake Manifold Removal

1. Disable fuel pump using B.U.D.S. Select the ECM and Activation tabs, then click on Disabled in the fuel pump area.



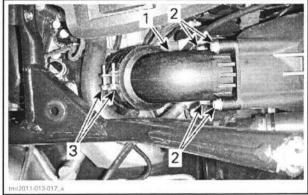
Click "Disabled"

- 2. Release fuel pressure by running engine until it runs out of gas.
- 3. Disconnect the fuel hoses at the fuel injectors, refer to ELECTRONIC FUEL INJECTION (EFI).

#### A CAUTION The fuel hose may still be under pressure.

- 4. Disconnect fuel injectors electrical connectors.
- 5. Remove intake plenum adapter.

Subsection 07 (TOP END)



1. Plenum adapter elbow

- 2. Plenum elbow to plenum retaining screws
- 3. Plenum elbow to intake manifold clamps
- Remove intake manifold to cylinder head retaining screws, then remove intake manifold.

#### 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.

Tighten intake manifold retaining screws to specified torque one cylinder at a time.

#### INTAKE MANIFOLD RETAINING SCREWS TIGHTENING TORQUE

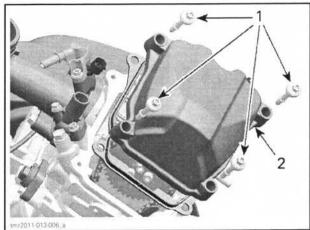
20 N•m ± 2.5 N•m (15 lbf•ft ± 2 lbf•ft)

Enable fuel pump using B.U.D.S.

## VALVE COVER

#### Valve Cover Removal

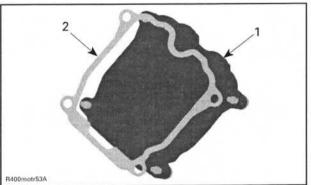
To remove cylinder 1 valve cover, remove plenum. Remove valve cover screws of valve cover.



1. Valve cover screws

2. Valve cover

Remove valve cover and gasket.



1 Valve cover

Gasket

Repeat the procedure for the other valve cover if required.

#### Valve Cover Inspection

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

#### Valve Cover Installation

For installation, reverse the removal procedure.

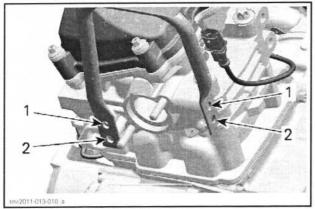
Tighten valve cover retaining screws to specified torque in a criss-cross sequence.

#### VALVE COVER RETAINING SCREWS TIGHTENING TORQUE

7 N•m ± 0.8 N•m (62 lbf•in ± 7 lbf•in)

On cylinder 1, install the plenum bracket using the appropriate mounting holes.

Subsection 07 (TOP END)



- Mounting holes for the 1000 engine
- 2 Mounting holes for the 800R engine

# **ROCKER ARM**

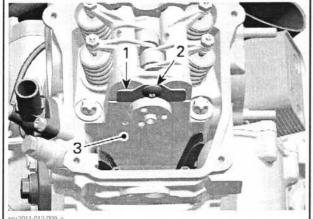
### **Rocker Arm Removal**

Remove valve cover.

Place the cylinder at TDC ignition, refer to TIMING CHAIN subsection.

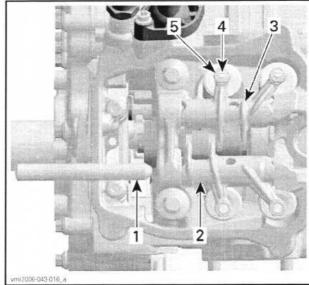
Remove timing chain tensioner and camshaft timing gear, refer to TIMING CHAIN subsection.

Remove pan head screw and camshaft retaining plate.



- Camshaft retaining plate Pan head screw
- 2 3. Cylinder head

Remove rocker arm shafts.

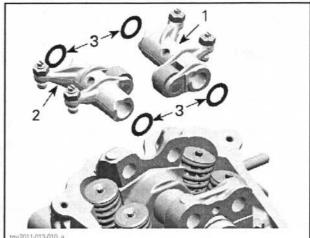


Rocker arm shaft

- Rocker arm (exhaust side) 2
- 3. Rocker arm (intake side)
- 4. Adjustment screw 5.
- Lock nut

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

Remove thrust washers.



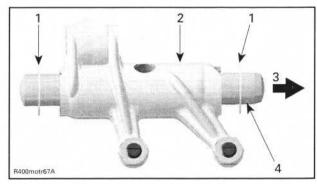
Rocker arm (exhaust side) Rocker arm (intake side) 1.

2

3. Thrust washers

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

Subsection 07 (TOP END)



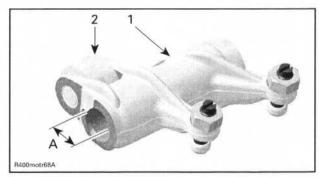
2 thrust washers

- Rocker arm (exhaust side)
   Cylinder head (spark plug side)
   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.



Rocker arm (exhaust side)

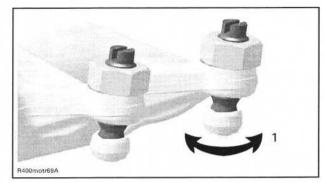
2 Roller

A. Bore for rocker arm shaft

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

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

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

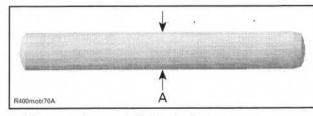


1. Free movement of adjustment screw top

#### 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	12.00 mm to 12.018 mm (.4724 in to .4731 in)
SERVICE LIMIT	11.990 mm (.472 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.

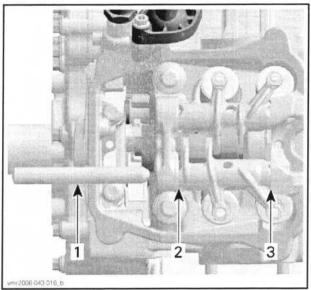
Install the rocker arm shafts with the chamfered edge first and use following procedure.

Insert a rocker arm pin through rocker arm pin bore.

Install a thrust washer at timing chain side, then the proper rocker arm (exhaust side or intake side).

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

Subsection 07 (TOP END)



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.

Adjust valve clearance, refer to *PERIODIC MAIN-TENANCE PROCEDURE*.

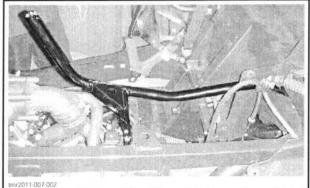
## CYLINDER HEAD

#### **Cylinder Head Access**

Refer to *BODY* and remove:

- Lower console
- LH and RH lateral console panels.

Remove LH passenger handhold bar.



LH PASSENGER HANDHOLD BAR

## 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.

Remove the intake manifold (see *INTAKE MANI-FOLD* in this subsection).

On cylinder 1, remove plenum.

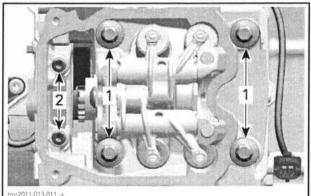
On cylinder 2, remove the shift cable bracket.

Remove the chain tensioner (see CHAIN TEN-SIONER in the TIMING CHAIN subsection).

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

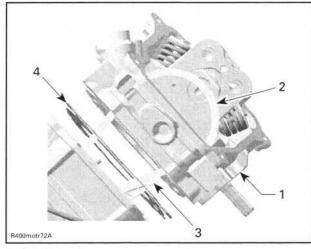
Remove the camshaft timing gear (see *TIMING CHAIN GEAR* in the *TIMING CHAIN* subsection).

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



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

Pull up cylinder head. Remove timing chain guide (fixed). Remove and discard the cylinder head gasket.



- Cylinder head
- Timing chain
   Chain guide (fixed)
   Cylinder head gasket

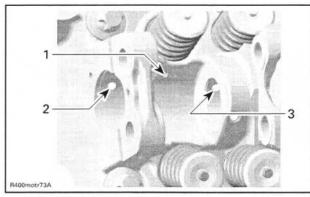
# Cylinder Head Inspection

Inspect timing chain guide (fixed) 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.



Oil port to lubricate camshaft lobes intake/exhaust 1.

- Oil supply to camshaft bearing journal (timing chain side) Oil supply to camshaft bearing journal (spark plug side) 3.

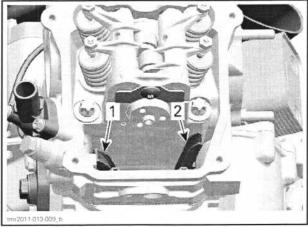
## Cylinder Head Installation

NOTE: Never invert front and rear cylinder heads. On the 800R, cylinder heads are not identical.

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

Ensure dowel pins are in place.

NOTICE Timing chain guide (fixed) has to be fixed between cylinder and cylinder head.



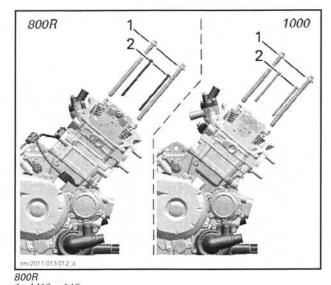
TYPICAL

Timing chain guide (tensioner side) mounted in crankcase

Timing chain guide (fixed) between cylinder and cylinder head

Install a NEW cylinder head gasket.

NOTICE Cylinder head screws of 800R engine and 1000 engine have different lengths.



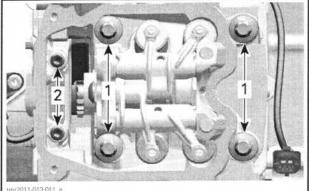
M10 x 140 M6 x 85 2 1000 M10 x 159 2. M6 x 105

First, torque M10 cylinder head screws in sequence 20 N•m ± 1 N•m criss-cross to  $(15 lbf \cdot ft \pm 1 lbf \cdot ft)$  then finish by tightening to 180° +/- 5°.

Subsection 07 (TOP END)

CYLINDER HEAD TIGHTENING TORQUE	
Preliminary torque	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)
Final torque	180° +/- 5°

Install cylinder head M6 screws.



Cylinder head screws M10

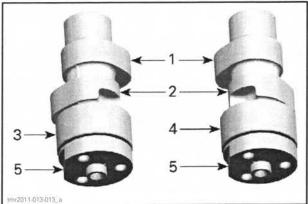
2. Cylinder head screws M6

Check timing chain guide (tensioner side) for movement.

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

On cylinder 1, install the plenum bracket using the appropriate mounting holes.





- Intake cam Exhaust cam
- 3.
- Camshaft of cylinder 1 Camshaft of cylinder 2 4
- 5. Flat spot

## 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 in this subsection).

Remove the chain tensioner (see CHAIN TEN-SIONER in the TIMING CHAIN subsection).

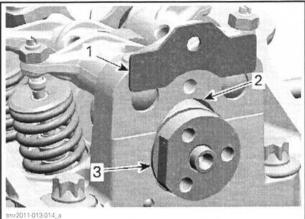
Remove the camshaft timing gear (see CAMSHAFT TIMING GEAR in the TIMING CHAIN subsection).

Remove the camshaft retaining plate.



Subsection 07 (TOP END)

NOTE: For removal rotate camshaft so that intake/exhaust lobe shows to upper side of cylinder head.

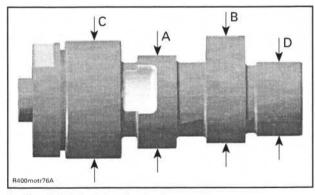


Camshaft retaining plate
 Area for camshaft lobes
 Camshaft

## **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.

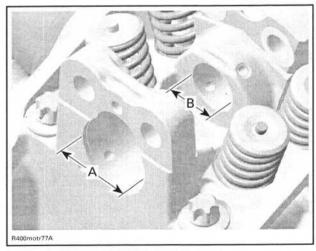


- Camshaft lobe (exhaust valves) A.
- Camshaft lobe (intake valves) Β.
- C. Camshaft journal (timing chain side) D. Camshaft journal (spark plug side)

	800B
CAMSHAFT	LOBE (EXHAUST)
NEW	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)
SERVICE LIMIT	32.930 mm (1.2965 in)
CAMSHAFT	LOBE (INTAKE)
NEW	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)
SERVICE LIMIT	32.870 mm (1.2941 in)

	1000	
CAMSHAFT LOBE (EXHAUST)		
NEW	32.860 mm to 33.060 mm (1.294 in to 1.302 in)	
SERVICE LIMIT	32.840 mm (1.293 in)	
CAMSHAF	LOBE (INTAKE)	
NEW	32.960 mm to 33.160 mm (1.298 in to 1.306 in)	
SERVICE LIMIT	32.940 mm (1.297 in)	
	AFT JOURNAL CHAIN SIDE)	
NEW	34.959 mm to 34.975 mm (1.3763 in to 1.377 in)	
SERVICE LIMIT	34.950 mm (1.376 in)	
	AFT JOURNAL PLUG SIDE)	
	01.000	
NEW	21.959 mm to 21.980 mm (.8645 in to .8654 in)	

Measure clearance between both ends of camshaft and cylinder head.



A. Camshaft bearing (timing chain side) B. Camshaft bearing (spark plug side)

Subsection 07 (TOP END)

er arrer a	AFT BEARING CHAIN SIDE)
NEW	35.000 mm to 35.025 mm (1.378 in to 1.3789 in)
SERVICE LIMIT	35.040 mm (1.3795 in)
	AFT BEARING PLUG SIDE)
NEW	22.000 mm to 22.021 mm
INEVV	(.8661 in to .867 in)

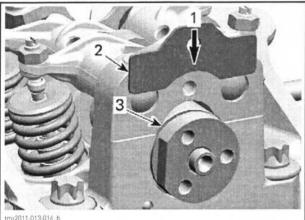
Replace parts that are not within specifications.

## Camshaft Installation

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

**NOTICE** 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.



tmr2011-013-014\_b

1. Direction of movement 2. Camshaft retaining plate

2. Carrishant retaining plate 3. Slot retaining camshaft

a. Side recoming constant

For other parts, refer to proper installation procedure.

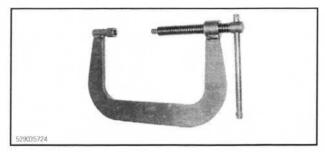
# VALVE SPRINGS

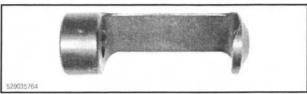
## Valve Spring Removal

Remove rocker arms (see *ROCKER ARM* in this subsection).

Remove cylinder head (see CYLINDER HEAD in this subsection).

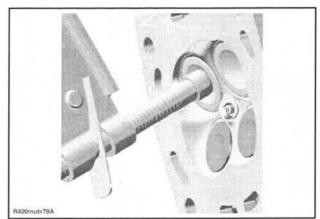
Compress valve spring using VALVE SPRING COMPRESSOR (P/N 529 035 724) and VALVE SPRING COMPRESSOR CUP (P/N 529 035 764).





# 

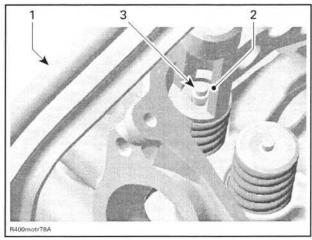
Always wear safety glasses when disassembling valve springs. Be careful when unlocking valves. Components could fly away because of the strong spring preload.



LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

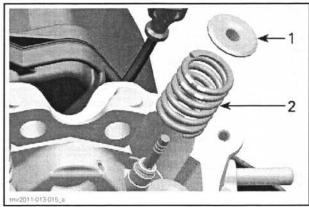
Remove valve cotters.

Subsection 07 (TOP END)



- 1. Valve spring compressor clamp
- 2. Valve spring compressor cup
- 3. Valve cotter

Remove valve spring compressor and withdraw valve spring retainer and valve spring.

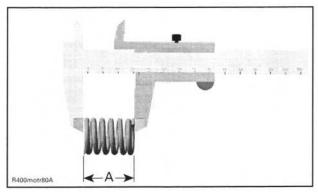


Valve spring retainer
 Valve spring

#### Valve Spring Inspection

Check valve spring for visible damage. 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.

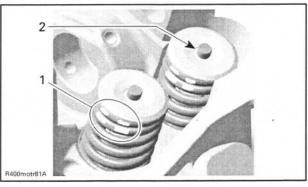
#### Valve Spring Installation

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.

**NOTICE** An improperly locked value spring will cause engine damage.

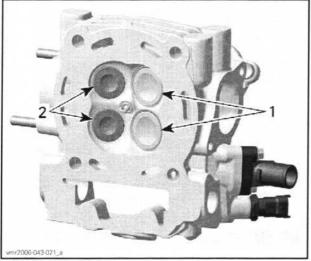
Subsection 07 (TOP END)

# VALVES

## Valve Removal

Remove valve spring, see VALVE SPRING in this subsection.

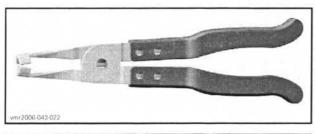
Push valve stem, then pull valves (intake and exhaust) out of valve guide.



1. Intake valves 31 mm

2. Exhaust valves 27 mm

Remove value stem seal with SNAP-ON PLIERS (P/N YA 8230) and discard it.





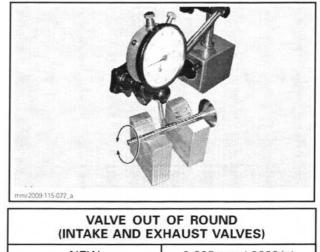
## Valve Inspection

#### 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.



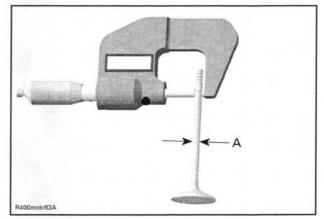
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

### 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.



A. Valve stem diameter

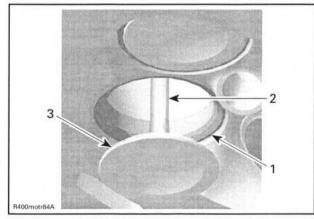
Subsection 07 (TOP END)

VALVE STEM DIAMETER		
EXHAUST VALVE		
NEW	4.956 mm to 4.970 mm (.1951 in to .1957 in)	
SERVICE LIMIT	4.930 mm (.1941 in)	
INTA	KE VALVE	
NEW	4.966 mm to 4.980 mm (.1955 in to .1961 in)	
SERVICE LIMIT	4.930 mm (.1941 in)	

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 in this subsection).

VALVE GUIDE DIAMETER (INTAKE AND EXHAUST VALVES)	
NEW	4.998 mm to 5.018 mm (.1968 in to .1976 in)
SERVICE LIMIT	5.050 mm (.1988 in)

Valve Face and Seat



- Valve seat 1.
- Exhaust valve contaminated area
   Valve face (contact surface to valve seat) Exhaust valve contaminated area

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 PRO-CEDURE in this subsection).

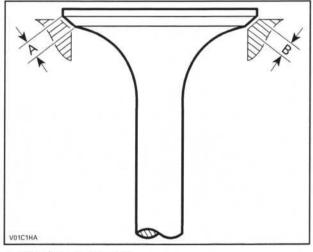
Measure valve face contact width.

NOTE: The location of contact area should be in center of valve seat.

Measure valve seat width using a caliper.

VALVE SEAT O	CONTACT WIDTH	
EXHAU	EXHAUST VALVE	
NEW	1.25 mm to 1.55 mm (.049 in to .061 in)	
SERVICE LIMIT	2.00 mm (.079 in)	
INTAK	E VALVE	
NEW	1.05 mm to 1.35 mm (.041 in to .053 in)	
SERVICE LIMIT	1.80 mm (.071 in)	

If valve seat contact width is too wide or has dark spots, replace the cylinder head.



Valve face contact width B. Valve seat contact width

#### Valve Installation

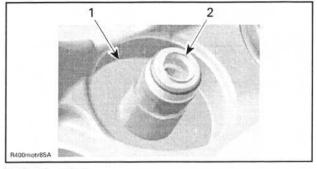
For installation, reverse the removal procedure. Pay attention to the following details.

Install a NEW valve stem seal. Make sure thrust washer is installed before installing seal.

Apply engine oil on valve stem and install it.

NOTICE Be careful when valve stem is passed through sealing lips of valve stem seal.

Subsection 07 (TOP END)



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.

**NOTICE** An improperly locked value spring will cause engine damage.

# VALVE GUIDES

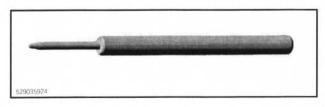
#### Valve Guide Removal

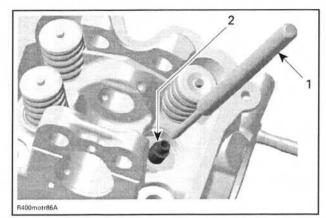
Remove cylinder head (see *CYLINDER HEAD* in this subsection).

Remove valves (see VALVES in this subsection).

**NOTE:** Clean valve guide area from contamination before removal.

Using the VALVE GUIDE REMOVER 5 MM (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

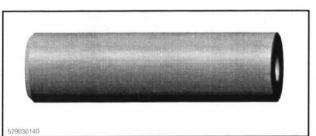
Always replace valve stem seals whenever valve guides are removed.

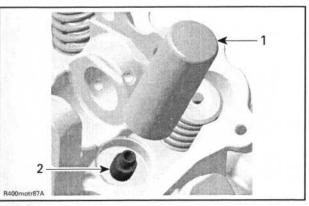
Clean the valve guide bore before reinstalling the valve guide into cylinder head.

### Valve Guide Installation

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

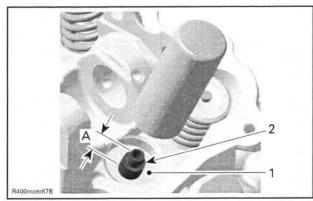
Use the VALVE GUIDE INSTALLER (P/N 529 036 140) to install valve guide.





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.

**NOTICE** Push valve guide in the cold cylinder head as per following illustration.



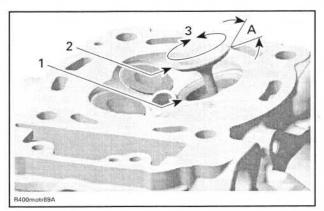
1. Thrust surface of cylinder head

2. Valve guide

A. Measurement from thrust surface to valve guide top

VALVE GUIDE	(MEASUREMENT "A")
NEW	14.00 mm to 14.40 mm (.5512 in to .5669 in)

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

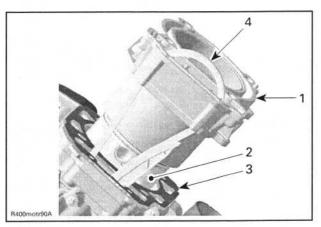
Remove chain tensioner (see *CHAIN TENSIONER* in the *TIMING CHAIN* subsection).

Remove the camshaft timing gear (see *CAMSHAFT TIMING GEAR* in the *TIMING CHAIN* subsection).

Remove the cylinder head (see *CYLINDER HEAD* in this subsection).

Pull cylinder.

Discard cylinder base gaskets.



1. Cylinder

2. Piston assembly

3. Cylinder base gasket

4. Camshaft timing chain

## Cylinder Inspection

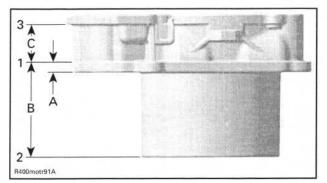
Check cylinder for cracks, scoring and wear ridges on the top and bottom of the cylinder. If so, replace cylinder.

#### 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.

Subsection 07 (TOP END)



- First measuring of diameter
- Second measuring of diameter
- 3. Third measuring of diameter

#### 800R

- 5 mm (.197 in) from cylinder bottom А. В.
- B. 63 mm (2.48 in) C. 32 mm (1.26 in)

#### 1000

- 5 mm (.197 in) from cylinder bottom A. 5 mm (.197 in) fro B. 58 mm (2.283 in)

С.	52 mm	(2.047 in)

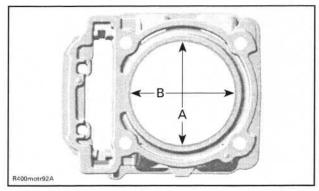
CYLINDER TAPER IN DIAMETER	
NEW (maximum)	0.038 mm (.0015 in)
SERVICE LIMIT	0.090 mm (.0035 in)

Distance between measurements should not exceed the service limit mentioned above.

#### 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.



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)

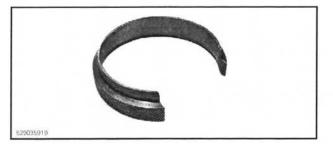
#### Cylinder Installation

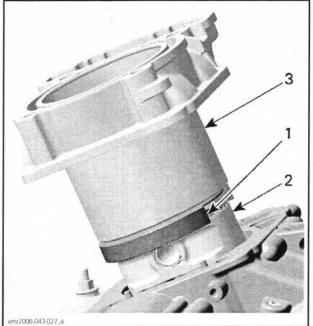
For installation, reverse the removal procedure. Pay attention to the following details.

#### NOTICE Always replace cylinder base gasket before installing the cylinder.

First mount cylinder 2. Then remove the CRANK-SHAFT 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 (P/N 529 035 919).





- Piston ring compressor tool 1.
- 2 Piston
- 3. Cylinder

**NOTE:** Put timing chain through the chain pit then put the cylinder in place.

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

Subsection 07 (TOP END)

**NOTE:** After both cylinders are installed, turn crankshaft until piston of cylinder 2 is at TDC and lock crankshaft. Refer to *CRANKSHAFT* in the *BOTTOM END* subsection.

Install cylinder head and the other parts in accordance with the proper installation procedures.

# PISTON

### **Piston Removal**

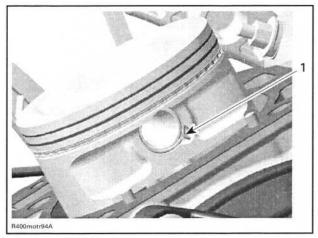
Remove cylinder head (see *CYLINDER HEAD* in this subsection).

Remove the cylinder (see *CYLINDER* in this subsection).

Place a rag under piston and in the area of timing chain compartment.

# A WARNING Piston circlips are spring loaded.

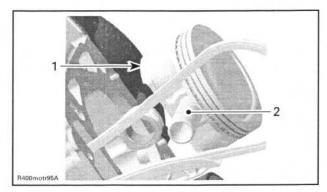
Remove one piston circlip and discard it.



1. Piston circlip

**NOTE:** The removal of both piston circlips is not necessary to remove piston pin.

Push piston pin out of piston.



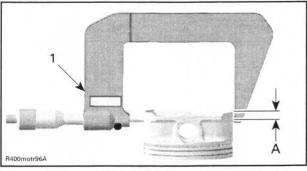
1. Piston 2. Piston pin

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)

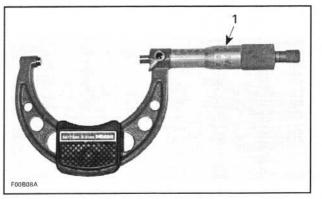
The measured dimension should be as described in the following tables. If not, replace piston.

PISTON M	PISTON MEASUREMENT	
NEW	90.950 mm to 90.966 mm (3.5807 in to 3.5813 in)	
SERVICE LIMIT	90.850 mm (3.577 in)	

#### Piston/Cylinder Clearance

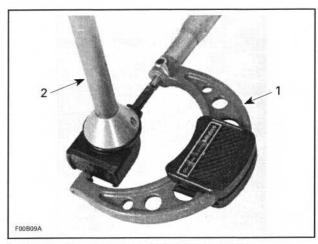
Adjust and lock a micrometer to the piston dimension.

Subsection 07 (TOP END)

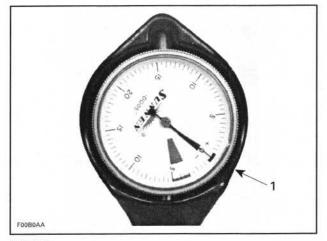


1. Micrometer set to the piston dimension

With the micrometer set to the dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).



Use the micrometer to set the cylinder bore gauge
 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	
NEW	0.027 mm to 0.057 mm (.0011 in to .0022 in)
SERVICE LIMIT	0.100 mm (.0039 in)

NOTE: Make sure used piston is not worn.

If clearance exceeds specified tolerance, replace piston by a new one and measure piston/cylinder clearance again.

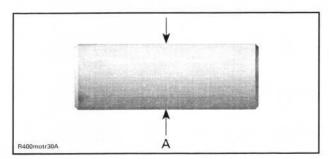
**NOTE:** Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

#### 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.



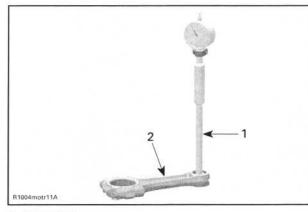
A. Piston pin diameter

PISTON PIN DIAMETER			
	800R		
NEW	19.996 mm to 20.000 mm (.7872 in to .7874 in)		
SERVICE LIMIT	19.980 mm (.7866 in)		
	1000		
NEW	21.996 mm to 22.000 mm (.866 in to .8661 in)		
SERVICE LIMIT	21.980 mm (.8654 in)		

Replace piston pin if diameter is out of specifications.

Measure inside diameter of connecting rod small end bushing.

Subsection 07 (TOP END)



Bore gauge Connecting rod

CONNECTING ROD SMALL END DIAMETER	
	800R
NEW	20.010 mm to 20.020 mm (.7878 in to .7882 in)
SERVICE LIMIT	20.060 mm (.7898 in)
	1000
NEW	20.010 mm to 20.020 mm (.7878 in to .7882 in)
SERVICE LIMIT	20.050 mm (.7894 in)

Replace connecting rod if diameter of connecting rod small end is out of specifications. Refer to BOTTOM END subsection for removal procedure.

Compare measurements to obtain the connecting rod/piston pin clearance.

	TING ROD/ CLEARANCE
SERVICE LIMIT	0.080 mm (.0031 in)

#### Piston Installation

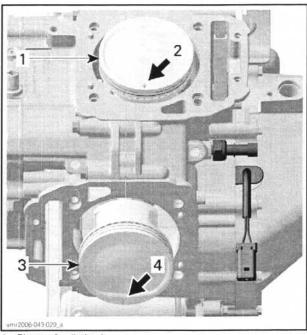
For installation, reverse the removal procedure. Pay attention to the following details.

Apply engine oil on the piston pin.

Insert piston pin into piston and connecting rod.

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.



Piston of cylinder 1

Mark on piston must show to intake side of cylinder 1 Piston of cylinder 2

Piston of cylinder 2
 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:

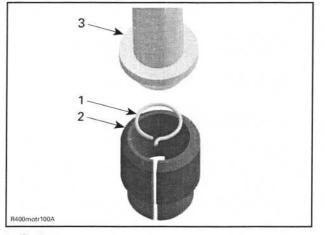
ENGINE TYPE	TOOL	
800R	PISTON CIRCLIP INSTALLER (P/N 529 035 921)	
1000	PISTON CIRCLIP INSTALLER (P/N 529 036 153)	



**NOTICE** 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.

Subsection 07 (TOP END)

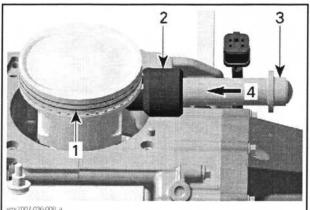


1. Circlip

Sleeve
 Assembly jig from piston clip installer

Push taper side of assembly jig until circlip reaches middle of sleeve.

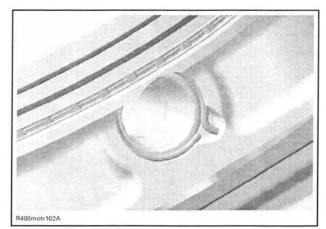
Align sleeve with piston pin axis and push assembly jig until circlip engages in piston.



vmr2007-036-008\_a

- 1. Hold piston while pushing circlip in place
- 2. Sleeve
- Assembly jig
   Direction to push circlip

**NOTE:** Take care that the hook of the piston circlip is positioned properly.



CORRECT POSITION OF THE PISTON CIRCLIP

# **PISTON RINGS**

## **Ring Removal**

Remove the piston (see *PISTON* in this subsection).

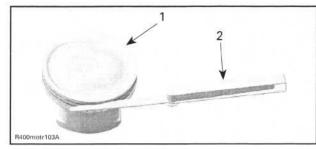
### **Ring Inspection**

#### **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 GR</b>	OOVE CLEARANCE		
UPPER COM	PRESSION RING		
NEW	0.03 mm to 0.07 mm (.0012 in to .0028 in)		
SERVICE LIMIT	0.150 mm (.0059 in)		
LOWER COM	PRESSION RING		
NEW	0.02 mm to 0.06 mm (.0008 in to .0024 in)		
SERVICE LIMIT	0.150 mm (.0059 in)		
OIL SCR.	APER RING		
NEW	0.01 mm to 0.18 mm (.0004 in to .0071 in)		
SERVICE LIMIT	0.250 mm (.0098 in)		

Subsection 07 (TOP END)



1. Piston

2. Feeler gauge

#### Ring End Gap

RING E	END GAP			
UPPER COMPRESSION RING				
NEW	0.20 mm to 0.40 mr (.008 in to .016 in)			
SERVICE LIMIT	0.60 mm (.024 in)			
LOWER COM	PRESSION RING			
NEW	0.20 mm to 0.40 mm (.008 in to .016 in)			
SERVICE LIMIT	0.70 mm (.028 in)			
OIL SCR	APER RING			
NEW	0.20 mm to 0.70 mm (.008 in to .028 in)			
SERVICE LIMIT	1.00 mm (.039 in)			

To measure the ring end gap place the ring in the cylinder in the area of 8 mm to 16 mm (5/16 in to 5/8 in) from top of cylinder.

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

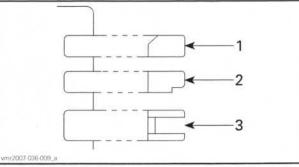
Using a feeler gauge, check ring end gap. Replace ring if gap exceeds above described specified tolerance.

#### **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.



1. Upper compression ring

Lower compression ring

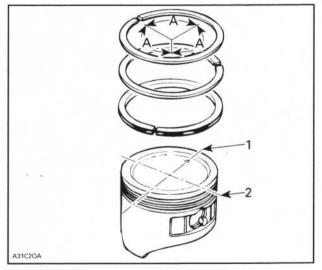
3. Oil scraper ring

# **NOTICE** Ensure that top and second rings are not interchanged.

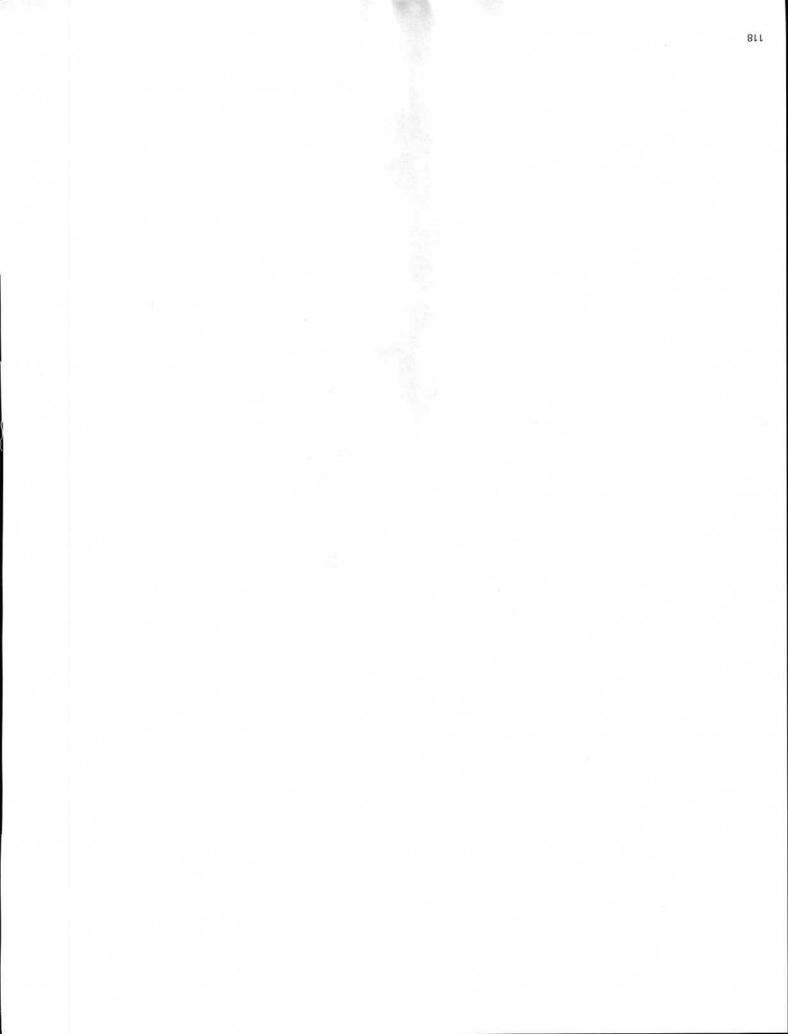
**NOTE:** Use a ring expander to prevent breakage during installation. The oil ring must be installed by hand.

Check that rings rotate smoothly after installation.

Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.



DO NOT align ring gap with piston thrust side axis
 DO NOT align ring gap with piston pin bore axis
 A. 120°



Subsection 08 (TIMING CHAIN)

# **TIMING CHAIN**

# SERVICE TOOLS

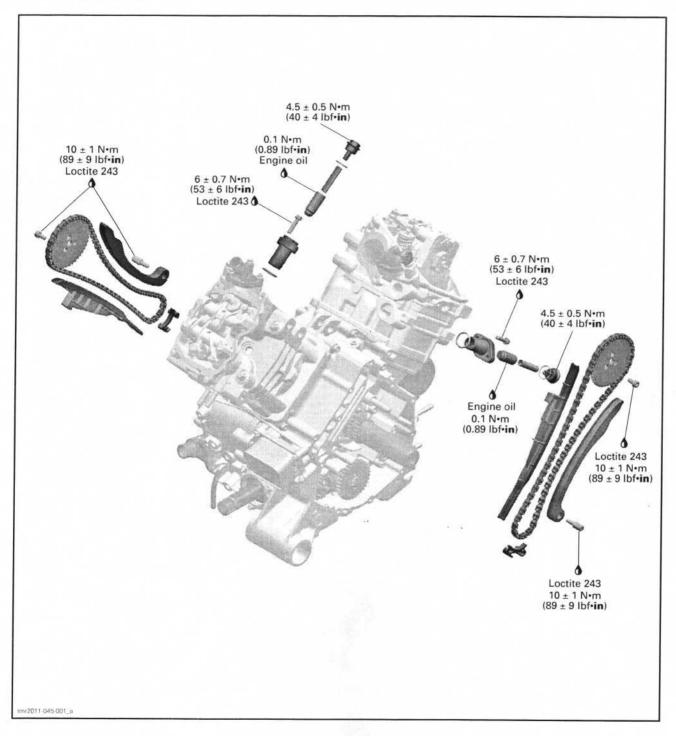
Description	Part Number	Page
CAMSHAFT TIMING TOOL	529 036 201	
CRANKSHAFT TDC POSITION TOOL	529 036 200	

# SERVICE PRODUCTS

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

Subsection 08 (TIMING CHAIN)

## TIMING CHAIN



## 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.

## 

Torque wrench tightening specifications must strictly be adhered to.

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

# TROUBLESHOOTING

#### UNUSUAL ENGINE NOISE OR VIBRATION

- 1. IMPROPER VALVE CLEARANCE ADJUSTMENT AND/OR WORN OUT ROCKER ARM(S)
  - Readjust valve clearance and/or replace defective part(s), refer to TOP END subsection.
- 2. DEFECTIVE CHAIN TENSIONER - Replace chain tensioner.
- 3. WORN OUT TIMING CHAIN GUIDE(S) - Replace timing chain guide(s).
- 4. STRETCHED TIMING CHAIN OR WORN OUT TIMING GEARS
  - Replace timing chain and timing gears.
- 5. LOOSE TIMING GEAR RETAINING SCREWS - Retighten screws to recommended torque.
- 6. INCORRECT CAMSHAFT TIMING
  - Replace damaged components and readjust camshaft timing.

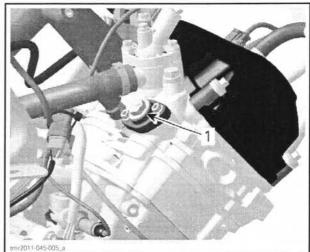
# ENGINE LACKS ACCELERATION OR POWER

#### 1. INCORRECT CAMSHAFT TIMING

 Replace damaged components and readjust camshaft timing.

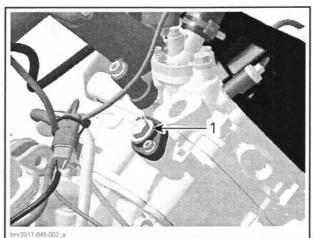
# PROCEDURES

TIMING CHAIN TENSIONERS Timing Chain Tensioner Location 800R Engine



800R ENGINE - CYLINDER HEAD (FRONT CYLINDER) 1. Timing chain tensioner

1000 Engine



1000 ENGINE - FRONT CYLINDER 1. Timing chain tensioner

## Timing Chain Tensioner Removal

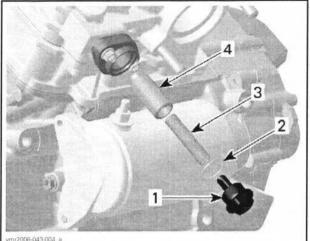
Make sure the respective cylinder is set to TDC ignition. Refer to *CAMSHAFT TIMING GEARS* in this subsection.

Carefully unscrew chain tensioner plug and release spring tension.

**A** CAUTION Tensioner is spring loaded.

Subsection 08 (TIMING CHAIN)

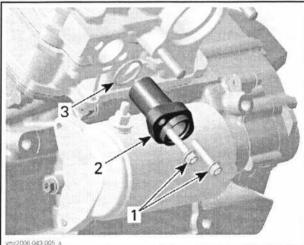
Remove O-ring, spring and chain tensioner plunaer.



- Chain tensioner plug
- 2 O-rina
- 3. Spring Chain tensioner plunger

Remove chain tensioner housing retaining

screws. Remove chain tensioner housing and O-ring.



Screws Chain tensioner housing

3 O-ring

## **Timing Chain Tensioner Inspection**

Check the chain tensioner housing and plug for cracks or other damages. Replace if necessary.

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

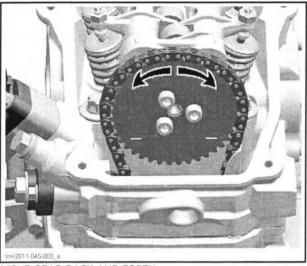
Check if O-rings are brittle, cracked or hard. Replace if necessary.

Check spring condition. Replace if broken or worn.

## Timing Chain 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.



MOVE GEAR BACK AND FORTH

Apply engine oil on the plunger before installation. Slightly turn the camshaft timing gear in order to get the timing chain play on the tensioner side.

Slightly screw the plunger in until the timing chain allows no more back and forth movement of the camshaft timing gear.

Screw the plunger in an additional 1/8 turn to reach the required specified torque.

TIMING CHAIN TENSIONER ADJUSTMENT (TORQUE)
0.1 N∙m (.9 lbf <b>∙in</b> )

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

Fit the spring on one side into the slot of the plug and on the other side into the plunger.

NOTE: 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 the plug in.

**NOTE:** To avoid overstressed timing chain, the plug must engage into threads within the first full turn.

Remove locking tool and install all other removed parts.

Finally, tighten the plug.

## CAMSHAFT TIMING GEARS

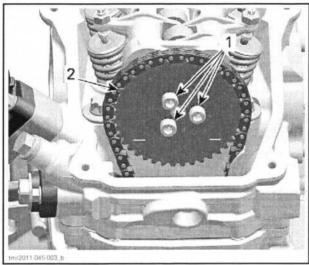
#### Camshaft Timing Gear Removal

Remove the valve cover, refer to TOP END subsection.

Turn crankshaft to TDC ignition of the respective cylinder and lock magneto flywheel, see *CAMSHAFT TIMING* in this subsection.

Unscrew timing chain tensioner. Refer to *TIMING CHAIN TENSIONERS* in this subsection.

Remove camshaft timing gear retaining screws.



Camshaft timing gear retaining screws
 Camshaft timing gear

Remove the camshaft timing gear.

NOTE: Secure timing chain with a piece of wire.

#### Camshaft Timing Gear Inspection

Check camshaft timing gear for wear or deterioration.

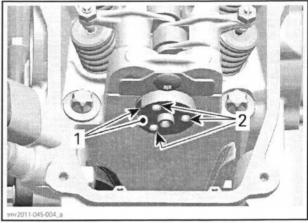
If gear is worn or damaged, replace it as a set (camshaft timing gear and timing chain).

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

#### Camshaft Timing Gear Installation

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

Clean mating surface and threads of camshaft prior installing camshaft timing gear.

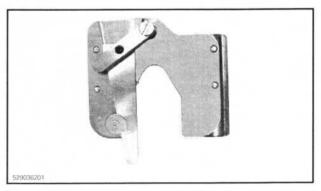


1. Mating surface on camshaft

2. Threads for camshaft screws

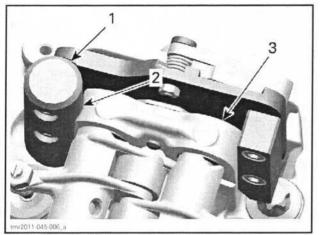
Crankshaft must be set to TDC ignition position before installing the timing chain, refer to *CAMSHAFT TIMING* in this subsection.

Install the CAMSHAFT TIMING TOOL (P/N 529 036 201).



**NOTE:** Align tube of camshaft adjustment tool properly with machined radius on cylinder head.

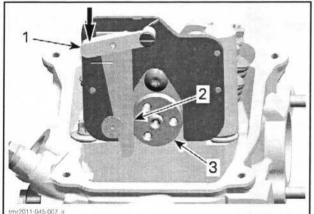
Subsection 08 (TIMING CHAIN)



- CAMSHAFT TIMING TOOL INSTALLED
- Tube (camshaft adjustment tool) Machined radius (camshaft adjustment tool) 2
- 3. Cylinder head

Set camshaft to TDC ignition position by aligning the camshaft flange flat spot with the tool lever.

NOTE: In addition, to ensure proper camshaft timing, press camshaft adjustment tool lever downwards.



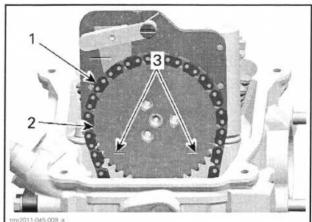
PRESS TOOL LEVER DOWN

- Lever Flat spot
- 3 Camshaft

NOTICE Crankshaft and camshaft must be locked at TDC ignition position to place camshaft timing gear and timing chain in the proper position.

Place camshaft timing gear along with the timing chain on the camshaft.

NOTE: The printed marks on the camshaft timing gear must be parallel to the cylinder head base.



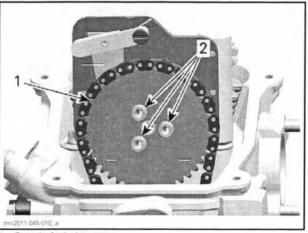
Timing chain 2 Camshaft timing gear

Printed marks on camshaft timing gear 3

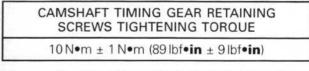
Install and adjust timing chain tensioner, refer to TIMING CHAIN TENSIONER in this subsection.

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on the camshaft timing gear retaining screw threads.

Install and tighten camshaft timing gear retaining screws to specified torque.



Camshaft timing gear Timing gear retaining screws 2

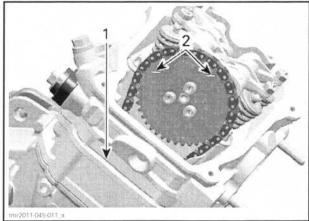


Remove the CAMSHAFT TIMING TOOL (P/N 529 036 201).

#### 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.

Subsection 08 (TIMING CHAIN)



#### TYPICAL

Cylinder head base
 Marks on timing gear of the opposite cylinder

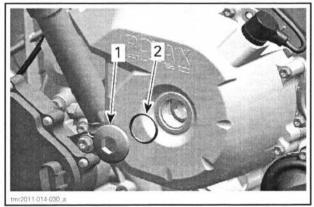
#### Camshaft Timing Cylinder 2 (rear)

Turn crankshaft until piston is at TDC ignition as follows.

Remove spark plug of both cylinders.

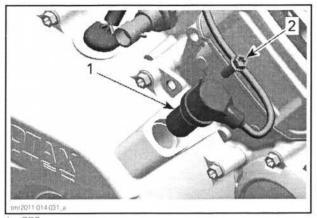
Remove valve covers of both cylinders.

Remove the plug and O-ring of magneto cover.



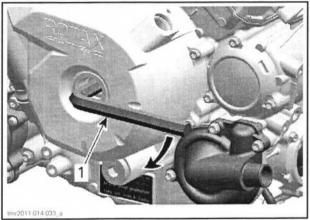
1. Plug 2. O-ring

Remove the crankshaft position sensor (CPS).



1. CPS 2. Screw

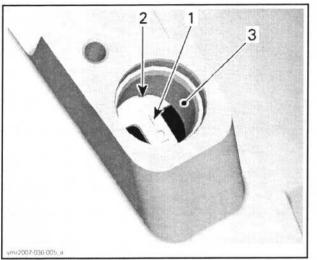
Use a 14 mm Allen key to turn crankshaft until piston 2, rear is at TDC ignition.



1. Allen key 14 mm

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

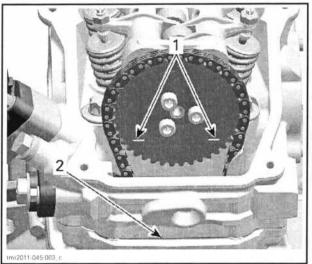
Subsection 08 (TIMING CHAIN)



CYLINDER 2 AT TDC IGNITION

- 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.



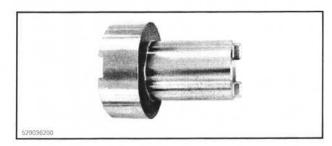
TYPICAL

Printed marks on camshaft timing gear

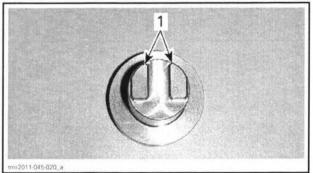
2 Cylinder head base

To lock crankshaft at TDC ignition, proceed as follows.

Insert CRANKSHAFT TDC POSITION TOOL (P/N 529 036 200) in CPS orifice to lock crankshaft in position.



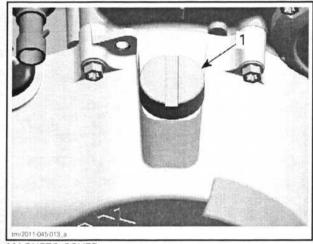
Make sure to match the crankshaft TDC position tool teeth with the magneto rotor shape.



Crankshaft TDC position tool teeth

1.

NOTICE Do not use the CRANKSHAFT TDC PO-SITION TOOL (P/N 529 036 200) to remove or install drive pulley or magneto retaining screws.

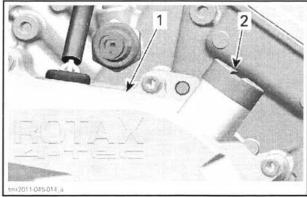


MAGNETO COVER 1. Crankshaft position sensor bore



NOTICE Tool must be inserted fully.

Subsection 08 (TIMING CHAIN)



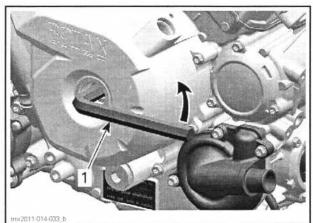
Magneto cover Tool

#### Camshaft Timing Cylinder 1 (front)

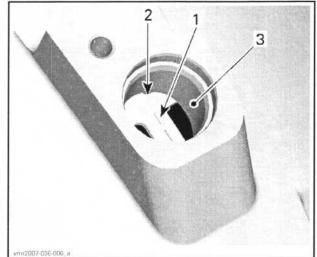
Turn cylinder 2 (rear) to TDC ignition, see CAMSHAFT TIMING CYLINDER 2 (REAR) in this subsection.

NOTE: Do not lock crankshaft yet.

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

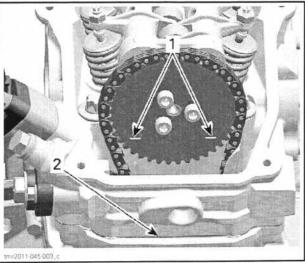


TURN CRANKSHAFT 280° COUNTERCLOCKWISE 1. Allen key 14 mm



CYLINDER 1 AT TDC IGNITION 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.

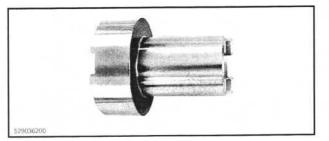


TYPICAL

Printed marks on camshaft timing gear

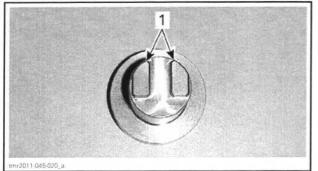
2. Cylinder head base

Insert the CRANKSHAFT TDC POSITION TOOL (P/N 529 036 200) in CPS orifice to lock crankshaft in position.



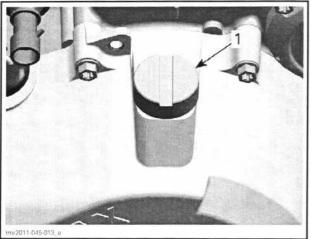
Subsection 08 (TIMING CHAIN)

Make sure to match the crankshaft TDC position tool teeth with the magneto rotor shape.



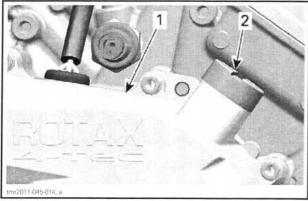
1. Crankshaft TDC position tool teeth

**NOTICE** Do not use the CRANKSHAFT TDC PO-SITION TOOL (P/N 529 036 200)to remove or install drive pulley or magneto retaining screws.



1. Crankshaft TDC position tool





1. Magneto cover 2. Tool

## 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)

Refer to *MAGNETO SYSTEM* subsection and remove following parts:

- Magneto cover
- Rotor
- Sprag clutch gear.

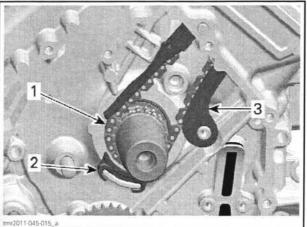
Refer to *TOP END* subsection and remove following parts:

- Valve cover.

Refer to following procedures in this subsection and remove following parts:

- Chain tensioner
- Camshaft timing gear.

Remove timing chain guide (tensioner side) and lower timing chain guide.



1. Timing chain

- . Timing chain . Lower timing chain guide
- 3. Timing chain guide (tensioner side)

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

Carefully pull the timing chain downwards and sideways, then out of the crankcase.

#### Timing Chain Removal (PTO Side)

Refer to *BOTTOM END* subsection and remove following parts:

- PTO cover
- Breather gear
- Intermediate gear.

Subsection 08 (TIMING CHAIN)

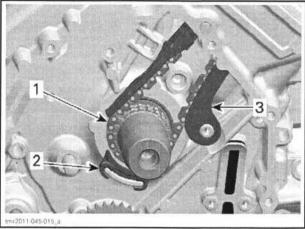
Refer to *TOP END* subsection and remove following parts:

- Valve cover.

Refer to following procedures in this subsection and remove following parts:

- Chain tensioner
- Camshaft timing gear.

Remove timing chain guide (tensioner side) and lower timing chain guide.



1. Timing chain

- 2. Lower timing chain guide
- 3. Timing chain guide (tensioner side)

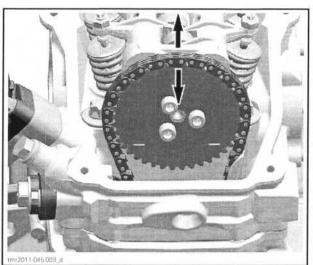
Carefully pull the timing chain sideward and down from the crankcase.

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

#### **Timing Chain Inspection**

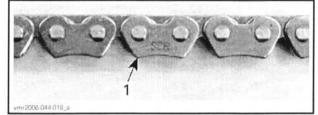
Inspection is the same for both timing chains.

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



CHECKING TIMING CHAIN 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).

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

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

#### Timing Chain Installation

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

NOTE: Installation is the same for both timing chains.

TIMING CHAIN GUIDE BEARING SCREW TIGHTENING TORQUE

10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

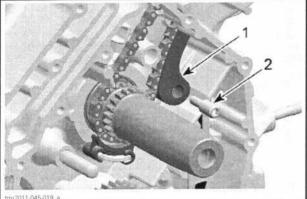
Install timing chain with camshaft timing gear.

**NOTE:** Ensure to carry out proper valve timing, refer to *CAMSHAFT TIMING GEARS* in this subsection.

**NOTICE** Improper valve timing will damage engine components.

Subsection 08 (TIMING CHAIN)

## TIMING CHAIN GUIDE (TENSIONER SIDE)



tmr2011-045-019\_a

Timing chain guide (tensioner side)
 Bearing screw

## Timing Chain Guide Removal (Tensioner Side)

Refer to TIMING CHAIN in this subsection.

## Timing Chain Guide Inspection (Tensioner Side)

Check timing chain guide for wear, cracks or deforming. Replace if necessary.

## Timing Chain Guide Installation (Tensioner Side)

The installation is the reverse of the removal procedure.

TIMING CHAIN GUIDE BEARING SCREW TIGHTENING TORQUE

10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

## **BOTTOM END**

## SERVICE TOOLS

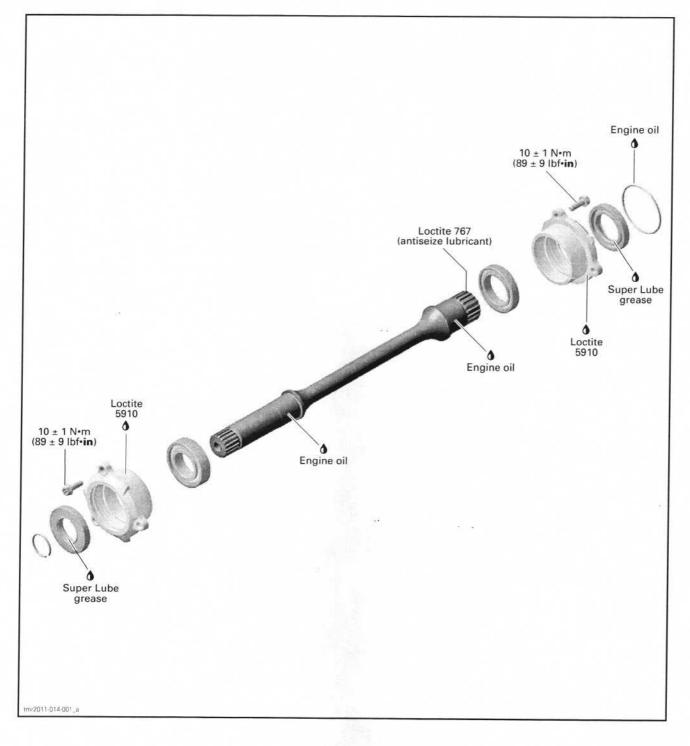
Description	Part Number	Page
CRANKCASE SUPPORT MAG/PTO	529 036 031	
CRANKSHAFT LOCKING BOLT	529 035 617	
DRIVE SHAFT OIL SEAL INSTALLER	529 036 028	
DRIVE SHAFT OIL SEAL PROTECTOR	529 036 029	
PLAIN BEARING REMOVER/INSTALLER	529 036 032	
PLAIN BEARING REMOVER/INSTALLER	529 035 917	
PTO COVER OIL SEAL INSTALLER	529 036 033	

## SERVICE PRODUCTS

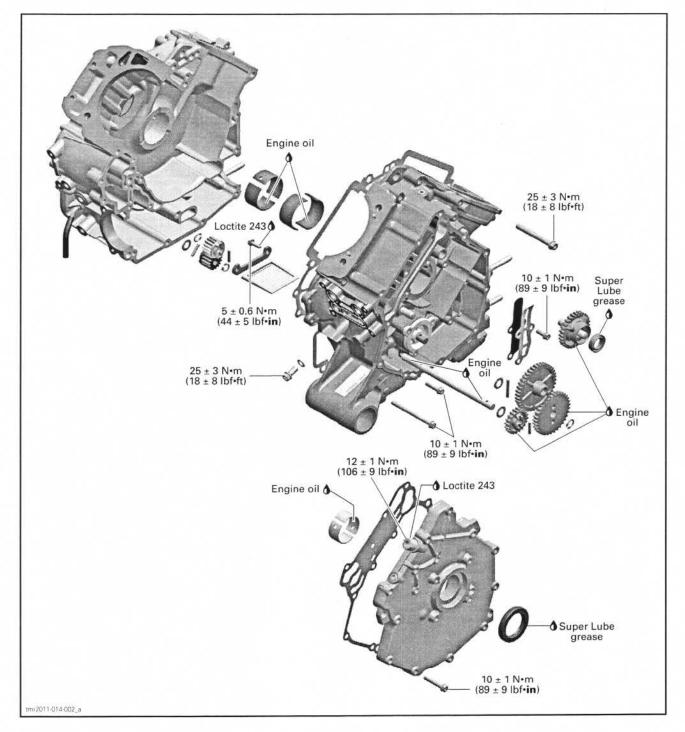
Description	Part Number	Page
LOCTITE 5910	293 800 081	
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	

Subsection 09 (BOTTOM END)

## ENGINE DRIVE SHAFT

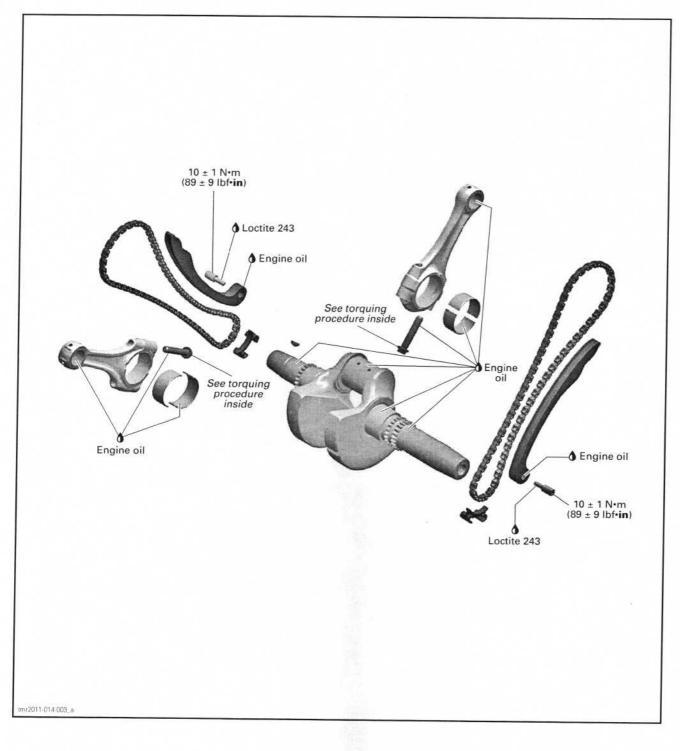


## CRANKCASE AND PTO COVER



Subsection 09 (BOTTOM END)

## CRANKSHAFT



Subsection 09 (BOTTOM END)

### 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.

#### A 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

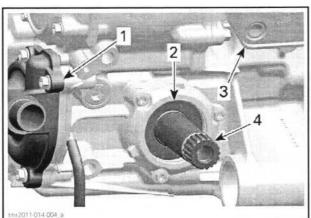
**NOTE:** The engine drive shaft transmits the power from the gearbox to the front differential and is located inside the crankcase.

## Oil Seal Replacement (Engine Drive Shaft)

Remove the engine, Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

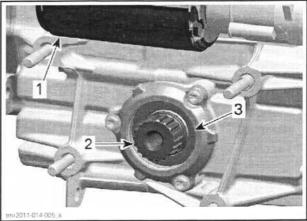
To remove the rear oil seal, the gearbox has to be removed from the engine, Refer to *GEARBOX AND 4X4 COUPLING UNIT* subsection.

To replace drive shaft oil seals, the bearing cover has to be removed. For bearing cover removal and installation refer to *ENGINE DRIVE SHAFT REMOVAL/INSTALLATION* in this subsection.



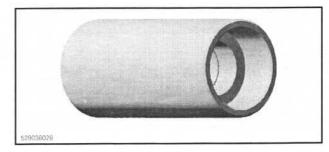
FRONT OF ENGINE 1. Water pump cover 2. Oil seal front side

- Oil cooler
   Drive shaft
- 4. Drive snaft



REAR OF ENGINE (GEARBOX REMOVED) 1. Electric starter 2. Drive shaft 3. Oil seal gearbox side

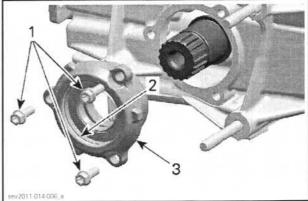
Use the DRIVE SHAFT OIL SEAL INSTALLER (P/N 529 036 028) to install drive shaft oil seals.



#### **Engine Drive Shaft Removal**

Remove the engine. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

At rear of engine, remove the bearing cover and its O-ring.



. Bearing cover screws

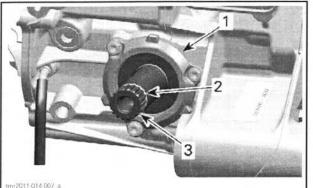
1. Bearing cover 2. O-ring

3. Bearing cover gearbox side

Remove the bearing cover at the front of the engine.

Subsection 09 (BOTTOM END)

**NOTICE** Check ends of the circlip for sharp edges or burr before removing the drive shaft, to avoid damaging the oil seal.



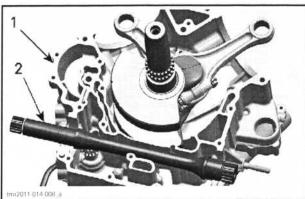
1. Bearing cover front drive side

2. Circlip 3. Drive shaft

section.

Split crankcase, refer to CRANKCASE in this sub-

Remove engine drive shaft from the crankcase.

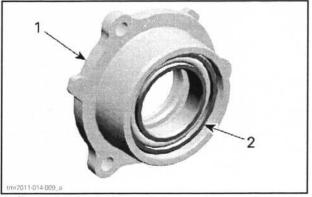


1. Crankcase MAG side 2. Engine drive shaft

## Engine Drive Shaft Inspection

Replace oil seals and/or O-ring (bearing cover gearbox side) if they are brittle, hard or damaged.

Check drive shaft bearings for contamination and/or metal shavings. Check if bearings turn freely and smoothly. Replace if necessary.



1. Bearing cover 2. Drive shaft bearing

Check drive shaft for cracks, bend, pitting or other visible damages.

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 solvent.

Crankcase surfaces and bearing covers 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.

## **NOTICE** Do not wipe with rags. Use a new clean hand towel only.

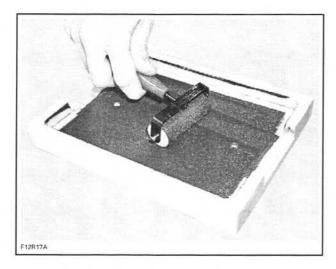
Use a suitable installer for installing bearings.

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 mm - 75 mm (2 in - 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.

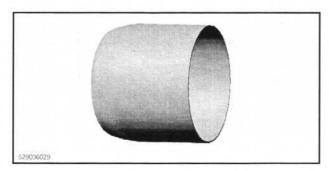
Subsection 09 (BOTTOM END)

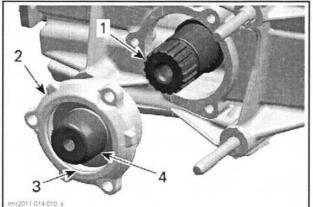


Do not apply in excess as it will spread out inside crankcase.

**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 at gearbox side, fit DRIVE SHAFT OIL SEAL PROTECTOR (P/N 529 036 029) into oil seal.





1. Drive shaft

- 2. Bearing cover gearbox side
- 3. O-ring
- 4. Protection sleeve

Finally check for axial play of the drive shaft.

### PTO COVER OIL SEAL

To replace oil seal it is not necessary to remove engine from vehicle.

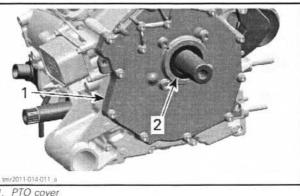
#### PTO Oil Seal Removal

Refer to *CONTINUOUSLY VARIABLE TRANSMIS-SION (CVT)* subsection to remove the following parts:

- CVT cover
- Drive pulley
- Driven pulley
- CVT air guide.

Remove oil seal with a small flat screwdriver.

#### **NOTICE** Avoid scoring surfaces with tool.



1. PTO cove 2. Oil seal

#### PTO Oil Seal Inspection

Check oil seal running surface of crankshaft PTO side for grooves. Replace if necessary.

#### PTO Oil Seal Installation

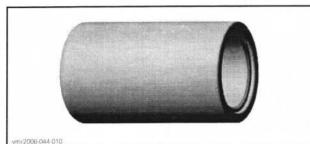
The installation is the reverse of the removal procedure.

Pay attention to the following details.

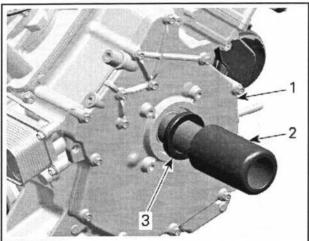
**NOTICE** Oil seal must be installed with sealing lip toward the engine.

Push oil seal in place by using the PTO COVER OIL SEAL INSTALLER (P/N 529 036 033).

Subsection 09 (BOTTOM END)



OIL SEAL INSTALLER



tmr2011-014-012\_a 1. PTO cover 2. Oil seal installer

2. Oil seal i 3. Oil seal

## PTO COVER

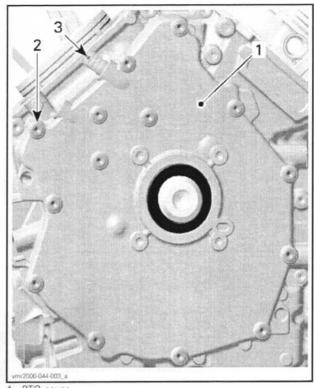
## PTO Cover Removal

Refer to *CONTINUOUSLY VARIABLE TRANSMIS-SION (CVT)* subsection to remove the following parts:

- CVT cover
- Drive pulley
- Driven pulley
- CVT air guide.

Disconnect vent hose.

Remove PTO cover screws and pull PTO cover.



- 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.

