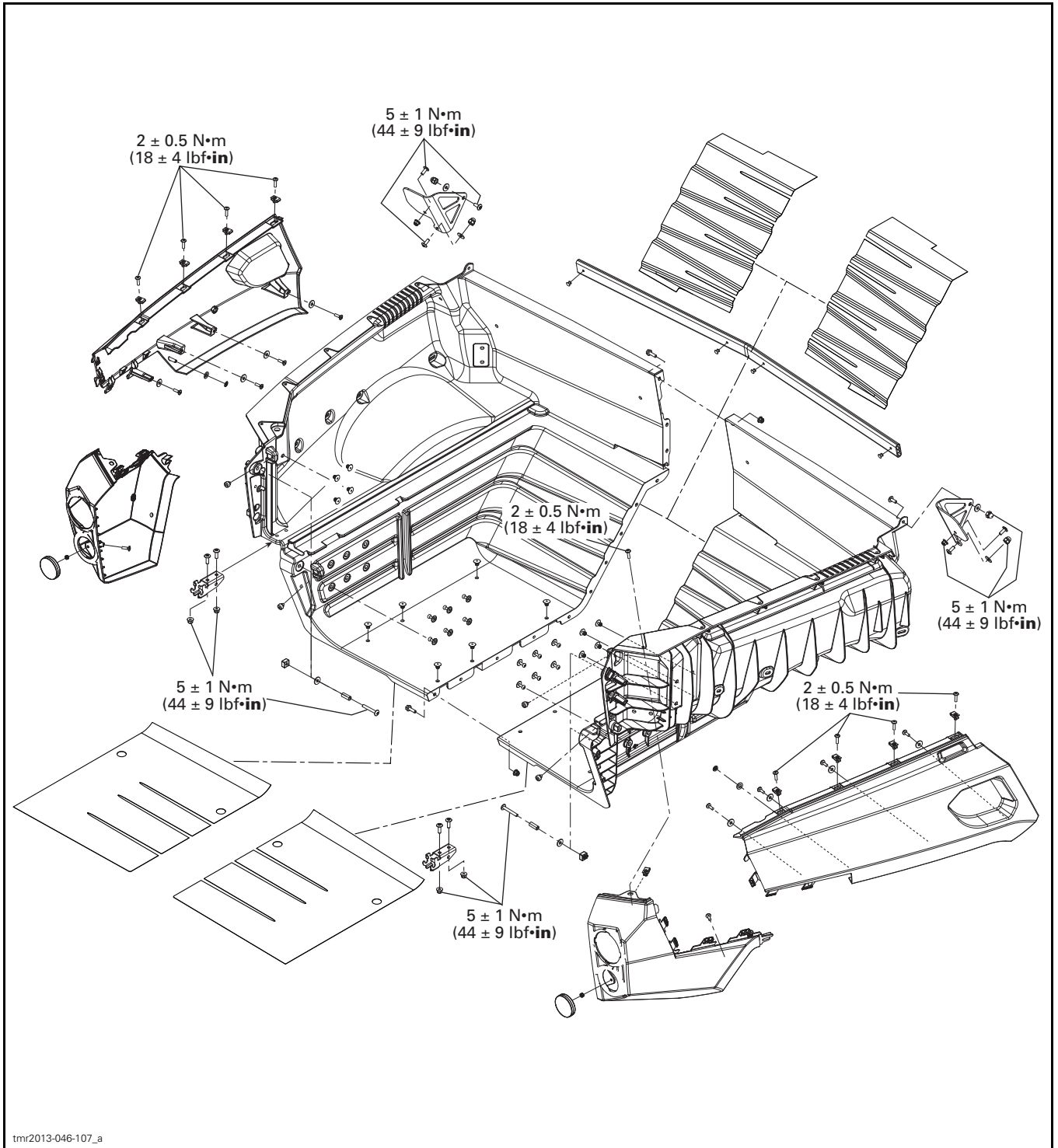
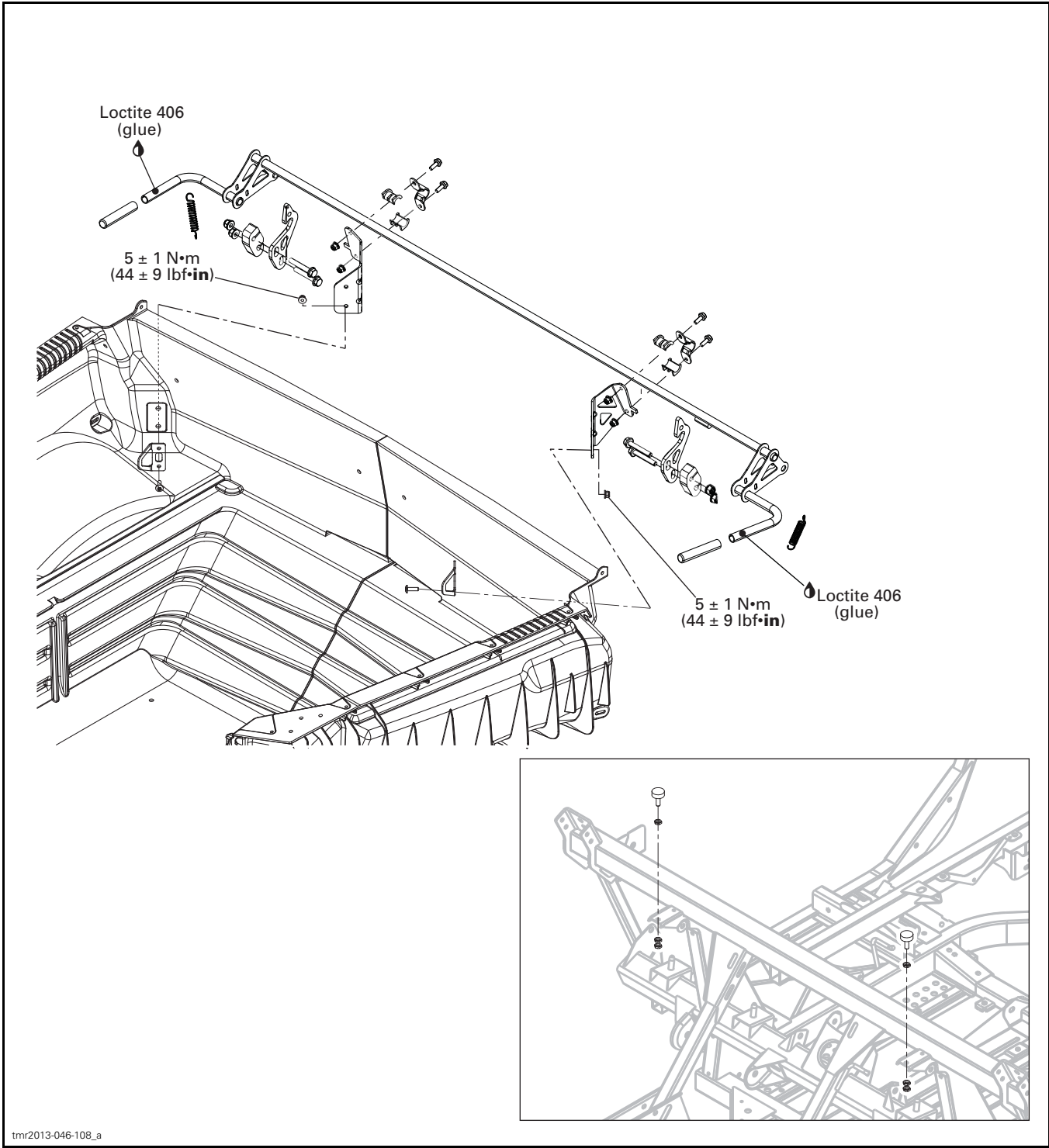


CARGO BOX

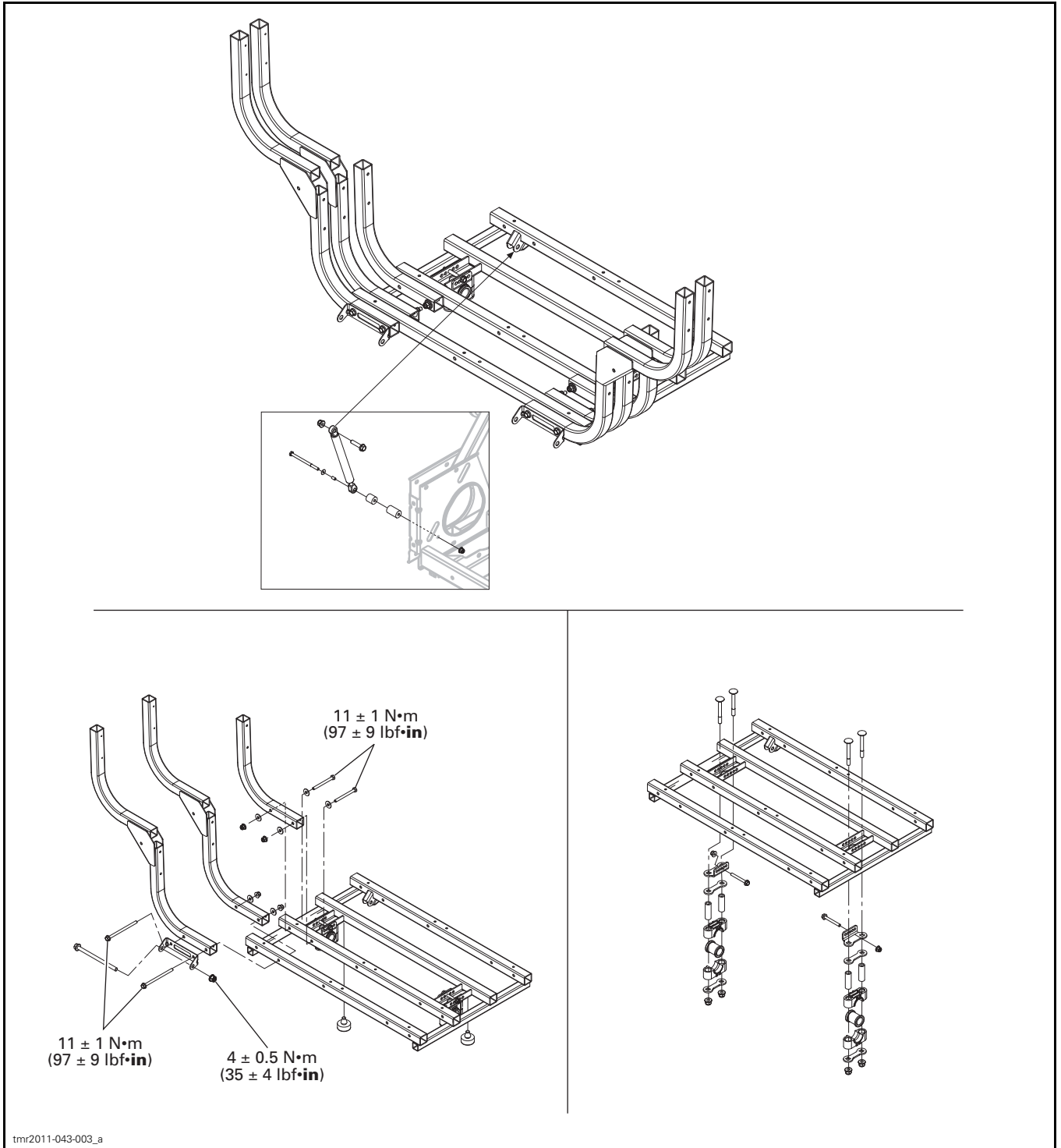
CARGO BOX TRIMS



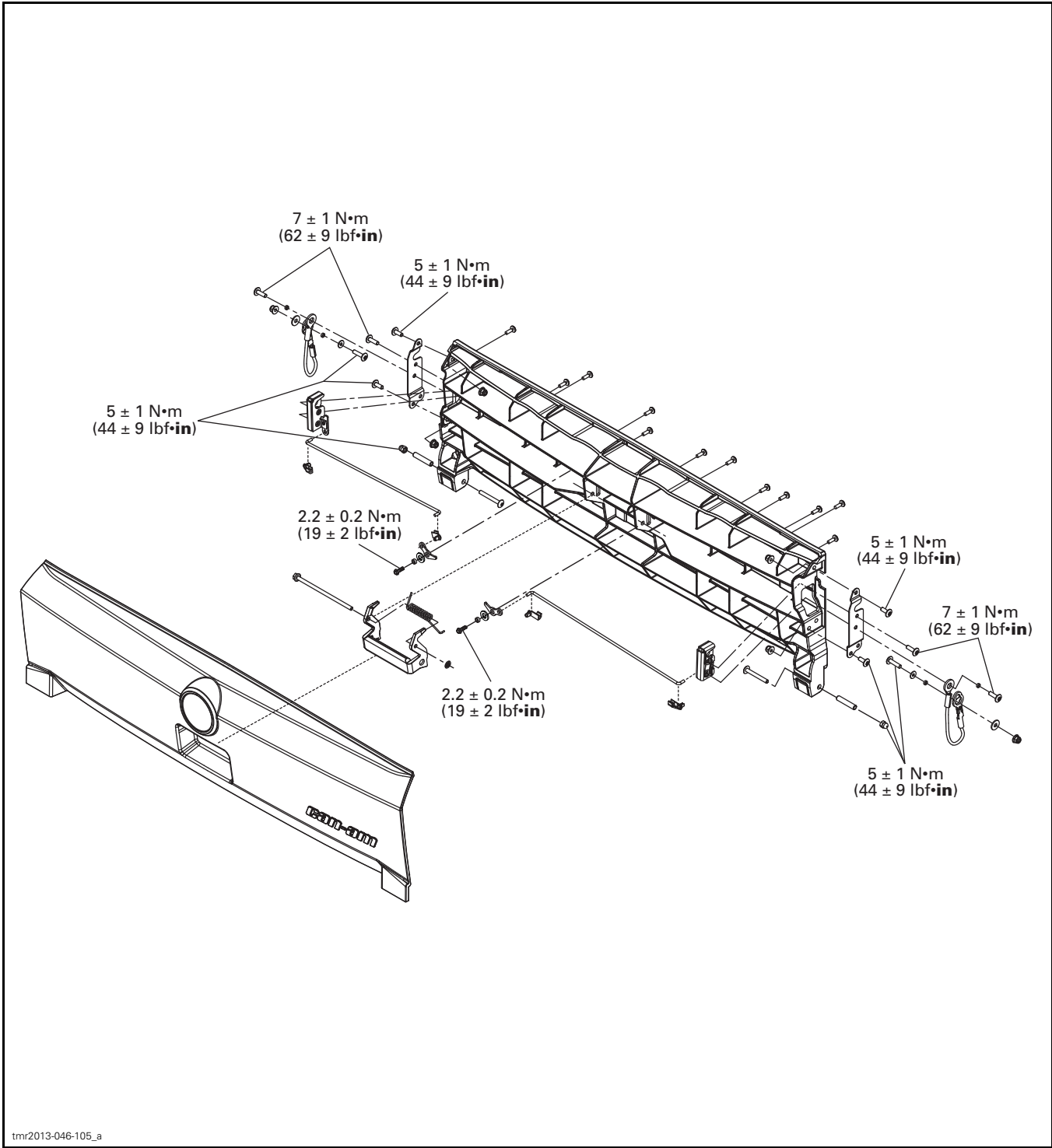
CARGO BOX TILT RELEASE MECHANISM



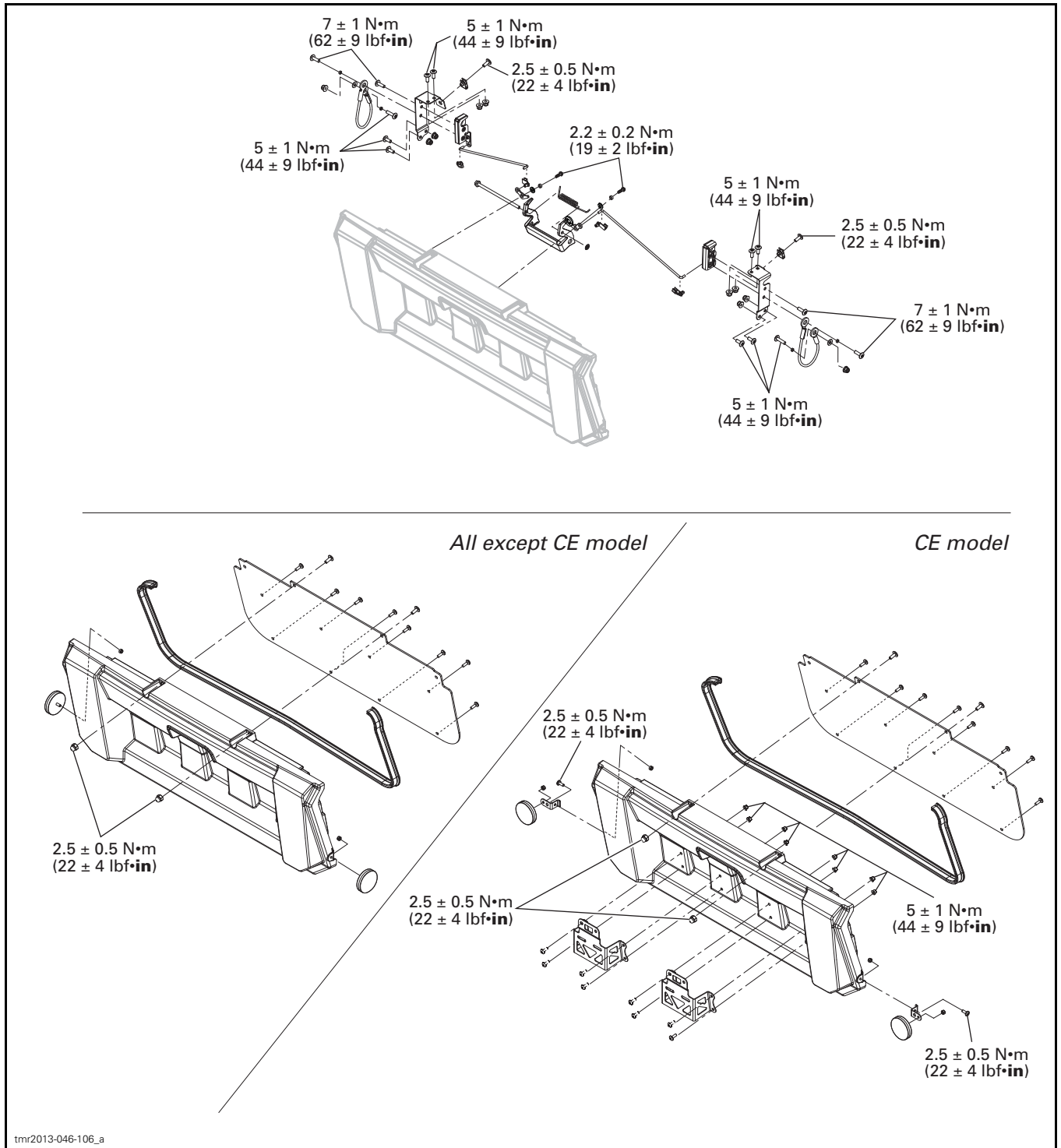
CARGO BOX SUPPORT



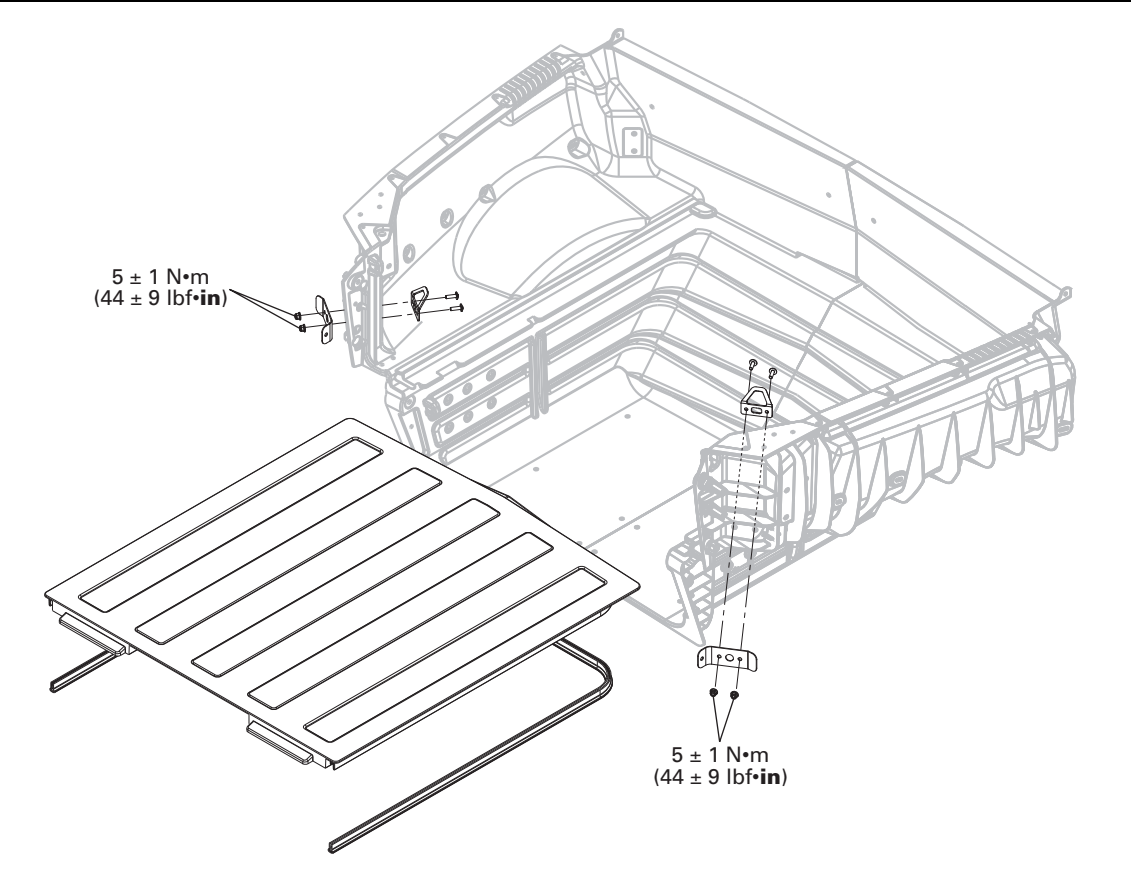
UPPER TAIL GATE



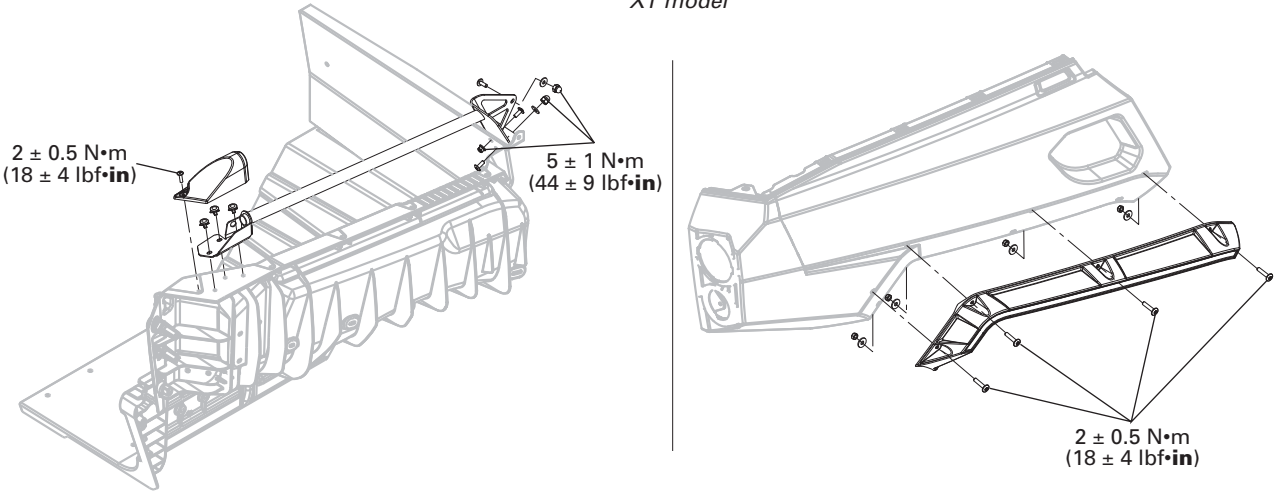
LOWER TAIL GATE



CARGO BOX ACCESSORIES



XT model



tmr2011-043-006_a

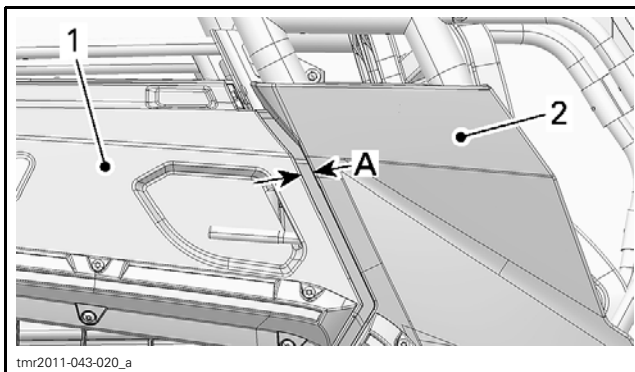
ADJUSTMENT

CARGO BOX ADJUSTMENTS

Cargo Box Alignment

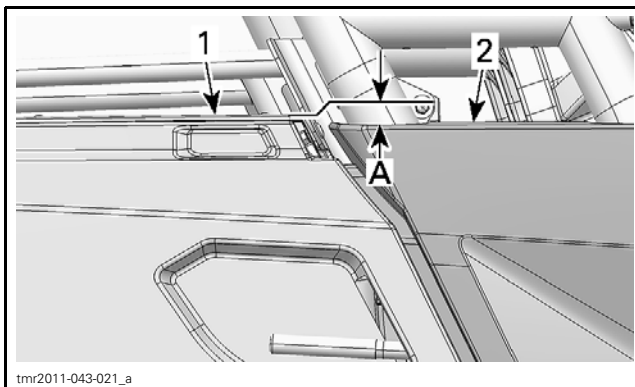
The cargo box is properly aligned when:

- The gap between the cargo box and rear lateral panel is equalled on each side ($\pm 19\text{ mm}$ ($3/4\text{ in}$)).
- Cargo box side and rear lateral panel are flushed. The top of cargo box side may be raised for a maximum of 6 mm ($15/64\text{ in}$) over the top of rear lateral panel.



GAP BETWEEN CARGO BOX AND REAR LATERAL PANEL

1. Cargo box side
2. Rear lateral panel
- A. Approximately 19 mm ($3/4\text{ in}$)

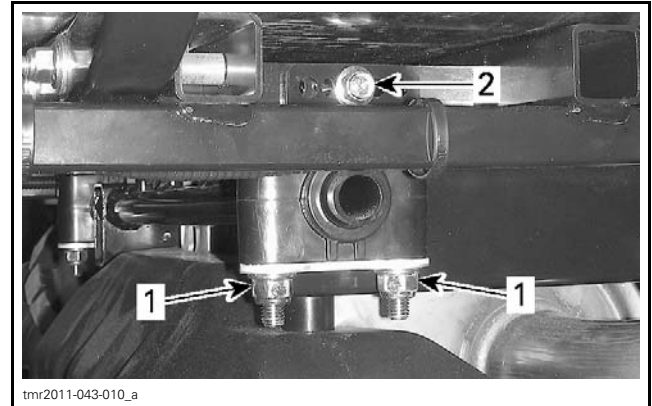


CARGO BOX HEIGHT GAP

1. Top of cargo box side
2. Top of rear lateral panel
- A. Maximum of 6 mm ($15/64\text{ in}$)

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.

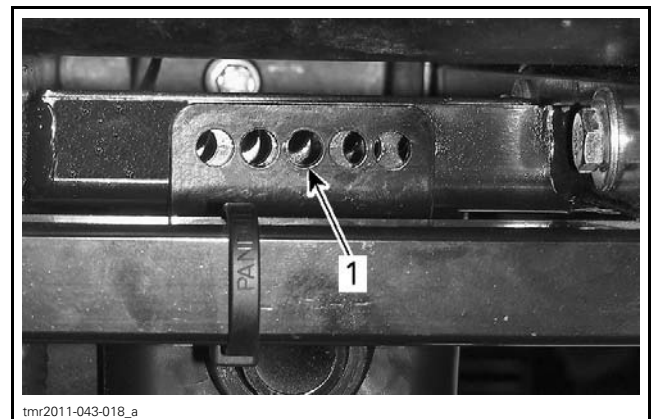


TYPICAL – RH SIDE SHOWN

1. 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.



1. Corresponding holes

5. Tighten nuts and bolts.

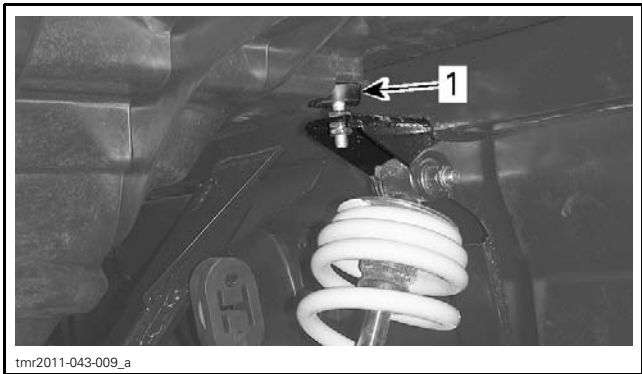
TIGHTENING TORQUE	
Adjuster bolts	$10\text{ N}\cdot\text{m} \pm 2\text{ N}\cdot\text{m}$ ($89\text{ lbf}\cdot\text{in} \pm 18\text{ lbf}\cdot\text{in}$)
Cargo box pivot point nuts	$24.5\text{ N}\cdot\text{m} \pm 3.5\text{ N}\cdot\text{m}$ ($18\text{ lbf}\cdot\text{ft} \pm 3\text{ lbf}\cdot\text{ft}$)

6. Verify the cargo box retainer height.

Cargo Box Retainer Height Adjustment

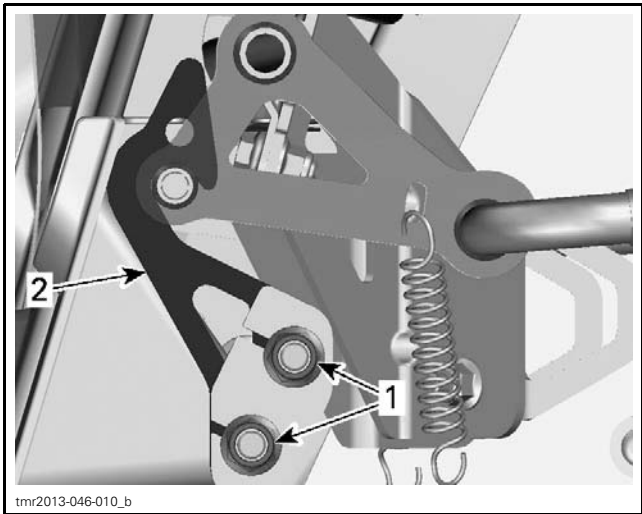
1. Open cargo box.
2. Loosen rubber bumpers.