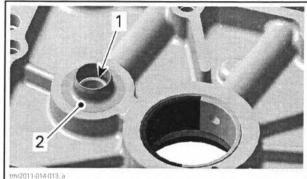
Clean oil breather bore in PTO cover from contaminations with part cleaner then use pressurized air to dry it.

## A WARNING

Always wear skin and eye protection. Chemicals can cause skin rash, skin burns and severe eye injury.

Check surface of sealing sleeve for wear or other damages. Replace PTO cover if damaged.

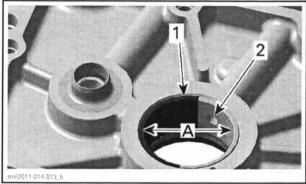
Subsection 09 (BOTTOM END)



1. Oil breather bore 2. Surface of sealing sleeve

Check plain bearings for scorings or other damages.

**NOTE:** Measure plain bearing inside diameter (PTO cover) and compare to crankshaft journal diameter (PTO cover bearing). Refer to *CRANK-SHAFT* in this section. Replace if the measurement is out of specification.



1. Plain bearing

- 2. Oil bore
- A. Measure plain bearing inside diameter

	INSIDE DIAMETER COVER)
SERVICE LIMIT	34.120 mm (1.3433 in)

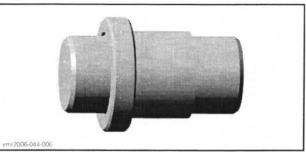
Plain Bearing Replacement (PTO Cover)

Plain Bearing Removal

**NOTICE** Unless otherwise instructed, never use a hammer to install plain bearings. Use a press only.

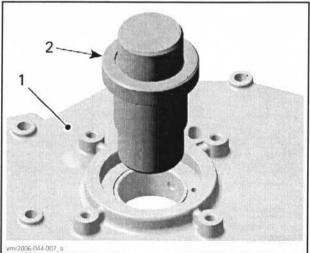
Carefully remove the PTO oil seal with a screwdriver, without damaging the PTO cover.

Push-out the plain bearings from the outside towards the inside using the PLAIN BEARING RE-MOVER/INSTALLER (P/N 529 036 032).



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.



PTO cover

2. Plain bearing remover/installer

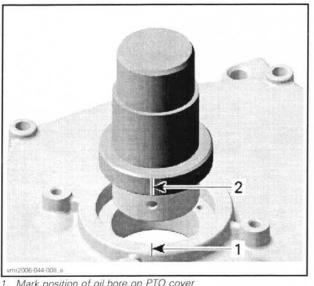
#### Plain Bearing Installation

**NOTE:** Do not lubricate plain bearings and/or PTO cover for installation.

Install plain bearings with the proper PLAIN BEAR-ING REMOVER/INSTALLER (P/N  $\,$  529 036 032) in a cool PTO cover.

**NOTICE** 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.

Subsection 09 (BOTTOM END)

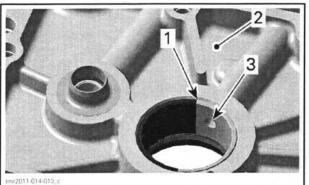


Mark position of oil bore on PTO cover Mark position of oil bore on plain bearing remover/installer 1.

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.

NOTE: Wrong oil bore position will stop oil supply to plain bearings and will damage the engine.

**NOTICE** The partition of the plain bearings must be positioned near to oil bore in counterclockwise direction.



- Partition PTO cover (inside) 2.
- Oil bore

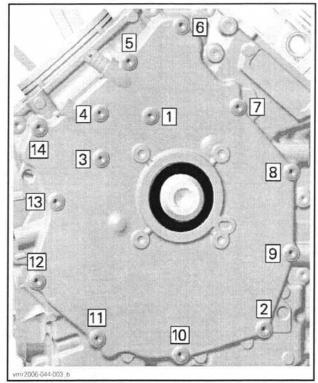
## **PTO Cover Installation**

For installation, reverse the removal procedure.

Pay attention to the following details.

NOTE: At installation, replace PTO cover gasket and oil seal.

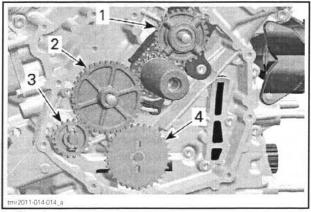
Tighten PTO cover screws following the illustrated sequence.



TIGHTENING SEQUENCE

## DRIVE GEARS

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



Breather gear 1

- Intermediate gear
- 2.3.4. Water pump drive gear Oil pump drive gear

## **Drive Gear Removal**

Remove PTO cover (refer to PTO COVER).

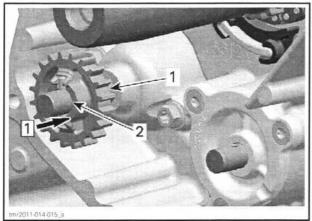
Withdraw intermediate gear and breather gear.

For oil pump drive gear removal, refer to OIL PUMP in LUBRICATION SYSTEM.

Subsection 09 (BOTTOM END)

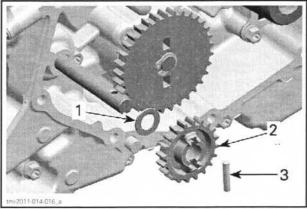
To remove water pump gear, pull the shaft assembly a bit out and turn it about one teeth until it stays out.

Then push water pump gear in.



Water pump drive gear
 Intermediate shaft
 Step 1: Push gear in

Remove needle pin and pull water pump gear out. Remove thrust washer from intermediate shaft.



1. Thrust washer

- 2. Water pump drive gear
- 3. Needle pin

#### **Drive Gears Inspection**

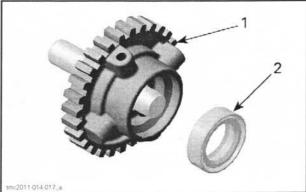
#### Intermediate Gear/Oil Pump Drive Gear/Water Pump Drive Gear

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 intake system.

Check if oil seal is brittle, hard or damaged. Replace if necessary.



1. Breather gear

2. Oil seal

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.

Adequately oil the ball bearing of the breather gear.

## CRANKCASE

#### Crankcase Disassembly

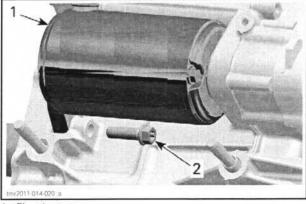
- 1. Refer to *PERIODIC MAINTENANCE PROCE-DURES* subsection and:
  - 1.1 Drain cooling system.
  - 1.2 Drain engine oil.
  - 1.3 Drain gearbox oil.
- 2. Lock crankshaft. Refer to CRANKSHAFT LOCKING PROCEDURE in the this section.
- 3. Refer to CONTINUOUSLY VARIABLE TRANS-MISSION (CVT) section to remove following parts:
  - CVT cover
  - Drive pulley
  - Driven pulley
  - CVT air guide.
- 4. Remove engine from vehicle. Refer to ENGINE REMOVAL AND INSTALLATION section.
- 5. Detach gearbox from engine. Refer to *GEAR-BOX AND 4X4 COUPLING UNIT*.
- 6. Refer to *MAGNETO SYSTEM* section to remove the following parts:
  - Magneto cover

Subsection 09 (BOTTOM END)

- Rotor with sprag clutch gear
- Starter drive gears.
- 7. Refer to following procedures in this subsection to remove the following parts:
  - PTO cover
  - Drive gears
  - Bearing covers of engine drive shaft.
- 8. Refer to TIMING CHAIN section to remove following parts:
  - Chain tensioners
  - Camshaft timing gears
  - Timing chains
  - Timing chain guides.
- 9. Refer to TOP END section to remove following parts:
  - Front cylinder head
  - Rear cylinder head
  - Cylinders.
- 10. Refer to COOLING SYSTEM section to remove following parts:
  - Water pump housing.
- 11. Refer to LUBRICATION SYSTEM section to remove following parts:
  - Oil filter
  - Oil cooler
  - Oil pump drive gear.

NOTE: Oil pump removal from crankcase is not necessary, but recommended to see condition of oil pump (refer to LUBRICATION SYSTEM section).

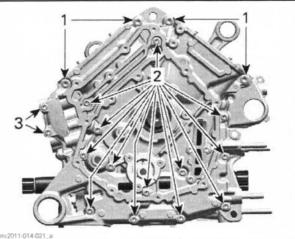
12. Remove electric starter.



Electric starter 1. Screw

NOTE: Before splitting the crankcase, measure crankshaft axial play. Refer to CRANKSHAFT.

Remove retaining screws of crankcase.

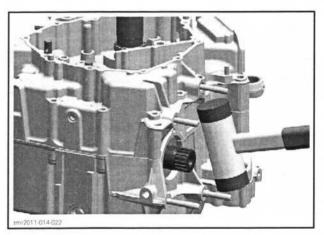


Four screws M8 x 65

13 screws M6 x 75 Two screws M6 x 25

2.

Carefully split crankcase halves by using a screwdriver and a soft hammer.

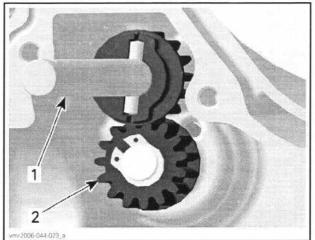


NOTE: During disassembly, do not damage the sealing surfaces of the crankcase halves.

Pull crankshaft out of crankcase.

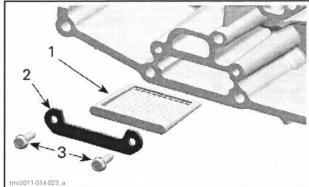
Remove the water pump intermediate shaft and the water pump gear.

Subsection 09 (BOTTOM END)



- 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.

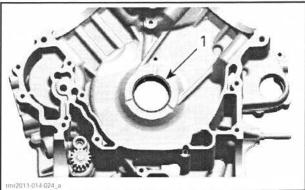
#### **Oil Strainer**

Clean the engine oil strainer (same procedure as for the crankcase).

#### Crankcase Inspection

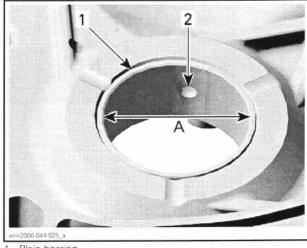
Check crankcase halves for cracks or other damage. Replace if damaged.

Check main bearings in MAG and PTO crankcase half for scorings or other damages.



1. Plain bearing

**NOTE:** Measure plain bearing inside diameter and compare to PTO/MAG main 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

MAIN BEARING INSIDE DIAMETER (PTO/MAG)		
SERVICE LIMIT	42.100 mm (1.6575 in)	

#### Plain Bearing Replacement (Main)

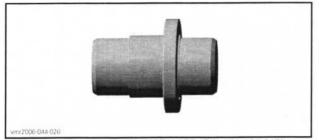
Plain Bearing Removal

**NOTICE** Always support crankcase halves properly when 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 with the PLAIN BEARING REMOVER/INSTALLER (P/N 529 035 917).

Subsection 09 (BOTTOM END)



PLAIN BEARING REMOVER/INSTALLER (P/N 529 035 917)

Carefully push the plain bearings out, from the crankcase half inside towards the outside.

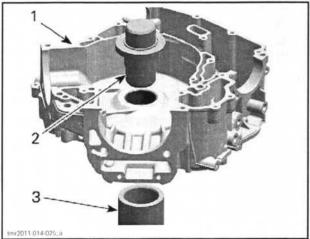
NOTE: Place the proper CRANKCASE SUPPORT MAG/PTO (P/N 529 036 031) under crankcase halves before removing plain bearings.



mr2006-044-028

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

Crankcase half

Plain bearing remover/installer 3. Crankcase support sleeve (P/N 529 036 031)

#### Plain Bearing Installation (Main)

NOTICE Unless otherwise instructed, never use hammer to install plain bearings. Use press only.

Install plain bearings with the proper PLAIN BEAR-ING 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 PROCE-DURE).

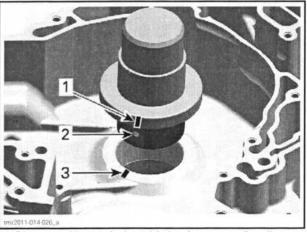
Carefully press in the plain bearings in the same direction as during disassembly, from the crankcase inside towards the outside.

During reassembly, make sure not to damage the sealing surfaces of the crankcase halves.

NOTE: Use an O-ring (Ø 42 x 1 mm to 1.5 mm (.04 in 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.

**NOTICE** Mark position of plain bearing oil bore on plain bearing remover/installer.

NOTICE Mark position of oil bore on crankcase half. Align mark on plain bearing remover/installer with mark on crankcase half.

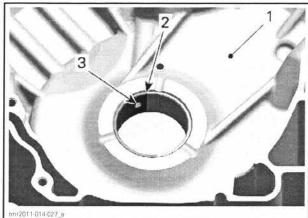


Oil bore position marked on plain bearing remover/installer 2.3. Plain bearing oil bore

Oil bore position marked on crankcase

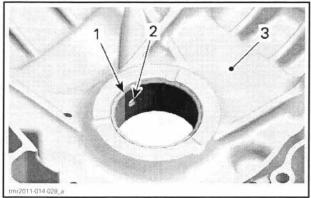
NOTE: Wrong oil bore position will stop oil supply to plain bearings and will cause engine damage.

**NOTICE** The partition of the plain bearings in crankcase half MAG side must be positioned near to oil bore in clockwise direction.



Crankcase half MAG (inside surface)
 Partition
 Oil bore

**NOTICE** The partition of the plain bearings in crankcase half PTO side must be positioned near to oil bore in counterclockwise direction.



1. Partition

- 2. Oil bore
- 3. Crankcase half PTO (inside)

#### 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.

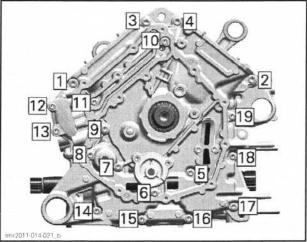
Oil the plain bearings before mounting the crank-shaft.

## **NOTICE** Correctly reinstall crankshaft (refer to *CRANKSHAFT*).

Properly reinstall engine oil strainer and screws.

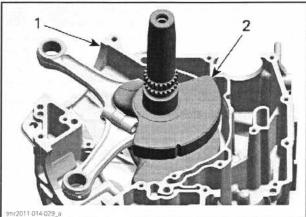
Reinstall water pump shaft shafts/gears (refer to *COOLING SYSTEM* section).

Tightening sequence for screws on crankcase is as per following illustration.



TIGHTENING SEQUENCE

## CRANKSHAFT



. Crankcase MAG

#### 2. Crankshaft

## Crankshaft Locking Procedure

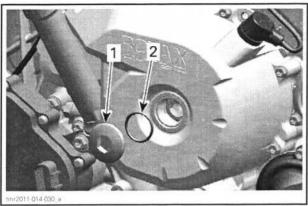
**NOTE:** When crankshaft is locked, the rear piston (cylinder 2, rear) is at TDC. Crankshaft can not be locked at cylinder 1 (front) TDC.

# **NOTICE** To see if the rear piston (cylinder 2, rear) is at TDC ignition refer to *CAMSHAFT TIMING GEAR* in the *TIMING CHAIN* section.

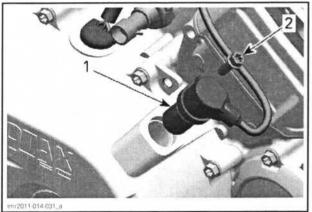
Remove:

- 1. spark plug cables and spark plugs of both cylinders
- 2. plug screw and O-ring of magneto cover

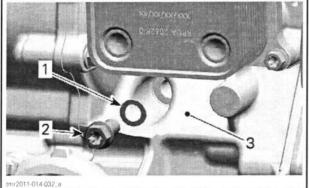
Subsection 09 (BOTTOM END)



- Plug screw O-ring
- 2
- 3. crankshaft position sensor

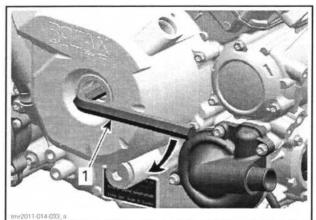


- Crankshaft position sensor Screw
- 2.
- 4. plug screw with sealing ring.



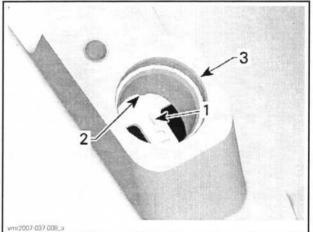
- Sealing ring
   Plug screw
   Crankcase PTO side, front side

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



Allen key 14 mm 1.

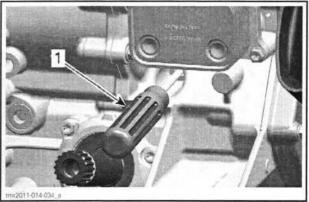
When rear piston is at TDC marks on magneto flywheel "2" and on the magneto cover are aligned.



Mark "2" on magneto flywheel

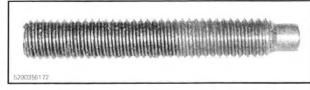
Notch on magneto cover Crankshaft position sensor location 2.

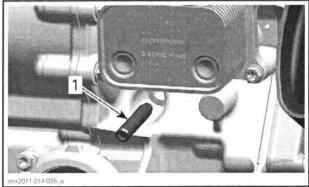
Use a screwdriver to check if the groove in the crankshaft is aligned with the hole.



Screwdriver 1.

Lock crankshaft with CRANKSHAFT LOCKING BOLT (P/N 529 035 617).





1. Crankshaft locking bolt

Gradually insert the tool in the crankshaft groove. Make sure that the tool tip enters the groove and does not jam on the crankshaft balancer surface.

#### Crankshaft Removal

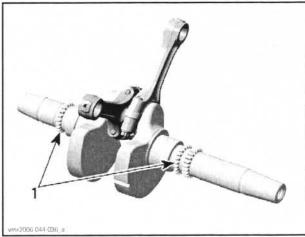
Refer to CRANKCASE.

#### 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.

**NOTICE** Components out of specifications 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.

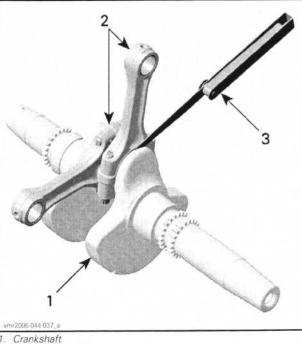
Measure play on PTO end, using a dial indicator.

CRANKSHA	FT AXIAL PLAY
NEW	0.200 mm to 0.500 mm (.008 in to .02 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.



Crankshaft
 Connecting rods

3. Feeler gauge

CONNECTING ROD	BIG END AXIAL PLAY	
800R Engine		
NEW	0.200 mm to 0.500 mm (.008 in to .02 in)	
SERVICE LIMIT	0.6mm (.024 in)	
1000	Engine	
NEW	0.25 mm to 0.55 mm (.01 in to .022 in)	
SERVICE LIMIT	0.6 mm (.024 in)	

Subsection 09 (BOTTOM END)

#### Connecting Rod/Piston Pin Clearance

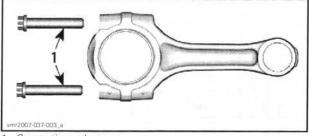
Refer to TOP END section.

#### 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).

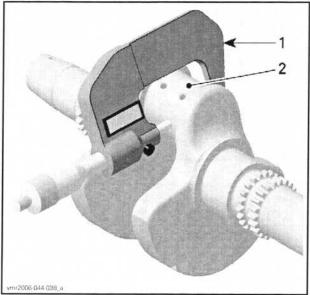
Remove connecting rods from crankshaft.

**NOTICE** Connecting rod screws are not reusable. Always discard screws and replace by new ones. It is recommended to install new plain bearings when reinstalling connecting rods.



1. Connecting rod screws

Measure crankpin. Compare to inside diameter of connecting rod big end.



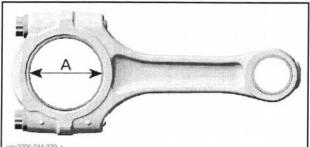
1. Micrometer

2. Crankpin area for plain bearing

To measure the connecting rod big end diameter, use the OLD connecting rod screws.

Install the OLD plain bearings as they were mounted initially.

Carry out the tightening procedure described in *CRANKSHAFT ASSEMBLY* in this subsection.



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A. Connecting rod big end plain bearing

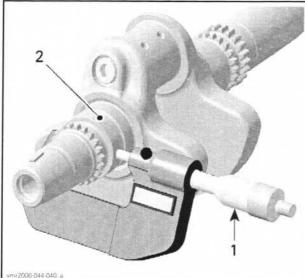
800	R Engine	
CRANKSHAFT PIN DIAMETER		
NEW	40.009 mm to 40.025 mm (1.5752 in to 1.5758 in)	
SERVICE LIMIT	39.990 mm (1.5744 in)	
CONNECTING RC	DD BIG END DIAMETER	
SERVICE LIMIT	40.100 mm (1.5787 in)	
	OD BIG END RADIAL	
SERVICE LIMIT	0.09 mm (.0035 in)	
100	0 Engine	
CRANKSHA	FT PIN DIAMETER	
NEW	41.986 mm to 42.010 mm (1.653 in to 1.6539 in)	
SERVICE LIMIT	41.967 mm (1.6522 in)	
CONNECTING RO	D BIG END DIAMETER	
SERVICE LIMIT	42.100 mm (1.6575 in)	
	OD BIG END RADIAL	
SERVICE LIMIT	0.09 mm (.0035 in)	

If crankshaft pin diameter is out of specification, replace crankshaft.

If connecting rod big end diameter or radial clearance is out of specification, replace plain bearings and recheck.

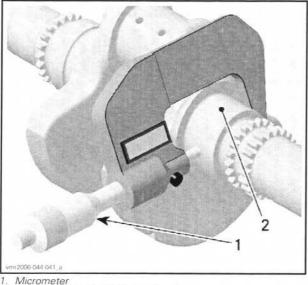
#### Crankshaft Radial Play MAG/PTO Side

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

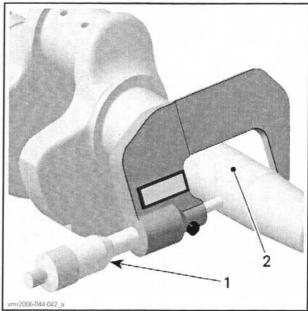


2. Crankshaft area for PTO plain bearing

	IN BEARING JOURNAL (MAG/PTO SIDE)
NEW	42.016 mm to 42.040 mm (1.6542 in to 1.6551 in)
SERVICE LIMIT	42.000 mm (1.6535 in)
CRANKSHAFT RADI	AL PLAY (MAG/PTO SIDE)
SERVICE LIMIT	0.07 mm (.0028 in)

#### Crankshaft Radial Play (PTO Cover Bearing)

Measure crankshaft journal diameter (PTO cover bearing). Compare to plain bearing inside diameter (PTO cover). Refer to *PTO COVER* in this subsection.



1. Micrometer

2. Crankshaft journal (PTO support bearing)

NEW	34.016 mm to 34.040 mm
INEVV	(1.339 in to 1.34 in)
SERVICE LIMIT	34.010 mm (1.339 in)

SERVICE LIMIT 0.10 mm (.0039 in)

If crankshaft journal diameter is out of specification, replace crankshaft.

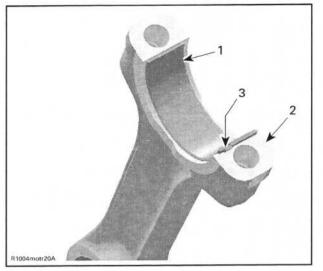
If crankshaft radial play (PTO cover bearing) out of specification, replace plain bearings and recheck.

#### Crankshaft Assembly

For assembly, reverse the disassembly procedure. Pay attention to following details.

Put plain bearings correctly in place and clean the split surface on both sides (cracked area) carefully with compressed air.

Subsection 09 (BOTTOM END)



Half plain bearing of connecting rod big end
 Split surface of the connecting rod
 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.

Oil NEW connecting rod screws.

Thread screws in the connecting rods, then tighten as per following procedure.

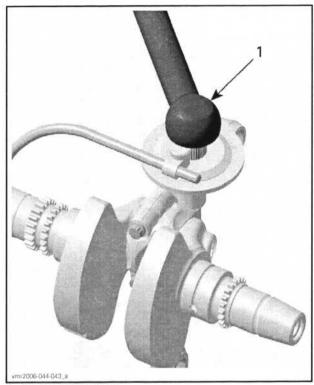
NOTICE Always use NEW connecting rod screws at final assembly. They are not reusable.

#### 800R Engine:

Tighten screws in the following sequence:

со	NNECTING RODS SCREWS TIGHTENING SEQUENCE
1.	Tighten to 1/2 of specified torque
2.	Tighten to 20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)
3.	Torque by an additional 60 ± 5° turn using an angle torque wrench

NOTE: Do not apply any thread locker.



Angle torque wrench

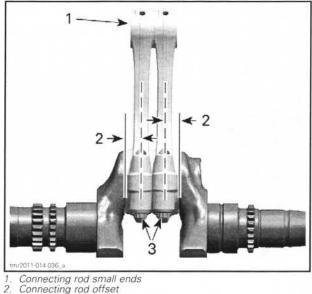
**NOTICE** Failure to strictly follow this procedure may cause screw to loosen and lead to severe engine damage.

NOTE: The running direction of the big end bearings and of the piston pins must not change.

#### 1000 Engine:

NOTICE Connecting rods are asymmetric. There must be no gap between the small ends when they face each other.

Subsection 09 (BOTTOM END)

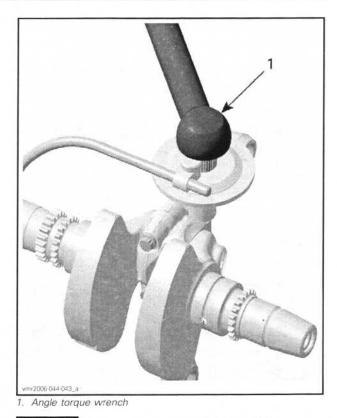


- 3. Connecting rod screws
- o. connecting rod sciews

Tighten screws in the following sequence:

CC	NNECTING RODS SCREWS TIGHTENING SEQUENCE
1.	Tighten to 1/2 of specified torque
2.	Tighten to 30 N∙m ± 2 N∙m (22 lbf∙ft ± 1 lbf∙ft)
3.	Torque by an additional 90 ± 5° turn using an angle torque wrench

NOTE: Do not apply any thread locker.



**NOTICE** Failure to strictly follow this procedure may cause screw to loosen and lead to severe engine damage.

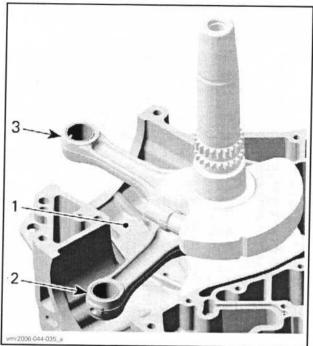
#### Crankshaft Installation

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.

**NOTICE** Observe the correct installation position when fitting the crankshaft with the connecting rods. The connecting rod MAG side has to face cylinder 1.

Subsection 09 (BOTTOM END)



Crankcase half MAG side
 Connecting rod cylinder 1
 Connecting rod cylinder 2

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

## CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

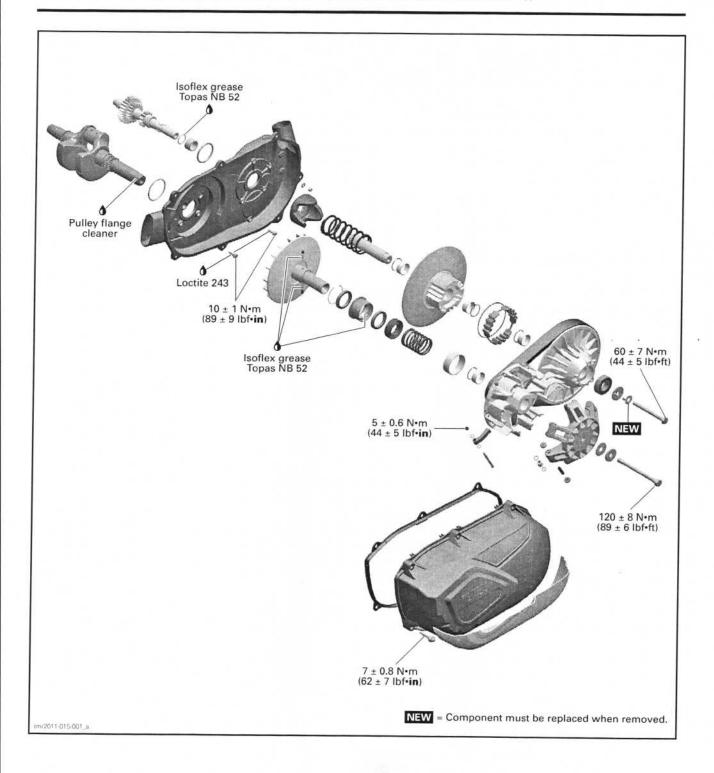
## SERVICE TOOLS

Description	Part Number	Page
CLUTCH PULLER	529 035 746	
DRIVE PULLEY HOLDER (CVT)	529 006 400	
DRIVEN CLUTCH HOLDER	529 035 771	
GEAR LOCK PIN	529 035 747	

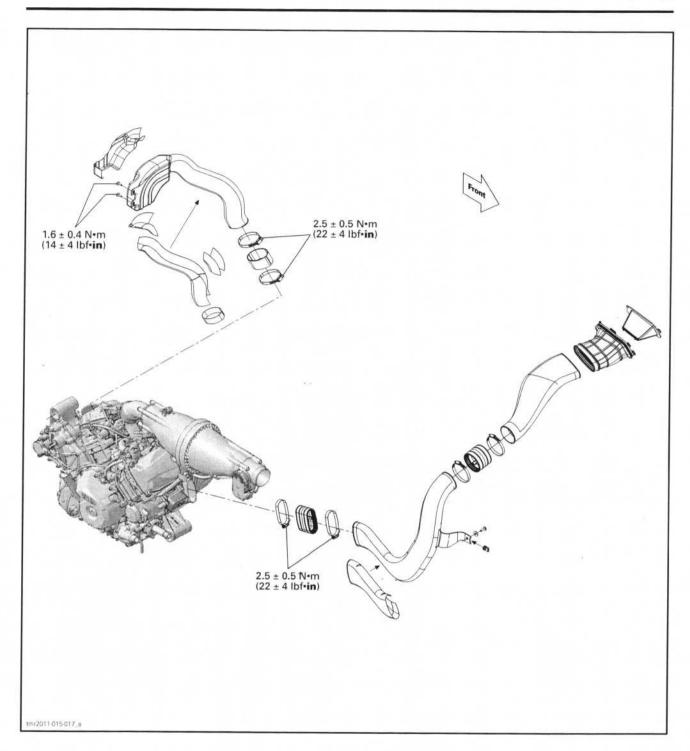
## SERVICE PRODUCTS

Description	Part Number	Page
ISOFLEX GREASE TOPAS NB 52	293 550 021	
PULLEY FLANGE CLEANER	413 711 809	

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



Subsection 10 (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.

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.

### A WARNING

Torque wrench tightening specifications must strictly be adhered to.

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

## 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.

**NOTICE** 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.

**NOTICE** 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.

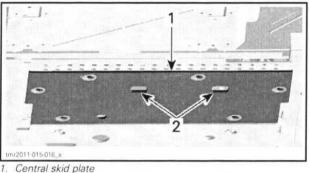
## PROCEDURES

## CVT COVER

#### CVT Cover Access

- 1. Refer to *BODY* and remove:
  - LH seat
  - LH lateral console panel.
- 2. Remove under seat storage compartment.

**NOTE:** The CVT cover lower screws are accessible through the square holes in the central skid plate.

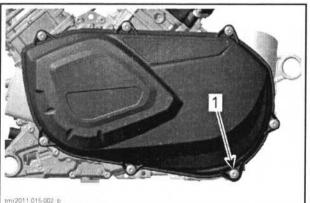


Central skid plate
 Access holes

### CVT Cover Draining

If water is present in CVT cover, it can be drained as follows:

1. Remove drain screw.



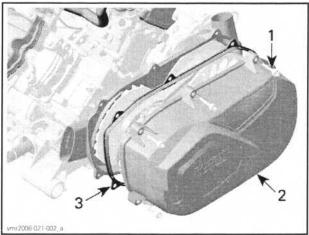
1. Drain screw

2. Let water drain from CVT cover.

3. Reinstall drain screw.

**NOTICE** If any debris entered the CVT cover, CVT must be cleaned and inspected.

CVT Cover 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.

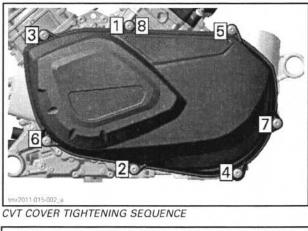


- 1. CVT cover screw
- 2. CVT cover
- 3. Gasket

#### **CVT** Cover Installation

Install the center top screw of first.

Tighten the CVT cover screws as per following sequence.



CVT COVER SCREWS TIGHTENING TORQUE 7 N•m ± 0.8 N•m (62 lbf•in ± 7 lbf•in)

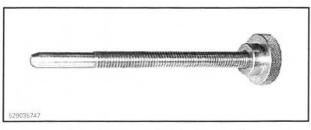
## DRIVE BELT

#### **Drive Belt Removal**

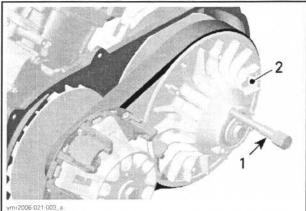
**NOTICE** In case of a drive belt failure, the CVT, cover and air outlet must be cleaned.

Remove CVT COVER.

Open driven pulley with the GEAR LOCK PIN (P/N 529 035 747).



Screw tool in the threaded hole of driven pulley and tighten to open the pulley.

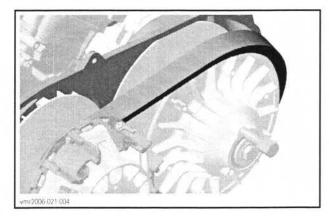


TYPICAL

1. Driven pulley expander

2. Fixed sheave of driven pulley

To remove belt, slip the belt over the top edge of fixed sheave, as shown.

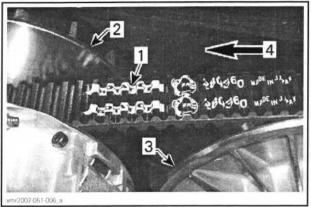


## **Drive Belt Installation**

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.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



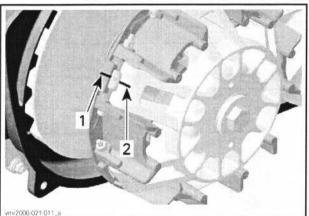
- Arrow printed on belt
- 2.3. Drive pulley (front)
- Driven pulley (rear) 4 Rotation direction

# **DRIVE PULLEY**

# **Drive Pulley Removal**

### Remove DRIVE BELT.

Prior to removing the drive pulley, mark sliding sheave and governor cup to ensure correct indexation at reinstallation.



Mark on drive pulley sliding sheave

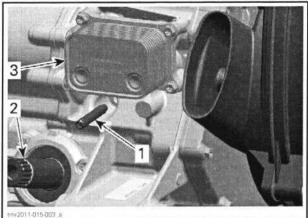
Mark on drive pulley si
 Mark on governor cup

Block the drive pulley using one of the following methods:

# First Locking Method:

Remove spark plugs.

Lock crankshaft at TDC position. Refer to BOT-TOM END section.

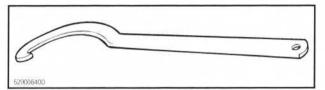


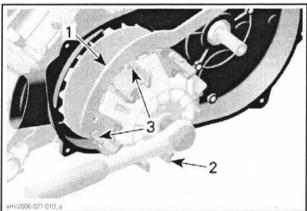
1

- Crankshaft locking bolt Engine drive shaft (front side) 2
- 3. Oil cooler

### Second Locking Method:

Block drive pulley with the DRIVE PULLEY HOLDER (CVT) (P/N 529 006 400).



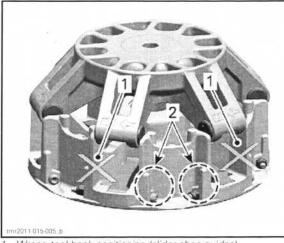


Pulley holding tool

- 1.2.3. Drive pulley sliding sheave Area to place holding tool hook

NOTICE Do not lean the tool hook on the slider shoe guides.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



Wrong tool hook positioning (slider shoe guides)

2. Correct tool hook positioning (outside slider shoe guides)

#### Drive Pulley Removal Continuation

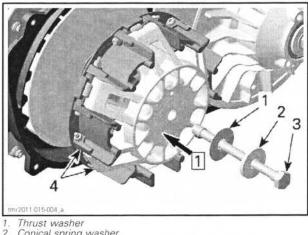
Loosen the drive pulley screw.

NOTE: Do not unscrew the drive pulley screw completely. If governor cup is stuck, hit it using a soft hammer.

Apply axial pressure with your hand on the sliding sheave and governor cup.

Remove drive pulley screw with its conical spring washer and thrust washer.

### A CAUTION Sliding sheave of drive pulley is spring loaded.

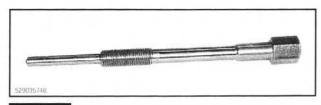


- Conical spring washer
- 3. Drive pulley screw 4. Sliding sheave with governor cup

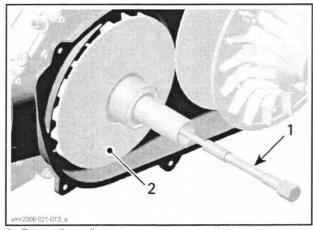
Step 1: Push

Slowly release and remove sliding sheave.

Screw CLUTCH PULLER (P/N 529 035 746) in fixed sheave to remove fixed pulley.



**NOTICE** Make sure to use the specified tool. Using another tool will damage the crankshaft threads.

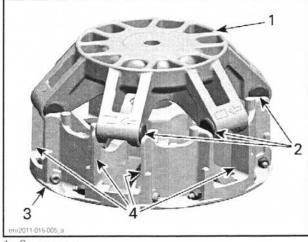


Drive pulley puller 2. Fixed sheave

# **Drive Pulley Disassembly**

### Governor Cup

Carefully lift governor cup until slider shoes come at their highest position into guides.



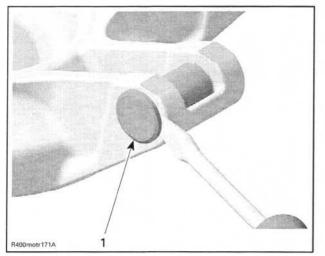
Governor cup 2 Slider shoes

- Sliding shave 3. 4
- Guides

**NOTE:** The following procedure is not necessary except if roller must be removed. Refer to /N-SPECTION before proceeding.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

Remove slider shoes out of each bearing sleeve. Use a flat screwdriver if necessary.



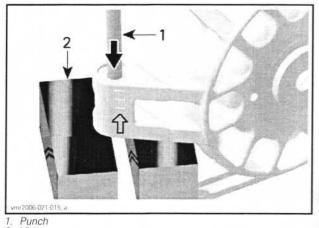
<sup>1.</sup> Slider shoe

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).

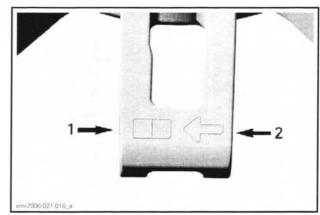
**NOTICE** Do not clamp the governor cup in the vice to push out bearing sleeve. Governor cup will be damaged.

**NOTE:** Use protection plates to avoid marks and/or damages to the governor cup.

**NOTICE** Always replace all rollers at the same time. Partly worn rollers may cause damage to the CVT system.

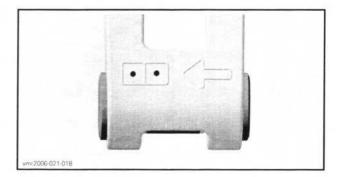


2. Vice



1. Removal direction 2. Assembly direction

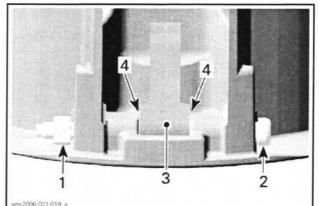
**NOTE:** Whenever removing a governor cup with already two marked boxes replace it by a new one.



#### Sliding Sheave

Unscrew lock nut and remove centrifugal lever pivot bolt. This drive pulley is equipped with 6 levers.

Remove centrifugal lever and both thrust washers.



- 1. Lock nut
- 2. Centrifugal lever pivot bolt
- 3. Centrifugal lever
- 4. Thrust washers

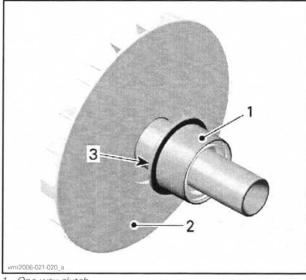
Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

#### Fixed Sheave

### WARNING

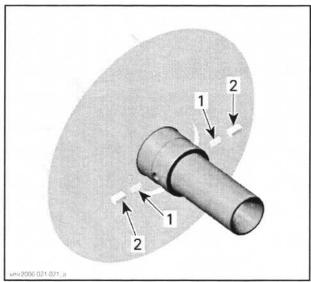
Always wear safety glasses to remove spring sleeves.

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

### **Drive Pulley 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.

# **NOTICE** Avoid contact between cleaner and crankshaft seal because damage may occur.

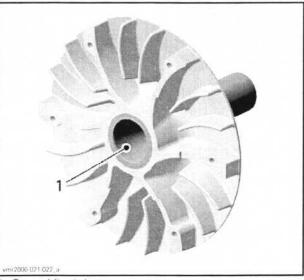
Remove all hardened oil deposits that have baked on crankshaft and pulley tapered surfaces with coarse or medium steel wool and/or sand paper no. 600.

**NOTICE** Do not use any other type of abrasive.

Reclean mounting surfaces with paper towel and PULLEY FLANGE CLEANER (P/N 413 711 809).

Wipe off the mounting surfaces with a clean, dry paper towel.

**NOTICE** Mounting surfaces must be free of any oil, cleaner or towel residue.

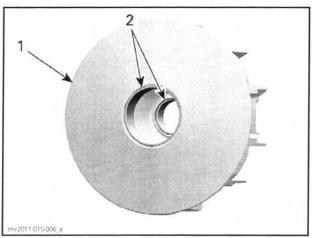


1. Taper of fixed sheave

Only use petrol base cleaner when cleaning bushings of sliding sheave.

**NOTICE** Do not use acetone to clean bushing.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



1. Sliding sheave 2. Bushings

# **Drive Pulley Inspection**

### Bushings

For bushing inspection, refer to *SLIDING SHEAVE* in this subsection.

# Governor Cup

Check governor cup for cracks or other visible damage. Replace if necessary.

### **Roller and Slider Shoe**

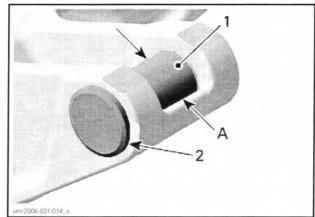
Check each roller for roundness of external diameter.

Check if rollers move freely.

**NOTICE** 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.



. Roller

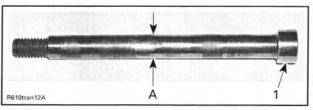
2. Slider shoe

A. Roller outer diameter

ROLLER	OUTER DIAMETER
NEW	13.70 mm to 13.80 mm (.539 in 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 mm (.354 in)

### Centrifugal Lever Pivot Bolt

Measure diameter of centrifugal lever pivot bolt, replace if it is out of specification.



1. Centrifugal lever pivot bolt

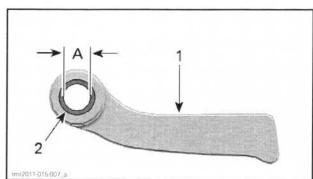
A. Measure diameter here

CENTRIFUGAL LEVER PIVOT BOLT DIAMETER	
NOMINAL	6.078 mm to 6.100 mm (.239 in to .24 in)
SERVICE LIMIT	6.00 mm (.236 in)

### **Centrifugal Lever**

Check bushing diameter in the centrifugal lever for wear. Replace centrifugal lever if necessary.

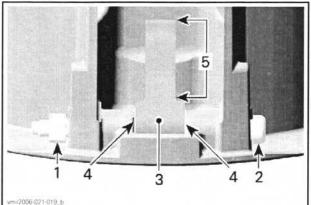
Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



- 1. Centrifugal lever
- 2. Bushing
- A. Bushing inner diameter

CENTRIFUGAL LEVER BORE DIAMETER	
NOMINAL	6.035 mm to 6.078 mm (.238 in to .239 in)
SERVICE LIMIT	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.



vmi2006-021-019

- Lock nut
   Centrifugal lever pivot bolt
- 3. Centrifugal lever
- 4. Thrust washers
- 5. Contact surface to the roller

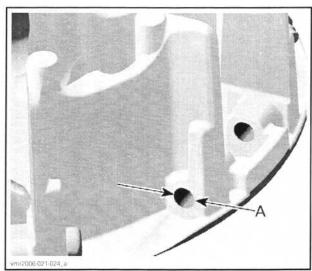
### 

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.

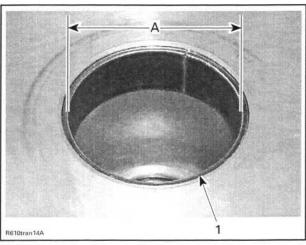


A. Centrifugal lever pivot bolt bore diameter

CENTRIFUGAL LEVER PIVOT BOLT BORE DIAMETER	
NOMINAL	6.113 mm to 6.171 mm (.241 in to .243 in)
SERVICE LIMIT	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.

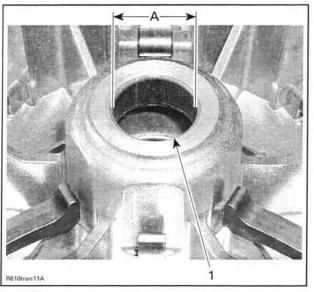


1. Bushing on fixed sheave side

A. Bore diameter of bushing

SLIDING SHEAVE LARGE BUSHING	
NOMINAL	55.000 mm to 55.040 mm (2.165 in to 2.167 in)
SERVICE LIMIT	55.200 mm (2.173 in)

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



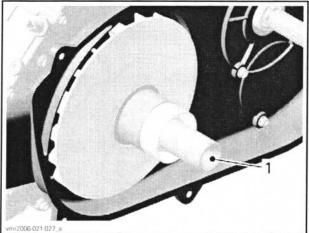
- 1. Bushing on governor cup side
- A. Bore diameter of bushing

SLIDING SHEAVE SMALL BUSHING	
NOMINAL	32.000 mm to 32.040 mm (1.26 in to 1.261 in)
SERVICE LIMIT	32.200 mm (1.268 in)

Replace sliding sheave if one of the bushings is 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

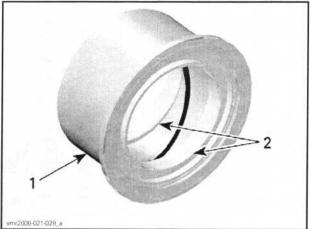
Measure spring free length and squareness. If spring is out of specification, replace by a new one.

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.

**NOTICE** Be careful not to damage the inside of one-way clutch during bearing removal.



. One-way clutch

2. Bearings

Measure length of spring sleeves and check if edges on top of the spring sleeve are excessively worn. If they out of specifications, replace both spring sleeves at the same time.

SPRING SLEEVE LENGTH	
NOMINAL	9.2 mm to 9.4 mm (.362 in to .37 in)
SERVICE LIMIT	9 mm (.354 in)

# **Drive Pulley Assembly**

For assembly, reverse the disassembly procedure. Pay attention to following details.

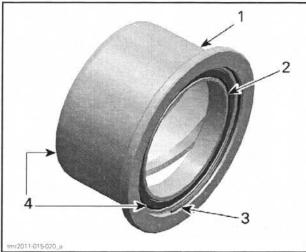
### One-Way Clutch

Clean parts.

Lubricate springs, spring sleeves and between one way clutch bearings using ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021). Push grease inside bearings to ensure adequate lubrication.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

**NOTE:** Ball bearings have a seal on one side only. Install bearings with the seal towards the outside of the one-way clutch.



- 1. One-way clutch
- 2. Bearing
- 3. Retaining ring 4. Seal
- 4. *3*cai

#### Sliding Sheave

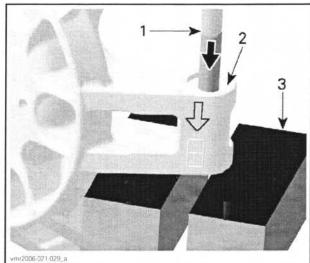
Install centrifugal levers with their thrust washers.

**NOTICE** Centrifugal levers must move easily after installation.

#### Governor Cup

Rebuild governor cup with new bearing sleeves, thrust washers, rollers and slider shoes.

**NOTICE** Final position has to be aligned with the contact surface of the slider shoes (no protrusion).



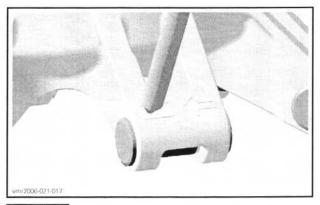
. Top edge of bearing sleeve

2. Mating surface of slider shoes

3. Vice

Each time when replacing the bearing sleeves sign the foreseen box with a punch.

**NOTICE** Do not tap too hard. Violent damage of the governor cup may appear.



**NOTICE** Rollers must move easily after installation.

Insert slider shoes into governor cup to properly slide in guides.

### **Drive Pulley Installation**

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

### A WARNING

Do not apply antiseize or any lubricant on crankshaft and drive pulley tapers.

**NOTICE** Never use any type of impact wrench at drive pulley removal and installation.

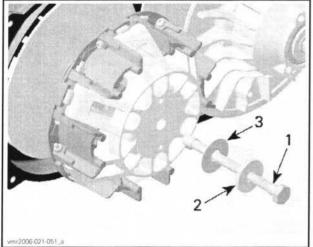
Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

Clean mounting surfaces as described in CLEAN-ING above.

Install drive pulley on crankshaft extension.

NOTICE 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.



- Drive pulley screw Conical spring washer
- Thrust washer

# WARNING

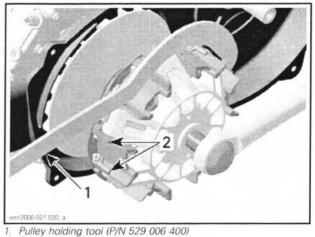
Never substitute conical spring washer and/or screw with jobber ones. Always use BRP genuine parts for this particular case.

To tighten the drive pulley screw, lock the drive pulley. Refer to the DRIVE PULLEY REMOVAL in this subsection for locking procedures.

Tighten drive pulley screw to specified torque.

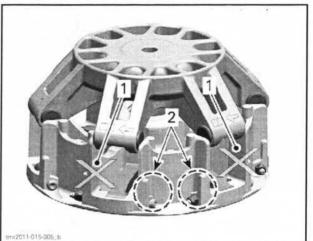
### DRIVE PULLEY SCREW TIGHTENING TORQUE

120 N•m ± 8 N•m (89 lbf•ft ± 6 lbf•ft)



2. Drive pulley removal/installation area

NOTICE Do not lean the tool hook on the slider shoe guides.



Wrong tool hook positioning (slider shoe guides) 2. Correct tool hook positioning (outside slider shoe guides)

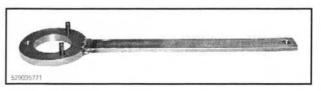
# DRIVEN PULLEY

# **Driven Pulley Removal**

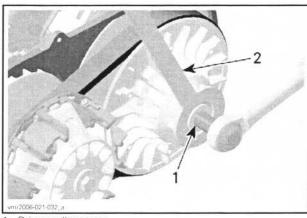
Remove DRIVE BELT.

Using the DRIVEN CLUTCH HOLDER (P/N 529 035 771), hold the driven pulley and loosen the driven pulley screw.

NOTE: Do not unscrew the driven pulley screw completely.



Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



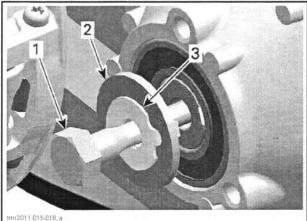
1. Driven pulley screw 2. Pulley holding tool

Apply axial pressure with your hand on driven pulley and maintain during screw removal.

Remove driven pulley screw, locking washer and washer.

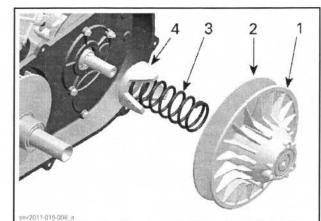
Discard locking washer.

**A** CAUTION Driven pulley is spring loaded. Hold driven pulley tight and slowly remove the driven pulley screw to release spring tension.



- Driven pulley screw Thrust washer
- 3. Locking washer

Remove the driven pulley with the spring and the cam.



Fixed sheave of driven pulley Sliding sheave of driven pulley

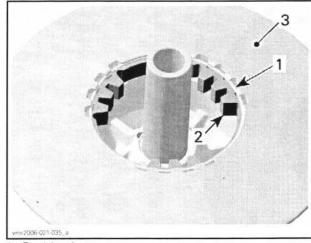
1.2.3.4.

Spring Cam

# **Driven Pulley Disassembly**

### **Fixed Sheave**

Remove retaining ring and lift torque gear.

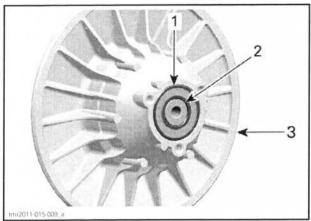


- Retaining ring
- Torque gear 3. Fixed sheave of driven pulley

**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.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

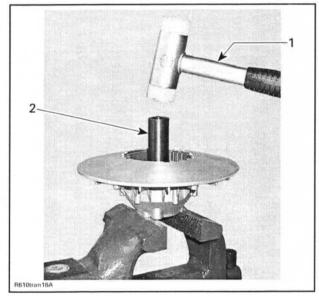




Shaft

2. Fixed sheave of driven pulley

Use a soft hammer to push shaft with bearing out of fixed sheave.

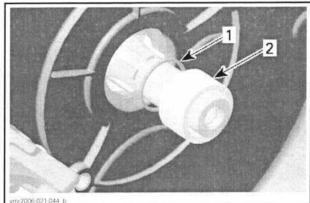


Soft hammer 1. Soft I 2. Shaft

Remove shaft from ball bearing.

Remove distance sleeve and O-ring from countershaft.

Replace O-ring if brittle, hard or damaged.





O-ring Distance sleeve 2

# **Driven Pulley Cleaning**

When a dust deposit has to be removed from the cam or the shaft, use dry cloth.

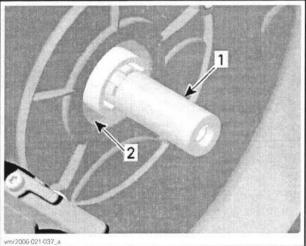
Clean pulley faces and shaft with fine steel wool and dry cloth.

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.

**NOTICE** To avoid damage, make sure cleaner does not contact the countershaft oil seal.



Countershaft support 1. Countershaft oil seal

# **Driven Pulley Inspection**

### **Sliding Sheave**

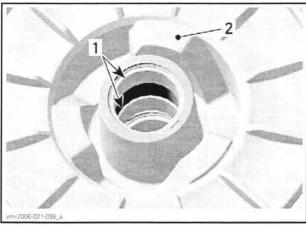
Check sliding sheave for cracks and sliding contact surface for excessive wear. Replace sliding sheave if necessary.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

Check bushings 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 are out of specification. Visually inspect coatings.



1. Bushings

2. Backside of sliding sheave of driven pulley

BUSHINGS BORE DIAMETER	
NOMINAL	30.060 mm to 30.100 mm (1.183 in to 1.185 in)
SERVICE LIMIT	30.200 mm (1.189 in)

### **Fixed Sheave**

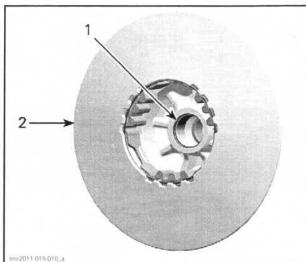
Check fixed sheave for cracks and excessive wear. Replace fixed sheave if necessary.

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 is out of specification. Visually inspect coatings.

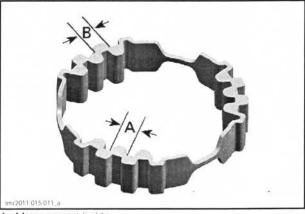


Bushina

2. Fixed sheave of driven pulley

BUSHING BORE DIAMETER	
NOMINAL	30.060 mm to 30.100 mm (1.183 in 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.



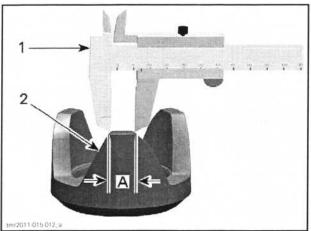
A. Measurement inside B. Measurement outside

WEAR ON TEETH BOTH SIDES	
SERVICE LIMIT	7.500 mm (.295 in)

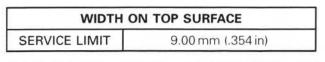
### Cam

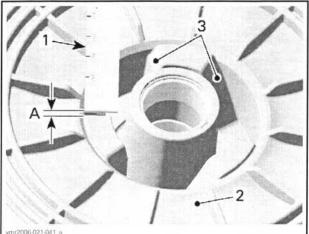
Check cam for visible damage and wear limit with a caliper.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



- Caliper Contact surface 2
- A. Width to be measured due to wear on contact surface





- Caliper Sliding sheave
- 3. Contact surface
- A. Wear to be measured

#### WEAR ON CONTACT SURFACE

1.00 mm (.039 in)

SERVICE LIMIT

### 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 SPF	RING SQUARENESS	
SERVICE LIMIT	3.8 mm (.15 in)	

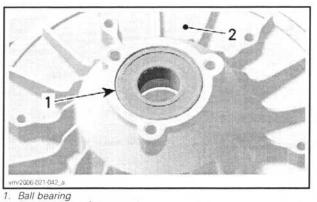
### **Driven Pulley Assembly**

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.

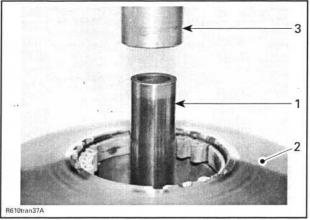
NOTE: Place new ball bearing in a freezer for 10 minutes before installation.

Install ball bearing with the writing on top and push only on the outer ring.



2. Fixed sheave of driven pulley

NOTICE Do not use hammer, use press machine only.

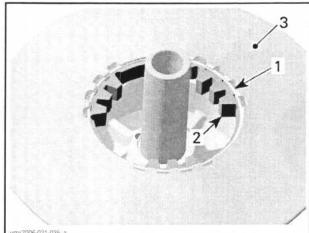


Shaft Fixed sheave

2. Fixed sheave 3. Press machine

Install torque gear then secure it with retaining ring.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



Retaining ring

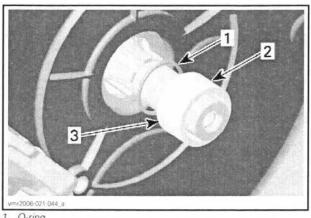
- Torque gear
- 3. Fixed sheave of driven pulley

# **Driven Pulley Installation**

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

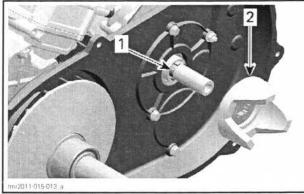
Place O-ring on countershaft splines and move it with distance sleeve in end position.

NOTICE Chamfer on inside diameter of the distance sleeve must face gearbox side.



- O-ring Distance sleeve
- Chamfered area of distance sleeve 3

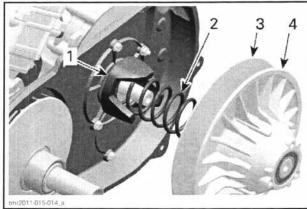
Install cam on countershaft end the right way on the countershaft splines.



1. Countershaft splines 2. Cam

Install sliding sheave into fixed sheave.

Place spring behind sliding sheave then align driven pulley with cam.



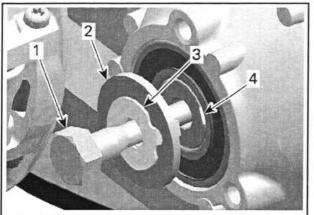
Cam 1

- Spring Sliding sheave Fixed sheave 2 3.
- 4

With your hand, push the driven pulley on the shaft to compress the spring. Install the driven pulley screw, locking washer and thrust washer.

NOTE: Insert locking washer tab through thrust washer hole, then in the shaft slot.

Subsection 10 (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



- Driven pulley screw
- Thrust washer 2 Locking washer
- Locking w
   Shaft slot

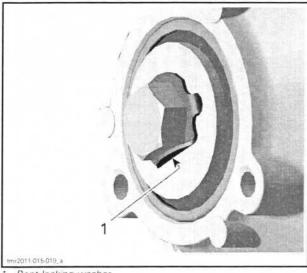
NOTE: Driven pulley end-play is 0 (zero).

Tighten driven pulley screw.

### DRIVEN PULLEY SCREW TIGHTENING TORQUE

60 N•m ± 7 N•m (44 lbf•ft ± 5 lbf•ft)

Bend the locking washer in order to lock the driven pulley screw.



1. Bent locking washer

# CVT AIR GUIDE

# **CVT Air Guide Removal**

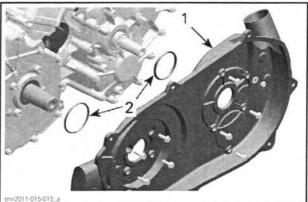
Remove the DRIVE PULLEY and the DRIVEN PULLEY.

Unscrew the clamps retaining the CVT air hoses. Remove CVT air guide.

# **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

# CVT Air Guide Installation

For installation reverse the removal procedure.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

# **GEARBOX AND 4X4 COUPLING UNIT**

# SERVICE TOOLS

Description	Part Number	Page
BLIND HOLE BEARING PULLER SET	529 036 117	
DRIVE SHAFT OIL SEAL INSTALLER	529 036 028	
ECM ADAPTER TOOL	529 036 166	
FLUKE 115 MULTIMETER	529 035 868	
HANDLE	420 877 650	
OIL SEAL INSTALLER (GEARBOX)	529 035 758	
OIL SEAL INSTALLER	529 036 204	

# SERVICE TOOLS - OTHER SUPPLIER

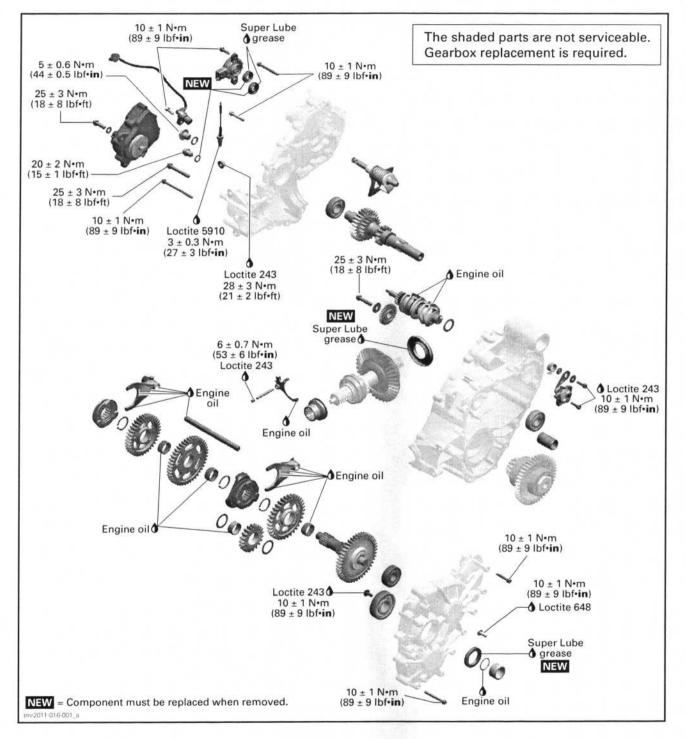
Description	Part Number	Page
FLUKE RIGID BACK-PROBE	TP88	

# SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	
SUPER LUBE GREASE	293 550 030	

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

# GEARBOX COMPONENTS AND 4X4 COUPLING MECHANISM



### Section 02 ENGINE, CVT AND GEARBOX Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

# 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.

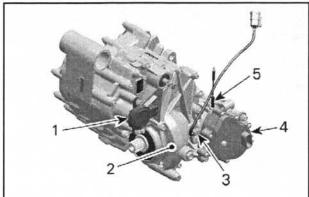
# WARNING

Torque wrench tightening specifications must strictly be adhered to. Locking devices when removed (e.g.: locking

tabs, elastic stop nuts, self-locking fasteners, etc.) must be replaced.

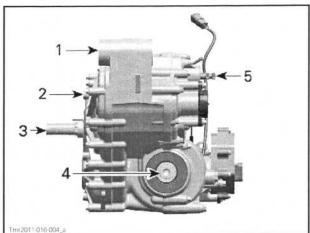
**NOTICE** Hoses, cables and locking ties removed during a procedure must be reinstalled as per factory standards.

# GEARBOX OVERVIEW



Tmr2011-016-003\_a

- 1. Gearbox position sensor (GBPS)
- Right cover
   Vehicle speed sensor (VSS)
- 4 Actuator
- 5. 4WD indicator switch



- 1. Center housing
- 2. Left cover
- 3. Countershaft
- Output shaft
   Shift shaft

# TROUBLESHOOTING

### UNUSUAL GEARBOX NOISE AND/OR VIBRATIONS

- 1. Low oil level in gearbox.
  - Oil leakage from gearbox. Replace damaged gasket(s) and/or oil seal(s).
- 2. Defective bearings.
  - Bearing(s) do(es) not turn smoothly. Replace bearing(s).
- 3. Damaged or worn gears.

- Inspect gears for damages or missing teeth. Replace respective gears.

### GEAR INDICATION FAILS

- 1. Defective gearbox position sensor (GBPS).
  - Perform a gearbox position sensor test.
  - Damaged wires. Repair as required.

### GEAR(S) IS (ARE) HARD TO SHIFT

- 1. Incorrect shifter cable adjustment.
  - Adjust shifter cable (refer to SHIFTER CABLE in SHIFTER subsection.

### **4 WHEEL DRIVE INDICATION FAILS**

- 1. 4WD indicator switch failure.
  - Test 4WD indicator switch. Replace as required.
  - Bad contact. Check for corrosion or loose connector.
  - Damaged wires. Repair as required.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

# 4 WHEEL DRIVE DOES NOT ENGAGE OR DISENGAGE

1. Defective 4WD switch.

- Check 4WD switch operation.

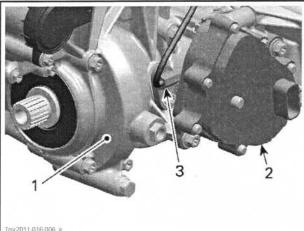
- 2. Defective actuator.
  - Test actuator.
- 3. Damaged or worn shifting fork or sleeve.
  - Remove actuator and inspect shifting fork and sleeve.

# PROCEDURES

# VSS (VEHICLE SPEED SENSOR)

# VSS Location

The vehicle speed sensor is located on the right housing of the gearbox behind the actuator.



1. Right housing of gearbox

- 2. Actuator
- 3. VSS (Vehicle Speed Sensor)

# VSS Access

To reach the VSS, remove the following parts:

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

# VSS Wire Identification

FUNCTION	PIN	COLOR
12-volt input from fuse F5	А	RED
Speed signal (to ECM-A E1)	В	WHITE
Ground (to ECM-A D4)	С	BLACK/GREEN

# VSS Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main	Fuse 5 of fuse block 1
relay activated	(from main relay R2)

# VSS Input Voltage Test

- 1. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Vdc.
- 2. Turn ignition switch ON.
- 3. Back-probe the VSS connector using FLUKE RIGID BACK-PROBE (P/N TP88) or equivalent.
- 4. Measure voltage as per following table.

VEHICLE SI	PEED SENSOR INP	UT VOLTAGE TEST
TEST	PROBES	RESULT (KEY ON)
PIN A (RED wire)	PIN C (BLACK/GREEN wire)	Battery voltage

If voltage is not as specified, test positive and ground separately.

# VSS Signal Test

- 1. Lift rear of vehicle so that rear wheels are off the ground.
- 2. Set transmission to 2WD and to Neutral.
- 3. Back-probe the VSS connector using FLUKE RIGID BACK-PROBE (P/N TP88) or equivalent.
- 4. Turn ignition switch ON.
- 5. Set multimeter to Vdc.
- 6. Measure voltage while slowly rotating rear wheels by hand.

VEH	CLE SPEED SENS	OR SIGNAL TEST	
TEST PROBES		RESULT (WHILE ROTATING WHEELS)	
PIN B (WHITE wire)	PIN C (BLACK/GREEN wire)	Alternate reading between battery voltage and 0 Vdc	

**NOTE:** Since we measure pulsating voltage, the numeric display will continuously change. The analog display may be easier to follow.

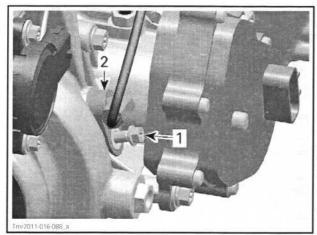
Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



1. Analog display

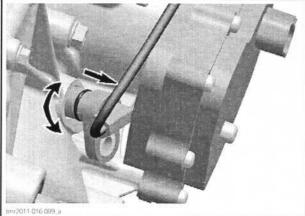
# **VSS** Removal

Remove screw retaining the VSS.



1. Screw 2. VSS

Turn sensor and weave it out of the gearbox right cover.



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# VSS Installation

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

Apply SUPER LUBE GREASE (P/N 293 550 030) on VSS O-ring.

# GBPS (GEARBOX POSITION SENSOR)

### **GBPS** Reset

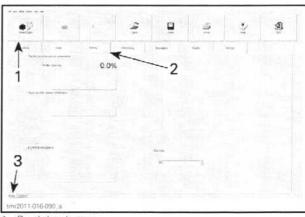
When replacing the gearbox position sensor (GBPS), it is required to reset (re-zero) its values for proper operation.

A reset must be carried out each time any of the following parts has been replaced:

- Gearbox assembly
- Shift drum
- GBPS
- ECM.
- 1. Connect vehicle to the latest applicable version of B.U.D.S. software, refer to *COMMUNICA-TION TOOLS AND B.U.D.S.* subsection.

**NOTE:** Ignition key must stay ON during the reset procedure. If the key is turned off, the procedure must be carried out again.

- 2. In B.U.D.S., select the following:
  - Read Data button
  - Setting page tab
  - ECM tab.