Subsection XX (CARGO BOX)



RH SIDE SHOWN
1. Rubber bumper

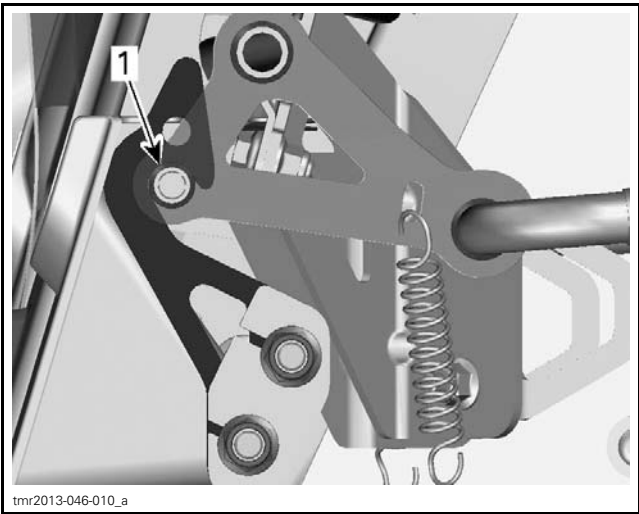
3. Close the cargo box and check the gap between cargo box retainer and the end of the latch lever.
- 3.1 Break torque from cargo box retainer bolts.



TYPICAL – RH SIDE SHOWN
1. Cargo box retainer nuts
2. Cargo box retainer

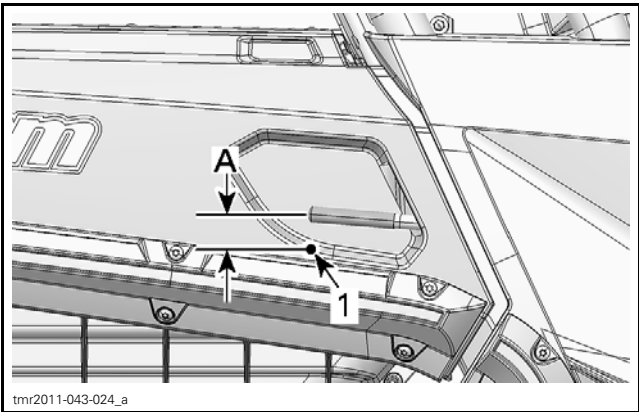
- 3.2 Using a small hammer, reposition the cargo box retainer. Temporarily retighten bolts.
- 3.3 Close the cargo box and check the cargo box retainer gap.

NOTE: No vertical gap is permitted between cargo box retainer and the end of the latch lever.



1. 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).

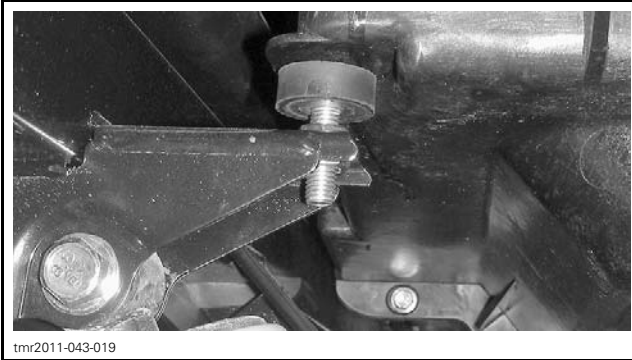


1. Reference point
A. Difference: approximately 2 mm (.079 in)

5. Repeat steps 3 and 4 until cargo box is properly adjusted.
6. Retighten all cargo box retainer bolts.

TIGHTENING 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

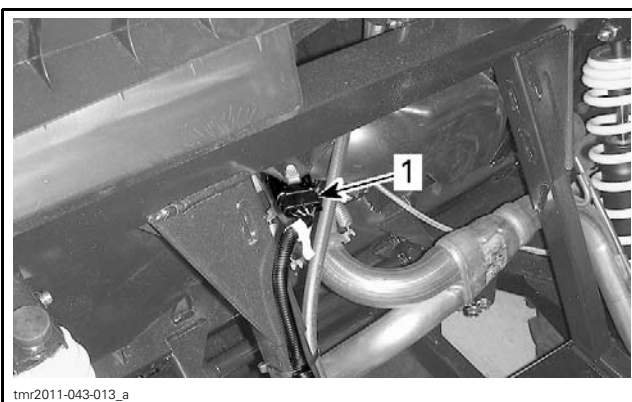
Cargo Box Gas Shock Replacement

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 the cargo box.

CARGO BOX

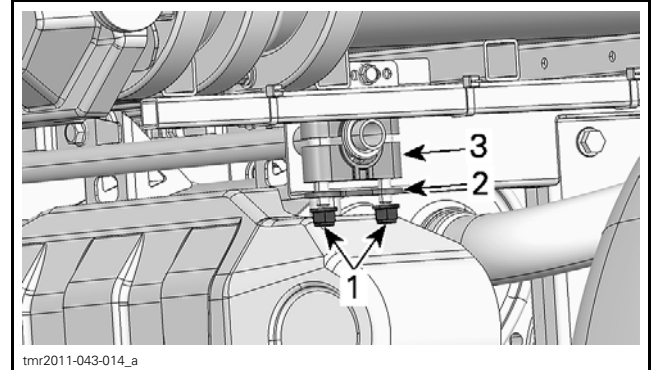
Cargo Box Removal

1. Unlock and raise the cargo box.
2. Unplug the cargo box harness connector.



1. Cargo box harness connector

3. From the LH of vehicle, cut all locking ties securing harness to frame.
4. Secure the cargo box with wooden blocks (or an equivalent) and remove the upper gas shock bolt.
5. Remove supports and lower the 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

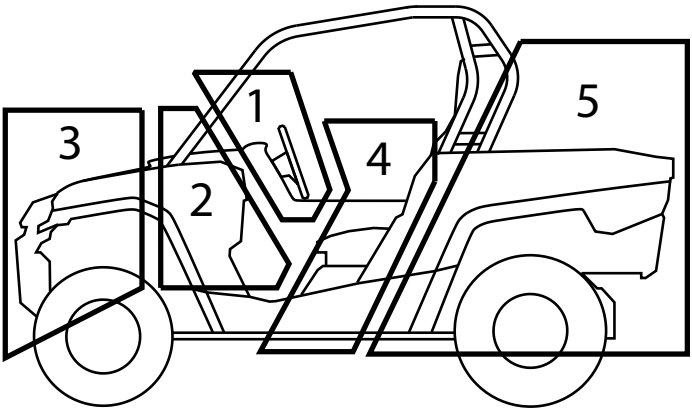
7. Unlock the cargo box.
8. Using a hoist or with the help of another person, remove the cargo box.

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. If any parts of the locking mechanism have been replaced or loosen, check cargo box adjustments. Refer to *CARGO BOX ADJUSTMENTS*.

COMMANDER 2013
ACS SYSTEM



MAIN
HARNESS
SIDE

ACS
HARNESS
SIDE

TERMINAL IDENTIFICATION				
	NAME	ZONE-	CONNECTOR NAME-	TERMINAL #/A
EX:	CI	1	- CI	- 15
EX:	CV	4	- CV	- A
EX:	ME	2	- ME	

AWG	MAX. CURRENT	MAX. FUSE CURRENT	MAX. WATT
# 6	100 amps	125 amps	1450 watts
# 8	65 amps	80 amps	930 watts
# 10	40 amps	50 amps	580 watts
# 12	25 amps	30 amps	365 watts
# 14	16 amps	20 amps	230 watts
# 16	10 amps	15 amps	145 watts
# 18	6 amps	7.5 amps	85 watts
* AT	50°C MAX		

ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE

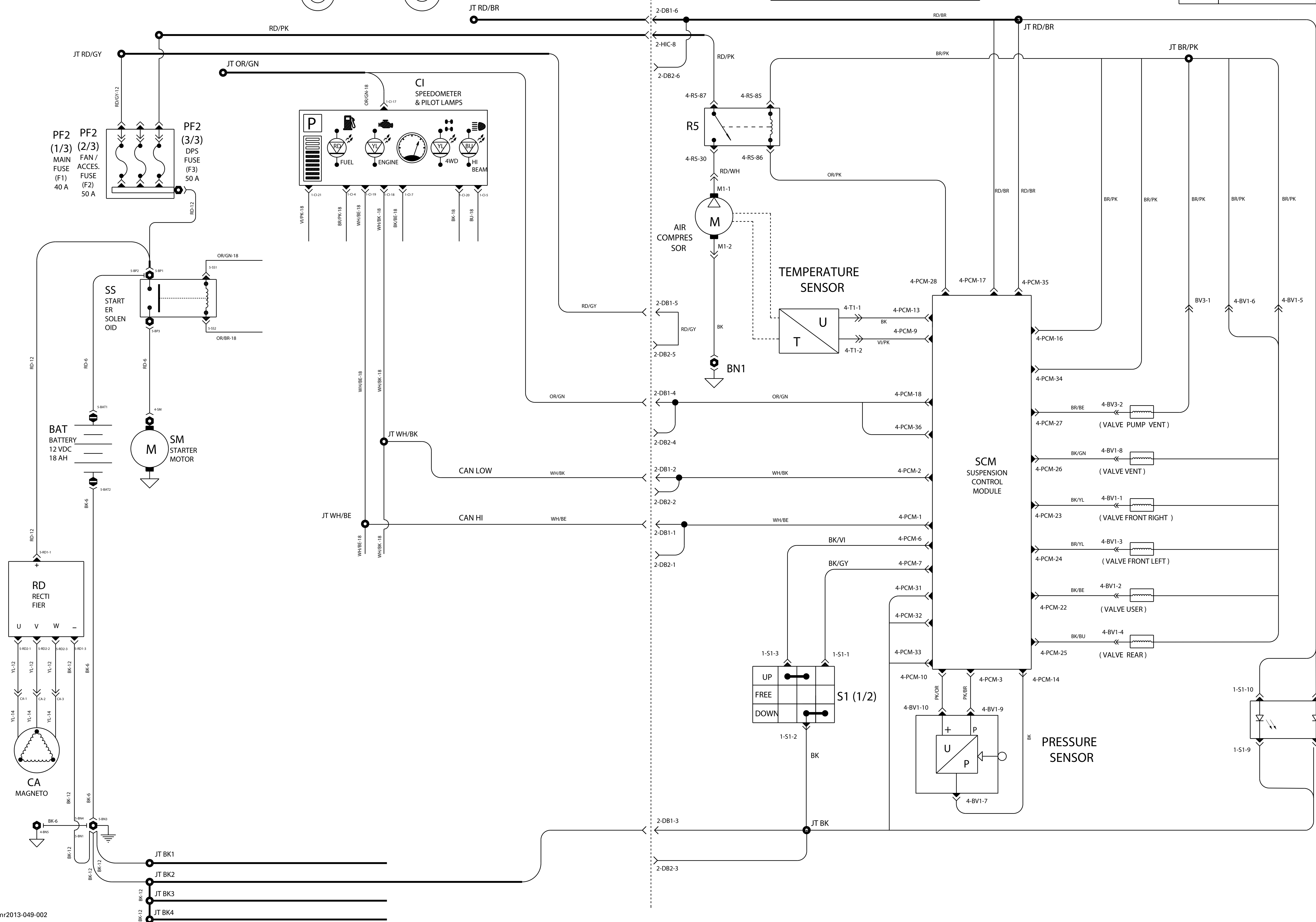
●	WELDED JOINT
—	SHRINKED JOINT
—	CROSSED WIRE
—	WIRE BUS
—	SIMPLE CONDUCTOR WIRE
—	FEMALE TERMINAL
—	MALE TERMINAL
—	STEEL LINK (FRAME)
—	TERMINAL

—	FRAME GROUND
—	ENGINE GROUND
—	PHILLIPS SCREW
—	NUT CONNECTION
—	SPLICE CONNECTION
—	COMPONENT CONNECTION
—	SECTION OF MODULE
—	SLOTTED SCREW
—	OPTIONAL

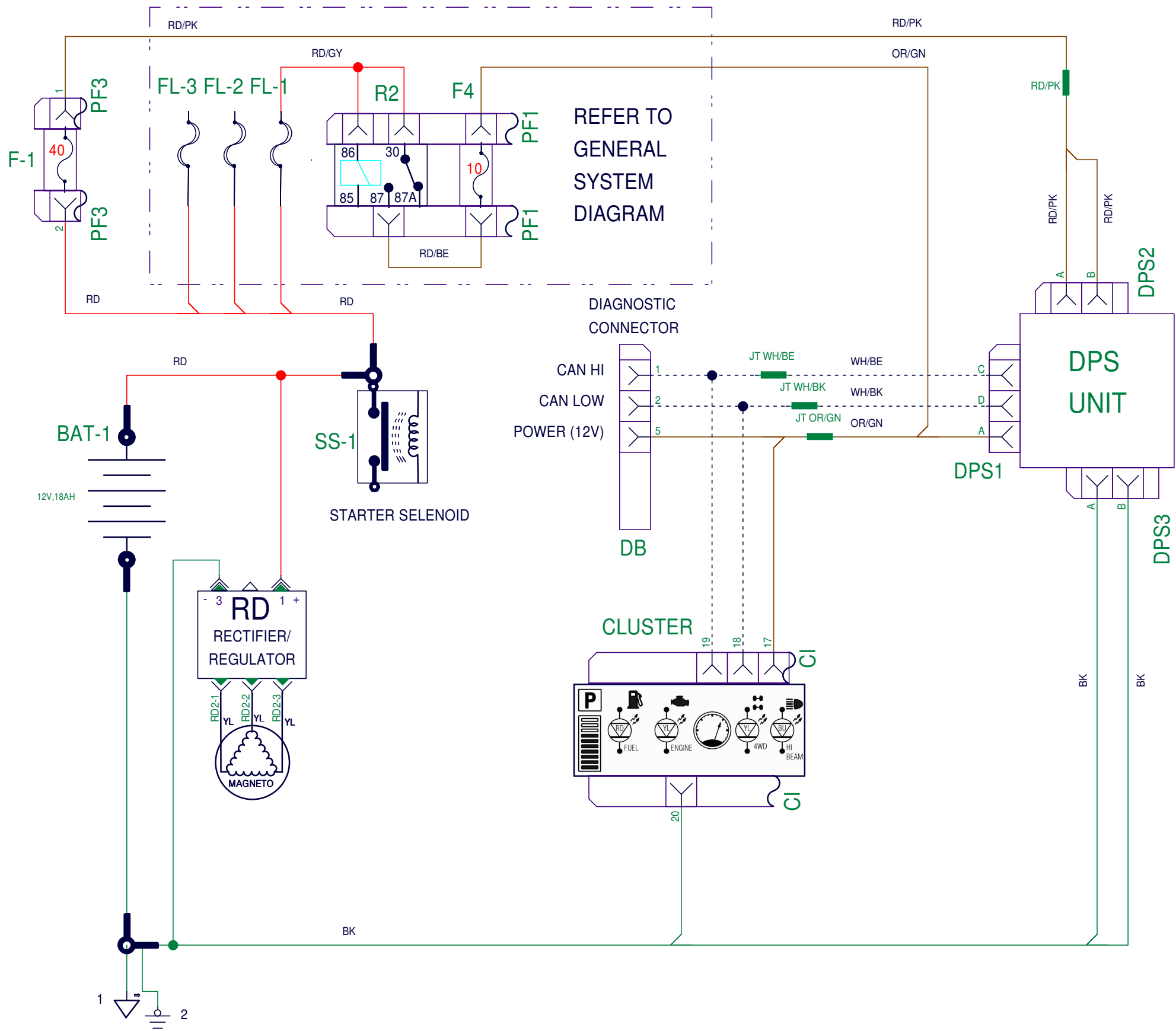
COLOR CODE	
BE	BEIGE
BK	BLACK
BU	BLUE
BR	BROWN
GN	GREEN
GY	GREY
OR	ORANGE
RD	RED
VI	VIOLET
WH	WHITE
YL	YELLOW
PK	PINK
LT BU	LIGHT BLUE

DB1 FROM MAIN HARNESS
DIAGNOSTIC CONNECTOR

SEE MAIN HARNESS DIAGRAM
FOR DETAILS ON DB1 AND HIC - 8



SSV MY16
DPS SYSTEM



MODEL	SSV
MY	16



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Products Inc. (BRP).

TITLE SSV MY16 DPS SYSTEM							
DRAWN BY		DESIGN BY	SR	REV		REV DATE	
DATE	2015-03-05	DATE		P. SIZE	A	PAGE	01

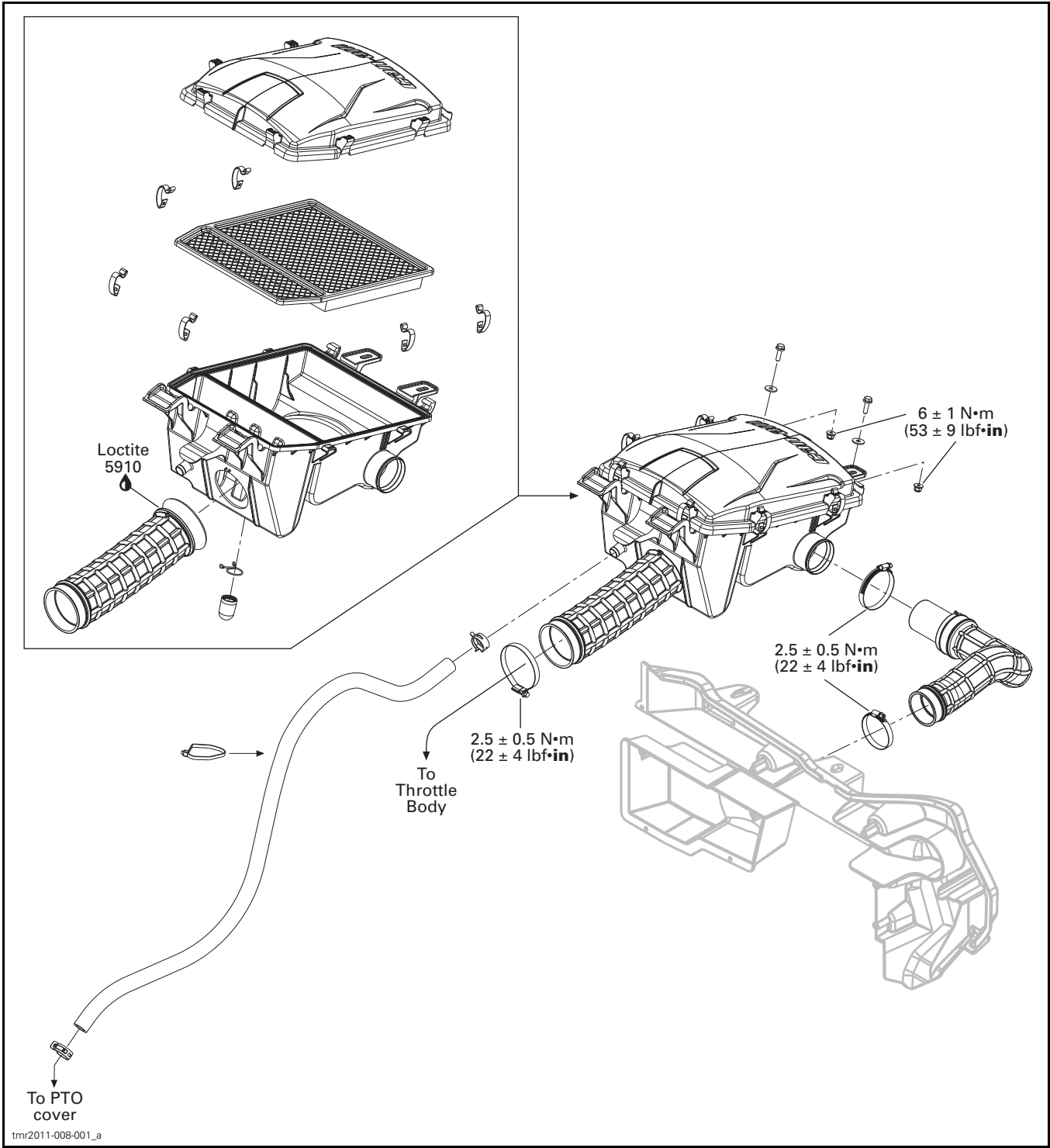
AIR INTAKE SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	6

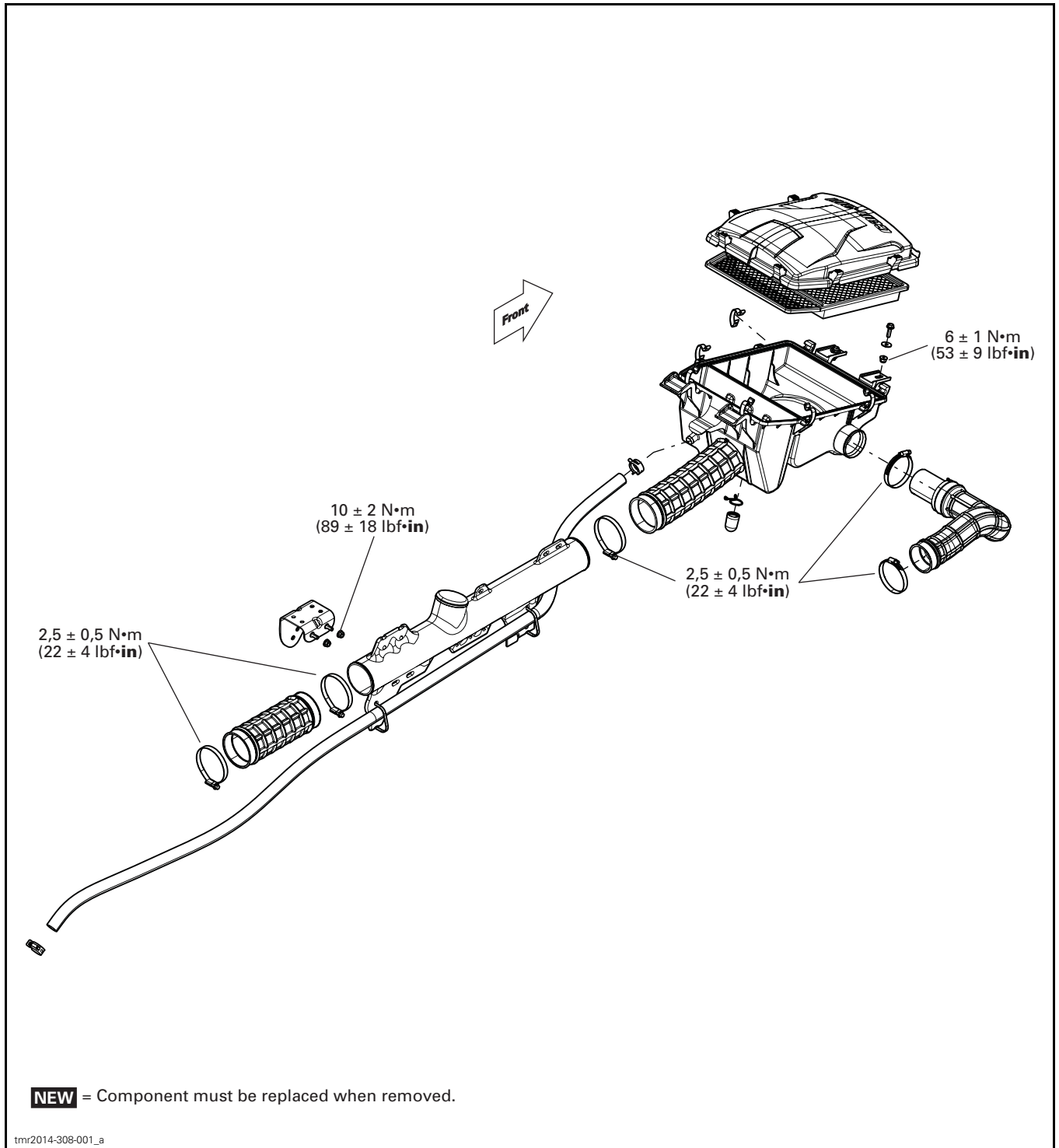
AIR FILTER HOUSING

2-UP Models



AIR FILTER HOUSING

MAX Models



GENERAL

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 MAINTENANCE PROCEDURES* subsection.

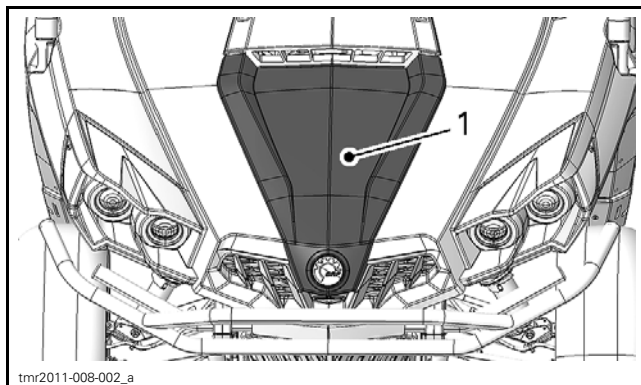
AIR FILTER HOUSING

Air Filter Housing Removal

2-UP Models

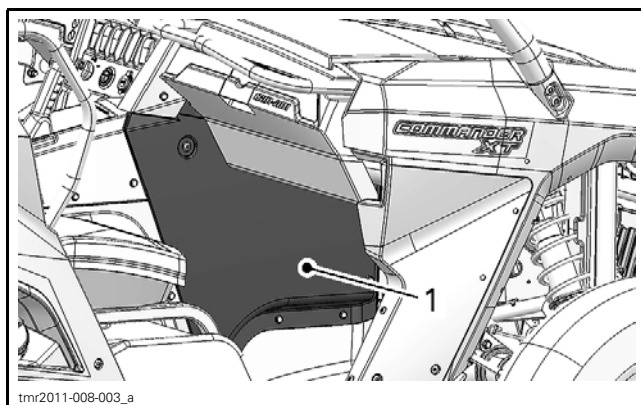
1. Remove the following parts:

1.1 Service cover



1. Service cover

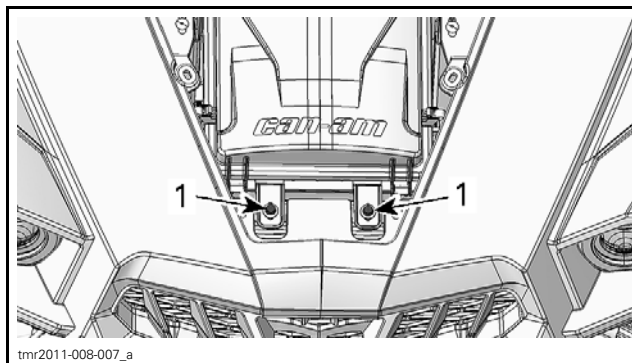
1.2 RH inner panel.



FROM INSIDE OF COCKPIT – PASSENGER SIDE

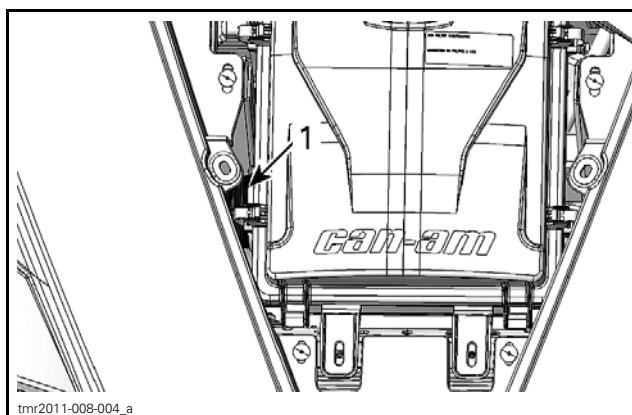
1. RH inner panel

2. Remove retaining bolts of air filter housing.



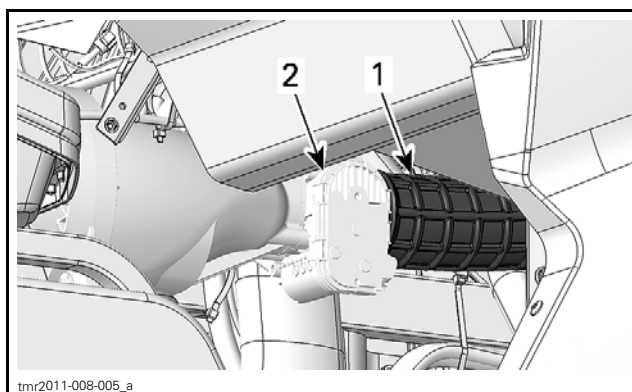
1. Air filter housing retaining bolts

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



1. Air inlet hose

4. Disconnect intake adapter from throttle body.

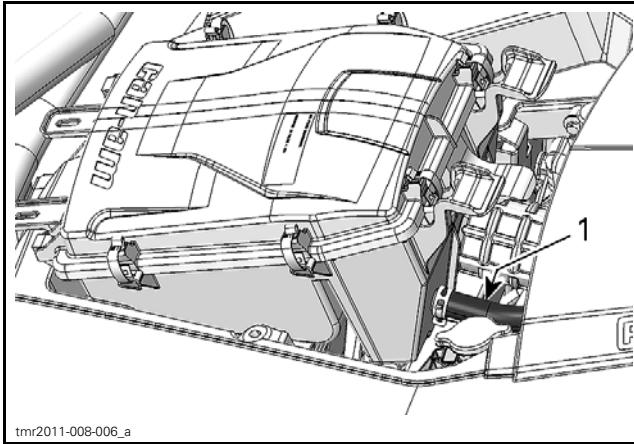


FROM INSIDE OF COCKPIT – PASSENGER SIDE

1. Intake adapter

2. Throttle body

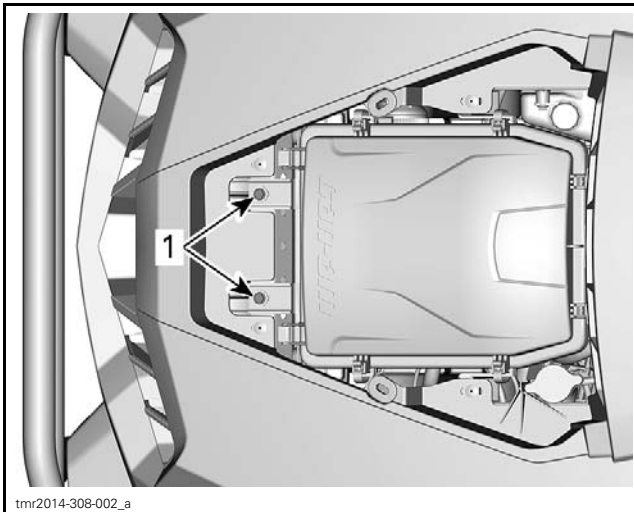
5. Disconnect vent hose from the rear of air filter housing.



1. Vent hose

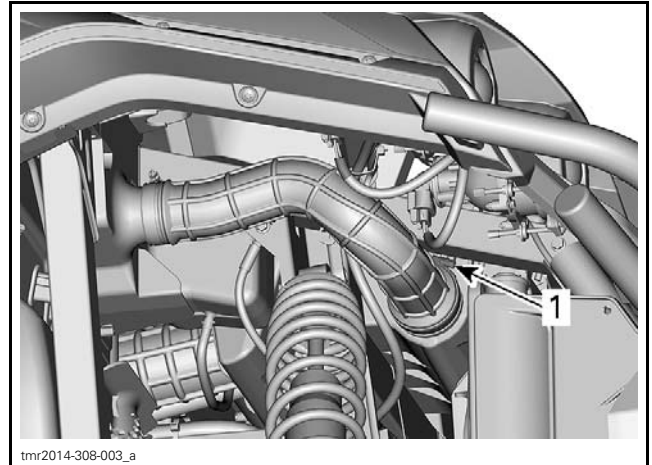
MAX Models

1. Refer to *BODY* and remove the following parts:
 - Service cover
 - RH inner kick panel
2. Remove retaining screws and washers of air filter housing.



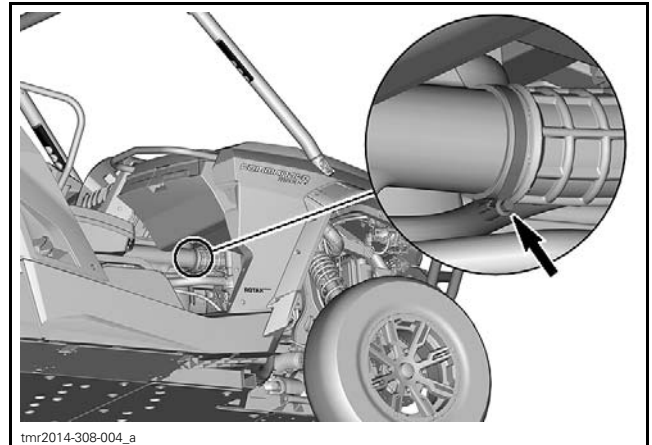
1. Air filter housing retaining screws and washers

3. Disconnect air inlet hose from the RH side of air filter housing.



1. Air inlet hose

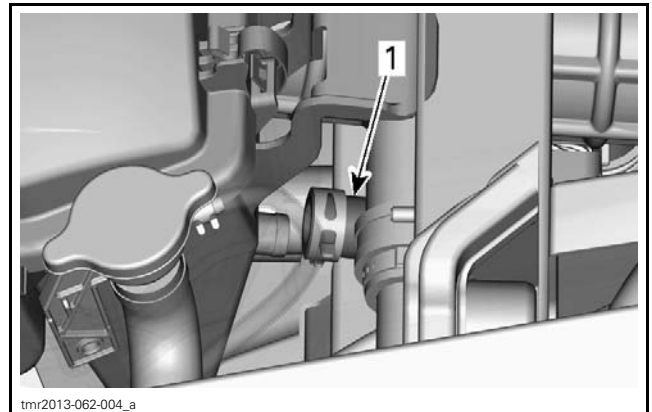
4. Disconnect intake adapter from central air intake adapter.



FROM INSIDE OF COCKPIT - PASSENGER SIDE

1. Central air intake adapter

5. Disconnect vent hose from the rear of air filter housing.



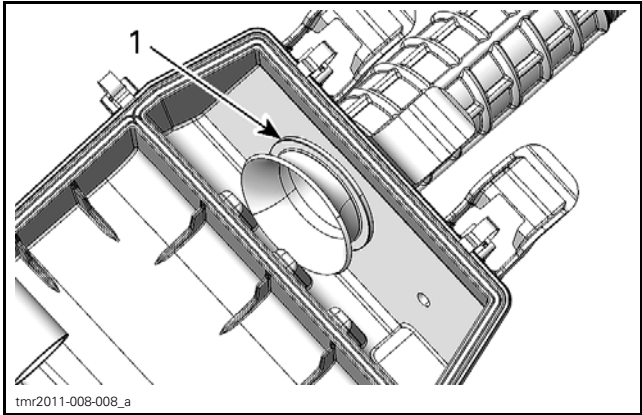
1. Vent hose

Air Filter Housing Installation

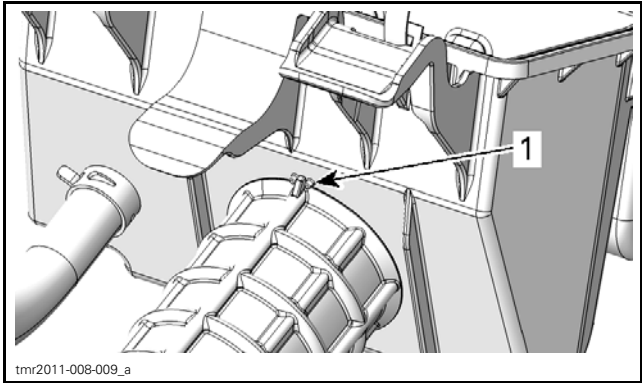
For installation, reverse the removal procedure but pay attention to the following.

Subsection XX (AIR INTAKE SYSTEM)

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.



1. Apply Loctite 5910 between intake adapter lips and housing wall



1. Intake adapter recess into air filter housing notch

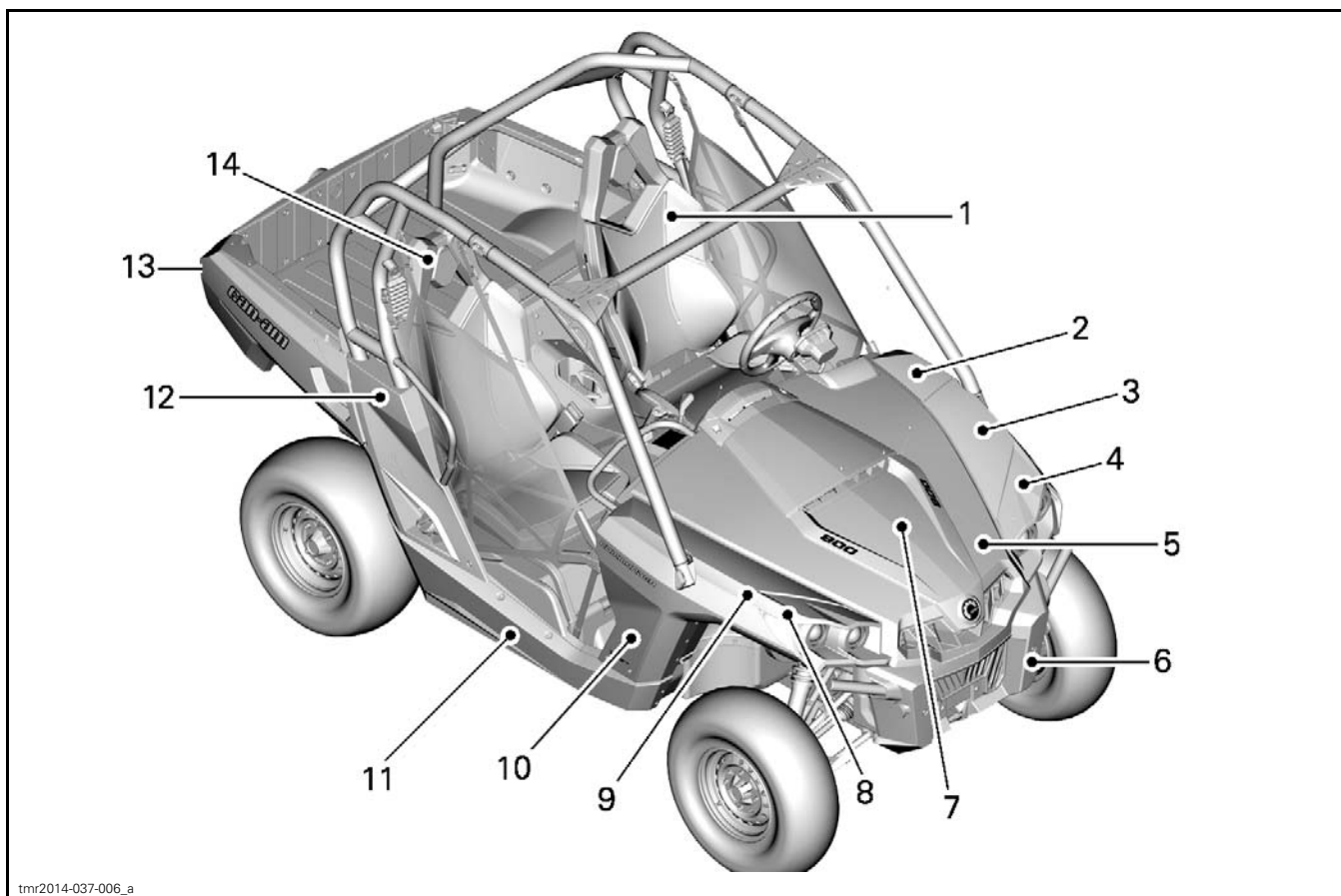
TORQUE	
Gear clamps	2.5 N•m ± 0.5 N•m (22 lbf•in ± 4 lbf•in)
Air filter housing nuts	6 N•m ± 1 N•m (53 lbf•in ± 9 lbf•in)

BODY (2-UP)

SERVICE TOOLS

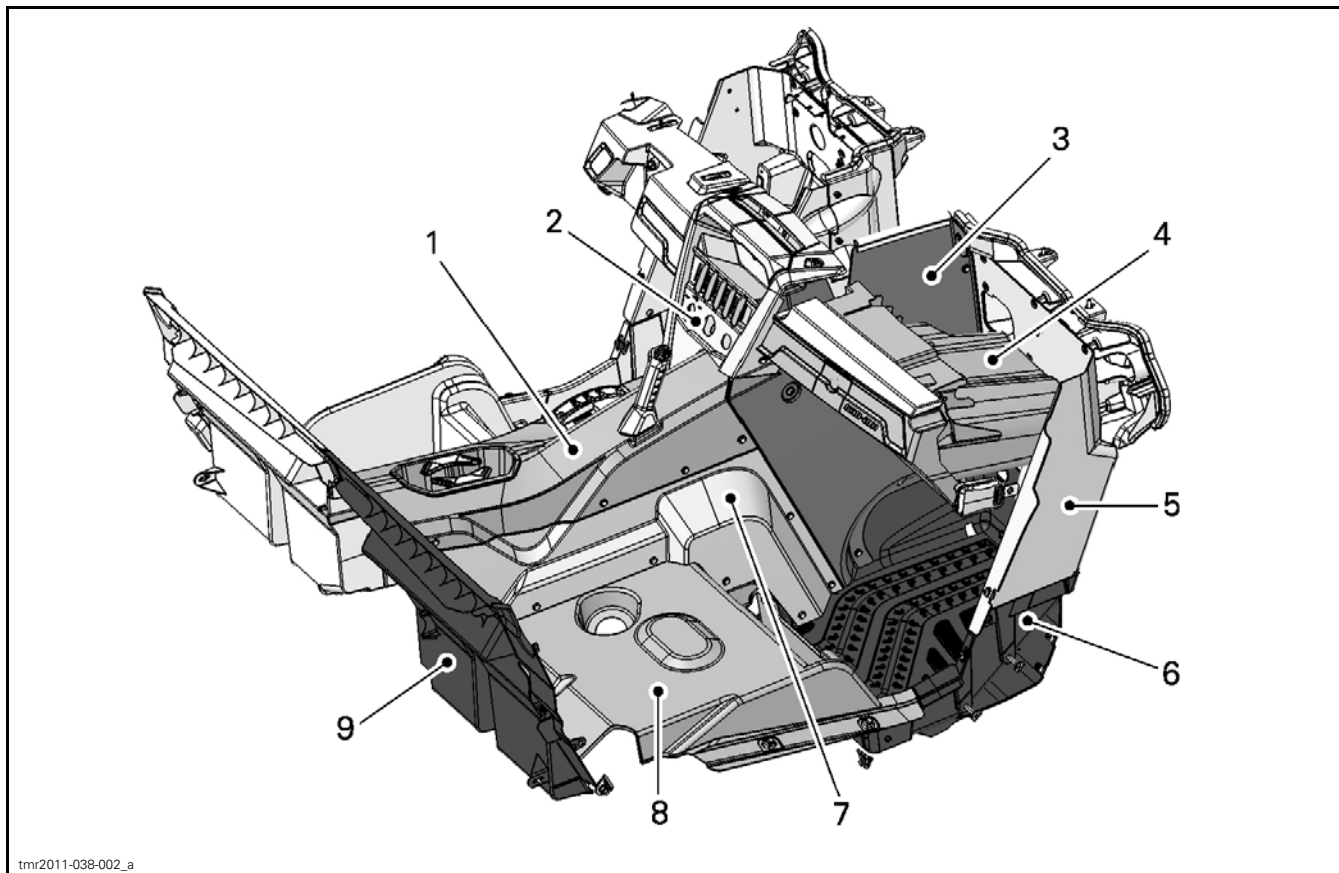
Description	Part Number	Page
OETIKER PLIER.....	295 000 070	14

BODY (Parts Nomenclature)



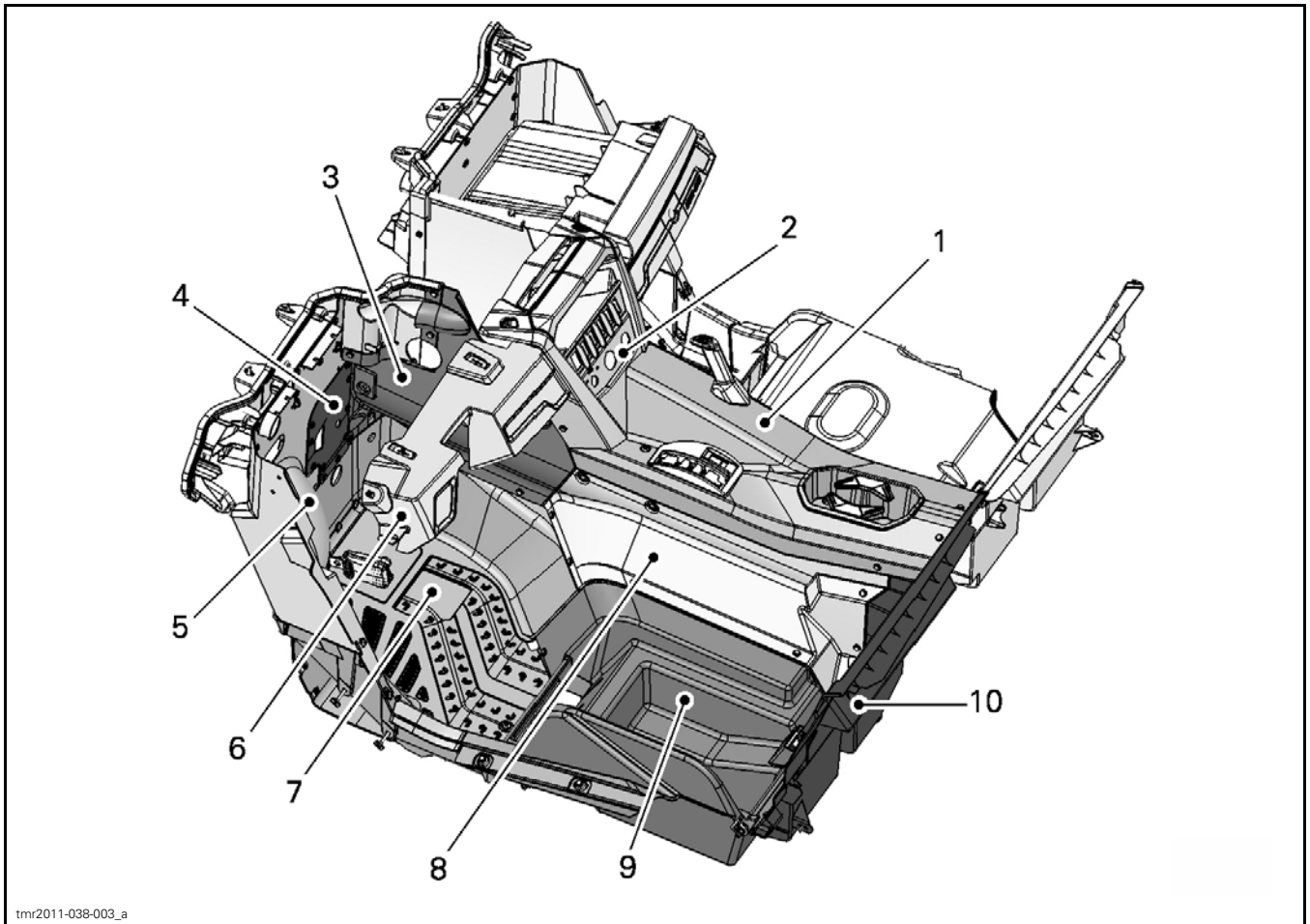
1. Driver seat
2. CVT air inlet cover
3. LH front fender
4. LH headlight trim
5. Hood
6. Front fascia
7. Service cover
8. RH headlight trim
9. RH front fender
10. Front lateral panel
11. Central lateral panel
12. Rear lateral panel
13. Cargo box
14. Passenger seat

COCKPIT – PASSENGER SIDE (Parts Nomenclature)



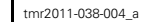
- tmr2011-038-002_a
1. Lower console
 2. Upper console
 3. RH inner kick panel
 4. Glove box
 5. Right front bulkhead
 6. Right floor panel
 7. Right lateral console panel
 8. Fuel tank cowl
 9. Right rear bulkhead

COCKPIT – DRIVER SIDE (Parts Nomenclature)

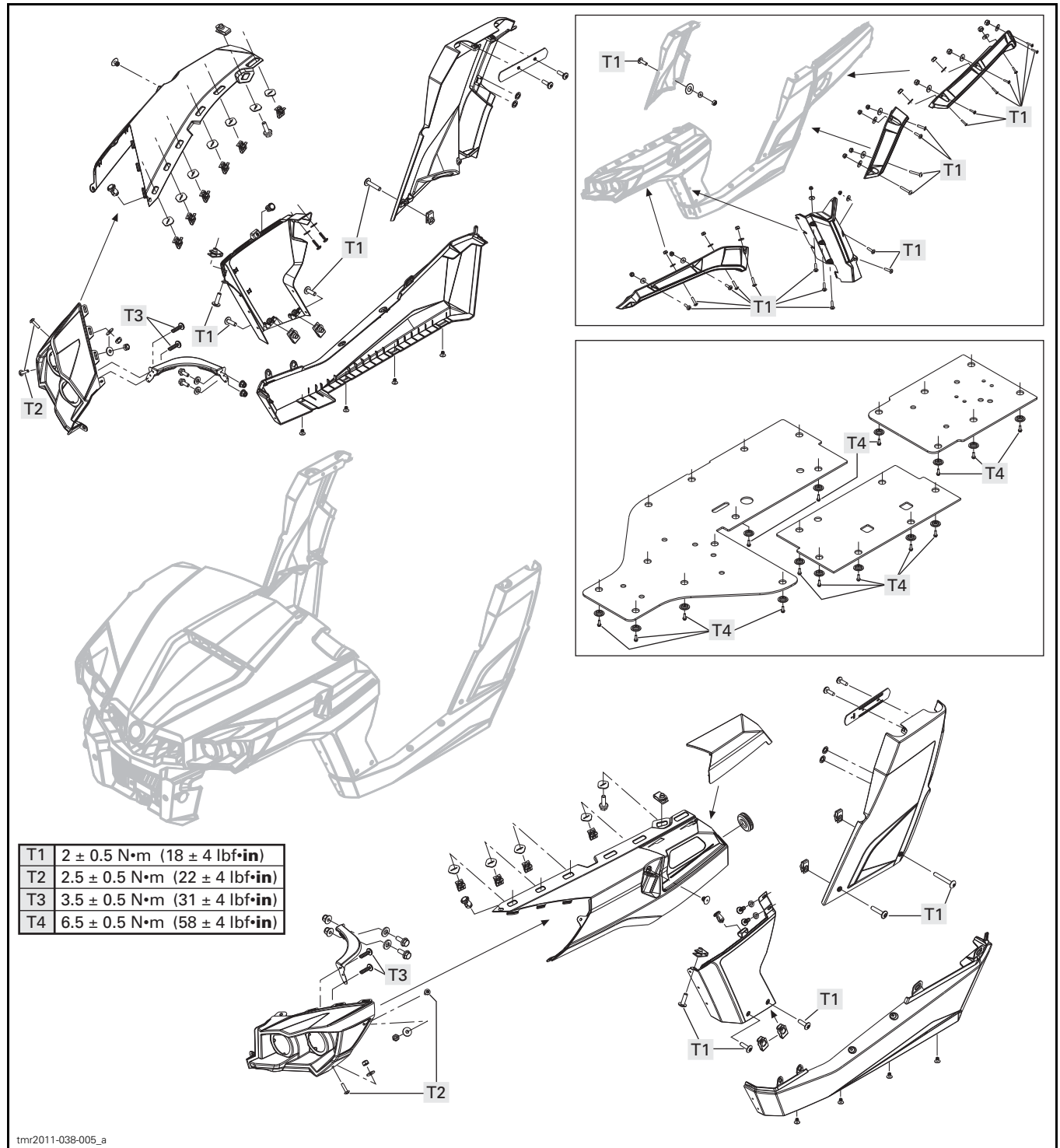


tmr2011-038-003_a

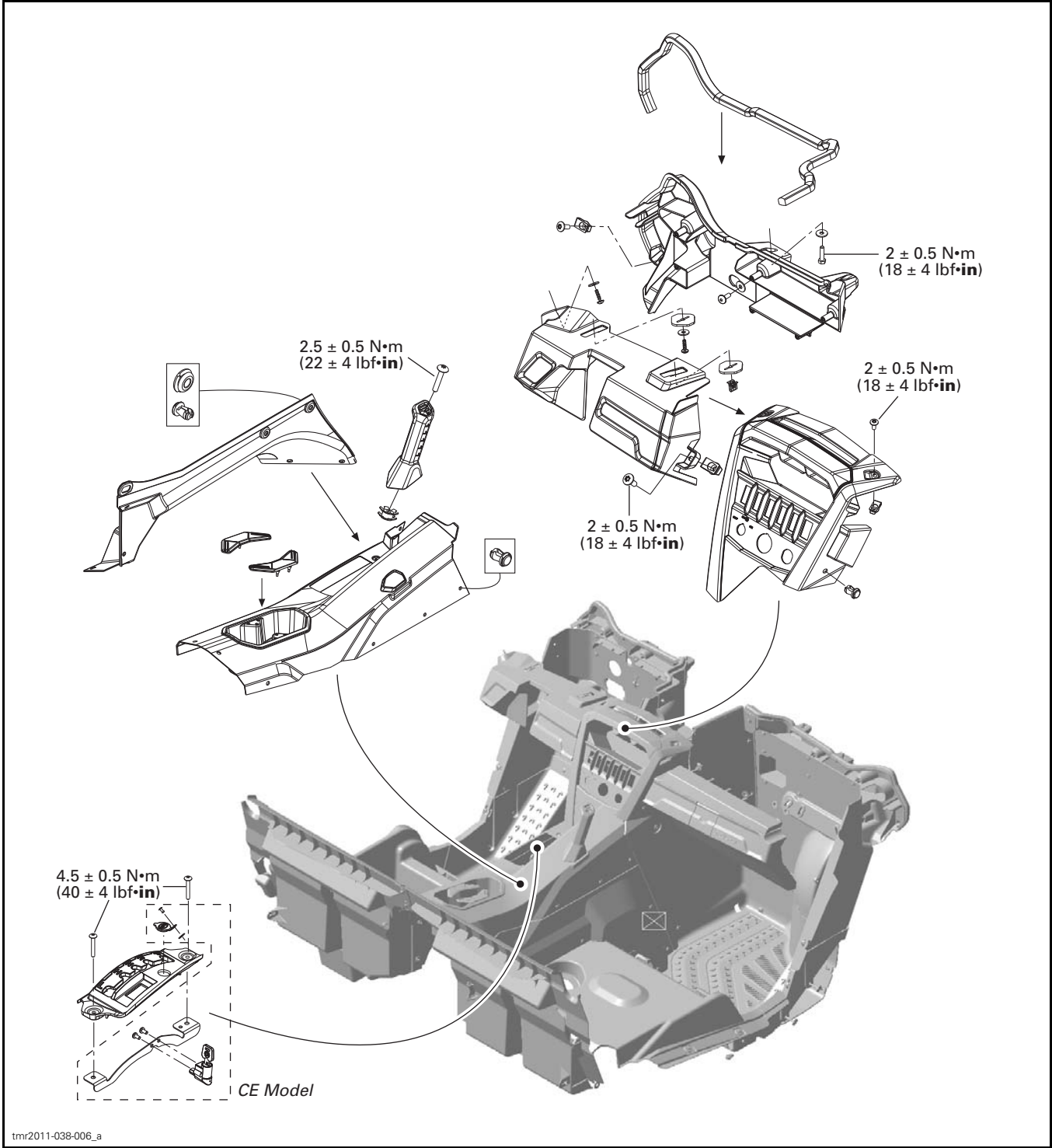
1. Lower console
2. Upper console
3. LH inner kick panel
4. Bulkhead access panel
5. Left front bulkhead
6. Dash
7. Left floor panel
8. Left lateral console panel
9. Under seat storage compartment
10. Left rear bulkhead



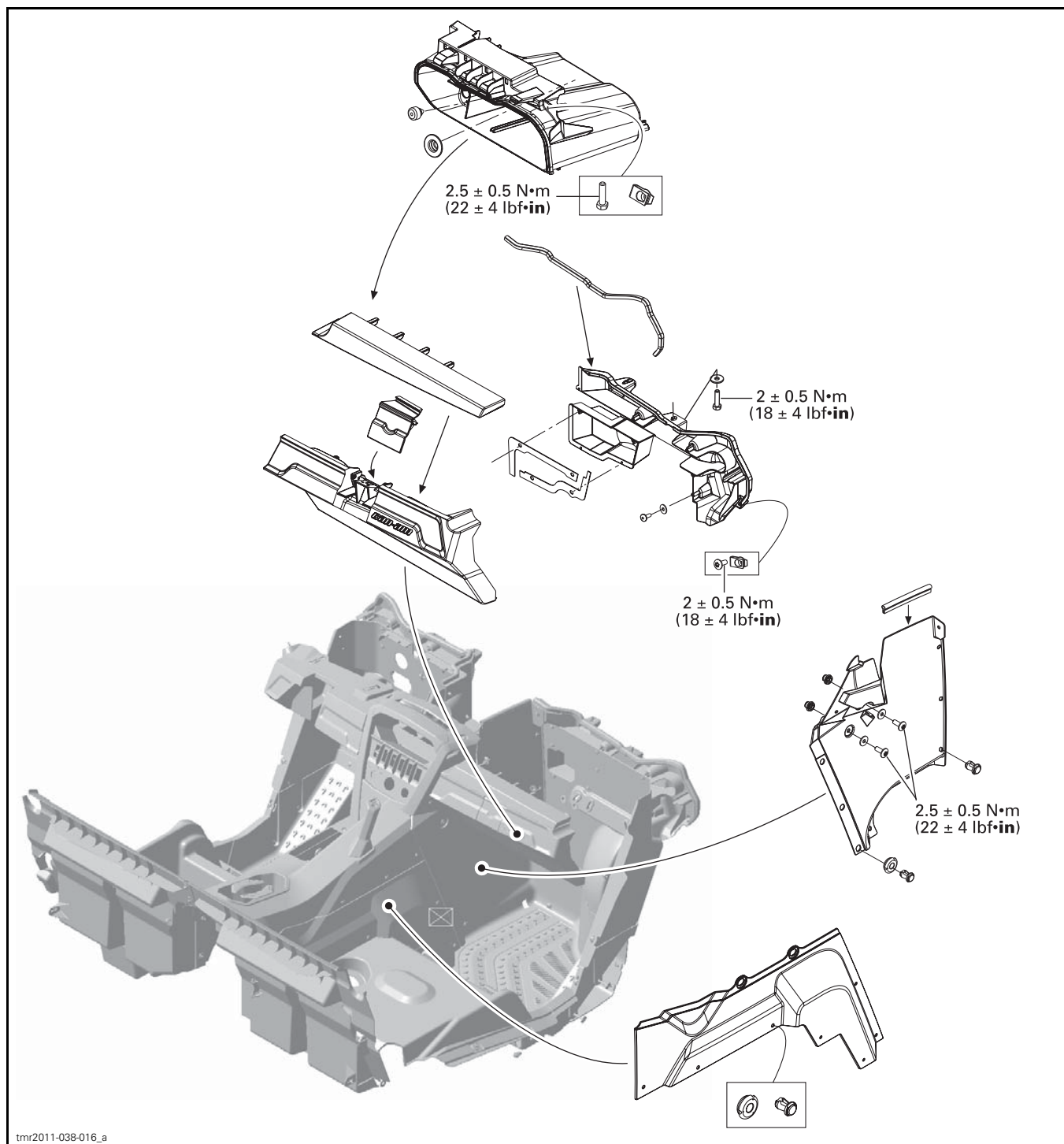
SIDE BODY PARTS (Torques and Service Products)