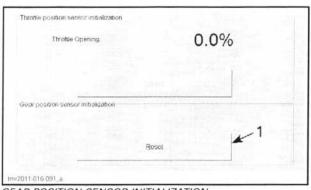


1. Read data button

2. Setting page tab 3. ECM tab

- 3. Make sure that gearbox is set to NEUTRAL position.
- 4. In the Gear Position Sensor Initialization field, click on the Reset button.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



GEAR POSITION SENSOR INITIALIZATION 1. Reset button

A message will be displayed if the operation is successful.

If an error occurred or the GBPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

- 5. If a fault message is displayed, follow the instructions in the message(s).
- 6. Check for fault codes.

If a fault code is generated:

- Carry out the service action
- Reset the fault code
- Repeat the reset procedure.
- 7. Close and disconnect B.U.D.S.

NOTE: Do not turn ignition key OFF.

- 8. Verify gears engagement.
  - 8.1 With the vehicle on ground and in NEU-TRAL position, start engine.
  - 8.2 During 4-5 seconds, rev engine to 2500 ± 200 RPM.
  - 8.3 Let engine returns to idle.
  - 8.4 Select an other position (P, R, H or L). Repeat substeps 8.2 and 8.3 until all position are verified.

**NOTE:** The vehicle must be in movement to complete the procedure on R, H and L position.

# **GBPS** Access

To reach the GBPS sensor, remove the following parts:

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

# GBPS Input Voltage Test

**NOTE:** Prior to conduct testing, check fault codes in B.U.D.S.

Set shift lever in NEUTRAL position.

Unplug the GBPS connector.

Test as follow:

MULTIMETER PROBE POSITIONS	VOLTAGE
PIN 1 and PIN 3 of the GBPS connector	
	5 volts

If voltage is adequate, check GBPS communication link (CAN).

If there is no voltage, check each GBPS input as follows.

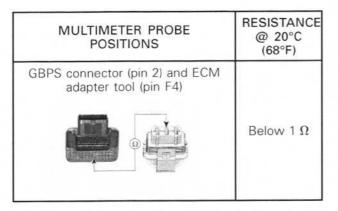
MULTIMETER PROBE POSITIONS	VOLTAGE
GBPS connector (pin 1) and battery ground	
	5 volts
GBPS connector (pin 3) and battery + terminal	Battery voltage

If there is no voltage, check wires and connector pins. Replace or repair defective parts and reset fault codes.

# GBPS Communication Link Continuity Test

Unplug connector "A" from ECM and connect it to the ECM ADAPTER TOOL (P/N 529 036 166).

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



If resistance is out of specification, check wires and connectors. Repair and reset fault codes.

If resistance is good and the other tests succeeded, replace the GBPS and reset fault codes.

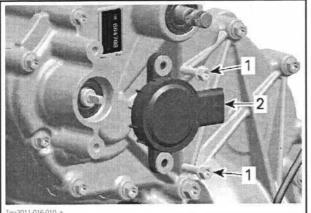
NOTE: The GBPS must be reset.

### **GBPS** Removal

Set shift lever in NEUTRAL position.

Unplug GBPS connector.

Remove screws and withdraw GBPS.



1. Screws

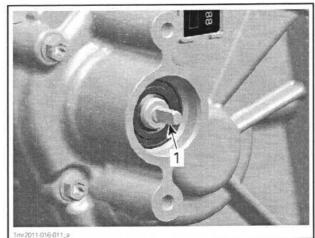
2. Gearbox Position Sensor (GBPS)

# **GBPS** Installation

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

Shift lever must be in the NEUTRAL position.

Align GBPS with the flat on the shift drum shaft.



1. Flat on shift drum shaft

Reset the GBPS. Refer to *GBPS RESET* in this subsection.

# 4WD INDICATOR SWITCH

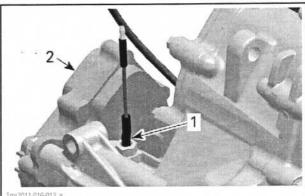
### 4WD Indicator Switch Access

To reach the 4WD indicator switch, remove the following parts:

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

# 4WD Indicator Switch Removal

Disconnect 4WD indicator switch connector.



1. 4 WD indicator switch

2. Actuator

# 4WD Indicator Switch Test

Measure switch resistance as follows.

SWITCH POSITION	SWITCH	I WIRE	RESISTANCE
2WD	BLACK/ BEIGE	Engine ground	Infinite (OL)

### Section 02 ENGINE, CVT AND GEARBOX Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

If the resistance is out of specification, replace the 4WD indicator switch.

### 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.

**NOTICE** Do not apply Loctite 5910 on switch plunger, as it will lead to switch malfunction.

# ACTUATOR

### Actuator Access

To access the actuator, remove the following parts:

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

Remove screws securing fuel tank and move tank on passenger's floor without disconnecting hoses and connector from fuel pump.

# Actuator Test

Using the FLUKE 115 MULTIMETER (P/N 529 035 868), check if the 2WD/4WD selector works properly.



Unplug actuator connector.

Turn ignition key ON.

Measure voltage as follows.

SWITCH POSITION	SWITCH V	VIRE	VOLTAGE
2WD	WHITE/BLUE	WHITE	Battery
4WD	WHITE/BLACK	VVHILE	voltage

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.

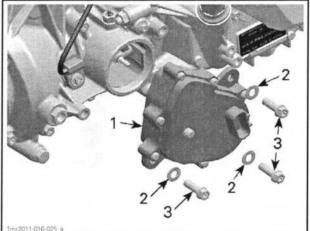
If the vehicle harness is good, replace the actuator.

### Actuator Removal

NOTE: Before beginning any servicing on the actuator, make sure the vehicle is in 4WD position. No need to remove engine from vehicle.

Place a drain pan under actuator.

Remove actuator screws.



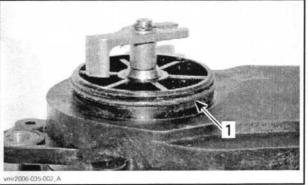
Actuator

2. Washe 3. Screw Washer

When all actuator bolts are removed, pull the actuator out of housing.

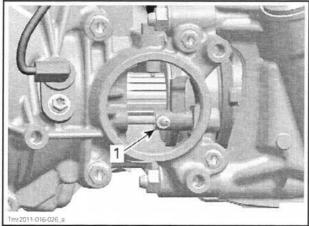
# Actuator Installation

Apply a small amount of SUPER LUBE GREASE (P/N 293 550 030) on actuator O-ring.



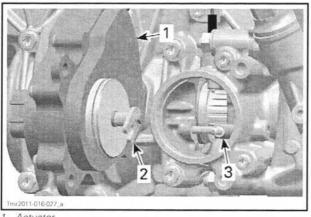
Actuator O-ring

Verify if coupling fork is in 4WD position. The coupling fork should be positioned toward the front of vehicle.



1. Coupling fork in 4WD position

Align the actuator fork with the pin on coupling fork then push the actuator in the housing. See the following illustration to position the actuator correctly.



- Actuator
   Actuator fork
- 3. Coupling fork

Rotate the actuator counterclockwise until it orients itself to mounting position.

**NOTICE** Do not cut or break the actuator O-ring.

Install all actuator screws and tighten them.

PART	TORQUE
Actuator screws	25 N•m ± 3 N•m (18 lbf•ft ± 2 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 should turn easily.

If the front propeller shaft does not turn, the actuator is not installed correctly. Remove actuator and reinstall it.

# **NOTICE** Refill missing gearbox oil, refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

Install all other removed parts.

# GEARBOX OIL SEALS

### Gearbox Oil Seal Replacement

Replace oil seals if they are brittle, hard or damaged.

A small flat screwdriver can be used to remove most of these oil seals.

**NOTICE** Avoid scoring parts during oil seal removal.

When replacing an oil seal, take this opportunity to inspect the following:

- Check bearings behind each oil seal for contamination and/or metal shavings.
- Check oil seal running surfaces for scratches.

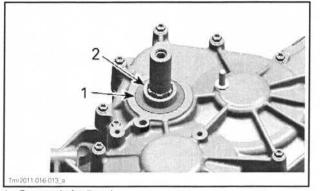
### Countershaft Oil Seal

To replace the countershaft oil seal, remove:

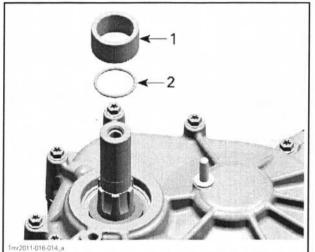
- Drive and driven pulleys
- CVT air guide.

**NOTE:** When oil seal is removed also inspect O-ring behind distance sleeve.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



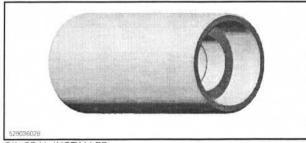
1. Countershaft oil seal 2. Distance sleeve



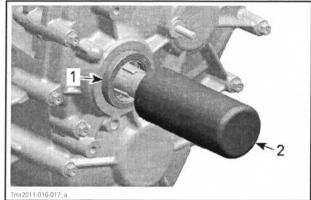
1. Distance sleeve

1. Distant 2. O-ring

Install countershaft oil seal with the DRIVE SHAFT OIL SEAL INSTALLER (P/N 529 036 028).



OIL SEAL INSTALLER



1. Countershaft oil seal

Countershaft oil se
 Oil seal installer

### Shift Shaft Oil Seal

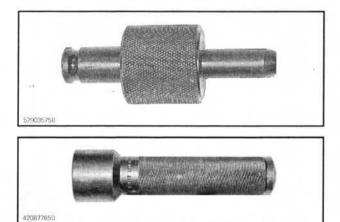
To replace the shift shaft oil seal, remove:

- RH lateral console panel and fuel tank cowl, refer to *BODY* subsection.
- Shift plate from shift shaft.

The shift shaft oil seal can be removed without removing the gearbox from the vehicle.

Use a suitable tube with the proper diameter to install the oil seal.

If gearbox housing is apart, use the OIL SEAL IN-STALLER (GEARBOX) (P/N 529 035 758) and the HAN-DLE (P/N 420 877 650) for shift shaft oil seal installation.



**NOTICE** Oil seal must be installed with sealing lip toward gearbox.

### Shift Drum Shaft Oil Seal

To replace the shift drum shaft oil seal, remove the *GBPS (GEARBOX POSITION SENSOR)*. See procedure in this subsection.

Use a suitable tube with the proper diameter to install the oil seal.

NOTICE Oil seal must be installed with sealing lip toward gearbox.

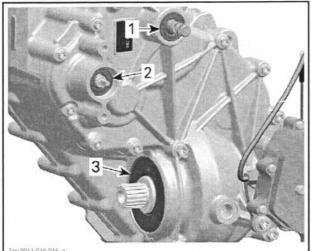
#### **Output Shaft Oil Seal**

To replace the output shaft oil seal, proceed as follows:

Remove propeller shaft screw from gearbox output shaft.

Remove rear final drive bolts.

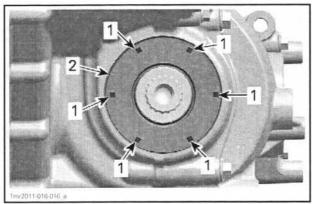
Move the rear final drive rearward to dislodge the propeller shaft from the gearbox output shaft.



- Shift shaft oil seal Shift drum shaft oil seal
- 3. Output shaft oil seal

Punch a sharp screwdriver through oil seal for removal.

NOTE: Position screwdriver only in marked areas to avoid damaging the ball bearing underneath oil seal during removal.



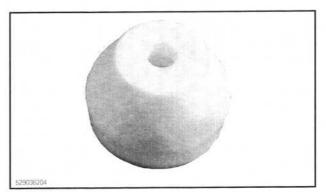
Marked areas for removal 2 Output shaft oil seal

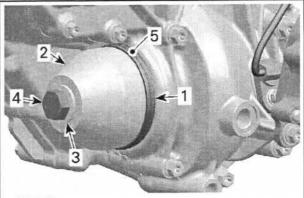
Before beginning the installation ensure gearbox is set to PARK position.

Apply SUPER LUBE GREASE (P/N 293 550 030) on sealing lips.

Apply engine oil on outer diameter of oil seal to avoid damaging it during installation.

Place oil seal on output shaft using the OIL SEAL INSTALLER (P/N 529 036 204) with a flat washer (P/N 250 200 102) and a M12 x 1.25 x 35 hexagonal screw (P/N 207 683 544).





- 2011-016-020
- Output shaft oil seal 2
- Oil seal installer Flat washer (P/N 250 200 102) 3.
- 4
- M12 x 1.25 x 35 hexagonal screw (P/N 207 683 544) 5. Apply engine oil on outer diameter of oil seal

# GEARBOX

### Gearbox Removal

Remove engine from vehicle. Refer to ENGINE REMOVAL AND INSTALLATION for the procedure.

Refer to CONTINUOUSLY VARIABLE TRANSMIS-SION (CVT) subsection to remove following parts:

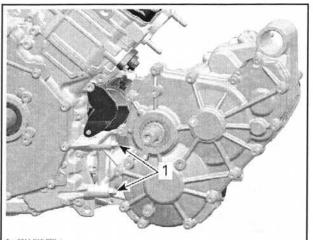
- CVT cover
- Drive and driven pulleys
- CVT air guide.

Drain gearbox. Refer to GEARBOX OIL RE-PLACEMENT in PERIODIC MAINTENANCE PRO-CEDURES subsection.

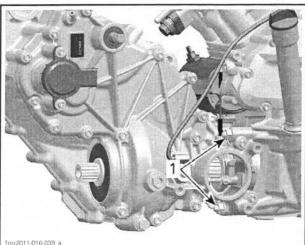
Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

Remove *ACTUATOR*, see procedure in this subsection.

Unscrew the four (4) nuts that attach the gearbox to the engine.



Tmr2011-016-038\_a LH SIDE OF ENGINE 1. Nut M8



RH SIDE OF ENGINE 1. Nut M8

Pull gearbox to separate it from engine.

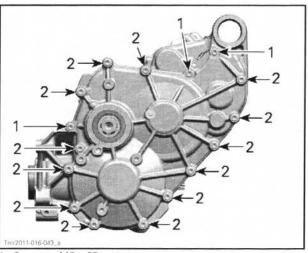
# Gearbox Disassembly

NOTE: During gearbox disassembly, inspect the condition of each part closely.

### Gearbox Left Cover

Set gearbox to NEUTRAL position.

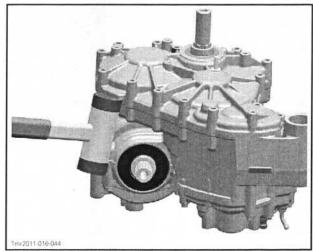
Unscrew all bolts retaining the gearbox left cover.



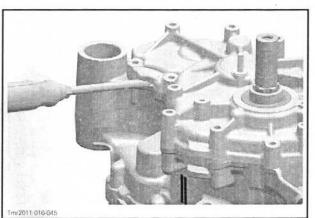
1. 3 screws M6 x 35 2. 13 screws M6 x 55

Place the center housing on a wood stand, left cover pointing upwards.

Using a big flat screwdriver and a soft hammer to lift the left cover.



POSITION FOR SOFT HAMMER



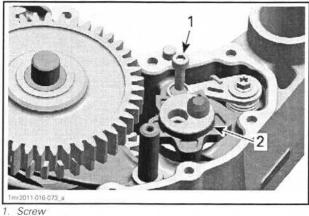
POSITION FOR BIG FLAT SCREWDRIVER

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

#### Index Lever and Index Washer

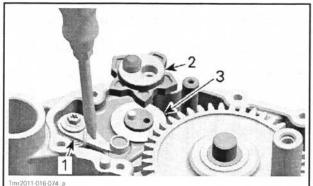
Set gearbox to NEUTRAL position.

Remove screw retaining the index washer to the shift drum.



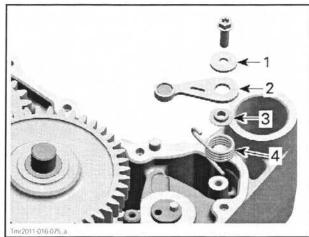
2 Index washer

Insert a flat screwdriver in the slot of index lever. Turn screwdriver clockwise and remove index washer.



- Index lever Index washer
- Index wash
   Shift drum

Remove the index lever with washer, step ring and spring.

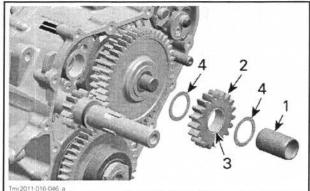


- Washer
- 1. 2. 3. 4.
- Index lever Step ring Index spring

### Main Shaft and Shift Forks

Remove bearing pin, reverse intermediate gear and thrust washers.

NOTE: Take care not to lose lower thrust washer during removal.

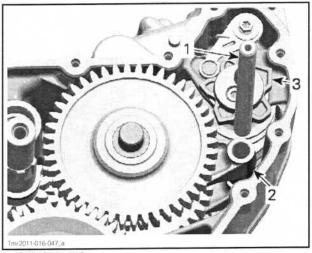


- Bearing pin 1.
- Reverse intermediate gear
   Needle bearing
   Thrust washers

Remove shift fork shaft.

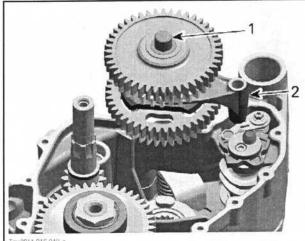
Disengage shift forks from shift drum.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



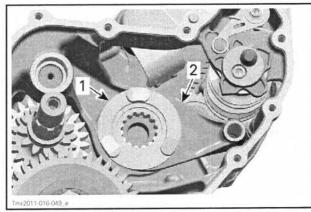
- Shift fork shaft Shift fork Shift drum
- 2.3

Remove main shaft assembly with shift fork.



016-048 Main shaft assembly 2 Shift fork

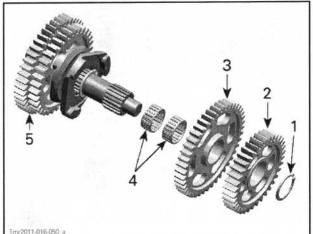
Remove shifting sleeve (HIGH range gear) and shift fork.



Shifting sleeve (HIGH range gear) Shift fork 2

When required, remove from main shaft assembly:

- Snap ring (discard)
- HIGH range gear
- LOW range gear
- Needle bearings.

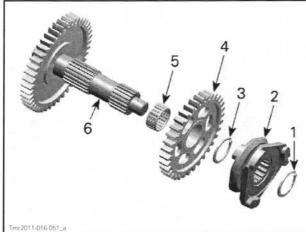


- Snap ring
   Free pinion (HIGH ran
   Free pinion (LOW ran
   Needle bearing
   Main shaft assembly Free pinion (HIGH range gear) Free pinion (LOW range gear)

Remove from main shaft assembly:

- Snap ring (discard)
- Shifting sleeve (LOW/REVERSE range gear)
- Snap ring (discard)
- REVERSE range gear
- Needle bearing.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

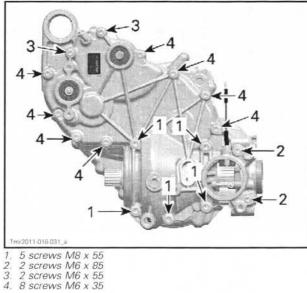


- Snap ring Shifting sleeve (LOW/REVERSE range gear) Snap ring 2
- 3.
- Sindy Img
   Free pinion (REVERSE range gear)
   Needle bearing
   Main shaft assembly

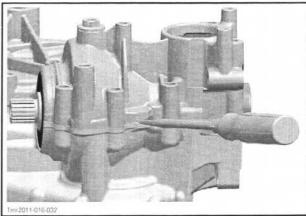
#### Gearbox Right Cover

Remove ACTUATOR and GBPS (GEARBOX PO-SITION SENSOR), see procedures in this subsection.

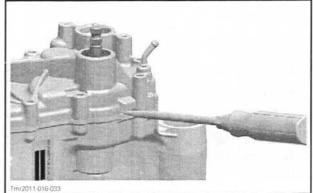
Unscrew all bolts retaining the gearbox right cover.



To remove cover, use 2 big screwdrivers.

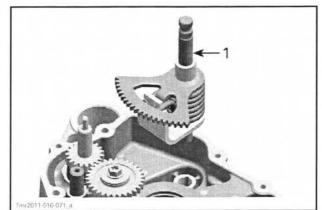


POSITION FOR BIG FLAT SCREWDRIVER



POSITION FOR BIG FLAT SCREWDRIVER

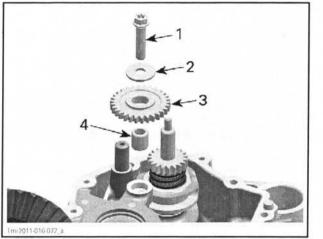
Shift Shaft and Shift Drum Withdraw shift shaft assembly.



1. Shift shaft assembly

Remove screw retaining the shifting intermediate gear.

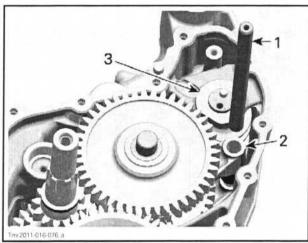
Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



- Screw
- Washer
- 3. Intermediate gear
- 4. Dowel pin

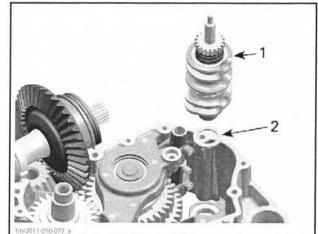
Remove shift fork shaft.

Disengage shift forks from shift drum.



- Shift fork shaft
- 2. Shift fork Shift drum

Remove shift drum and thrust washer.

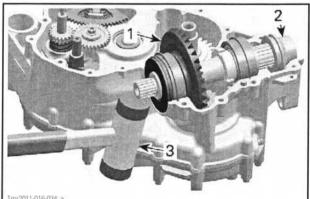


Shift drum Thrust washer 1.

### Output Shaft and 4x4 Coupling Mechanism

Remove output shaft from center housing and withdraw 4x4 coupling sleeve.

NOTICE Use a soft hammer to remove output shaft.

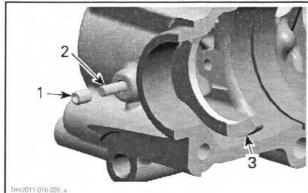


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- Output shaft
- 2. 4x4 coupling sleeve 3. Soft hammer

Remove set screw, coupling fork shaft and coupling fork from right cover.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



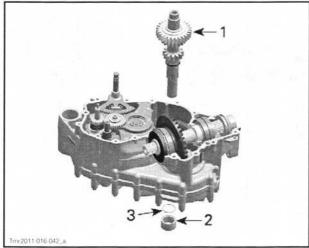
Set screw

- 2. Coupling fork shaft
- 3. Coupling fork

#### Countershaft

Use a soft hammer to push out countershaft from gearbox CVT side.

Remove distance sleeve and O-ring.



- Countershaft
- 2. Distant 3. O-ring Distance sleeve

#### **Gearbox Bearings**

If necessary heat housing up to 100°C (212°F) before removing ball bearings.

### A WARNING

Clean oil, outside and inside, from housing before heating.

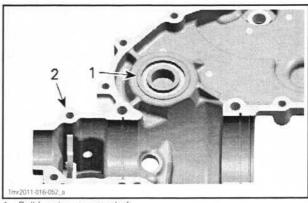
NOTICE Always support gearbox housings properly when ball bearings are removed. Housing damages may occur if this procedure is not performed correctly.

To remove ball bearings of countershaft (right cover) and main shaft (left cover) use the BLIND HOLE BEARING PULLER SET (P/N 529 036 117).



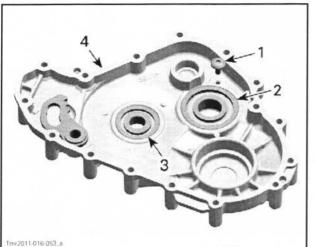
Remove screw securing the countershaft bearing in the left cover.

For ball bearings of countershaft (left cover) and main shaft (center housing) push with a suitable puller from outside in.



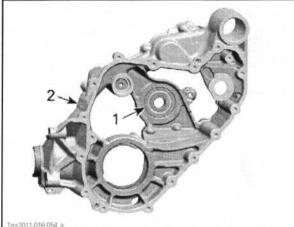
Ball bearing countershaft 2. Right cover

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



Screw

- 1. 2. 3. Ball bearing countershaft
- Ball bearing main shaft
- 1 Left cover



Ball bearing main shaft 1.2. Center housing

### **Gearbox Inspection**

Always verify for the following when inspecting gearbox components:

- Gear teeth damage
- Worn or scoured bearing surfaces
- Rounded engagement dogs and slots
- Worn shift fork engagement groove
- Worn splines on shafts and shifting sleeves.

### Bearings

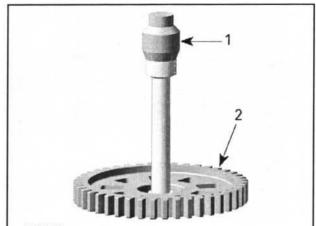
Check if ball bearings turn freely and smoothly.

Check all bearings, bearing points, tooth flanks and taper grooves.

### **Free Pinions**

NOTE: Always replace snap rings and use special pliers to install them.

Check free pinions for wear.



2005-022-080 TYPICAL

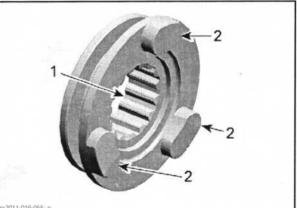
Micrometer

100	-	And the second second second
2.	Free	nininn
4	1100	pinion

DIAMET	TER FREE PINION
NEW	29.000 mm to 29.013 mm (1.1417 in to 1.1422 in)
SERVICE LIMIT	29.015 mm (1.1423 in)

### **Shifting Sleeves**

Check shifting sleeves for worn inner splines and rounded or damaged engagement dogs.

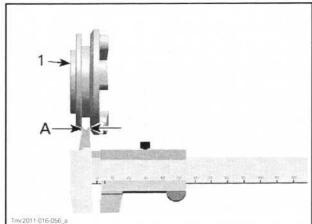


TYPICAL

Inner splines 2. Engagement dogs

Measure the width of shift fork engagement aroove.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



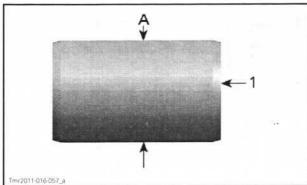
TYPICAL

- 1. Shifting sleeve
- A. Width of shift fork engagement groove

WIDTH OF SHIFT FO	RK ENGAGEMENT GROOVE
NEW	5.30 mm to 5.40 mm (.209 in to .213 in)
SERVICE LIMIT	5.50 mm (.217 in)

### Shafts

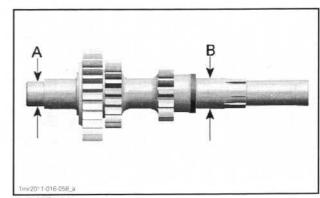
Check bearing pin of reverse intermediate gear for wear.



- Bearing pin
- A. Outer diameter

BEARING PIN OUTER DIAMETER	
NEW	24.987 mm to 25.000 mm (.984 in to .984 in)
SERVICE LIMIT	24.977 mm (.9833 in)

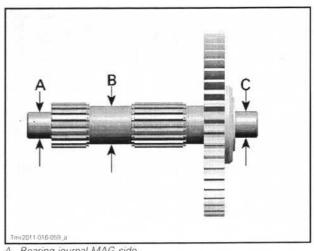
Check countershaft bearing journals for wear.



A. MAG side B. Bearing journal CVT side

COUNTERSHAFT BEARING JOURNALS		
MAG SIDE		
NEW	19.977 mm to 19.990 mm (.786 in to .787 in)	
SERVICE LIMIT	19.973 mm (.786 in)	
	CVT SIDE	
NEW	24.977 mm to 24.990 mm (.983 in to .984 in)	
SERVICE LIMIT	24.970 mm (.983 in)	

Check main shaft for wear.



A. Bearing journal MAG side B. Free pinion bearing C. Bearing journal CVT side

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

MAIN SHAFT FREE PINION BEARING		
SERVICE LIMIT	24.984 mm (.984 in)	
BEARING JO	URNAL CVT/MAG SIDE	
NEW	16.980 mm to 16.991 mm (.669 in to .669 in)	
SERVICE LIMIT	16.976 mm (.668 in)	

# Shift Shaft

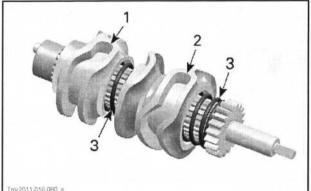
Check shift shaft for worn splines and gears. Check shift shaft spring for damages.

# Shift Drum

# NOTICE Do not disassemble shift drum.

Check if shifting gates move easily on shift drum splines and check condition of springs.

Check shift drum tracks for scouring or heavy wear, like rounded engagement slots.



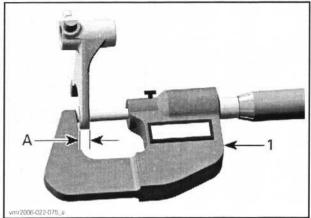
- Track for the low/reverse range gear shift fork
- Track for the high range gear shift fork 3. Springs

# Shift Forks

Check both shift forks for visible damage, wear or bent shift fork claws.

Check engagement rollers for wear and smooth movement.

Measure the shift fork claw thickness.



Micrometer 1

A Shift fork claw thickness

SHIFT FORK CLAW THICKNESS	
NEW	5.10 mm to 5.20 mm (.201 in to .205 in)
SERVICE LIMIT	5.00 mm (.197 in)

# Shift Fork Shaft

Check shift fork shaft for visible damage or wear. Check if shift fork shaft is straight.

### Index Lever and Parking Lever

Index lever with roller must move freely.

Check parking lever for cracks or other damages.

### **Output Shaft**

Check output shaft and its gear for cracks, bend, pitting or other visible damages.

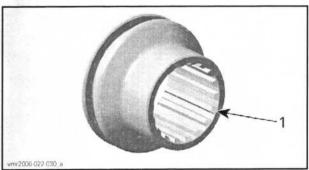
Check output shaft splines for wear or other damages.

Check if the output shaft bearings turn freely and smoothly.

Replace oil seal if brittle, hard or damaged.

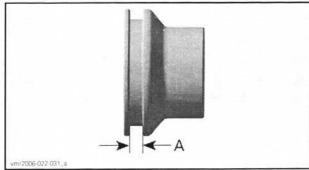
### 4x4 Coupling Sleeve

Check splines of coupling sleeve for wear or other damages.



1. Inspect splines

Measure the coupling sleeve groove width.



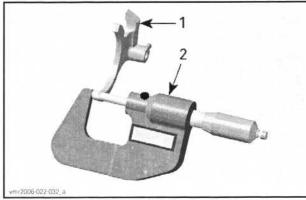
A. Groove width

COUPLING SLEEVE GROOVE WIDTH	
NEW	5.25 mm to 5.35 mm (.207 in to .211 in)
SERVICE LIMIT	5.50 mm (.217 in)

### **Coupling Fork**

Check coupling fork for visible damage, wear or bent coupling fork claws.

Check coupling fork claw thickness.



Coupling fork 2. Micrometer

COUPLING FORK CLAW THICKNESS	
NEW	4.95 mm to 5.05 mm (.195 in to .199 in)
SERVICE LIMIT	4.80 mm (.189 in)

# Gearbox Assembly

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

### **Gearbox Bearings**

Unless otherwise instructed, never use hammer to install ball bearings. Use press machine only.

If necessary heat housings up to 100°C (212°F) before installing ball bearings.

### 

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 main shaft.

NOTE: Place gearbox housings on a wood stand before installing ball bearings.

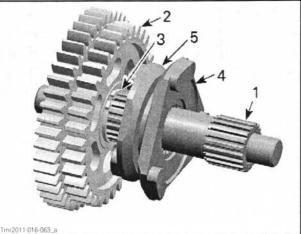
Install new oil seals with the proper installer (refer to OIL SEALS in this subsection).

Main Shaft and Shift Forks

Install NEW snap rings.

NOTE: Ensure snap rings are installed in the grooves properly.

Install free pinion (REVERSE range gear) and shifting sleeve (LOW/REVERSE range gear) properly.

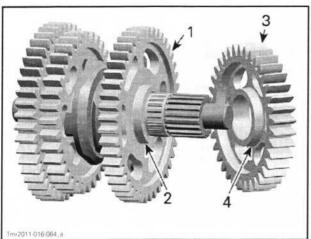


- Main shaft 1.
- Free pinion (REVERSE range gear) 2.
- 3. Snap ring
- Shifting sleeve (LOW/REVERSE range gear) 4. 5

Shifting dogs (REVERSE range gear)

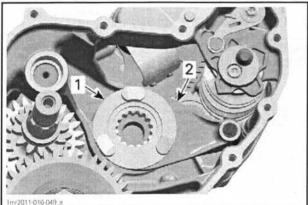
Collars of free pinion (LOW range gear) and free pinion (HIGH range gear) must point together.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



- Free pinion (LOW range gear), 44 T
- 1. Free p 2. Collar 3. Free p 4. Collar
- Free pinion (HIGH range gear), 36 T

Place shifting sleeve (HIGH range gear) with shift fork in the center of on main shaft bearing in center housing.

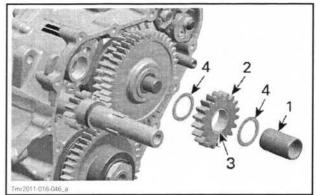


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Shifting sleeve (HIGH range gear) Shift fork

Carefully fit main shaft assembly with shift fork (LOW/REVERSE range gear) into inner splines of shifting sleeve (HIGH range gear).

Install reverse intermediate gear.



Bearing pin 1

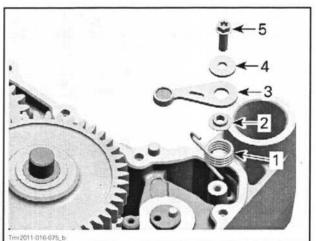
- Reverse intermediate gear Needle bearing 2.3
- 4 Thrust washers

Finally engage shift forks in shift drum and install shift fork shaft.

NOTE: Run all gears as a final function check before installing left housing.

#### Index Lever and Index Washer

Fit step ring into index lever.



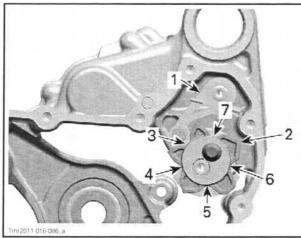
1. Index spring

- Step ring
- 2.3. Index lever
- 4. Washer Screw

Install index washer on shift drum.

Insert a flat screwdriver in the slot of the index lever, turn screwdriver clockwise and engage lever in index washer in neutral position as per following illustration.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



- 1. Index lever
- 2. Index washer
- 3. Neutral position 4. High range gear position
- 5. Low range gear position
- 6. Parking position
- 7. Reverse range gear position

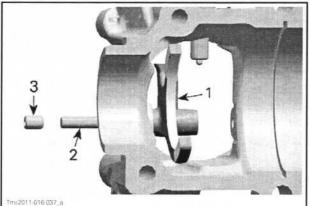
#### Output Shaft and 4x4 Coupling Mechanism

Install coupling sleeve onto the output shaft.

Place the output shaft with oil seal and coupling sleeve into the center housing.

**NOTE:** If same oil seal is installed, turn oil seal 90° offset to its original position to avoid leakage at housing mating surface.

Install coupling fork, coupling fork shaft and set screw in right cover before applying sealant to the mating surface.



1. Coupling fork

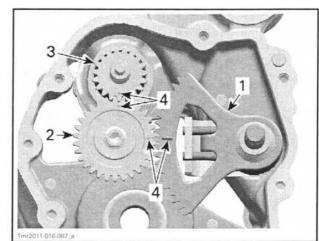
2. Coupling fork shaft 3. Set screw

#### 3. Set screw

#### Shift Shaft and Shift Drum

Install shift drum and shift shaft.

Install shifting intermediate gear. Align its marks with the marks on shift drum gear and shift shaft.



1. Shift shaft assembly

- 2. Shifting intermediate gear
- 3. Shift drum gear 4. Marks

Engage both shift fork pins in their corresponding groove on the shift drum.

Install shift fork shaft.

NOTE: Turn gears to validate proper operation.

#### Sealing Compound Application

**NOTE:** Unless otherwise specify, the procedure to apply the sealant is the same for right or left cover.

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).

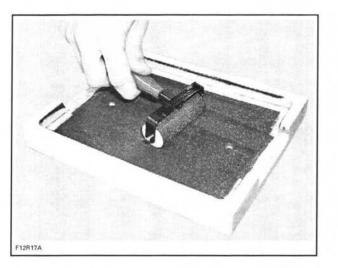
**NOTICE** Do not wipe with rags. Use a new clean hand towel only.

**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 mm - 75 mm (2 in - 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.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)



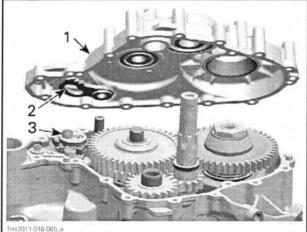
Do not apply in excess as it will spread out inside gear housing.

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).

#### Left Cover

Apply sealing compound on mating surfaces of central housing. Refer to SEALING COMPOUND APPLICATION.

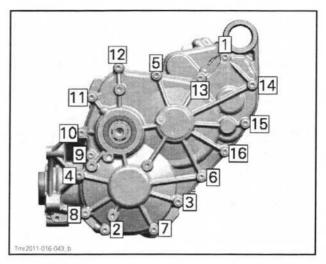
At installation of left cover, engage parking lock lever slot onto index washer pin.



Left cover

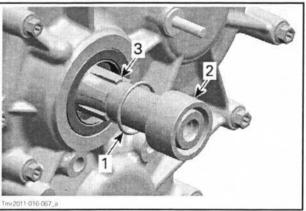
- Parking lock lever slot
- 3. Index washer pin

Install all screws on left cover and tighten them as per following sequence.



Install O-ring including distance sleeve on countershaft CVT side.

NOTICE Place O-ring including distance sleeve right away. Chamfered bore of distance sleeve has to face the gearbox.



COUNTERSHAFT END CVT SIDE

- O-ring
- Distance sleeve 2. Countershaft end CVT side

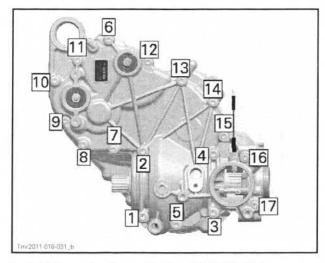
#### **Right Cover**

Apply sealing compound on mating surfaces of central housing. Refer to SEALING COMPOUND APPLICATION.

To install the right cover align the coupling fork with the groove in the coupling sleeve.

Install all screws on right cover and tighten them as per following sequence.

Subsection 11 (GEARBOX AND 4X4 COUPLING UNIT)

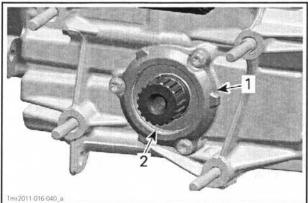


Install the actuator, refer to ACTUATOR.

#### Gearbox Installation

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

Before gearbox installation check O-ring in bearing cover if brittle, hard or damaged. Replace if necessary.

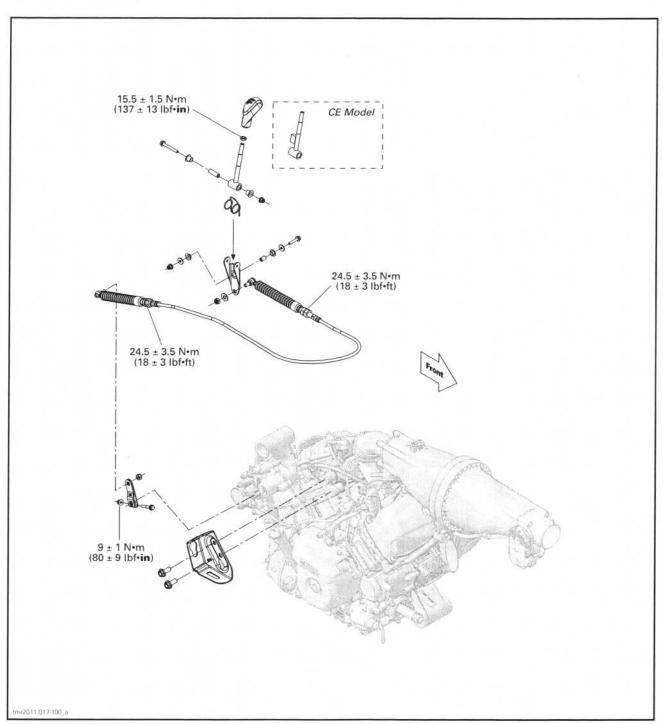


1. Bearing cover 2. O-ring

After installation refill gearbox oil, refer to *PERI-ODIC MAINTENANCE PROCEDURES*.

### Section 02 ENGINE, CVT AND GEARBOX Subsection 12 (SHIFTER)

# SHIFTER



Subsection 12 (SHIFTER)

# GENERAL

Before performing any servicing on shifter system, be sure the shift lever is on **NEUTRAL** position and the vehicle is secured using wheel blocks.

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.

## A WARNING

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

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

# PROCEDURES

# SHIFT LEVER

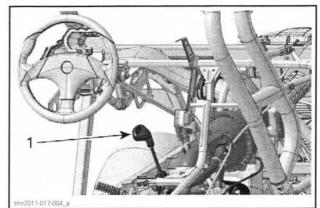
#### Shift Lever Access

- 1. Refer to *BODY* subsection and remove the following components:
  - Seats
  - Lower console
  - RH and LH lateral console panels.

**NOTE:** Move upper console upwards to access to lower console.

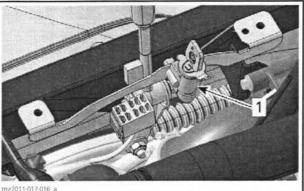
## Shift Lever Removal

- 1. Remove body parts as required. Refer to *SHIFT LEVER ACCESS* in this subsection.
- 2. Place shift lever in NEUTRAL position.
- 3. Secure vehicle using wheel blocks.
- 4. Unscrew shift lever handle.



1. Shift lever handle

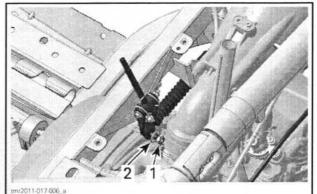
5. On CE models, remove locking device from vehicle.



CE MODELS

1. Locking device

Detach shifter cable from shift lever by removing nut and washer.

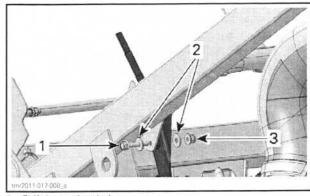


. Shift lever nut

2. Shift lever washer

7. Remove shift lever pivot bolt, washers and nut.

Subsection 12 (SHIFTER)



- Shift lever pivot bolt
   Shift lever pivot washers
- 2. Shift lever pivot wash 3. Shift lever pivot nut
- 8. Remove shift lever.

#### Shift Lever Inspection

Check shift lever for bending or cracks.

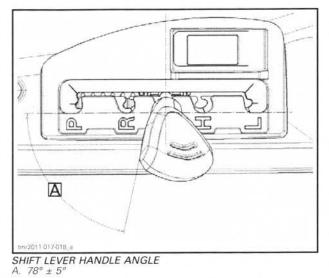
Check spring and bushing condition.

Replace all damaged parts.

#### Shift Lever Installation

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

Adjust shift lever handle as per the following illustration.



Tighten shift lever handle nut to specification.

SHIFT LEVER HANDLE NUT TORQUE
15.5 N•m ± 1.5 N•m (137 lbf•in ± 13 lbf•in)

Adjust shifter cable, refer to *SHIFTER CABLE AD-JUSTMENT* in this subsection.

Check if shift lever works properly in all positions.

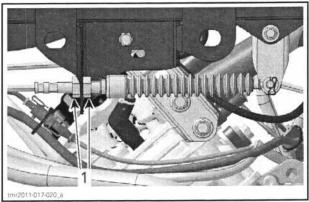
# SHIFTER CABLE

#### Shifter Cable Adjustment

1. Place shift lever in NEUTRAL position.

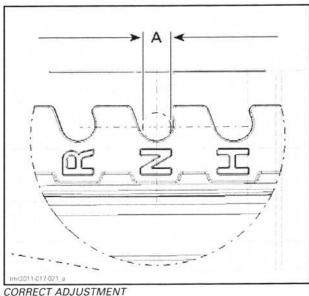
**NOTICE** Move vehicle back and forth to ensure gearbox is set in neutral position.

- 2. Secure vehicle using wheel blocks.
- 3. Remove body parts as required. Refer to *SHIFT LEVER ACCESS* in this subsection.
- 4. Loosen cable adjustment nuts.



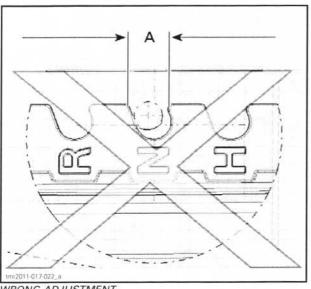
1. Adjustment nuts

Adjust cable nuts in order to center shift lever in neutral notch.



A. Shift lever centered in neutral notch

Subsection 12 (SHIFTER)

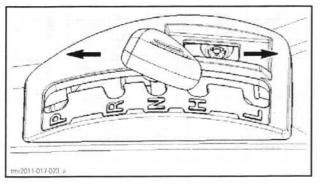


WRONG ADJUSTMENT A. Shift lever centered in neutral opening

6. Tighten cable adjustment nuts to specification.

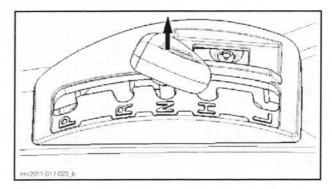
ADJUSTMENT NUTS TORQUE 24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

7. Move shift lever in R position then in H position.



- 8. Place shift lever in NEUTRAL position.
- 9. Check if shift lever is properly centered in neutral notch. Readjust as required.

NOTE: To properly check shift lever alignment into notch, move shift lever toward the RH side then let it return to position.



10. Test the shifter to confirm that the system works properly in all positions.

# 

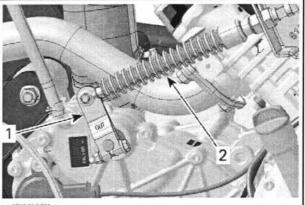
After adjustment, make sure that PARK position works properly.

# SHIFT PLATE

## Shift Plate Removal

NOTE: Do not remove shift plate needlessly.

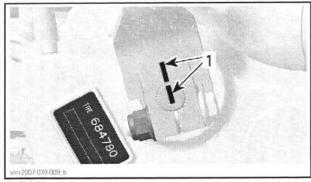
1. Remove shifter cable from shift plate.



2011-017-011

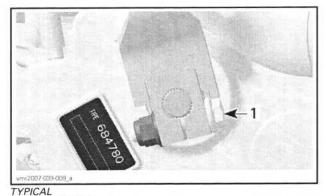
- 1. Shift plate 2. Shifter cable
- 2. Index shift plate and shift shaft.

Subsection 12 (SHIFTER)



TYPICAL

- 1. Trace a mark on both parts
- 3. Remove shift plate nut and bolt.



<sup>1.</sup> Shift plate bolt

4. Remove shift plate.

#### Shift Plate Inspection

Check shift plate for:

- Cracks
- Bending
- Spline condition.

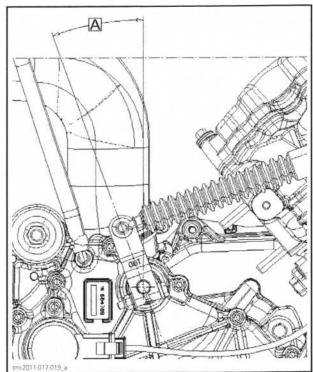
#### Shift Plate Installation

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

Place gearbox in **NEUTRAL** position before shift plate installation.

Install and align shift plate using marks previously traced.

If shift plate is installed on a new engine, adjust it as per the following illustration.



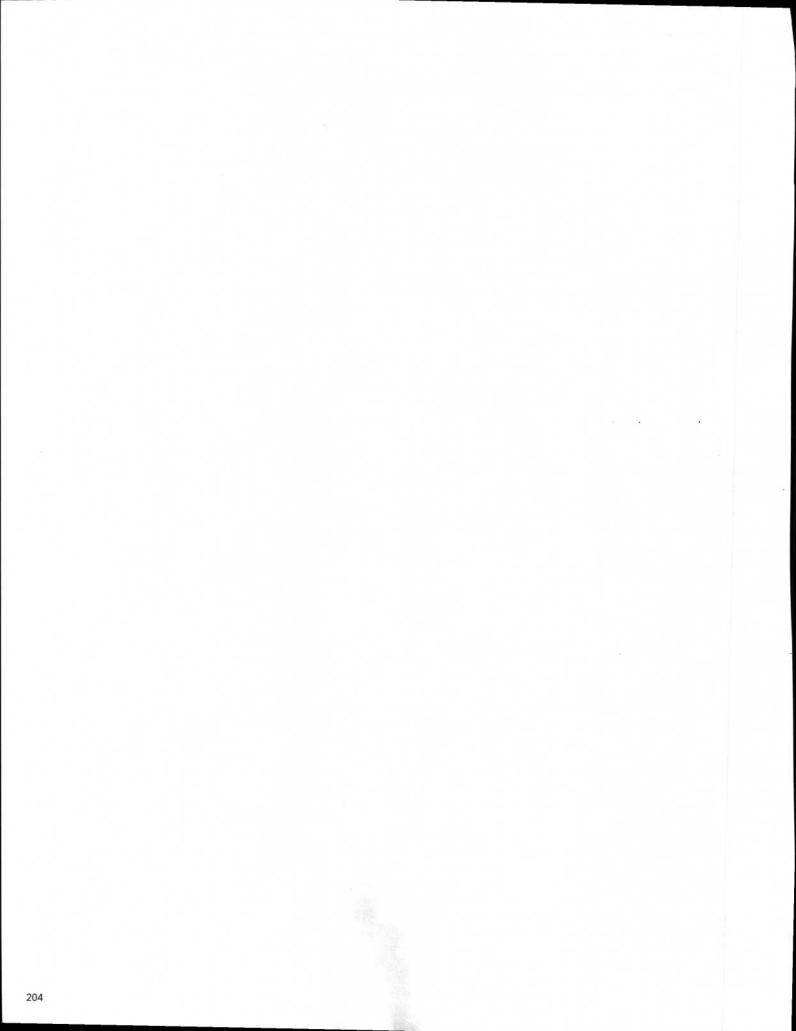
SHIFT PLATE ANGLE FROM VERTICAL PLANE A. 20° ± 2.5°

Adjust shifter cable, refer to SHIFTER CABLE AD-JUSTMENT in this subsection.

Tighten shift plate nut to specification.

SHIFT PLATE NUT TORQUE

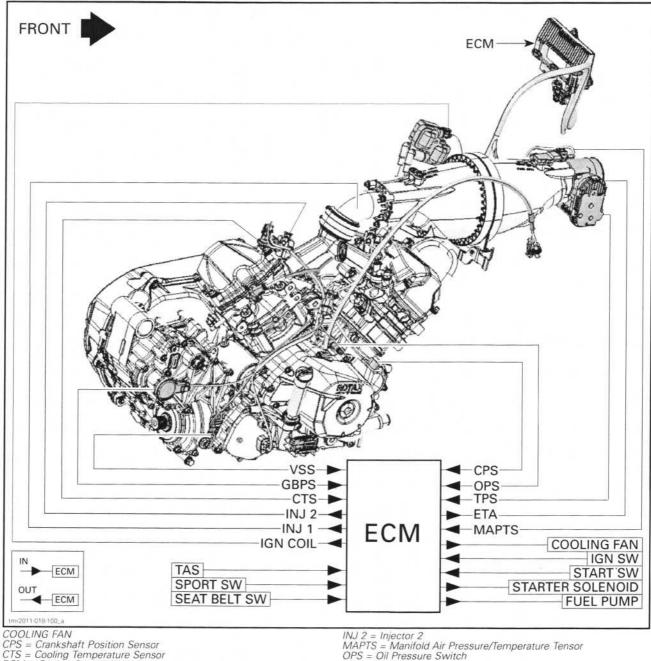
9N•m ± 1N•m (80 lbf•in ± 9 lbf•in)



# Section 03 ELECTRONIC MANAGEMENT SYSTEM

Subsection 01 (ENGINE MANAGEMENT SYSTEM (EMS))

# **ENGINE MANAGEMENT SYSTEM (EMS)**



CTS = Clarinstratic Fosition Sensor CTS = Cooling Temperature Sensor ECM = Engine Control Module ETA = Electric Throttle Actuator FRONT FUEL PUMP GBPS = GearBox Position Sensor IGN COIL = Ignition coil IGN SW = Ignition switch IN = Input INJ 1 = Injector 1 MAPTS = Manifold Air Pressure/Temperature Tensor OPS = Oil Pressure Switch OUT = Output SEAT BELT SWITCH SPORT SWITCH STARTER SOLENO!D SW = Switch TAS = Throttle Accelerator Sensor TPS = Throttle Position Sensor VSS = Vehicle Speed Sensor Subsection 01 (ENGINE MANAGEMENT SYSTEM (EMS))

# GENERAL

# SYSTEM DESCRIPTION

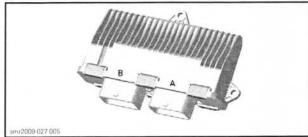
A highly advanced engine management system (EMS) is used to ensure a high power output with cleaner combustion.

There are 7 main systems that are controlled by the engine management system (EMS):

- 1. Electronic Fuel Injection (EFI)
- 2. Intelligent throttle control
- 3. Cooling system (cooling fan)
- 4. Ignition system
- 5. Starting system
- 6. Fuel pump system
- 7. D.E.S.S. system.

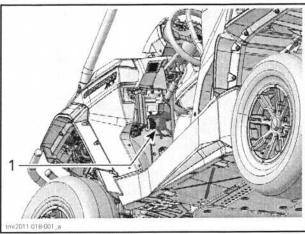
**NOTE:** For further information related to these systems, refer to the applicable subsection.

The ECM (Engine Control Module) is the central point of the engine management system.



TYPICAL - ECM

The ECM is located under the dashboard on the driver's side, above the control pedals.



TYPICAL - ECM LOCATION 1. ECM location

The ECM reads input signals from various switches, controls, and sensors, that it compares to pre-determined parameters, makes computations, and provides control signal outputs required for proper engine management.

The ECM also interacts through CAN bus with the gauge module for various functions, information exchange and display of messages. Refer to *CONTROLLER AREA NETWORK (CAN)* and *LIGHTS, GAUGE AND ACCESSORIES* subsections.

The ECM also features a permanent memory that will store the information on the various ignition keys programmed to the vehicle, fault codes, customer information, and other engine information, even when the battery is removed from the vehicle.

### **Diagnostic Mode**

The ECM features a self-diagnostic mode that is activated on system power up (ignition key ON) for certain systems and components, and when the engine is running for others. Refer to *DIAG-NOSTIC SYSTEM AND FAULT CODES* subsection for more information.

#### Monitoring System

The MONITORING SYSTEM monitors various electrical and electronic components of the engine control systems such as the:

- ETA (Electric Throttle Actuator)
- TPS (Throttle Position Sensor)
- TAS (Throttle Accelerator Sensor)
- ECM (Engine Control Module).

The engine management system provides for redundancies in these components should a failure or partial failure occur to which it will adjust system operation to protect the vehicle and most of importantly, the driver.

Should the engine management system not respond (or not respond correctly) to a failure, then the monitoring system will react to ensure vehicle and driver safety.

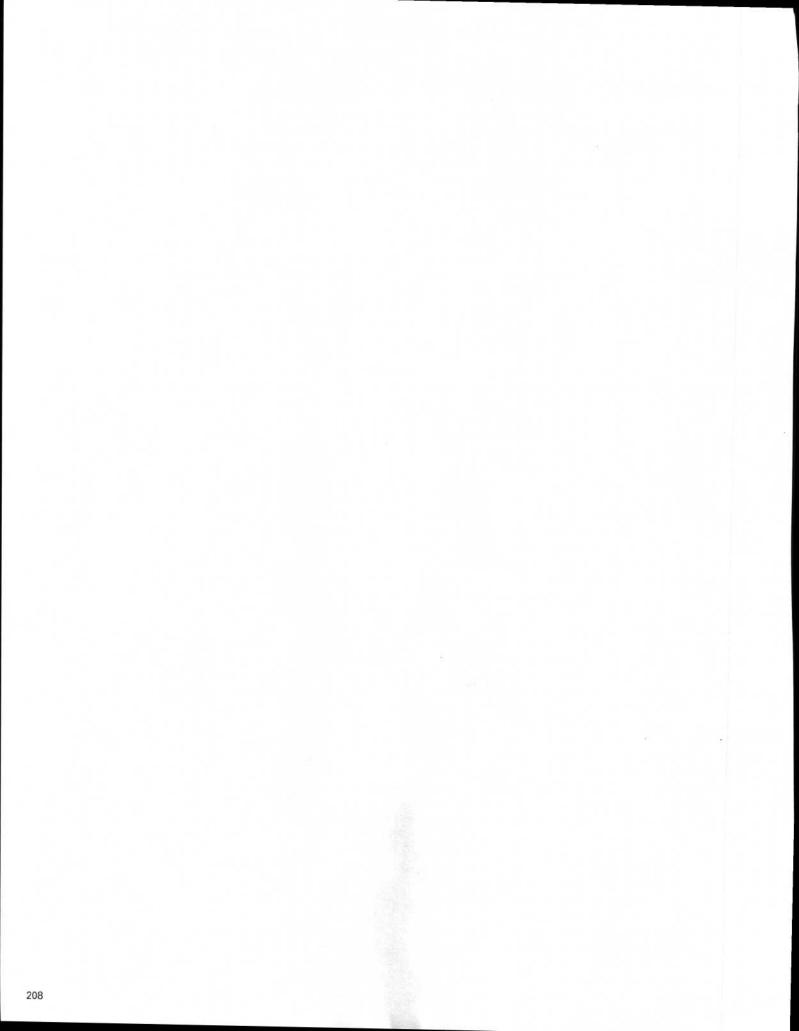
The monitoring system therefore ensures the engine management system is functioning correctly.

#### Limp Home Mode

The ECM may automatically put the engine in LIMP HOME MODE using default parameters when certain major faults are detected. LIMP HOME MODE may also be manually engaged

# Section 03 ELECTRONIC MANAGEMENT SYSTEM Subsection 01 (ENGINE MANAGEMENT SYSTEM (EMS))

under certain fault conditions. For more information, refer to *DIAGNOSTIC SYSTEM AND FAULT CODES*.



# COMMUNICATION TOOLS AND B.U.D.S.

# SERVICE TOOLS

Description	Part Number	Page
MPI-2 DIAGNOSTIC CABLE	710 000 851	
MPI-2 INTERFACE CARD	529 036 018	

# SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
MALE-FEMALE EXTENSION SERIAL CABLE	DB9	

# GENERAL

Refer to *PROCEDURES* for instructions on the communication tools.

If communication problems occur, refer to *TROU-BLESHOOTING* in this subsection.

# TROUBLESHOOTING

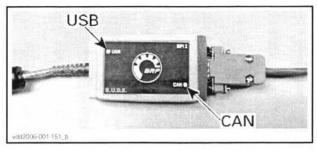
# DIAGNOSTIC TIPS

**IMPORTANT:** Make sure all connections are made and vehicle is powered up **before starting B.U.D.S.** to allow proper communication between the vehicle and B.U.D.S. software.

# MPI-2 Connection Troubleshooting

#### MPI-2 Status Lights

The MPI-2 includes 2 status lights that indicate the connection condition: USB and CAN. Both lights must be GREEN for the MPI-2 to function properly. Otherwise, refer to the following charts.



#### Prerequisite for USB Communication:

- PC Computer turned on.
- MPI-2 connected to PC computer.

USB LIGHT		
STATUS	WHAT TO DO	
Light is OFF	<ul> <li>Check USB connection between MPI-2 and PC computer.</li> <li>Check USB operation on PC computer (hardware or Windows drivers).</li> </ul>	
Light is GREEN	<ul> <li>Connections are GOOD.</li> <li>Communication can take place on USB side.</li> </ul>	

#### Prerequisite for CAN Communication:

- MPI-2 connected to diagnostic connector on vehicle.
- ECM turned on (electrical system powered up without engine started).
- Ignition key installed and turned to ON.
- B.U.D.S. started and logged on.

CAN LIGHT				
STATUS	WHAT TO DO			
Light is OFF	Check connection between MPI-2 and diagnostic connector on vehicle.			
Light is RED	Check CAN wires/connectors on vehicle.			
Light is GREEN	Connections are GOOD. Communication can take place on CAN side.			

# Section 03 ELECTRONIC MANAGEMENT SYSTEM

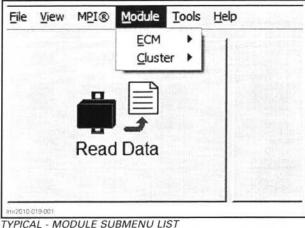
Subsection 02 (COMMUNICATION TOOLS AND B.U.D.S.)

## **Communication Problems when Using** B.U.D.S.

### **Missing Module**

If one or more "ECU" is (are) not communicating with the MPI, a module(s) may not be powered or may be defective.

- 1. To see which module is missing in B.U.D.S., first select the Read Data button at the top of the B.U.D.S. page.
- 2. Then click on Module in the menu bar to expand its submenu.
- 3. Look at the list of modules in the submenu. If a module is not visible in the submenu list, then it is not communicating with the MPI.



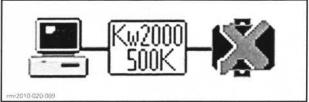
MOL	DULE LIST
MODULES	VEHICLE MODEL
ECM	Commander 800R and
Cluster	1000 models

- 4. Ensure the missing module is properly connected.
- 5. If the module is connected, remove the connector from the module and test for the following:
  - Proper input voltage to the module
  - Ground circuit continuity
  - CAN bus continuity.

Refer to the applicable WIRING DIAGRAM or appropriate subsection for details.

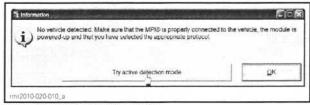
#### No Vehicle Detected

If an "X" is shown in the status bar and the protocol tool is blinking between Kw2000 500K and Kw2000, it means that no "ECU" is communicating with the MPI.



TYPICAL

- 1. Check connections between the PC computer and the vehicle.
- 2. Activate the vehicle electrical system without starting the engine. Refer to POWER DISTRI-BUTION SYSTEM subsection.
- 3. Ensure both USB and CAN lights on the MPI-2 are GREEN. Refer to MPI-2 CONNECTION TROUBLESHOOTING subsection.
- 4. If B.U.D.S. is trapped in a loop that continually displays the following message box, press on the Try active detection mode button in the message box. This will test if there is communication with the vehicle.



TRY ACTIVE DETECTION MODE

#### Message Box: "Some of the Information Normally Displayed ... "

If the following message box is displayed in B.U.D.S.:

1	Some of the information normally displayed will be missing due to communication error with the ECM.
	OK I

1. Click on the OK button in the box.

2. Click on the Read Data button in B.U.D.S.

## Message Box: "Engine must be Stopped..."

If the following message box is displayed in B.U.D.S .:

#### Section 03 ELECTRONIC MANAGEMENT SYSTEM Subsection 02 (COMMUNICATION TOOLS AND B.U.D.S.)

0	Engine must be a requested	topped or conditions not correct for the service you
		Data

- 1. Click on the Cancel button in B.U.D.S.
- 2. Continue with the procedure undertaken prior to the appearance of the message box.

# PROCEDURES

# MPI-2

The MPI-2 (Multi-Purpose Interface-2) in conjunction with the MPI-2 diagnostic cable is used with B.U.D.S. software to communicate with the ECM (engine control module) and other modules.

#### MPI-2 Power

The MPI-2 interface card uses the power from the PC computer's USB port.

#### **Diagnostic Connector Location**

The 6-pin diagnostic connector is located under the dashboard on the driver's side. It is stored in it's protective cap on the lower RH side of the battery rack.



1. Diagnostic connector

**NOTE:** Do not mismatch the diagnostic connector with the one on the LH side of the battery rack. This connector has only 2 wires attached to it and is for manufacturer's use only.

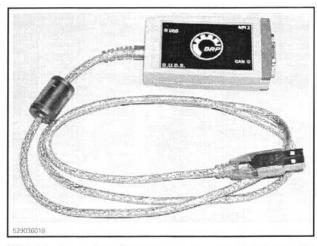
## Connecting the PC to the Vehicle

- 1. Locate the 6-pin diagnostic connector, refer to *DIAGNOSTIC CONNECTOR LOCATION* in this subsection.
- 2. Disconnect the 6-pin diagnostic connector from it's holder (protective cap).
- Connect one end of the MPI-2 DIAGNOSTIC CA-BLE (P/N 710 000 851) to the vehicle connector.



1. Diagnostic cable connected to vehicle

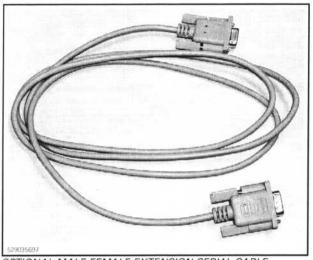
4. Connect the other end of diagnostic cable to the MPI-2 INTERFACE CARD (P/N 529 036 018).



**NOTE:** An optional MALE-FEMALE EXTENSION SE-RIAL CABLE (P/N DB9) available at electronic retail outlets can be used between diagnostic cable and MPI-2 interface. Do not exceed 7.6 m (25 ft).

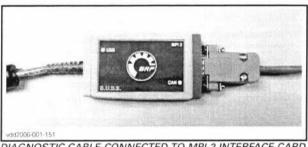
#### Section 03 ELECTRONIC MANAGEMENT SYSTEM

Subsection 02 (COMMUNICATION TOOLS AND B.U.D.S.)

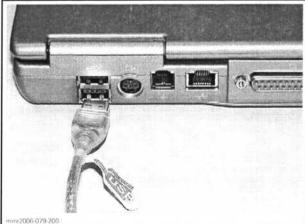


OPTIONAL MALE-FEMALE EXTENSION SERIAL CABLE

5. Connect the MPI-2 INTERFACE CARD (P/N 529 036 018) to the USB port of a PC (personal computer).



DIAGNOSTIC CABLE CONNECTED TO MPI-2 INTERFACE CARD



MPI-2 INTERFACE CARD CONNECTED TO USB PORT

6. 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 allow programming key(s) to the vehicle, allow electrical and electronic component monitoring, activation of certain components for diagnostic purposes, and to carry out setting changes.

For more information pertaining to the use of the B.U.D.S. software, use its Help menu which contains detailed information on its functions.

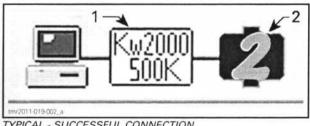
Always use the latest applicable B.U.D.S. version available on BOSSWeb.

## How to Establish Communication Using B.U.D.S. Software

**IMPORTANT:** Ensure all connections have been made before starting B.U.D.S. to allow proper operation. Refer to MPI-2 in this subsection.

- 1. Turn ignition switch to ON using any of the keys provided with the vehicle. Do not start the engine.
- 2. Start B.U.D.S. and logon.
- 3. Ensure the status bar shows the Kw2000 (500K) protocol and the appropriate number of modules to its right according to the vehicle model.

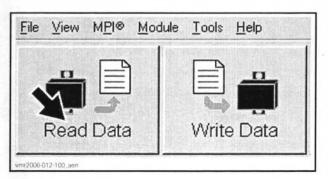
VEHICLE MODEL	PROTOCOL	NUMBER OF MODULES
Commander 800R and 1000	Kw2000 (500K)	2



TYPICAL - SUCCESSFUL CONNECTION

Connection protocol Number of modules read

4. Read ECUs by clicking the Read Data button.



B.U.D.S. is now ready to use.

## Section 03 ELECTRONIC MANAGEMENT SYSTEM

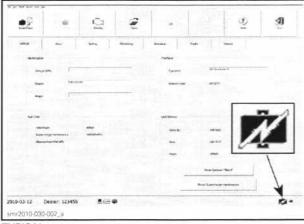
Subsection 02 (COMMUNICATION TOOLS AND B.U.D.S.)

When clicking on the **Read Data** button, B.U.D.S. will read the cluster and the ECM modules through CAN bus.

#### Electronic Modules ("ECU") Updates

**NOTICE** Failure to strictly follow a procedure to update a module may permanently damage the module.

Whenever B.U.D.S. is started, check for an update icon in the B.U.D.S. status bar.

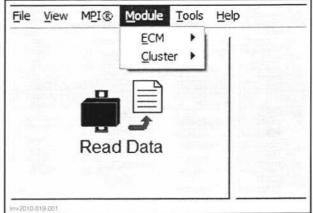


TYPICAL

If the icon is visible, it indicates that a file is available in B.U.D.S. to update at least one of the electronic modules:

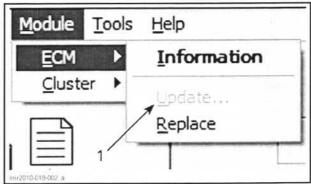
**NOTE:** If an update file is available on BOSSWeb but the B.U.D.S. software being used is not up to date, the update icon will not appear. Refer to the Service Bulletins to see if there is an update available.

Use the **Module** submenu and check all modules one at a time to see which module(s) can be updated.



TYPICAL - MODULE SUBMENU LIST

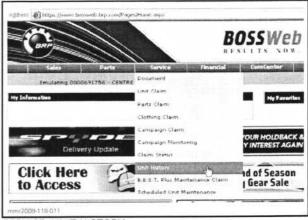
- 1. If the **Update** option is **greyed out**, no update file is available for this module.
- 2. If the **Update** option is **black**, an update file is available for this module.



<sup>1.</sup> Greyed out: No update to perform

Black: Update file available

Before applying an update, log onto BOSSWeb and look in **Service** menu for the **Unit history** to find out if any information or publication related to the vehicle is available. If so, carefully follow the given instructions.



SERVICE, UNIT HISTORY

#### Section 03 ELECTRONIC MANAGEMENT SYSTEM Subsection 02 (COMMUNICATION TOOLS AND B.U.D.S.)

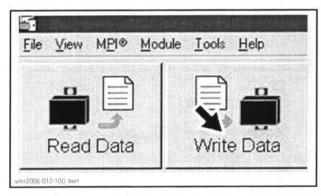
**NOTE:** When selecting the update menu in B.U.D.S., a dialog box will appear and the update file description may give some clue to finding the vehicle-related information in BOSSWeb.