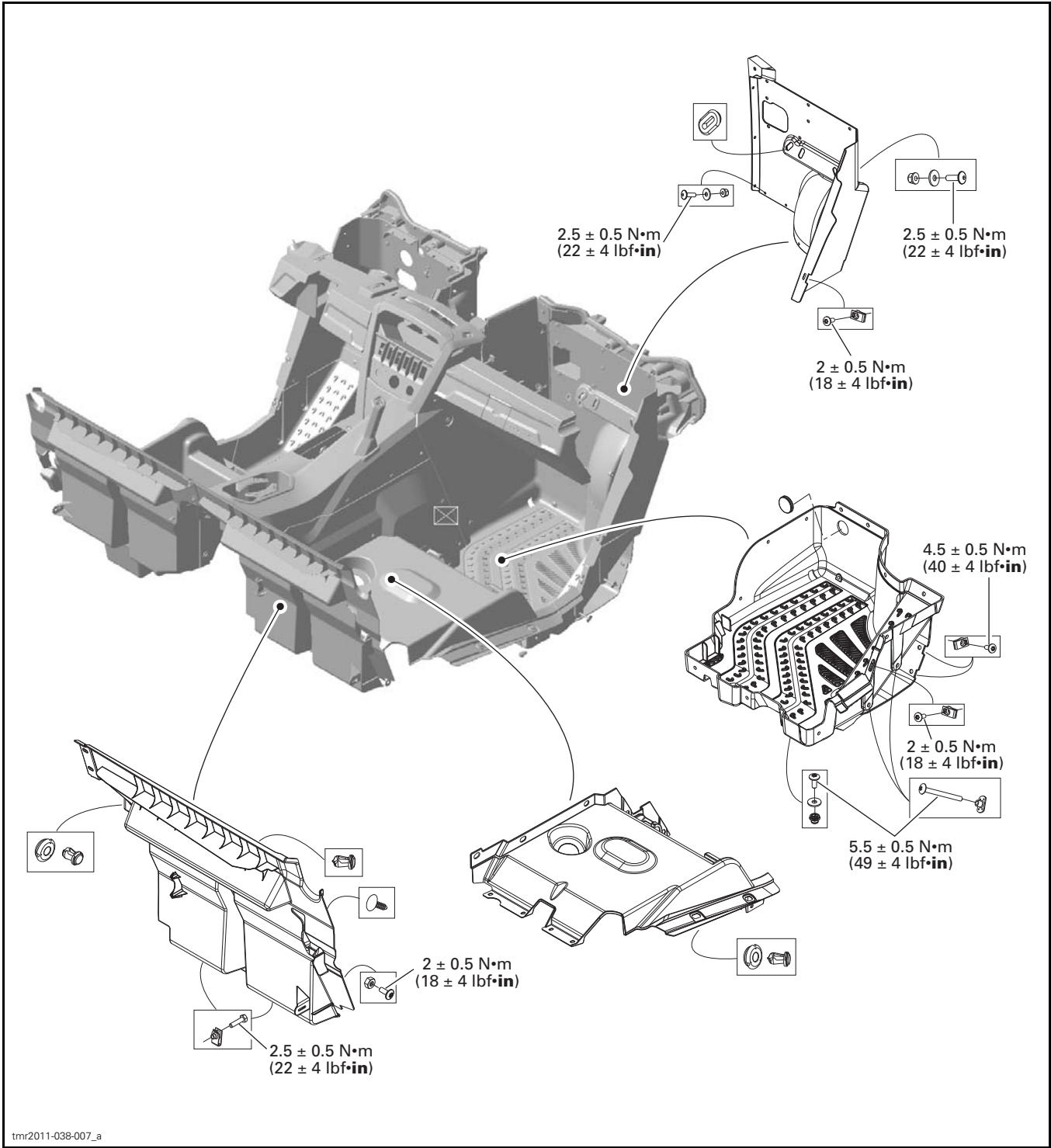
COCKPIT TRIMS – DRIVER SIDE (Torques and Service Products)



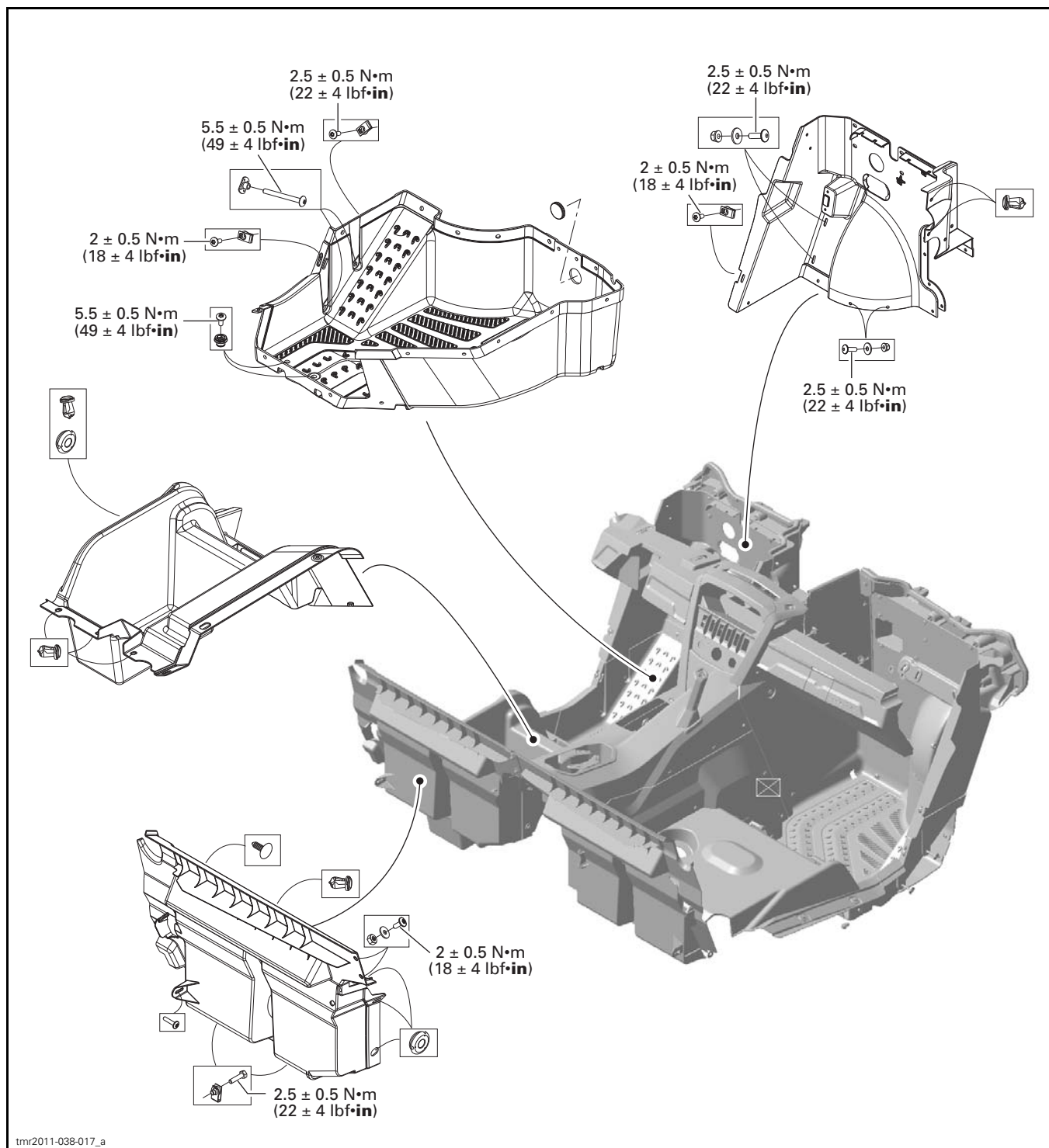
COCKPIT TRIMS – PASSENGER SIDE (Torques and Service Products)



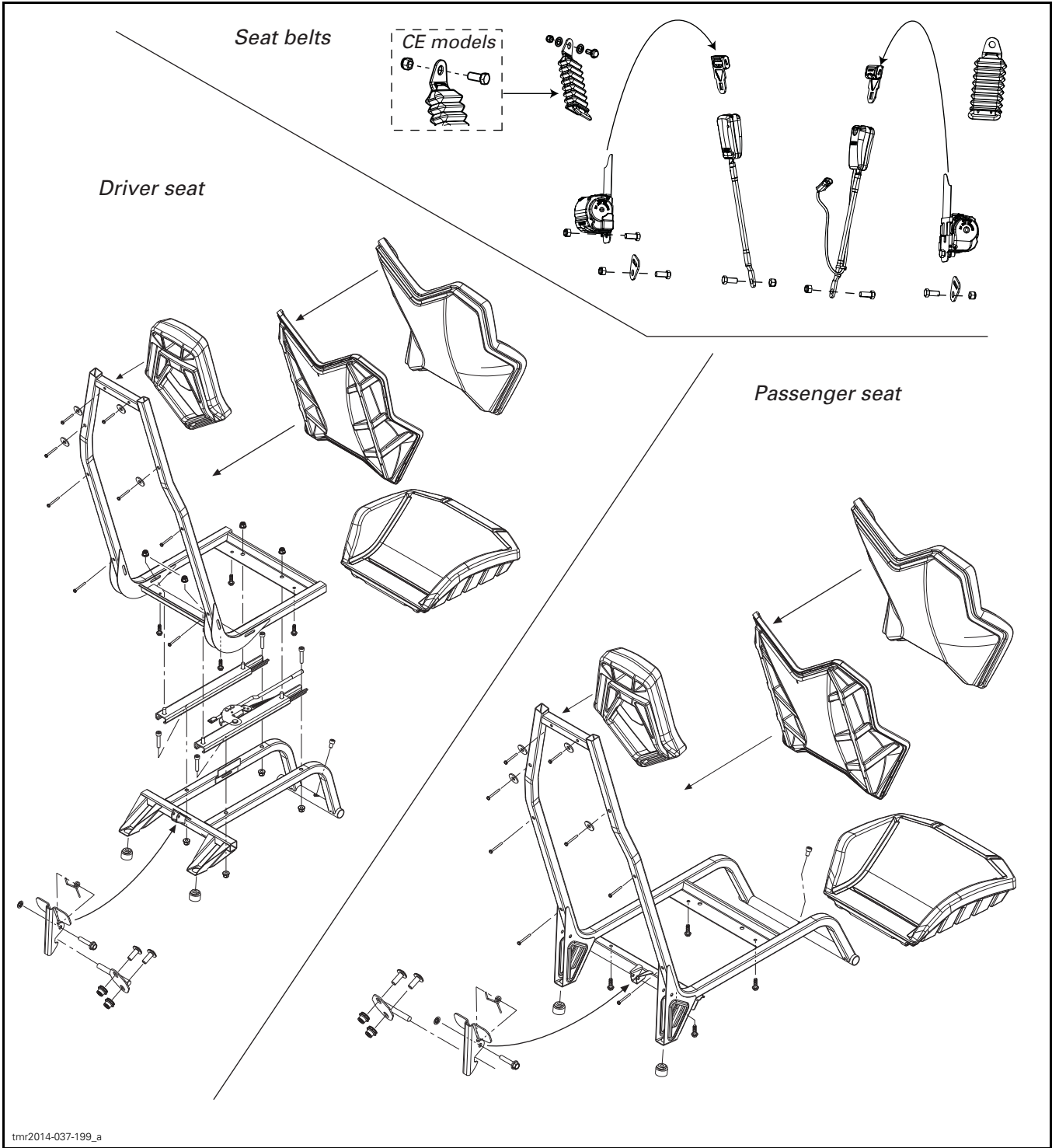
COCKPIT STRUCTURE PANELS – PASSENGER SIDE (Torques and Service Products)



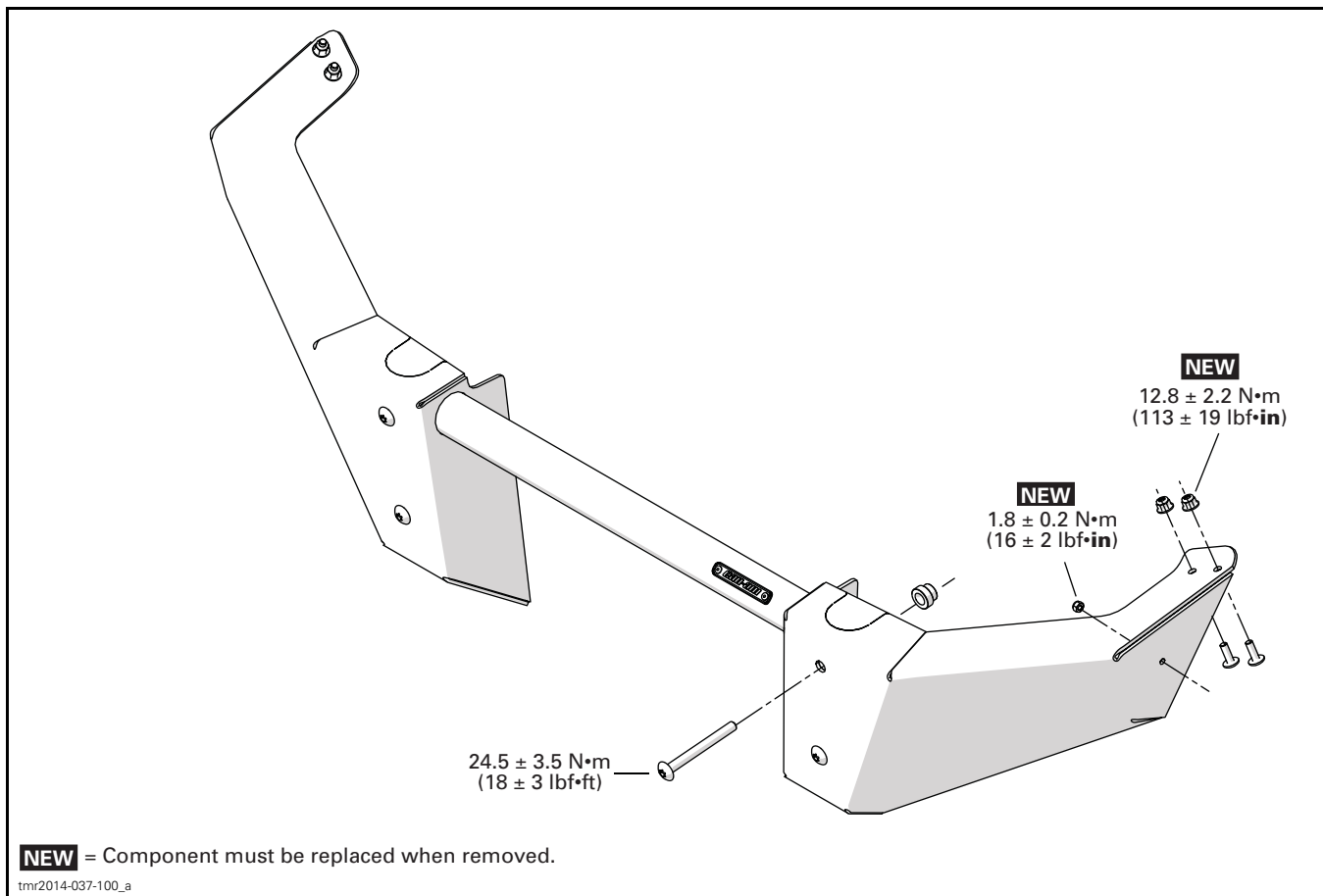
COCKPIT STRUCTURE PANELS – DRIVER SIDE (Torques and Service Products)



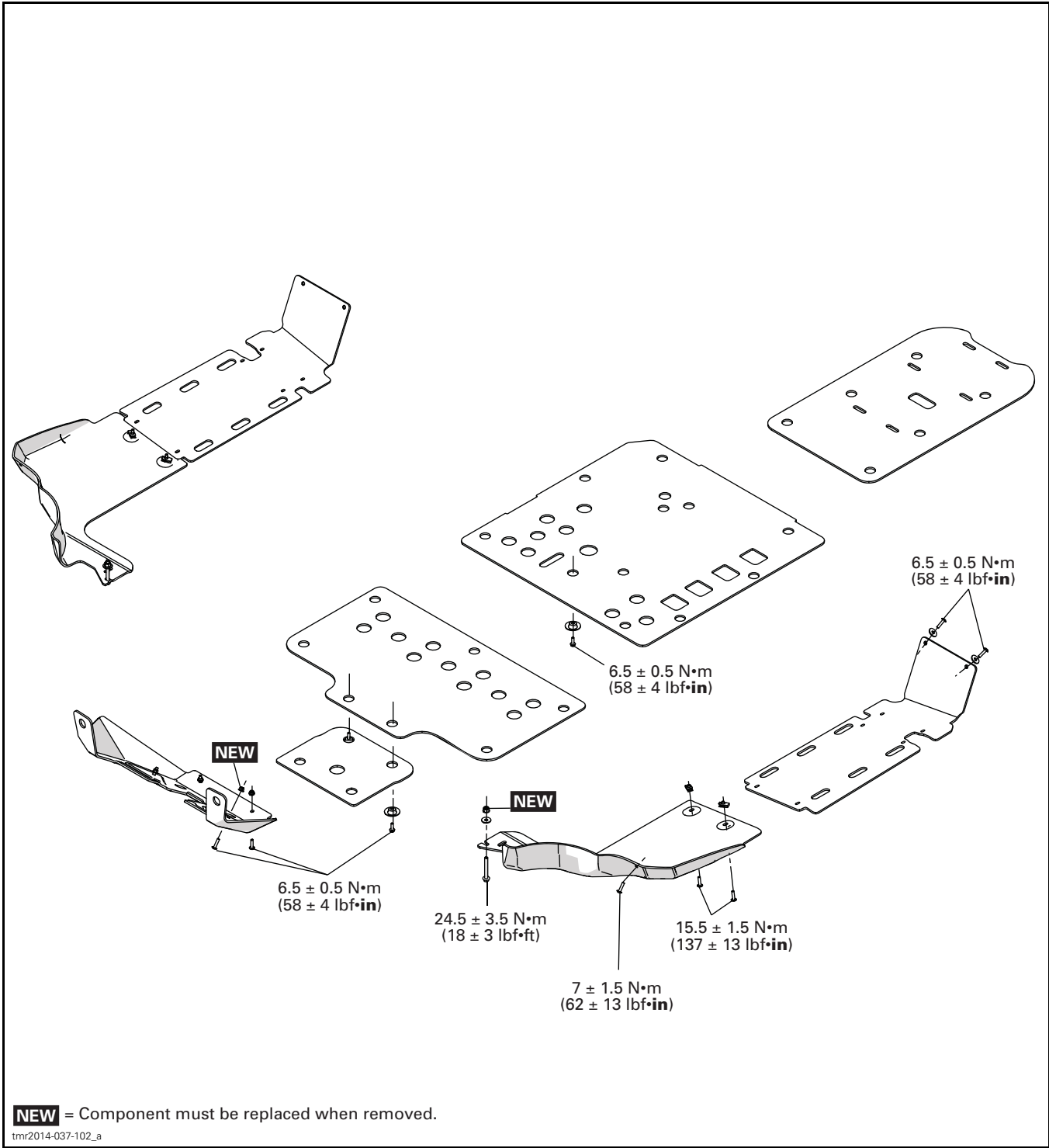
SEATS



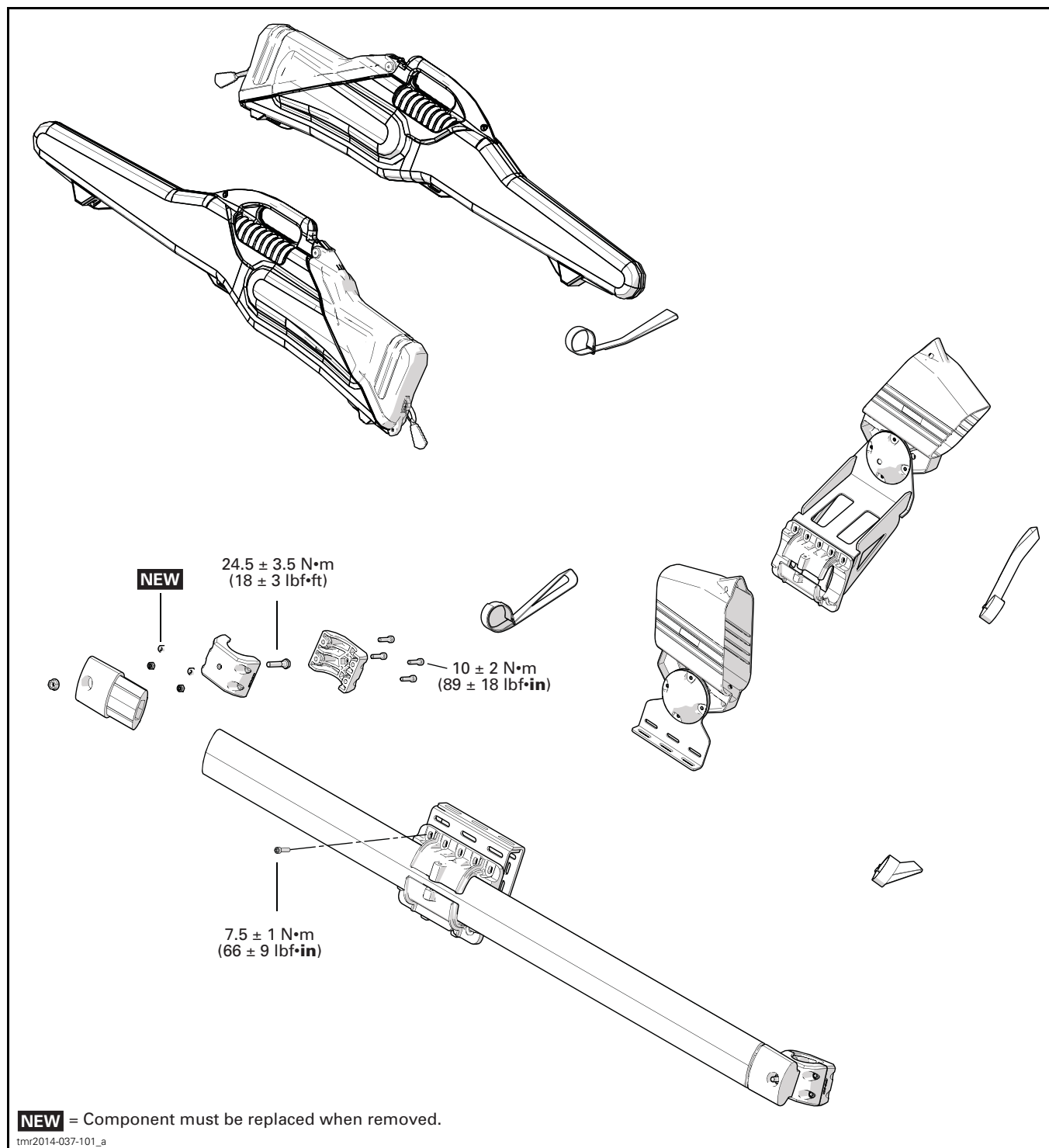
Hunting Edition - Front Bumper



Hunting Edition - Skid Plates



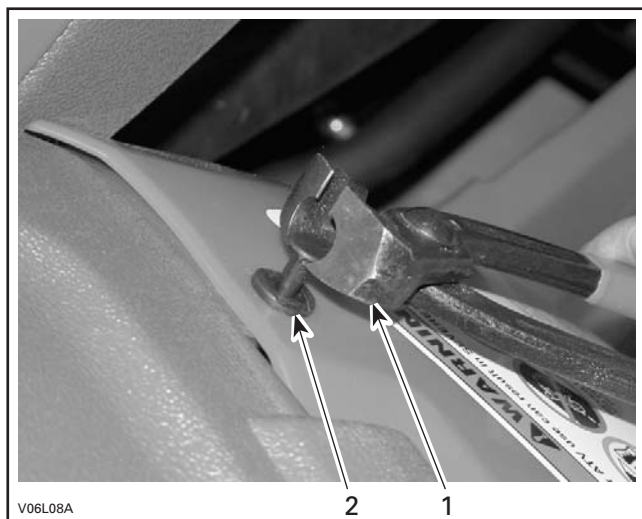
Hunting Edition - Gear Rail and Gun Boots



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 PLIER (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.

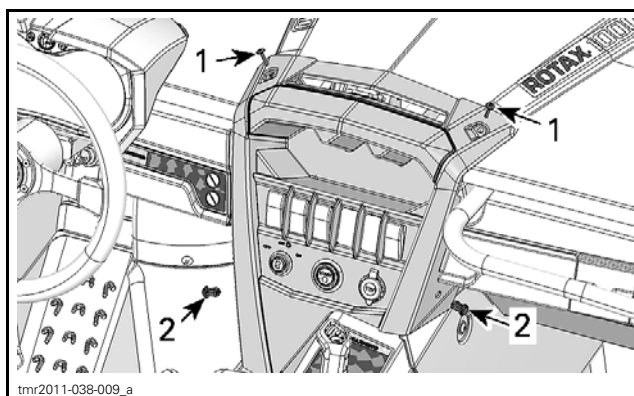
Apply liquid soap to new decal and carefully position it. Using a sponge or a squeegee, remove the air bubbles and surplus water working from the center toward the edges. Allow to air dry.

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

2. Pull out the upper console and disconnect electrical connectors.

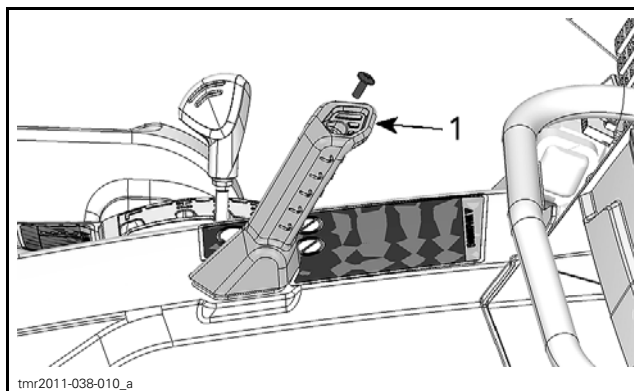
3. Remove the upper console.

The installation is the reverse of the removal procedure.

LOWER CONSOLE

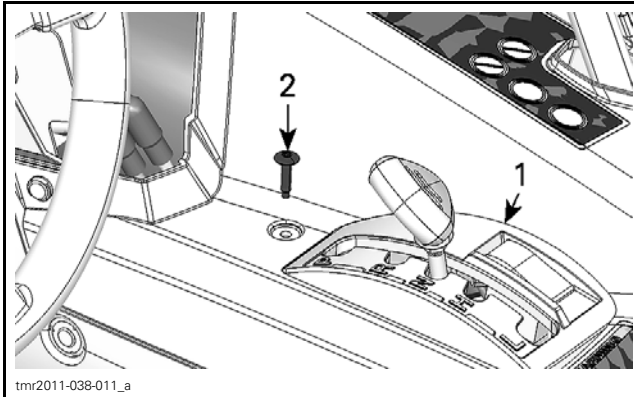
Lower Console Removal and Installation

1. Remove both seats.
2. Remove screws and plastic rivets securing the upper console and place it on the hood.
3. Remove the LH passenger handhold screw.



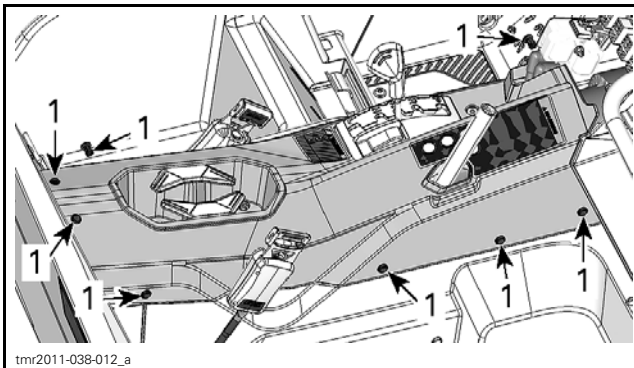
1. LH passenger handhold

4. Remove the front screw of the shift lever indicator.



1. Shift lever indicator
2. Front retaining screw

5. Remove all plastic rivets securing the lower console.



1. Plastic rivets

6. Remove the lower console.

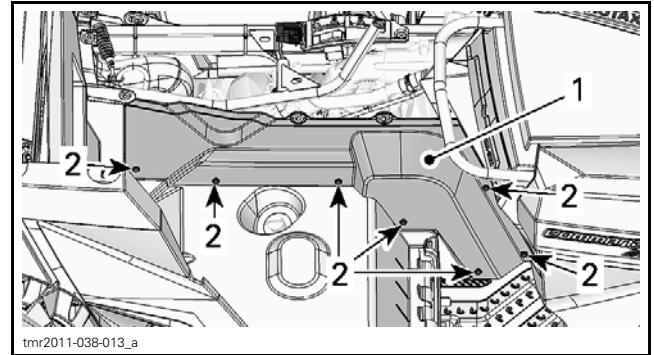
The installation is the reverse of the removal procedure.

LATERAL CONSOLE PANELS

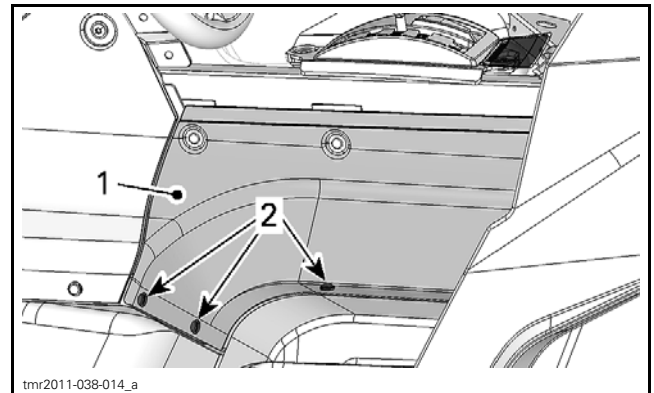
Lateral Console Panels Removal and Installation

1. Remove seat.
2. Remove plastic rivets securing the lateral console panel.
3. Remove the lateral console panel.

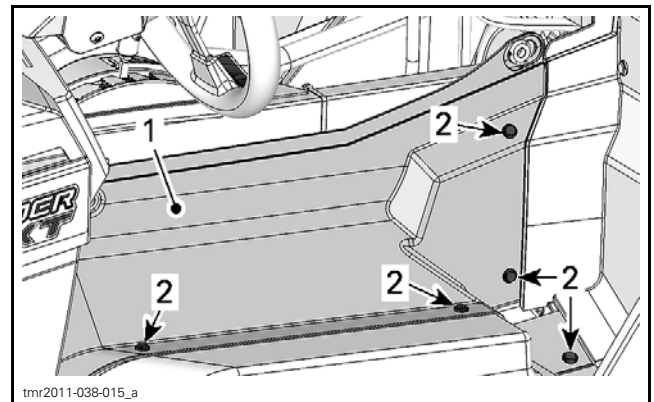
NOTE: On following illustrations, the cage and the side net are removed for clarity purpose.



1. RH lateral console panel
2. Plastic rivets



1. LH lateral console panel
2. Plastic rivets



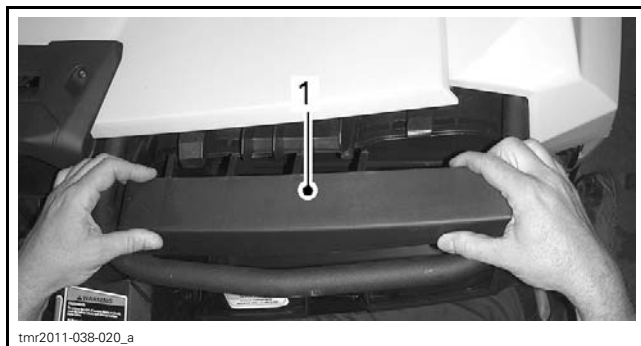
1. LH lateral console panel
2. Plastic rivets

The installation of the lateral console panels is the reverse of the removal procedure.