(core)e	Date	Description	File Maria
X8-8X2-8X7 XXXXXXXXX	2008 xx xx	xxx Snowmobile Calibration update	*** *** *** to
Add Ubdate		Circum	Hone Details

1. File description

## Writing Changes (Saving) to a Module

1. When making a data or setting change in a module using B.U.D.S., save the new data (or setting) in the module by clicking the **Write Data** button.



**NOTE:** If the word **Modified** appears in the vehicle file identification number at the top of the B.U.D.S. page, then a change has been made that requires selecting the **Write Data** for the change to be saved.

		in the second second	1~	1
		1 5		1 1
Read Data	White Data	Stating	Open	5446
Vehicle	Settino	Monitoring	Activation	Faults

1. Indicate setting or data modified; Write Data to save

2. After the write data operation, turn the ignition key to the OFF position.

Disconnect MPI connections and store the vehicle diagnostic connector in its protective cap.



1. Diagnostic connector in its storage cap

**NOTICE** Failure to secure the diagnostic connector in its protective cap may result in corrosion or other damage to the terminals.

NOTE: There is a 120  $\Omega$  resistor in the protective cap to minimize the possibility of communication error.

# DIAGNOSTIC SYSTEM AND FAULT CODES

# GENERAL

# DIAGNOSTIC SYSTEM

The EMS features a diagnostic system that self-diagnoses various electrical and electronic components. This mode becomes active when the ignition key is turned ON.

**NOTE:** Some components require the engine to be running for them to be monitored for normal operation (fuel injectors for example).

The diagnostic system continuously validates that the components (control modules, sensors and actuators) are not faulty or defective. When a malfunction is detected, the related electronic module(s):

- Sets an active fault code.
- Adapts the proper protection strategy according to the failure.
- Sends out signals to the multifunction gauge to inform the rider of a particular condition.

If a minor fault occurs, the engine and vehicle will continue to operate without noticeable loss of performance. If a more important fault occurs, engine RPM may be limited. The engine/vehicle will continue to operate with reduced performance.

If a major component of the EMS fails, engine RPM will be limited as well as vehicle speed.

These strategies are used to protect engine/electrical system from damage and to maintain safe operation of the vehicle. In extreme cases, the engine may also be completely shut down.

#### Pilot Lamps

When a problem is detected, a pilot lamp will turn on or blink in the multifunction gauge. If the fault that caused the pilot lamp to come on is momentary, the pilot lamp may turn off automatically, or may need to be reset by powering down the vehicle and then restarting it.

A message may also be displayed to provide additional information related to the fault that turned on the pilot lamp. Refer to the following chart.

PILOT	LAMP	MULTIFUNCTION GAUGE MESSAGE	CAUSE	ADDITIONAL INFORMATION
	ON	ні темр	Engine is overheating.	Turns on when engine temperature reaches 114°C (237°F).
	ON	CHECK ENGINE	An engine management component is not functioning properly.	A fault code is active or has been activated that requires attention. No engine limitation.
Ē	Blinks	LIMP HOME	An important engine management component is not working properly.	An active fault code pertaining to a critical engine function has been activated that requires attention as soon as possible. Engine behavior is modified or engine RPM is limited to protect engine.
	ON	PARK BRAKE (Early production models)		Turns ON when brake switch is activated continuously for 15 seconds. Brake pressure felt at switch or switch failed in closed position.
	ON	BRAKE ACTIVATION (Later production models)		Turns ON when brake switch is activated continuously for 15 seconds above 5 km/h (3 MPH). Brake pressure felt at switch or switch failed in closed position.
"E" displa	ayed inste	ead of selected gear.	GBPS fault or related part.	GBPS signal fault or communication error.

## Limp Home Mode

When a major component of the EMS is not operating properly, limp home mode will be set.

Engine RPM will be limited and/or engine behavior and control may be modified depending on the cause of the failure.

This mode allows the rider to return home, which would otherwise not be possible without this advanced system.

LIMP HOME will be displayed in the multifunction gauge and the CHECK ENGINE light symbol will be on in the gauge.

# FAULT CODES

A fault code is an indication that a glitch or malfunction is detected by the monitoring system of the vehicle.

A fault code consists of 5 digits that starts by a letter followed by a 4 digit code that may be comprised of numbers and/or letters. The first letter defines the type of fault code while the remaining digits refer to a unique fault.

There are 2 types of fault codes used on the vehicle:

- "P" for power train and related system faults (Pxxxx)
- "U" for communication faults (Uxxxx)

There are 2 modules that generate and store the fault codes:

- ECM (Engine Control Module)
- Multifunction Gauge.

The ECM stores mainly "P" codes and some "U" codes.

The multifunction gauge stores a few "P" and "U" codes.

When many fault codes that may or may not be related to a specific system are set at the same time, it is likely to be the result of low battery voltage, a burnt fuse(s) or a faulty relay.

**NOTE:** The faults detected are saved in the ECM (Engine Control Module) or multifunction gauge even if the battery is disconnected.

## Fault Code States

Fault codes have 3 possible states:

- Active state
- Occurred state
- Inactive state.

All types of fault codes may be viewed in the Faults page of B.U.D.S. Only fault codes in an active state may be viewed in the multifunction gauge.

#### Active Fault Codes

An active fault code is an indication of a fault that is presently active. The active fault may or may not compromise normal operation of the system(s) in question as indicated by the fault code(s). Service action should be taken to correct the problem that caused the fault code.

Once the cause of the active fault is corrected, the fault code must be cleared using B.U.D.S. to prevent it from being retained in memory.

#### **Occurred Fault Codes**

An occurred fault code indicates a fault that was active, but no longer is. The occurred fault does not presently affect system or component operation but is retained as a history of the faults that were detected.

The fault may have been generated due to a system or component that was momentarily operating outside normal parameters. Repeated occurred faults of this type should be considered when troubleshooting a problem, and may require that maintenance action be taken.

An occurred fault may also be generated when disconnecting and reconnecting a component, replacing a burnt fuse, when the software update of an electronic module has been carried out, or may be due to a momentary high or low voltage.

#### **Inactive Fault Codes**

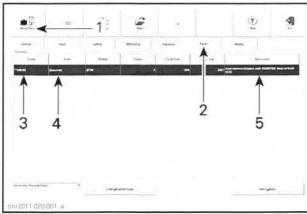
An inactive fault code represents a fault code that is neither active, nor occurred. It is simply part of a list of all possible faults that can be monitored by the ECM and multifunction gauge, which may become active or occurred if the monitoring system detects an applicable fault. These codes can be viewed in B.U.D.S.

# How to Read Fault Codes Using B.U.D.S. Software

- 1. Connect vehicle to the applicable version of B.U.D.S. software, refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
- 2. Click on the Read Data button.
- 3. Select the Faults tab.

## Section 03 ELECTRONIC MANAGEMENT SYSTEM

Subsection 03 (DIAGNOSTIC SYSTEM AND FAULT CODES)



- Read Data button
- Faults page tab Recorded fault code
- 3. Fault code state 4
- 5. Fault code description

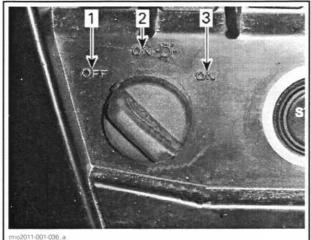
For more information pertaining to the fault codes and report, refer to B.U.D.S. online help.

#### How to Read Fault Codes Using the Multifunction Gauge

A fault code must be active to be displayed in the multifunction gauge. If a fault code is occurred, it must be read using B.U.D.S.

#### Analog/Digital Gauge

Proceed as follows to view the active fault codes: 1. Turn ignition key to ON with lights position.

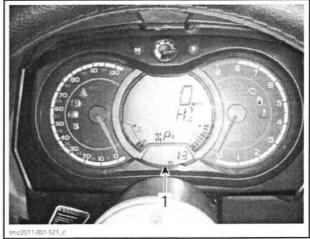


IGNITION SWITCH POSITION

- 1. OFF 2. ON with lights (turn key to this selection) 3. ON
- 2. Wait for the multifunction gauge to complete its self test function.
- 3. Press the S (set) button repeatedly until Hr (hour) is displayed in the secondary digital display.



M (mode) button 2 S (set) button (pressed repeatedly to toggle secondary display)



Toggle this digital display to Hr

4. Press and hold the M (mode) button while quickly toggling the HI - LO beam switch to enter the fault code display function.

NOTE: A minimum of 3 HI - LO toggles must be completed within 2 seconds.

#### Section 03 ELECTRONIC MANAGEMENT SYSTEM

Subsection 03 (DIAGNOSTIC SYSTEM AND FAULT CODES)



Low/High beam headlight switch

If a fault code is active, it will be displayed in the main digital display.

If no fault code is active, a scrolling NO ACTIVE FAULT CODE message will be displayed.

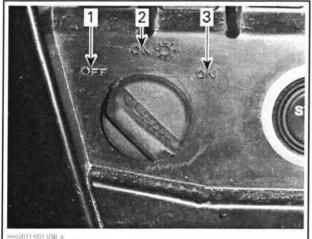
If there are multiple fault codes, the display will cycle through each fault code repeatedly. A maximum of 10 fault codes may be displayed.

If the fault code display function has been interrupted by another message, a fault code(s) may not have been displayed. Repeat the fault code display procedure to view all active fault codes.

To exit the fault code display function, press both the M and S buttons simultaneously.

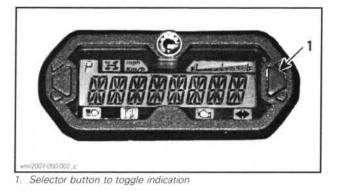
#### LCD Gauge

1. Turn ignition key to ON with lights position.



IGNITION SWITCH POSITION OFF 2. ON (with lights) 3. ON

2. Press the selector button on the gauge repeatedly until Engine Hour (EH) is displayed on the gauge.





TYPICAL - EH (ENGINE HOUR DISPLAY)

3. Press and HOLD the M button while QUICKLY toggling HI - LO beam switch to enter the fault code display function.

NOTE: A minimum of 3 HI - LO toggles must be completed within 2 seconds.



Low/High beam headlight switch to toggle quickly

If no P-Code is active, a "No Active P Codes" scrolling message will be displayed.

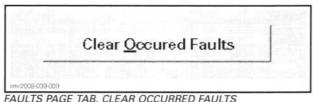
If there is an active P-Code, it will be displayed.

If there are multiple fault codes, the display will cycle through each fault code.

Once the last fault code is displayed, the gauge displays END then defaults back to normal operation.

# How to Clear Fault Codes Using B.U.D.S. Software

The fault(s) (occurred state only) can be cleared by pressing the **Clear Occurred Faults** button in B.U.D.S.



This will reset the appropriate counter(s) and will also record that the problem has been fixed in the related ECU memory.

**NOTE:** An active fault code cannot be cleared. In other words, the problem relevant to the fault code must be repaired before the fault can be cleared.

# SPECIFIC FAULTS

# TPS Fault

A TPS fault may be considered to be a major fault as the TPS provides the most important feedback (2 signals) to the ECM on throttle position.

A TPS fault affects engine control as the throttle plate is moved by the ETA (electric throttle actuator) which, is controlled by the ECM (see *INTEL-LIGENT THROTTLE CONTROL (ITC)* subsection).

A TPS fault is generally followed by LIMP HOME mode and the engine is brought back to idle, or may be completely shutdown.

# Low Battery Voltage Fault

If the battery voltage is low when the engine is running at idle RPM, the ECM will command an increase in RPM to a set value, thereby increasing the charging system output in order to prevent the battery from being discharged, and to allow normal system operation.

### TAS Fault

If one TAS (throttle accelerator sensor) signal is missing, LIMP HOME MODE will be activated and the check engine light will come ON. Pressing and holding the OVERRIDE button will allow normal control of the accelerator pedal.

If both sensors in the TAS are at fault, a TAS FAULT message will appear in the gauge, the check engine light will come ON and the engine will run at idle. The accelerator pedal will not have any affect on engine RPM. However, the vehicle may be driven in LIMP HOME MODE by pressing the OVERRIDE button.

When limp home mode is engaged using the override button, a MANUAL LIMP HOME message will appear in the gauge. The OVERRIDE button can then be used as the accelerator, vehicle speed is controlled by pressing and/or releasing the button.

## PARK BRAKE Fault Message in Gauge

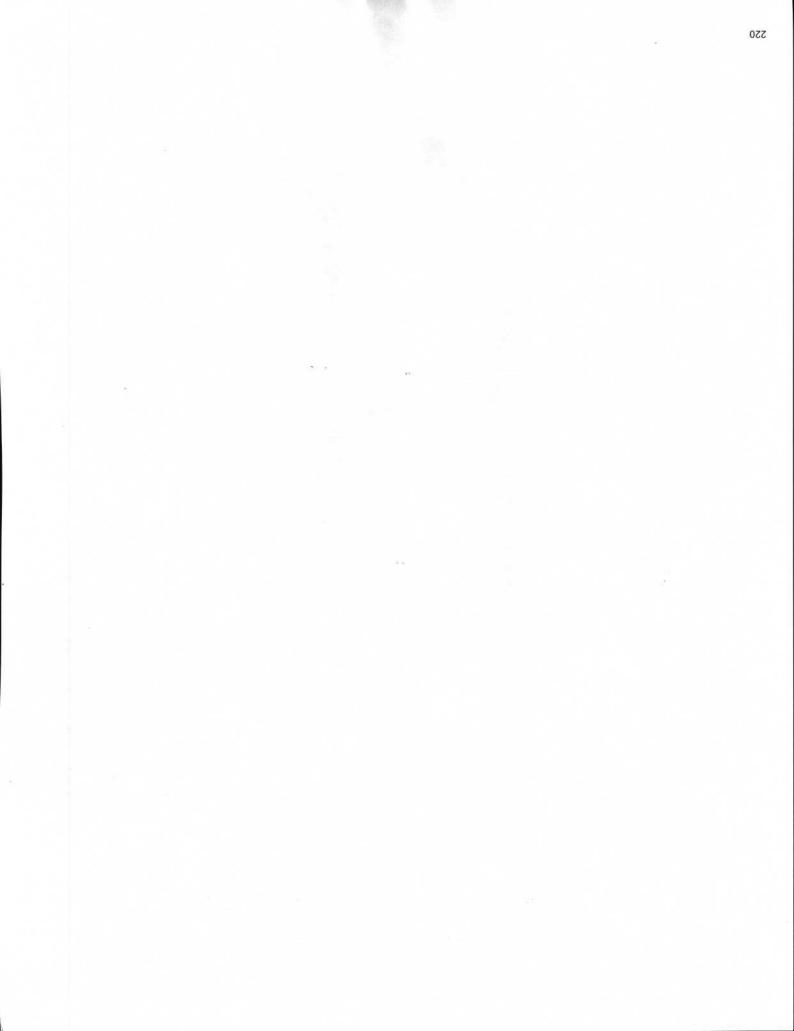
#### Early Production Models (Only)

Although this vehicle is not equipped with a park brake, a PARK BRAKE message will be displayed in the gauge if a brake signal is received continuously for 15 seconds.

# BRAKE ACTIVATION Fault Message in Gauge

#### Late Production Models

If a brake signal is received continuously for 15 seconds above 5 km/h (3 MPH), a BRAKE ACTIVA-TION message will be displayed in the gauge.



# INTELLIGENT THROTTLE CONTROL (iTC) GENERAL

# SYSTEM DESCRIPTION

The iTC is an electronic throttle control system that includes:

- Throttle accelerator sensor (TAS)
- Electric throttle actuator (ETA)
- Throttle position sensor (TPS).

The TAS is part of the accelerator pedal module. The ETA and TPS are comprised in the throttle body.

The iTC is often referred to as a "throttle by wire" system (no throttle cable is used).

According to the accelerator pedal position and other EMS inputs, the ECM powers the ETA motor using pulse width modulation (PWM), to control the throttle plate. When the ECM detects through the TPS that the throttle plate has reached the targeted position, the ECM stops the throttle actuator.

Depending on various conditions and the type of key used, the iTC can modify the ETA response, limit the engine torque or vehicle speed.

For torque limitation, the ECM processes the TAS input differently depending on the specific mode. In other words, the driver's demand may not necessarily result in the corresponding throttle opening.

For vehicle speed limitation, the iTC controls the throttle opening to maintain a maximum set speed even if the accelerator is pedal fully depressed.

# SYSTEM MAIN FEATURES

The use of the iTC allows the following features:

- Key modes
- Normal/Sport modes
- Override functions.

#### **Key Modes**

#### Normal Key

When a normal key is used, engine delivers approximately 70% of the accelerator pedal demand (less if normal mode is selected). Vehicle speed is limited to 70 km/h (43 MPH).

#### Performance Key

When a performance key is used, engine delivers 100% of the accelerator pedal demand (less if normal mode is selected). The vehicle speed is limited to 120 km/h (75 MPH).

#### Work Key (Option)

When a work key is used, engine delivers approximately 50% of the accelerator pedal demand (less if normal mode is selected). Vehicle speed is limited to 40 km/h (25 MPH).

#### Normal/Sport Modes

When sport mode is selected, the full potential of the specific ignition key is deployed except when gearbox is in reverse or low gear.

When normal mode selected, the full potential of the specific ignition key is not reached and the accelerator pedal response is smoother than in sport mode

#### **Reverse Override Function**

In reverse gear, engine delivers less than the accelerator pedal demand and vehicle speed is limited to 20 km/h (12 MPH). Also, the accelerator pedal response is smoother than in high gear.

If the override button is depressed, vehicle speed and engine acceleration are increased. Even with the override is activated, the ECM will not allow the engine to deliver 100% of the accelerator pedal demand.

# SYSTEM OTHER FEATURES

#### Driver's Seat Belt Monitoring

If driver's seat belt not fastened, speed is limited to approximately 15 km/h (9 MPH).

#### Brake Monitoring

If the ECM receives a brake switch signal while gearbox is in gear and the vehicle moving, the ETA will decrease throttle plate opening and engine speed will drop to idle.

NOTE: A defective brake light switch that would stay in a closed position would force the engine to run at idle.

# Low Range Operation

When gearbox is in low range, engine delivers less than the accelerator pedal demand and the accelerator pedal response is smoother than in high gear.

## Half Shaft Saver

In a case where the drive wheels would momentarily leave the ground while the driver holds the throttle, this mode protects the drive system.

The system will enter the half shaft saver mode if the ECM detects an excessive wheel acceleration rate. In such a case, the iTC will reduce the engine torque. When the wheels slow down, the system returns to normal mode.

# **Engine Temperature Monitoring**

If coolant gets too hot, engine will deliver less than the accelerator pedal demand. The limitation is proportional to the overheat degree.

## Battery Voltage Monitoring

If the battery voltage gets low, the engine idle RPM will be increased at approximately 1500 RPM.

## **Drowned Mode**

In case of a fuel flood, the engine can be cranked without fuel injection.

To enter the drowned mode, depress and hold accelerator pedal (at least 20% of the travel) while cranking engine.

# Limp Home Mode

When certain faults are occurring, the ECM will enter the limp home mode. In this mode, the engine will deliver less than the accelerator pedal demand.

# PROCEDURES

# SPORT/NORMAL SWITCH

## Sport/Normal Switch Wire Information

FUNCTION	PIN	COLOR
Signal (to ECM B pin D4)	1	BROWN/GREEN
Ground through ECM (to ECM B pin A1)	2	ORANGE/VIOLET

# SEAT BELT SWITCH

#### Seat Belt Switch Wire Information

FUNCTION	PIN	COLOR
Signal (to ECM B pin E3)	1	YELLOW/GREY
Ground through ECM (to ECM B pin A1)	2	ORANGE/VIOLET

# **OVERRIDE SWITCH**

### **Override Switch Wire Information**

FUNCTION	PIN	COLOR
Normal position signal (to ECM B pin D3)	1	VIOLET/YELLOW
Ground through ECM (to ECM B pin B1)	2	VIOLET/GREY
Override position signal (to ECM B pin F3)	3	VIOLET/ORANGE

# THROTTLE ACCELERATOR SENSOR (TAS)

### **TAS** Description

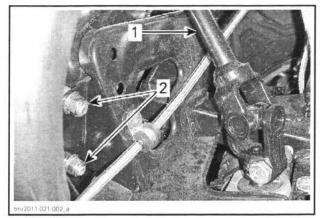
The throttle accelerator sensor (TAS) is a double hall effect sensor that sends a signal to the ECM which is proportional to the accelerator pedal. The redundancy is used for security purposes.

The voltage output of the hall effect sensors are different.

# TAS Removal and Installation

The TAS is part of the accelerator pedal.

- 1. Note the wire routing and tie-wrap position.
- 2. Disconnect electrical connector.
- 3. Remove both accelerator pedal retaining nuts by outside the passenger compartment. Reach nuts by the RH side of the vehicle.



Steering column 2. Accelerator pedal retaining nuts

To install, reverse the removal procedure, however pay attention to the following:

Route and attach wires correctly.

Tighten nuts to the specified torque.

ACCELERATOR PEDAL RETAINING NUTS TIGHTENING TORQUE	
13 N∙m ± 1 N∙m (115 lbf•in ± 9 lbf•in)	

Carry out the ECM FIRST INITIALIZATION, refer to ELECTRONIC FUEL INJECTION (EFI) subsection.

#### TAS Wire Information

FUNCTION	PIN	COLOR
Signal	A	BLUE/GREEN
Ground through ECM	В	BLUE/RED
Voltage input (5 volt)	C	BLUE/ORANGE
Voltage input (5 volt)	D	BLUE/BLACK
Signal	E	BLUE/PINK
Ground through ECM	F	BLUE/VIOLET

## TAS Failure

If one TAS signal fails, the vehicle will enter the limp home mode. In this case, depressing the override button will temporarily restore accelerator pedal operation (while button is depressed).

If both TAS signals fail, the engine speed will drop to idle. Depressing the override button will force the ECM to open the ETA to an angle that allows the vehicle to move.

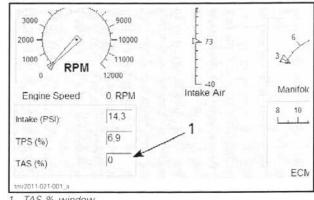
## TAS Test with B.U.D.S.

The TAS signal can be monitored in B.U.D.S.

Connect to the latest applicable B.U.D.S. software. Refer to COMMUNICATION TOOLS AND B.U.D.S. section.

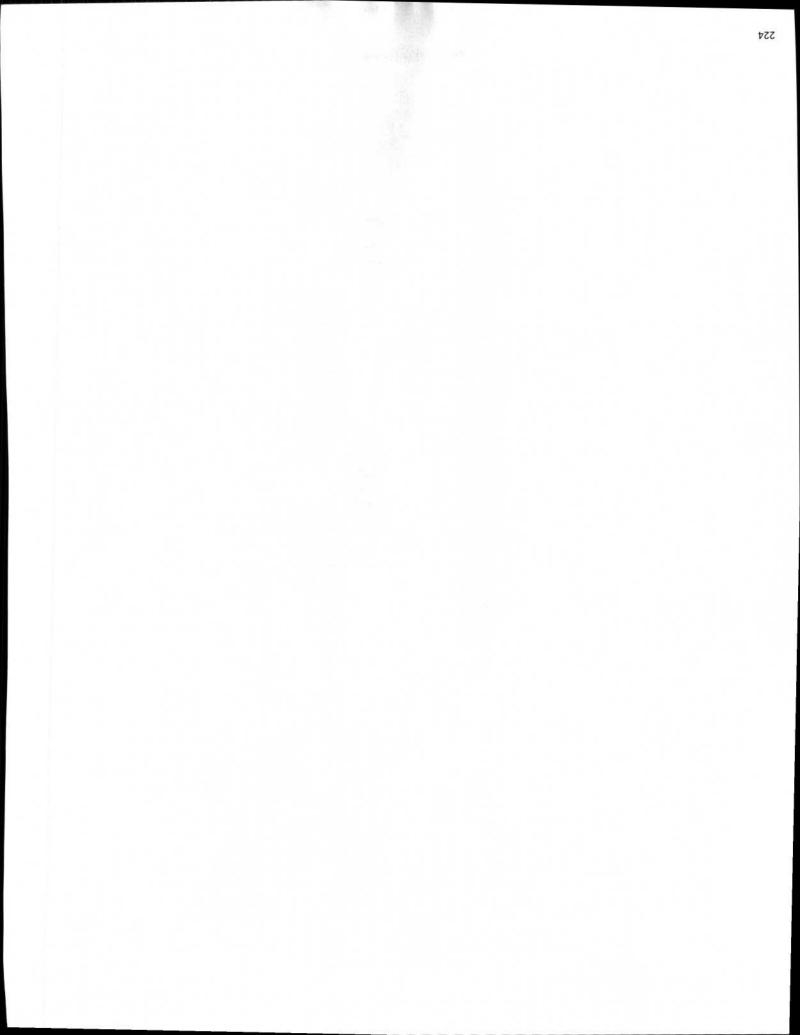
Select the Monitoring and ECM tabs.

Look at the TAS (%) window as you depress the accelerator pedal.



1. TAS % window

The TAS signal should vary from near 0% to near 100% depending on the pedal position, which confirms the TAS signal reaches the ECM.



# **ELECTRONIC FUEL INJECTION (EFI)**

# SERVICE TOOLS

Description	Part Number	Page
DIGITAL INDUCTION TACHOMETER	529 014 500	
ECM ADAPTER TOOL	529 036 166	
FLUKE 115 MULTIMETER	529 035 868	
OETIKER PLIERS		

# SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	
	293 550 010	

# GENERAL

### 

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.

# 

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. Wipe off any fuel spillage. Do not allow fuel to spill on hot engine parts and/or on electrical connectors.

# A WARNING

Replace any damaged, leaking or deteriorated fuel lines or connections. Always, pressurize the fuel system if any fuel related component was disconnected or removed. Proceed with care when removing/installing high pressure test equipment.

# SYSTEM DESCRIPTION

The electronic fuel injection system (EFI) is comprised of various sensors used for detecting ongoing operating conditions of the engine and vehicle, and includes all the components that perform the required adjustments to the engine.

# **Electrical System**

#### ECM (Electronic Control Module)

From input signals, the ECM acknowledges driver demands and converts them to an engine torque requirement through calculation of several variables. Then, the ECM controls the iTC, the injection system and the ignition system to meet the torque requirement.

The ECM manages the engine torque requirements and controls engine operation to ensure it is delivering optimum performance and fuel economy. The ECM also controls idle RPM and limits maximum engine speed through the iTC system.

#### EFI Sensors

The ECM reads the inputs from the sensors which it compares to predetermined parameters stored in the ECM, makes computations, and activates the outputs accordingly (injectors, ignition coils etc.).

Signals from sensors are used by the ECM to determine the injection and ignition parameters (referenced to fuel maps) as required to maintain the optimum air-fuel ratio.

## Air Intake System

#### Air Filter

Air, drawn into the air filter housing, first passes through an inlet duct.

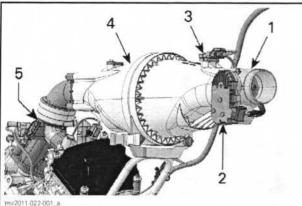
After it passes through the air filter, an air duct (intake adapter) is used to channel the air to the throttle body.

## Section 04 FUEL SYSTEM Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

## Throttle Body

The throttle body is mounted on the front end of the plenum, aft of the air filter housing.

Air for combustion, drawn in by the engine, flows through the air intake system, then through the throttle body where it is regulated by a throttle plate.



1 Throttle

1. Throttle body 2. ETA and TPS

3. MAPTS (Manifold Air Pressure Temperature Sensor)

4. Plenum 5. Air intake manifold

Fitted on the throttle body, an electric throttle actuator (ETA) allows the ECM to electronically control the throttle plate opening which regulates the amount of air that enters the engine, and therefore engine torque.

There is no idle air control valve (IACV).

The TPS is also incorporated in the throttle body. It provides a signal to the ECM of the actual throttle plate position.

#### Plenum

After the air flows through the throttle body, it enters the plenum. The plenum provides a resonance effect which leads to an improved cylinder charge.

# Fuel System

#### Fuel Rail

Two fuel rails, one for each injector, are mounted on the intake manifold. The fuel rails, which are used to secure the injectors to the manifold, also provide to the injectors the fuel pressure that they receive from the fuel pump.

The fuel pressure applied to the fuel rails is regulated by the fuel pressure regulator located in the fuel pump module.

### **Fuel Injectors**

The fuel injectors are used to inject fuel into the intake ports of the cylinder head. One injector is used per cylinder.

#### Fuel Pump

An electric fuel pump with an integrated pressure regulator and fuel system filters is used. For more details on the fuel pump unit, refer to *FUEL TANK AND FUEL PUMP* subsection.

# ADJUSTMENT

# IDLE SPEED

Idle speed is not adjustable. The ECM controls the idle speed of the engine primarily through control of the throttle plate position.

The vehicle multifunction gauge can provide an accurate digital readout of the engine's idle speed.

If desired, the engine RPM can be verified using a DIGITAL INDUCTION TACHOMETER (P/N 529 014 500).

Install the tachometer wire on a spark plug cable.

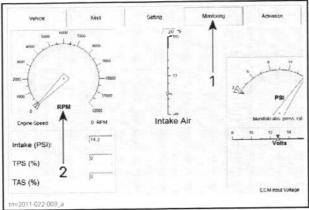


VERIFYING ENGINE RPM USING A DIGITAL INDUCTION TACHOMETER

The engine RPM may also be verified using the applicable B.U.D.S. software version, refer to *COM-MUNICATION TOOLS AND B.U.D.S.* subsection.

In B.U.D.S., select the following:

- Read Data button
- Monitoring page tab
- ECM tab.



VERIFYING ENGINE RPM USING B.U.D.S. 1. Monitoring page tab 2. Engine RPM indication

**NOTE:** The multifunction gauge and B.U.D.S. use the same signal to provide the engine RPM indication.

# TROUBLESHOOTING

# DIAGNOSTIC TIPS

Engine problems are not necessarily related to the fuel injection system.

It is important to ensure that the engine and propulsion system, fuel delivery and electrical systems are functioning normally.

For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

After a problem has been solved, be sure to clear the fault(s) in the ECM using the B.U.D.S. software.

#### A WARNING

Electrical actuators and electronic modules may be powered up as soon as the ignition switch is set to ON. Always disconnect the battery prior to disconnecting any electrical or electronic parts.

Never use a battery charger to temporarily substitute the battery as it may cause the ECM to function erratically, or not at all.

Check related-circuit fuse solidity and condition with an ohmmeter. A visual inspection could lead to a false diagnosis.

## **Electrical Related Problems**

It is important to check the following in the electrical system:

- Battery voltage

- Fuses
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are genuine OEM. Any modification to the wiring harness may lead to poor system operation or generate fault codes.

#### **Electrical Connections**

Pay particular attention to ensure that terminals and pins are not out of their connectors, corroded, or out of shape.

When probing terminals, pay attention not to deform the terminals as this could cause a loose or intermittent connection that would be difficult to troubleshoot.

# PROCEDURES

# ENGINE CONTROL MODULE (ECM)

**NOTE:** As a first troubleshooting step, always check for applicable fault codes using B.U.D.S. software.

## Quick Test to Validate ECM Operation

Turn ignition key to ON.

**NOTE:** Setting the ignition switch to ON wakes up the ECM, which then turns on the following.

QUICK INDICATION THAT ECM IS FUNCTIONING (assuming the observed component is in good working order)

Multifunction gauge turns ON.

Fuel pump turns on for approx. 5 seconds.

Rear lights turn on.

Headlamps turn on (ignition key on with lights position).

# **ECM First Initialization**

This procedure performs a reset of the following values in the ECM:

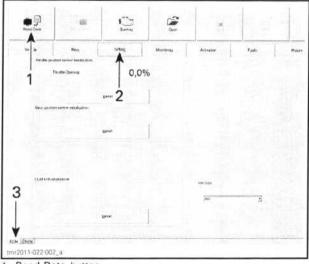
- TAS (Throttle Accelerator Sensor)
- TPS (Throttle Position sensor)
- GBPS (Gearbox Position Sensor).

This reset **must** be carried out whenever the ECM has been replaced.

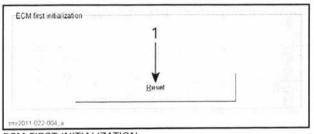
## Section 04 FUEL SYSTEM Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

This reset may be carried out whenever any of the following components have been replaced instead of their respective reset procedures:

- Throttle body (for TPS)
- GBPS (Gearbox Position Sensor).
- 1. Connect vehicle to the applicable B.U.D.S. version. refer to COMMUNICATION TOOLS AND B.U.D.S. subsection.
- 2. In B.U.D.S., select the following:
  - Read Data button
  - Setting page tab
  - ECM page tab



- Read Data button
- Setting page tab
- 3. ECM page tab
- 3. In the ECM first initialization field, click on the Reset button.



ECM FIRST INITIALIZATION Reset button

- 4. Follow the instructions in the message boxes that appear in B.U.D.S.

If the operation is successful, a message will be displayed stating that the reset was successful.

If an error occurred or a component is out of range, a message may be displayed. Follow the instructions in the message and repeat the procedure.

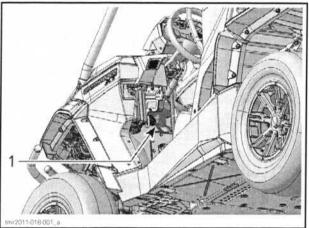
5. Check for fault codes

If a fault code is generated, carry out the service actions, reset the fault and repeat the reset procedure.

6. Start engine and make sure it operates normally throughout its full engine RPM range.

# ECM Access

The ECM is located under the dashboard, driver's side, above the control pedals.

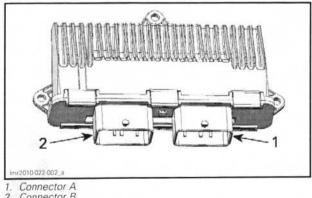


TYPICAL - ECM LOCATION 1 FCM location

# ECM Connector Identification

There are 2 connectors connected to the ECM:

- Engine harness connected to ECM-A
- Vehicle system control harness connected to FCM-B.



2. Connector B

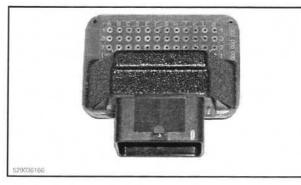
The ECM connectors have 48 pins.

NOTE: For connector information, cleaning and probing, refer to CONNECTOR INFORMATION subsection.

#### Section 04 FUEL SYSTEM Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

## ECM Adapter Tool

To probe ECM connector terminals, use the ECM ADAPTER TOOL (P/N 529 036 166).



**NOTE:** This tool will prevent deforming or enlarging terminals which would lead to bad ECM terminal contact creating intermittent or permanent problems.

# ECM Power Supply Test

- 1. Disconnect connector "B" from the ECM.
- 2. Install ECM connector "B" on the ECM ADAPTER TOOL (P/N 529 036 166).
- 3. Install a jumper wire between B-H2 and B-M2 on the ECM adapter tool.
- 4. Turn the ignition switch to ON.
- 5. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Vdc.
- 6. Check for voltage as follows.

ECM ADAPTER	BATTERY	VOLTAGE
B-M4	Negative post	Battery voltage

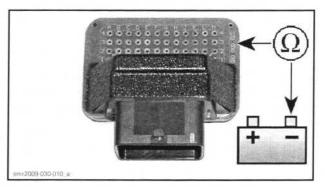
If voltage is not measured, check the following:

- Main relay
- Wiring and connections, refer to the WIRING DIAGRAM.

# Continuity Test of ECM Ground Circuits

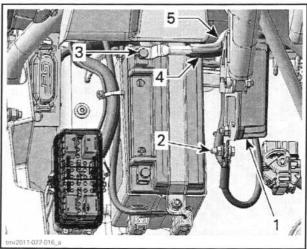
- 1. Disconnect connector "B" from ECM.
- 2. Install the ECM ADAPTER TOOL (P/N 529 036 166) on ECM-B connector.
- 3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select  $\Omega.$
- 4. Probe adapter terminals as per following table.

ECM ADAPTER	BATTERY POST	RESISTANCE
Pins B-L1, B-M2 and B-M3	Ground	Close to 0 Ω (continuity)



If any measurement is out of specification, check the following:

- Engine ground
- Battery ground
- Frame ground.



- 1. Voltage regulator/rectifier 2. Frame ground stud
- 2. Frame ground stud 3. Negative (-) battery pos
- 3. Negative (-) battery post
- Battery ground wire
   Engine ground wire

# ECM Removal

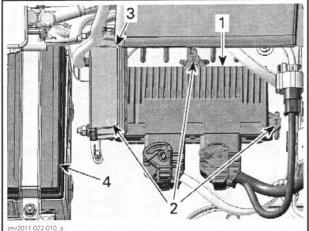
**NOTE:** If a new ECM is to be installed, first read the procedures in *ECM REPLACEMENT* in this subsection.

1. Disconnect battery cables.

**NOTICE** Always disconnect the BLACK negative (–) battery cable first, then disconnect RED positive (+) cable.

2. Disconnect both ECM connectors from ECM.

3. Unscrew all retaining screws and remove the ECM from its support.



ECM

- Retaining screws
- Voltage regulator/rectifier 3.
- Battery

# **ECM** Installation

Reverse removal procedure however, pay attention to the following.

ECM	ECM INSTALLATION		
TORQUE	2 N•m ± 0.2 N•m (18 lbf•in ± 2 lbf•in)		

- 1. Reconnect ECM connectors.
- 2. Reconnect battery cables.

### WARNING

Always reconnect the RED positive (+) battery cable first, then reconnect BLACK negative (-) cable.

3. If a new ECM is installed, refer to ECM RE-PLACEMENT in this subsection.

# ECM Replacement

Prior to replacing an ECM, ensure that all the recommendations in the general introduction of this section have been followed.

NOTE: Proceed with an ECM FIRST INITIALIZA-TION as it may resolve the problem.

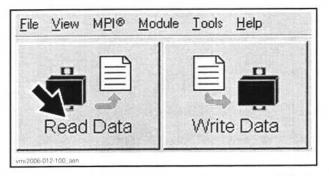
If the ECM is replaced, data must be transferred or entered into the new ECM using one of the following methods:

- If the faulty ECM can be read with B.U.D.S., refer to ECM AUTOMATED DATA TRANSFER.
- If the faulty ECM cannot be read with B.U.D.S., refer to ECM MANUAL DATA ENTRY.

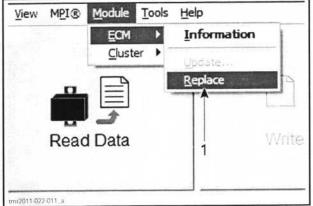
# ECM Automated Data Transfer

To transfer the information recorded in the faulty ECM to the new ECM, carry out the following.

- 1. Connect vehicle to the applicable B.U.D.S. version. Refer to COMMUNICATION TOOLS AND B.U.D.S. subsection.
- 2. Turn ignition switch to ON to wake up the ECM.
- 3. In B.U.D.S., click the Read Data button to load the information from the faulty ECM into B.U.D.S.



- 4. Keep B.U.D.S. running while replacing ECMs. The data will remain stored in the PC computer as long as B.U.DS. is running.
- 5. Remove the old ECM. Refer to ECM REMOVAL in this subsection.
- 6. Install and connect the new ECM. Refer to ECM INSTALLATION in this subsection.
- 7. Turn ignition switch to ON to wake up the new ECM.
- 8. From the Module menu at the top of the B.U.D.S. page, choose:
  - ECM
  - Replace.



TYPICAL

1. ECM Replace function in B.U.D.S.

B.U.D.S. will automatically write the data from the PC computer into the new ECM.

- 9. Program the vehicle ignition keys into the new ECM, refer to *Digital Encoded Security System (D.E.S.S.)* subsection.
- 10. Perform the *ECM FIRST INITIALIZATION* procedure, refer to *ENGINE CONTROL MODULE* in this subsection.
- 11. Reinstall any remaining removed parts.

# ECM Manual Data Entry

There are 2 possible methods to collect the required information. The 1st being the easiest:

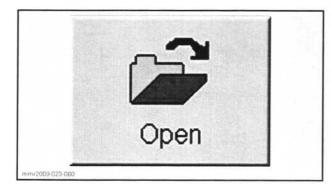
- 1. Use B.U.D.S. to obtain the data from a saved .mpem file on your PC computer.
- 2. Collect the information from the vehicle and BOSSWeb.

# 1st Collecting Method: Obtaining the Data from a Saved .mpem File

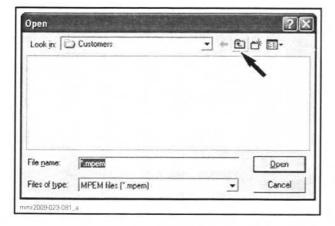
1. Use the B.U.D.S.

**NOTE:** It is not necessary to perform any connection. The PC computer can be used alone.

2. In B.U.D.S., click on the Open button.



Click once on the Folder Up button in the Open box.



Double click on the AutoSave folder.

Look in: BUDS P2.3.18				
AutoSave Customer DEU ENU ESN				
-FIN				
	[*.mpem		<u>O</u> pen	

**NOTE:** You may have to go to another AutoSave folder from a previous version of B.U.D.S.

Choose the latest file saved for this specific vehicle.

Open										?
Look in	) AutoSave				•	\$	£	ď	-	
P2.3.22.1 P2.3.22.1 P2.3.22.1	2_28P58K80 2_28P5CX98 2_28P5CX98 2_28P5CX98 2_VDV48588 2_28P5CX98	859V00010 859V00010 0A909_200	01_2009 01_2009 090206	90206_ 90206_ _14180	10455 10455 3.mpe	54.mp 58.mp em	oem oem			
P2.3.22.1	2_28PSCX98 2_28PSCX98	359700010	01_2009	90229		S. 1997 (1997)				
P2.3.22.1	2_28PSCX98 2_28PSCX98	359700010	01_2009	90229_ 90229_	11 455	8.mp	em		<u>O</u> per	n

**IMPORTANT:** Be sure to use the file that specifically matches the vehicle you are servicing.

NDTE: The file name structure is as follows: B.U.D.S. version\_VIN\_date read (yyyymmdd)\_hour read (hhmmss).mpem

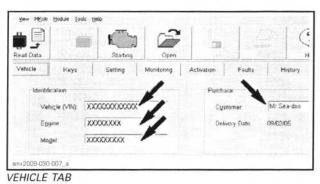
Example:

P2.3.22.12\_2BPSBK8C68V000168\_20090206\_111640.mpem

Therefore: B.U.D.S. version: P2.3.22.12 VIN: 2BPSBK8C68V000168 Date: 2009 02 06 Hour: 11h 16m 40s

- 5. Select the Vehicle page tab and record (write down) the following information.
  - 1. Vehicle serial number
  - Engine serial number (without the leading "M")

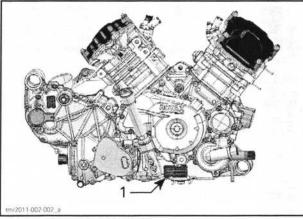
- 3. Vehicle model number
- 4. Customer name.



6. Enter recorded data in ECM as detailed in ENTERING THE COLLECTED INFORMATION INTO THE ECM.

# 2nd Collecting Method: Collect the Information from the Vehicle and BOSSWeb

1. Record engine serial number.



TYPICAL - RH SIDE OF ENGINE 1. Engine serial number

- 2. Record the following numbers using BOSSWeb. Look in **Service** menu and choose Unit history.
  - 1. Vehicle serial number
  - 2. Vehicle model number
  - 3. Customer name.

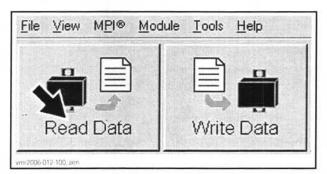


SERVICE, UNIT HISTORY

3. Enter the recorded data in the new ECM as detailed in *ENTERING THE COLLECTED INFOR-MATION INTO THE ECM*.

# Entering the Collected Information Into the ECM

- 1. Use the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- 2. Turn ignition key to ON position.
- 3. In B.U.D.S., click the **Read Data** button to read the new ECM.



The following screen window will pop up.

		and the second	
		f vehicle you are connected to because t model must either be "SBCAT", an	ne
alphanumerical va	alue or an entirely nur	merical value. Enter the appropriate vehi	icle
nodel in the edit l	DOX DIBROW,		
Model			
	- <u>1</u>		

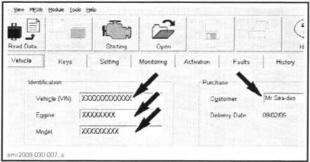
4. Enter the vehicle model number.

# Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

**NOTICE** Enter only the appropriate product model number as obtained when gathering the information.

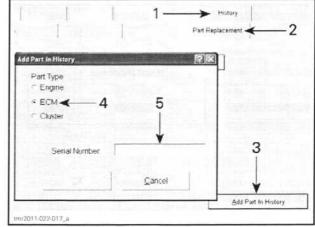
etiide model is iphanumerical	missing. The value or an en	vehicle model mu	u are connected to because t st either be "SBOAT", an lue. Enter the appropriate veh
nodel in the edi	EDOX D9IOW.		
Model		349A	
			Cancel

- 5. Select the Vehicle tab and enter the information you recorded previously.
  - 1. Vehicle serial number
  - Engine number (do not enter the "M" at the beginning of the engine number)
  - 3. Customer name.



VEHICLE TAB

- 6. Click on the following tabs:
  - History
  - Part Replacement
  - Add Part in History.
- 7. Enter the old ECM serial number in the Add Part In History window.

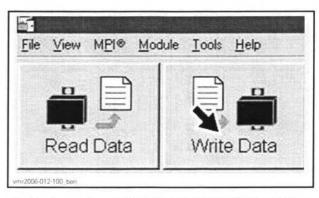


ADDING PART IN HISTORY

- 1. History page tab 2. Part Replacement to
- Part Replacement tab
   Add part in history button
- Add part in his
   ECM selection
- 5. Add ECM serial number here

**NOTE:** The ECM serial number can be found on the ECM sticker that also identifies the part number.

- 8. Click on the OK button.
- 9. Click on the Write Data button.



- 10. Perform the ECM FIRST INITIALIZATION reset.
- 11. Program the vehicle ignition keys into the new ECM, refer to *Digital Encoded Security System (D.E.S.S.)* subsection.
- 12. Reinstall any remaining removed parts.

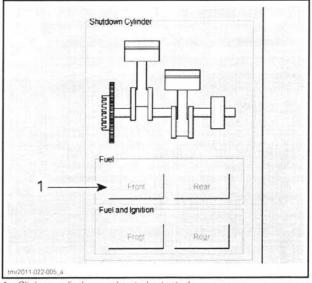
# FUEL INJECTOR

# Fuel Injector Operation Test Using B.U.D.S. (Dynamic)

**NOTE:** As a first troubleshooting step, always check for applicable fault codes using B.U.D.S.

1. Connect vehicle to the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

- 2. Start engine.
- 3. In B.U.D.S., select the following:
  - Read Data button
  - Monitoring page tab
  - ECM page.
- 4. Using the B.U.D.S., shut down fuel injection to each engine cylinder one at a time by clicking on the button under the applicable cylinder.



1. Click on cylinder number to be tested

If the engine RPM drops momentarily when clicking on a cylinder, the injector on this cylinder is functioning normally.

If the engine RPM does not drop momentarily when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to FUEL INJEC-TOR BALANCE TEST USING B.U.D.S.
- Spark plug and ignition coil. Refer to *IGNITION* SYSTEM subsection.
- Engine condition.

# Fuel Injector Balance Test Using B.U.D.S.

**NOTICE** After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine and prevent a potential backfire due to fuel accumulation in engine.

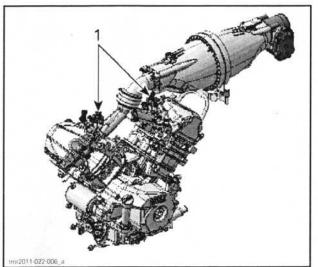
1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* of *FUEL TANK AND FUEL PUMP* subsection.

- 2. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- 3. Turn the ignition key to ON.
- 4. In B.U.D.S., select the following:
  - Read Data button
  - Activation page tab.
- 5. In B.U.D.S., click on the Fuel Pump button to activate fuel pump.

Fuel Pump		
	○ Disabled	
Activate		
	Fuel Pump <	1
	<u>C</u> ooling Fan	
	Accessory Relay	
r2011-011-017_d		

1. Fuel Pump activation button

- 6. Fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.
- 7. In B.U.D.S., energize fuel injector no. 1.



1. Click on injector to activate

8. Record the fuel pressure drop for injector no. 1.

9. In B.U.D.S., click on the Fuel Pump button to activate fuel pump.

- 10. Repeat the procedure for fuel injector no.2 and record the pressure drop for each injector.
- The maximum fuel pressure drop between injectors should not exceed the following specification:

MAXI	IUM FUEL PRESSURE DROP ALLOWED BETWEEN FUEL INJECTORS
	10 kPa (1.5 PSI)

If pressure drop of any fuel injector is greater than the specification, replace that injector then repeat the test.

- 12. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
- 13. Remove fuel pressure gauge and reinstall removed parts.

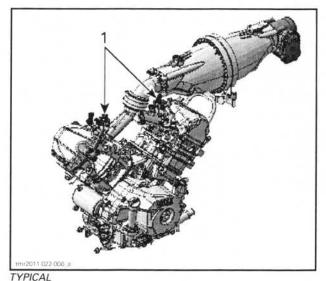
# Fuel Injector Leak Test

Carry out the *FUEL PUMP PRESSURE TEST* as detailed in the *FUEL TANK AND FUEL PUMP* subsection.

# Fuel Injector Activation Test Using B.U.D.S.

Turn ignition key to ON.

On the Activation page of B.U.D.S. software, energize the fuel injector to be tested.



1. Click on injector to activate

You should hear the injector functioning.

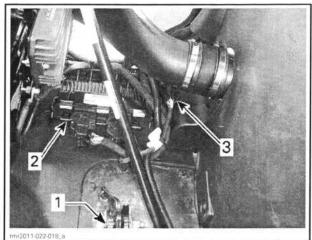
This will validate the injector mechanical and electrical operation. If the injector does not function, carry out the FUEL INJECTOR RESISTANCE TEST.

### Fuel Injector Resistance Test

Disconnect connector "A" from the ECM.

Disconnect the engine connector (HIC).

NOTE: The HIC connector is located to the right of the ECM.



HIC CONNECTOR LOCATION

Accelerator pedal (not visible)
 ECM

3. HIC connector

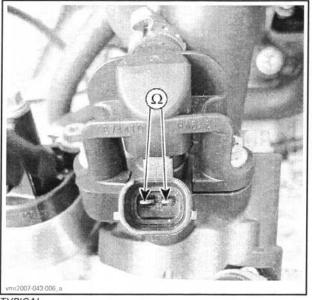
Using a FLUKE 115 MULTIMETER (P/N 529 035 868), check resistance value between terminals as follows.

FUEI		RESISTANCE DNNECTOR	TEST AT
INJECTOR	HIC CONNECTOR	ECM CONNECTOR "A"	RESISTANCE @ 20°C (68°F)
	800R and	1000 Engine	S ·
FRONT	D	A-J1	11.4 12.00
REAR	D	A-K1	11.4 - 12.6 Ω

If resistance value obtained is incorrect, remove injector connector and check resistance value between injector pins as follows.

		RESISTA	NCE TEST AT	
INJECTOR	INJEC	TOR PIN	RESISTANCE @ 20°C (68°F)	
	800R an	d 1000 Er	ngines	
FRONT	1	0	11.4 10.0 0	
REAR	]	2	11.4 - 12.6 Ω	

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))



TYPICAL

If readings are out of specifications, replace injector.

If readings are good, carry out a *FUEL INJECTOR INPUT VOLTAGE* test.

# Fuel Injector Input Voltage Test

Disconnect the fuel injector connector.

**NOTE:** If the connector is hard to unlock, gently use a screwdriver to release connector.

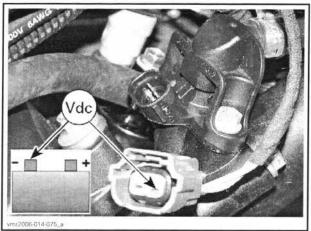


TYPICAL

**NOTE:** It is not necessary to activate the injector since it is continuously powered when the ignition key is set to ON.

Use a multimeter and set it to Vdc. Read voltage.

CYLINDER	INJEC CONNE		MEASUREMENT	
	WIRE			
FRONT	VIOLET/	Battery	10.1/1-	
REAR	BLUE	ground	12 Vdc	



TYPICAL

If supply voltage is not good, check continuity between fuse F5 and injector (see *WIRING DIA-GRAMS*).

**NOTE:** Probe fuse exactly as shown. This validates fuse at the same time.

Use a multimeter and set it to  $\Omega$ . Read resistance.

	INJECTOR CIRCUIT		MEAGUDEMENT	
CYLINDER	WI	RE	MEASUREMENT	
FRONT	VIOLET/	5.05° (1407)		
REAR	BLUE	Fuse F5	Close to 0 $\Omega$	

If continuity is good, check relay and wiring from battery.

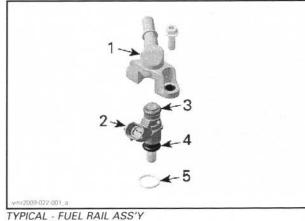
If continuity is faulty, check fuse and if OK, repair/replace wiring going to injector.

If supply voltage is good, check ground circuit between injector and ECM (see *WIRING DIA-GRAMS*).

- If ground circuit is faulty, repair/replace wiring and connectors.
- If ground circuit is good, refer to ECM RE-PLACEMENT.

### Fuel Injector Removal

To remove the injector, first remove the fuel rail refer to *FUEL RAIL* for the procedure.



Fuel rail

- Fuel injector
- Injector top O-ring
   Injector bottom O-ring
   Manifold O-ring

Then pull fuel injector out of the fuel rail.

#### Fuel Injector Installation

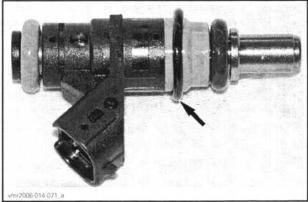
For the installation, reverse the removal procedure. Pay attention to the following details.

Apply a thin film of engine oil to O-rings to ease insertion in rail.

Install fuel injector with your hand. Do not use any tool.

FUEL INJECTOR INSTALLATION				
O-RINGS	New	Lubricate with engine oil		

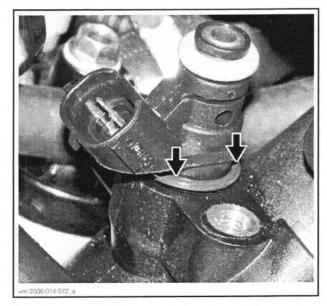
Position the manifold O-ring on injector as in following illustration.



TYPICAL - MANIFOLD O-RING POSITION

Carefully insert injector in manifold paying attention to the manifold O-ring.

NOTICE Gently push O-ring in evenly all around while inserting injector. O-ring must be completely inserted and not visible, before completing the insertion of the injector.



Firmly push injector until it bottoms out. Reinstall fuel rail.

# FUEL RAIL **Fuel Rail Replacement**

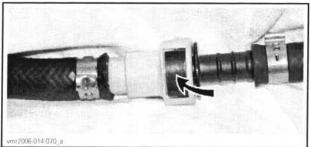
#### **Fuel Rail Removal**

- 1. Connect vehicle to the applicable B.U.D.S. software version and select the following:
  - Read Data button
  - Activation page tab
  - ECM page tab
  - Fuel pump Disabled.

Fuel Pump	1	
○ Enabled	Disabled	
Activate		
	Fuel Pump	
	<u>C</u> ooling Fan	
	Accessory Relay	
2011-011-017 b		

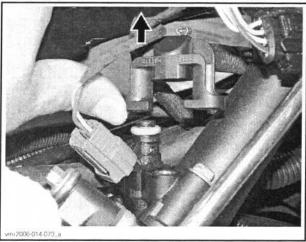
- 1. Click here to disable the fuel pump
- 2. Release fuel pressure by running engine until it runs out of gas.
- 3. Turn ignition key OFF.

4. Wrap a rag around the inlet hose and release the quick fitting.



TYPICAL

- 5. Unscrew rail retaining screws.
- 6. Gently pull rail off by hand.



TYPICAL

To disconnect fuel rail from hose, cut clamp on fuel hose using OETIKER PLIERS (P/N 295 000 070). Refer to FUEL TANK AND FUEL PUMP for clamp removal/installation procedures.

NOTE: If fuel rail is removed for access to fuel injector, it is not necessary to cut hose clamp. Only to replace fuel rail.

#### Fuel Rail Installation

For installation, reverse the removal process however, pay attention to the following.

Install new clamps using pliers as per removal (if fuel rail was replaced).

Install fuel rail and evenly tighten screws a little at a time each side.

FUEL RAIL INSTALLATION		
INJECTOR O-RINGS	RETAINING SCREW TORQUE	
NEW (Lubricate with engine oil)	10 N∙m ± 1 N∙m (89 lbf∙in ± 9 lbf∙in)	

After securing fuel hose quick fitting to injector, re-enable fuel pump using B.U.D.S.

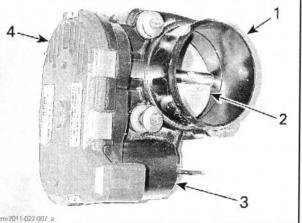
K	n Pinchad	
• Enabled	C Disabled	
Activate		
	Fuel Pump	
C 171 195	<u>C</u> ooling Fan	
	Accessory Relay	
11-011-017_c		

### 

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

Throttle Body Description



- Throttle body
- Throttle plate
- 2.3. Electric throttle actuator (electric motor inside)
- Throttle position sensor (TPS) (inside)

# **Throttle Body Access**

Refer to *AIR INTAKE SYSTEM* and remove the following parts:

- Air filter housing
- Air intake adapter.

# **Throttle Body Lubrication**

No lubrication is required.

### Throttle Body Cleaning

- 1. Remove air inlet hose from throttle body.
- 2. Check throttle body cleanliness using a flashlight. Fully open throttle plate and verify:
- Throttle body bore
- Throttle plate edge.

Look for:

- Dirt
- Oily surfaces
- Carbon and salt deposits on throttle plate and the surrounding bore.
- 3. Clean as necessary.
- 4. Use a throttle body cleaner such as GUNK IN-TAKE MEDIC or an equivalent.

**NOTICE** Only use an appropriate throttle body cleaner that will not damage O-rings and EFI sensors.

**A** CAUTION Use the product in a well ventilated area. Refer to product manufacturer's warnings.

5. To avoid getting dirt into engine, spray cleaner on a clean rag then rub rag against throttle plate and bore. A toothbrush may also be used.

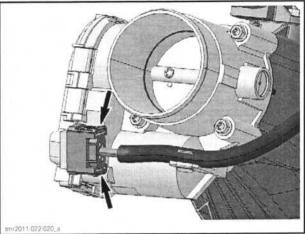
**CAUTION** Ensure ignition key is removed so that nobody can activate the electrical system, otherwise the ECM would turn on and the throttle actuator (ETA) would cycle. This could cause serious finger injury as the throttle plate moves quickly.

- 6. Gently open throttle plate and hold fully open to reach all surfaces.
- 7. To remove residual dirt, spray cleaner on throttle plate and on bore.
- 8. Reinstall removed parts.

# Throttle Body Removal

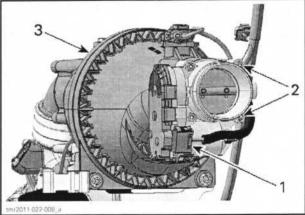
- 1. Disconnect air inlet hose from throttle body.
- 2. Disconnect throttle body connector.

To remove connector from throttle body, simultaneously press the end of both connector locking tabs illustrated.



THROTTLE BODY CONNECTOR- PRESS HERE TO UNLOCK

3. Remove screws retaining throttle body to plenum.



1. Throttle body connector

- 2. Screws (4) 3. Plenum
- 4. Pull throttle body off plenum.

### Throttle Body Installation

Installation of the throttle body is the reverse of the removal procedure. However, pay attention to the following.

TORQUE FOR THROTTLE BODY RETAINING SCREWS

10 N•m ± 1.2 N•m (89 lbf•in ± 11 lbf•in)

1. Perform the *THROTTLE POSITION SENSOR INITIALIZATION* reset procedure. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

# THROTTLE POSITION SENSOR (TPS)

# **TPS** Description

NOTE: The TPS is part of the throttle body.

The throttle position sensor (TPS) is a double potentiometer that sends signals to the ECM that are proportional to the throttle plate angle.

NOTE: As a first troubleshooting step, always check for applicable fault codes using B.U.D.S. software

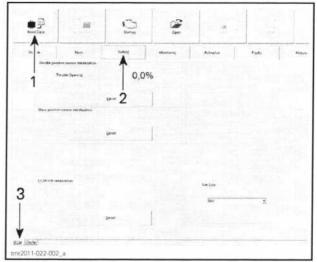
# Throttle Position Sensor Initialization

NOTE: The TPS iniatialization procedure must be carried out whenever the throttle body is replaced, unless an ECM first initialization reset is carried OUIT

This operation performs a reset of the TPS basic values in the ECM. This reset is very important as the TPS values are part of the basic parameters for all fuel mapping calculations and control of several settings such as for idle speed, LIMP HOME mode and maximum RPM of the engine.

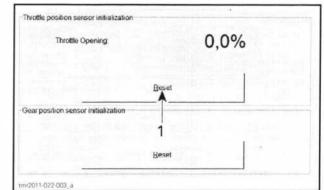
**NOTICE** An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.

- 1. Connect vehicle to the applicable B.U.D.S. software version, refer to COMMUNICATION TOOLS AND B.U.D.S. subsection.
- 2. In B.U.D.S., select the following:
  - Read Data button
  - Setting page tab
  - ECM tab.



1 Read Data button

- 2. Setting page tab
- ECM page tab
- 3. Ensure the accelerator pedal is fully released and at the idle position.
- 4. In the Throttle position sensor initialization field, click on the Throttle Opening Reset button.



THROTTLE POSITION SENSOR INITIALIZATION

1. Throttle Opening Reset button

A message will be displayed if the operation is successful.

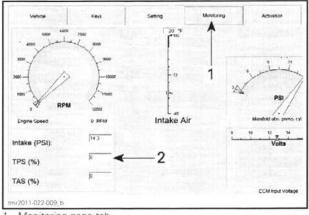
If an error occurred or the TPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

- 5. If a fault message is displayed, follow the instructions in the message(s).
- 6. Check for fault codes.
- 7. If a fault code is generated,
  - Carry out the service actions
  - Reset the fault
  - Repeat the reset procedure.
- 8. Start engine and make sure it operates normally throughout its full engine RPM range.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

#### **TPS** Wear Test

- 1. With the engine turned off, slowly press on the accelerator pedal and pay attention for smooth operation without physical stops.
- 2. Activate the electrical system to wake up the ECM.
- 3. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- 4. In B.U.D.S., select the following:
  - Monitoring page tab
  - ECM page tab.
- 5. Slowly and regularly move the accelerator pedal.
- 6. Observe the Throttle Opening indication movement in B.U.D.S.



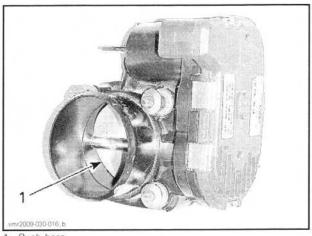
1. Monitoring page tab 2. TPS indication

**NOTE:** The indication should move gradually and regularly as you move the accelerator pedal. If the TPS indication is erratic or suddenly drops off, it may indicate a worn TPS that needs to be replaced. An initial slight delay after the accelerator pedal is moved and before the indication starts to move is normal.

If the indication behavior is not as expected, proceed with the following steps.

7. Manually move the throttle plate in the throttle body using a blunt tool (without sharp tip).

**CAUTION** Do not move throttle plate with your fingers. Otherwise, if ECM should turn off, it would quickly close the throttle plate which could cause finger injury.



1. Push here

- 8. Check the indication movement again.
- If the indication moves as expected, check the throttle accelerator sensor (TAS). Refer to *THROTTLE ACCELERATOR SENSOR (TAS)* in this subsection.
- If the indication does not move as expected, perform the TPS RESISTANCE TEST in this subsection.

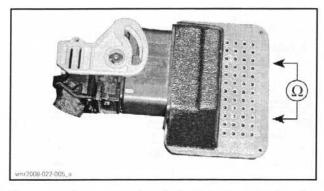
# **TPS** Resistance Test

- 1. Ensure the throttle body connector is properly connected.
- Disconnect ECM connector A from the ECM and install it on the ECM ADAPTER TOOL (P/N 529 036 166).
- 3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select  $\Omega_{\rm \cdot}$
- 4. Probe circuit as per following table while using your hand to manually move throttle plate.

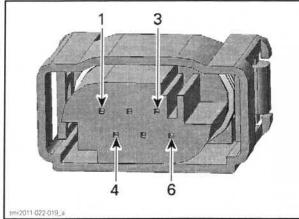
1000	CM PTER	FULLY CLOSED THROTTLE PLATE (1)		TLE THROTTLE		
			RESISTA	NCE (Ω)		
P	IN	MIN.	MAX.	MIN.	MAX.	
A-A2	A-K4	875	1625	875	1625	
A-A2	A-K3	954	1934	228	585	
A-A2	A-F3	254	634	980	1983	
A-K3	A-K4	228	585	954	1934	
A-K3	A-F3	1385	2315	1385	2315	
A-K4	A-F3	980	1983	254	634	

(1) To obtain the fully closed position, it is necessary to push against the throttle plate in the throttle body with your hand and hold it in this position for the measurement.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))



If any resistance value is incorrect, check wire continuity between ECM and throttle body before assuming the TPS is at fault. Refer to *WIRING DIAGRAM* subsection.

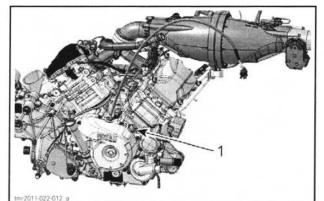


THROTTLE BODY CONNECTOR PIN-OUT

### **TPS Replacement**

Carry out a *THROTTLE POSITION SENSOR INI-TIALIZATION* procedure as detailed in *THROTTLE BODY* of this subsection.

# CRANKSHAFT POSITION SENSOR (CPS)

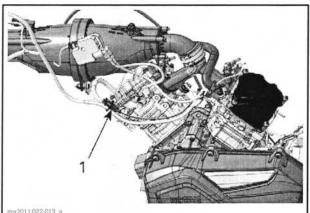


TYPICAL - RH SIDE OF ENGINE 1. CPS location

**NOTE:** Take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth. First check fault codes using B.U.D.S., then check the encoder wheel teeth condition if necessary (refer to *MAGNETO SYSTEM*).

# **CPS Resistance Test**

Disconnect CPS wiring harness connector.



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TYPICAL - LH SIDE OF VEHICLE 1. CPS connector location

Probe terminals as per following table.

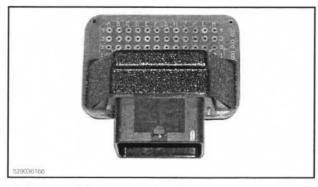
PIN		MEASUREMENT
		RESISTANCE Ω @ 20°C (68°F)
1	2	700 - 900 Ω

If resistance is not within specifications, replace the CPS.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

If resistance tests good, reconnect the CPS connector and disconnect the connector "A" on the ECM.

Install ECM-A connector on ECM ADAPTER TOOL (P/N 529 036 166).



Using a multimeter, recheck resistance as per table.

PIN		MEASUREMENT
		RESISTANCE Ω @ 20°C (68°F)
A-H1	A-K2	700 - 900 Ω

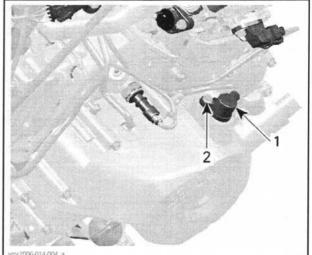
If resistance value is correct, refer to ECM RE-PLACEMENT.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CPS.

### **CPS** Replacement

Disconnect CPS connector and cut harness locking tie.

Remove CPS retaining screw and pull up on CPS to remove it.



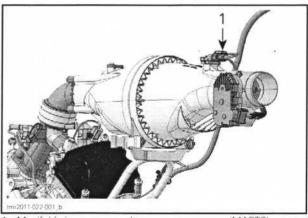
TYPICAL

1. CPS 2. Retaining screw

Install new CPS and secure harness with a new locking tie.

CPS INSTALLATION	
	PRODUCT
O-RING	XPS SYNTHETIC GREASE (P/N 293 550 010)
SENSOR SCREW	TORQUE
	10 N∙m ± 1 N∙m (89 lbf∙in ± 9 lbf∙in)

# MANIFOLD AIR PRESSURE AND TEMPERATURE SENSOR (MAPTS)



1. Manifold air pressure and temperature sensor (MAPTS)

NOTE: This sensor is a multifunction device.

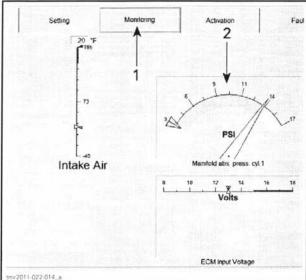
# **MAPTS** Pressure Function

Before the engine is started, when power is applied to the system, the sensor measures the ambient air atmospheric pressure. The ambient pressure is, at that moment, stored in the ECM. Thereafter, once the engine is started, it measures the air pressure in the inlet end of the plenum at operating RPMs.

The sensor must be correctly installed on plenum. Otherwise, the MAPTS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. If this is the case, remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

#### **MAPTS Pressure Function Quick Test**

- 1. Connect vehicle to the applicable B.U.D.S. software version.
- 2. In B.U.D.S., select the following:
  - Read Data
  - Monitoring page tab
  - ECM page.



. Monitoring page tab

2. MAPTS pressure reading

- 3. Look for and take note of the MAPTS pressure reading while the engine is stopped.
- 4. Perform the same test with a new MAPTS and compare both readings.

Values have to be within  $\pm$  3.4 kPa (0.5 PSI).

RESULT	MAPTS Voltage rep		ON
NO READING			Repair or replace wiring
VALUE IS OUT OF RANGE	Replace MAPTS		

#### MAPTS Input Voltage Test

Check the voltage output from ECM to the pressure sensor.

- 1. Turn ignition key ON.
- 2. Remove electrical connector from MAPTS.
- 3. Using a FLUKE 115 MULTIMETER (P/N 529 035 868), measure for input voltage as per following table.

MAPTS C	ONNECTOR	MEASUREMENT	
F	PIN	VOLTAGE	
1	3	5 Vdc	

If voltage test is good, replace the MAPTS.

If voltage test is not good, carry out the *MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNC-TION).* 

# MAPTS Circuit Continuity Test (Pressure Function)

- 1. Disconnect the ECM "A" connector.
- 2. Install ECM-A connector on ECM ADAPTER TOOL (P/N 529 036 166).
- 3. Using a multimeter, check continuity of the following circuits.

MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNCTION)		
ECM-A	MAPTS CONNECTOR	RESISTANCE VALUE
Pin B4	Pin 3	
Pin G4	Pin 4	Close to 0 $\Omega$
Pin H2	Pin 1	

If resistance is not within specification, repair or replace the wiring harness between ECM connector and the MAPTS.

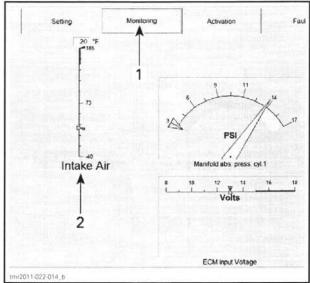
# Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

**MAPTS** Temperature Function

The sensor monitors the temperature in the inlet of the plenum.

#### MAPTS Quick Test (Temperature Function)

- 1. Connect vehicle to the applicable B.U.D.S. software version.
- 2. In B.U.D.S., select the following:
  - Read Data
  - Monitoring page tab
  - ECM page.
- 3. Look for the Intake Air temperature reading while the engine is stopped.



1. Monitoring page tab

2. Monitoring page tab 2. MAPTS temperature reading

4. Perform the same test with a new MAPTS and compare both readings.

If the engine's MAPTS temperature reading is significantly different than the new MAPTS, replace it.

**NOTE:** Both sensors must feel same ambient air temperature.

If there is no reading, carry out a *MAPTS RESIS-TANCE TEST (TEMPERATURE FUNCTION).* 

# MAPTS Resistance Test (Temperature Function)

Disconnect the connector from the MAPTS.

Using the FLUKE 115 MULTIMETER (P/N 529 035 868), check the resistance of the sensor itself as shown.

M	APTS	MEASUREMENT	
F	PIN	RESISTANCE Ω @ 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.

Install ECM-A connector on ECM ADAPTER TOOL (P/N 529 036 166).



Using a multimeter, recheck resistance value as per following table.

ECM COM	NECTOR	MEASUREMENT
PIN		RESISTANCE $\Omega$ @ 20°C (68°F)
A-H2	A-H3	2280 - 2740

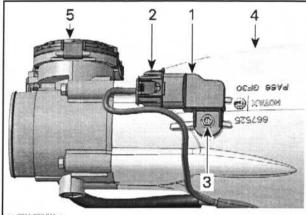
#### MAPTS TEMPERATURE SENSOR TEST RESULTS

RESULT	SERVICE ACTION		N
NO READING	Circuit Continuity Test of MAPTS Temperature Function	MAPTS Input Voltage Test	Repair or replace wiring
INCORRECT RESISTANCE VALUE	Replace MAPTS		

MAPTS Circuit Continuity Test (Temperature Function)

	CIRCUIT CONTINU		
ECM-A	MAPTS CONNECTOR	RESISTANCE VALUE	
Pin H2	Pin 1	Close to 0 Ω	
Pin H3	Pin 2		

# **MAPTS** Replacement



#### tmr2011-022-015\_

- 1. MAPTS 2. MAPTS connector
- 3. Retaining screw
- 4. Plenum
- 5. Throttle body

Disconnect MAPTS connector and remove the MAPTS from the plenum.

Install new MAPTS as per following table.

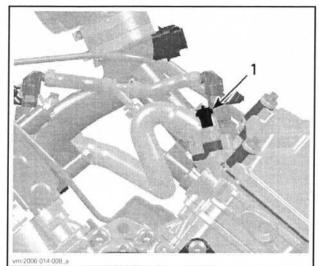
TORQUE	PRODUCT
6 N∙m ± 0.7 N∙m	LOCTITE 243 (BLUE)
(53 lbf∙in ± 6 lbf∙in)	(P/N 293 800 060)

# CTS (COOLANT TEMPERATURE SENSOR)

# **CTS** Access

The CTS is located on the LH of the engine, aft cylinder. To access it, remove the:

- Driver's seat
- LH lateral console panel.

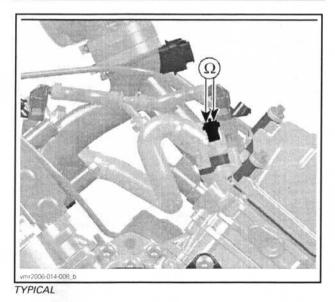


TYPICAL - LH SIDE OF THE ENGINE, AFT CYLINDER 1. Coolant temperature sensor (CTS)

# **CTS** Resistance Test

1. Disconnect the plug connector from the CTS and check the resistance of the sensor itself.

CTS S	ENSOR	MEASUREMENT
Ρ	IN	RESISTANCE Ω @ 20°C (68°F)
1	2	2280 - 2740

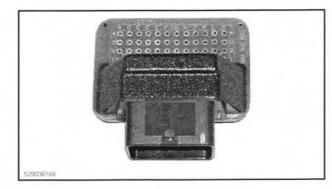


If resistance is out of specification, replace the CTS.

If resistance test is good, reconnect the CTS and disconnect the ECM connector "A" from the ECM.

2. Install ECM-A connector on ECM ADAPTER TOOL (P/N 529 036 166).

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))



3. Using a multimeter, recheck resistance from the ECM connector as per table.

ECM "A CONNECTOR PIN		MEASUREMENT
		Resistance Ω @ 20°C (68°F)
A1	J2	2280 - 2736

If resistance value is correct, refer to ECM RE-PLACEMENT.

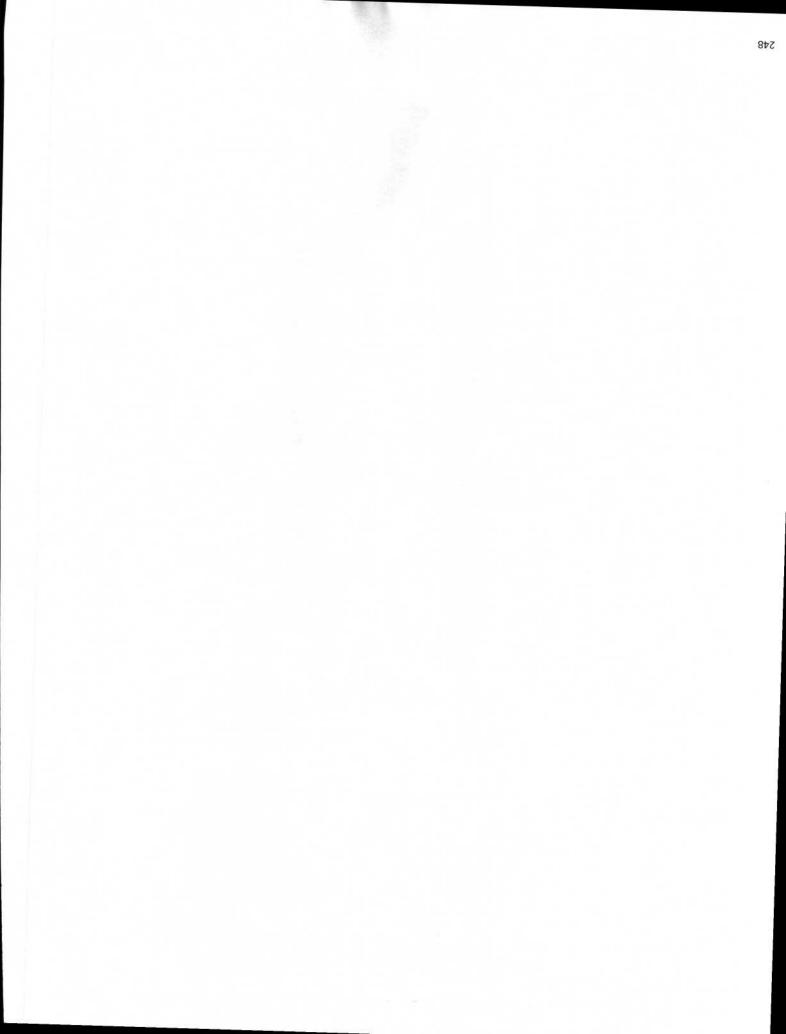
If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CTS.

### **CTS** Replacement

- 1. Disconnect CTS connector and remove CTS.
- 2. Install the new CTS and torque as specified.

CTS TORQUE	
16 N•m ± 2 N•m (142 lbf•in ±	18 lbf•in)

- 3. Reinstall remaining removed parts.
- 4. Refill and bleed the cooling system, refer to COOLING SYSTEM subsection.



# **FUEL TANK AND FUEL PUMP**

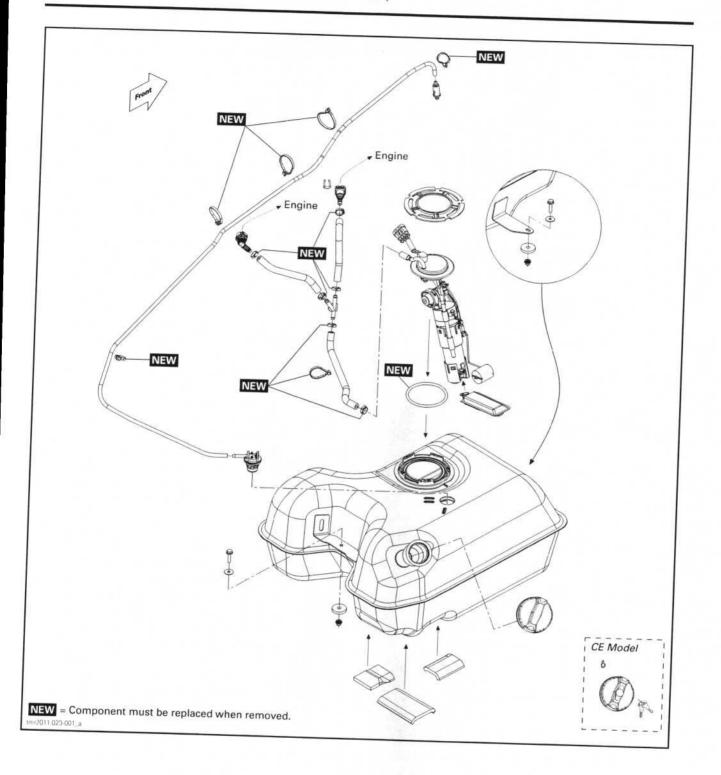
# SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	
FLUKE 115 MULTIMETER	529 035 868	
FUEL HOSE ADAPTER	529 036 023	
OETIKER PLIERS	295 000 070	
PRESSURE GAUGE	529 035 709	
VACUUM/PRESSURE PUMP	529 021 800	

# SERVICE TOOLS - OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBE	TP88	

Subsection 03 (FUEL TANK AND FUEL PUMP)



# GENERAL

# A 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.

# 

Always disconnect battery prior to working on the fuel system.

# A WARNING

Torque wrench tightening specifications must be strictly adhered to.

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

# 

Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses.

# A WARNING

Do not allow fuel to spill on hot engine parts and/or on electrical connectors.

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 subsection.

Fuel lines remain under pressure at all times. Proceed with care when removing/installing high pressure test equipment.

Use the B.U.D.S. software or disconnect the fuel pump electrical connector to disable fuel pump and crank engine to release fuel pressure prior to disconnecting any fuel hose.

Cover the fuel hose connections with an absorbent shop rag and carefully disconnect them to minimize spilling.

Wipe off any fuel spillage.

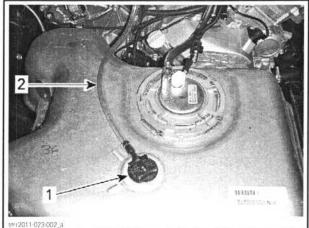
Hoses, cables or locking ties removed during a procedure must be reinstalled as per factory standards.

# SYSTEM DESCRIPTION

# Fuel Tank Vent System

The fuel tank is equipped with a vent system that ensures the fuel tank remains at ambient pressure.

Air can enter the fuel tank at all times through the fuel tank vent valve. This prevents negative pressure within the fuel tank which could cause fuel starvation.



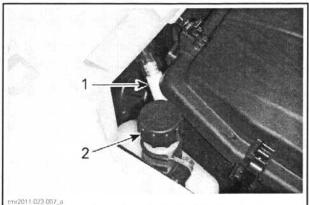
1. Vent valve

2. Air inlet hose

The vent valve also prevents fuel from flowing out through the inlet of the vent system should the vehicle be overturned.

#### Fuel Tank Vent Breather Filter

The air inlet hose of the vent system is equipped with an in-line breather filter that prevents entry of particles such as dust or small insects. It is located behind the air filter housing next to the coolant reservoir. To access the breather filter, remove the service cover.



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1. Fuel tank vent breather filter

2. Cooling system expansion tank

#### Section 04 FUEL SYSTEM Subsection 03 (FUEL TANK AND FUEL PUMP)

# Fuel Pump Module

The fuel pump module is inserted in the fuel tank. It provides fuel delivery for the EFI system and encompasses the following components:

- Electric fuel pump
- Fuel pre-filter (replaceable)
- Fuel pressure regulator
- Fuel level sender.

### **Fuel Filters**

The system comprises two levels of filtration.

A replaceable prefilter element attached to the bottom of the pump, and a non-replaceable fine filter element that is integral to the fuel pump module.

# Fuel Pump Pressure Regulator

The fuel pressure regulator is integral to the fuel pump module. The pressure regulator maintains proper fuel pressure for the EFI system.

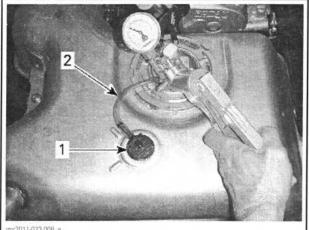
# INSPECTION

# FUEL TANK LEAK TEST

# 

Always carry out a fuel tank leak test whenever the fuel tank shows signs of wear or damage which may cause a leak, or when the fuel pump has been removed or replaced, or if you suspect a leak. If the fuel tank is damaged, the fuel tank should be replaced even if no leak is present. Do not attempt to repair the fuel tank.

- 1. Refill fuel tank and ensure fuel tank cap is in good condition and properly installed.
- 2. Refer to *BODY* subsection and remove the following:
  - RH passenger seat
  - RH lateral console panel
  - Fuel tank cover panel.
- 3. Remove the vent hose from the fuel tank vent valve.
- 4. Using the VACUUM/PRESSURE PUMP (P/N 529 021 800) and a short piece of hose, pressurize the fuel tank through the vent valve.



. Fuel tank vent valve

2. Vent hose to vacuum/pressure pump

PRESSURE	TIME WITHOUT PRESSURE DROP
14 kPa (2 PSI)	3 minutes

If pressure drops, locate fuel leak(s) and repair or replace leaking component(s).

To locate a leak, check for a fuel smell or leaking fuel.

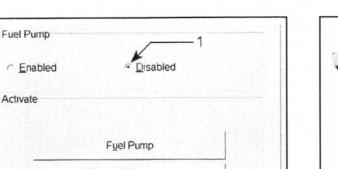
To ease locating leak(s), spray soapy water on all hose connections and components; bubbles will indicate the leak location(s).

# FUEL PUMP PRESSURE TEST

The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator, the fuel pump and tests for leaks in the system.

**NOTE:** Refer to the *FUEL SYSTEM DIAGNOSTIC FLOW CHART* to help diagnose a fuel system related problem.

- 1. Ensure there are no leaks from hoses and fittings. Repair any leak.
- 2. Ensure the fuel level in the tank is sufficient.
- Before proceeding with the pressure test ensure the battery is fully charged. Battery voltage must be over 12 volts.
- 4. Connect vehicle to the applicable B.U.D.S. software version and select the following:
  - Read Data button
  - Activation page tab
  - ECM page tab
  - Fuel pump Disabled.



#### tmr2011-011-017\_b 1. Click here to disable the fuel pump

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

Cooling Fan

Accessory Relay

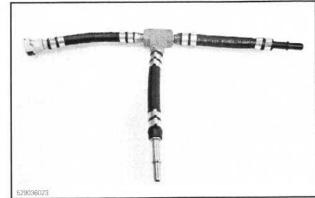
- 6. Remove the following items, refer to the *BODY* subsection
  - Passenger seat
  - Fuel tank cover
  - RH lateral console panel.
- Carefully disconnect the fuel pump outlet hose by pressing on the release tab of the quick disconnect fitting.
- 8. Install fuel PRESSURE GAUGE (P/N 529 035 709) and FUEL HOSE ADAPTER (P/N 529 036 023) between disconnected hose and fuel rail (in-line installation).



PRESSURE GAUGE

### Section 04 FUEL SYSTEM

Subsection 03 (FUEL TANK AND FUEL PUMP)



T-FITTING

Using B.U.D.S., reactivate fuel pump by selecting Enabled.

Enabled	C <u>D</u> isabled	
Activate		
	Fuel Pump	
	<u>C</u> ooling Fan	
	Accessory Relay	

10. Turn ignition key ON and observe fuel pressure.

FUEL PRESSURE 350 kPa (51 PSI)

- 11. Start engine and observe fuel pressure.
- 12. Stop engine.
- 13. In B.U.D.S., select the fuel pump **Disabled** function.
- 14. Release fuel pressure by running engine until it runs out of gas.
- 15. Remove tool and connect hose on fuel rail.

#### **Test Conclusion**

The fuel pressure should be within specification in static or dynamic tests.

A rapid pressure drop after the engine is stopped indicates leakage either from a fuel hose, fuel rail, or from the fuel pump check valve.

Check fuel hoses, fuel rail and fittings for leaks.
 If not leaking, replace fuel pump.

<sup>1.</sup> Click here to disable the fuel pump

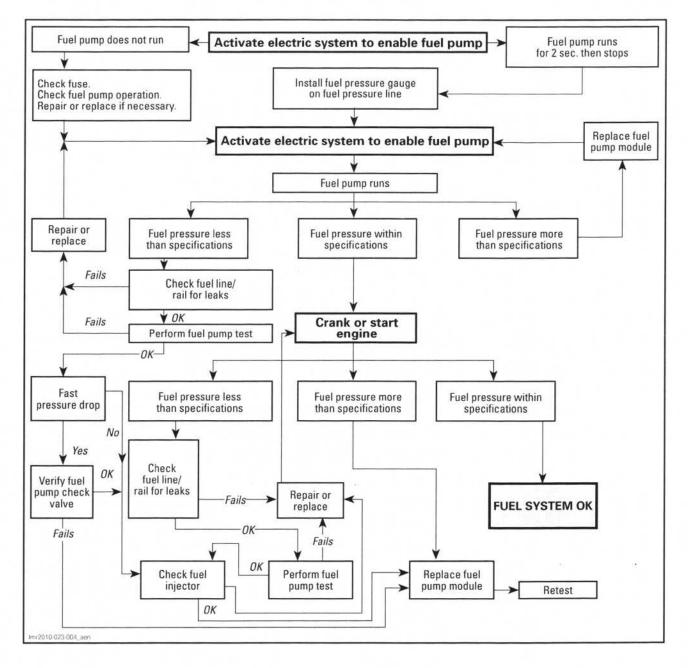
# Section 04 FUEL SYSTEM Subsection 03 (FUEL TANK AND FUEL PUMP)

A slow pressure drop after the engine is stopped indicates leakage either from a fuel injector or from the fuel pressure regulator.

 Check fuel injectors for leaks. If not leaking, replace fuel pump.

# TROUBLESHOOTING

# FUEL SYSTEM DIAGNOSTIC FLOW CHART



Subsection 03 (FUEL TANK AND FUEL PUMP)

# 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.

# A WARNING

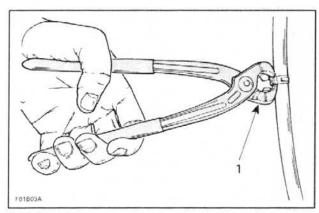
Use of fuel lines other than those recommended by BRP may compromise fuel system integrity.

# 

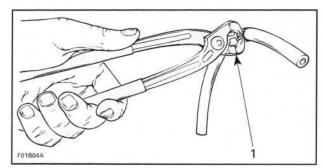
Whenever removing a hose in the fuel system, always use new Oetiker clamps at assembly. Then validate fuel system tightness by performing a fuel pressure test.

#### **Oetiker Clamp Replacement**

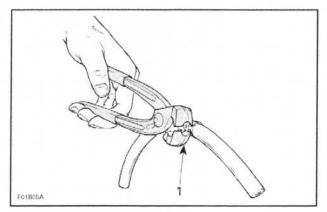
To secure or cut Oetiker clamps on fuel lines, use OETIKER PLIERS (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



1. Securing clamp in limited access

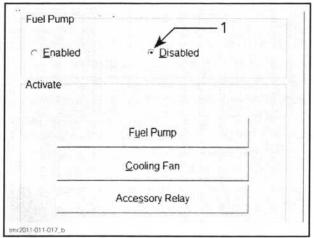
# FUEL TANK

#### Fuel Tank Draining

Remove fuel tank cap and siphon gas into an approved fuel container.

### **Fuel Tank Removal**

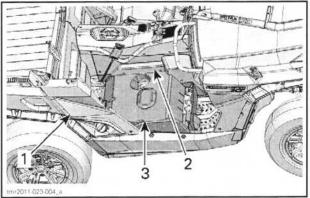
- 1. Drain fuel tank. Refer to *FUEL TANK DRAINING* above in this subsection.
- 2. Connect the vehicle to the applicable B.U.D.S. software version.
- 3. In B.U.D.S., select the following to disable the fuel pump:
  - Read Data button
  - Activation page tab
  - ECM page tab
  - Fuel pump Disabled.



1. Click here to disable the fuel pump

- 4. Release fuel pressure by running engine until it runs out of gas.
- 5. Disconnect battery, refer to CHARGING SYS-TEM subsection.

- Remove RH passenger seat, refer to the BODY subsection.
- 7. Refer to *BODY* subsection and remove the body parts indicated in the following illustration.

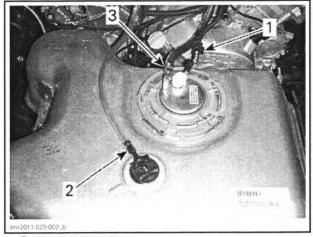


TYPICAL

- 1. RH Lateral body panel
- RH side panel on the console
   Fuel tank cover panel
- 5. Ther tank cover partor

8. Disconnect the fuel pump connector.

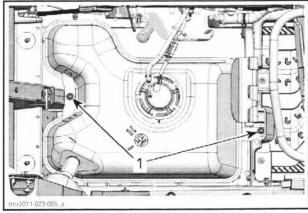
- 9. Remove the vent hose from the fuel tank valve.
- 10. Disconnect the high pressure fuel hose at the fuel injectors.



1. Fuel pump connector

2. Vent hose 3. High pressure fuel hose

11. Remove fuel tank retaining screws (2).



1. Fuel tank mounting screws (2)

12. Pull fuel tank out from the RH side of vehicle.

# **Fuel Tank Inspection**

Inspect fuel tank for any damages or cracks which may result in fuel leaks.

Inspect tank and protector attachment points for damages.

Inspect protector for damages.

If cracks, gouges or other damages which may lead to a fuel leak, or damages to attachment points that could prevent the tank from being secure are found, replace fuel tank.

# Fuel Tank Installation

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

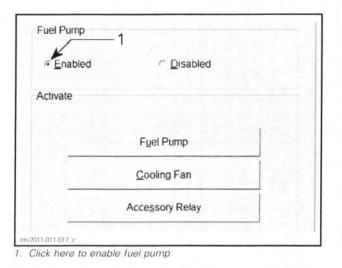
Be sure to reinstall the 2 rubber washers between the fuel tank and the frame.

Be sure to properly connect and route:

- Fuel tank vent tube
- Fuel pump pressure hose
- Electrical connector.

Using B.U.D.S., reactivate fuel pump by selecting **Enabled**.

Subsection 03 (FUEL TANK AND FUEL PUMP)



Refuel tank and ensure there are no leaks by performing a *FUEL TANK LEAK TEST* and a *FUEL PRESSURE TEST* as described in this subsection.

# FUEL PUMP

# Fuel Pump Pressure Test

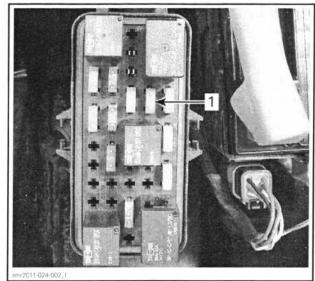
Refer to INSPECTION in this subsection.

# Fuel Pump Quick Test

- 1. Turn ignition key to ON.
- 2. Listen for fuel pump operation.
- 3. Fuel pump should come ON for a few seconds, then stop.

If fuel pump does operate as in previous steps, carry out the following:

- Check fuel pump fuse.
- Check in B.U.D.S. for applicable fault codes.
   Refer to COMMUNICATION TOOLS AND B.U.D.S. subsection.
- Carry out a fuel pump input voltage test.



1. Fuel pump fuse

# Fuel Pump Input Voltage Test

1. Remove RH passenger seat and fuel tank cover, refer to *BODY* subsection.

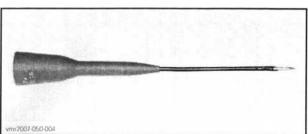
Disconnect the fuel pump connector.

2. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) with the FLUKE RIGID BACK PROBE (P/N TP88).

Set multimeter to Vdc.



FLUKE 115 MULTIMETER



FLUKE RIGID BACK PROBE

- 3. Set multimeter to Vdc.
- 4. Turn ignition key ON.
- 5. Read voltage as follows.

FUEL PUMP INPUT VOLTAGE TEST		
TEST PROBES		VOLTAGE READING
Fuel pump connector Pin 3	Fuel pump connector Pin 4	Battery voltage

If battery voltage is read, carry out a fuel pump resistance test.

If battery voltage is not read, test fuel pump power input as follows.

FUEL PUMP POWER WIRE TEST		
TEST PF	ROBES	VOLTAGE READING
Fuel pump connector Pin 3	Battery ground	Battery voltage

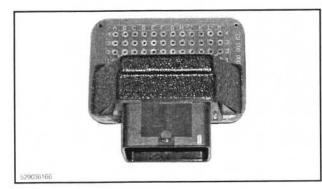
If battery voltage is now read, check fuel pump ground circuit between fuel pump connector 5-FP-4 and ECM connector 3-B-M1.

If battery voltage is still not read, check fuel pump:

- Fuse (F15)
- Power circuit
- Wiring and connectors.

# **Fuel Pump Resistance Test**

- 1. Remove the fuel pump fuse.
- Remove connector B from the ECM and connect it to the ECM ADAPTER TOOL (P/N 529 036 166).



- 3. Set multimeter to  $\Omega$ .
- 4. Measure fuel pump resistance as follows.

FUEL	PUMP RESIS	
TEST PROBES		RESISTANCE Ω @ 20°C (68°F)
Fuse box contact 5D	ECM B-M1	Approximately 2 $\Omega$

If resistance test failed, disconnect fuel pump connector and measure resistance at fuel pump connector.

	FUEL PUMP RESISTANCE TEST (AT FUEL PUMP CONNECTOR)	
Pins 1 and 2	Approximately 2 $\Omega$	

If test failed at pump connector, replace fuel pump.

If test succeeded at pump connector, check wiring and connectors from fuse box to ECM connector. Repair or replace as necessary.

# Fuel Pump Removal

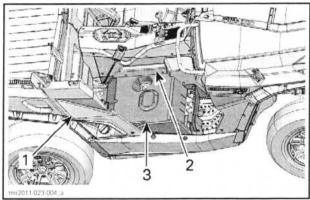
- 1. Using B.U.D.S., select the following to disable the fuel pump:
  - Read Data button
  - Activation page tab
  - ECM page tab
  - Fuel pump Disabled.

Fuel Pump	1	
○ Enabled	© Disabled	
Activate		
	Fyel Pump	
	<u>C</u> ooling Fan	
	Accessory Relay	
tmr2011-011-017_b		

1. Click here to disable the fuel pump

- 2. Release fuel pressure by running engine until it runs out of gas.
- 3. Refer to *BODY* subsection and remove the body parts indicated in the following illustration.

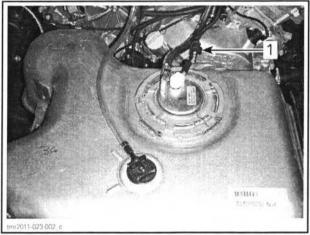
#### Section 04 FUEL SYSTEM Subsection 03 (FUEL TANK AND FUEL PUMP)



#### TYPICAL

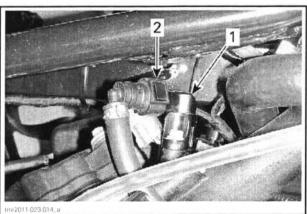
- 1. RH Lateral body panel 2. RH side panel on the console 3. Fuel tank cover panel

- 4. Disconnect fuel pump electric connector.



Fuel pump connector

5. Disconnect high pressure fuel hose at fuel rails (2 disconnects).



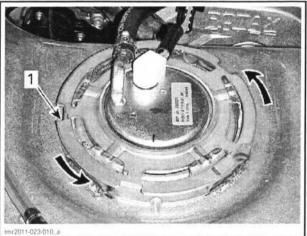
Fuel rail (1 each cylinder)

2. High pressure fuel hose disconnect ((1 each cylinder)

6. Using a soft face hammer and a brass drift in the notched portion of the locking ring, remove fuel pump locking ring.

#### A WARNING

Fuel vapors are flammable and explosive under certain conditions. Use only non-sparking tools.



FUEL PUMP LOCKING RING REMOVAL 1. Notch in fuel pump locking ring

7. Carefully pull out fuel pump.

A CAUTION While pulling out the fuel pump, pay attention to fuel sender float arm. Float arm can get stuck and bend reducing fuel sender accuracy.

8. Discard gasket ring.

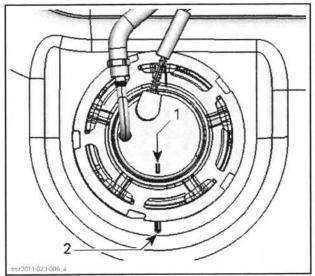
#### Fuel Pump Installation

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

#### A CAUTION Manipulate fuel pump with care.

- 1. Install a NEW gasket ring.
- 2. Place gasket so that it is located between pump and tank mounting surface.

- Gasket ring here
- 2 Fuel pump flange
- 3. Pump locking ring
- 3. Pay attention to pump orientation as in following illustration.



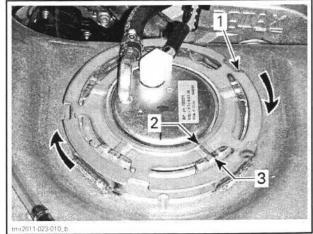
- Fuel pump index 1.
- 2. Fuel tank pump index
- 4. Insert fuel pump locking ring over the fuel pressure hose and electrical wiring connector.
- 5. While firmly holding pump against tank, engage fuel pump locking ring on fuel tank flange.
- 6. Using a soft face hammer and a brass drift in the notched portion of the locking ring, turn locking ring until it is fully engaged.

# 

Fuel vapors are flammable and explosive under certain conditions. Use only non-sparking tools. Ensure pump locking ring is fully engaged.

# Section 04 FUEL SYSTEM

Subsection 03 (FUEL TANK AND FUEL PUMP)



FUEL PUMP LOCKING RING INSTALLATION

- Notch in locking ring
   Raised portion in locking ring (5 places)
   Lock position on tank flange (5 places)
- 7. Using B.U.D.S., enable the fuel pump.

Enabled	☐ Disabled	
Activate		
	Fuel Pump	
	<u>C</u> ooling Fan	- 63
	Accessory Relay	

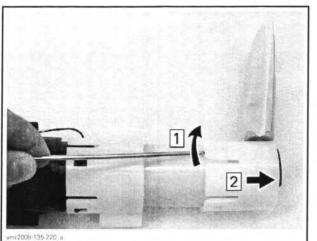
1. Click here to enable the fuel pump

- 8. Refuel tank and ensure there are no leaks by performing a FUEL TANK LEAK TEST and a FUEL PRESSURE TEST as described in this subsection.
- 9. Check fuel level sender operation.

### Fuel Pump Strainer Replacement

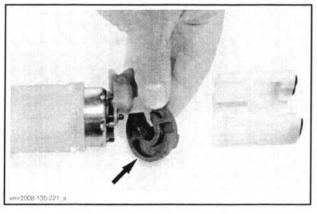
- 1. Remove FUEL PUMP, see FUEL PUMP RE-MOVAL procedure in this subsection.
- Unlock 3 tabs on plastic ring.

Subsection 03 (FUEL TANK AND FUEL PUMP)

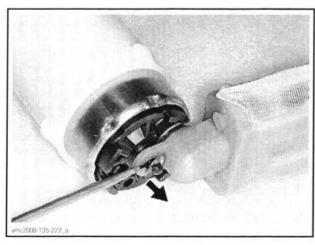


Step 1: Lift these tabs to unlock ring Step 2: Pull ring off pump inlet

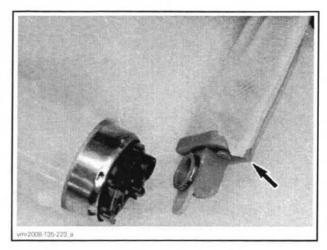
#### 3. Remove rubber pad.



4. Remove push nut securing strainer to fuel pump. Be careful not to break the plastic pin.



5. Pull strainer off fuel pump.

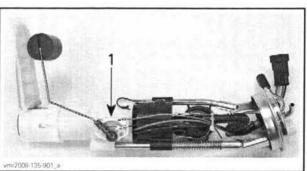


**NOTE:** A non serviceable filter is located in fuel pump. If it is clogged, replace fuel pump.

- 6. Insert the new strainer on fuel pump making sure to press it in tightly against pump face.
- 7. Press in a NEW push nut to secure strainer.
- 8. Reinstall remaining removed parts.

# FUEL LEVEL SENDER

The fuel level sender is a float actuated variable resistance type that is part of the fuel pump.

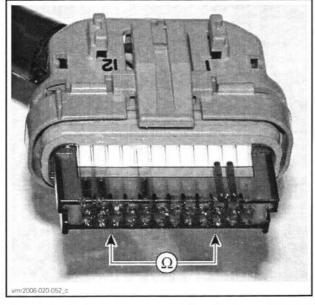


TYPICAL - FUEL PUMP 1. Fuel level sender

# Fuel Level Sender Resistance Test

- 1. Remove and disconnect multifunction gauge, refer to the *LIGHTS/GAUGE/ACCESSORIES* subsection.
- 2. Use a multimeter and select  $\Omega$ .
- 3. Measure the resistance of the sender as follows.

FUEL LEVEL SENDER RESISTANCE TEST		
FUEL LEVEL	GAUGE CONNECTOR	RESISTANCE Ω @ 20°C (68°F)
Full	Dine 4 and 21	5 $\Omega$ ± 1
Empty	Pins 4 and 21	$100 \ \Omega \pm 5$



If readings are out of specification, repeat test at fuel pump connector. If resistance test at fuel pump connector is not good, replace fuel level sender.

If readings are as specified, carry out a FUEL LEVEL SENDER INPUT VOLTAGE TEST.

# Fuel Level Sender Input Voltage Test

- 1. Set ignition switch to ON.
- 2. Disconnect fuel pump connector.
- 3. Use a multimeter and select Vdc.
- 4. Measure the input voltage as follows.

FUEL LEVEL S	ENDER INPUT	VOLTAGE TEST
FUEL PUMP CONNECTOR	BATTERY	VOLTAGE
Pin 1	Negative terminal	Battery voltage

If battery voltage is not read, test wiring continuity between sender and multifunction gauge.

If wiring continuity is good, replace multifunction gauge.

If continuity is not obtained, repair or replace wiring.

# Fuel Level Sender Replacement

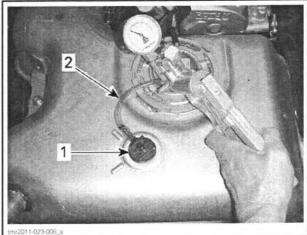
Replace fuel pump. See fuel pump removal and installation procedures in this subsection.

# FUEL TANK VENT VALVE

# Fuel Tank Vent Valve Test

# Test for Normal Operation

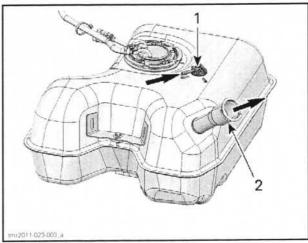
- 1. Disconnect vent hose from fuel tank vent valve.
- Connect the VACUUM/PRESSURE PUMP (P/N 529 021 800) and a short piece of hose to the fuel tank vent valve.



1. Fuel tank vent valve

2. Vent hose to vacuum/pressure pump

- 3. Remove fuel tank cap.
- 4. Set vacuum/pressure pump to PRESSURE and activate pump. The gauge on the pump should not change in reading; air should flow through the vent valve and fuel tank freely.

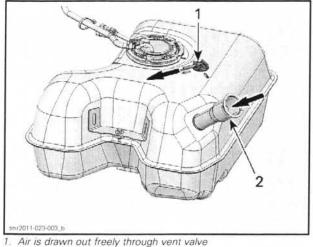


1. Air flows freely in through vent valve

2. Air flows out of fuel tank

#### Section 04 FUEL SYSTEM Subsection 03 (FUEL TANK AND FUEL PUMP)

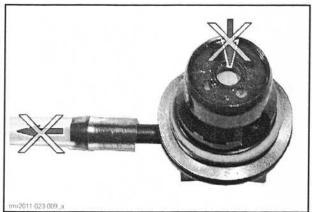
5. Set vacuum/pressure pump to VACUUM and activate pump. The gauge should not change in reading; air should flow through the vent valve and fuel tank freely.



1. Air flows in fuel tank

#### Test for Rollover Protection

- 1. Remove the fuel tank valve, refer to FUEL TANK VALVE REMOVAL AND INSTALLATION in this subsection.
- 2. Turn the valve upside down.
- 3. Set vacuum/pressure pump to VACUUM and activate pump. The vacuum gauge reading should increase; air should not flow through the valve.

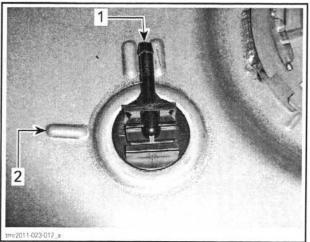


VALVE DOES NOT LET AIR PASS OUT UPSIDE DOWN

The fuel tank vent valve is defective if air flows freely through the valve when upside down and the vacuum indication does not increase on the pump gauge.

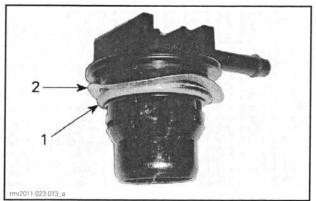
#### Fuel Tank Vent Valve Removal and Installation

- 1. When removing or installing the fuel tank vent valve, pay attention to the following:
  - Valve lock position index (dual)
  - Valve unlock position index.



Lock position index (dual) Unlock position index 1.

- 2. Remove the vent hose from the valve.
- 3. Use an open end wrench of the appropriate size on the rectangular portion of the valve to rotate it to the unlock position for removal.
- 4. Ensure the wave spring and O-ring seal on the valve to be installed are in good condition.

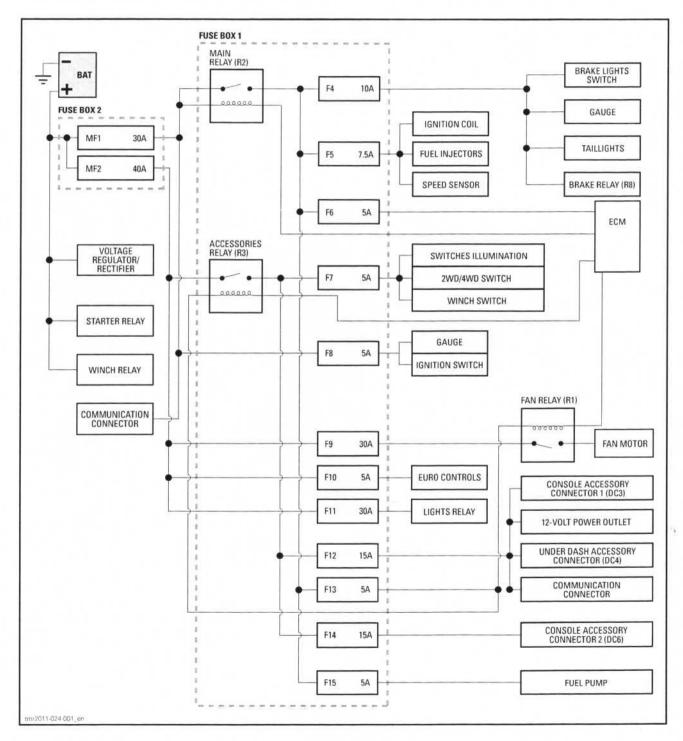


O-ring seal 1.

- Wave spring
- 5. Insert the valve in the tank.
- 6. Press down on the valve and rotate it so that its stem rests between the dual valve locking position index (see first illustration).
- 7. Reconnect the vent hose to the valve stem.

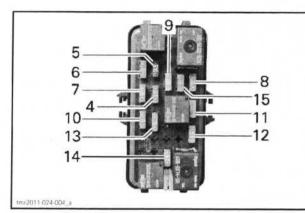
# **POWER DISTRIBUTION** GENERAL

# POWER DISTRIBUTION DIAGRAM

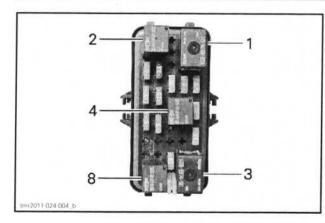


Subsection 01 (POWER DISTRIBUTION)

# FUSE BOX 1

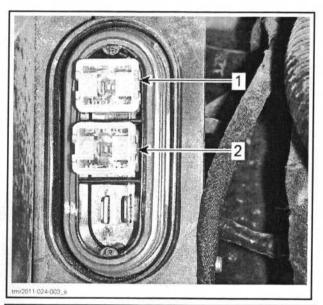


FL	JSE IDENTIFICA	TION
	4	10 A
[	5	7.5 A
[	6	5 A
	7	5 A
	8	5 A
Fuse	9	30 A
luse	10	5 A
	11	30 A
	12	15 A
	13	5 A
	14	15 A
	15	5 A



REL	AY IDENTIFIC	CATION
	1	Cooling fan
	2	Main
Relays	3	Accessories
	4	Headlights
	8	Brake lights

# FUSE BOX 2



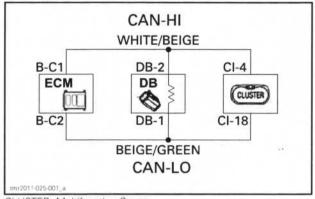
	FUSE	IDENTIFICATION	
Fuse	1	Main	30 A
Fuse	2	Fan/accessories	40 A

# CONTROLLER AREA NETWORK (CAN) GENERAL

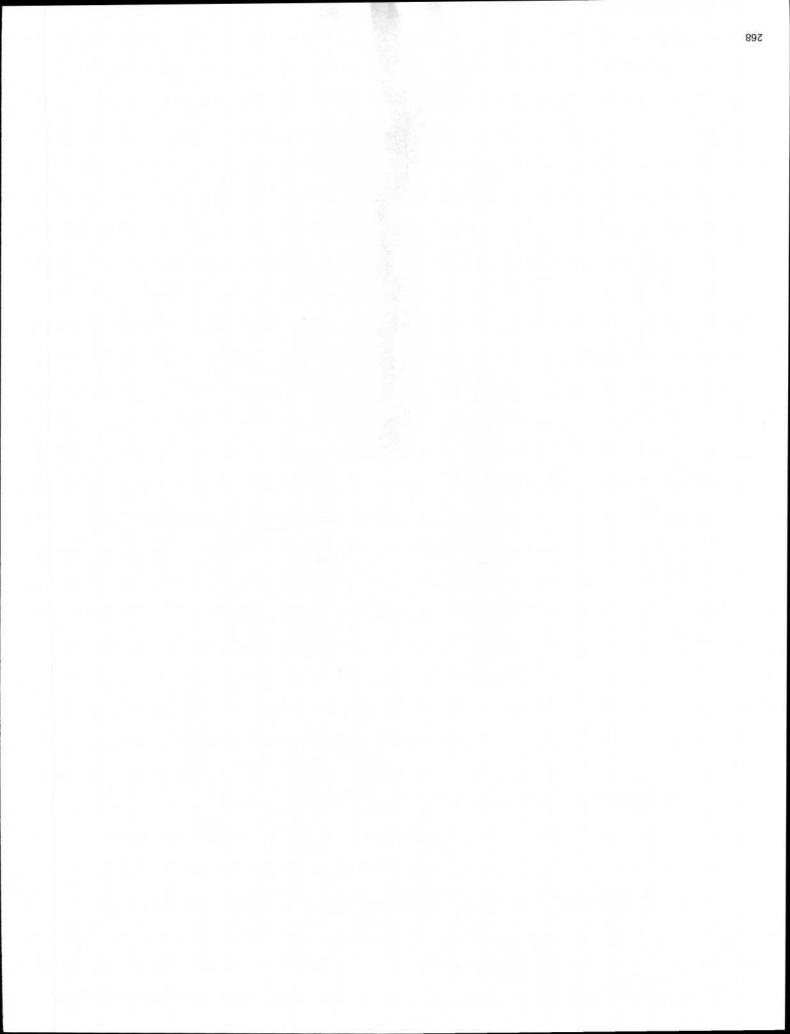
# SYSTEM DESCRIPTION

The CAN (Controller Area Network) protocol is an ISO standard for serial data communication. The CAN bus links the ECM and multifunction gauge together so that they communicate to interact as required. The components are connected together by 2 wires and they are in constant communication with each other at a rate of about every 20 milliseconds. CAN lines consist of a pair of wires (WHITE/BEIGE and BEIGE/GREEN).

If a component or system malfunction is detected, a module (ECM or multifunction gauge) may generate a fault code, which it transmits through the CAN bus as a signal. The fault signal may be used for various functions such as triggering the display of an error message in the multifunction gauge cluster, turning on a fault indicator light, limiting or inhibiting vehicle or engine operation, or viewed using the B.U.D.S. software for troubleshooting.



CLUSTER: Multifunction Gauge DB: Diagnostic Connector ECM: Engine Control Module WH/BE: White/Beige BE/GN: Beige/Green



# **IGNITION SYSTEM**

# SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	
FLUKE 115 MULTIMETER	529 035 868	

## GENERAL

### WARNING

Torque wrench tightening specifications must be strictly adhered to. Locking devices when removed (e.g.: locking

tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.) must be replaced.

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

# SYSTEM DESCRIPTION

The battery supplies the primary side of ignition coil through the main relay (R2) 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.

The EMS controls the ignition system. For more information, refer to *ENGINE MANAGEMENT* section.

## Ignition Timing

Ignition timing is not adjustable.

# TROUBLESHOOTING

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

Always refer to the *WIRING DIAGRAM* when troubleshooting an electrical circuit.

Refer to *POWER DISTRIBUTION* for fuse and relay information.

# DIAGNOSTIC GUIDELINES

The following is provided to help in diagnosing the probable cause of a problem. It is a guideline and should not be assumed to list all possible causes.

# ENGINE WILL NOT START (ENGINE TURNS OVER)

- 1. Fouled or defective spark plug Replace.
- 2. Defective CPS
  - Check operation of CPS and replace if necessary. Refer to ELECTRONIC FUEL INJECTION section.
- 3. Defective trigger wheel
  - Check. Refer to PTO HOUSING/MAGNETO.

#### 4. Defective ignition circuit

 Check fuse 5 of fuse box 1, ignition coil and wiring condition.

- 5. Defective fuel pump
  - Check fuel pump, refer to FUEL SYSTEM.
- Defective fuel injectors or circuit

   Check fuel injectors, refer to ENGINE MANAGE-MENT.

### ENGINE HARD TO START

- 1. Spark plug faulty, fouled or worn out - Check spark plug condition. Replace if necessary.
- 2. Low fuel pressure - Test fuel pressure, refer to FUEL SYSTEM.

### ENGINE MISFIRES, RUNS IRREGULARLY

- 1. Fouled, defective, worn spark plugs - Check/verify heat range/gap/replace.
- 2. Damaged trigger wheel/loose CPS - Check. Refer to PTO HOUSING/MAGNETO.
- 3. Defective ignition circuit - Check ignition coil, fuse 5, and wiring condition.
- Poor engine grounds

   Check/clean/repair.

Subsection 03 (IGNITION SYSTEM)

# ENGINE CONTINUALLY BACKFIRES

- 1. Fouled, defective spark plugs Clean/replace.
- 2. Damaged trigger wheel/defective or loose CPS - Check, refer to ELECTRONIC FUEL INJECTION.

# PROCEDURES

# IGNITION SWITCH

# Ignition Switch Quick Test

Turn ignition switch to ON position.

If multifunction gauge turns on (assuming it works), the ignition switch is good.

If multifunction gauge does not turn on, check the following in this order:

- Battery
- Fuses 1 and 2 of fuse box 2
- Fuse 4 and 8 of fuse box 1
- ECM is properly powered (refer to ENGINE MANAGEMENT)
- Ignition switch.

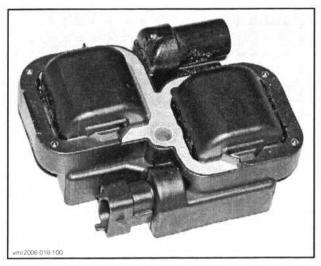
# Ignition Switch Access

Refer to BODY and remove upper console.

# Ignition Switch Wire Identification

FUNCTION	PIN	WIRE COLOR
12 Vdc output (lights)	А	YELLOW/BLUE
12 Vdc input	В	BEIGE/WHITE
Ground (through ECM)	С	ORANGE/VIOLET
Ground signal to ECM in OFF position	D	YELLOW/ORANGE
D.E.S.S. signal	E	ORANGE/RED
12 Vdc output (ECM, starter solenoid and start switch)	F	BLACK/YELLOW

# **IGNITION COIL**



# Ignition Coil Access

Refer to *BODY* and remove upper console.

# Ignition Coil Installation

Install a new elastic nut and tighten to the specified torque.

IGNITION COIL RETAINING BOLT TIGHTENING TORQUE

8N•m ± 1N•m (71 lbf•in ± 9 lbf•in)

# Quick Test with B.U.D.S.

Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* section.

In B.U.D.S., select the Activation tab and the ECM tab.

You should hear the spark occurring. In doubt, use an inductive spark tester. If there is no spark, perform the following checks.

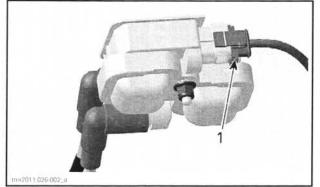
**NOTE:** Keep in mind that even if there is a spark during this static test, voltage requirement is higher to produce a spark in the combustion chamber when engine is running. Ignition coil could be not working in real operation. Replacing ignition coil may be necessary as a test.

**NOTE:** Ensure spark plug cable is on the appropriate cylinder.

# Ignition Coil Input Voltage Test

Disconnect the 3-pin connector from the ignition coil.

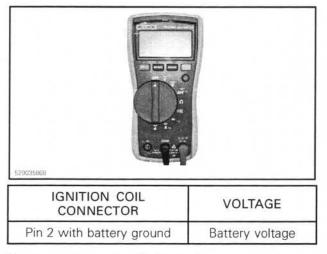
Subsection 03 (IGNITION SYSTEM)



1. Ignition coil connector

Turn ignition switch to ON.

Using a the FLUKE 115 MULTIMETER (P/N 529 035 868), read voltage.



Battery voltage should be read.

If Battery voltage is NOT read, check continuity of ignition coil supply circuit.

### Ignition Coil Ground Circuit Continuity Test

Disconnect the ECM connector "A" and connect it to the ECM ADAPTER TOOL (P/N 529 036 166).



Check wiring continuity as per following table.

COMPONENT	PIN (IGNITION COIL CONNECTOR)	PIN (ECM CONNECTOR)
Cylinder 1 (front)	1	A-M1
Cylinder 2 (rear)	3	A-M2

### 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 cables from spark plugs.

#### **Primary Windings**

Disconnect ECM "A" connector and connect it to the ECM ADAPTER TOOL (P/N 529 036 166).

Using a multimeter, check resistance in primary windings as follows.

PRIMARY CIRCUIT	ENGINE CONNECTOR (HIC)	ECM CONNECTOR "A"	RESISTANCE @ 20°C (68°F)
Cylinder 1 (front)		A-M1	
Cylinder 2 (rear)	Pin E	A-M2	.36 Ω

If any resistance is not good, measure resistance directly on coil. If second test is ok, check wiring.

#### Secondary Windings

Due to the integrated diode, it is not possible to take any resistance measurement of the secondary winding.

## SPARK PLUG

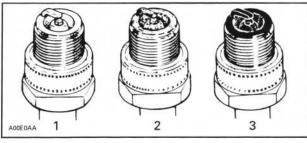
For spark plug replacement procedure, refer to *PERIODIC MAINTENANCE PROCEDURE* subsection.

### 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

Overheated (light grey, white)
 Normal (light brown, brown)
 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).

# **CHARGING SYSTEM**

# SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	

# SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	

# GENERAL

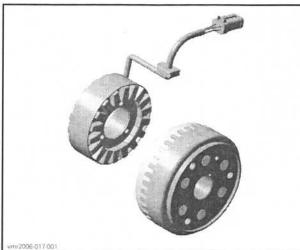
# SYSTEM DESCRIPTION

The purpose of the charging system is to keep the battery at a full state of charge and to provide the electrical system with the required electrical power for normal vehicle operation.

### Magneto

The magneto is the primary source of electrical energy. It transforms magnetic field into electric current (AC).

The magneto has a 3 phase series stator.

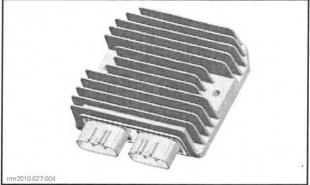


TYPICAL

## Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage to prevent any damage to electrical components.



TYPICAL - VOLTAGE REGULATOR/RECTIFIER

### Battery

The battery supplies DC power to the electric starter for cranking the engine. During engine starting, it also supplies DC power to the entire electrical system.

At low engine RPM operation and high current load conditions, it supplements the magneto output and helps to maintain a steady system voltage.

# INSPECTION

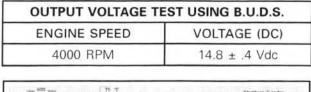
# CHARGING SYSTEM OUTPUT

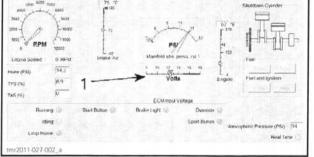
First ensure that battery is in good condition prior to performing the following tests.

## Output Voltage Test Using B.U.D.S.

- 1. Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- 2. In B.U.D.S., select the **Monitoring** tab then the **ECM** tab.
- 3. Start engine.

4. Increase engine RPM as specified in the following table and read voltage in the ECM Input Voltage box.





1. ECM Input Voltage box

If voltage is above specification, replace voltage regulator/rectifier.

If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *MAGNETO SYSTEM* subsection.

# Output Voltage Test Using a Multimeter

- 1. Set multimeter to Vdc.
- 2. Connect multimeter to battery posts.
- 3. Start engine.
- Increase engine RPM as specified in the following table and read voltage with the multimeter.

OUTPUT VOLTAGE TEST U	JSING A MULTIMETER
TEST ENGINE SPEED	VOLTAGE (DC)
4000 RPM	14.8 ± .4 Vdc

If voltage is above specification, replace voltage regulator/rectifier.

If voltage is below specification, check stator and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *MAG-NETO SYSTEM* subsection.

# TROUBLESHOOTING

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

## BATTERY REGULARLY DISCHARGED OR WEAK

- 1. Loose or corroded battery cables connections.
- Tighten or repair battery cables connections.
- Worn or defective battery.
   Charge and test battery.
- 3. Defective magneto stator.
  - Test stator.
- 4. Defective regulator/rectifier.
  - Test system voltage.
- 5. Damaged magneto rotor or Woodruff key. - Replace magneto rotor or Woodruff key.

# PROCEDURES

# VOLTAGE REGULATOR/ RECTIFIER

# Voltage Regulator/Rectifier Static Test

Due to internal circuitry, there is no static test available.

# Voltage Regulator/Rectifier Access

The voltage regulator/rectifier is located on the LH side, underneath dashboard, on the RH side of the battery rack.

# Voltage Regulator/Rectifier Wire Identification

FUNCTION	PIN	COLOR
12 Vdc output	RD1-1	RED
12 Vdc ground	RD1-3	BLACK
12 Vac input	RD2-1	YELLOW
12 Vac input	RD2-2	YELLOW
12 Vac input	RD2-3	YELLOW

# 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.

Subsection 04 (CHARGING SYSTEM)

### Battery Voltage Test (No Load Applied)

**NOTE:** A voltage test is carried out 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.

A voltage reading provides an instant indication of the state of charge of the battery, not of it's current output capacity. A load test gives a more accurate indication of the battery's condition.

If the battery has just received a charge, allow it to rest for 1 - 2 hours before taking a voltage reading.

Set multimeter to Vdc and connect to battery terminals. Always respect polarity.

FULLY CHARGED BATTERY VOLTAGE
12.6 Vdc minimum

**NOTE:** A battery that shows a voltage of 12.0 Vdc is considered completely discharged and need to be recharged.

### **Battery Load Test**

This is the best test to indicate a battery condition. Use a load testing device such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260). It has a 500 Amp adjustable load.

Apply a load of 3 times the ampere-hour rating of the battery. At 14 seconds into the test, check battery voltage.

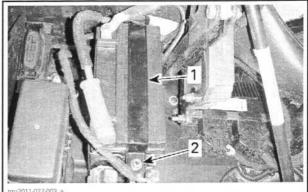
TIME TO MEASURE INTO TEST	VOLTAGE
14 seconds	Min. 10.5 Vdc @ 20°C (68°F)

### **Battery Removal**

1. Disconnect BLACK (-) cable first, then the RED (+) cable.

**NOTICE** Always respect this order for removal; disconnect BLACK (-) cable first.

2. Remove battery strap retaining nut.



. Battery strap

2. Battery strap retaining nut

- 3. Unhook the top of battery strap.
- 4. Remove battery.

### **Battery Cleaning**

Clean the battery rack, cables and battery posts using a solution of baking soda and water.

Remove corrosion (if so) from battery cable terminals and battery posts using a firm wire brush. Rinse with clear water and dry well.

#### **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.

### A WARNING

Ensure to store battery in a safe place, out of reach for children.

### **Battery Installation**

**NOTICE** Always connect RED (+) cable first then BLACK (-) cable.

# Subsection 04 (CHARGING SYSTEM)

Installation is the reverse of removal procedure, however pay attention to the following:

- Install the battery with the positive post down.
- Tighten battery strap retaining nut to the specified torque.

#### BATTERY STRAP RETAINING NUT TIGHTENING TORQUE

3.4 N•m ± 0.3 N•m (30 lbf•in ± 3 lbf•in)

# **STARTING SYSTEM**

## SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	
FLUKE 115 MULTIMETER	529 035 868	

# SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	

## GENERAL

### 

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

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

# SYSTEM DESCRIPTION

The starting system is composed of an electric starter supplied in current by the battery through a solenoid.

The starter solenoid receives a 12 volt input from the ignition switch and the ground signal is provided by the ECM when the following engine cranking conditions are met.

- Ignition switch ON.
- Transmission in Park or Neutral position and/or brake pedal held.
- Start button held.

**NOTE:** If the ignition switch is left ON for more than 15 minutes, engine will not start unless ignition switch is turned OFF, then ON again.

# TROUBLESHOOTING

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

NOTE: Clear any fault code after solving a problem. Always refer to the *WIRING DIAGRAM* when troubleshooting an electrical circuit.

Refer to *POWER DISTRIBUTION* for fuse and relay information.

Check all connections, cables and wires. Tighten any loose connections. Replace any chafed or corroded wires/cables.

# DIAGNOSTIC GUIDELINES

#### FUSE 8 INFUSE BOX 1 BURNS WHILE ATTEMPTING TO CRANK ENGINE

#### 1. Defective D2 Diode

- Test diode, see procedure in this subsection.

- 2. Defective starter solenoid
  - Test starter solenoid, see procedure in this subsection.
- 3. Wiring short to ground

- Check wiring.

# ENGINE DOES NOT CRANK AND GAUGE DOES NOT TURN ON

- 1. Burnt main fuse (F1) in fuse box 2 - Check fuse.
- Burnt fuse F8 in fuse box 1

   Check fuse.
- 3. Defective or discharged battery - Test battery, refer to CHARGING SYSTEM.
- Defective ignition switch or circuit

   Check ignition switch, refer to IGNITION SYSTEM.

Subsection 05 (STARTING SYSTEM)

### ENGINE DOES NOT CRANK BUT GAUGE TURNS ON

1. Defective brake switch

- Check brake switch, refer to BRAKES section.

2. Defective gearbox position sensor (GPBS)

- Check GPBS, refer to GEARBOX AND 4X4 COU-PLING UNIT subsection.

- 3. Defective start button or circuit
  - Test start button, see procedure in this subsection.
- 4. Defective starter solenoid or circuit

- Test starter solenoid, see procedure in this subsection.

- 5. Defective starter motor
  - Check starter motor, see procedure in this subsection.

# PROCEDURES

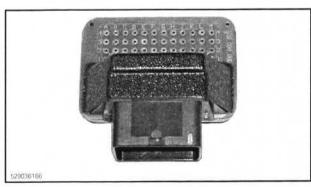
# D2 DIODE (STARTER SOLENOID)

# **Diode Location**

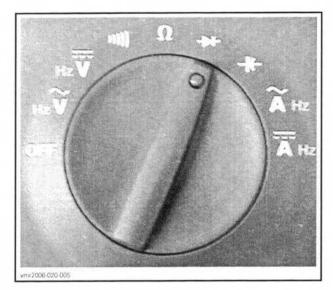
The diode is located in the main harness, near starter solenoid.

# Diode Test

- 1. Make sure ignition switch is OFF.
- 2. Disconnect pins SS1 and SS2 from starter solenoid.
- 3. Disconnect ECM connector B.
- 4. Connect ECM ADAPTER TOOL (P/N 529 036 166) to the ECM connector B.



5. Set multimeter to "diode check".



6. Test diode as per following table.

D2 DIODE TEST			
MULTIMETER POSITIVE PROBE	MULTIMETER NEGATIVE PROBE	RESULT	
ECM-B pin A2	ECM-B pin L4	Overload (open)	
ECM-B pin L4	ECM-B pin A2	Approximately 0.5 volts	

If diode fail any test, replace it.

# START BUTTON

## Start Button Access

Remove upper console.

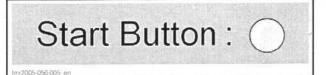
## Start Button Wire Identification

FUNCTION	PIN	COLOR
12 volt input from ignition switch	1	BLACK/YELLOW
12 volt output to ECM-B pin D1	2	YELLOW/RED

# Start Button Test with B.U.D.S.

Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* section.

In B.U.D.S., select the **Monitoring** and **ECM** tabs. Press the vehicle's start button and look at the **Start Button** LED.



It should turn on, indicating the start signal reaches the ECM.

If it does not turn on, check the start button and wiring.

## Start Button Resistance Test

Disconnect start button connector.

Using the FLUKE 115 MULTIMETER (P/N 529 035 868), measure resistance as per the following table.

POSITION	START BUTTON CONNECTOR PIN		RESISTANCE
Switch released			Infinite (OL)
Switch depressed and held	1	2	0.6 Ω max.

Replace start button if defective.

# STARTER SOLENOID

### Starter Solenoid Access

The starter solenoid is located on the LH side, underneath dashboard, on top of battery rack.

To access starter solenoid, remove the CVT vent inlet tube.

### Starter Solenoid Wire Identification

FUNCTION	PIN	WIRE COLOR
12 volt input from ignition switch	SS1	BLACK/ YELLOW
Ground from ECM-B pin L4	SS2	ORANGE/ BROWN

### Starter Solenoid Operational Test

- 1. Disconnect both terminals (SS1 and SS2) from the starter solenoid.
- 2. Connect SS1 to the positive battery terminal.
- 3. Momentarily connect SS2 to the chassis ground.

If starter runs, carry out the *STARTER SOLENOID INPUT VOLTAGE TEST*.

If starter does not run, carry out the STARTER SO-LENOID WINDING RESISTANCE TEST.

### Starter Solenoid Input Voltage Test

- 1. Disconnect connector with BLACK/YELLOW wire.
- 2. Turn ignition switch ON.
- 3. Measure voltage as per following table.

STARTER SOLENOID INPUT VOLTAGE TEST		
TEST PROBES		RESULT (START BUTTON RELEASED)
BLACK/ YELLOW wire	Battery ground	Battery voltage

### Starter Solenoid Ground Signal Test

- Disconnect SS2 (ORANGE/BROWN) from solenoid.
- 2. Turn ignition switch ON.
- 3. Measure voltage as per following table.

STARTER S	OLENOID GROU	JND SIGNAL TEST
TEST PROBES		RESULT (START BUTTON DEPRESSED)
ORANGE/ BROWN wire	Battery positive post	Battery voltage

### Starter Solenoid Winding Resistance Test

Disconnect terminals from solenoid.

With a multimeter, check primary winding resistance as follows.

STA	RTER SOLENOIL RESISTANCE	
TEST PROBES		RESULT @ 20°C (68°F)
Starter solenoid SS1 pin	Starter solenoid SS2 pin	Approximately 5 $\Omega$

If measurement is out of specification, replace solenoid.

Starter Solenoid Voltage Drop Test Turn ignition key ON.

Subsection 05 (STARTING SYSTEM)

Measure voltage as per following table while cranking engine in drowned mode (to prevent engine starting).

NOTE: For drowned mode, refer to ENGINE MANAGEMENT subsection.

STARTER SOLENOID VOLTAGE DROP TEST		
TEST PROBES		RESULT (WHILE CRANKING)
Post coming from battery	Post going to starter	0.2 Vdc max.



mr2006-019-009\_a

If voltage is out of specification, replace solenoid.

# ELECTRIC STARTER

#### Starter Access

To access starter electrical terminal, refer to BODY and remove LH seat and LH lateral console panel.

To access starter for removal, remove drive pullev. driven pulley and CVT back cover, refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) subsection.

### Starter Operation Test

Using booster cables, carefully supply current from a 12 volt 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, test other starting system components.

### Starter Removal

Turn OFF ignition switch.

Disconnect BLACK (-) cable from battery.

### A WARNING

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

Disconnect RED (+) cable from starter.

Clean starter area.

Remove starter retaining screw.



TYPICAL - SOME PARTS REMOVED FOR CLARITY PURPOSE ONLY

Carefully pry starter out of the engine crankcase.

### 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 crankcase.

Push starter in place and align mounting ear to install screw. Tighten to the specified torque.

STARTER MOUNTING S	
Starter mounting screw	25 N•m (18 lbf•ft)

Connect the RED (+) cable to the starter and tighten nut and apply specified product.

**A** CAUTION When connecting the RED (+) cable to the starter motor, make sure the battery cables are disconnected.

STARTER CABLE NUT		
TIGHTENING TORQUE	PRODUCT	
6 N∙m (53 lbf•in)	DIELECTRIC GREASE (P/N 293 550 004)	

First connect RED (+) cable to battery then connect the BLACK (-) cable.

Connect battery cables.

# Always connect RED (+) cable first then BLACK (-) cable last.

Test starter operation.



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Subsection 06 (DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.))

# DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.)

## GENERAL

# SYSTEM DESCRIPTION

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 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.

**NOTE:** All ignition keys have the same teeth pattern. Therefore, they can be used and turned in the switch of any D.E.S.S.-equipped vehicle. However, unless the D.E.S.S. 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.

Up to 10 ignition keys may be programmed in the memory of the ECM. They can also be erased individually or all at once.

Note that the D.E.S.S. circuitry is already activated on all new ECM.

# TROUBLESHOOTING

## DIAGNOSTIC TIPS

**NOTE:** It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step.

If D.E.S.S. 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.

# PROCEDURES

## **KEY PROGRAMMING**

Use the appropriate B.U.D.S. software version available from BOSSWeb. Refer to *COMMU-NICATION TOOLS AND B.U.D.S. SOFTWARE* subsection for proper connection instructions.

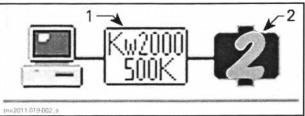
The B.U.D.S. software is designed to allow, among other things, the programming of ignition key(s) and entering customer information.

For more information pertaining to the use of the software B.U.D.S., use its help which contains detailed information on its functions.

### 

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.

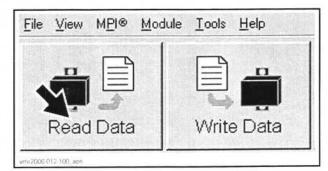
- 1. Turn ignition switch to ON using any of the key provided with the vehicle. DO NOT start the engine.
- 2. Start B.U.D.S. and logon.
- 3. Wait during detection setup.
- 4. Ensure the status bar shows the Kw2000 protocol and the appropriate number of modules to its right according to the vehicle model.



TYPICAL - SUCCESSFUL CONNECTION

1. Connection protocol 2. Number of modules

#### 5. Click the Read Data button.



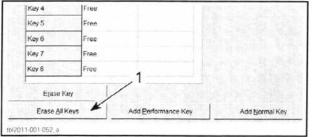
6. Click on Keys tab.

#### Section 05 ELECTRICAL SYSTEM Subsection 06 (DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.))

Head Data	1	الالتينية (Starting	2
Verticale	Keys	Setting	Montosing
KeyUsage		State	Туре
Key Usage	Used	State	Туре
	Used Uxed	State	Туре

#### KEYS TAB

7. Click on Erase All Keys button.

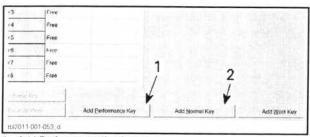


1. Click here to erase all keys

- 8. Click "YES" to confirm the action.
- 9. Confirm key color in ignition switch.
- 10. Program the key by selecting the right type according to chart.

KEY	KEY TYPE
BLACK key	Performance key
GRAY key	Normal key

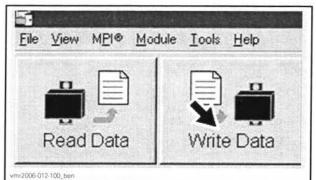
NOTE: The work key (ORANGE key) is optional.



1. Add Performance Key button 2. Add Normal Key button

- 11. Turn ignition switch to OFF. Remove the key.
- 12. Install the other key.
- 13. Turn ignition key to ON position.

- 14. Program the other key by selecting the right type according to above chart.
- 15. Repeat previous steps to program other keys.
- 16. Click on Write Data button to transfer new settings and information to the ECM.