GLOVE BOX REMOVAL AND INSTALLATION

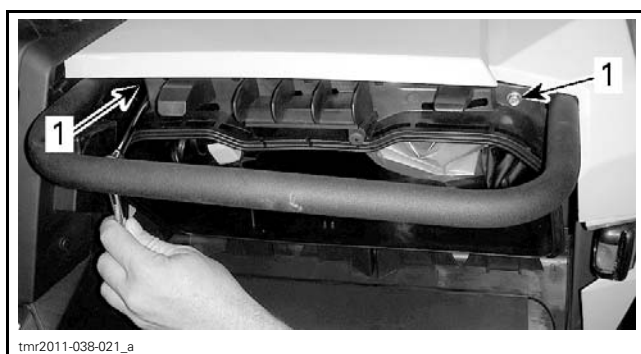
1. Remove the glove box trim.

Subsection XX (BODY (2-UP))



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.

FUEL TANK COWL

Fuel Tank Cowl Removal and Installation

Remove rivets securing fuel tank cowl.

Remove fuel tank cowl.

The installation of the fuel tank cowl is the reverse of the removal.

SEAT COVER

Seat Cover Removal

Remove plastic clips securing seat cover to seat.

Remove seat cover from seat.

Seat Cover Installation

Install seat cover onto seat.

Apply pressure to padded areas for a close fit.

Insert plastic clips to secure seat cover onto seat.

SEAT BELTS

Seat Belt Operation

All models except CE models are now equipped with a slide locking tab on the seat belt.



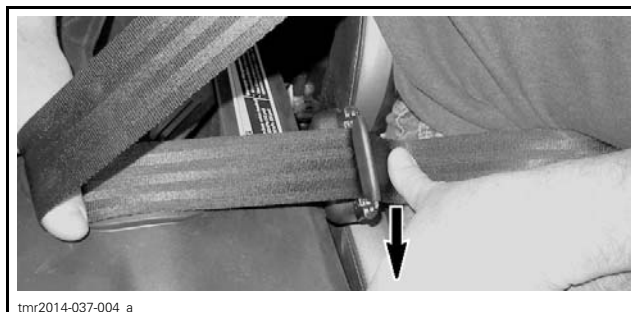
SEAT BELT ENGAGED

1. Slide locking tab

1. To lock: adjust the seat belt tightly against your body and raise or move the lap belt upward.



2. To unlock: place seat belt as shown and push down on the lap belt where indicated.



Seat Belt Cleaning

To clean dirt and debris from the seat belts, sponge the straps with mild soap and water. Do not use bleach, dye, or household detergents.

⚠ WARNING

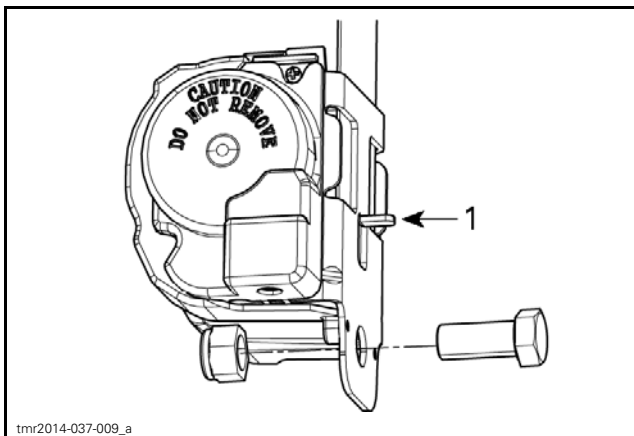
Do not use pressure washer to clean seat belt components. Use of pressure washer can permanently damage seat belt components.

Seat Belt Replacement

Follow standard torque specifications and pay attention to mounting hardware.

When installing seat belt retractor, the hardware must be assembled as illustrated below.

Align locating tab with hole in frame bracket.



SEAT BELT RETRACTOR

1. Locating tab

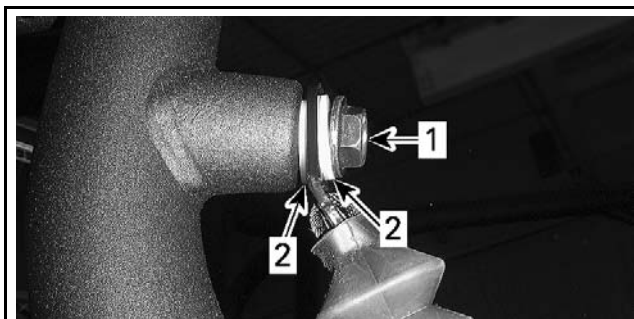
TIGHTENING TORQUE

7/16-20 x 1 hexagonal
flange bolt

60 N•m (44 lbf•ft)

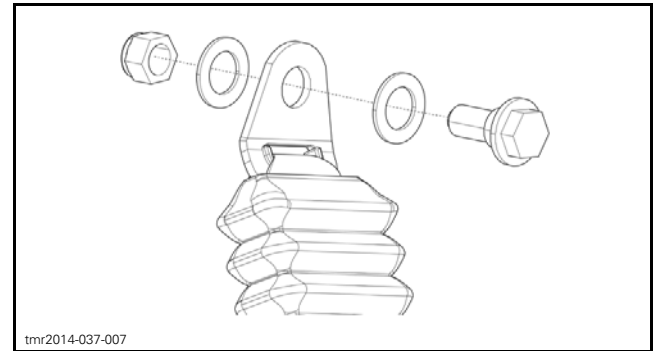
Except CE models.

NOTICE Make sure belt is not twisted.



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1. Shoulder bolt
2. Nylon flat washer



TIGHTENING TORQUE

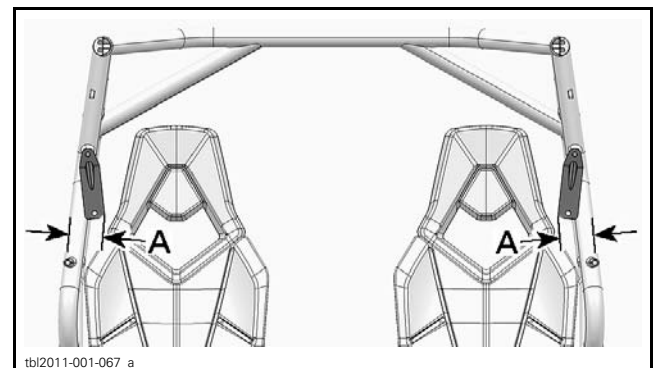
7/16-20 x 1
shoulder bolt

60 N•m (44 lbf•ft)

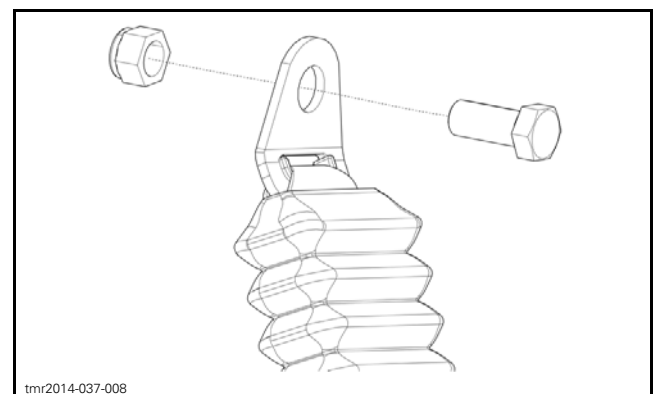
CE models.

NOTICE Make sure belt is not twisted.

Position seat belt bracket as per the following illustration. No nylon flat washers are necessary.



A. Approximately 90 mm (3-17/32 in)



TIGHTENING TORQUE

7/16-20 x 1 hexagonal
flange bolt

60 N•m (44 lbf•ft)

BRAKES

SERVICE TOOLS

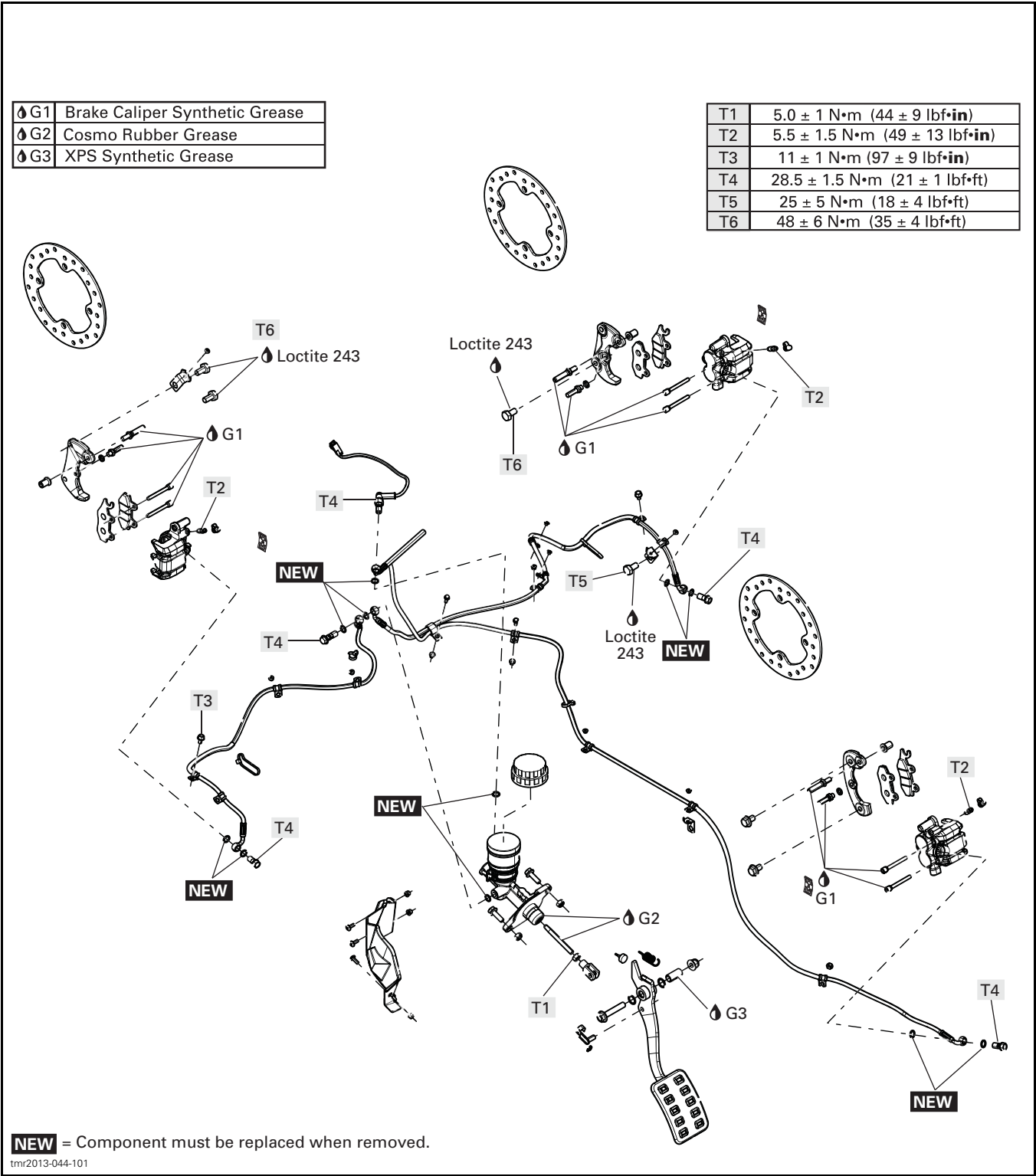
Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	6

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	9
XPS BRAKES AND PARTS CLEANER (USA)	219 701 705	9

Subsection XX (BRAKES)

2-UP Models

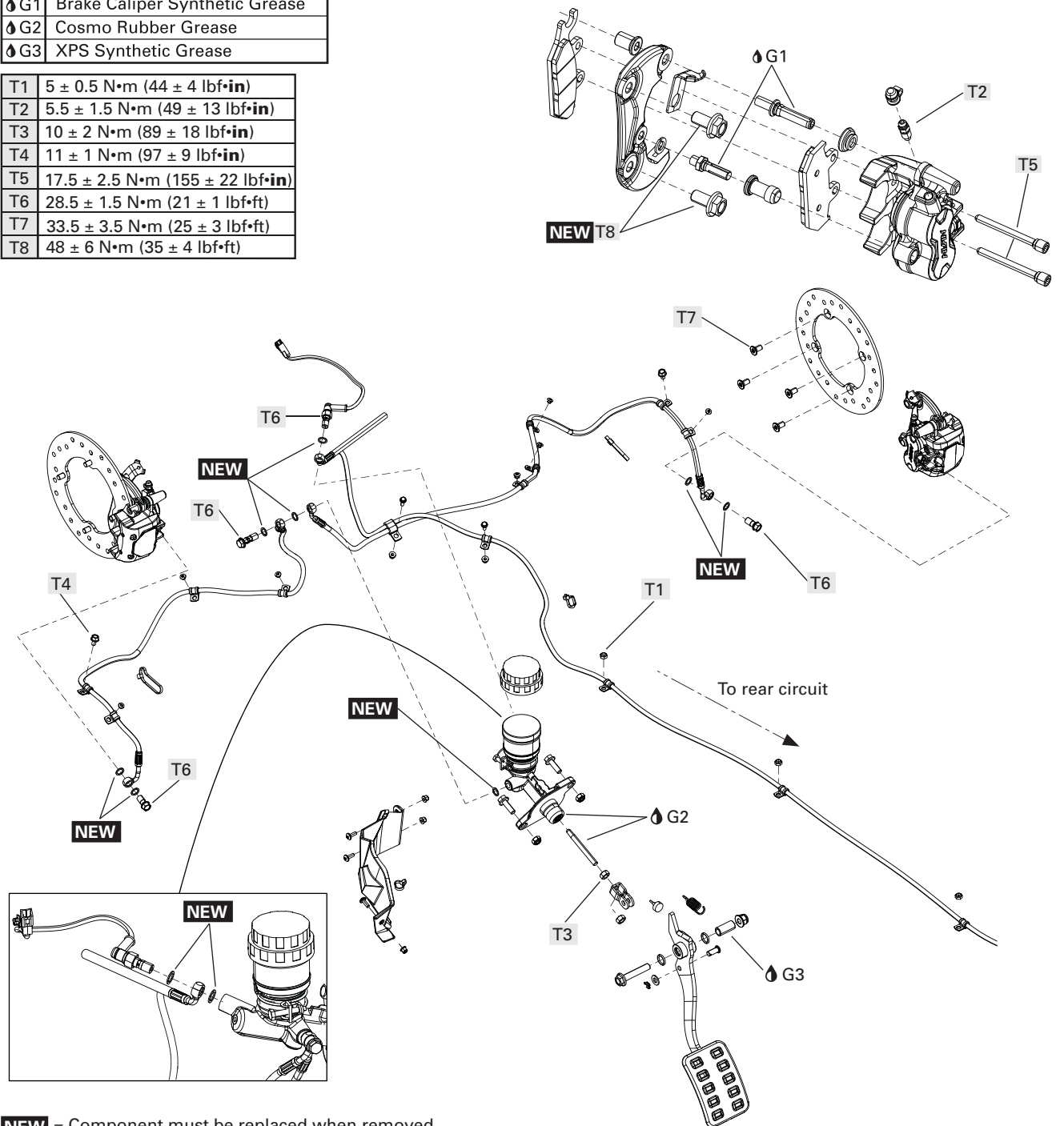


FRONT BRAKE SYSTEM

MAX Models

G1	Brake Caliper Synthetic Grease
G2	Cosmo Rubber Grease
G3	XPS Synthetic Grease

T1	$5 \pm 0.5 \text{ N}\cdot\text{m}$ ($44 \pm 4 \text{ lbf}\cdot\text{in}$)
T2	$5.5 \pm 1.5 \text{ N}\cdot\text{m}$ ($49 \pm 13 \text{ lbf}\cdot\text{in}$)
T3	$10 \pm 2 \text{ N}\cdot\text{m}$ ($89 \pm 18 \text{ lbf}\cdot\text{in}$)
T4	$11 \pm 1 \text{ N}\cdot\text{m}$ ($97 \pm 9 \text{ lbf}\cdot\text{in}$)
T5	$17.5 \pm 2.5 \text{ N}\cdot\text{m}$ ($155 \pm 22 \text{ lbf}\cdot\text{in}$)
T6	$28.5 \pm 1.5 \text{ N}\cdot\text{m}$ ($21 \pm 1 \text{ lbf}\cdot\text{ft}$)
T7	$33.5 \pm 3.5 \text{ N}\cdot\text{m}$ ($25 \pm 3 \text{ lbf}\cdot\text{ft}$)
T8	$48 \pm 6 \text{ N}\cdot\text{m}$ ($35 \pm 4 \text{ lbf}\cdot\text{ft}$)



NEW = Component must be replaced when removed.

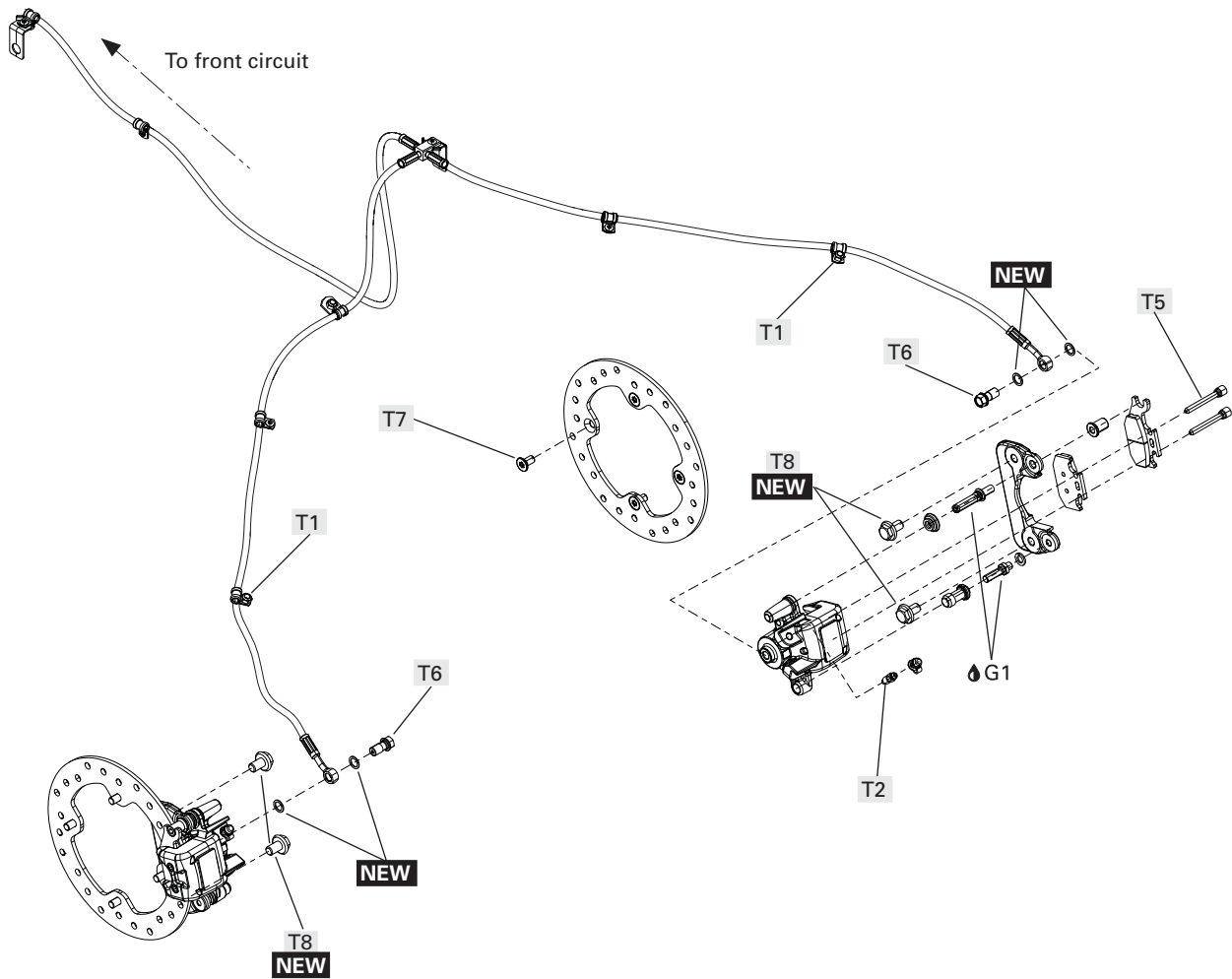
tmr2014-316-102_a

REAR BRAKE SYSTEM

MAX Models

⚡ G1	Brake Caliper Synthetic Grease
⚡ G2	Cosmo Rubber Grease
⚡ G3	XPS Synthetic Grease

T1	$5 \pm 0.5 \text{ N}\cdot\text{m}$ ($44 \pm 4 \text{ lbf}\cdot\text{in}$)
T2	$5.5 \pm 1.5 \text{ N}\cdot\text{m}$ ($49 \pm 13 \text{ lbf}\cdot\text{in}$)
T3	$10 \pm 2 \text{ N}\cdot\text{m}$ ($89 \pm 18 \text{ lbf}\cdot\text{in}$)
T4	$11 \pm 1 \text{ N}\cdot\text{m}$ ($97 \pm 9 \text{ lbf}\cdot\text{in}$)
T5	$17.5 \pm 2.5 \text{ N}\cdot\text{m}$ ($155 \pm 22 \text{ lbf}\cdot\text{in}$)
T6	$28.5 \pm 1.5 \text{ N}\cdot\text{m}$ ($21 \pm 1 \text{ lbf}\cdot\text{ft}$)
T7	$33.5 \pm 3.5 \text{ N}\cdot\text{m}$ ($25 \pm 3 \text{ lbf}\cdot\text{ft}$)
T8	$48 \pm 6 \text{ N}\cdot\text{m}$ ($35 \pm 4 \text{ lbf}\cdot\text{ft}$)



NEW = Component must be replaced when removed.

GENERAL

⚠ WARNING

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.

NOTE: Sealing washers must be discarded and replaced with new ones every time a Banjo fitting is unscrewed.

NOTE: Always clean the area around a brake component before servicing.

INSPECTION

BRAKE SYSTEM PRESSURE
VALIDATION

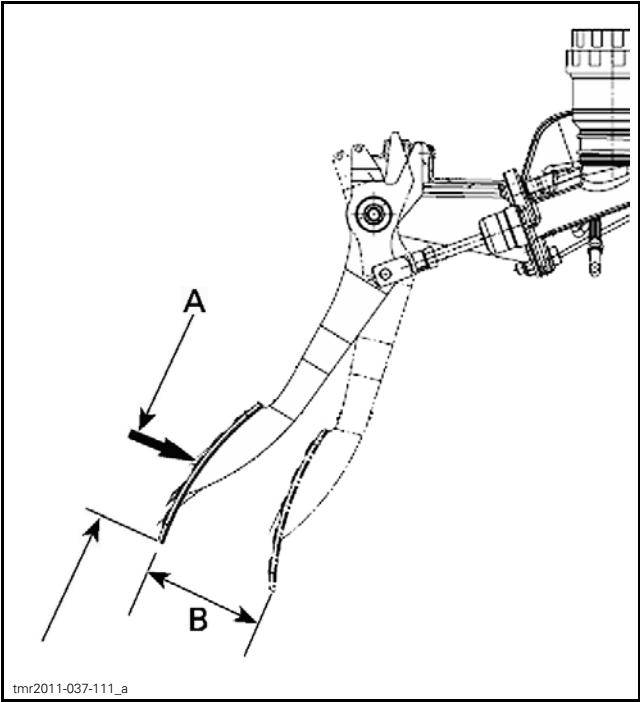
NOTICE Do not pump up the brake pedal repeatedly before doing the validation.

- 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 mm ± 5 mm (2.5 in ± .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.



TYPICAL

- 5. Read the maximum 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)

- 7. If load reading is not in accordance with the specification:
 - 7.1 Perform a brake system inspection and cleaning.
 - 7.2 Bleed brake system.

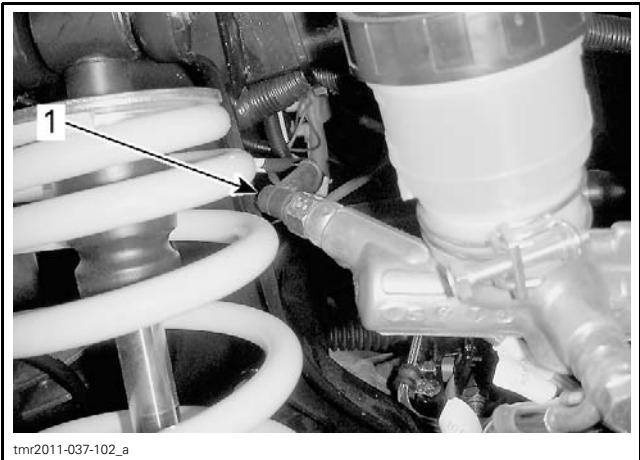
NOTE: Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

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	PIN		RESISTANCE
Firmly pushed	1	2	Close to 0 Ω
Released			Infinite (OL)

If switch is defective, replace with a new one.
If the switch tests good, verify wire continuity between harness connector and ECM-B connector.
NOTE: Use the ECM ADAPTER TOOL (P/N 529 036 166).



ECM-B CONNECTOR PIN	HARNESS CONNECTOR WIRES	RESISTANCE
C-3	RED/ORANGE	Close to 0 Ω

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.

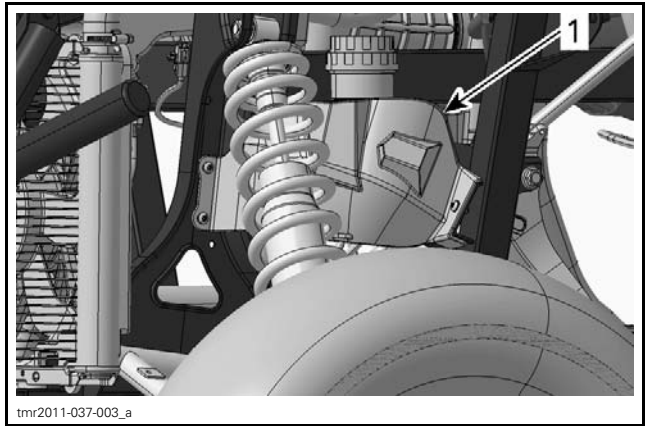
BRAKE LIGHT SWITCH NUT TORQUE
28.5 N•m ± 1.5 N•m (21 lbf•ft ± 1 lbf•ft)

- 6. Connect brake light switch connector.
- 7. Refill and bleed brake system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

MASTER CYLINDER

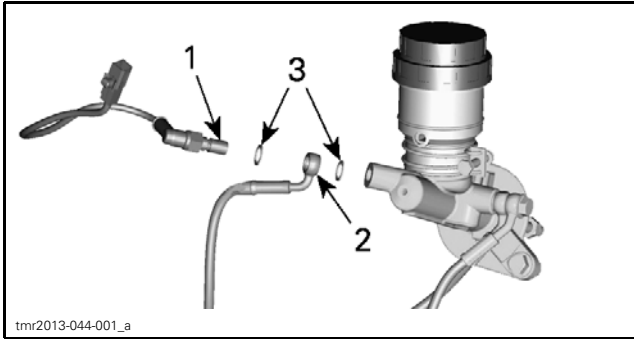
Master Cylinder Removal

- 1. Drain brake system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
- 2. Remove master cylinder protective cover.



1. Master cylinder protective cover

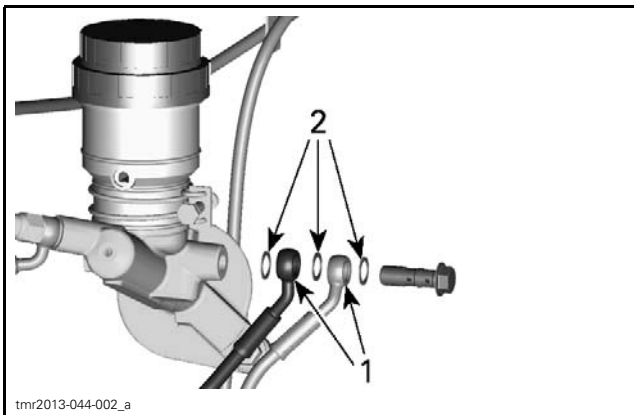
- 3. Remove brake light switch retaining rear brake hose.



SOME PARTS REMOVED FOR CLARITY PURPOSE

1. Brake light switch
2. Rear brake hose
3. Sealing washers

4. Unscrew front brake hoses from master cylinder.



SOME PARTS REMOVED FOR CLARITY PURPOSE

1. Front brake hoses
2. Sealing washers

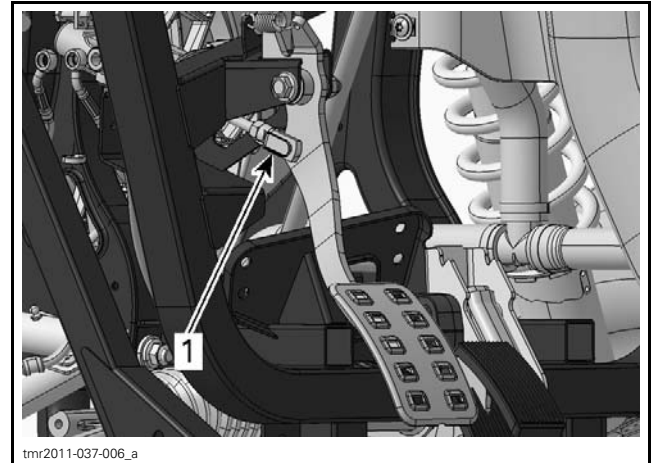
5. Remove protective rubber from underneath dashboard.



UNDERNEATH DASHBOARD

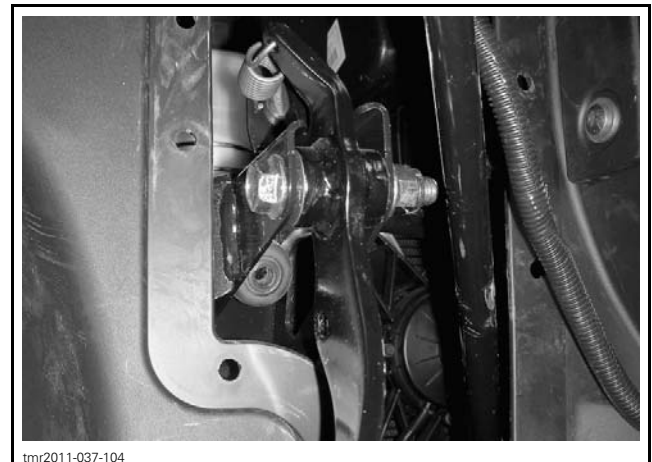
1. Protective rubber

6. Remove cotter pin.
7. Disconnect brake pedal clip.
8. Disconnect master cylinder rod from brake pedal.



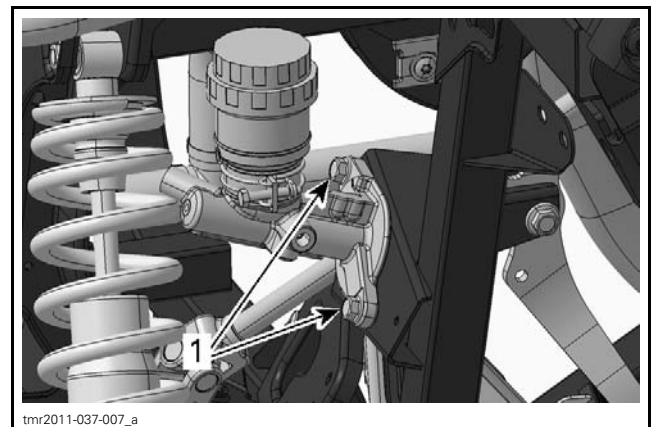
1. Master cylinder rod

9. Remove master cylinder rod from master cylinder.



MASTER CYLINDER ROD REMOVED

10. Remove master cylinder retaining bolts and nuts.



1. Master cylinder retaining bolts

11. Remove master cylinder from vehicle.

Master Cylinder Inspection

Check boot for crack.