WRITE DATA BUTTON

- 17. Click on EXIT button to end session.
- 18. Disconnect all cables and hardware from vehicle.
- 19. Ensure to reinstall the connector into its housing.

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

# LIGHTS, GAUGE AND ACCESSORIES

# SERVICE PRODUCTS

#### Description

DIELECTRIC GREASE

GENERAL	G	EI	N	E	R	A	L
---------	---	----	---	---	---	---	---

**NOTICE** 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.

# TROUBLESHOOTING

# DIAGNOSTIC TIPS

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

**IMPORTANT:** When troubleshooting an electrical system fault, check battery condition, cables and connections first.

## **Circuit Testing**

Check the related-circuit fuse condition with a fuse tester or test lamp (a visual inspection could lead to a wrong conclusion).

NOTE: If the ignition switch is left ON for more than 30 minutes, the accessory relay will shut down.

## **Electrical Connection Inspection**

When replacing an electric or electronic component, always check electrical connections. Make sure they are tight, make good contact, and are corrosion-free. Dirty, loose or corroded contacts are poor conductors and are often the source of a system or component malfunction.

Pay particular attention to ensure that pins are not bent or pushed out of their connectors.

Ensure all wire terminals are properly crimped on wires, and connector housings are properly fastened.

Check for signs of moisture, corrosion or dullness. Clean pins properly and coat them with DIELEC-TRIC GREASE (P/N 293 550 004) or other appropriate lubricant when reassembling them, except if otherwise specified such as for the ECM connectors. Pay attention to ground wires.

# PROCEDURES

# CONSOLE SWITCHES

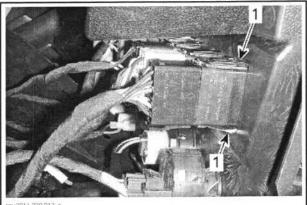
## Switches Access

Refer to *BODY* and remove upper console.

## Switches Removal and Installation

Disconnect electrical connector.

Release retaining clips, then push switch out of the console.



1. Retaining clips

For installation, reverse removal procedure.

### Switches Illumination Wire Identification

FUNCTION	PIN	COLOR
12 volt input from fuse F7	See note	RED/BLACK

**NOTE:** The illumination circuit of all console switches is supplied by the RED/BLACK wire (except hazard switch if equipped) but the pin location differ from one to another.

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

# Switches Illumination Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with accessories relay activated	Fuse 7 of fuse block 1 (from accessories relay R3)

# MULTIFUNCTION GAUGE (LCD AND ANALOG/DIGITAL)

# Multifunction Gauge Wire Identification

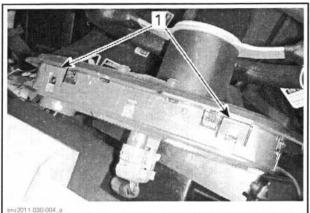
FUNCTION	PIN	COLOR
12 volt input from fuse F4	17	ORANGE/GREEN
12 volt input from fuse F8	16	BEIGE/WHITE
Ground	20	BLACK
CAN LO	18	BEIGE/GREEN
CAN HI	19	WHITE/BEIGE
Fuel level gauge supply	4	BROWN/PINK
Fuel level gauge ground	21	VIOLET/PINK
2WD/4WD switch signal (-)	7	BLACK/BEIGE
HI beam signal (+)	5	BLUE

# Multifunction Gauge Circuit Protection

CONDITION	CIRCUIT PROTECTION	
Supplied at all times	Fuse 8 of fuse block 1 (from fuse 1 of fuse block 2)	
Supplied with main relay activated	Fuse 4 of fuse block 1 (from main relay R2)	

## Multifunction Gauge Removal

- 1. Remove gauge cover.
- 2. Disconnect gauge connector.
- 3. Release retaining clips at the top of gauge.



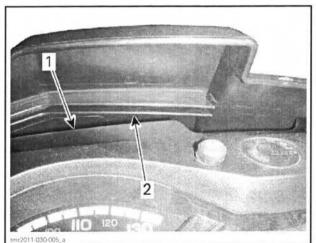
#### ANALOG/DIGITAL GAUGE SHOWN 1. Retaining clips

Tilt top of gauge rearward, then pull it up to remove it from its support.

### Multifunction Gauge Installation

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

Align gauge support top in the gauge cover slots on each side.



ANALOG/DIGITAL GAUGE SHOWN
1. Gauge support top
2. Gauge cover slot

### Maintenance Soon Message

### Maintenance Soon Message Manual Reset

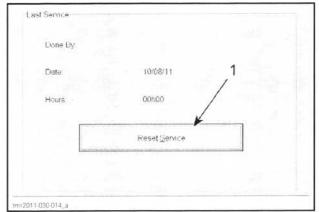
With the ignition switch ON, alternately depress the override button and brake pedal 3 times.

# Maintenance Soon Message Reset Using B.U.D.S.

Connect to the applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

Select Vehicle tab.





Reset Service button 1.

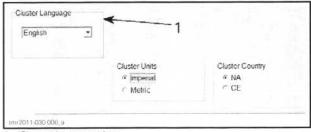
### Multifunction Gauge Set-Up Using B.U.D.S.

Connect to the applicable B.U.D.S. software. Refer to COMMUNICATION TOOLS AND B.U.D.S. subsection.

#### Language Selection

Select Setting and Cluster tabs.

Scroll and select the desired display language in the Cluster Language box.

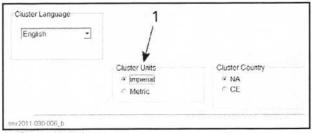


Cluster Language box 1.

#### **Units Selection**

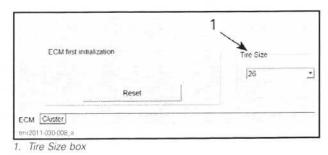
Select Setting and Cluster tabs.

Select Imperial or Metric in the Cluster Units box.



Cluster Units box

**Tire Size Selection** Select Setting and ECM tabs. Scroll and select the appropriate tire diameter (see inscriptions on the tires) in the Tire Size box.



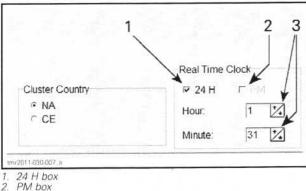
#### **Clock Setting**

Select Setting and Cluster tabs.

To set clock to the 24-hour format, check the 24 H box. To set it to the 12-hour format, leave the box empty.

If 12-hour format was selected, check the PM box if required.

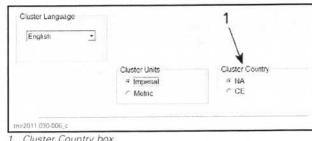
Set hour and minutes using the up or down arrows.





### **Country Selection**

To enable flasher pilot lamp on European Community (CE) models, select Cluster and Setting tabs. Select CE in the Cluster Country box.



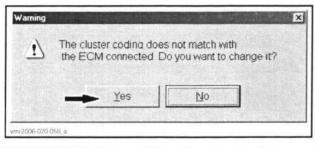
Cluster Country box 1

Outside Europe, select NA.

#### Section 05 ELECTRICAL SYSTEM Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

# 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.

## Multifunction Gauge Test with B.U.D.S.

Connect to the applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

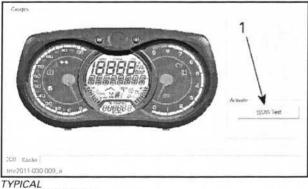
#### Wow Test

This function is used to check if the indicator lights, display and analog indicators (if applicable) are functional.

NOTE: This function does not test the signals or external circuits.

Select the Activation and Cluster tabs.

Click on the WOW Test button.



1. WOW Test button

### Indicator Lights Monitoring

Select Monitoring and Cluster tabs.

Use the **Cluster Lamp Active** box to monitor different indicator lights outputs.

Oil Pres	sure switch:	Engine Hi Temp:
	Low Fuel:	Engine Warning:
	Low Batt:	
	High bat: 🛞	
ECM Clust	er	

CLUSTER LAMP ACTIVE BOX

This function confirms that the signals are broadcasting and the indicator lights should be ON in the multifunction gauge.

#### Switches Input Monitoring

Select Monitoring and Cluster tabs.

Use the **Switch Inputs** box to monitor different switch inputs as you activates the switches.

Switch inputs	Real Lime:
Flasher L:	Mode Button:
4WD:	Set Button:
	High Beam: 🔘
	Park Brake:

SWITCH INPUTS BOX

This function confirms that the ECM receives the inputs.

#### Vehicle Parameters Monitoring

Select Monitoring and Cluster tabs.

In the upper area, the fuel level, engine speed (RPM), vehicle speed and engine coolant temperature are displayed.

This function confirms that the signals are broadcasting and the information should be displayed on the multifunction gauge.

# **12 VOLT POWER OUTLET**

# 12 Volt Power Outlet Removal and Installation

Refer to BODY and remove upper console.

Unplug the connectors of the power outlet.

Unscrew the retaining nut.

Reverse procedure for installation.

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

# 12 Volt Power Outlet Wire Identification

FUNCTION	PIN	COLOR
12 volt input from fuse F12	2	RED/BROWN
Ground (to ground terminal BK3)	1	BLACK

### 12 Volt Power Outlet Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with	Fuse 12 of fuse block
accessories relay	1 (from accessories
activated	relay R3)

# HEADLIGHTS

### Headlight Wire Identification

HEADLIGHTS RELAY (R4)			
FUNCTION	PIN	COLOR	
12 volt input from fuse F11 (headlights power)	7D	YELLOW/BLACK	
12 volt input from ignition switch pin A (relay winding input)	6D	YELLOW/BLUE	
12 volt output to headlights low beam and low/high beam switch	6C	GREEN	
Relay winding ground (from ECM-B G1)	7C	ORANGE/BLACK	

#### HEADLIGHT LOW/HIGH BEAM SWITCH (EXCEPT EUROPE)

			_
FUNCTION	PIN	COLOR	
12 volt input from headlights relay	2	GREEN	
12 volt output to high beam headlights	3	BLUE	

HEADLIGHT LOW/HIGH BEAM SWITCH (EUROPE - IN MULTIFUNCTION SWITCH)			
FUNCTION	PIN	COLOR	
12 volt input from headlights relay	MGC-4	GREEN	
12 volt output to high beam headlights (HI position)	MGC-5	BLUE	
12 volt output to high beam headlights (PASS position)	MGC-2	BLUE	

## **Headlights Circuit Protection**

CONDITION	CIRCUIT PROTECTION
Supplied at all times	Fuse 11 of fuse block 1 (from fuse 2 of fuse block 2)

### **Headlight Test**

Disconnect headlight connector. Refer to *BULB REPLACEMENT*.

Using a multimeter, measure the voltage on headlight connector as follows.

SWITCH POSITION	WIRE COLOR		VOLTAGE
LO beam/ HI beam	GREEN (Low beam bulb)	BLACK	Battery
HI beam	BLUE (Hi beam bulb)	BLACK	voltage

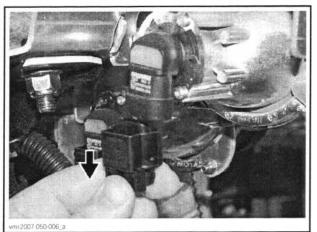
### Headlight Bulb Replacement

**NOTICE** 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.

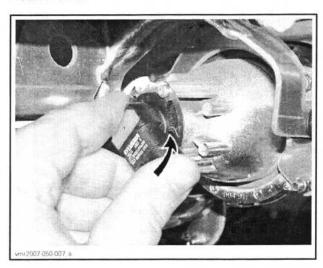
**NOTE:** The same bulb type is used for LO and HI beams on both sides of vehicle.

Unplug connector from bulb.

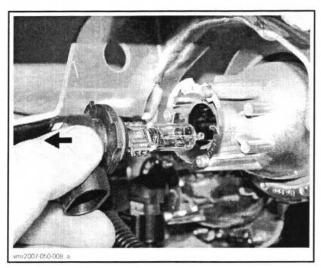
Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)



Rotate bulb.



Pull bulb out.



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

Validate headlight operation.

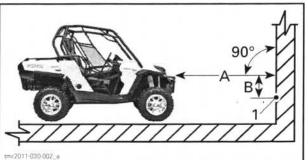
# Headlamp Beam Aiming

Select high beam.

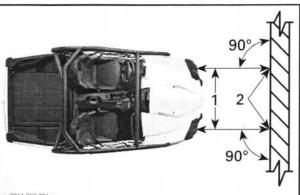
Beam aiming is correct when center of high beam is 130 mm (5 in) below the headlight horizontal center line, scribed on a test surface, 5 m (16 ft) away.

NOTE: Load vehicle as per normal use.

Measure headlight center distance from the ground. Scribe a line at this height on test surface (wall or screen). Light beam center should be 130 mm (5 in) below scribed line.



- 1. Light beam center
- A. 5 m (17 ft)
- B. 131 mm (5 in)



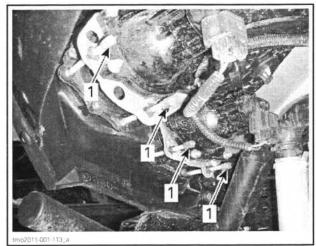
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1. Headlight center lines 2. Light beam center

## Beam Aiming Adjustment

Turn adjustment screws to adjust beam height and side orientation as described below. Adjust both headlight evenly.

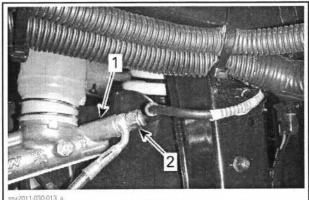
Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)



1. Adjustment screws

# TAILLIGHTS/BRAKE LIGHTS Taillight/Brake Light Switch Access

The taillight/brake light switch is located on the brake master cylinder.



- Master cylinder Taillight/brake light switch 1.

### Taillight/Brake Light Wire Identification

BRAKE LIGHT RELAY (R8)				
FUNCTION	PIN	COLOR		
12 volt input from fuse F4 (LH brake light power)	12B	ORANGE/GREEN		
12 volt input from brake light switch (relay winding input)	11B	RED/ORANGE		
12 volt output to LH brake light	11A	WHITE/ORANGE		
Relay winding ground (to ground terminal BK2)	12A	BLACK		

BRAKE LIGHT SWITCH			
FUNCTION	PIN	COLOR	
12 volt input from fuse F4	2	ORANGE/GREEN	
12 volt output to RH brake light and R8 relay winding	1	RED/ORANGE	

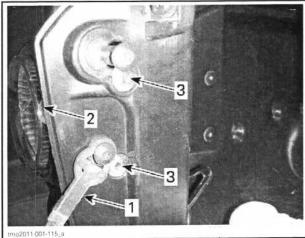
## Taillight/Brake Light Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay activated	Fuse 4 of fuse block 1 (from main relay R2)

### Taillight/Brake Light Bulb Replacement

Open upper tail gate.

Remove both taillight retaining screws.

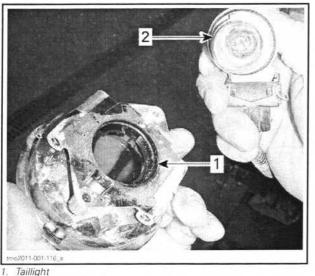


Tail gate cable

Tail gate cable
 Taillight
 Retaining screws

Pull taillight out of its location. Remove bulb socket from taillight.

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)



2. Light bulb and socket

Push the bulb in and hold while turning counterclockwise to release.

Installation is the reverse of the removal procedure.

# WINCH

#### XT Models Only

#### Winch Wire Identification

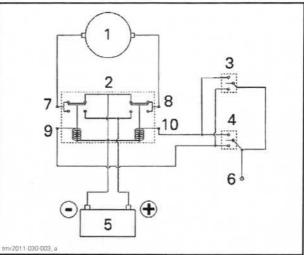
WINCH RELAY			
FUNCTION	PIN	COLOR	
12 volt input from battery (winch power)	BP4	RED	
Ground	BN4	BLACK	
12 volt input from switch ("IN")	SW1	GREEN/BLUE	
12 volt input from switch ("OUT")	SW2	LIGHT BLUE	
Motor power (switches polarity depending on rotation direction)	SW3	RED (with blue sleeve)	
Motor power (switches polarity depending on rotation direction)	SW5	RED (with Yellow sleeve)	

NOTE: The small black wire at terminal BN4 is connected to the diodes used to prevent electric arcs in the switch.

WINCH SWITCH			
FUNCTION	PIN	COLOR	
12 volt input from fuse 7	2	RED/BLACK	
12 volt output to relay winding ("IN")	1	GREEN/BLUE	
12 volt output to relay winding ("OUT")	3	LIGHT BLUE	

#### WARNING 4

Before testing, make sure the winch is in FREESPOOL mode (Freespool clutch disengaged).



SIMPLIFIED WINCH WIRING DIAGRAM

- Winch motor 1.
- 2 Winch relay
- 3. Winch remote control 4. Winch switch
- 5. Battery
- 5. J2 volt input to switch (switch pin 2 from fuse 7)
   7. Winch motor power (SW3)
   8. Winch motor power (SW5)

- 9. 12 volt input to relay winding ("IN" SW1) 10.12 volt input to relay winding ("OUT" SW2)

### Winch Switch Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with	Fuse 7 of fuse block
accessories relay	1 (from accessories
activated	relay R3)

### Winch Removal

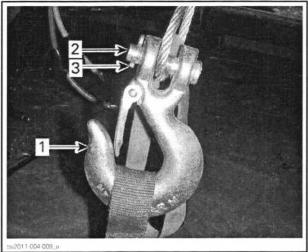
1. Disconnect, the battery BLACK (-) cable first, then the RED (+) cable.

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

### A 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.

- 2. Remove the hook.
  - 2.1 Remove and discard the cotter pin.
  - 2.2 Remove the hook pin.



- 1. Hook
- Hook pin
   Cotter pin
- 3. Remove the four retaining screws from underneath the winch motor.

4. Disconnect both winch power cables.

**NOTE:** Note the position of the power cables for reinstallation.

- 5. Protect radiator using strong cardboard.
- 6. Pass the cable through the roller fairlead.
- 7. Remove winch.

**NOTICE** Be careful not to lean on the radiator while removing winch.

### Winch Installation

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

Tighten winch retaining screws to  $24.5 \text{ N} \cdot \text{m} \pm 3.5 \text{ N} \cdot \text{m}$  (18 lbf  $\cdot \text{ft} \pm 3 \text{ lbf} \cdot \text{ft}$ ).

Connect wires the yellow wire at rear and the blue one at front.

Install a new cotter pin on the hook pin.

## TURN SIGNALS/HAZARD (EC MODELS ONLY)

### Turn Signal Wire Identification

FLASHER MODULE			
FUNCTION	PIN	COLOR	
12 volt input from fuse F10	MC2-1	RED/WHITE	
12 volt input from fuse F4	MC1-5	ORANGE/GREEN	
RH turn 12 volt input from turn signal switch	MC1-1	BEIGE/ORANGE	
LH turn 12 volt input from turn signal switch	MC1-2	BEIGE/GREY	
Output to RH turn signal lights	MC2-2	BROWN	
Output to LH turn signal lights	MC2-3	GREY	
Output to multifunction gauge (turn signal indicator)	MC2-4	ORANGE	
Ground	MC1-4	BLACK	
Hazard 12 volt input from hazard switch	MC1-6	GREEN/ORANGE	

#### TURN SIGNAL SWITCH (IN MULTIFUNCTION SWITCH)

FUNCTION	PIN	COLOR
12 volt input from fuse F4	MGB-3	ORANGE/GREEN
RH turn 12 volt output to flasher module	MGB-4	BEIGE/ORANGE
LH turn 12 volt output to flasher module	MGB-2	BEIGE/GREY

HAZARD SWITCH		
FUNCTION	PIN	COLOR
12 volt input from fuse F10	2	RED/WHITE
12 volt output to flasher module	3	GREEN/ORANGE
Hazard indicator 12 volt input from fuse F4	8	ORANGE/BROWN
Hazard indicator ground (through bulbs)	7	BLACK/ORANGE

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

# Turn Signal/Hazard Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay (R2) activated	Fuse 4 of fuse block 1 (from main relay R2)
Supplied at all times	Fuse 10 of fuse block 1 (from fuse 2 of fuse box 2)

# HORN (EC MODELS ONLY)

# Horn Wire Identification

HORN SWITCH (IN N	ULTIFUN	NCTION SWITCH)
FUNCTION	PIN	COLOR
12 volt input from fuse F10	MGB-1	ORANGE/GREEN
12 volt output to horn	MGB-6	BEIGE/BLUE
	HORN	
FUNCTION	PIN	COLOR
12 volt input from horn switch	2	BEIGE/BLUE
Ground		BLACK

# Horn Circuit Protection

CONDITION	CIRCUIT PROTECTION	
Supplied with main relay	Fuse 4 of fuse block 1	
(R2) activated	(from main relay R2)	

# **FRONT DRIVE**

# SERVICE TOOLS

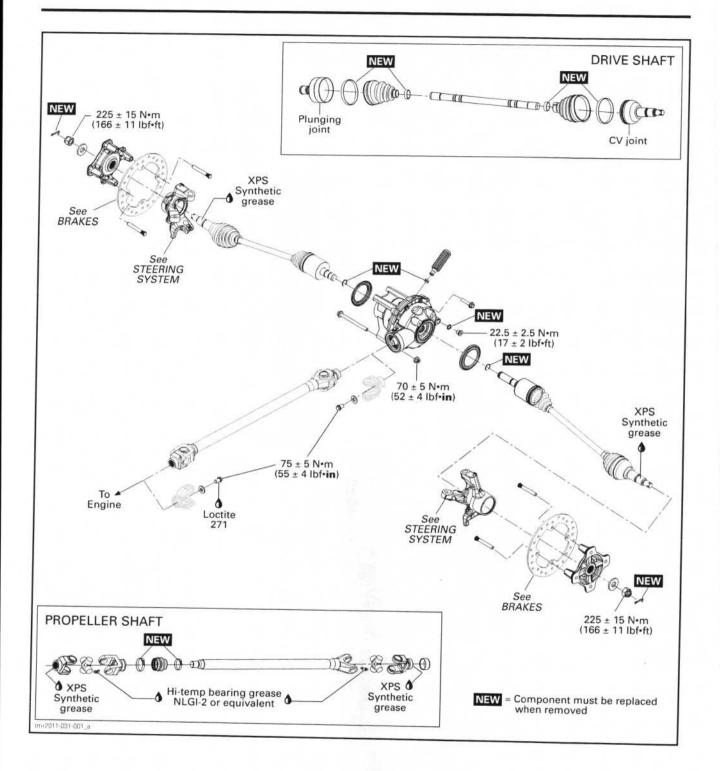
Description	Part Number	Page
BACKLASH MEASUREMENT TOOL	529 035 665 .	
	529 036 005 .	
OFTIKER PLIERS	295 000 069 .	
OETIKER PLIERS	295 000 070 .	
SPANNER SOCKET	529 035 649 .	

# SERVICE PRODUCTS

Description	Part Number	Page
I OCTITE 271 (RED)	293 800 005	
LOCTITE 277		
XPS SYNTHETIC GREASE	293 550 010	

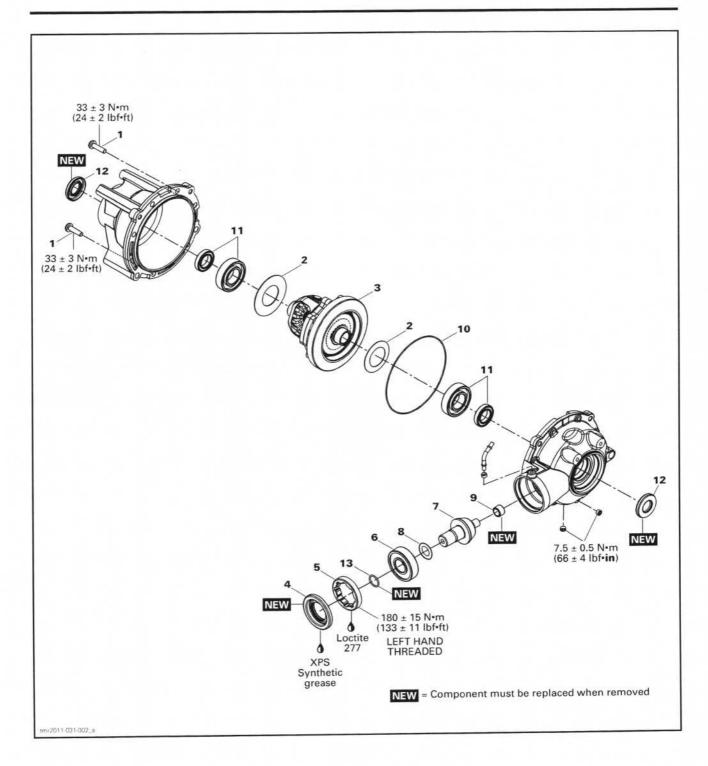
#### Section 06 DRIVE SYSTEM

Subsection 01 (FRONT DRIVE)



# Section 06 DRIVE SYSTEM

Subsection 01 (FRONT DRIVE)



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.

### 

Torque wrench tightening specifications must strictly be adhered to.

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

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

# SYSTEM DESCRIPTION

The Visco-Lok<sup>®</sup> system constantly monitors front wheel speed and, if it detects one wheel spinning faster than its mate, it progressively sends more power to the wheel with the better traction.

The Visco-Lok system is comprised of two principal components, a shear pump and the controlled multi-plate clutch.

A unique feature of the shear pump is that it is self-contained and independent. It does not require an external source of hydraulic fluid. The self-contained viscous shear pump generates a pressure proportional to wheel speed differential - meaning the difference in rotational speed between the two wheels. This pressure engages the friction clutch via a piston to transmit the torque.

In the event of a failure, the entire Visco-Lok pump and its carrier will have to be replaced. The Visco-Lok pump itself is a non-serviceable item. If the pump is disassembled, the viscous fluid contained inside will be lost and it cannot be replaced.

# PROCEDURES

## WHEEL HUB

### Wheel Hub Removal

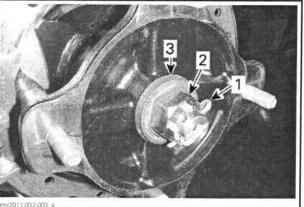
Lift and support vehicle. Refer to *INTRODUC-TION* section for proper procedure.

Select the 4WD position and place the transmission lever on "P".

Remove caliper from knuckle. Refer to *BRAKES* subsection.

Remove the following parts:

- Wheel
- Cotter pin
- Castellated nut
- Belleville washer.





. Belleville washer

Remove 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.

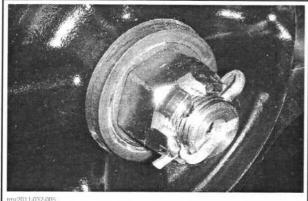
### Wheel Hub Installation

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

Install Belleville washer with its concave side towards outward.

PART	TORQUE
Castellated nut	225 N•m ± 15 N•m (166 lbf•ft ± 11 lbf•ft)

**NOTE:** Tighten further castellated nut if required to align grooves with drive shaft hole. Install a NEW cotter pin.



# FRONT DRIVE SHAFT

### Front Drive Shaft Removal

Lift and support vehicle. Refer to INTRODUC-TION section for proper procedure.

Remove the wheel hub, see procedure in this subsection.

Remove the knuckle. Refer to STEERING SYS-TEM subsection.

Strongly pull drive shaft out of differential.

Discard the stop ring at the end of the shaft.

### Front Drive Shaft Inspection

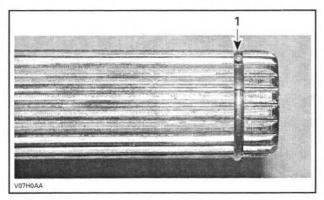
Inspect the condition of boots. If there is any damage or evidence of leaking lubricant, replace them. Refer to DRIVE SHAFT BOOT.

Check splines for excessive wear. Replace if necessary.

NOTE: If the splines on plunging joint are worn, a check of differential inner splines should be done.

### Front Drive Shaft Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Install a NEW stop ring.



1. Stop ring

Apply XPS SYNTHETIC GREASE (P/N 293 550 010) to the splines.

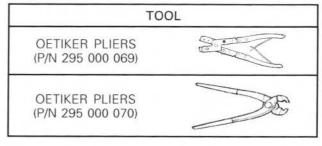
The wear ring should be closed to the differential. Reinstall all removed parts.

# DRIVE SHAFT BOOT

### Drive Shaft Boot Removal

Remove the drive shaft from the vehicle.

Remove drive shaft boot clamps using the following tools:



Dislodge the large boot end.

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.

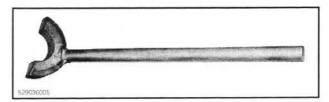
Pull hard on shaft to remove from joint.

Remove boot from drive shaft.

Remove and discard the circlip. A new one is included in the boot kit.

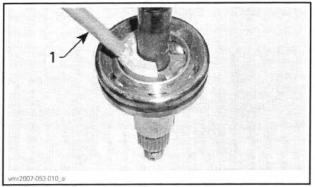
#### With the Special Tool

Place drive shaft in vice with the joint downward. Install the CV JOINT EXTRACTOR (P/N 529 036 005) on bearing.



#### Section 06 DRIVE SYSTEM

Subsection 01 (FRONT DRIVE)



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.

### Drive Shaft Boot Installation

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

Install the NEW circlip.

Pack bearing area with grease (included with the new boot kit).

NOTE: Do not use or add other grease.

# FRONT DIFFERENTIAL

#### Front Differential Removal

Drain the differential. Refer to *PERIODIC MAIN-TENANCE PROCEDURES* subsection.

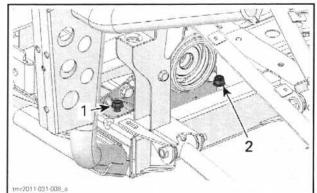
Remove both drive shafts. See procedure in this subsection.

Remove heavy duty front bumper (X and XT models) with front fascia.

Remove the radiator. Refer to *COOLING SYSTEM* subsection.

Remove bolts that attach winch bracket to the frame (XT models).

Remove front screw and rear nut securing the LH lower differential support.



FROM THE LEFT SIDE OF VEHICLE 1. Front retaining screw 2. Rear retaining nuts

Remove the upper differential bolts.

Remove nuts securing the lower bolts. Pull bolts to free the left support.

**NOTE:** Differential removal is required to remove lower bolts and LH lower differential support.

Remove the large clamp from the propeller shaft rubber boot.

Remove the differential from the front of vehicle. Remove yoke if required.

### Front Differential Inspection

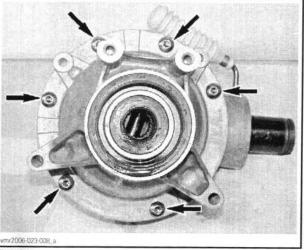
Check backlash and drag torque, see *FRONT DIF*-*FERENTIAL ADJUSTMENT* in this subsection.

Check if oil seals are brittle, hard or damaged. Replace if necessary.

### Front Differential Disassembly

#### Visco-Lok Carrier/Ring Gear

Unscrew the differential housing screws no. 1, then separate half housings.



TYPICAL

### Section 06 DRIVE SYSTEM

Subsection 01 (FRONT DRIVE)

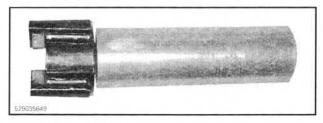
NOTE: Be careful to keep track of shims no.2 on each end of the Visco-Lok carrier no.3.

Extract Visco-Lok carrier out of half housing.

#### Pinion Gear

Remove and discard oil seal no. 4.

Unscrew the pinion nut **no.5**. Use the SPANNER SOCKET (P/N 529 035 649).



NOTE: The pinion nut is left hand threaded. Unscrew by turning clockwise.

Remove the bearing **no.6** at the same time as the pinion gear **no.7**. Be careful to keep track of shims **no.8**.

The pinion gear and bearing can be easily removed using the following suggested tool:

PART	QTY	
Pipe: 89 mm (3-1/2 in) diameter x 127 mm (5 in) in length	1	
Screwed rod: M12 x 1.25, 178 mm (7 in) length	1	
M12 x 1.25 nut	3	
Flat bar	1	

Remove and discard the needle bearing no.9.

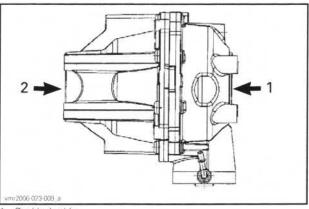
#### Front Differential Adjustment

A shimming procedure must be done when Visco-Lok carrier, pinion gear or housing is (are) changed.

Install recommended shims accordingly with the following table.

RECOMMENDED SHIMS	
PINION GEAR	1.67 mm ± 0.04 mm (.066 in ± .002 in)
BACKLASH	0.5 mm (.02 in)
PRELOAD	(for preliminary adjustment)

**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).



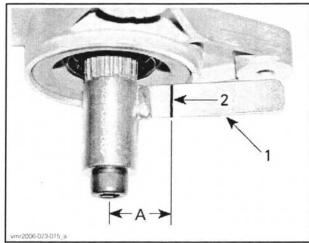
Backlash side
 Preload side

Temporarily assemble the front differential. See procedure in *FRONT DIFFERENTIAL ASSEMBLY* below in this subsection.

#### Backlash

Using a dial indicator and the BACKLASH MEA-SUREMENT 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

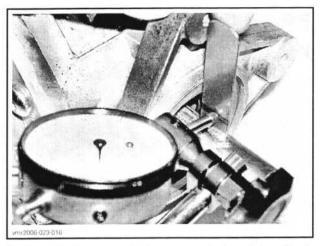
2. Mark on tab

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 re-

Gently, move the tab back and forth. Note the result.

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.

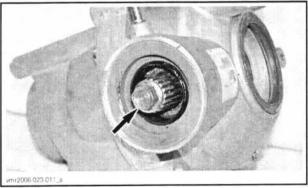
If backlash is below 0.05 mm (.002 in), increase backlash shim and check the backlash again.

If backlash is greater than 0.356 mm (.014 in), decrease backlash shim and check the backlash again.

Measure preload.

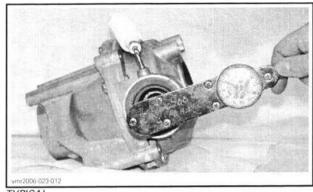
#### Preload

Screw the propeller shaft adaptor bolt in pinion gear.



TYPICAL

Using a needle torque wrench, measure the drag torque.



TYPICAL

If the drag torque is greater than 0.5 N•m (5 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.

### Front Differential Assembly

#### Visco-Lok Carrier/Ring Gear

To assemble, reverse the removal procedure. Pay attention to the following.

Check condition of seal no. 10. Replace if damage.

Check bearings no. 11. Replace if damage.

Tighten differential housing screws no. 1.

	PART	TORQUE	
-	Differential housing screws	33 N•m ± 3 N•m (24 lbf•ft ± 2 lbf•ft)	

#### Pinion Gear

To install, reverse the removal procedure. Pay attention to the following details.

Replace the O-ring no. 13.

Install the shim(s) no. 8 then the ball bearing no. 6.

Install a new needle bearing no.9.

Apply LOCTITE 277 (P/N 293 800 073) to pinion nut no.5.

**NOTE:** If a new pinion nut is used, a self-locking product is already applied, do not use Loctite 277. Install and tighten the pinion nut.

PART	TORQUE	
Pinion nut (LEFT HAND THREADED)	180 N•m ± 15 N•m (133 lbf•ft ± 11 lbf•ft)	

#### Front Differential Installation

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

When inserting the small portion of propeller shaft into propeller shaft boot, make sure both parts of propeller shaft are well indexed.

PARTS	TORQUE	
Differential retaining nuts	70 N•m ± 5 N•m (52 lbf•ft ± 4 lbf•ft)	
Differential upper bolts	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)	
Differential support nut	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)	
Differential support bolt	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)	

Refill the front differential with recommended oil. Refer to *PERIODIC MAINTENANCE PROCE-DURES* subsection.

### FRONT PROPELLER SHAFT

#### Front Propeller Shaft Removal

Remove the RH lateral console panel.

Remove propeller shaft screws (on engine and differential).

Remove lower and upper differential bolts.

Move the differential forwards.

Dislodge the propeller shaft from the engine and differential.

Remove front propeller shaft.

#### Front Propeller Shaft Inspection

Inspect if propeller shaft is not bent or twisted.

Check propeller shaft splines for wear or damage. Check if propeller shaft bellows is pierced or brittle.

### Front Propeller Shaft Installation

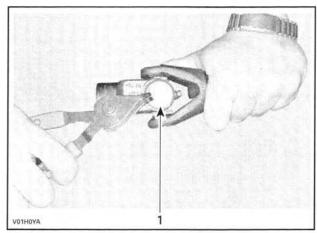
Installation is the reverse of removal procedure. However, pay attention to the following.

Apply XPS SYNTHETIC GREASE (P/N 293 550 010) to splines on engine side.

PARTS	TORQUE	
Propeller shaft screw (differential side)	75 N•m ± 15 N•m (55 lbf•ft ± 11 lbf•ft)	
Propeller shaft screw (engine side)	75 N•m ± 15 N•m (55 lbf•ft ± 11 lbf•ft) + LOCTITE 271 (RED) (P/N 293 800 005)	

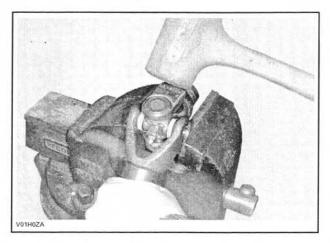
### PROPELLER SHAFT U-JOINTS Propeller Shaft U-Joint Removal

Remove internal snap ring from bearing caps.



1. Snap ring

Support inner yoke in vice and drive other yoke down with a soft hammer.



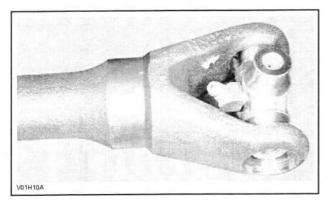
Support U-joint in vice and drive inner yoke down to remove remaining bearing caps. Remove U-joint cross.

Propeller Shaft U-Joint Installation

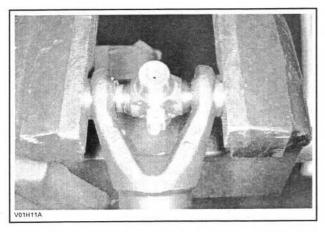
Install new U-joint in inner yoke.

Subsection 01 (FRONT DRIVE)

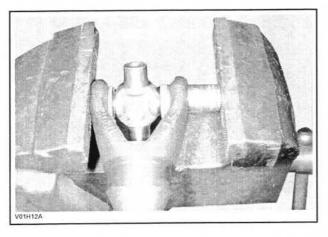
NOTE: Position propeller shaft U-joint as shown for proper grease fitting location.



Install bearing caps. Use a vise to insert bearing caps.



Using a suitable pusher, fully seat bearing cap on one side.



Install snap ring. Grease U-joints. Refer to *PERIODIC MAINTE-NANCE PROCEDURES* subsection.

# **REAR DRIVE**

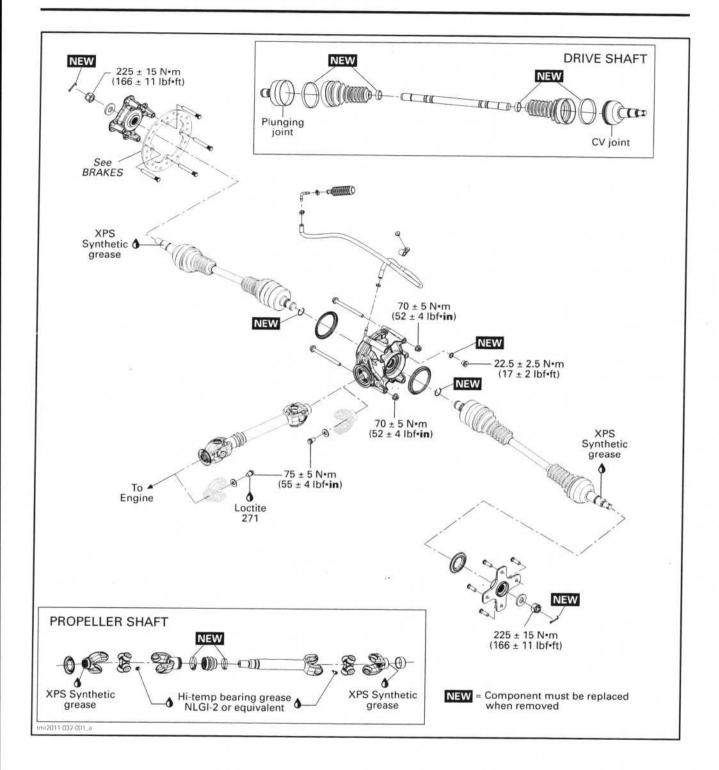
# SERVICE TOOLS

Description	Part Number	Page
BACKLASH MEASUREMENT TOOL	529 035 665	
CV JOINT EXTRACTOR		
OETIKER PLIERS		
OETIKER PLIERS		
SPANNER SOCKET		

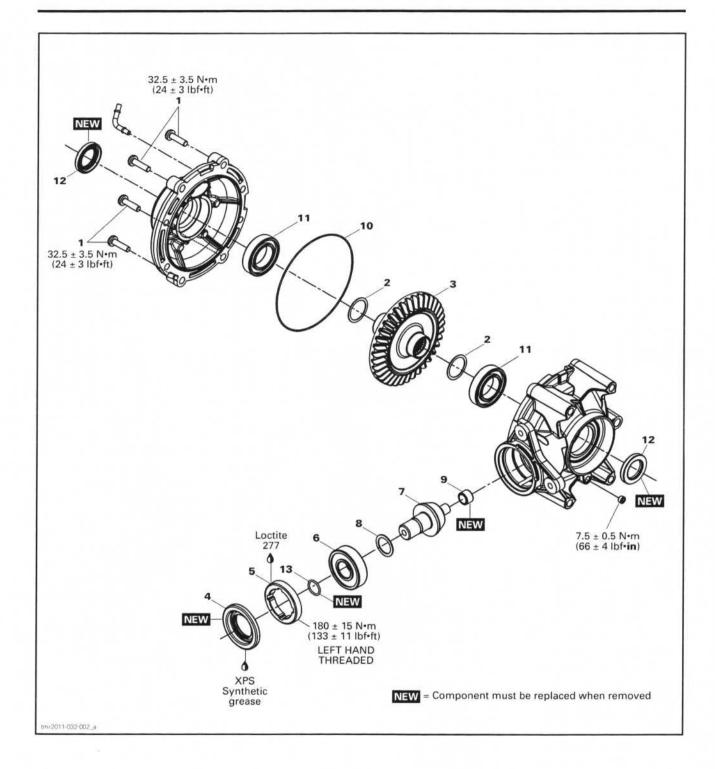
## SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 271 (RED)	293 800 005	
LOCTITE 277	293 800 073	

Subsection 02 (REAR DRIVE)



Subsection 02 (REAR DRIVE)



Subsection 02 (REAR DRIVE)

# GENERAL

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

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

### WARNING

Torque wrench tightening specifications must strictly be adhered to. Locking devices when removed (e.g.: locking

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

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

# PROCEDURES

### WHEEL HUB

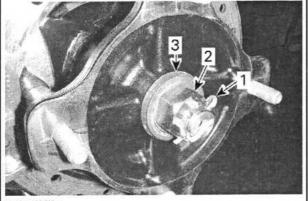
### Wheel Hub Removal

Lift and support vehicle. Refer to *INTRODUC-TION* section for proper procedure.

Remove the wheel.

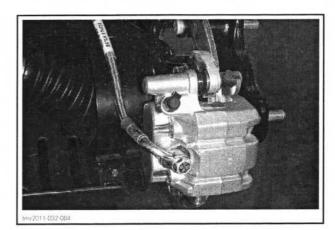
Remove the following parts:

- Cotter pin
- Wheel hub nut
- Belleville washer.



- 1. Cotter pin
- 2. Wheel hub nut
- 3. Belleville washer

NOTE: On RH side, remove also the brake caliper.



Remove wheel hub.

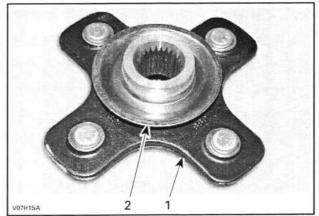
### Wheel Hub Inspection

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 or deformed, replace the wear ring.



TYPICAL – LH WHEEL HUB SHOWN 1. Wheel hub 2. Wear ring

### Wheel Hub Installation

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

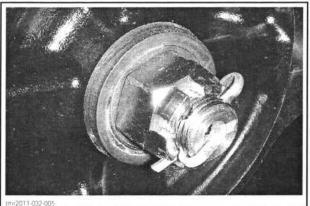
Apply XPS SYNTHETIC GREASE (P/N 293 550 010) on drive shaft splines.

Install Belleville washer with its concave side towards outward.

PART	TORQUE	
Wheel hub nut	225 N•m ± 15 N•m (166 lbf•ft ± 11 lbf•ft)	

#### Section 06 DRIVE SYSTEM Subsection 02 (REAR DRIVE)

NOTE: Tighten further castellated nut if required to align grooves with drive shaft hole. Install a NEW cotter pin.



# DRIVE SHAFT

#### **Drive Shaft Removal**

Lift and support vehicle. Refer to INTRODUC-TION section for proper procedure.

Remove the wheel hub. See procedure in this subsection.

Remove trailing arm. Refer to REAR SUSPEN-SION.

Strongly pull drive shaft out of final drive.

#### Drive Shaft Inspection

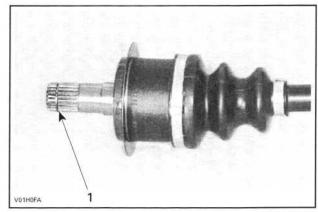
Inspect the condition of boots. If there is any damage or evidence of leaking lubricant, replace them. Refer to DRIVE SHAFT BOOT.

Check shaft splines. Replace drive shaft if necessary.

Check dust shield on drive shaft end. Replace if necessary.

#### **Drive Shaft Installation**

The installation is the reverse of the removal procedure. However, pay attention to the following. Install a NEW stop ring.



1. Stop ring

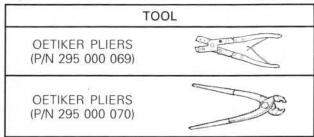
After drive shaft insertion in rear final drive, validate if properly locked.

## DRIVE SHAFT BOOT

#### Drive Shaft Boot Removal

Remove the drive shaft from vehicle. See procedure in this subsection.

Remove drive shaft boot clamps using the followina tools:



Dislodge the large boot end.

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.

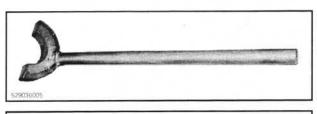
Remove boot from drive shaft.

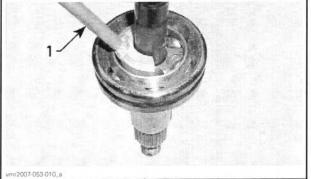
Remove and discard the circlip. A new one is included in the boot kit.

#### With the Special Tool

Place drive shaft in vice with the joint downward. Install the CV JOINT EXTRACTOR (P/N 529 036 005) on bearing.

Subsection 02 (REAR DRIVE)





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.

Remove drive shaft boot.

### Drive Shaft Boot Installation

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

Pack bearing area with grease (included with the new boot kit).

NOTE: Do not use any other grease.

# PROPELLER SHAFT

### Propeller Shaft Removal

- 1. Remove the fuel tank. Refer to FUEL TANK subsection.
- 2. Remove propeller shaft screw from gearbox output shaft.
- 3. Lift and support vehicle. Refer to *INTRODUC-TION* section for proper procedure.
- Remove propeller shaft screw from rear final drive yoke.
- 5. Remove rear final drive bolts. Refer to *REAR FINAL DRIVE* in this subsection.
- 6. Move the rear final drive rearward to dislodge the propeller shaft.
- 7. Dislodge the propeller shaft from the engine.

8. Remove the propeller shaft.

### Propeller Shaft Inspection

Inspect if propeller shaft is not bent or twisted. Check propeller shaft splines for wear or damage. Check if propeller shaft bellows is pierced or brittle.

### Propeller Shaft Installation

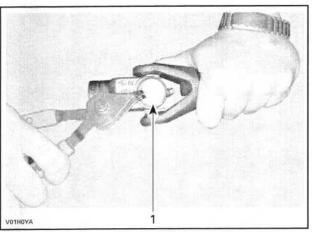
Installation is essentially the reverse of removal procedure. Pay attention to the following details. Apply XPS SYNTHETIC GREASE (P/N 293 550 010) to splines.

PARTS	TORQUE
Propeller shaft screw (final drive side)	75 N∙m ± 5 N∙m (55 lbf∙ft ± 4 lbf∙ft)
Propeller shaft screw (engine side)	75 N•m ± 5 N•m (55 lbf•ft ± 4 lbf•ft) + LOCTITE 271 (RED) (P/N 293 800 005)

# PROPELLER SHAFT U-JOINTS

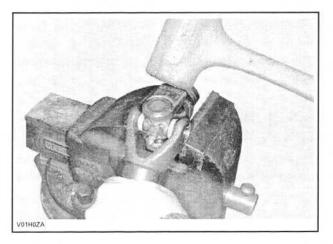
### Propeller Shaft U-Joint Removal

Remove internal snap ring from bearing caps.



1. Snap ring

Support inner yoke in vice and drive other yoke down with a soft hammer.

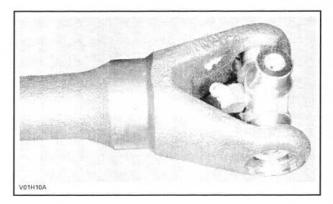


Support U-joint in vice and drive inner yoke down to remove remaining bearing caps. Remove U-joint cross.

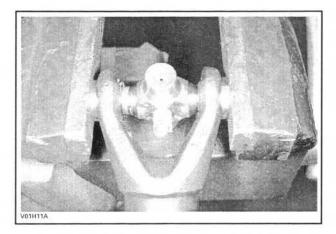
#### Propeller Shaft U-Joint Installation

Install new U-joint in inner yoke.

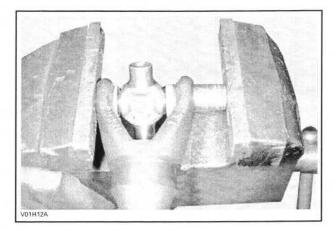
**NOTE:** Position propeller shaft U-joint as shown for proper grease fitting location.



Install bearing caps. Use a vise to push bearing caps.



Using a suitable pusher, fully seat bearing cap on one side.



Install snap ring.

Complete installation for the other bearing caps. Grease U-joint. Refer to *PERIODIC MAINTE-NANCE PROCEDURES* subsection.

## REAR FINAL DRIVE

#### **Rear Final Drive Removal**

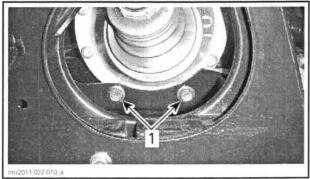
Drain oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove drive shafts. See procedure in this subsection.

Remove the rear skid plate.

Remove the propeller shaft screw from the rear final drive yoke.

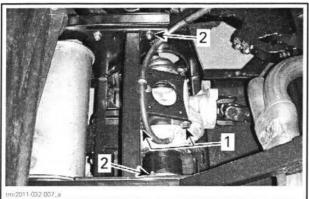
Remove final drive lower bolts.



1. Lower final drive bolts

Remove final drive upper bolts and the front bolts of the final drive support.

Subsection 02 (REAR DRIVE)



Upper final drive bolts Final drive support front bolts

Unplug the vent hose from final drive.

Loosen rear bolts of the final drive support and tilt the support rearward to make room.

Remove the final drive.

#### **Rear Final Drive Inspection** (Assembled)

Turn rear final drive gear with a finger; it should turn smoothly. Replace if necessary.

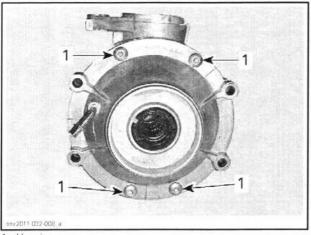
Check backlash and drag torque, see REAR FINAL DRIVE ADJUSTMENT in this subsection.

Check if oil seals are brittle, hard or damaged. Replace if necessary.

### **Rear Final Drive Disassembly**

#### **Ring Gear**

Unscrew the final drive housing screws no. 1.



Housing screws

Split final drive housings.

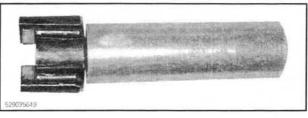
NOTE: Be careful to keep track of shims no. 2 on ring gear no.3.

Extract ring gear out of half housing.

#### Pinion Gear

Remove and discard oil seal no. 4.

Unscrew the pinion nut no.5. Use the SPANNER SOCKET (P/N 529 035 649).



NOTE: The pinion nut is left hand threaded. Unscrew by turning clockwise.

Remove the bearing no.6 at the same time as the pinion gear no.7. Be careful to keep track of shims no.8.

The pinion gear and bearing can be easily removed using the following suggested tool:

PART	
Pipe: 89 mm (3-1/2 in) diameter x 127 mm (5 in) in length	1
Screwed rod: M12 x 1.25, 178 mm (7 in) length	1
M12 x 1.25 nut	3
Flat bar	1

Remove and discard the needle bearing no.9.

### Rear Final Drive Adjustment

A shimming procedure must be done when pinion gear, ring gear or housing is (are) changed.

Install recommended shims accordingly with the following table.

RECOMMENDED SHIMS		
PINION GEAR	1.67 mm ± 0.04 mm (.066 in ± .002 in)	
BACKLASH	0.5 mm (.02 in) (for preliminary adjustment)	
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).

#### Section 06 DRIVE SYSTEM Subsection 02 (REAR DRIVE)

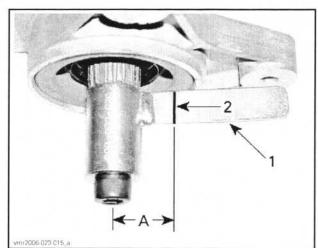
1. Backlash side 2. Preload side

Temporarily assemble the final drive. See procedure in *REAR FINAL DRIVE ASSEMBLY* below in this subsection.

#### Backlash

Using a dial indicator and the BACKLASH MEA-SUREMENT TOOL (P/N 529 035 665), measure the backlash. Place the backlash measurement tool at the end of pinion gear.

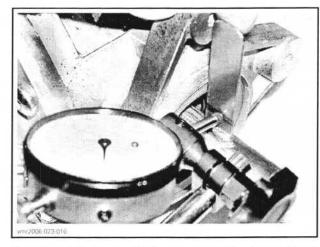
From center of bolt, measure 25.4 mm (1 in) and scribe a mark on the tab.



- 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.

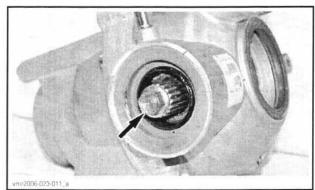
If backlash is below 0.05 mm (.002 in), increase backlash shim and check the backlash again.

If backlash is greater than 0.356 mm (.014 in), decrease backlash shim and check the backlash again.

Measure preload.

#### Preload

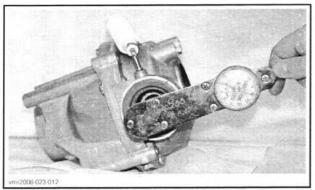
Screw the propeller shaft adaptor bolt in pinion gear.



TYPICAL - FRONT DIFFERENTIAL SHOWN

Using a needle torque wrench, measure the drag torque.

Subsection 02 (REAR DRIVE)



TYPICAL — FRONT DIFFERENTIAL SHOWN

If the drag torque is greater than 0.5 N•m (5 lbf•in), reduce preload shim and check drag torque again.

If the drag torque is less than 0.06 N•m (.5 lbf•in), increase preload shim and check drag torque again.

### **Rear Final Drive Assembly**

#### **Ring Gear**

To assemble, reverse the removal procedure. Pay attention to the following.

Check condition of seal no. 10. Replace if damaged.

Check bearings no. 11. Replace if damaged.

Tighten final drive housing screws no. 1.

PART	TORQUE	
Final drive housing screws	32.5 N•m ± 3.5 N•m (24 lbf•ft ± 3 lbf•ft)	

#### Pinion Gear

To install, reverse the removal procedure. Pay attention to the following.

Replace the O-ring no. 13.

Install the shim(s) no. 8 then the ball bearing no. 6.

Install a new needle bearing no.9.

Apply LOCTITE 277 (P/N 293 800 073) to pinion nut no. 5.

**NOTE:** If a new pinion nut is used, a self-locking product is already applied, do not use Loctite 277.

Install and tighten the pinion nut.

PART	TORQUE
Pinion nut (LEFT HAND THREADED)	180 N•m ± 15 N•m (133 lbf•ft ± 11 lbf•ft)

Lubricate oil seal no.4.

## **Rear Final Drive Installation**

The installation is the reverse of the removal procedure.

PART	TORQUE	
Final drive retaining nuts	70 N•m ± 5 N•m (52 lbf•ft ± 4 lbf•ft)	

Refill the final drive with recommended oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

# Subsection 01 (WHEELS AND TIRES)

# WHEELS AND TIRES

### SERVICE PRODUCTS

#### Description

LOCTITE 767 (ANTISEIZE LUBRICANT)

### GENERAL

#### A WARNING

Torque wrench tightening specifications must be strictly adhered to.

### PROCEDURES

#### TIRES

#### WARNING

Do not rotate tires. The front and rear tires have a different size. Respect direction of rotation when applicable.

#### Tire Pressure

#### 

Tire pressure greatly affects vehicle handling and stability. Insufficient pressure may cause tire to deflate and rotate on wheel. Excessive pressure may burst the tire. Always follow recommended pressure.

Check pressure when tires are **cold** before using the vehicle. Tire pressure changes with temperature and altitude. Recheck pressure if one of these conditions has changed.

TIRE PRESSURE	FRONT	REAR
MIN.	69 kPa (10 PSI)	83 kPa (12 PSI)
MAX. (USE WHEN TOTAL LOAD IS GREATER THAN 180 KG (400 LB))	83 kPa (12 PSI)	152 kPa (22 PSI)

#### **Tire Inspection**

Check tire for presence of slits, bulges, wear or other damage. Replace if necessary.

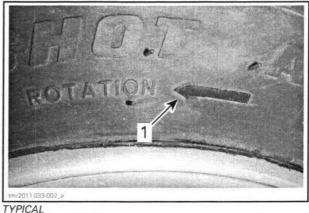
#### **Tire Replacement**

Use an automotive tire changer to replace tires.

Part Number	Page
 293 800 070	

#### A WARNING

- Replace tires only with the same type and size as original tires.
- For unidirectional tread pattern, ensure that the tires are installed in the correct direction of rotation.



1. Direction of rotation

#### Tire Mounting on Beadlock Wheels

#### X Models

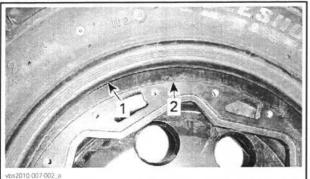
**NOTE:** Tires should be mounted, by an experienced person, in accordance to good tire mounting practices using acceptable tire mounting equipment designed for the tire industry.

- 1. Mount the tire on wheel.
  - On the opposite side of beadlock, apply the tire mounting lube on inner bead of tire and wheel to ensure proper seating when inflating.
  - 1.2 Mount the inner bead over the wheel.

**NOTICE** Mount tire from beadlock side only.

1.3 Seat the tire outer bead in the shoulder of the beadlock inner ring and center the tire.

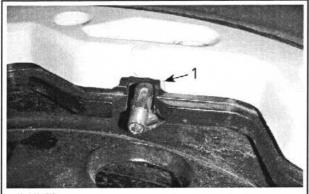
#### Section 07 CHASSIS Subsection 01 (WHEELS AND TIRES)



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Tire outer bead
 Beadlock inner ring shoulder

2. Place the beadlock clamp ring on the tire. Align the valve opening with valve.

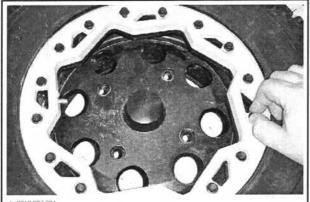


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1. Clamp ring valve opening

- 3. Lubricate all beadlock screws with LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) or an equivalent product to prevent screw sticking.
- 4. Install all beadlock screws. To avoid cross threading, start all screws by hand.

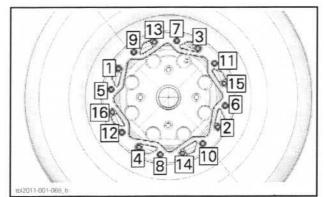
**NOTICE** Do not use an impact wrench for installing beadlock screws. The risk of screw breaking or screw stripping is high when using an impact wrench.



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5. First tightening sequence: Using a torque wrench, tighten beadlock screws at first to 3N•m ± 1N•m (27 lbf•in ± 9 lbf•in) following the illustrated sequence.

NOTE: To ensure even pressure on the beadlock clamp ring, tighten screws a few turns at a time.



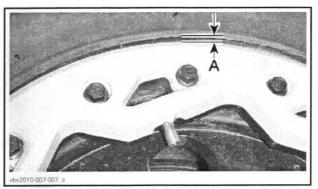
FIRST AND SECOND TIGHTENING SEQUENCE

- At this time check if the tire is still centered on wheel. Reposition it if necessary.
- Second tightening sequence: Retighten all screws to 8 N•m ± 1 N•m (71 lbf•in ± 9 lbf•in) using the same sequence.

The beadlock clamp ring should be in contact the beadlock inner ring.

**NOTE:** The beadlock clamp ring can flex slightly to match the tire bead. IT IS NORMAL.

8. Verify the gap between tire and beadlock clamp ring, it should be practically equal all around the ring.

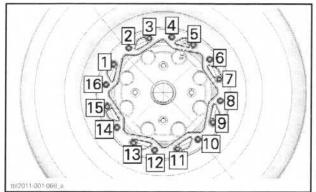


A. Gap equal all around beadlock clamp ring

If the gap is uneven:

- Loosen all screws.
- Check tire position on wheel and reposition it if necessary.
- Restart the tightening sequence from the beginning.

9. Final tightening step: 8N•m ± 1N•m (71 lbf•in ± 9 lbf•in) following the illustrated sequence.



FINAL TIGHTENING SEQUENCE

 Inflate tire to seat the inner bead on wheel. Always use safe practices, such as a tire safety cage.

#### 

Never exceed tire's recommended maximum pressure for seating beads.

### WHEELS

#### Wheel Removal

Loosen nuts just enough to be able to unscrew them once the vehicle will be off the ground.

Lift and support the vehicle. Refer to *INTRODUC-TION* subsection.

Remove nuts, then remove wheel.

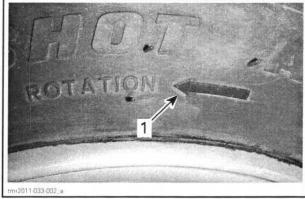
#### Wheel Inspection

Inspect wheel for wear or damage especially at the mounting holes.

#### Wheel Installation

At installation, it is recommended to apply antiseize lubricant on threads.

Check if tires are unidirectional.

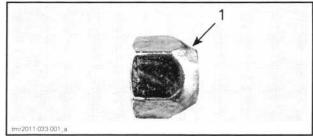


TYPICAL

1. Direction of rotation

Install in the right direction of rotation.

Install lug nuts with the taper towards the wheel.



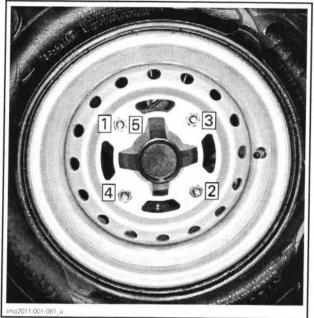
TYPICAL

1. Taper (towards the wheel)

Tighten wheel lug nuts to the specified torque using the illustrated sequence.

WHEEL LUG NUTS	
TORQUE	100 N∙m ± 10 N∙m (74 lbf∙ft ± 7 lbf∙ft)

Subsection 01 (WHEELS AND TIRES)



TIGHTENING SEQUENCE

**NOTICE** Always use the recommended wheel nuts for the type of wheel. Using a different nut could cause damages to the rim or studs.

# STEERING SYSTEM

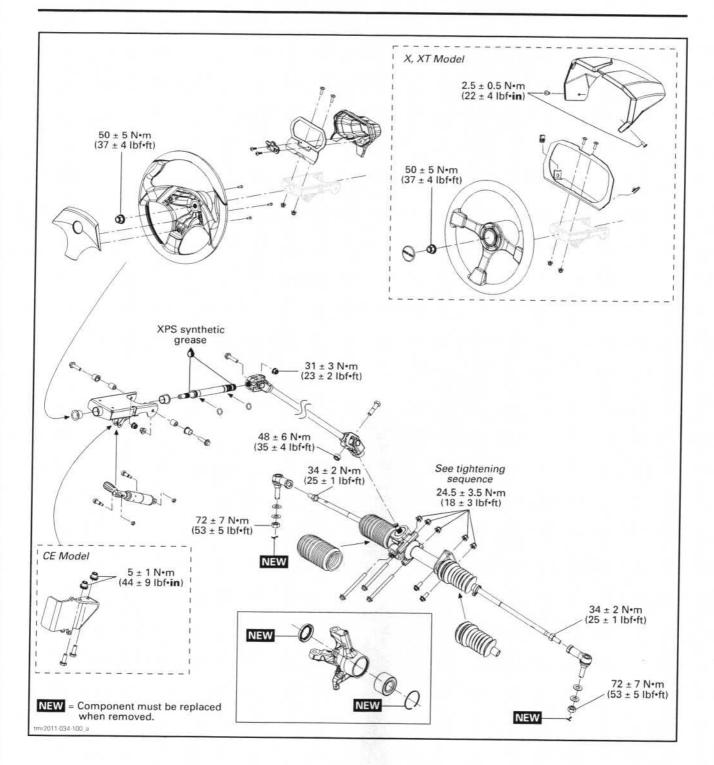
# SERVICE TOOLS

	Part Number	Page
Description STEERING ALIGNMENT TOOL	529 036 059	

# SERVICE PRODUCTS

	Part Number	Page
Description XPS SYNTHETIC GREASE	293 550 010	

Subsection 02 (STEERING SYSTEM)



### GENERAL

The procedures described below are 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.

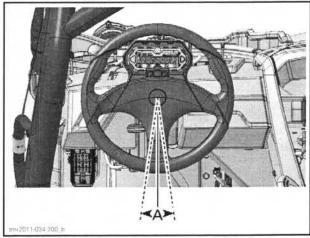
Locking devices when removed (e.g.: locking tabs, cotter pins, etc.) must be replaced.

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

### ADJUSTMENT

### STEERING ALIGNMENT

- 1. Place vehicle on a level surface.
- 2. Inflate tires to recommended pressure.
- 3. Find rack and pinion center to center as follows:
  - 3.1 Calculate the total steering wheel rotations from side to side.
  - 3.2 Position the steering wheel at half the total rotations.
- 4. Check steering wheel position:
  - 4.1 If steering angle is within  $\pm$  3°, go to step 6.
  - 4.2 If steering angle is above ± 3°, go to step 5.

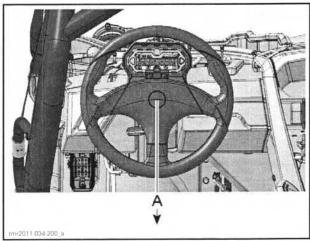


A. Steering wheel angle  $\pm 3^{\circ}$ 

5. Reposition steering wheel onto steering shaft as follows:

**NOTICE** Make sure rack and pinion does not move during steering wheel repositioning.

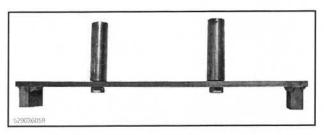
- 5.1 Remove steering wheel, refer to *STEER-ING WHEEL REMOVAL*.
- 5.2 Reinstall steering wheel to the closest centered position (nearest spline).
- 6. Center steering wheel.



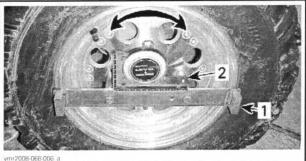
A. Steering wheel centered

- 7. Remove two wheel lug nuts from a rear wheel.
- 8. Install STEERING ALIGNMENT TOOL (P/N 529 036 059) using proper spacers.

Subsection 02 (STEERING SYSTEM)

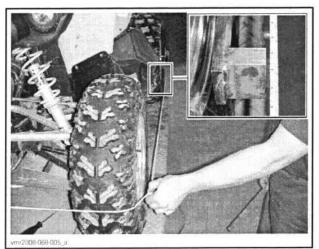


9. Move vehicle to place the tool level with the ground.



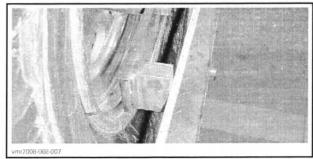
REAR WHEEL 1. Steering adjustment tool 2. Angle gauge or level

- 10. Place a rope around vehicle tires
- 11. Using an elastic, link both ends together.
- 12. Adjust rope at the center of the wheels.
- From the front of vehicle, near the front of rim, move rope so that it does not touch the first spacer of tool.



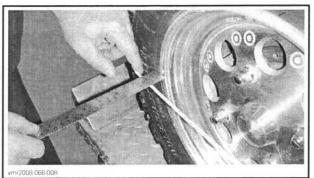
TYPICAL

14. Slowly move rope back until it makes contact with spacer.

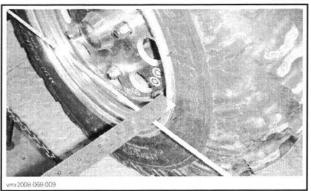


TYPICAL

- 15. Keep rope in this position.
- 16. Measure distance of the front wheel between rope and rim as follows:
  - At the front of rim
  - At the rear of rim.



TYPICAL — AT THE FRONT OF RIM



TYPICAL — AT THE REAR OF RIM

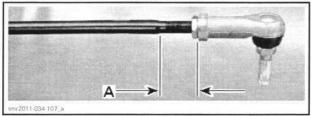
- 17. Calculate the difference between the rear and the front measurement.
- 18. The difference must be as per the following specification:

WHEEL TOE 0 mm ± 4 mm (0 in ± .157 in)

- 19. If the wheel toe measurement is out of specification:
  - 19.1 Adjust tie-rod end.

#### A WARNING

The maximum tie-rod end length not engaged in the tie rod must not exceed 32 mm (1.26 in).



A. Maximum tie-rod end length

19.2 Tighten tie-rod end locking nut to specification.

TIE-ROD END LOCKING NUT TORQUE	
 34 N•m ± 2 N•m (25 lbf•ft ± 1 lbf•ft)	

20. Repeat procedure for the other wheel.

# TROUBLESHOOTING

### DIAGNOSTIC TIPS

#### **Turning Radius Unequal**

If vehicle turns more on one side than the other, check rack and pinion center to center. Refer to *STEERING ALIGNMENT* in this subsection.

### PROCEDURES

### STEERING WHEEL

#### Steering wheel Removal

#### All Models Except X and XT

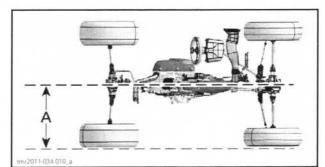
- 1. From underneath steering wheel, unscrew cap retaining screws.
- 2. Remove steering wheel cap.
- 3. Remove nut securing steering wheel to shaft.
- 4. Remove steering wheel by pulling it upwards.

#### X and XT Models

- 1. Remove steering wheel cap using a small screwdriver.
- 2. Remove nut securing steering wheel to shaft.
- 3. Remove steering wheel by pulling it upwards.

#### Steering Wheel Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Prior to installing the steering wheel, place front wheels parallel with longitudinal plane of vehicle.



A. Front wheels parallel

Tighten steering wheel retaining nut to specification.

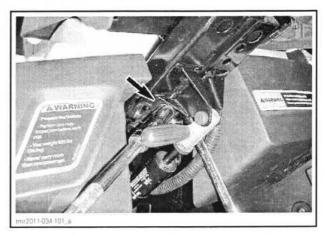
STEERING WHEEL RETAINING NUT TORQUE 50 N•m ± 5 N•m (37 lbf•ft ± 4 lbf•ft)

Check front wheel alignment. Refer to *STEERING ALIGNMENT* in this subsection.

## STEERING COLUMN

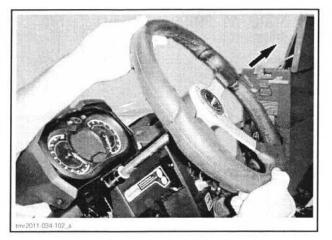
#### Steering Column Removal

- 1. Center steering wheel.
- 2. Remove bolt and nut securing upper universal joint to steering shaft.

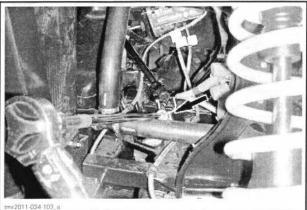


3. Remove steering wheel and steering shaft as an assembly.

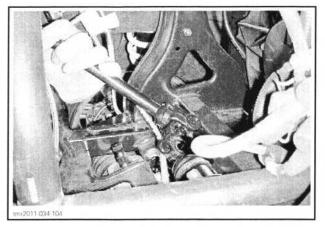
Subsection 02 (STEERING SYSTEM)



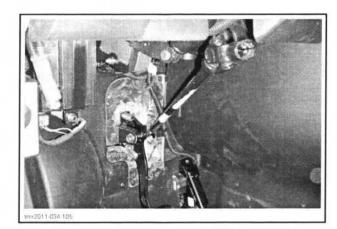
4. Remove bolt and nut securing lower universal joint to rack and pinion.



5. Pull steering column upwards to detach it from rack and pinion.



6. Carefully push steering column downwards to release it from steering support.



7. Remove steering column from vehicle.

#### Steering Column Inspection

Check steering column for wear, cracks or bending.

Check steering shaft for wear, cracks or bending. Check if universal joints move freely.

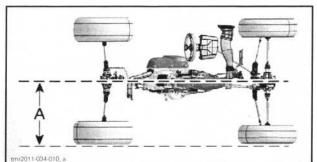
Check if steering shaft O-rings are brittle, hard or otherwise damaged.

Replace if necessary.

#### Steering Column Installation

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

Prior to installing the steering column, place front wheels parallel with longitudinal plane of vehicle.



A. Front wheels parallel

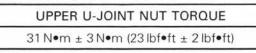
Lubricate steering shaft.

#### STEERING SHAFT LUBRICATION

XPS SYNTHETIC GREASE (P/N 293 550 010)

Install steering wheel and steering shaft. Make sure steering wheel is properly centered.

Tighten steering column U-joints to specification.



# Subsection 02 (STEERING SYSTEM)

#### LOWER U-JOINT NUT TORQUE

 $48 \text{N} \cdot \text{m} \pm 6 \text{N} \cdot \text{m}$  (35 lbf  $\cdot \text{ft} \pm 4 \text{ lbf} \cdot \text{ft}$ )

Check front wheels alignment. Refer to STEER-ING ALIGNMENT in this subsection.

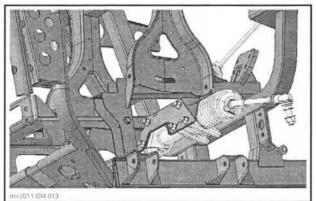
### RACK AND PINION

#### **Rack and Pinion Servicing**

Rack and pinion is not serviceable except for boots and tie rods replacements.

#### Rack and Pinion Removal

- 1. Safely lift and support the front of vehicle. Refer to *INTRODUCTION* subsection.
- 2. Remove both front wheels.
- 3. Remove steering column, refer to *STEERING COLUMN REMOVAL* in this subsection.
- 4. Detach tie-rods from knuckles. Refer to *TIE ROD REPLACEMENT* in this subsection.
- 5. Remove bolts and nuts securing rack and pinion to frame.



SOME PARTS REMOVED FOR CLARITY PURPOSE

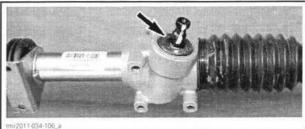
6. From the LH side, remove rack and pinion from vehicle.

#### Rack and Pinion Installation

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

Find rack and pinion center to center as follows:

- Calculate the total pinion shaft rotations from side to side.
- Position the pinion shaft at half the total rotations.
- Align pinion shaft mark onto housing mark.

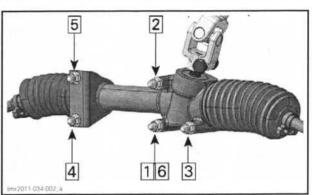


MARKS

Install all retaining bolts and nuts of rack and pinion loosely first.

Torque retaining nuts of rack and pinion according to specification using the following tightening sequence.

RACK AND PINION RETAINING NUTS TORQUE 24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

Check the steering alignment, refer to *STEERING ALIGNMENT* in this subsection.

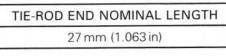
# TIE-ROD ENDS

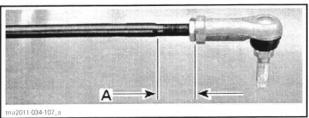
### Tie-Rod End Replacement

- 1. Safely lift and support the front of vehicle. Refer to *INTRODUCTION* subsection.
- 2. Remove front wheel.
- 3. Detach tie-rod end by removing:
  - Cotter pin
  - Tie-rod end retaining nut
  - Hardened washers.

#### Section 07 CHASSIS Subsection 02 (STEERING SYSTEM)

- Cotter pin Tie-rod end retaining nut 3 Hardened washers
- 4. Discard cotter pin.
- 5. Replace tie-rod end.
- 6. Adjust tie-rod end to the nominal length.





A. Nominal length

### WARNING

The maximum tie-rod end length not engaged in the tie rod must not exceed 32 mm (1.26 in).

7. Tighten tie-rod end locking nut to specification.

TIE-ROD END LOCKING NUT	TORQUE
34 N•m ± 2 N•m (25 lbf•ft ±	1 lbf•ft)

- 8. Attach tie-rod end on knuckle as the reverse of removal.
- 9. Tighten tie-rod end retaining nut to specification.

### TIE-ROD END RETAINING NUT TORQUE

72 N•m ± 7 N•m (53 lbf•ft ± 5 lbf•ft)

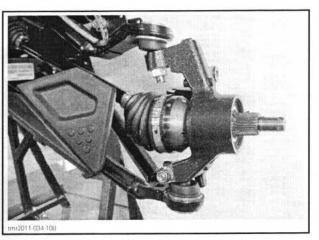
10. Install NEW cotter pin. Both ends of cotter pins must be folded.

- 11 Install front wheel.
- 12. Check the steering alignment, refer to STEER-ING ALIGNMENT in this subsection.

# KNUCKLES

### Knuckle Removal

- 1. Safely lift and support the front of vehicle. Refer to INTRODUCTION subsection.
- 2. Remove front wheel.
- 3. Detach tie-rod end from knuckle, refer to TIE-ROD END in this subsection.
- 4. Remove wheel hub, refer to FRONT DRIVE subsection.
- 5. Remove caliper, refer to *BRAKES* subsection.



- 6. Detach upper suspension arm from knuckle, refer to FRONT SUSPENSION.
- 7. Detach lower suspension arm from knuckle, refer to FRONT SUSPENSION.
- 8. Remove knuckle from vehicle.

### Knuckle Inspection

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

### Knuckle Installation

The installation is the reverse of the removal procedure.

# WHEEL BEARINGS

#### Wheel Bearing Inspection (Maintenance)

Refer to PERIODIC MAINTENANCE PROCE-DURES subsection.

# Wheel Bearing Inspection (During Component Removal)

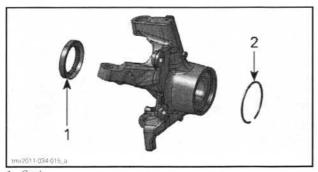
Whenever the drive axle or knuckle is removed, check wheel bearing as follows:

- Check if wheel bearing turns freely and smoothly.
- Check seal condition.

Replace if necessary.

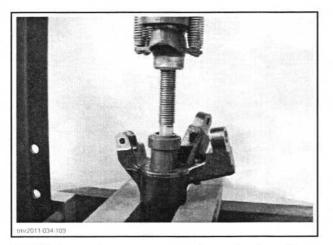
### Wheel Bearing Removal

- 1. Remove knuckle from vehicle, refer to KNUCKLE REMOVAL in this subsection.
- 2. Remove and discard knuckle seal.
- 3. Remove circlip.



1. Seal 2. Circlip

- 4. Install knuckle on a press.
- 5. Use an appropriate bearing remover.
- 6. Remove bearing from knuckle.



**NOTE:** It may be necessary to heat the knuckle to remove bearing.

#### 

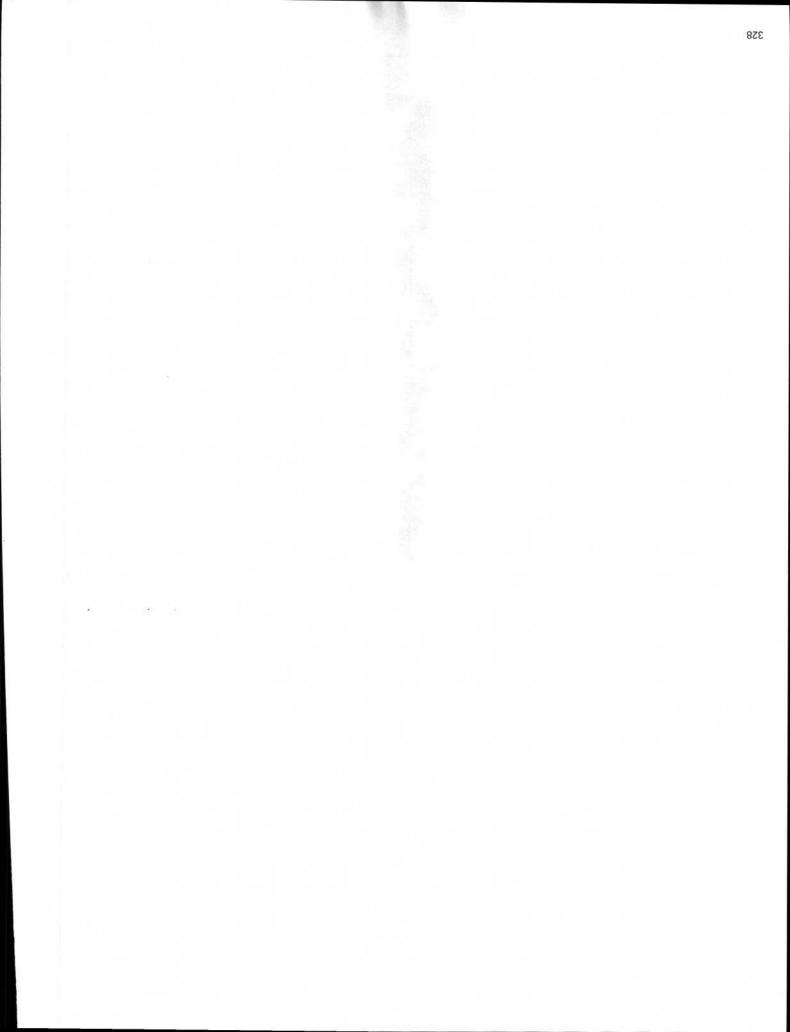
Clean all grease, outside and inside, from knuckle before heating it.

### Wheel Bearing Installation

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

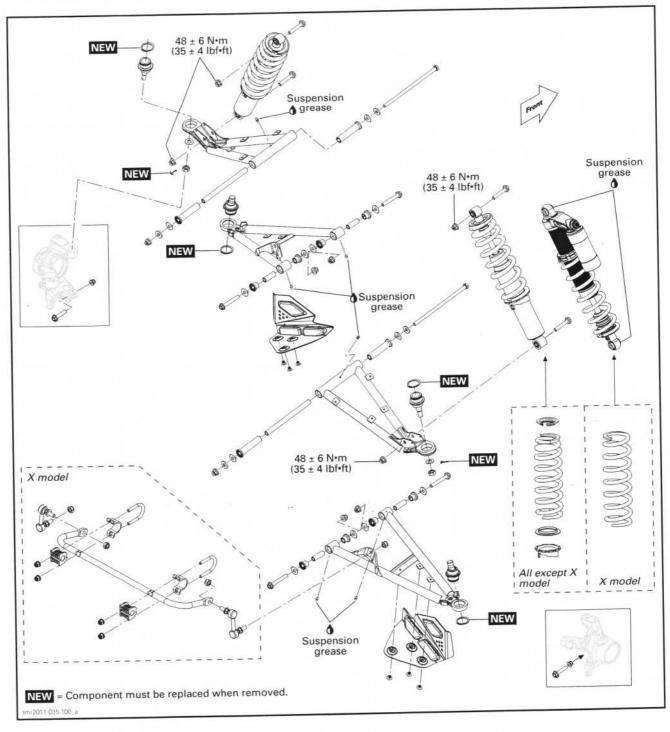
- To ease wheel bearing installation:
- Place bearing in a freezer for 10 minutes.
- Place knuckle in oven to 100°C (212°F) for 30 minutes maximum.

When knuckle is cooled down, install  $\ensuremath{\text{NEW}}$  circlip and  $\ensuremath{\text{NEW}}$  seal.



Subsection 03 (FRONT SUSPENSION)

# FRONT SUSPENSION



### 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.

#### 

Torque wrench tightening specifications must strictly be adhered to. Locking devices when removed (e.g.: locking

tabs, cotter pins, etc.) must be replaced.

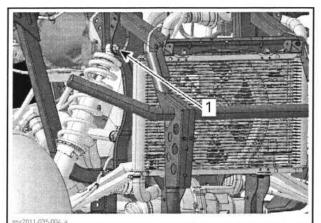
**NOTICE** Hoses, cables and locking ties removed during a procedure must be reinstalled as per factory standards.

### PROCEDURES

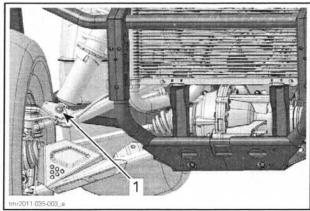
### SHOCK ABSORBER

#### Shock Absorber Removal

- 1. Safely lift and support the vehicle of the ground. Refer to *INTRODUCTION* subsection.
- 2. Remove bolts and nuts retaining shock absorber.



1. Upper bolt



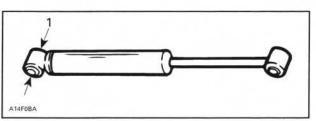
1. Lower bolt

3. Remove shock absorber.

#### Shock Absorber Inspection

Remove spring from shock absorber. Refer to *SPRINGS* in this subsection.

Secure the end of shock body in a vise with its rod upward.



TYPICAL

1. Clamp here

**NOTICE** Do not clamp directly on shock body.

Extend and compress the piston several times over its entire stroke. Check that it moves smoothly and with uniform resistance with its rod upward.

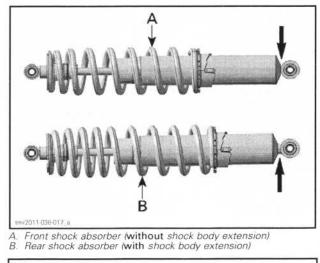
Check the following conditions that will denote a defective shock:

- A skip or a hang back when reversing stroke at mid travel.
- Seizing or binding condition except at extreme end of either stroke.
- Oil leakage.
- A gurgling noise, after completing one full compression and extension stroke.

Replace if any faults are present.

#### Shock Absorber Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Make sure to install the proper type of shock absorber  ${\bf no}. A$  on the front of vehicle



SHOCK ABSORBER NUTS TORQUE

48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

# SHOCK ABSORBER BUSHINGS

Refer to *SHOCK ABSORBER BUSHINGS* in *REAR SUSPENSION* subsection for complete procedures.

### SPRINGS

Refer to *SPRINGS* in *REAR SUSPENSION* subsection for complete procedures.

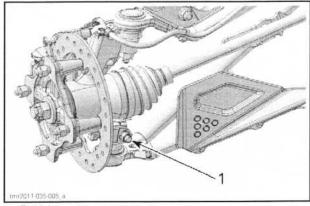
### LOWER SUSPENSION ARM

#### Lower Suspension Arm Removal

- 1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
- 2. Remove wheel, refer to *WHEELS AND TIRES* subsection.

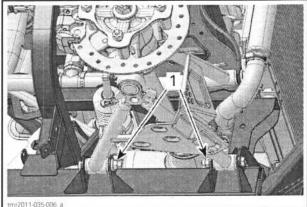
**NOTE:** For X model, disconnect anti-sway bar from suspension arm.

3. Remove bolt and nut securing lower ball joint to knuckle.



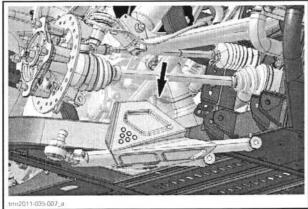
1. Ball joint nut

4. Remove bolts and nuts securing suspension arm to frame.



1. Suspension arm nuts

5. Remove suspension arm.



MOVE DOWNWARDS

### Lower Suspension Arm Installation

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

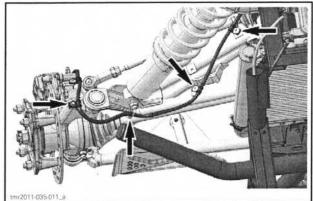
Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Subsection 03 (FRONT SUSPENSION)

### UPPER SUSPENSION ARM

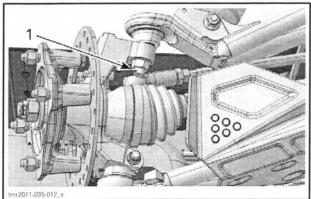
#### Upper Suspension Arm Removal

- 1. Safely lift and support the vehicle off the ground. Refer to INTRODUCTION subsection.
- 2. Remove wheel, refer to WHEELS AND TIRES subsection.
- 3. Remove fasteners retaining brake hose to vehicle.



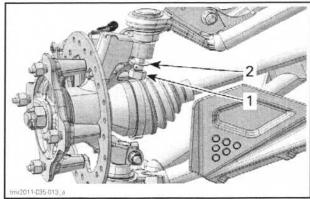
BRAKE HOSE FASTENERS (4X)

4. Remove and discard cotter pin retaining ball joint.



Ball joint cotter pin

5. Remove ball joint nut and washer.



- Ball joint nut
   Ball joint hardened washer
- 6. Carefully move brake hose aside.
- 7. Using a plastic hammer, carefully hit on the knuckle side to separate ball joint from knuckle.

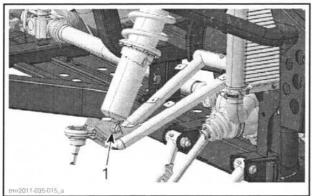
NOTE: A ball joint remover can be used if the ball joint is jammed into knuckle.

NOTICE Never hit on suspension arm to avoid to damage it permanently.



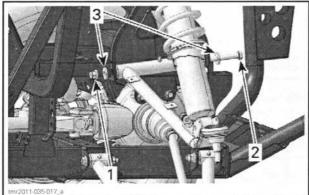
CAREFULLY HIT ON KNUCKLE SIDE

8. Remove bolt and nut securing suspension arm to shock absorber.



1. Shock absorber nut

- 9. Remove radiator from vehicle. Refer to RADIA-TOR in COOLING SYSTEM subsection.
- 10. Remove fasteners securing suspension arm to frame.



- 1. Suspension arm pivot nut
- 2. Suspension arm pivot holt
- 3. Suspension arm pivot washers
- 11. Remove suspension arm.

#### Upper Suspension Arm Installation

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

Refer to *COOLING SYSTEM* subsection for radiator installation.

**NOTICE** Properly bleed cooling system. Refer to *COOLING SYSTEM* subsection.

Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Install a NEW cotter pin to secure ball joint nut. Both end of cotter pin must be folded.

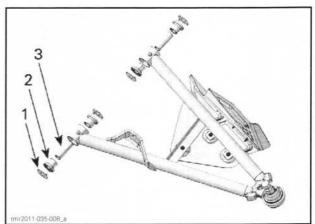
#### SHOCK ABSORBER NUTS TORQUE

48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

### SUSPENSION ARM BUSHINGS

#### Suspension Arm Bushings Removal

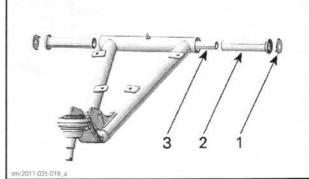
1. Remove wear plates, cushions and inner bushing from suspension arm.



LOWER SUSPENSION ARM

Wear plate
 Cushion

3. Inner bushing



UPPER SUSPENSION ARM

1. Wear plate

Cushion
 Inner bushina

#### Suspension Arm Bushings Installation

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

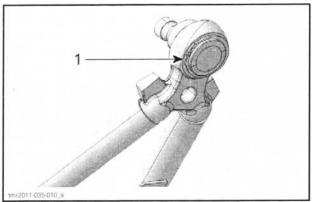
Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

# **BALL JOINTS**

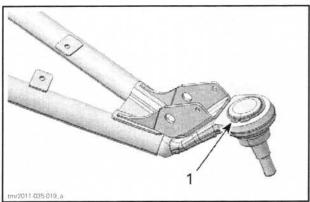
#### **Ball Joint Removal**

- 1. Remove suspension arm from vehicle. Refer to *SUSPENSION ARM REMOVAL* in this subsection.
- 2. Remove circlip from ball joint.

Subsection 03 (FRONT SUSPENSION)

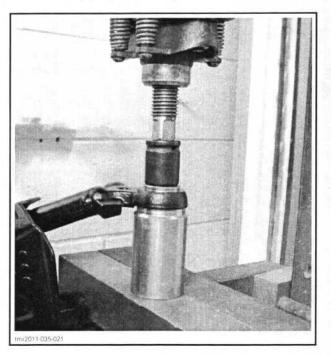


LOWER BALL JOINT



UPPER BALL JOINT

- 1. Circlip
- 3. Install suspension arm on a press.
- 4. Use an appropriate ball joint remover.



5. Remove ball joint from suspension arm.

**NOTICE** Make sure that suspension arm is properly supported on the press during ball joint removal.

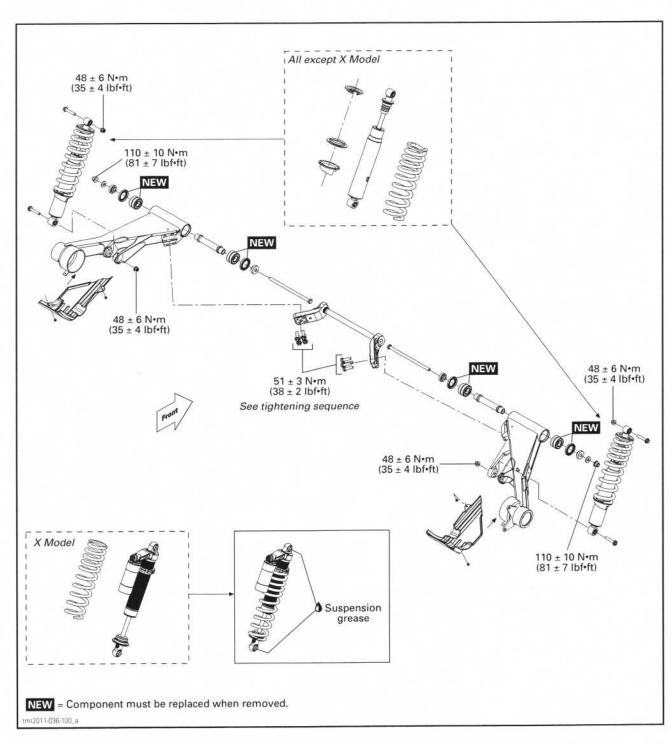
### **Ball Joint Installation**

The installation is the reverse of the removal procedure. However, pay attention to the following. Install a **NEW** circlip to secure ball joint.

# **REAR SUSPENSION**

# SERVICE TOOLS

Description	Part Number	Page
SPRING COMPRESSOR	529 036 184	



### 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 must be replaced when removed (e.g.: locking tabs, cotter pins, etc.).

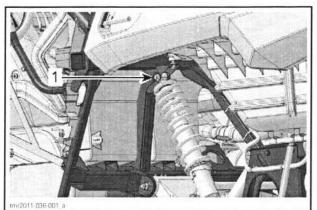
**NOTICE** Hoses, cables and locking ties removed during a procedure must be reinstalled as per factory standards.

# PROCEDURES

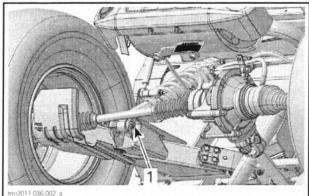
### SHOCK ABSORBERS

#### Shock Absorber Removal

- 1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
- 2. Open cargo box.
- 3. Remove bolts and nuts retaining shock absorber.



1. Upper bolt



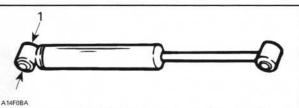
. Lower bolt

4. Remove shock absorber.

#### Shock Absorber Inspection

Remove spring from shock absorber. Refer to *SPRINGS* in this subsection.

Secure the end of shock body in a vise with its rod upward.



TYPICAL

1. Clamp here

**NOTICE** Do not clamp directly on shock body.

Extend and compress the piston several times over its entire stroke. Check that it moves smoothly and with uniform resistance with its rod upward.

Check the following conditions that will denote a defective shock:

- A skip or a hang back when reversing stroke at mid travel.
- Seizing or binding condition except at extreme end of either stroke.
- Oil leakage.
- A gurgling noise, after completing one full compression and extension stroke.

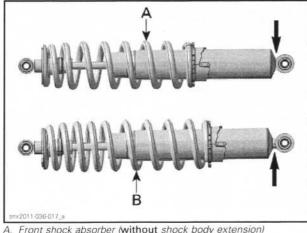
Replace if any faults are present.

#### Shock Absorber Installation

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

#### Section 07 CHASSIS Subsection 04 (REAR SUSPENSION)

Make sure to install the proper type of shock absorber **no.B** on the rear of vehicle.



A. Front shock absorber (without shock body extension) B. Rear shock absorber (with shock body extension)

SHOCK ABSORBER NUTS TORQUE

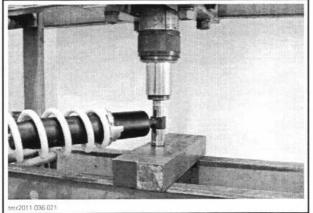
48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

# SHOCK ABSORBER BUSHINGS

#### Shock Absorber Bushing Replacement

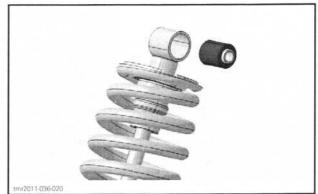
#### All Shock Absorbers Except HPG with Remote Reservoir

- 1. Remove shock absorber from vehicle. Refer to SHOCK ABSORBERS in this subsection.
- 2. Install shock absorber on a press.
- 3. Use an appropriate socket to push bushing.



TYPICAL

4. Remove bushing from shock absorber.



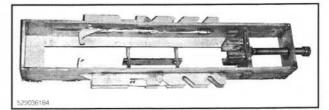
TYPICAL

- 5. Install a NEW bushing as the reverse of removal.
- 6. Install shock absorber on vehicle.

# SPRINGS

#### Spring Removal

- 1. Remove shock absorber from vehicle. Refer to SHOCK ABSORBERS in this subsection.
- 2. Use SPRING COMPRESSOR (P/N 529 036 184).



- 3. Place the tool in a vise.
- 4. Position the shock absorber in the tool.
- 5. Install the spring compressor pins.
- Tighten spring remover screw until the spring is sufficiently compressed to remove spring cap.
- 7. Remove spring cap from shock absorber.
- 8. Release spring remover screw.
- 9. Remove spring from shock absorber.

#### Spring Inspection

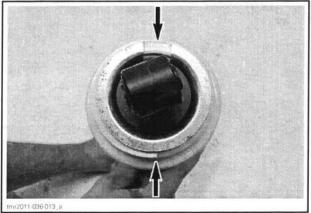
Inspect the spring for damage. Replace if necessary.

#### Spring Installation

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

Install spring cap opening at 180° from spring stopper opening.

Subsection 04 (REAR SUSPENSION)

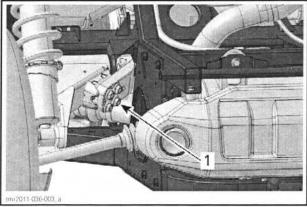


CAP OPENING AT 180°

# ANTI-SWAY BAR

#### Anti-Sway Bar Removal

- 1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
- 2. Open cargo box.
- 3. Remove anti-sway bar retaining screws (4 on each side).



1. Anti-sway bar retaining screw

4. Remove anti-sway bar.

#### Anti-Sway Bar Inspection

Check anti-sway bar for cracks, bending or other damages.

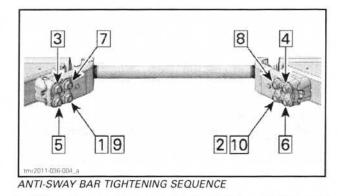
Replace if necessary.

#### Anti-Sway Bar Installation

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

Install all retaining screws of anti-sway bar loosely first.

Torque retaining screws of anti-sway bar according to the following sequence.



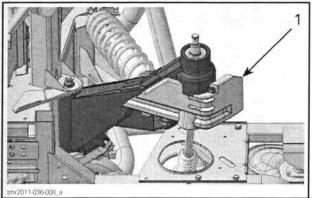
ANTI-SWAY BAR SCREWS TORQUE

51 N•m ± 3 N•m (38 lbf•ft ± 2 lbf•ft)

## TRAILING ARM

#### Trailing Arm Removal

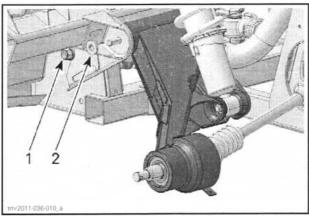
- 1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
- 2. Remove wheel, refer to WHEELS AND TIRES subsection.
- 3. Open cargo box.
- 4. Remove anti-sway bar, refer to *ANTI-SWAY BAR REMOVAL* in this subsection.
- 5. Remove wheel hub, refer to *REAR DRIVE* subsection.
- 6. Remove protective plate from trailing arm.



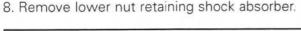
1. Protective plate

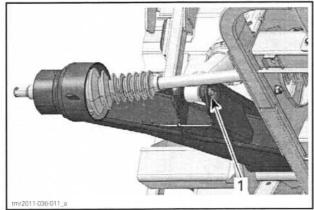
**NOTE:** If applicable, remove fasteners retaining brake hose to vehicle.

7. Remove nut and washer securing trailing arm pivot.



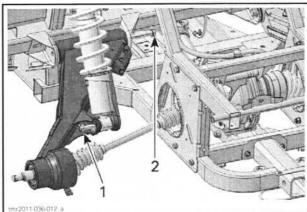
Pivot nut
 Pivot washer





1. Lower nut

- 9. Firmly hold trailing arm then remove:
  - Shock absorber lower bolt
  - Trailing arm pivot bolt and washer.



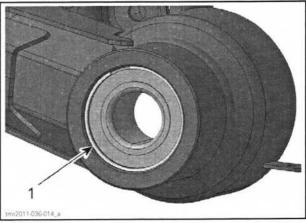
Shock absorber lower bolt
 Trailing arm pivot bolt

10. Remove trailing arm from vehicle.

## Trailing Arm Disassembly

#### Drive Shaft Bearing Removal

1. Remove circlip securing bearing into trailing arm.

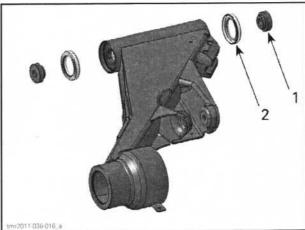


1. Circlip

- 2. Install trailing arm on a press.
- 3. Use an appropriate bearing remover.
- 4. Remove drive shaft bearing from trailing arm.

#### Trailing Arm Pivot Bearing Removal

1. Remove both spacers and seals from trailing arm pivot.

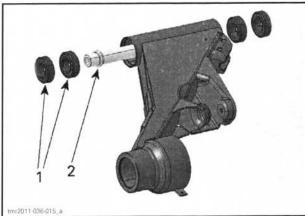


tmr2011-036-016\_a

1. Spacer 2. Seal

- 2. Install trailing arm on a press.
- 3. Use an appropriate bearing remover.
- 4. Remove pivot bearings and bushing from trailing arm.

Subsection 04 (REAR SUSPENSION)



Pivot bearings

Pivot bearings
 Pivot bushing

#### Trailing Arm Inspection

Check trailing arms for:

- Cracks
- Bending.

Check seals condition.

Check inner race of each pivot bearing with your finger:

- Bearings should turn smoothly and quietly.

Replace all damaged parts.

#### Trailing Arm Assembly and Installation

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

Install the following NEW parts:

- Pivot bearings
- Seals
- Circlip.

#### TRAILING ARM PIVOT NUT TORQUE

110 N•m ± 10 N•m (81 lbf•ft ± 7 lbf•ft)

# BRAKES

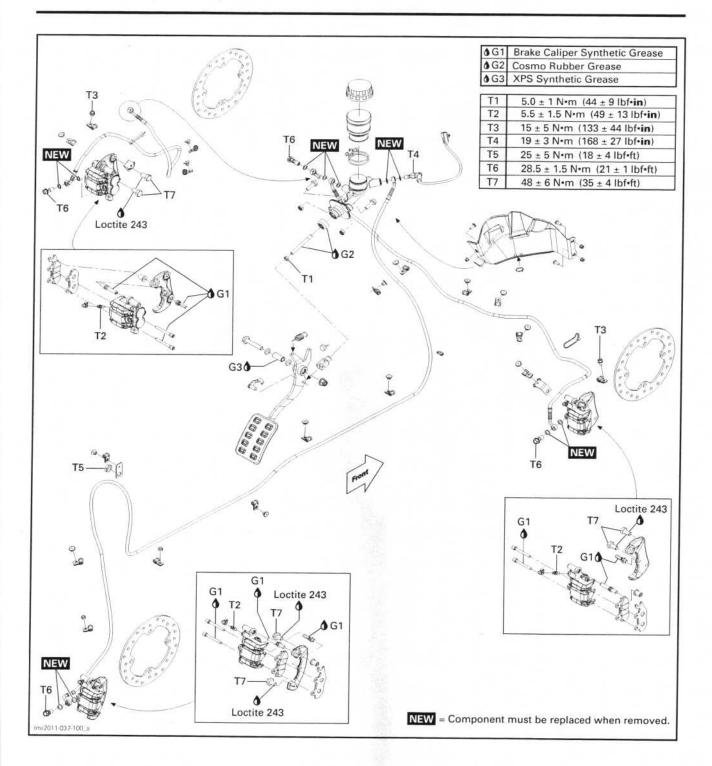
# SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166 .	

# SERVICE PRODUCTS

Description	Part Number	Page
COSMO RUBBER GREASE	293 550 055	
LOCTITE 243 (BLUE)	293 800 060	
XPS PARTS AND BRAKES CLEANER	219 701 705	

Subsection 05 (BRAKES)



Subsection 05 (BRAKES)

## 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 must be replaced when removed (e.g.: locking tabs, cotter pins, etc.).

#### 

Always check brake system operation after removing or servicing a brake component. If brake pedal feels spongy, make sure all components are properly installed and system is properly bled.

**NOTICE** Avoid spilling brake fluid on plastic, rubber or painted parts. Protect these parts with a rag when servicing brake system.

**NOTICE** Sealing washers must be discarded and replaced with new ones every time a Banjo fitting is unscrewed.

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

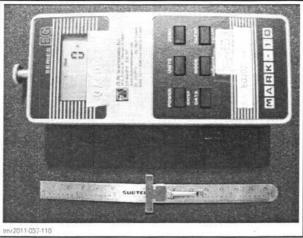
NOTE: Always clean the area around a brake component before servicing.

### INSPECTION

# BRAKE SYSTEM PRESSURE VALIDATION

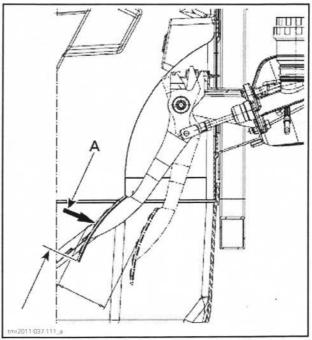
**NOTICE** Do not pump up the brake pedal repeatedly before doing the validation.

1. Use an appropriate compression force gauge such as *MARK-10 EG-200* and a ruler.



TYPICAL

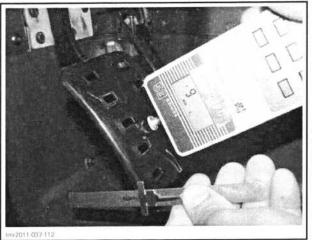
- 2. Position force gauge on brake pedal at  $64 \text{ mm} \pm 5 \text{ mm}$  (2.5 in  $\pm$  .2 in) from lower edge.
- 3. Position a ruler perpendicularly to brake pedal.



A. 64 mm ± 5 mm (2.5 in ± .2 in)

4. Push brake pedal from 70 mm (2-3/4 in) using force gauge.

Subsection 05 (BRAKES)



TYPICAL

- 5. Read the load recorded by the force gauge.
- 6. Load reading must be as per the following table.

## BRAKE PEDAL LOAD AT 70 MM

Minimum 250 N (56 lbf)

- If load reading is not in accordance with the specification:
  - 7.1 Perform a brake system inspection and cleaning.
  - 7.2 Bleed brake system.

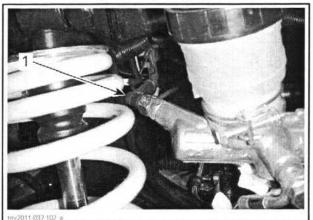
**NOTE:** Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

# PROCEDURES

## BRAKE LIGHT SWITCH

#### Brake Light Switch Location

Brake light switch is located underneath LH front fender on master cylinder.



1. Brake light switch

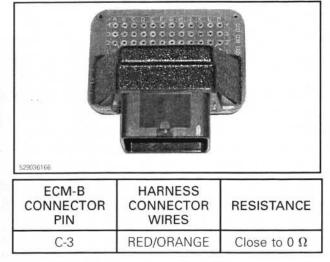
#### Brake Light Switch Resistance Test

- 1. Disconnect brake light switch connector.
- 2. Check switch operation as follows.

BRAKE LIGHT SWITCH POSITION		IN	RESISTANCE
Firmly pushed	1	2	Close to 0 $\Omega$
Released		2	Infinite (OL)

If switch is defective, replace with a new one. If the switch tests good, verify wire continuity between harness connector and ECM-B connector.

NOTE: Use the ECM ADAPTER TOOL (P/N 529 036 166).



NOTE: If only the LH taillight does not work, check brake relay (R8) in fuse box 1.

### Brake Light Switch Replacement

- 1. Disconnect brake light switch connector.
- 2. Drain rear brake line.
- 3. Remove brake light switch from master cylinder.

NOTE: Use shop rags to catch any spilled brake fluid.

- 4. Install NEW sealing washers.
- 5. Install brake light switch on master cylinder.

BRAKE LIGHT SWITCH NUT TORQUE

19 N•m ± 3 N•m (168 lbf•in ± 27 lbf•in)

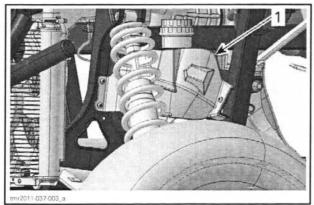
- 6. Connect brake light switch connector.
- 7. Refill and bleed brake system, refer to *PERI-ODIC MAINTENANCE PROCEDURES* subsection.

Subsection 05 (BRAKES)

## MASTER CYLINDER

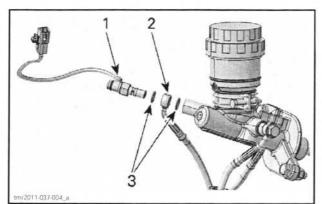
#### Master Cylinder Removal

- 1. Drain brake system, refer to PERIODIC MAIN-TENANCE PROCEDURES subsection.
- 2. Remove master cylinder protective cover.



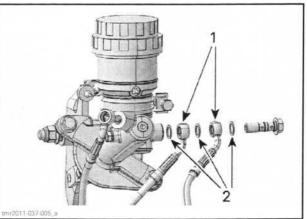
Master cylinder protective cover

3. Remove brake light switch retaining rear brake hose.



SOME PARTS REMOVED FOR CLARITY PURPOSE

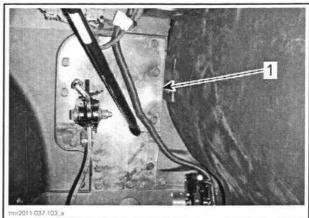
- Brake light switch
   Rear brake hose
   Sealing washers
- 4. Unscrew front brake hoses from master cylinder.



SOME PARTS REMOVED FOR CLARITY PURPOSE Front brake hoses

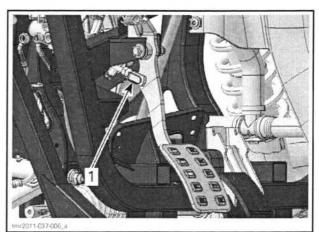
Front brake nose
 Sealing washers

5. Remove protective rubber from underneath dashboard.



UNDERNEATH DASHBOARD Protective rubber 1

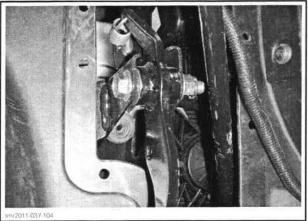
6. Disconnect master cylinder rod from brake pedal.



Master cylinder rod 1.

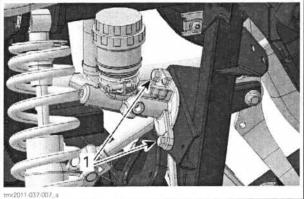
#### Section 07 CHASSIS Subsection 05 (BRAKES)

7. Remove master cylinder rod from master cylinder.



MASTER CYLINDER ROD REMOVED

8. Remove master cylinder retaining bolts and nuts.



1. Master cylinder retaining bolts

9. Remove master cylinder from vehicle.

### Master Cylinder Inspection

Check boot for crack.

Check rod for wear and scratch.

Check master cylinder housing for leak or damage.

# Master Cylinder Installation

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

Tighten brake light switch and front brake hoses to specification.

# FRONT BRAKE HOSES SCREW TORQUE

28.5 N•m ± 1.5 N•m (21 lbf•ft ± 1 lbf•ft)

## BRAKE LIGHT SWITCH NUT TORQUE

19 N•m ± 3 N•m (168 lbf•in ± 27 lbf•in)

Lubricate push rod end and inside master cylinder boot.

#### PUSH ROD END LUBRICATION

COSMO RUBBER GREASE (P/N 293 550 055)

MASTER CYLINDER BOOT LUBRICATION

COSMO RUBBER GREASE (P/N 293 550 055)

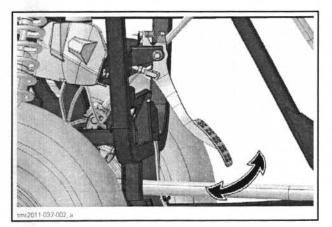
#### Install NEW sealing washers.

Refill and bleed brake system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Adjust master cylinder rod, refer to *MASTER CYLINDER ROD ADJUSTMENT* in this subsection.

## Master Cylinder Rod Adjustment

- 1. Loosen locking nut of master cylinder rod.
- 2. Move brake pedal up and down to check if there is a free play.



3. Rotate master cylinder rod to generate a free play according to specification.

#### BRAKE PEDAL FREE PLAY

3.5 mm ± 1.5 mm (1/8 in ± 1/16 in)

4. Tighten locking nut of master cylinder rod to specification.

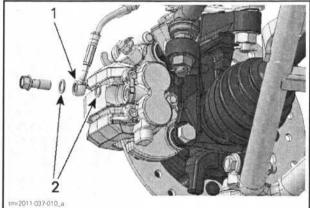
#### ROD LOCKING NUT TORQUE

5 N•m ± 1 N•m (44 lbf•in ± 9 lbf•in)

# CALIPER

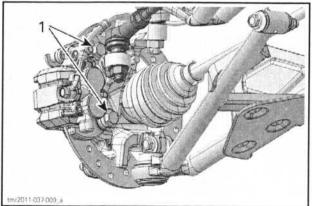
#### Caliper Removal

- 1. Safely lift and support the vehicle. Refer to *IN*-*TRODUCTION* subsection.
- 2. Remove wheel, refer to *WHEELS AND TIRES* subsection.
- 3. If caliper is removed from vehicle for replacement:
  - 3.1 Drain brake system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
  - 3.2 Unscrew brake hose from caliper.



TYPICAL - FRONT CALIPER SHOWN

- 1. Brake hose
- 2. Sealing washers
- 4. Remove fasteners retaining brake hose to knuckle.
- 5. Remove screws securing caliper support to knuckle.



TYPICAL - FRONT CALIPER SHOWN

1. Caliper screws

6. Place caliper assembly onto a support.

**NOTICE** Do not let caliper hangs by the hose and do not stretch or twist hose.

### **Caliper Installation**

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

If caliper was removed for replacement:

- Refill and bleed brake system, refer to *PERI-ODIC MAINTENANCE PROCEDURES* subsection.
- Install NEW sealing washers.

Apply threadlocker on caliper retaining screws.

CALIPER RETAINING SCREWS THREADLOCKER

LOCTITE 243 (BLUE) (P/N 293 800 060)

Tighten caliper retaining screws to specification.

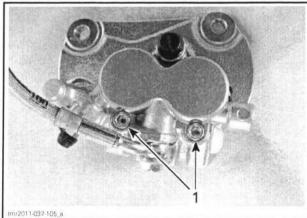
CALIPER RETAINING SCREWS TORQUE

48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

# BRAKE PADS

#### Brake Pads Replacement

- 1. Remove caliper from knuckle, refer to *CALIPER REMOVAL* in this subsection.
- 2. Remove brake pad pins from caliper.

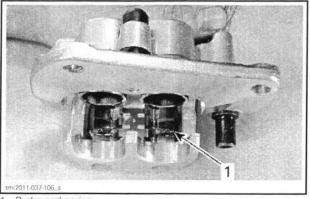


- 1. Brake pad pins
- 3. Remove brake pads.
- 4. Clean pistons end using XPS PARTS AND BRAKES CLEANER (P/N 219 701 705).
- 5. Push caliper pistons inward.

**NOTE:** To avoid damaging pistons, use an old pad to push it into the caliper using a C-clamp.

6. Ensure brake pad spring is properly positioned onto caliper.

Subsection 05 (BRAKES)



1. Brake pad spring

- 7. Install NEW brake pads.
- 8. Clean then lubricate brake pad pins using an appropriate *BRAKE CALIPER SYNTHETIC GREASE*.
- 9. Install brake pad pins on caliper.
- 10. Install caliper on knuckle, refer to *CALIPER IN-STALLATION* in this subsection.

# BRAKE DISC

#### Brake Disc Inspection

- 1. Check disc surfaces for scratches or grooves on both sides.
- 2. Measure thickness of the disc.

DISC MINIMUM THICKNESS		
FRONT	4.1 mm (.161 in)	
REAR	4.1 mm (.161 in)	

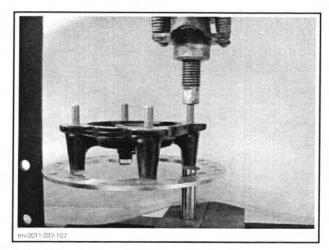
**NOTICE** Brake discs must never be machined.

3. Check warpage of the disc.

MAXIMUM DISC WARPAGE		
FRONT	0.2	
REAR	0.2 mm (.01 in)	

## Brake Disc Replacement

- 1. Remove caliper from knuckle, refer to *CALIPER REMOVAL* in this subsection.
- 2. Remove wheel hub, refer to *FRONT DRIVE* or *REAR DRIVE* subsection.
- 3. Remove wheel studs using a press.



- 4. Replace brake disc.
- 5. Install wheel studs using a press.
- 6. Align wheel stud knurling into hub grooves.

NOTE: If wheel studs are damaged, replace them.

- 7. Install wheel hub then caliper.
- 8. Install NEW cotter pin to secure wheel hub nut.

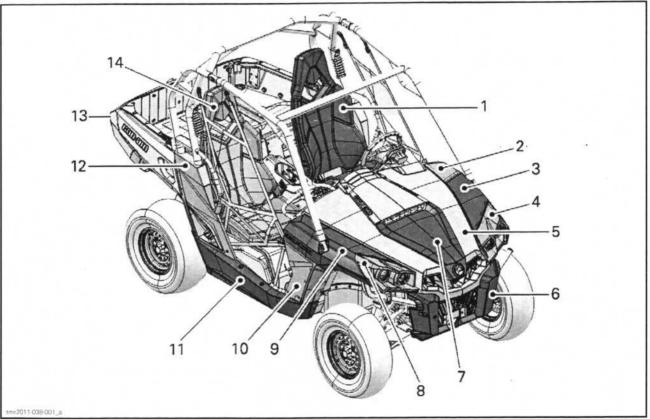
Subsection 06 (BODY)

# BODY

# SERVICE TOOLS

Description	Part Number	Page
OETIKER PLIERS	295 000 070	

#### BODY (Parts Nomenclature)

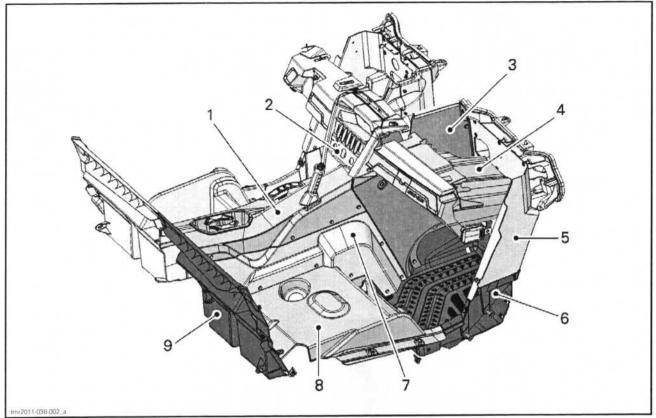


- 1
- 2
- Driver seat CVT air inlet cover LH front fender LH headlight trim

- CVT air inlet cover
   LH front fender
   LH headlight trim
   Hood
   Front fascia
   Service cover
   RH headlight trim
   RH front fender
   Front lateral panel
   Central lateral panel
   Ray lateral panel
   Cargo box
   Passenger seat

#### Section 07 CHASSIS Subsection 06 (BODY)

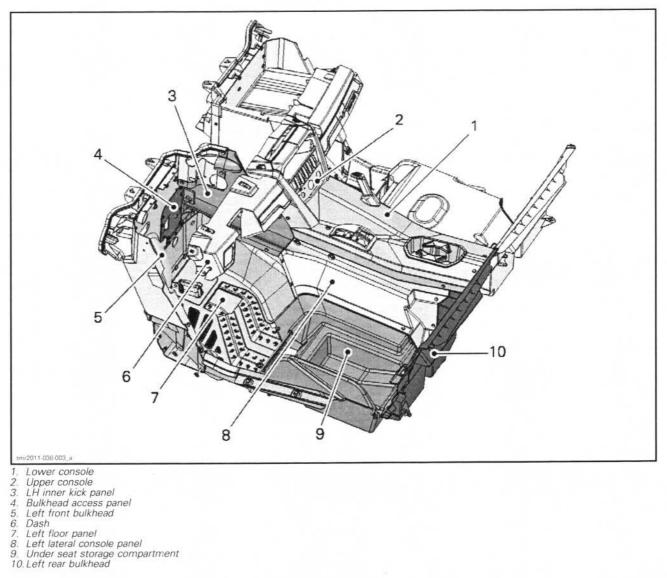
COCKPIT - PASSENGER SIDE (Parts Nomenclature)



- 1. Lower console 2. Upper console 3. RH inner kick panel 4. Glove box 5. Right front bulkhead 6. Right floor panel 7. Right lateral console panel 8. Fuel tank cowl 9. Right rear bulkhead

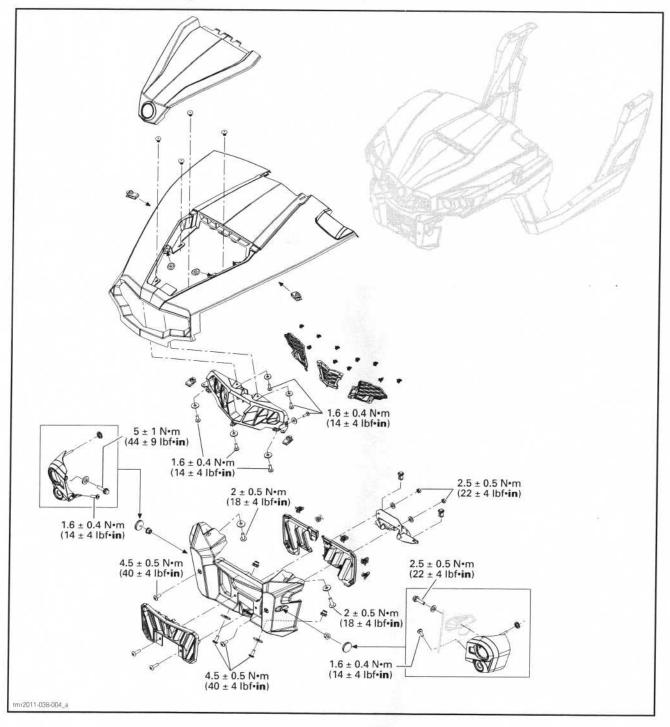
#### Section 07 CHASSIS Subsection 06 (BODY)





Subsection 06 (BODY)

FRONT BODY PARTS (Torques and Service Products)

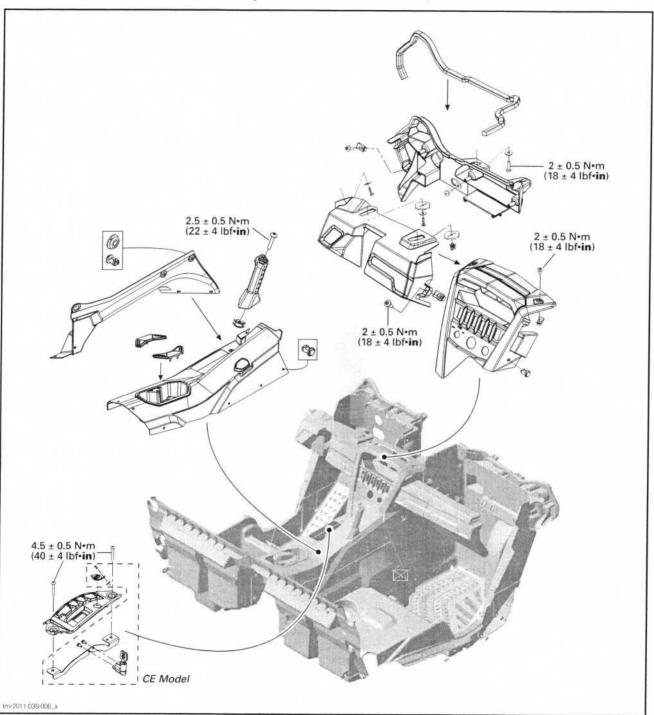


#### Section 07 CHASSIS Subsection 06 (BODY)

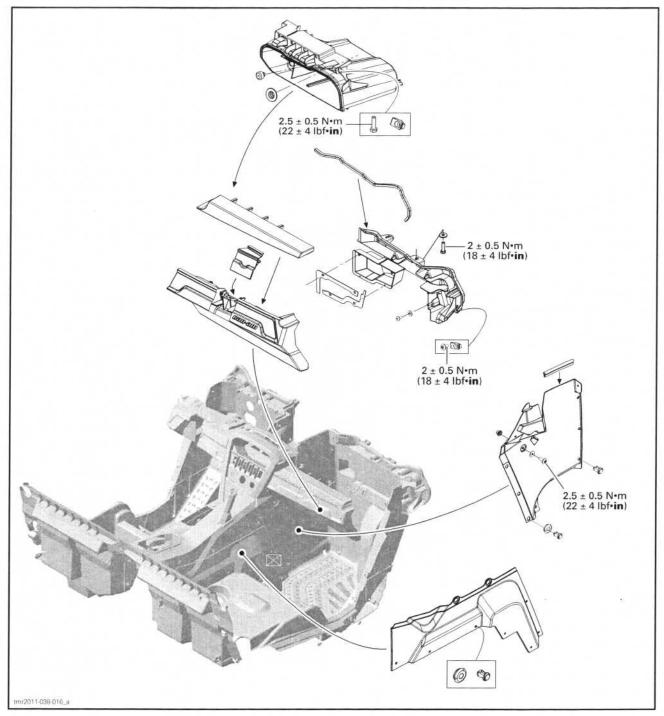
T1 T1 2 ± 0.5 N•m (18 ± 4 lbf•in) T2 2.5 ± 0.5 N•m (22 ± 4 lbf•in) T3 3.5 ± 0.5 N•m (31 ± 4 lbf•in) T4 6.5 ± 0.5 N·m (58 ± 4 lbf·in) T2 tmr2011-038-005\_a

SIDE BODY PARTS (Torques and Service Products)

Subsection 06 (BODY)

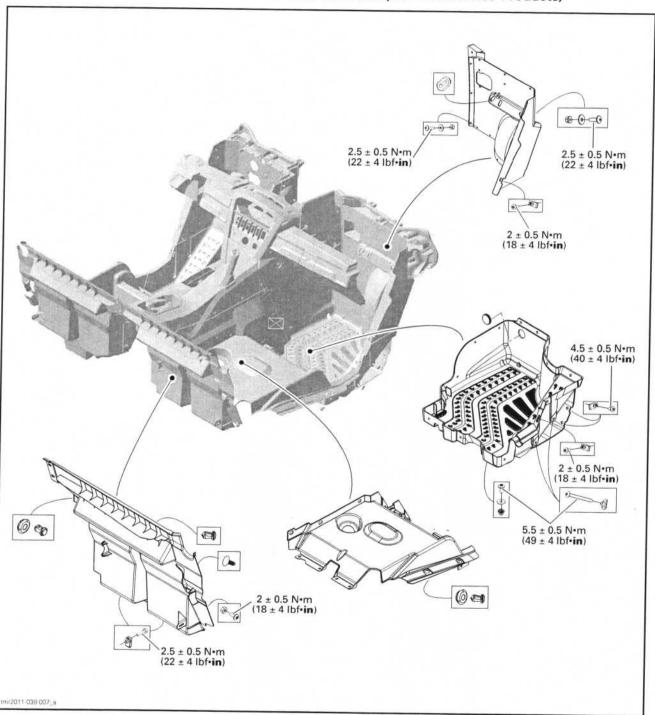


COCKPIT TRIMS - DRIVER SIDE (Torques and Service Products)



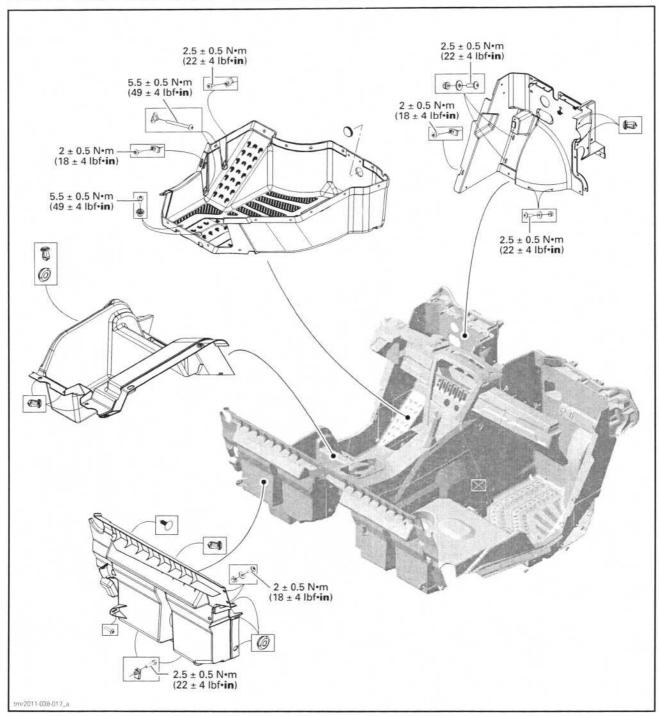
COCKPIT TRIMS - PASSENGER SIDE (Torques and Service Products)

Subsection 06 (BODY)



COCKPIT STRUCTURE PANELS - PASSENGER SIDE (Torques and Service Products)

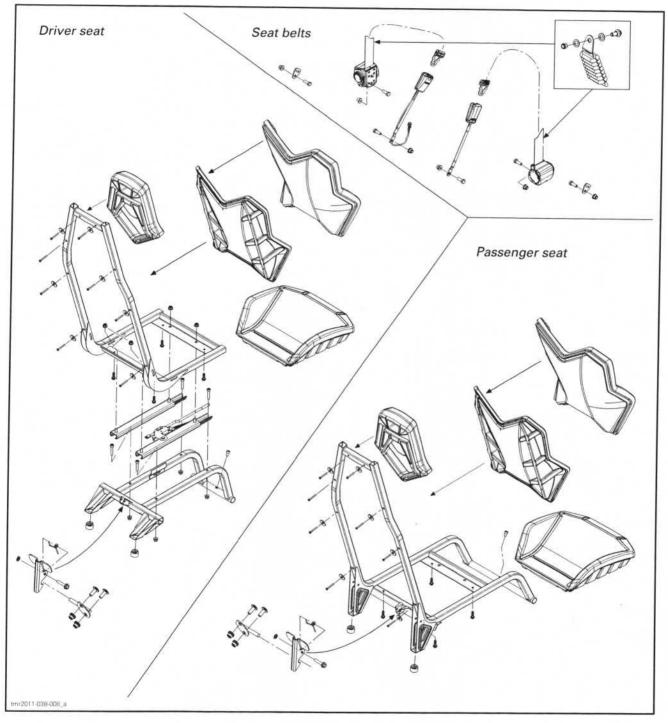
Subsection 06 (BODY)



COCKPIT STRUCTURE PANELS – DRIVER SIDE (Torques and Service Products)

Subsection 06 (BODY)

## SEATS



## 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.

## A WARNING

Torque wrench tightening specifications must strictly be adhered to.

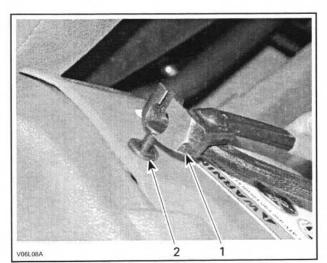
Locking devices when removed (e.g.: locking tabs, elastic stop nuts, cotter pins, etc.) must be replaced.

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

# PROCEDURES

# PLASTIC RIVET

Plastic rivets are used in the riveting of the various body parts. Plastic rivets can be reused many times. Use the OETIKER PLIERS (P/N 295 000 070) to remove them.



#### TYPICAL 1. Pliers 2. Plastic rivet

## 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.

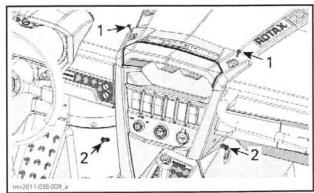
Apply liquid soap to new decal and carefully position it. Using a sponge or a squeegee, remove the air bubbles and surplus water working from the center toward the edges. Allow to air dry.

**NOTICE** Do not apply isopropyl alcohol or solvent directly on decals. Use these products in a well ventilated area.

# UPPER CONSOLE

# Upper Console Removal and Installation

- 1. Remove:
  - Screws
  - Plastic rivets.



- 1. Top screws 2. Plastic rivets
- Pull out the upper console and disconnect electrical connectors.
- 3. Remove the upper console.

The installation is the reverse of the removal procedure.

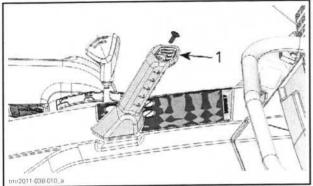
# LOWER CONSOLE

# Lower Console Removal and Installation

1. Remove both seats.

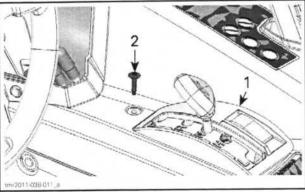
#### Section 07 CHASSIS Subsection 06 (BODY)

- 2. Remove screws and plastic rivets securing the upper console and place it on the hood.
- 3. Remove the LH passenger handhold screw.

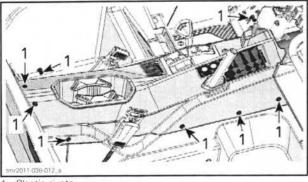


LH passenger handhold

4. Remove the front screw of the shift lever indicator.



5. Remove all plastic rivets securing the lower console.



Plastic rivets

6. Remove the lower console.

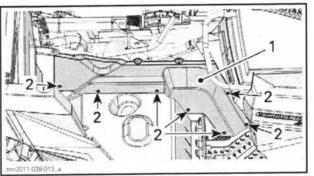
The installation is the reverse of the removal procedure.

# LATERAL CONSOLE PANELS

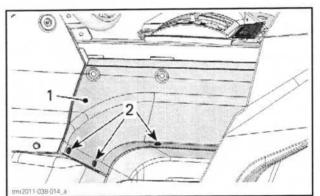
#### Lateral Console Panels Removal and Installation

- 1. Remove seat.
- 2. Remove plastic rivets securing the lateral console panel.
- 3. Remove the lateral console panel.

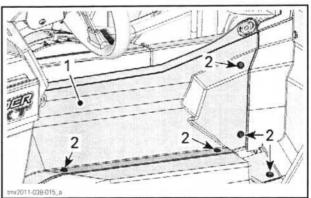
NOTE: On following illustrations, the cage and the side net are removed for clarity purpose.



RH lateral console panel Plastic rivets



FRONT PORTION OF THE LH LATERAL CONSOLE PANEL LH lateral console panel Plastic rivets



REAR PORTION OF THE LH LATERAL CONSOLE PANEL LH lateral console panel Plastic rivets 1.

Shift lever indicator Front retaining screw 2

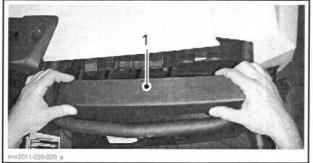
tmr2011-038

# Subsection 06 (BODY)

The installation of the lateral console panels is the reverse of the removal procedure.

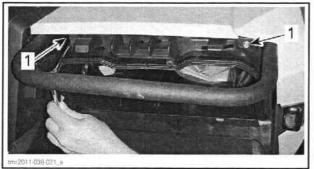
# GLOVE BOX REMOVAL AND INSTALLATION

1. Remove the glove box trim.



1. Glove box trim

2. Remove glove box retaining screws.



1. Glove box retaining screws

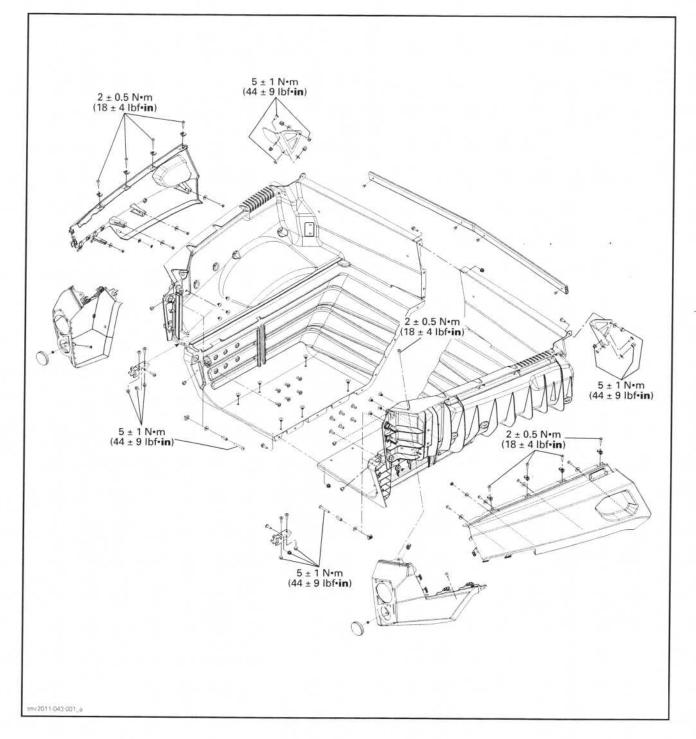
3. Pull glove box to remove it.

The installation of the glove box is the reverse of the removal procedure.