Subsection XX (BRAKES)

Check rod for wear and scratch.
Check master cylinder housing and reservoir for leaks 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
28.5 N•m ± 1.5 N•m (21 lbf•ft ± 1 lbf•ft)

Lubricate push rod end and inside master cylinder boot.

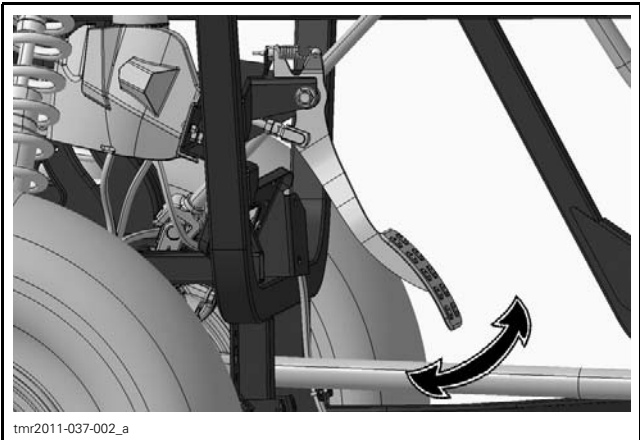
PUSH ROD END LUBRICATION
(P/N 293 550 055)

MASTER CYLINDER BOOT LUBRICATION
(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)

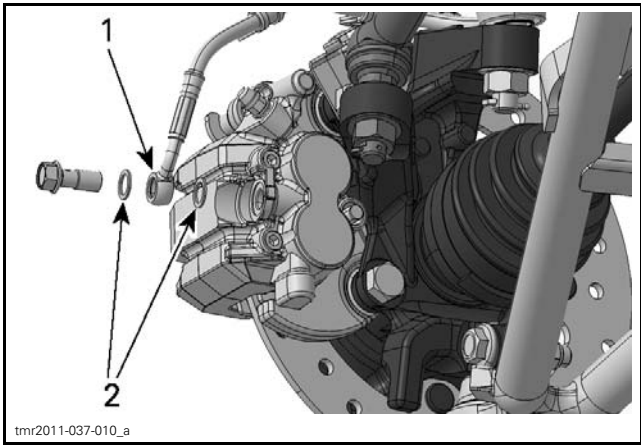
- 4. Tighten locking nut of master cylinder rod to specification.

ROD LOCKING NUT TORQUE
5 N•m ± 1 N•m (44 lbf•in ± 9 lbf•in)

CALIPER

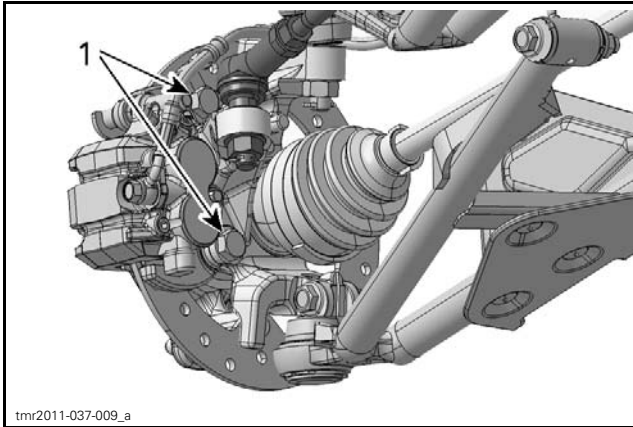
Caliper Removal

- 1. Safely lift and support the vehicle. Refer to *INTRODUCTION* 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.



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TYPICAL - FRONT CALIPER SHOWN

1. Caliper screws

6. Place caliper assembly onto a support.

NOTICE Do not let caliper hang 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 *PERIODIC 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.

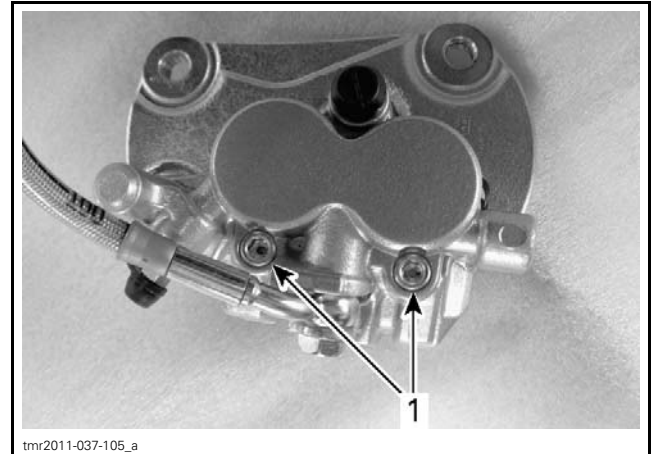
CALIPER RETAINING SCREWS TORQUE

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.



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1. Brake pad pins

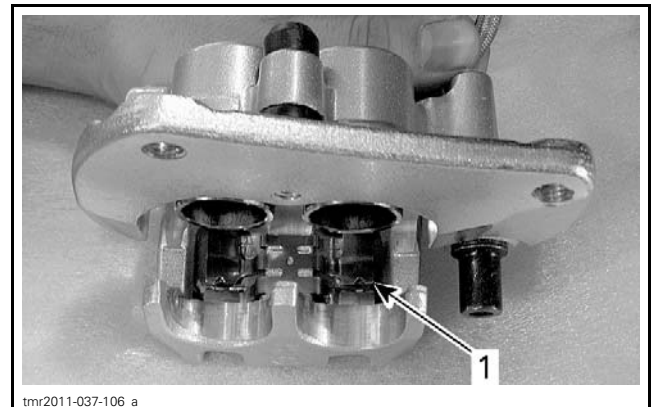
3. Remove brake pads.

4. Clean pistons end using XPS BRAKES AND PARTS CLEANER (USA) (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.



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1. Brake pad spring

7. Install **NEW** brake pads.

8. Clean brake pad pins using XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705).

9. Install brake pad pins on caliper and torque to specification.

BRAKE PAD PINS

17.5 N•m ± 2.5 N•m (155 lbf•in ± 22 lbf•in)

10. Install caliper on knuckle, refer to *CALIPER INSTALLATION* 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 mm (.157 in)
REAR	4 mm (.157 in)

NOTICE Brake discs must never be machined.

- 3. Check warpage of the disc.

MAXIMUM DISC WARPAGE	
FRONT	0.2 mm (.01 in)
REAR	

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. Align wheel stud knurling into hub grooves.
 - 6. Install wheel studs using a press.
- NOTE:** If wheel studs are damaged, replace them.
- 7. Install wheel hub then caliper.
 - 8. Install **NEW** cotter pin to secure wheel hub nut.

CHARGING SYSTEM

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	3

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	4

GENERAL

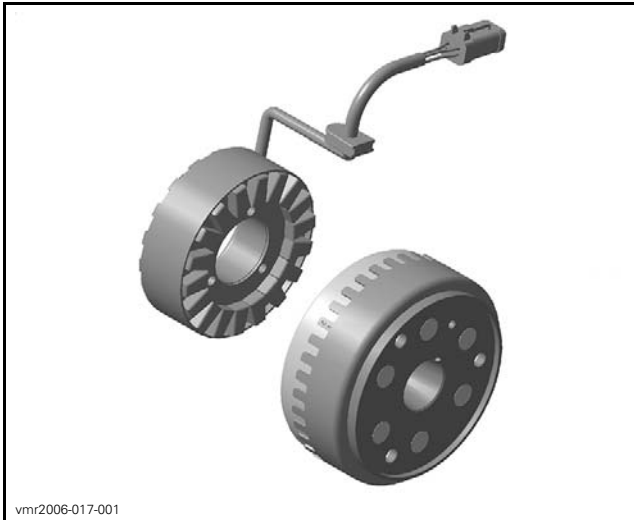
SYSTEM DESCRIPTION

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.



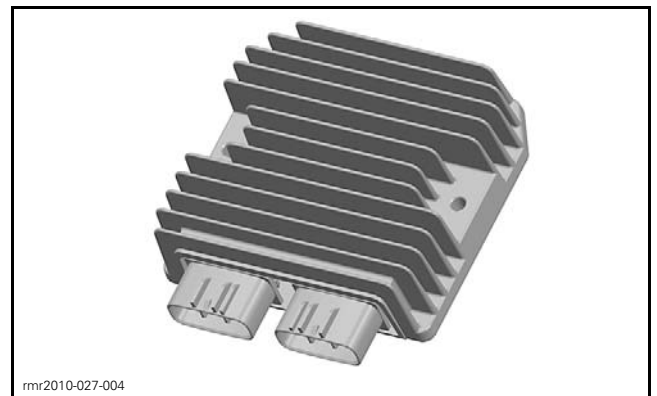
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TYPICAL

Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage to prevent any damage to electrical components.



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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.

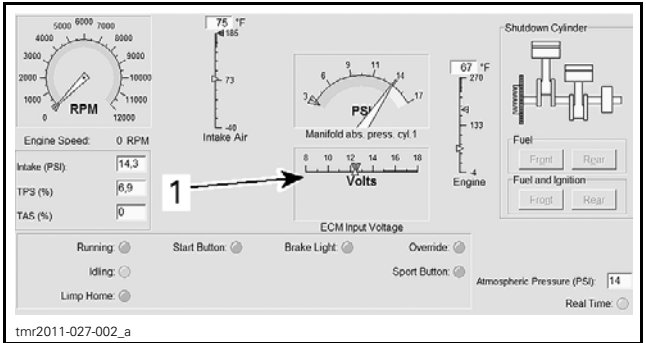
Output Voltage Test Using B.U.D.S.

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.

Subsection XX (CHARGING SYSTEM)

4. Increase engine RPM as specified in the following table and read voltage in the ECM Input Voltage box.

OUTPUT VOLTAGE TEST USING B.U.D.S.	
ENGINE SPEED	VOLTAGE (DC)
4000 RPM	14.8 ± .4 Vdc



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.
- 4. Increase engine RPM as specified in the following table and read voltage with the multimeter.

OUTPUT VOLTAGE TEST USING A MULTIMETER	
TEST ENGINE SPEED	VOLTAGE (DC)
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 *MAGNETO 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.
- 2. 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

2-UP Models

The voltage regulator/rectifier is located on the LH side, underneath dashboard, on the RH side of the battery rack.

MAX Models

The voltage regulator/rectifier is located on the RH side of vehicle, underneath rear passenger seat, on the LH 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 Location

2-UP Models

The battery is located on the LH side, underneath dashboard.

MAX Models

The battery is located on the RH side of vehicle, underneath rear passenger seat.

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.

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

MAX Models

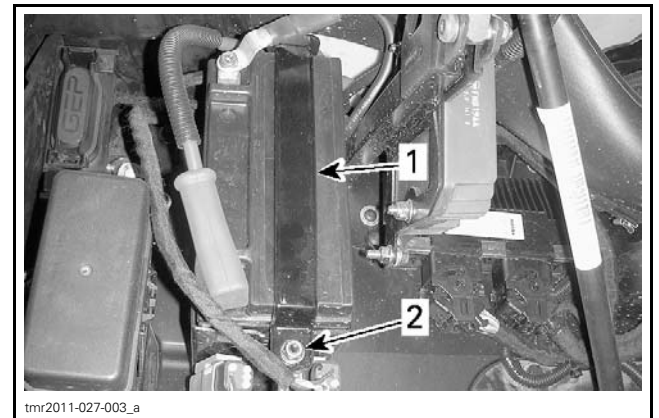
1. Remove RH side rear passenger seat.
2. Remove battery cover.

All Models

3. Disconnect BLACK (-) cable first, then the RED (+) cable.

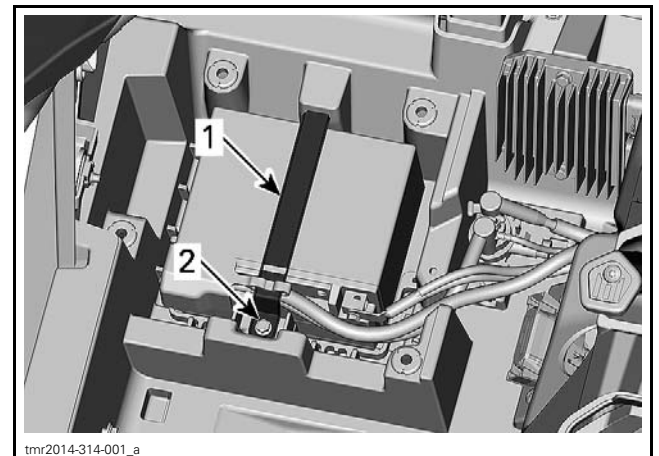
NOTICE Always respect this order for removal; disconnect BLACK (-) cable first.

4. Remove battery strap retaining nut.



2-UP MODELS

1. Battery strap
2. Battery strap retaining nut



MAX MODELS

1. Battery strap
2. Battery strap retaining nut

5. Unhook the top of battery strap.
6. Remove battery.

Subsection XX (CHARGING SYSTEM)

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.

 **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.

Installation is the reverse of removal procedure, however pay attention to the following:

- For 2-UP models, install the battery with the positive post down.
- For MAX models, install the battery with the positive post towards RH side and front of vehicle
- 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)

COMMUNICATION TOOLS AND B.U.D.S.

SERVICE TOOLS

Description	Part Number	Page
DIAGNOSTIC CABLE	710 000 851	1, 3
MPI-2 INTERFACE CARD	529 036 018	1
MPI-3 INTERFACE CARD	529 036 353	1

GENERAL

Refer to *PROCEDURES* for instructions on the communication tools.

If communication problems occur, refer to *TROUBLESHOOTING* in this subsection.

REQUIRED TOOLS

MANDATORY TOOLS	
A personal computer (laptop or desktop)	
MPI-2 INTERFACE CARD (P/N 529 036 018)	
OR	
MPI-3 INTERFACE CARD (P/N 529 036 353)	
DIAGNOSTIC CABLE (P/N 710 000 851)	
OPTIONAL TOOL	
Extension cable available at electronic retail outlets. Do not exceed 7.5 m (25 ft)	

TROUBLESHOOTING

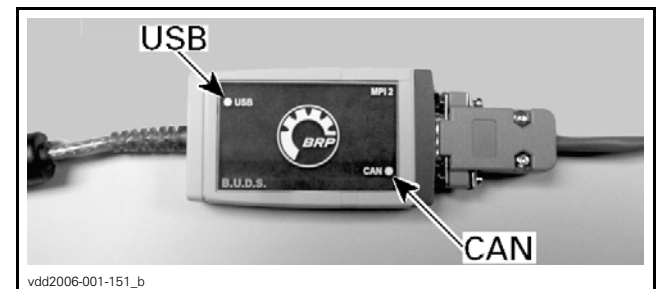
DIAGNOSTIC TIPS

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 the BRP Utility and Diagnostic Software (B.U.D.S.).

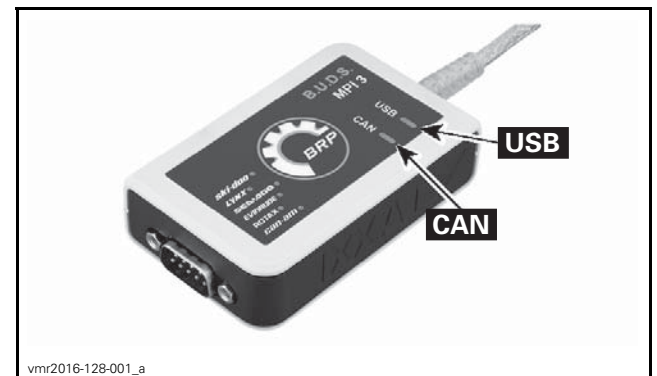
Multi-Purpose Interface Card Connection Troubleshooting

MPI Status Lights

The MPI card includes 2 status lights that indicate the connection condition: USB and CAN. Both lights must be GREEN to function properly. Otherwise, refer to the following charts.



MPI-2 CARD



MPI-3 CARD

Prerequisite for USB Communication:

- PC Computer turned on.
- MPI card connected to PC computer.

Subsection XX (COMMUNICATION TOOLS AND B.U.D.S.)

USB LIGHT	
STATUS	WHAT TO DO
Light is OFF	Check USB connection between MPI card and PC computer. Check USB operation on PC computer (hardware or USB drivers)
Light is GREEN	Connections are GOOD. Communication can take place on USB side

Prerequisite for CAN Communication:

- MPI card connected to diagnostic connector on vehicle.
- Ignition key installed and turned to ON (electrical system powered up without engine started).
- B.U.D.S. started and logged on.

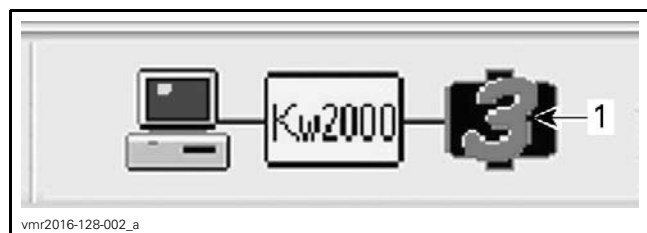
CAN LIGHT	
STATUS	WHAT TO DO
Light is OFF	Check connection between MPI card and diagnostic connector on vehicle
Light is RED	Check CAN wires/connectors on vehicle
Light is GREEN	Connections are GOOD. Communication can take place on CAN side

Communication Problems when Using B.U.D.S.

Missing Module

Ensure the appropriate number of modules is shown at the bottom of B.U.D.S. screen.

MODEL	NUMBER OF MODULES
Models without DPS	2 (ECM and multifunction gauge)
Models with DPS	3 (ECM, DPS and multifunction gauge)



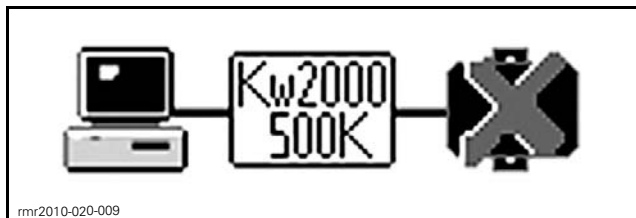
TYPICAL

1. Number of modules

If one or more "ECU" is not communicating with the MPI card, refer to *DIAGNOSTIC AND FAULT CODES*.

No Vehicle is Detected

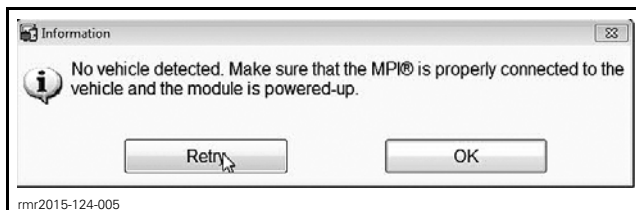
If an "X" is shown in the status bar and the protocol indication is blinking between Kw2000 500K and KW2000, it means that no "ECU" is communicating with the MPI card.



Check the following:

- Connections between the PC computer and the vehicle.
- The multifunction gauge is powered up.

If B.U.D.S. does not automatically exit the following message box, click the Retry button. This will manually establish the communication with the vehicle.



PROCEDURES

MULTI-PURPOSE INTERFACE CARD (MPI-2 OR MPI-3)

The MPI (Multi-Purpose Interface) in conjunction with the diagnostic cable is used with B.U.D.S. to communicate with the ECM (engine control module) and other modules.

MPI Card Power

The MPI card uses the power from the PC computer's USB port.

Diagnostic Connector Location

The 6-pin diagnostic connector is located under the hood, stored in its protective cap.



1. Diagnostic connector

Connecting the PC to the Vehicle

⚠ WARNING

If the computer you are using is connected to the 110 Vac power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the VCK.

1. Locate the 6-pin diagnostic connector, refer to *DIAGNOSTIC CONNECTOR LOCATION* in this subsection.
2. Disconnect the 6-pin diagnostic connector from it's holder (protective cap).
3. Connect one end of the DIAGNOSTIC CABLE (P/N 710 000 851) to the vehicle connector.



DIAGNOSTIC CABLE CONNECTED TO VEHICLE

4. Connect the other end of diagnostic cable to the MPI card.
5. Connect the MPI card to the USB port of a PC (personal computer).



MPI CARD CABLE CONNECTED TO USB PORT

6. Use B.U.D.S. as described further in *B.U.D.S. SOFTWARE* topic

B.U.D.S. SOFTWARE

B.U.D.S. is designed for:

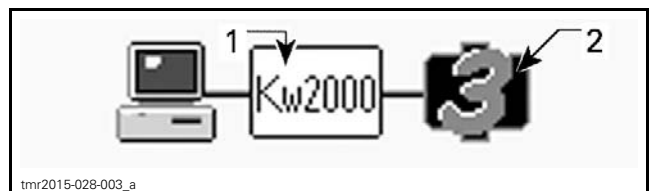
- Programming ignition key(s) to the vehicle
- Monitoring some electrical and electronic components
- Activating certain components for diagnostic purposes
- Updating electronic module software
- And, to carry out setting changes.

Always use the latest applicable B.U.D.S. version available on Knowledge Center.

Reading the Electronic Control Units 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 *CONNECTING THE PC TO THE VEHICLE* in this subsection.

1. Turn ignition switch to ON position (ACC will not work). Do not start the engine.
2. Start B.U.D.S. and logon.
3. Ensure the status bar shows the appropriate 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 read

Subsection XX (COMMUNICATION TOOLS AND B.U.D.S.)

MODEL	NUMBER OF MODULES
Models without DPS	2 (ECM and multifunction gauge)
Models with DPS	3 (ECM, DPS and multifunction gauge)

If the number is less than indicated in *NUMBER OF MODULES* table, refer to *TROUBLESHOOTING* in this subsection.

4. Read the ECUs by clicking the Read Data button.



B.U.D.S. is now ready to use.

Updating Electronic Module (ECU) Software

NOTICE Vehicle voltage should be stable during the update process (no disconnection on the MPI, battery or key to OFF) to make sure updates are processed properly

NOTICE Failure to strictly follow a procedure to update a module may permanently damage the module.

Whenever B.U.D.S. is first connected to a vehicle, check for an update icon in the status bar at the bottom of the Vehicle page.

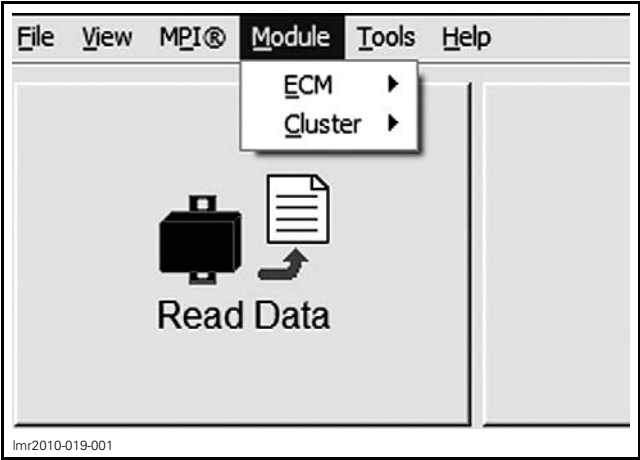


TYPICAL

If the update icon is visible, B.U.D.S. indicates that a file is available to update at least one of the electronic modules:

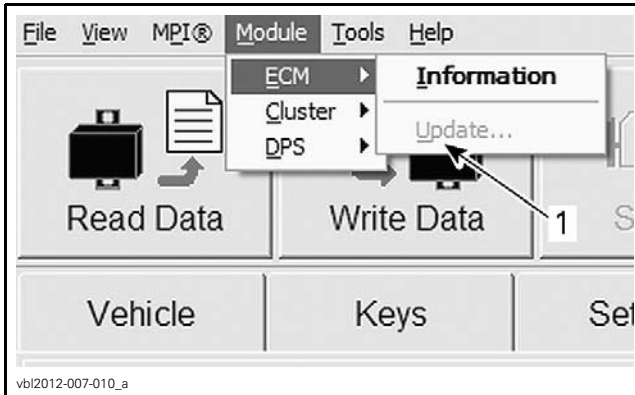
NOTE: If an update file is available on *KNOWLEDGE CENTER* but the B.U.D.S. software being used is not up to date, the update icon will not appear. Refer to the *SERVICE BULLETINS* to see if there is an update available.

Use the Module submenu and check all modules one at a time to see which module(s) can be updated.



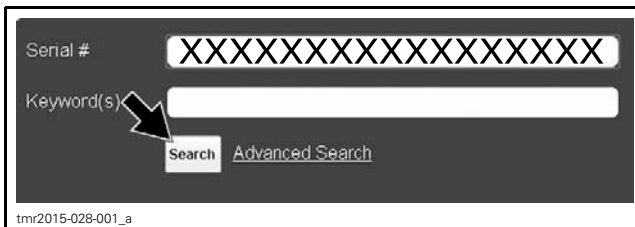
TYPICAL - MODULE SUBMENU LIST

1. If the Update option is greyed out, no update file is available for this module.
2. If the Update option is black, an update file is available for this module.



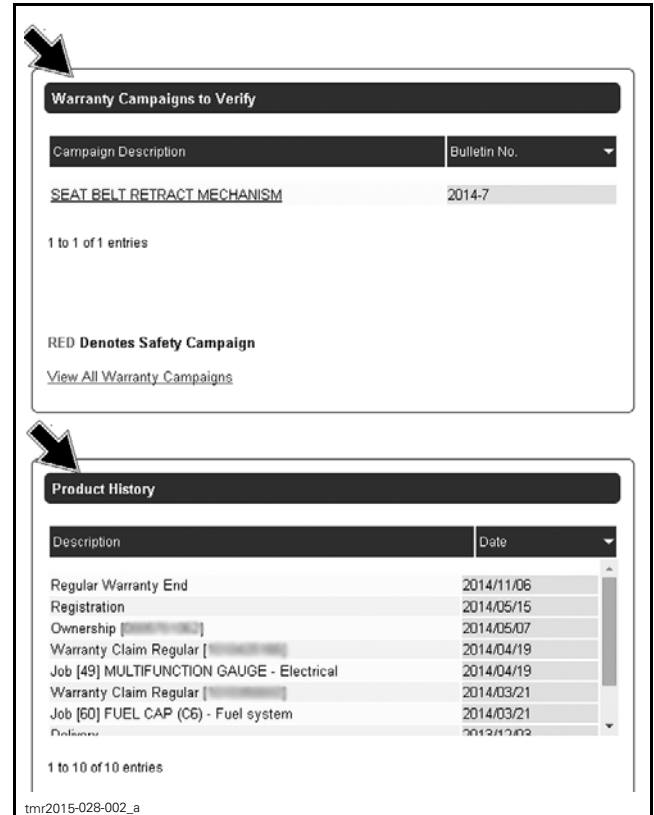
1. Greyed out: No update to perform
Black: Update file available

Before applying an update, log onto *KNOWLEDGE CENTER* and search the vehicle's VIN to find the unit's history.

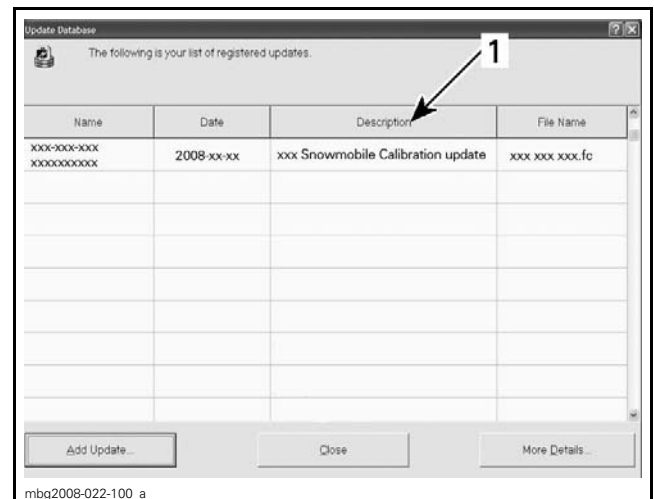


Complete all *WARRANTY CAMPAIGNS TO VERIFY*.

NOTE: *PRODUCT HISTORY* will show all repairs performed and claimed under warranty.



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 on *KNOWLEDGE CENTER*.

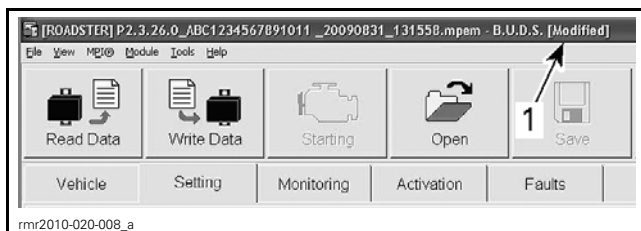


TYPICAL
1. File description

Saving Changes to an ECU

If the word Modified appears at the end of the vehicle file name at the top of the B.U.D.S. page, then a change has been made that requires it to be saved to the proper electronic module.

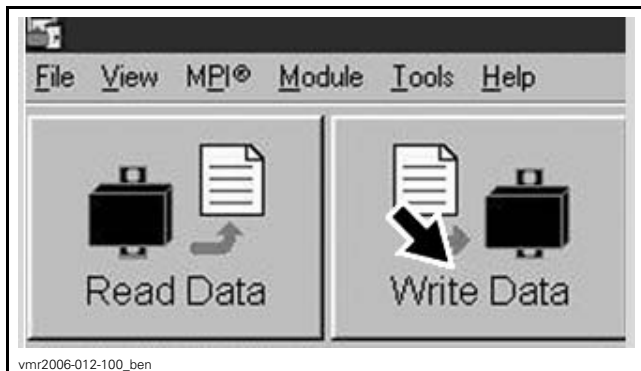
Subsection XX (COMMUNICATION TOOLS AND B.U.D.S.)



TYPICAL

1. Indicate setting or data modified; Write Data to save

Click the Write Data button.



NOTE: A message box will confirm a successful operation.

In such a case, turn ignition switch OFF, then wait for the message to disappear before disconnecting the MPI.

Disconnect MPI card and store the vehicle diagnostic connector in its protective cap.

NOTICE Failure to secure the diagnostic connector in its protective cap may result in corrosion or other damage to the terminals.

CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

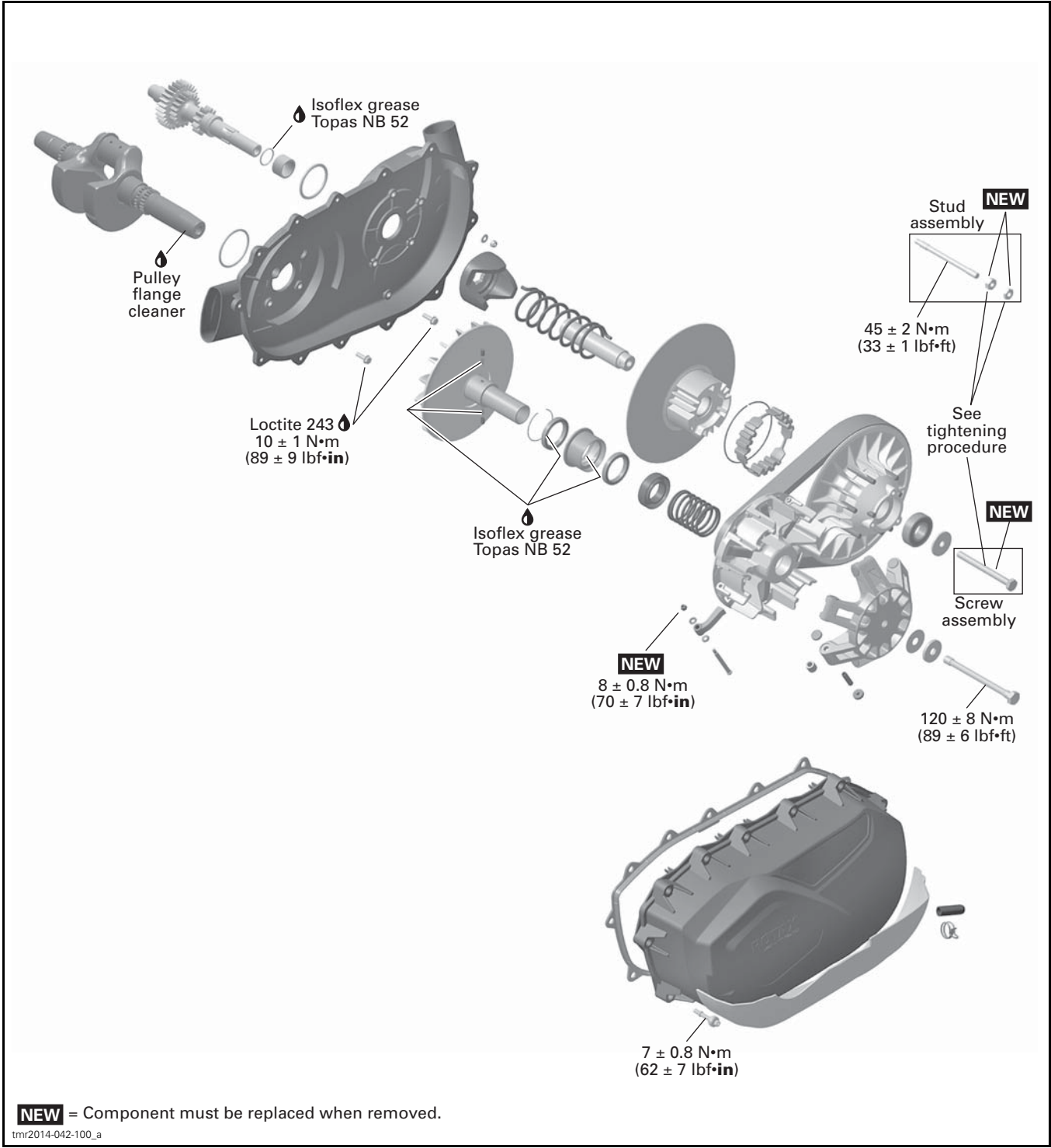
SERVICE TOOLS

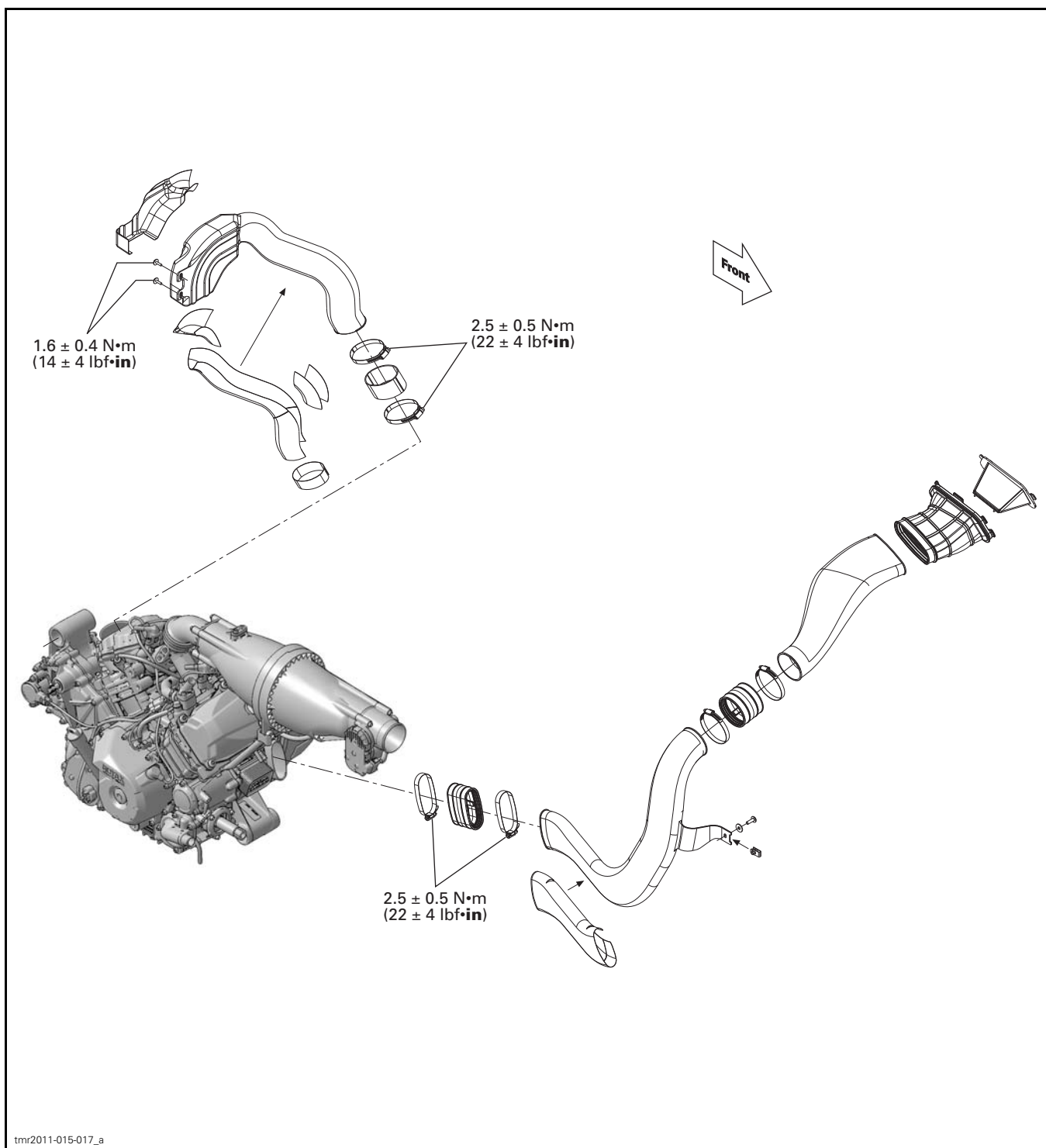
Description	Part Number	Page
CLUTCH HOLDER.....	529 036 238	6, 13, 21, 24
CLUTCH PULLER	529 035 746	6
COUNTERSHAFT RETAINER TOOL.....	529 036 312	15, 23
DRIVEN PULLEY STUD TOOL	529 036 360	15, 22
PULLER/LOCKING TOOL.....	529 036 098	5, 24

SERVICE PRODUCTS

Description	Part Number	Page
ISOFLEX GREASE TOPAS NB 52	293 550 021	11–12
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	23
PULLEY FLANGE CLEANER	413 711 809	8
XPS BRAKES AND PARTS CLEANER (USA)	219 701 705	16
XPS BRAKES AND PARTS CLEANER	219 701 776	16

Subsection XX (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.

⚠ 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.

⚠ WARNING

The clutch assembly is a precisely balanced unit. Never replace parts with used parts from another clutch assembly.

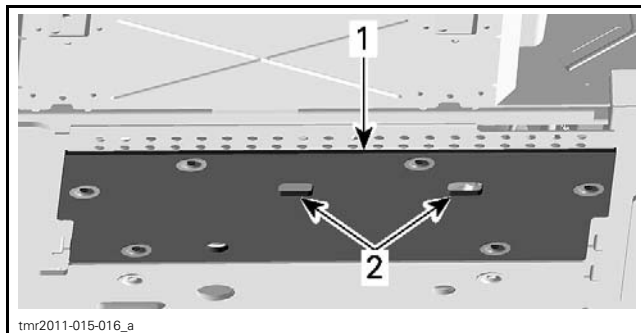
PROCEDURES

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.

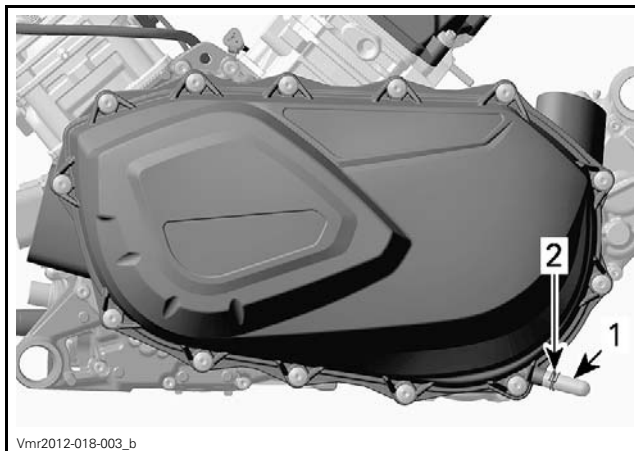


1. Central skid plate
2. Access holes

CVT Cover Draining

If water is present in CVT cover, it can be drained as follows:

1. Remove drain reservoir from CVT cover.



1. Drain reservoir
2. Spring clip

2. Let water drain from CVT cover.
3. Reinstall drain reservoir.

NOTICE If any debris entered the CVT cover, CVT must be cleaned and inspected.

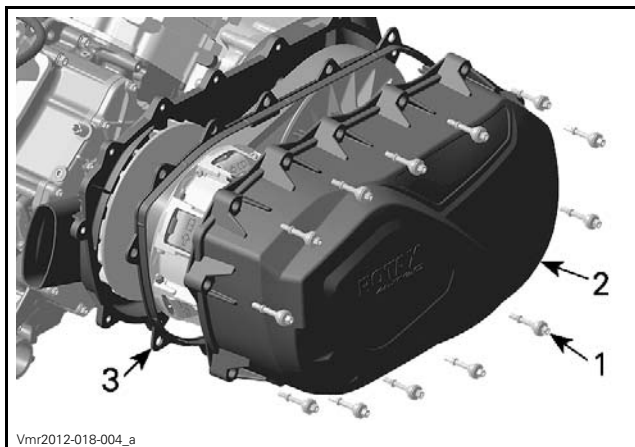
CVT Cover Removal

Remove CVT cover screws.

NOTE: Remove the center top screw last to support the cover during removal.

NOTE: Do not use and impact tool to remove CVT cover screws.

Remove the CVT cover and its gasket.

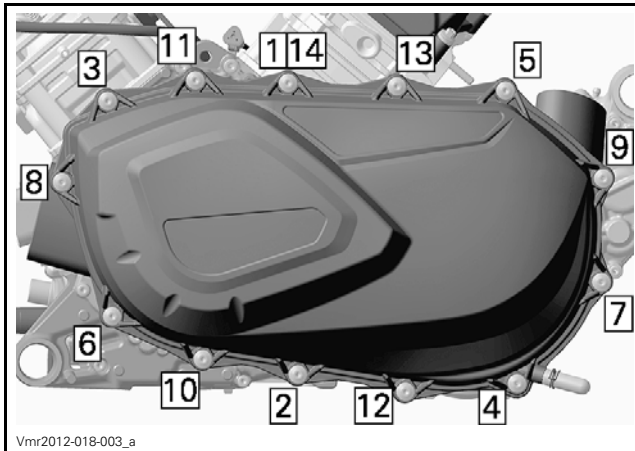


1. CVT cover screw
2. CVT cover
3. Gasket

CVT Cover Installation

Install the center top screw of first.

Tighten the CVT cover screws as per following sequence.



CVT COVER TIGHTENING SEQUENCE

CVT COVER SCREWS	
Tightening torque	7 N•m ± 0.8 N•m (62 lbf•in ± 7 lbf•in)

DRIVE BELT

Drive Belt Removal

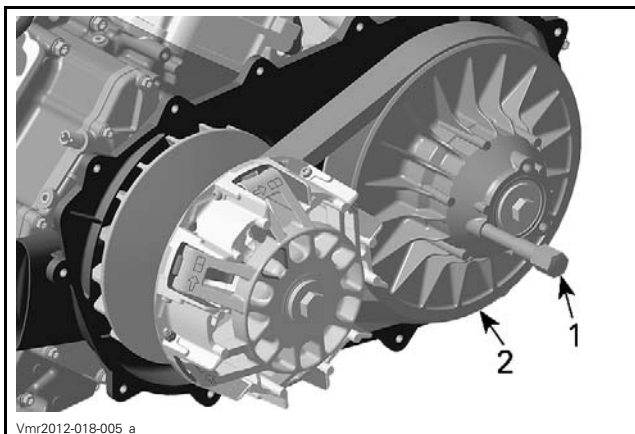
NOTICE In case of a drive belt failure, the CVT, cover and air outlet must be cleaned.

Remove *CVT COVER*.

Open driven pulley.

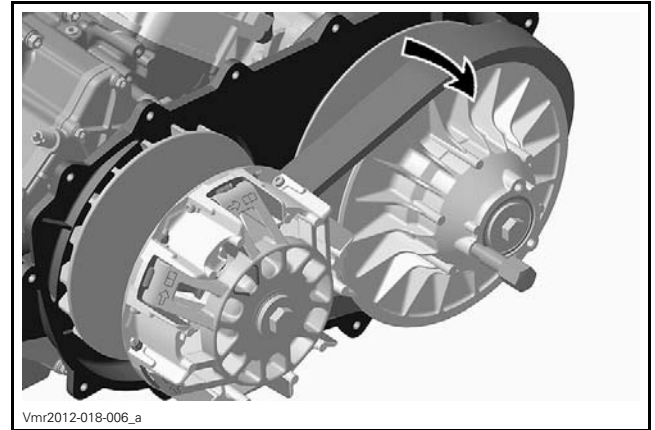
REQUIRED TOOL	
PULLER/LOCKING TOOL (P/N 529 036 098)	

Screw tool in the threaded hole of driven pulley and tighten to open the pulley.



TYPICAL
1. Puller/locking tool
2. Fixed sheave of driven pulley

To remove belt, slip the belt over the top edge of fixed sheave, as shown.



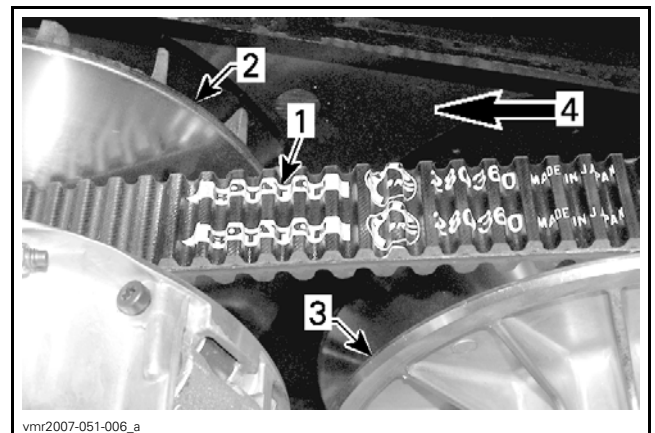
Drive Belt Inspection

For drive belt inspection refer to *DRIVE BELT INSPECTION* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.

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.



1. Arrow printed on belt
2. Drive pulley (front)
3. Driven pulley (rear)
4. Rotation direction

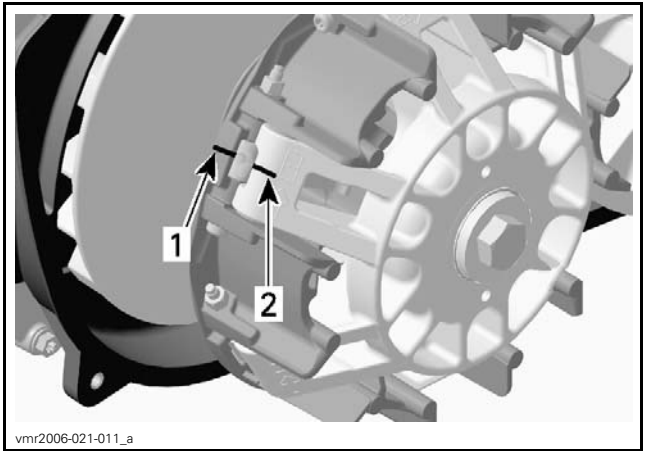
DRIVE PULLEY

Drive Pulley Removal

1. Remove *DRIVE BELT*, see procedure in this subsection.

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

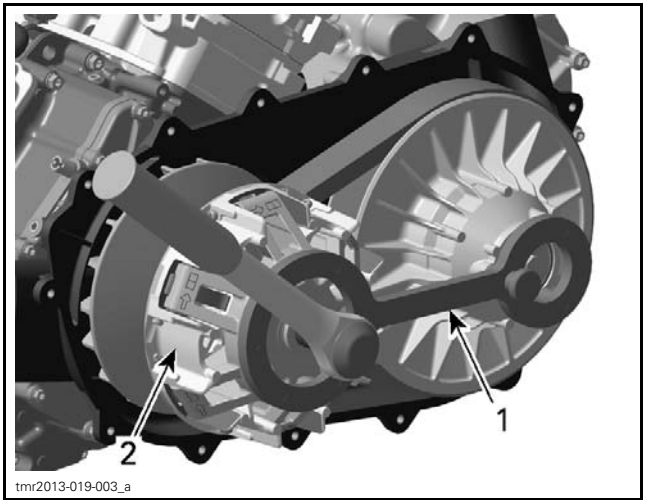
2. Prior to removing the drive pulley, mark sliding sheave and governor cup to ensure correct in-dexation at reinstallation.



1. Mark on drive pulley sliding sheave
2. Mark on governor cup

3. Lock the drive pulley.

REQUIRED TOOL	
CLUTCH HOLDER (P/N 529 036 238)	



1. Clutch holder
2. Drive pulley sliding sheave

4. Loosen the drive pulley screw.

NOTICE Never use any type of impact wrench for drive pulley removal.

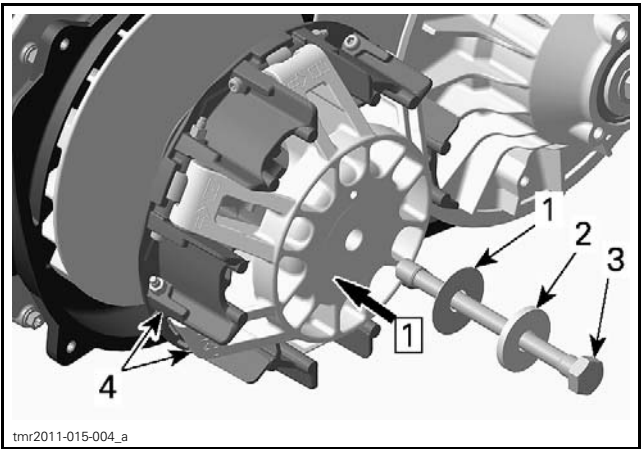
NOTE: Do not unscrew the drive pulley screw completely. If governor cup is stuck, hit it using a soft hammer.

5. Remove service tool.

6. Apply axial pressure with your hand on the sliding sheave and governor cup.

7. Remove drive pulley screw with its conical spring washer and thrust washer.

CAUTION Sliding sheave of drive pulley is spring loaded.



Step 1: Push

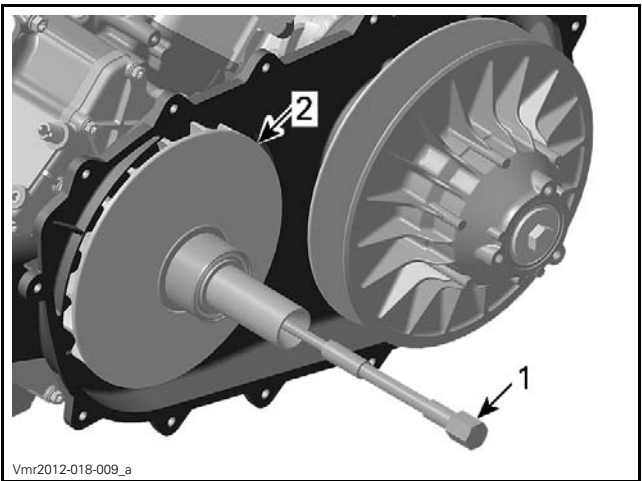
1. Thrust washer
2. Conical spring washer
3. Drive pulley screw
4. Sliding sheave with governor cup

8. Slowly release and remove sliding sheave.

9. Screw clutch puller in fixed sheave to remove fixed pulley.

NOTICE Use only recommended tool.

REQUIRED TOOL	
CLUTCH PULLER (P/N 529 035 746)	

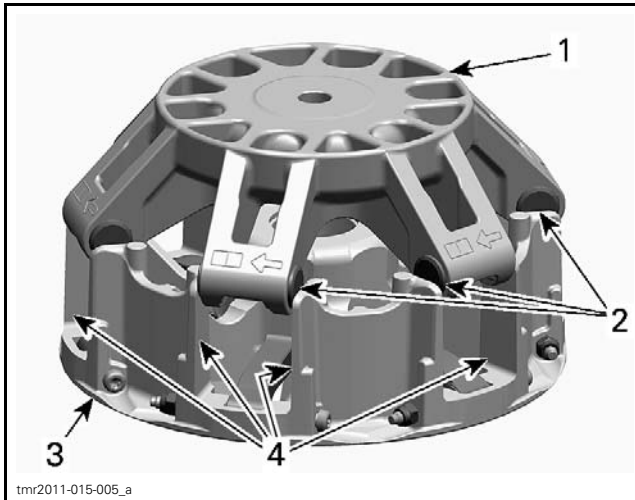


1. Drive pulley puller
2. Fixed sheave

Drive Pulley Disassembly

Governor Cup

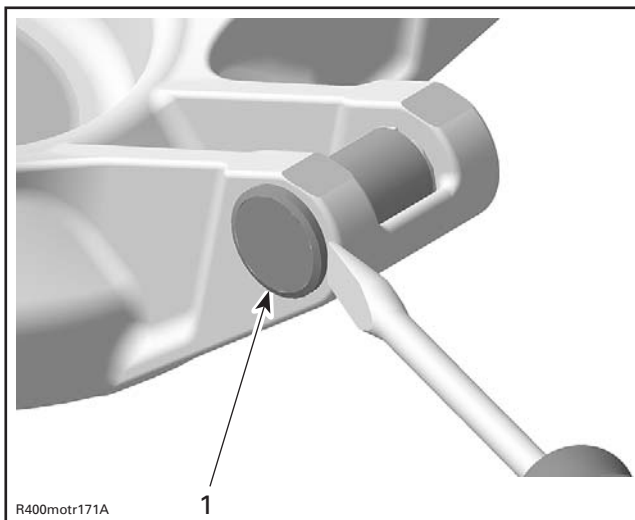
Carefully lift governor cup until slider shoes come at their highest position into guides.



1. Governor cup
2. Slider shoes
3. Sliding shave
4. Guides

NOTE: The following procedure is not necessary except if roller must be removed. Refer to *INSPECTION* before proceeding.

Remove slider shoes out of each bearing sleeve. Use a flat screwdriver if necessary.



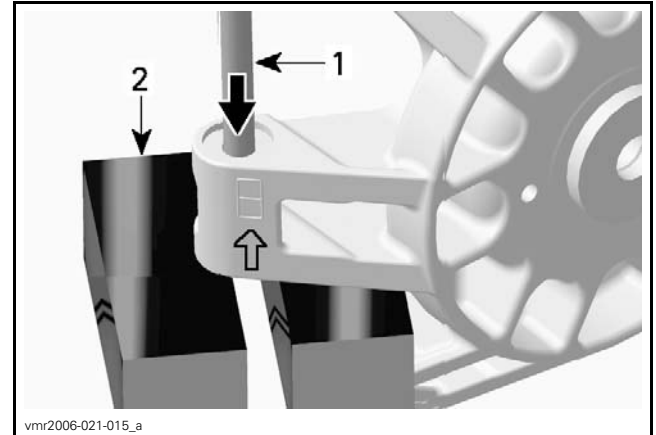
1. Slider shoe

Put governor cup on a vice to push out bearing sleeve of roller in the foreseen direction (against arrow). Use an appropriate punch (diameter of punch must be smaller than the bearing sleeve diameter).

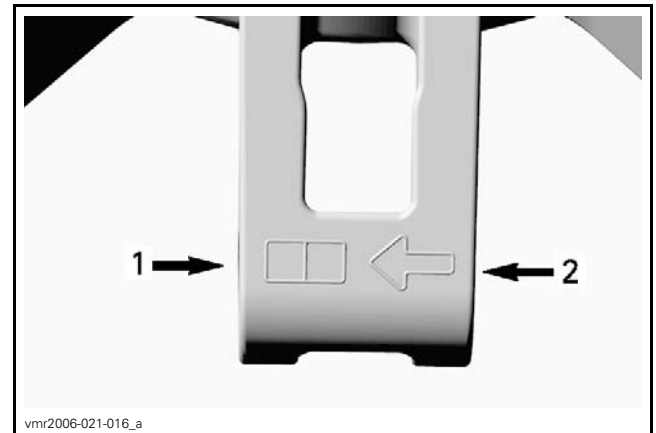
NOTICE Do not clamp the governor cup in the vice to push out bearing sleeve. Governor cup will be damaged.

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.

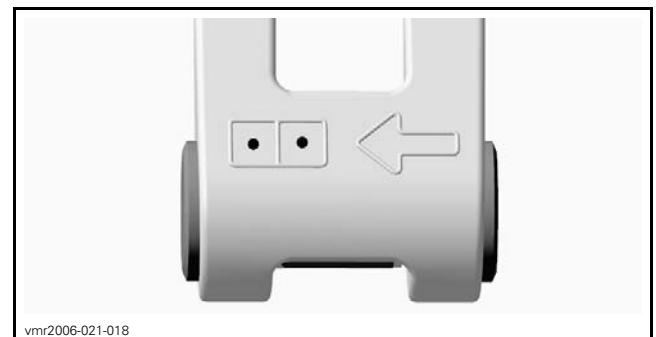


1. Punch
2. Vice



1. Removal direction
2. Assembly direction

NOTE: Whenever removing a governor cup with already two marked boxes replace it by a new one.

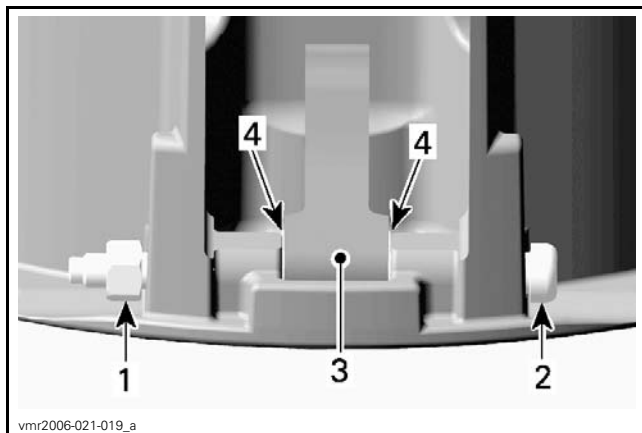


Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

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.



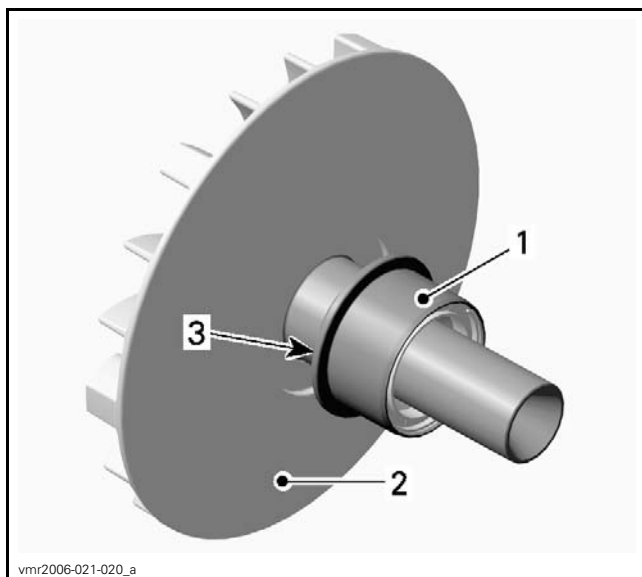
1. Lock nut
2. Centrifugal lever pivot bolt
3. Centrifugal lever
4. Thrust washers

Fixed Sheave

WARNING

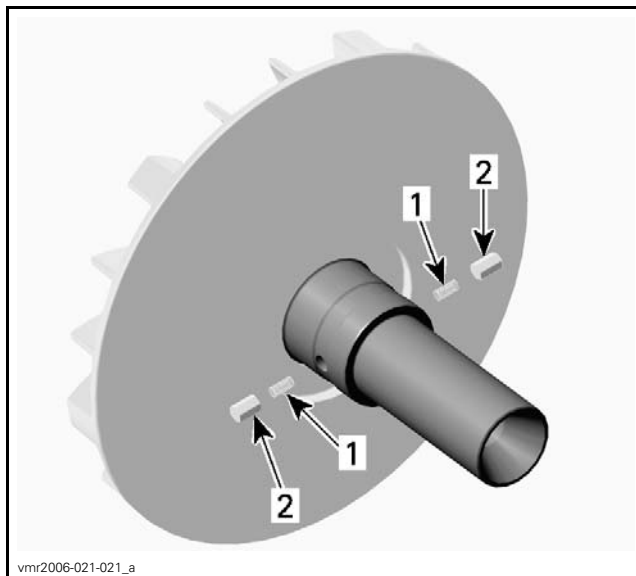
Always wear safety glasses to remove spring sleeves.