Section 07 CHASSIS Subsection 07 (CARGO BOX)

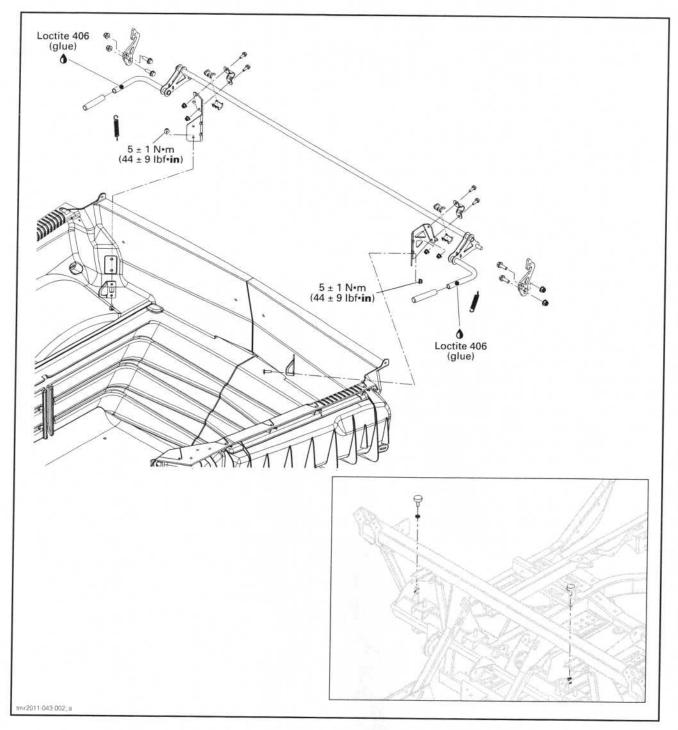
# CARGO BOX

CARGO BOX TRIMS



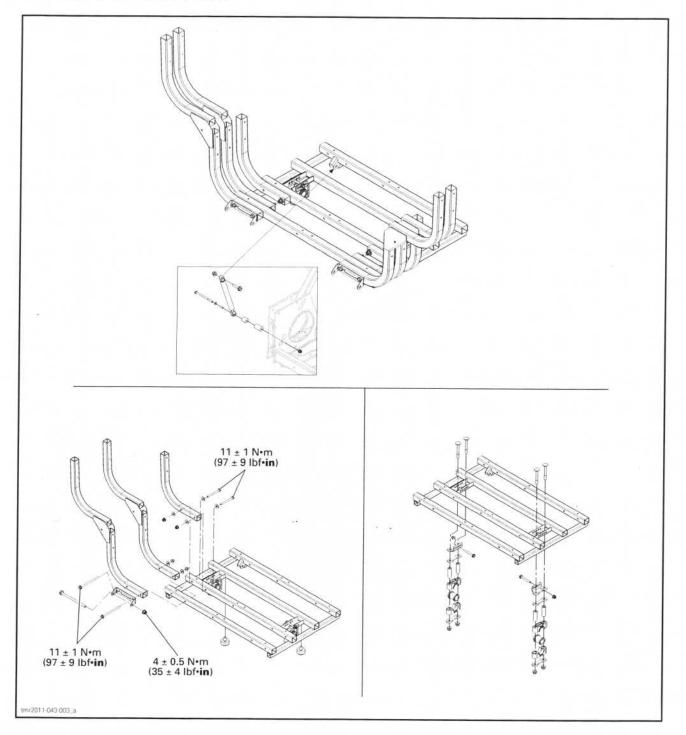
Subsection 07 (CARGO BOX)

# CARGO BOX TILT RELEASE MECHANISM



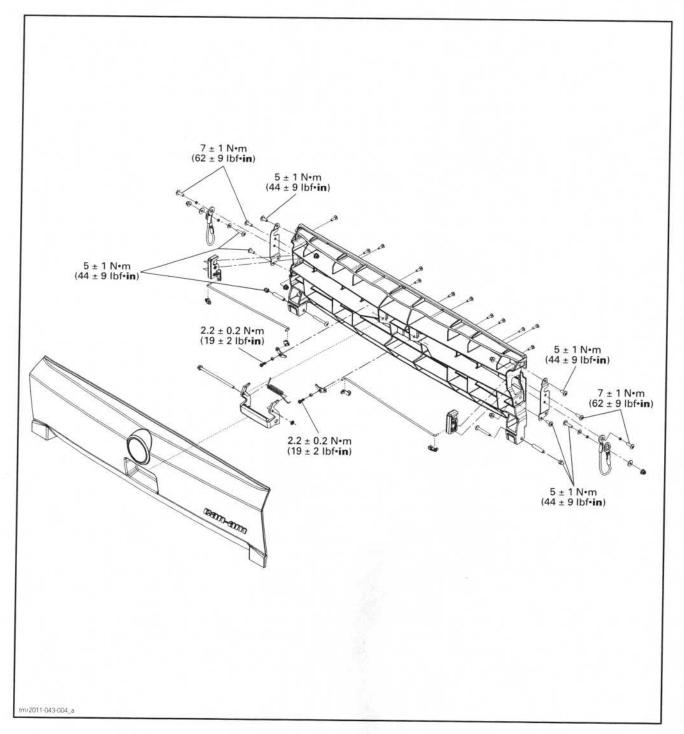
#### Section 07 CHASSIS Subsection 07 (CARGO BOX)

## CARGO BOX SUPPORT

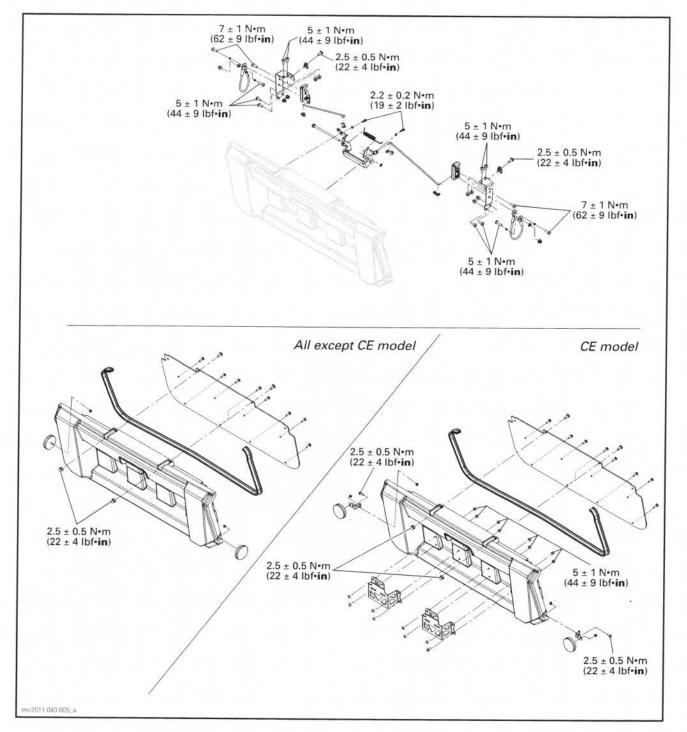


Subsection 07 (CARGO BOX)

## UPPER TAIL GATE

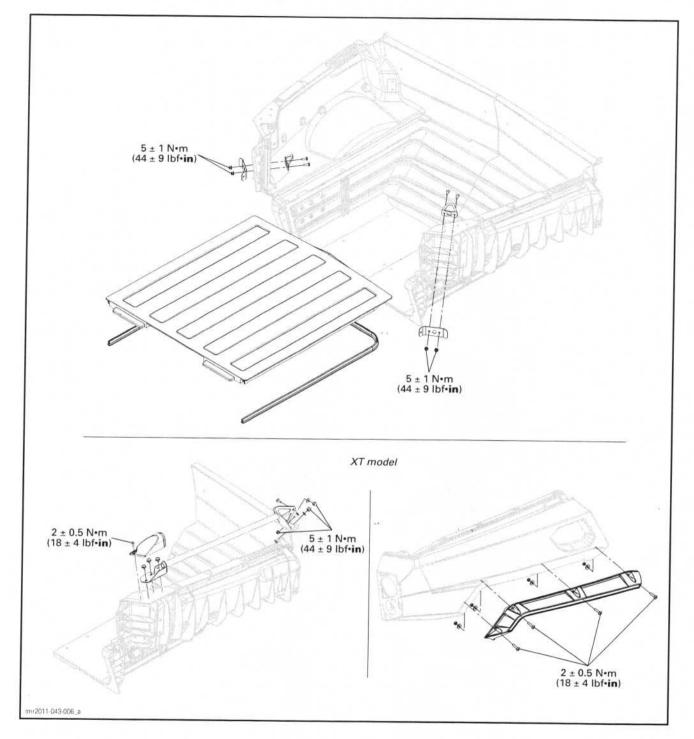


# LOWER TAIL GATE



Subsection 07 (CARGO BOX)

## CARGO BOX ACCESSORIES



## 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.

### 

Torque wrench tightening specifications must strictly be adhered to. Locking devices when removed (e.g.: locking

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

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

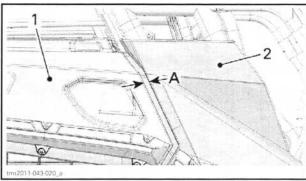
# ADJUSTMENT

## CARGO BOX ADJUSTMENTS

#### Cargo Box Alignment

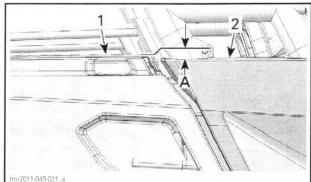
The cargo box is properly aligned when:

- The gap between the cargo box and rear lateral panel is equalled on each side (± 19mm (3/4 in)).
- Cargo box side and rear lateral panel are flushed. The top of cargo box side may be raised for a maximum of 6 mm (15/64 in) over the top of rear lateral panel.



GAP BETWEEN CARGO BOX AND REAR LATERAL PANEL

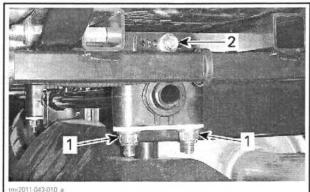
- Cargo box side 2. Rear lateral panel
- A. Approximately 19 mm (3/4 in)



- CARGO BOX HEIGHT GAP
- 1. Top of cargo box side 2. Top of rear lateral panel
- A. Maximum of 6 mm (15/64 in)

If an adjustment is required, proceed as follows:

- 1. Loosen cargo box pivot point nuts.
- 2. Remove adjuster bolts securing the cargo box to cargo box support adjuster.

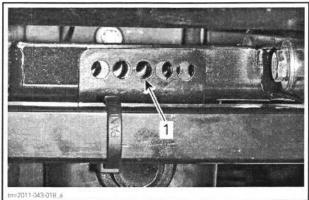


TYPICAL – RH SIDE SHOWN

Cargo box pivot point nuts

2. Adjuster bolt

- 3. Position cargo box to align it as described above.
- 4. Reinstall adjuster bolts in corresponding holes.



Corresponding holes

Tighten nuts and bolts.

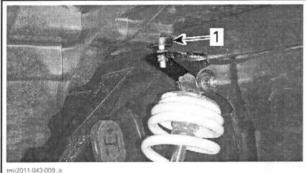
Subsection 07 (CARGO BOX)

PART	TORQUE
Adjuster bolts	10 N•m ± 2 N•m (89 lbf•in ± 18 lbf•in)
Cargo box pivot point nuts	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

6. Verify the cargo box retainer height.

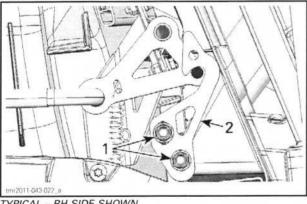
## Cargo Box Retainer Height Adjustment

- 1. Open cargo box.
- 2. Loosen rubber bumpers.



RH SIDE SHOWN

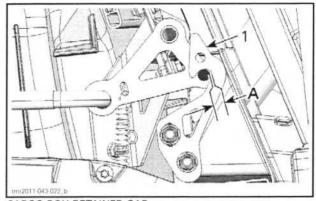
- 1. Rubber bumper
- 3. Close the cargo box and check the gap between cargo box retainer and the end of the latch lever.
  - 3.1 Break torque from cargo box retainer bolts.



TYPICAL - RH SIDE SHOWN

Cargo box retainer nuts
 Cargo box retainer

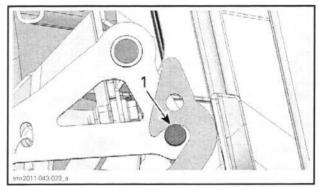
- 3.2 Using a small hammer, reposition the cargo box retainer. Temporarily retighten bolts.
- 3.3 Close the cargo box and check the cargo box retainer gap.



CARGO BOX RETAINER GAP 1. Cargo box retainer

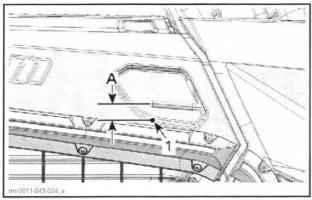
A. 1.5 mm to 3.0 mm (.059 in to .118 in)

NOTE: No vertical gap is permitted between cargo box retainer and the end of the latch lever.



<sup>1.</sup> No gap here

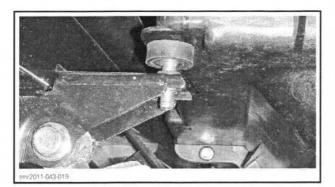
- 4. Check the tilt release handle stroke.
  - 4.1 Determine a reference point on the body.
  - 4.2 With the cargo box unlatch, measure the distance between the handle and your reference point.
  - 4.3 Latch the cargo box and repeat the measurement using same reference points (handle and body).
  - 4.4 The difference between measurements should be approximately 2 mm (.079 in).



- 1. Reference point
- A. Difference: approximately 2 mm (.079 in)
- 5. Repeat steps 3 and 4 until cargo box is properly adjusted.
- 6. Retighten all cargo box retainer bolts.

PART	TORQUE	
Cargo box retainer bolts	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)	

7. Reposition the rubber bumper against the cargo box without any pressure.



# PROCEDURES

## CARGO BOX GAS SHOCK

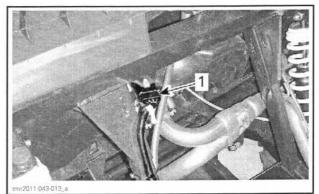
#### Cargo Box Gas Shock Replacement

- 1. Unlock and raise the cargo box.
- 2. Secure the cargo box with wooden blocks (or an equivalent).
- 3. Remove the upper and lower gas shock bolts.
- 4. Remove gas shock from vehicle and install the new one.
- 5. Remove supports and lower cargo box.

## CARGO BOX

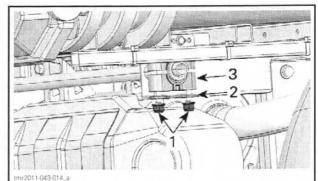
#### Cargo Box Removal

- 1. Unlock and raise the cargo box.
- 2. Unplug the cargo box harness connector.



1. Cargo box harness connector

- From the LH of vehicle, cut all locking ties securing harness to frame.
- Secure the cargo box with wooden blocks (or an equivalent) and remove the upper gas shock bolt.
- 5. Remove supports and lower cargo box.
- 6. From underneath of cargo box, remove nuts, support plates and halve housings.



#### RH SIDE SHOWN

- 1. Nuts
- 2. Support plate 3. Half housing
- 7. Unlock the cargo box.
- 8. Using a hoist or with the help of another person, remove the cargo box.

**A** CAUTION To avoid injury or vehicle damages, never handle the cargo box alone.

### Cargo Box Installation

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

#### Section 07 CHASSIS Subsection 07 (CARGO BOX)

If any parts of the locking mechanism have been replaced or loosen, check cargo box adjustments. Refer to *CARGO BOX ADJUSTMENTS*.

# FRAME

# SERVICE TOOLS - OTHER SUPPLIER

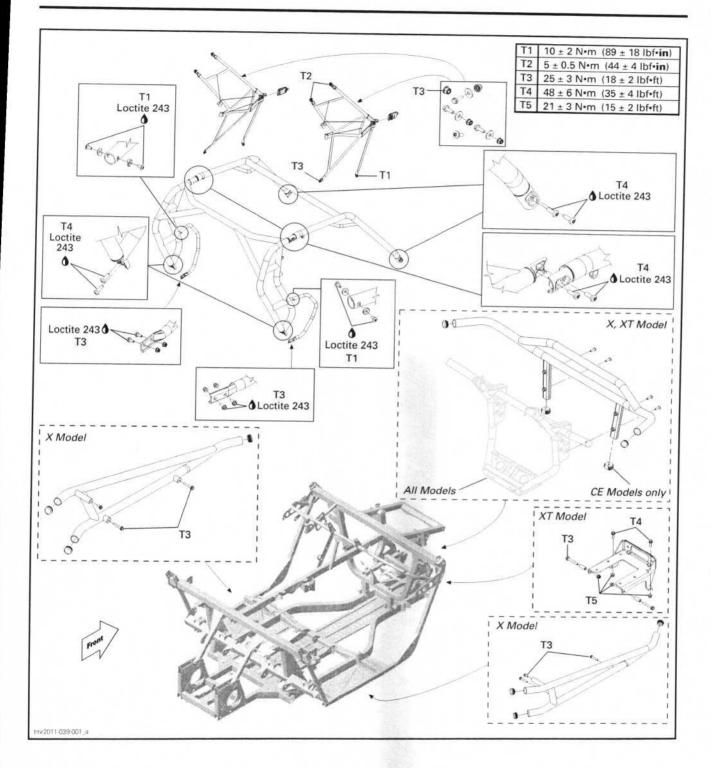
Description	Part Number	Page
BLIND THREADED INSERT INSTALLER	model 9600	

# SERVICE PRODUCTS

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

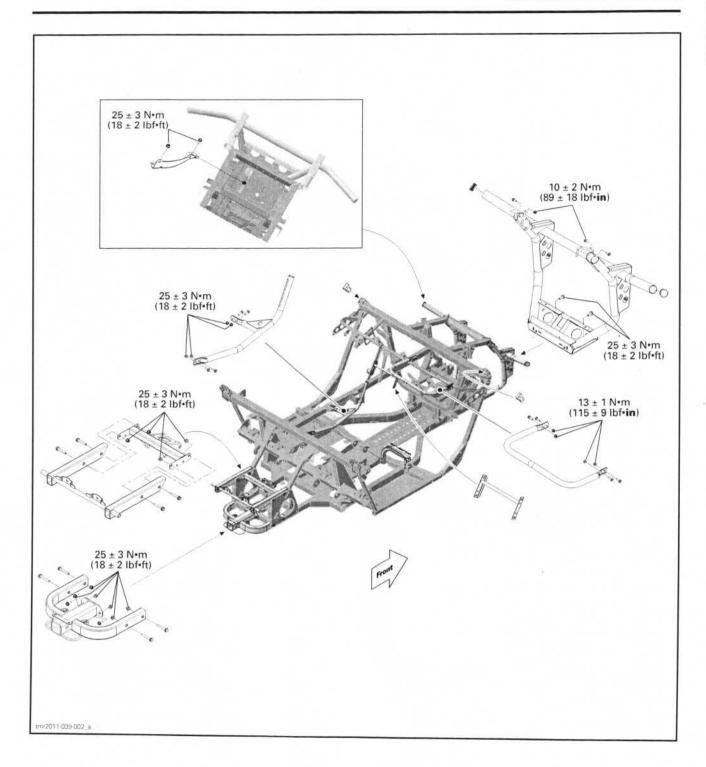
# Section 07 CHASSIS

Subsection 08 (FRAME)



### Section 07 CHASSIS

Subsection 08 (FRAME)



# GENERAL

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

NOTE: It is recommended to use new screws and nuts when removed.

If the same fasteners are reused, clean threads before applying a threadlocker. Refer to *SELF-LOCKING FASTENERS* and *LOCTITE AP-PLICATION* at the beginning of this manual for complete procedure.

# A WARNING

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

# PROCEDURES

# CAGE

### A WARNING

Never modify the mounting points of the shoulder nets and the seat belts. If they are found modified or damaged, contact a BRP service representative.

# A WARNING

Never drill holes, weld or modify the cage. Since this is an important protection component, any modification might compromise passenger safety.

# Cage Inspection

Check cage for bending, cracks, weld damages or any other damage.

### A WARNING

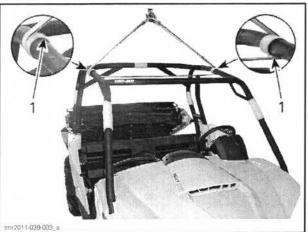
Any damaged cage components must be replaced.

# Cage Installation

# A WARNING

When the cage mounting bolts are removed, they must be replaced with new ones or have their threads cleaned then have LOCTITE 243 (BLUE) (P/N 293 800 060) applied. Ensure to use only 8.8 grade fasteners.

- 2. Position straps on cage tubes as shown.
- 3. Install lifting straps to the cage. Make a loop in the strap to prevent the cage to slip while manipulating.



. Loops in the strap around the cage tubes

4. Using a hoist, lift the cage assembly over the vehicle and carefully position it on vehicle.

# **A** CAUTION To avoid injury or vehicle damages, never handle the cage alone.

**NOTE:** As an alternate method, 4 persons at each attachment point can position the cage on the vehicle.

5. Insert the rear of cage first. Loosely install screws.

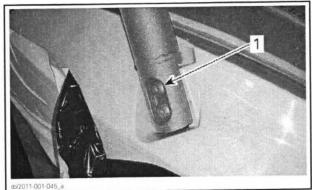


RH REAR CAGE ATTACHMENT POINT SHOWN
1. Mounting screws

6. Insert the front of cage last. Loosely install screws.

NOTE: Installing the top screw first will ease the assembly.

1. Loosely assemble the cage.



RH FRONT CAGE ATTACHMENT POINT SHOWN
1. Install top screw first

- Properly torque all the following cage screws to 48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft) in this order.
  - Rear attachment points
  - Joints between front and rear portion of cage
  - Front attachment points.

# FRAME

#### Frame Inspection

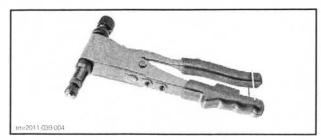
Check frame for bending, cracks, weld damages or any other damage. Replace frame as necessary.

### Frame Welding

No welding should be done on frame except if mentioned or required on an approved BRP Bulletin.

### Frame Insert Replacement

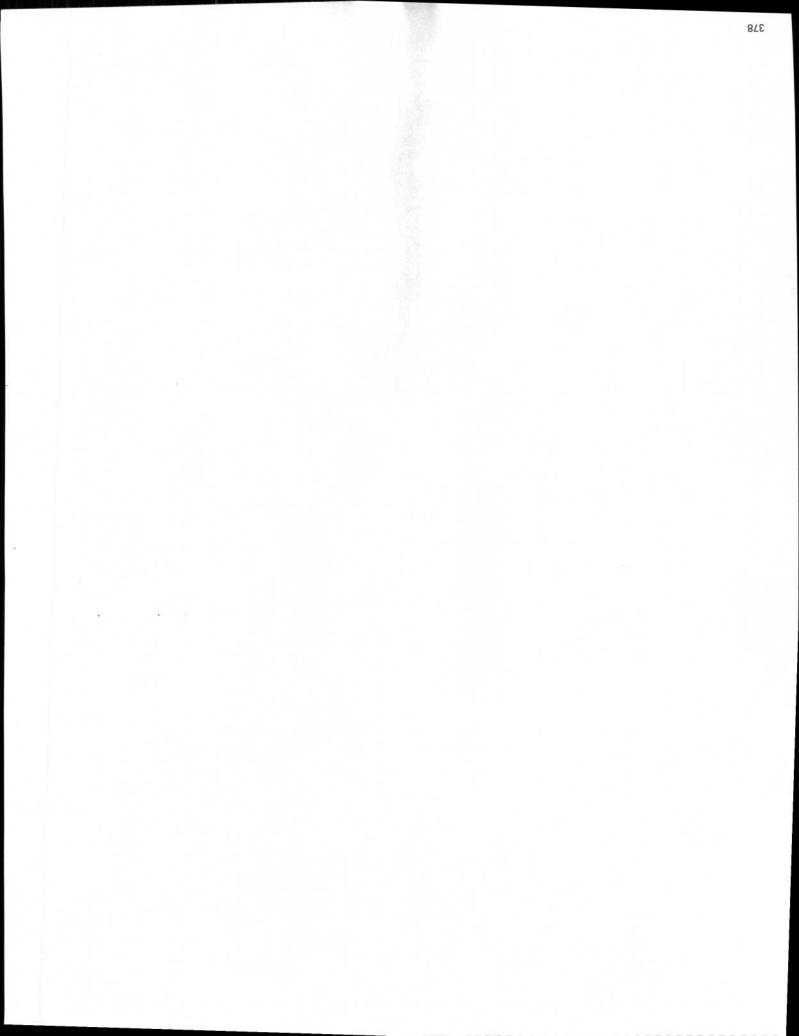
To install a new blind threaded insert, use the following tool: BLIND THREADED INSERT INSTALLER (P/N MODEL 9600) from Textron. See their web site at: www.textronfasteningsystems.com.



After insert installation, ensure insert can hold the torque applied to the screw it retains. Otherwise, install a new insert.

### Frame Replacement

**NOTE:** Blind threaded inserts are not installed on replacement frames. Make sure to order 14 inserts when replacing frame.



Subsection 01 (COMMANDER 800R AND 1000)

# **COMMANDER 800R AND 1000**

MODEL			COMMANDER 800R	COMMANDER 1000
ENGINE				
			ROTAX® 810	ROTAX <sup>®</sup> 1010
Engine type			4-stroke, Single Ov (SOHC), lig	ver Head Camshaft juid cooled
Number of cylinders			1	2
Number of valves			8 valves (mechai	nical adjustment)
Bore			91 mm	(3.58 in)
Stroke			61.5 mm (2.42 in)	75 mm (2.95 in)
Displacement			799 cm <sup>3</sup> (48.8 in <sup>3</sup> )	976 cm <sup>3</sup> (59.6 in <sup>3</sup> )
Compression ratio			10.3:1	10.5:1
Maximum HP RPM			7250 rpm	7000 rpm
Exhaust system			Spark arrestor approved	by USDA Forest Service
Air filter			Flat corrugated	composite fiber
Intake valve opening			5° B	TDC
Intake valve closing			45° ABDC	60° ABDC
Exhaust valve opening		44	55° BBDC	65° BBDC
Exhaust valve closing			5° ATDC	- 5° ATDC
Intake			0.06 mm to 0.14 mm	(.0024 in to .0055 in)
Valve clearance	Exhaust		0.11 mm to 0.19 mm (.0043 in to .0075 in)	
	Intake	New	4.966 mm to 4.980 mm (.1955 in to .1961	
4 J		Service limit	4.930 mm (.1941 in)	
Valve stem diameter		New	4.956 mm to 4.970 mm (.1951 in to .1957	
	Exhaust	Service limit	4.930 mm (.1941 in)	
del an and a formal	last start starts	New	0.005 mm (.0002 in)	
Valve out of round	Intake and exhaust	Service limit	0.06 mm	(.0024 in)
1.1		New .	4.998 mm to 5.018 mm (.1968 in to .1976 in	
Valve guide diameter		Service limit	5.050 mm (.1988 in)	
		New	40.81 mm (1.607 in)	
Valve spring free length		Service limit	39.00 mm (1.535 in)	
	1.461	New	1.05 mm to 1.35 mm	n (.041 in to .053 in)
And an and a state of the state	Intake	Service limit	1.8 mm (.071 in)	
Valve seat contact width	F. 1.	New	1.25 mm to 1.55 mm	n (.049 in to .061 in)
	Exhaust	Service limit	2 mm (.	079 in)
		New	12.036 mm to 12.050 m	m (.4739 in to .4744 in)
Rocker arm bore diameter		Service limit	12.060 mm	(.4748 in)
		New	12.000 mm to 12.018 m	m (.4724 in to .4731 in)
Rocker arm shaft diameter		Service limit	11.990 mm	n (.472 in)
Distan diamatan		New	90.950 mm to 90.966 mm	(3.5807 in to 3.5813 in)
Piston diameter		Service limit	90.900 mm	(3.5787 in)
Distant for the days of		New	0.027 mm to 0.057 mm	(.0011 in to .0022 in)
Piston/cylinder clearance		Service limit	0.100 mm (.0039 in)	

	MODEL		COMMANDER 800R	COMMANDER 1000
ENGINE (CONT'D)				
		1st	Upper compressio	on ring, rectangular
Piston ring type		2 <sup>nd</sup>	Lower compression	n ring, tapered face
		3rd	Oil scra	aper ring
	Rectangular		0.20 mm to 0.40 mi	m (.008 in to .016 in)
	Tapered face	New	0.20 mm to 0.40 mi	m (.008 in to .016 in)
Ding and gap	Oil scraper ring		0.20 mm to 0.70 mi	m (.008 in to .028 in)
Ring end gap	Rectangular		0.60 mm	n (.024 in)
	Tapered face	Service limit	0.70 mm	n (.028 in)
	Oil scraper ring	1	1.00 mm	n (.039 in)
	Rectangular		0.03 mm to 0.07 mm	(.0012 in to .0028 in)
	Tapered face	New	0.02 mm to 0.06 mm	(.0008 in to .0024 in)
Ring/piston groove clearance	Oil scraper ring		0.01 mm to 0.18 mm	(.0004 in to .0071 in)
	Rectangular		0.15 mm	(.0059 in)
	Tapered face	Service limit	0.15 mm	(.0059 in)
	Oil scraper ring		0.25 mm	(.0098 in)
Cylinder bore		New	90.993 mm to 91.007 m	m (3.5824 in to 3.583 in)
o.r		Maximum New	0.038 mm	(.0015 in)
Cylinder taper		Service limit	0.090 mm (.0035 in)	
		Maximum New	0.015 mm (.0006 in)	
Cylinder out of round		Service limit	0.020 mm (.0008 in)	
	T. J. J. J. Jak	New	34.959 mm to 34.975 mm (1.3763 in to 1.377	
o	Timing chain side	Service limit	34.950 mm (1.376 in)	
Camshaft main bearing journal		New	21.959 mm to 21.980 m	nm (.8645 in to .8654 in)
	Spark plug side	Service limit	21.950 mr	n (.8642 in)
	The transformed and a	New	35.000 mm to 35.025 m	m (1.378 in to 1.3789 in)
A	Timing chain side	Service limit	35.040 mm	i (1.3795 in)
Camshaft main bearing journal bore	1445 VOIN 12 18400	New	22.000 mm to 22.021 r	nm (.8661 in to .867 in)
	Spark plug side	Wear limit	22.040 mm	n (.8677 in)
	Intake valve	New	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)	
0		Service limit	32.870 mm (1.2941 in)	32.940 mm (1.2969 in)
Camshaft lobe	Exhaust valve	New	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)	32.860 mm to 33.060 mm (1.2937 in to 1.3016 in)
		Service limit	32.930 mm (1.2965 in)	32.840 mm (1.2929 in)
Crankshaft main bearing journal diameter (MAG/PTO side)		New	42.016 mm to 42.040 mr	m (1.6542 in to 1.6551 in)
		Service limit	42.000 mm	i (1.6535 in)
Crankshaft radial play (MAG/PTO side)		Service limit	0.07 mm	(.0028 in)
0 1 1 6 1	(in DTO accord)	New	34.016 mm to 34.040 mm	m (1.3392 in to 1.3402 in)
Crankshaft bearing journal diameter	(In PTU cover)	Service limit	34.010 mm	n (1.339 in)
Crankshaft radial play (PTO cover be	earing)	Service limit	0.10 mm	(.0039 in)
		New	0.200 mm to 0.500 mm	m (.0079 in to .0197 in)
Crankshaft axial play		Service limit	0.600 mm	i (.0236 in)

Subsection

101 (	COMMANDER	800R	AND	1000)

	MODEL		COMMANDER 800R	COMMANDER 1000
ENGINE (CONT'D)		5 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		12 June 1
Crankshaft pin diameter		New	40.009 mm to 40.025 mm (1.5752 in to 1.5758 in)	
		Service limit	39.990 mm (1.5744 in)	41.967 mm (1.6522 in)
Crankshaft deflection	MAG/PTO side	New	0.050 mn	n (.002 in)
Crankcase plain bearing	MAG/PTO side	Service limit	42.100 mm	(1.6575 in)
PTO cover plain bearing		Service limit	34.120 mm	(1.3433 in)
Connecting rod big end diame	ter	Service limit	40.100 mm (1.579 in)	42.100 mm (1.6575 in)
Connecting rod big end radial	play	Service limit	0.09 mm	(.0035 in)
Connecting rod big end axial		New	0.200 mm to 0.500 mm (.008 in to .02 in)	0.250 mm to 0.550 mm (.0098 in to .0217 in)
services ing the englishe enter (	(14)	Service limit	0.600 mm	n (.024 in)
Connecting rod small end diar	neter	New	20.010 mm to 20.020 mm (.7878 in to .7882 in)	22.010 mm to 22.020 mm (.8665 in to .8669 in)
connecting for other one diamotor		Service limit	20.060 mm (.7898 in)	22.050 mm (.8681 in)
Piston pin diameter		New	19.996 mm to 20.000 mm (.7872 in to .7874 in)	21.996 mm to 22.000 mm (865.984 in to 866.142 in)
		Service limit	19.980 mm (786.614 in)	21.980 mm (.8654 in)
Connecting rod/piston pin clea	rance (radial play)	Service limit	0.080 mm	(.0031 in)
LUBRICATION SYSTEM				States and the states
	Туре		Wet sump. Replacea	ble cartridge oil filter
	Oil filter		BRP Rotax paper	type, replaceable
	Engine oil pressure	Minimum	300 kPa (44 PSI) at 6000 RPM	
		Capacity (oil change with filter)	2.2 L (2.3 qt (U.S. liq.))	
Engine oil		Recommended	blend oil (summer grad For the winter seaso oil (winter grade) ( If not available, use a	n, use XPS synthetic P/N 293 600 112). a 5W40 motor oil that ents for API service
COOLING SYSTEM			en in the second	West States of States
Coolant	Туре		Ethyl glycol/water mix (5 Use premixed BRP (P/N 219 coolant specifically design	700 362) or
	Capacity		3.9 L (1 U.S. gal.)	4.3 L (1.1 U.S. gal.)
<b>T</b> I	Starts to open		65°C (	149°F)
Thermostat	Fully open		75°C (167°F)	88°C (190°F)
Radiator cap opening pressure			110 kPa	/16 PCI)

MODEL		COMMANDER 800R	COMMANDER 1000
TRANSMISSION		Lotar (Carel Statue -	139
Туре		CVT (Continuously V	ariable Transmission)
Engagement RPM		1750 ±	100 RPM
Drive belt width	Service limit	30.00 mm	ı (1.181 in)
	New	13.70 mm to 13.80 m	nm (.539 in to .543 in)
Governor cup roller outer diameter	Service limit	13.20 m	m (.52 in)
	New	8.05 mm to 8.15 mr	m (.317 in to .321 in)
Governor cup roller inner diameter	Service limit	9.00 mm	(.354 in)
	New	6.078 mm to 6.100 r	nm (.239 in to .24 in)
Centrifugal lever pivot bolt diameter	Service limit	6.000 mn	n (.236 in)
	New	6.035 mm to 6.078 mr	n (.2376 in to .2393 in)
Centrifugal lever bore diameter	Service limit	6.200 mn	n (.244 in)
Drive pulley sliding half centrifugal lever pivot bolt bore	New	6.113 mm to 6.171 m	nm (.241 in to .243 in)
diameter	Service limit	6.300 mn	n (.248 in)
	New	55.000 mm to 55.040 m	nm (2.165 in to 2.167 in)
Drive pulley sliding half large bushing	Service limit	55.200 mn	n (2.173 in)
ACTO ME ACTIVE CAS MES COMPANY CARA	New	32.000 mm to 32.040 r	nm (1.26 in to 1.261 in)
Drive pulley sliding half small bushing	Service limit	32.200 mn	n (1.268 in)
Drive pulley spring free length	Service limit	85 mm (3.346 in)	105 mm (4.134 in)
Drive pulley spring free squareness	Service limit	4 mm (	.157 in)
	New	9.2 mm to 9.4 mm	n (.362 in to .37 in)
Spring sleeve length	Service limit	9.0 mm (.354 in)	
	New	30.060 mm to 30.100 mm (1.183 in to 1.1	
Driven pulley sliding half bushing	Service limit	30.200 mn	n (1.189 in)
	New	30.060 mm to 30.100 m	nm (1.183 in to 1.185 in)
Driven pulley sliding fixed bushing	Service limit	30.200 mn	n (1.189 in)
Torque gear on driven pulley	Service limit	7.500 mm (.295 in)	
Driven pulley spring free length	Service limit	125 mm	(4.921 in)
Driven pulley spring free squareness	Service limit	3.8 mm	(.15 in)
GEARBOX			
Туре		Dual range (HI-LO) with	park, neutral and reverse
	Capacity	450 ml (1	5 U.S. oz)
Gearbox oil	Recommended		oil (P/N 293 600 140) -5 synthetic gear oil
0 1 10	New	5.25 mm to 5.35 mm	n (.207 in to .211 in)
Coupling sleeve groove width	Service limit	5.50 mm	(.217 in)
	New	4.95 mm to 5.05 mm	n (.195 in to .199 in)
Coupling fork claw thickness	Service limit	4.80 mm	(.189 in)
Shift fork claw thickness	New	5.10 mm to 5.20 mm	n (.201 in to .205 in)
(high, low and reverse gear shift fork)	Service limit	5.00 mm	(.197 in)
	New	5.30 mm to 5.40 mm	n (.209 in to .213 in)
Width of shift fork engagement groove	Service limit	5.50 mm	(.217 in)

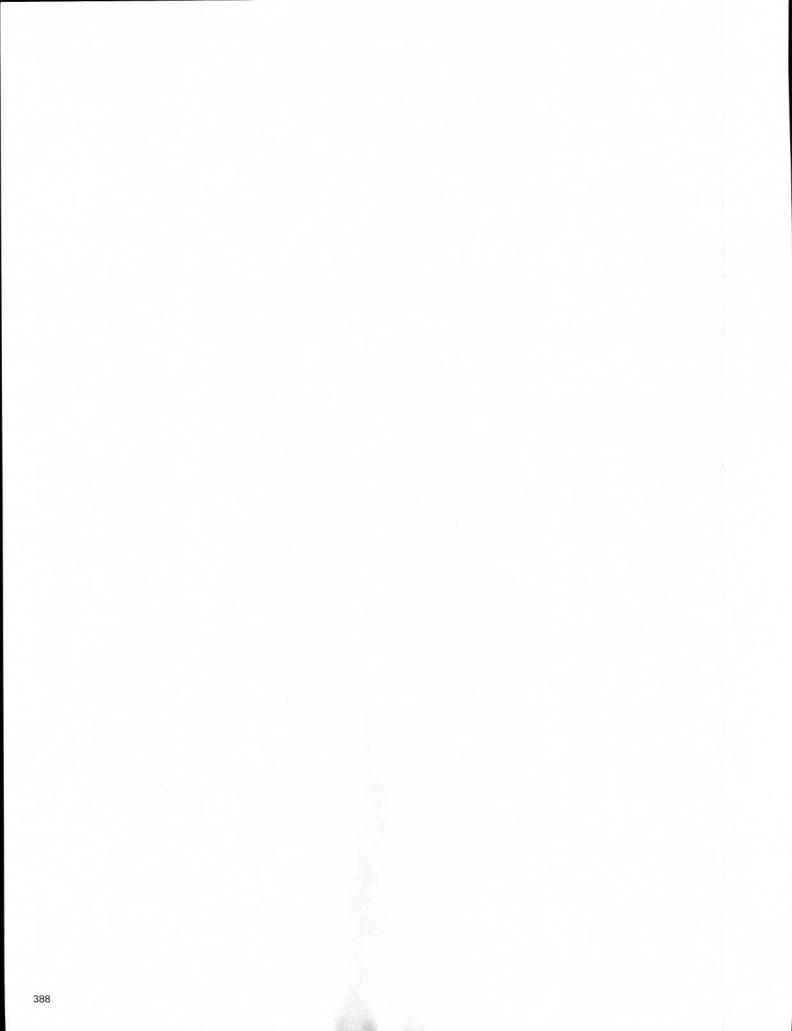
MODEL			COMMANDER 800R	COMMANDER 1000	
GEARBOX (CONT'D)		Single integrits			
New			29.000 mm to 29.013 mi	m (1.1417 in to 1.1422 in)	
Diameter free pinions		Service limit	29.015 mm	i (1.1423 in)	
latarmadiata agar shaft		New	24.987 mm to 25.000 n	nm (.9837 in to .9843 in)	
Intermediate gear shaft		Service limit	24.977 m	m (.983 in)	
	MAG side	New	19.977 mm to 19.990 r	mm (.7865 in to .787 in)	
Countershaft	MAG SIDE	Service limit	19.973 mr	n (.7863 in)	
Countersnart	CVT side	New	24.977 mm to 24.990 m	nm (.9833 in to .9839 in)	
	CVT SIDE	Service limit	24.970 mr	n (.9831 in)	
	Free pinion	New	24.987 mm to 25.000 m	nm (.9837 in to .9843 in)	
Main shaft	bearing	Service limit	24.984 mr	n (.9836 in)	
	Bearing journal	New	16.980 mm to 16.991 mm (.6685 in to .6689 in)		
	MAG/CVT side	Service limit	16.976 mr	n (.6683 in)	
ELECTRICAL SYSTEM	and the second second	all and the second second		Electronic and the second	
Magneto generator output			650 W @	650 W @ 6000 RPM	
Stator resistance (20C)			0.15 to	0.15 to 0.30 Ω	
Ignition system type			IDI (Inductive Di	scharge Ignition)	
Ignition timing			Not ad	justable	
	Quantity		2		
Spark plug	Make and type		NGK DCPR8E		
	Gap		0.7 mm to 0.8 mm (.028 in to .031 in)		
	Forward	,	8050 rpm		
Engine RPM limiter setting	Reverse		20 km/h to 25 km/h (12 MPH to 16 MPH) (8050 rpm with Override)		
	Туре		Maintena	ance free	
Dattan	Voltage		12	volts	
Battery	Nominal rating		18	A●h	
Power starter output			0.7 KW		
Headlight			4 x 1	50 W	
Faillight			2 X 8	/21 W	
Turn signals (CE)			10	W	
Position light			LED, 0.7 V appr	oximately (each)	

MODEL			COMMANDER 800R	COMMANDER 1000
ELECTRICAL SYSTEM (	CONT'D)		in de Manifester se	- When the first
	– Main	MF1	30	A
	- Main accessories	MF2	40	A
	<ul> <li>Brake lights switch</li> <li>Gauge</li> <li>Taillights</li> <li>Brake relay</li> </ul>	F4	10	A
	<ul> <li>Ignition coils</li> <li>Fuel injectors</li> <li>Speed sensor</li> </ul>	F5	7.5	А
	- Engine control modul	e (ECM) F6	5	A
	<ul> <li>Handlebar switches</li> </ul>	F7	5	A
Fuses	<ul> <li>Gauge</li> <li>Ignition switch</li> </ul>	F8	5 A	
	- Fan motor	F9	30 A	
	<ul> <li>Euro controls</li> </ul>	F10	5 A	
	<ul> <li>Lights relay</li> </ul>	F11	30 A	
	<ul> <li>Connectors (DC3 and</li> <li>12 V power outlet</li> <li>Communication connection</li> </ul>	F12	15	А
	- Relays coils (R1 and	R3) F13	5 A	
	<ul> <li>Connector DC6</li> </ul>	F14	15 A	
	– Fuel pump	F15	5 A	
UEL SYSTEM		- 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995		
Fuel delivery	Туре		Electronic Fuel Injectio body with iTC (Intellig 1 injector p	gent Throttle Control),
that a second	Туре		Electrical (in fuel tank)	
uel pump	Operating pressure		350 kPa	(51 PSI)
dle speed			1250 rpm ± 100	(not adjustable)
	Туре		Regular unlea	ded gasoline
uel	Octane rating	e North America	87 (R+M)/2	or higher
	Outsi	de North America	92 RON	or higher
uel tank capacity			37.8 L (10	U.S. gal.)
uel remaining when low	fuel light turns ON		± 12 L (3.2	U.S. gal.)

MODEL			COMMANDER 800R	COMMANDER 1000
DRIVE SYSTEM			- Stars "	Server 1
Front drive			Visco-lok† fro	ont differential
Front drive ratio			3.	6:1
Rear drive			Shaft dr	iven/spool
Rear drive ratio			3.	6:1
	Capacity			17 U.S. oz)
Front differential oil	Recommende	ed		oil (P/N 293 600 043) oil 75W90 API GL-5
	Capacity		The second s	1.8 U.S. oz)
Rear final drive oil	Recommende	ed	XPS synthetic gear of or synthetic gear of	oil (P/N 293 600 140) il 75W140 API GL-5
CV joint grease			CV joint grease (	(P/N 293 550 019)
Propeller shaft grease			Hi-temp bearing grease	NLGI-2 or an equivalent
STEERING	MICH AND	South States		
Steering wheel			Adjustable tilt steering	
Turning radius			240 cm (94.5 in)	
Total toe (vehicle on ground	)		0 mm ± 4 mm (0 in ± .157 in)	
Camber angle (vehicle on gr	ound)		0.7° positive	
Tie-rod maximum length une	engaged threads		32 mm	(1.26 in)
FRONT SUSPENSION			Children of the Dirth	
Suspension type			Double suspension-arm v	with dive-control geometr
Suspension travel			254 mm (10 in)	
	Qty			2
Shock absorber	Ŧ	Standard and XT	(	Dil
	Туре	Х	HPG Cli	cker (gas)
		Standard	355.6 m	ım (14 in)
Spring free length		Х	N.A.	350 mm (13.78 in)
		XT	363 mm	(14.291 in)
Spring P/N		Standard	706 200	859 (YL)
		Х	N.A.	706 201 124 (YL)
		XT	706 200 860 (YL) 706 201 369 (BK)	706 200 860 (YL) 706 201 367 (RD) 706 201 369 (BK)
Declared adjustment to an		Standard and XT	5 positi	ions cam
Preload adjustment type		Х	Threaded sp	pring retainer

MODEL			COMMANDER 800R	COMMANDER 1000
REAR SUSPENSION		- soler ist	the off the second second	all and the Mark
Suspension type				m Independant (TTI) al sway bar
Suspension travel				n (10 in)
	Qty			2
Shock absorber		Standard and XT	0	)il
	Туре	X	HPG Clic	cker (gas)
		Standard		14.094 in)
Spring free length		Х	N.A.	373 mm (14.685 in)
		XT	358 mm (	14.094 in)
		Standard	706 000	667 (YL)
		Х	N.A.	706 000 821 (YL)
Spring P/N		XT	706 000 667 (YL) 706 001 045 (BK)	706 000 667 (YL) 706 001 043 (RD) 706 001 045 (BK)
		Standard and XT	5 positi	ons cam
Preload adjustment type		X		ring retainer
BRAKES	-03-01			
	Qty			2
Front brake	Туре		214 mm ventilated disc brakes with hydraul twin-piston calipers	
	Qty		1	
Rear brake	Туре		214 mm ventilated disc brake with hydrauli twin-piston caliper	
Brake fluid	Capacity			.2 U.S. oz)
	Туре		DO	T 4
Caliper				iting
Brake pad material	Front		Metallic	
	Rear		Metallic	
Minimum brake pad thickness				(.04 in)
Minimum brake disc thickness	Front		4.1 mm (.161 in)	
Winning Brake dise anekness	Rear		4.1 mm (.161 in)	
Maximum brake disc warpage			0.2 mm	(.01 in)
TIRE	1.1			
8	Front		Maximum: 83 kPa (12 PSI) Minimum: 69 kPa (10 PSI)	
Pressure Rear		Ť.	Maximum: 152 kPa (22 PSI) Minimum: 83 kPa (12 PSI)	
Minimum tire thread depth			3 mm (	.118 in)
		Standard	27 x 9 :	x 12 (in)
	Front	Х	27 X 9 .	X 12 (in)
Size		XT	27 X 9 .	X 14 (in)
3128		Standard	27 x 11	x 12 (in)
	Rear	Х	27 X 11	X 12 (in)
		XT	27 X 11	X 14 (in)

	MODEL			COMMANDER 1000	
WHEELS		nin a inželi – i – i – i – i – i – i – i – i – i –	800R	- 19-10-10-10-10-10-10-10-10-10-10-10-10-10-	
		Standard	Si	eel	
Туре		X XT		adlock wheels	
				luminum	
		Standard	12 X	6 (in)	
	Front	Х	12 X	6 (in)	
Rim size		XT	14 X	7 (in)	
		Standard	12 X	8 (in)	
	Rear	Х	12 X	7.5 (in)	
		XT	14 X	8.5 (in)	
Wheel nuts torque			100 N • m ± 10 N • m	(74 lbf•ft $\pm$ 7 lbf•ft)	
CHASSIS		Strengthered Super-			
Cage type				r, high strength steel roved cage	
DIMENSION		Carl Charles and the state			
Overall length			300.4 cm (118.3 in)		
Overall width			148.9 cm (58.6 in)		
Overall height			182.9 c	m (72 in)	
Wheel base			192.4 cm	192.4 cm (75.7 in)	
Wheel track	Front		125.7 cm (49.5 in)		
Wheel track	Rear		121.9 cm (48 in)		
Ground clearance			27.9 cn	27.9 cm (11 in)	
WEIGHT AND LOADING	CAPACITY	e distanti de la companya de la comp		A starting of the start of the	
Dry weight			584 kg (1,287 lb)	587 kg (1,295 lb)	
Weight distribution	Front/rear		44	44/56	
		Total (upper + lower)	272 kg	(600 lb)	
Cargo box capacity		Upper	181 kg	(400 lb)	
		Lower	272 kg	272 kg (600 lb)	
Total vehicle load allowed (including driver, passenger accessories)		ded	363 kg	(800 lb)	
Gross vehicle weight rating		990 kg (	2,183 lb)		
Towing capacity	Hitch support	50.8 mm (2 in) X 50.8 mm (2 in)	680 kg (1,500 lb)		
Tongue capacity		68 kg (	150 lb)		



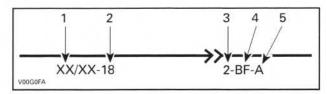
#### Section 09 WIRING DIAGRAM Subsection 01 (WIRING DIAGRAM INFORMATION)

WIRING DIAGRAM INFORMATION GENERAL

# WIRING DIAGRAM LOCATION

The wiring diagram is stored in the back cover pocket.

# WIRING DIAGRAM CODES

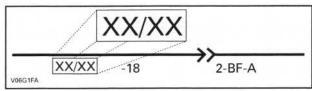


Wire colors

- Wire gauge 3
- Connector housing area Connector identification 4
- Wire location in connector 5

### 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.

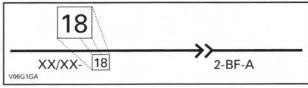


THE SHADED PART INDICATES THE WIRE COLOR

Example: YL/BK is a YELLOW wire with a BLACK stripe.

### Wire Gauge

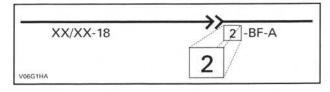
The number after wire color indicates the gauge of a wire.



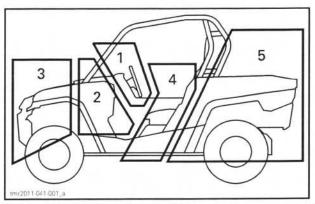
THE SHADED PART INDICATES THE WIRE GAUGE

Example: The number that follows the wire color indicates the wire size used, in this case 18 gauge wire.

**Connector Housing Area** 



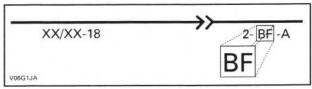
The first number in the connector/pin contact number represents the area in the vehicle where the connector is located.



AREA	LOCATION
1	Steering, dashboard and upper console area
2	Under dashboard and front bulkhead area
3	Front of vehicle
4	Engine, seat and lower console area
5	Rear of vehicle

# Connector Identification

The letters in the middle of the connector/pin contact number 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 09 WIRING DIAGRAM

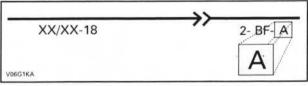
Subsection 01 (WIRING DIAGRAM INFORMATION)

ABBREVIATION	DESCRIPTION
BA	Ignition coil
BAT	Battery
BD	2WD/4WD switch
BP	Battery power
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
ETA	Electric throttle actuator
ETC	Electronic throttle control
FP	Fuel pump
FRA	Brake light switch
FT	Cooling fan
GBPS	Gearbox position sensor
HIBM	High beam (headlights)
HIC	Harness interconnect (engine/vehicle)
INJ1 and INJ2	Fuel injector
MAPTS	Manifold air pressure and temperature sensor
MD	2WD/4WD actuator
MG	multifunction switch
OPS	Oil pressure switch
OV	Override button
PD	RH headlight
PF1	Fuse Holder (main)
PF2	Fuse Holder
PG	LH headlight
RD	Voltage regulator/rectifier
SB	Seat belt
SD	2WD/4WD actuator switch
SM	Starter motor
SPK1 and SPK2	Spark plug
SS	Starter solenoid

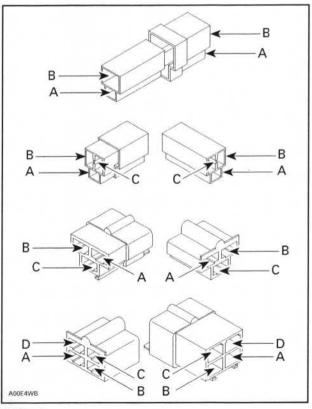
ABBREVIATION	DESCRIPTION	
STSW	Start switch	
SW	Winch relay	
SWW	Winch switch	
TPS	Throttle position sensor	
TAS	Throttle accelerator sensor	
WM	Winch motor	

### Wire Location in Connector

This is the wire position in the connector. The number or letter given refers to the physical identification stamped or molded on the connector.



THE SHADED PART INDICATES THE CONNECTOR LOCATION IN HOUSING



TYPICAL

# **CONNECTOR INFORMATION**

# SERVICE TOOLS

Description	Part Number	Page
CRIMPING TOOL (HEAVY GAUGE WIRE)	529 035 730	
FCM ADAPTER TOOL	529 036 166	
ECM TERMINAL REMOVER 2.25	529 036 175	
ECM TERMINAL REMOVER 3.36	529 036 174	

# SERVICE TOOLS - OTHER SUPPLIER

Description	Part Number	Page
GM TERMINAL EXTRACTOR	12094430	
SNAP-ON TERMINAL REMOVER TOOL	TT600-4	

# GENERAL

# DEUTSCH CONNECTORS

### Deutsch Connector Application

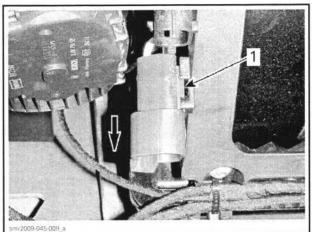
A variety of Deutsch connectors are used on various systems:

- Engine connector
- Magneto connector.

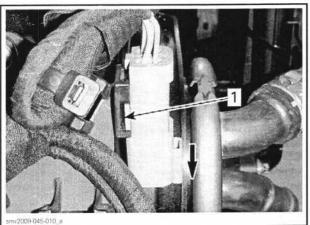
The following procedures may be used on each as they are similar in construction.

# Deutsch Connector Removal from its Support

- 1. Insert a small flat screwdriver between the support and the Deutsch connector.
- 2. Pry the connector away from the support slightly while sliding it out in the direction shown.



TYPICAL - MALE CONNECTOR REMOVED FOR CLARITY 1. Insert screwdriver here



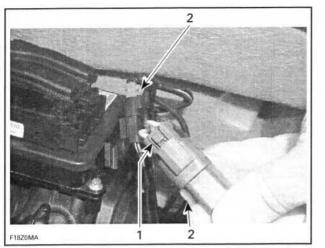
TYPICAL - MALE CONNECTOR REMOVED FOR CLARITY 1. Insert screwdriver here

# Deutsch Connector Disconnect

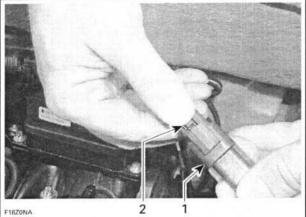
1. To disconnect a Deutsch connector, press the release tab and twist a small flat screwdriver between the male and female housing to disengage and disconnect them.

### Section 09 WIRING DIAGRAM

Subsection 02 (CONNECTOR INFORMATION)

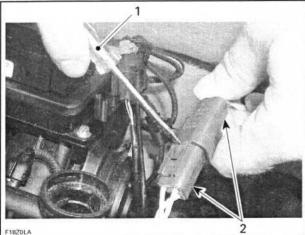


- TYPICAL
- Release tab Deutsch connector
- 2



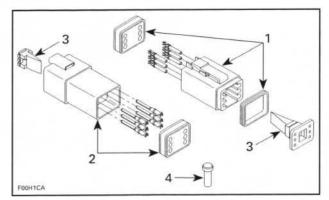
- TYPICAL
- Deutsch connector Press release button





TYPICAL Flat screwdriver Deutsch connector 2

### Deutsch Connector Disassembly and Reassembly



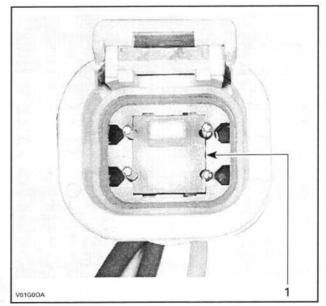
- TYPICAL DEUTSCH CONNECTOR
- Male connector
   Female connector
   Secondary lock
   Sealing cap

**NOTICE** Do not apply dielectric grease on terminal inside connector.

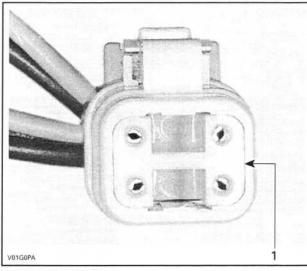
#### **Terminal Removal**

To remove terminals from connector, proceed as follows:

1. Using long nose pliers, pull out the secondary plastic lock from between the terminals.



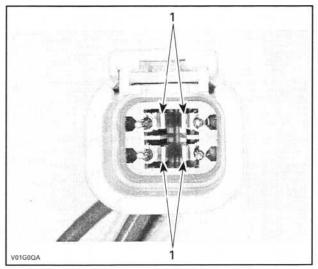
FEMALE CONNECTOR Female lock 1



MALE CONNECTOR 1. Male lock

**NOTE:** Before pin extraction, push wire forward to relieve pressure on retaining tab.

- 2. Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
- 3. Pry the retaining tab away from the terminal while gently pulling the wire and terminal out of the back of the connector.

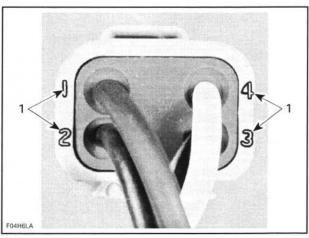


FEMALE CONNECTOR 1. Retaining tab

#### **Terminal Insertion**

- 1. For insertion of a terminal, ensure the secondary plastic lock is removed.
- 2. Insert terminal through the back of the connector in the appropriate position, and push it in as far as it will go. You should feel or hear the terminal lock engage.

- 3. Pull back on the terminal wire to be sure the retention fingers are holding the terminal.
- 4. After all required terminals have been inserted, the lock must be installed.



CONNECTOR PIN-OUT 1. Terminal position identification numbers

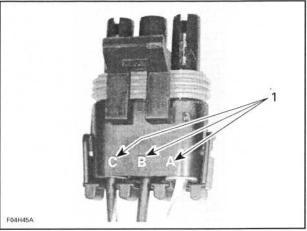
# PACKARD CONNECTORS

### Packard Connector Application

Packard connectors are used to connect:

- Electrical harnesses
- Gauges
- VCM
- EFB.

### 3-Pin Packard Connector

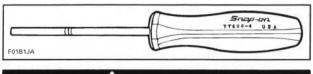


VIEW OF A 3-PIN PACKARD CONNECTOR 1. Identification letters

**NOTE:** This type of connector also comes in other pin configurations.

### Section 09 WIRING DIAGRAM Subsection 02 (CONNECTOR INFORMATION)

To remove a terminal from a 3-pin Packard connector, use the SNAP-ON TERMINAL REMOVER TOOL (P/N TT600-4).

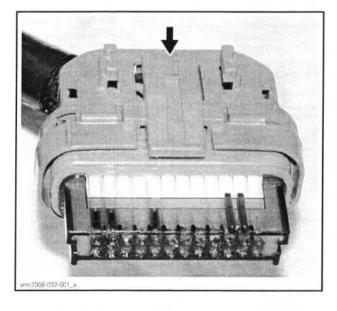


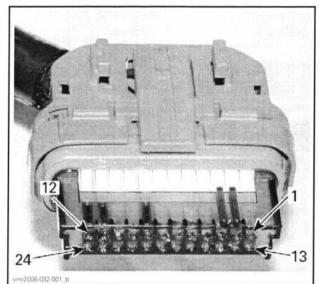
### 

Ensure all terminals are properly crimped on wires and connectors are properly fastened.

# PACKARD CONNECTOR (MULTIFUNCTION GAUGE)

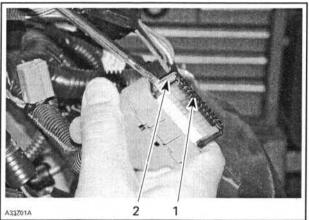
Firmly push down tab and hold to unlock connector while pulling it out.





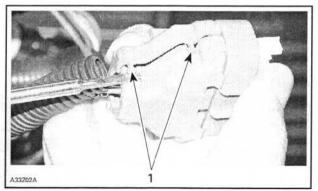
CONNECTOR PINOUT

Push on both tabs to remove retainer.



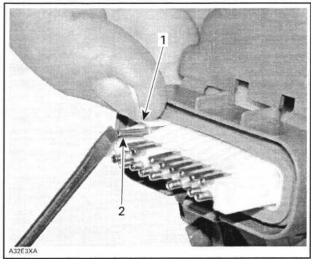


Open housing by lifting 4 tabs.



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

# MOLEX CONNECTOR

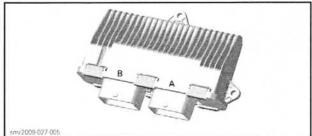
# Molex Connector Application

The Molex connector is used on the ECM.

There are 2 MOLEX connectors on the ECM.

The engine wiring harness connector is connected to ECM connector "A". The vehicle wiring harness connector is connected to ECM connector "B".

Each ECM connector has 48 pins.

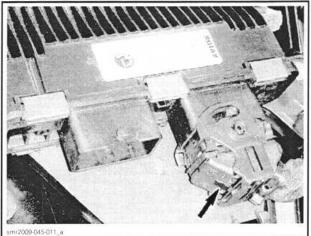


ECM CONNECTORS

Do not apply any product to the pins in the ECM connector.

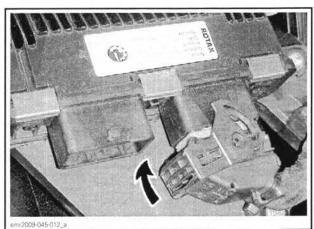
### **Connector Removal**

1. To access the ECM, refer to *ELECTRONIC FUEL INJECTION* subsection. 2. Press and hold the locking tab on the connector to be disconnected.



LOCKING TAB TO PRESS AND HOLD

As you hold the locking tab, rotate the connector locking cam until it stops.



CONNECTOR LOCKING CAM ROTATION TO RELEASE

4. Pull connector off ECM.



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#### Section 09 WIRING DIAGRAM Subsection 02 (CONNECTOR INFORMATION)

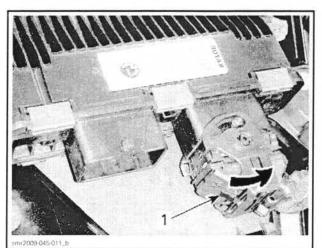
### **Connector Installation**

1. Fully open connector locking cam.



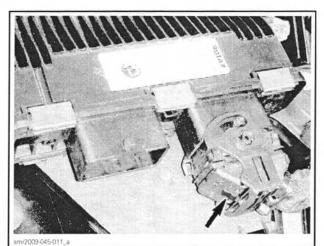
CONNECTOR LOCKING CAM IN RELEASE POSITION

- 2. Insert connector on ECM.
- 3. As you push the connector onto the ECM, rotate the connector locking cam until it snaps locked.



1. Locked here

4. Ensure the locking tab is fully out.



LOCKING TAB FULLY OUT

### **Connector Inspection**

Before replacing an ECM, always check electrical connections.

- 1. Ensure connector locking mechanism is functioning properly.
- 2. Ensure all wire terminals (pins) are properly locked in the connector.
- 3. Ensure they are very tight, make good contact with the pins in the ECM.
- 4. Ensure the pins in the harness connector and the ECM connector are clean, shiny and corrosion-free.
- 5. Check wiring harness for signs of scoring.

**NOTE:** A "defective ECM module" could possibly be repaired simply by disconnecting and reconnecting it.

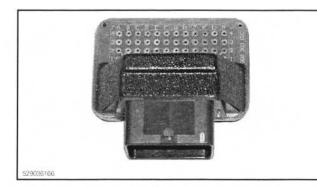
**NOTICE** Do not apply any lubricant product to the pins of the ECM connector.

### **Connector Probing**

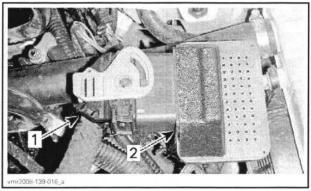
The most recommended and safest method to probe the MOLEX (ECM) connector terminals is to use the ECM ADAPTER TOOL (P/N 529 036 166). This tool will prevent deforming or enlarging of the terminals, which would lead to bad ECM terminal contact creating intermittent or permanent problems.

# Section 09 WIRING DIAGRAM

Subsection 02 (CONNECTOR INFORMATION)



- 1. Disconnect the ECM connector to be probed, and reconnect it on the ECM adapter.
- 2. Probe wire terminals of the circuit to be tested directly in the adapter holes.



TYPICAL

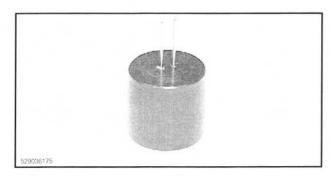
1. ECM connector 2. ECM adapter

NOTICE Never probe directly on the ECM harness connector. This could change the shape or enlarge the terminals and create intermittent or permanent contact problems.

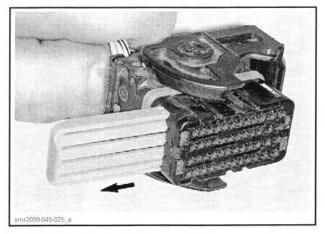
### **Connector Terminal Removal (Harness** Connector)

To remove a signal terminal from the ECM harness connector, use the ECM TERMINAL RE-MOVER 2.25 (P/N 529 036 175).

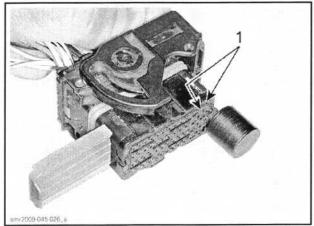
To remove a power terminal, use the ECM TERMI-NAL REMOVER 3.36 (P/N 529 036 174).



- 1. Remove rear protector from connector.
- 2. Pull out the connector lock.



3. Insert tool to unlock terminal.

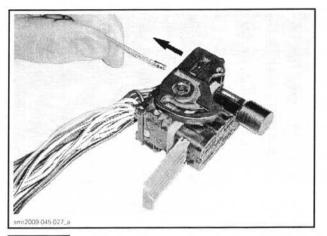


Unlock here

4. Gently pull on the wire to extract the terminal out the back of the connector.

### Section 09 WIRING DIAGRAM

Subsection 02 (CONNECTOR INFORMATION)



NOTICE Before installing wire terminals in the connector, ensure all terminals are properly crimped on wires. After installation of wire terminals in the connectors, ensure they are properly locked by gently pulling on them as if to extract them.

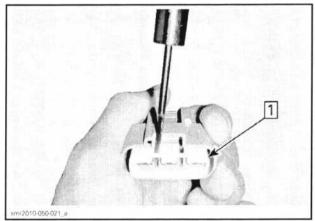
# FURUKAWA CONNECTOR

### **Furukawa Connector Application**

Voltage regulator/rectifier.

### Terminal Removal

1. Remove the secondary lock (plastic insert).

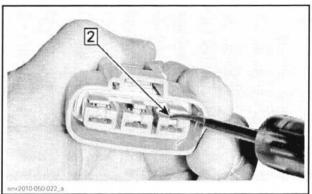


Step 1: Remove the secondary lock

2. Carefully insert the GM TERMINAL EXTRACTOR (P/N 12094430) between the lock and the pin to release the pin.

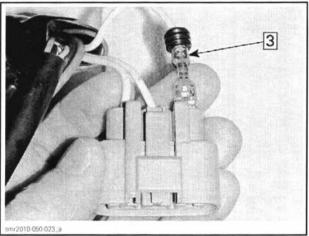






Step 2: Insert GM extractor tool (P/N 12094430)

3. Gently pull on the wire to extract the pin out the back of the connector.



Step 3: Pull wire to extract pin

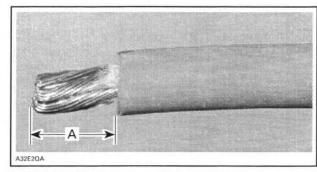
NOTICE Before installing terminals in the connectors, ensure all terminals are properly crimped on the wires. After installation of the wire terminals in the connectors, ensure they are properly locked by gently pushing on them as if to extract them.

# BATTERY AND STARTER CABLE TERMINALS

### Cable Crimping

Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.

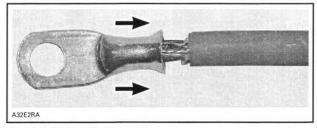
#### Section 09 WIRING DIAGRAM Subsection 02 (CONNECTOR INFORMATION)



A. 10 mm (3/8 in)

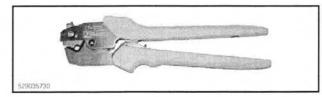
NOTE: Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate *PARTS CATALOG*.

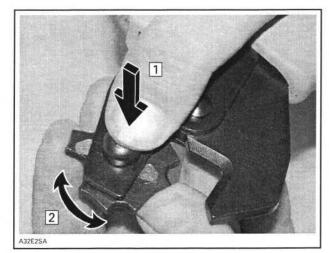


INSTALLATION OF TERMINAL

Follow the instructions provided with the CRIMP-ING TOOL (HEAVY GAUGE WIRE) (P/N 529 035 730) to select the proper position of the tool.

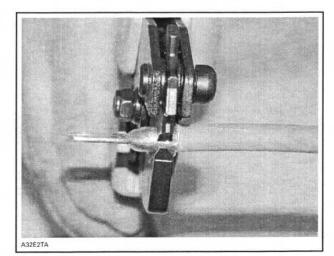


**NOTE:** Different wires require different crimping pliers settings.

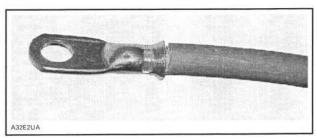


POSITIONING THE CRIMPING PLIERS Step 1: Step 1: Press Step 2: Step 2: Rotate

After positioning the crimping pliers, crimp the terminal already installed on wire.



CRIMPING OF WIRE



PROPERLY CRIMPED WIRE

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

**NOTICE** Never weld the wire to the terminal. Welding can change the property of the wire and it can become brittle and break.

### Section 09 WIRING DIAGRAM Subsection 02 (CONNECTOR INFORMATION)

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

**NOTICE** Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.