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.

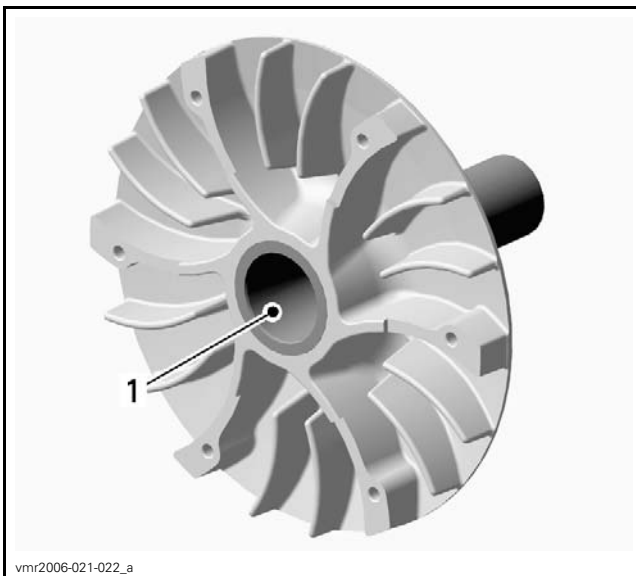
Remove all hardened oil deposits that have baked on crankshaft and pulley tapered surfaces with coarse or medium steel wool and/or sand paper no. 600.

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.

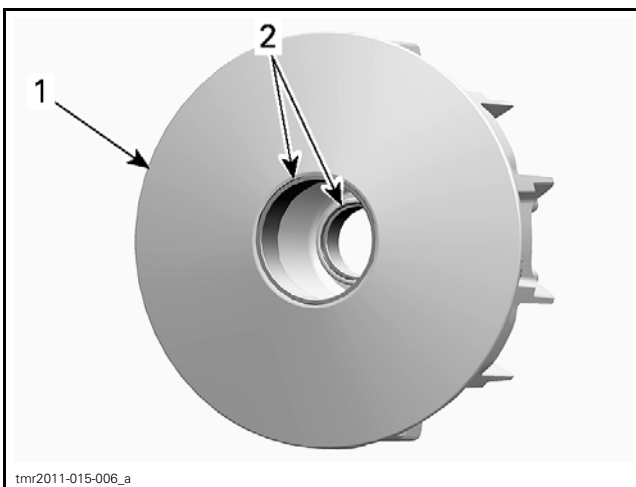
NOTICE Mounting surfaces must be free of any oil, cleaner or towel residue.



1. Taper of fixed sheave

Only use petrol base cleaner when cleaning bushings of sliding sheave.

NOTICE Do not use acetone to clean bushing.



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

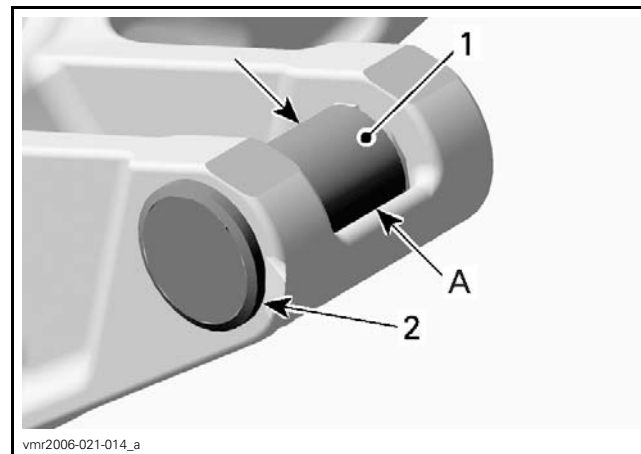
Check each roller for roundness of external diameter.

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.

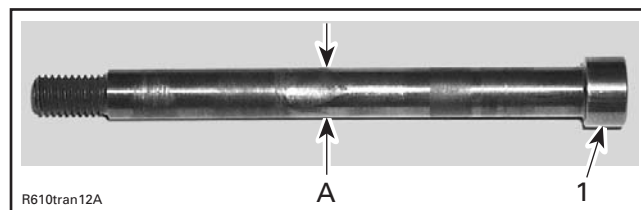


1. Roller
2. Slider shoe
A. Roller outer diameter

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.



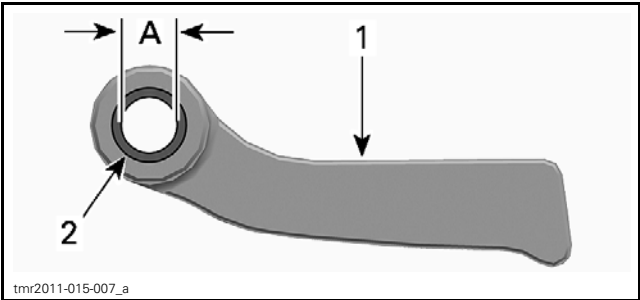
1. Centrifugal lever pivot bolt
A. Measure diameter here

CENTRIFUGAL LEVER PIVOT BOLT DIAMETER	
NEW	6.078 mm to 6.100 mm (.239 in to .24 in)
SERVICE LIMIT	6.00 mm (.236 in)

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

Centrifugal Lever

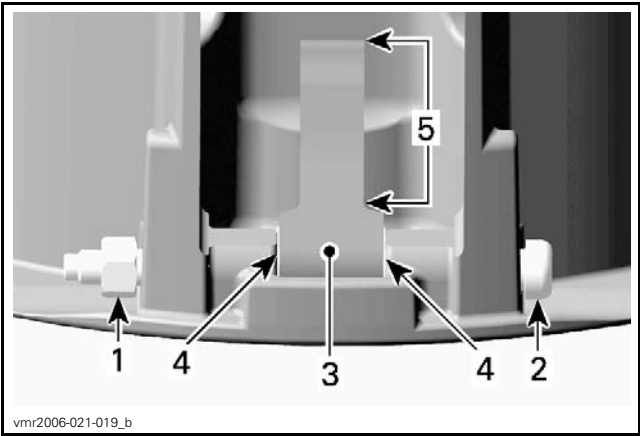
Check bushing diameter in the centrifugal lever for wear. Replace centrifugal lever if necessary.



- 1. Centrifugal lever
- 2. Bushing
- A. Bushing inner diameter

CENTRIFUGAL LEVER BORE DIAMETER	
NEW	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.



- 1. Lock nut
- 2. Centrifugal lever pivot bolt
- 3. Centrifugal lever
- 4. Thrust washers
- 5. Contact surface to the roller

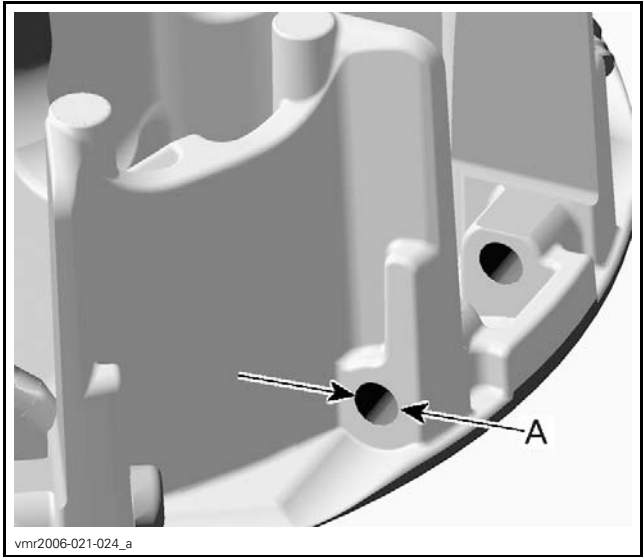
**WARNING**

Whenever replacing centrifugal levers, always replace all lever at the same time. Otherwise, unbalanced drive pulley will occur because of levers difference.

Sliding Sheave

Check sliding sheave for cracks and sliding contact surface for excessive wear. Replace sliding sheave if necessary.

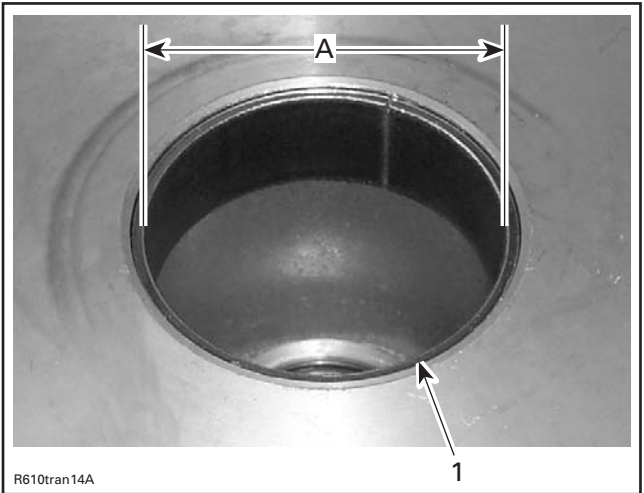
Measure centrifugal lever pivot bolt bores. Replace sliding sheave if bores are out of specification or otherwise damaged.



A. Centrifugal lever pivot bolt bore diameter

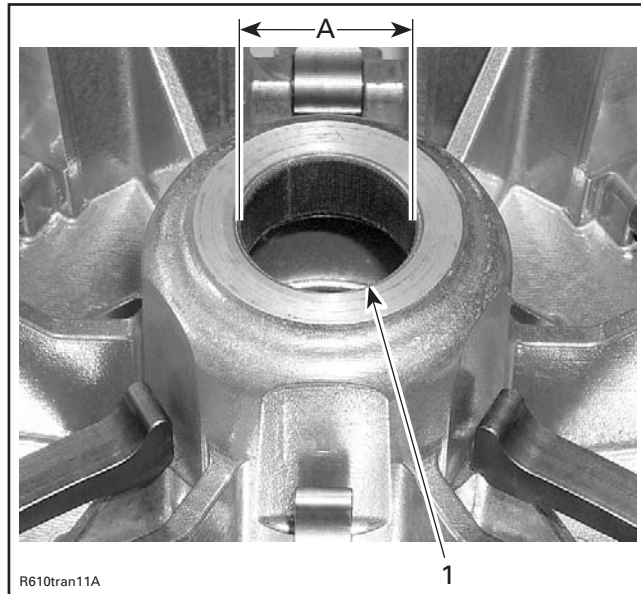
CENTRIFUGAL LEVER PIVOT BOLT BORE DIAMETER	
NEW	6.113 mm to 6.171 mm (.241 in to .243 in)
SERVICE LIMIT	6.300 mm (.248 in)

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	
NEW	55.000 mm to 55.040 mm (2.165 in to 2.167 in)
SERVICE LIMIT	55.200 mm (2.173 in)



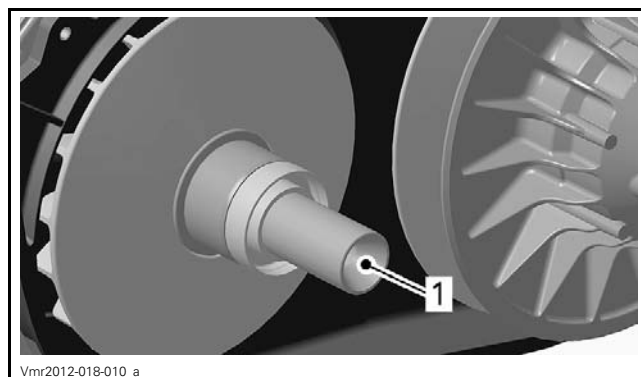
1. Bushing on governor cup side
A. Bore diameter of bushing

SLIDING SHEAVE SMALL BUSHING	
NEW	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

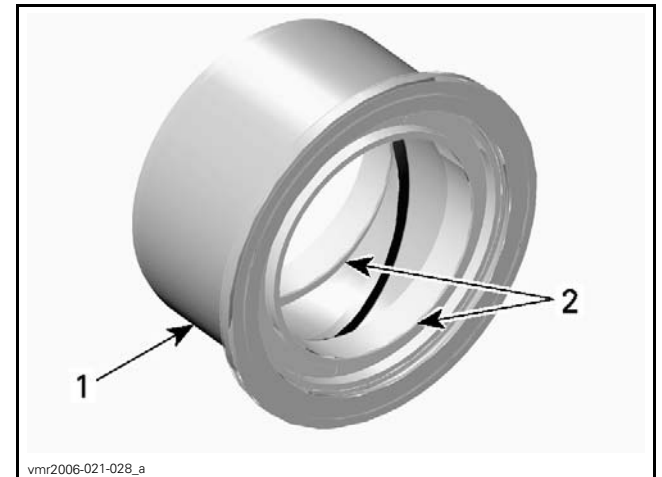
Measure spring free length and squareness. If spring is out of specification, replace by a new one.

CLUTCH SPRING SQUARENESS	
SERVICE LIMIT	4 mm (.157 in)

One-Way Clutch

Check bearings for excessive play and smooth operation. Replace one-way clutch bearings if necessary.

NOTICE Be careful not to damage the inside of one-way clutch during bearing removal.



1. 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	
NEW	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

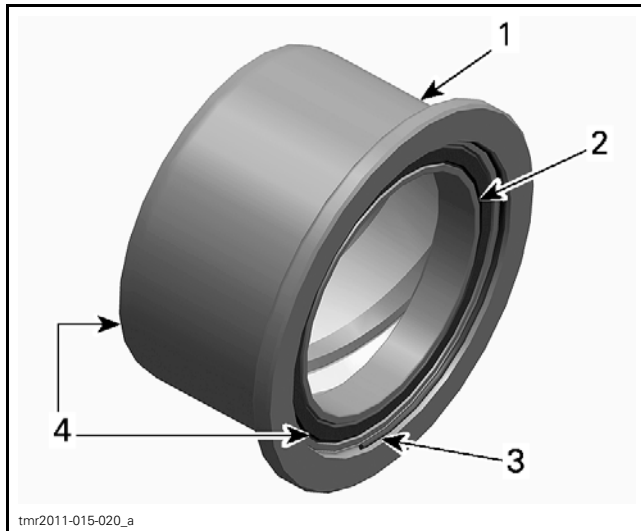
Clean parts.

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 XX (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.

NOTE: Apply ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021) inside ball bearings to ensure adequate lubrication.



1. One-way clutch
2. Bearing
3. Retaining ring
4. Seal

Sliding Sheave

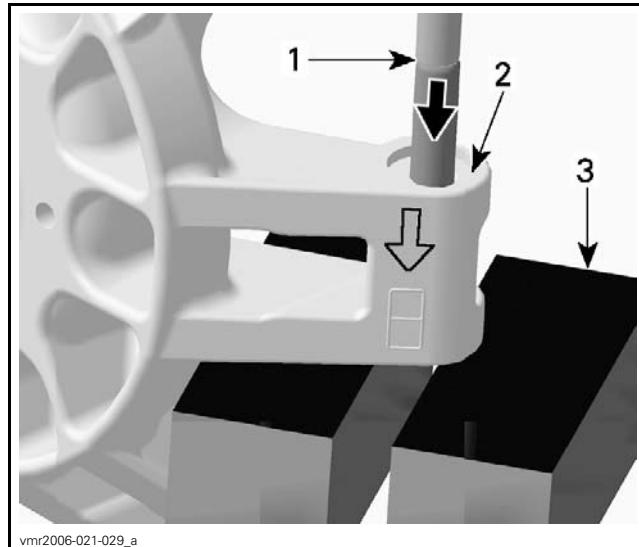
Install centrifugal levers with their thrust washers.

NOTICE Centrifugal levers must move easily after installation.

Governor Cup

Rebuild governor cup with new bearing sleeves, thrust washers, rollers and slider shoes.

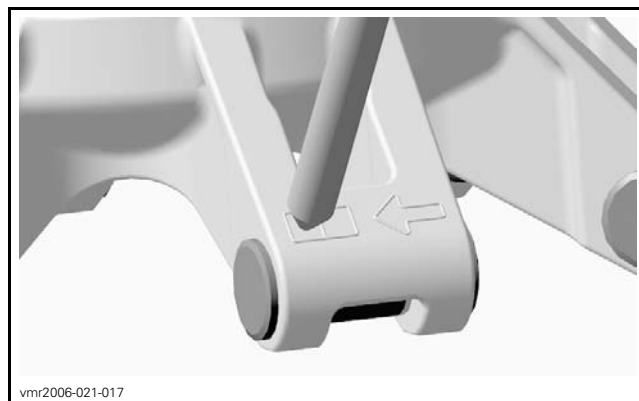
NOTICE Final position has to be aligned with the contact surface of the slider shoes (no protrusion).



1. Top edge of bearing sleeve
2. Mating surface of slider shoes
3. Vice

Each time when replacing the bearing sleeves sign the foreseen box with a punch.

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.

⚠ WARNING

Do not apply antiseize or any lubricant on crankshaft and drive pulley tapers.

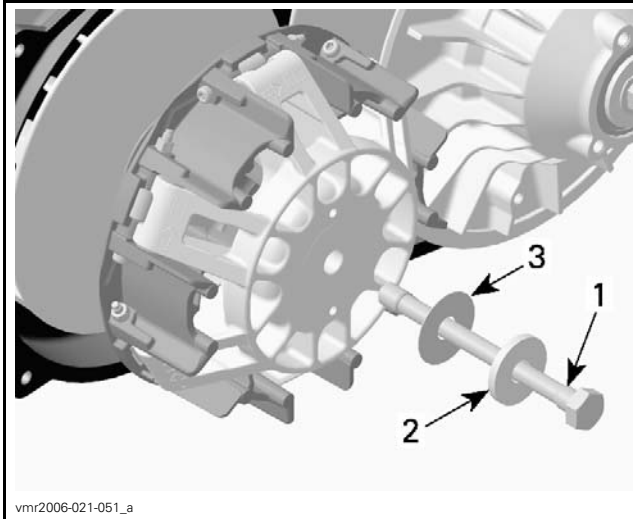
NOTICE Never use any type of impact wrench at drive pulley removal and installation.

Clean mounting surfaces as described in *CLEANING* 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.



1. Drive pulley screw
2. Conical spring washer
3. Thrust washer

⚠ WARNING

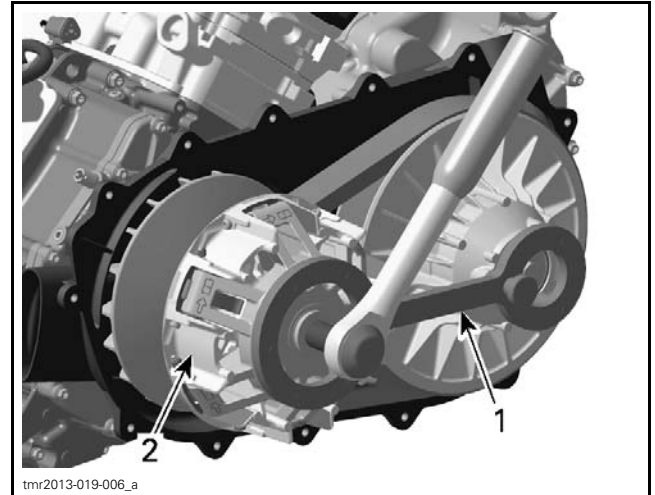
Never substitute conical spring washer and/or screw with jobber ones. Always use BRP genuine parts for this particular case.

Lock the drive pulley as per removal procedure.

Tighten drive pulley screw to specified torque.

NOTICE Never use any type of impact wrench for drive pulley installation.

DRIVE PULLEY SCREW	
Tightening torque	120 N•m ± 8 N•m (89 lbf•ft ± 6 lbf•ft)



1. Clutch holder (P/N 529 036 238)
2. Drive pulley

DRIVEN PULLEY

Driven Pulley Removal

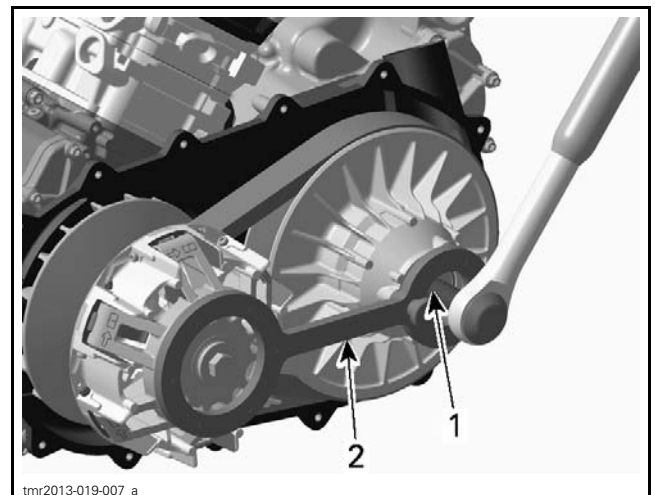
Remove *DRIVE BELT*.

Screw Assembly

Hold the driven pulley and loosen the driven pulley screw.

NOTE: Do not unscrew the driven pulley screw completely.

REQUIRED TOOL	
CLUTCH HOLDER (P/N 529 036 238)	



1. Driven pulley screw (to discard)
2. Clutch holder

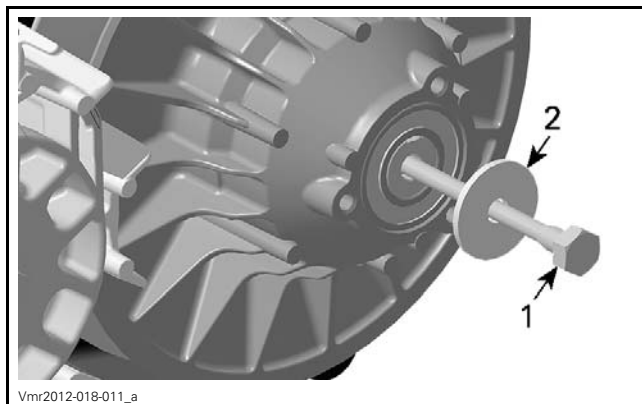
Remove service tool.

Apply axial pressure with your hand on driven pulley and maintain during screw removal.

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

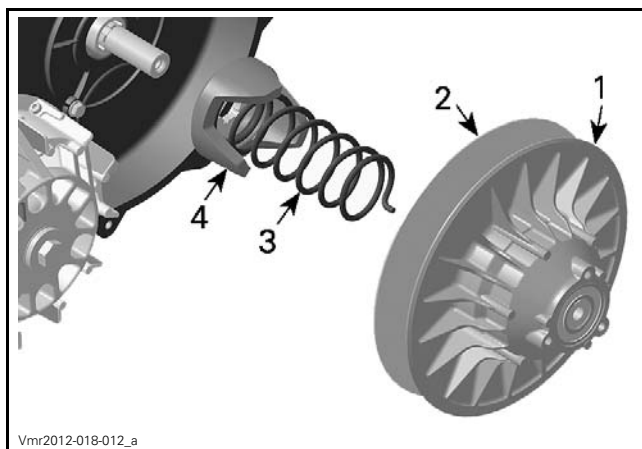
Remove driven pulley screw and washer.
Discard screw.

⚠ CAUTION Driven pulley is spring loaded. Hold driven pulley tight and slowly remove the driven pulley screw to release spring tension.



1. Driven pulley screw
2. Thrust washer

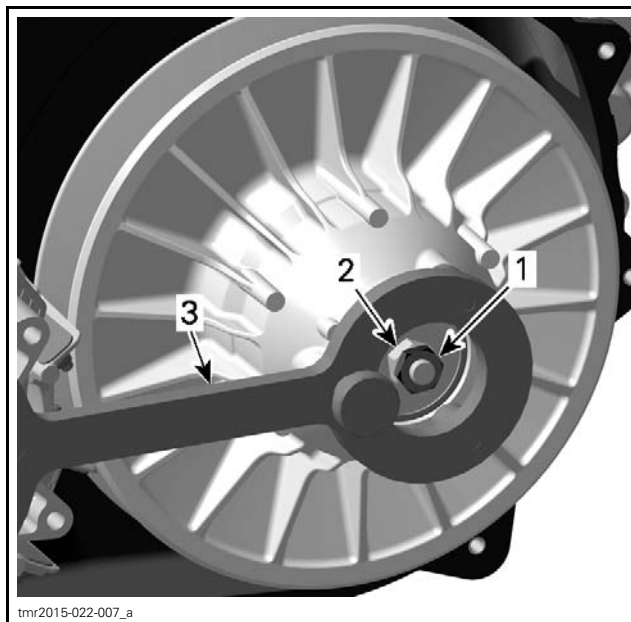
Remove the driven pulley with the spring and the cam.



1. Fixed sheave of driven pulley
2. Sliding sheave of driven pulley
3. Spring
4. Cam

Stud Assembly

Remove the counter nut and discard it.



1. Counter nut
2. Driven pulley nut
3. Clutch holder

Loosen the driven pulley nut.

NOTE: Do not unscrew the driven pulley nut completely.



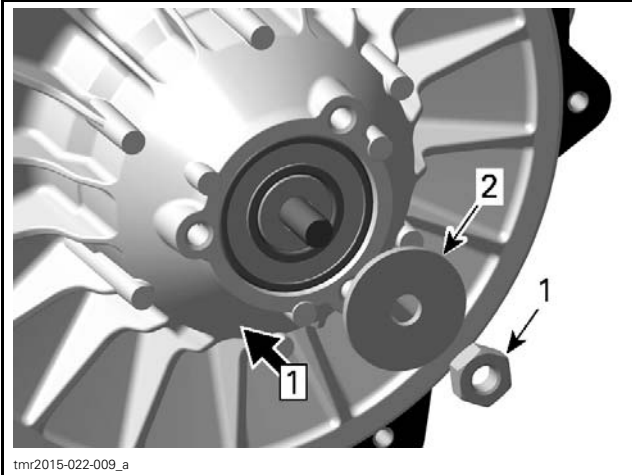
1. Driven pulley nut

Remove service tool.

Apply axial pressure with your hand on driven pulley and maintain during nut removal.

Remove driven pulley nut (discard) and washer.

⚠ CAUTION Driven pulley is spring loaded. Hold driven pulley tight and slowly remove the driven pulley nut to release spring tension.

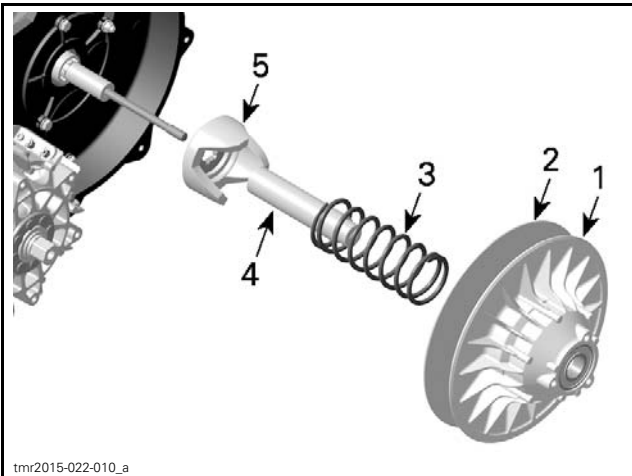


Step 1: Push

1. Driven pulley nut (discard)
2. Thrust washer

Remove:

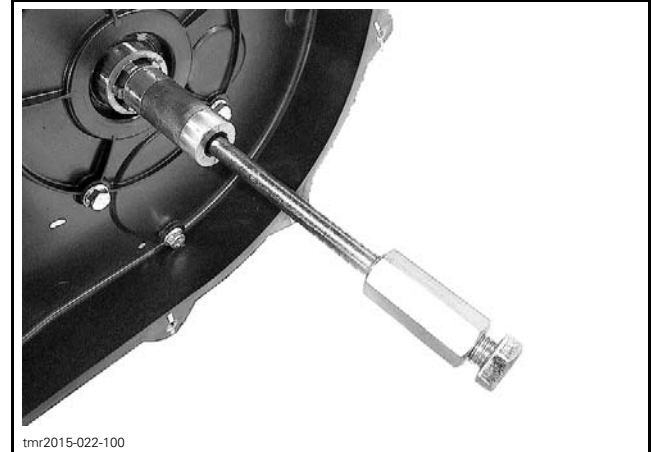
- Driven pulley
- Spring
- Shaft
- Cam.



1. Fixed sheave of driven pulley
2. Sliding sheave of driven pulley
3. Spring
4. Shaft
5. Cam

Install the tightening tool on the stud.

REQUIRED TOOL	
DRIVEN PULLEY STUD TOOL (P/N 529 036 360)	



Block countershaft.

REQUIRED TOOL	
COUNTERSHAFT RETAINER TOOL (P/N 529 036 312)	



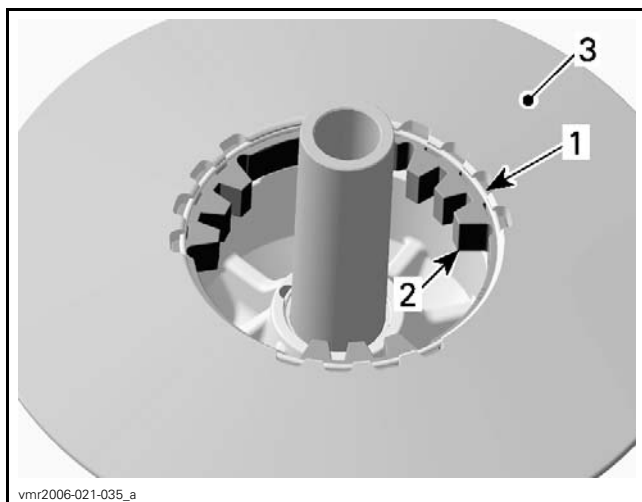
Remove stud.

Driven Pulley Disassembly

Fixed Sheave

Remove retaining ring and lift torque gear.

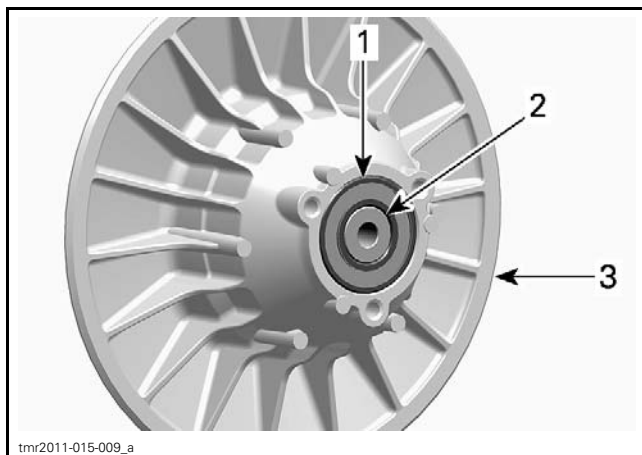
Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



1. Retaining ring
2. Torque gear
3. Fixed sheave of driven pulley

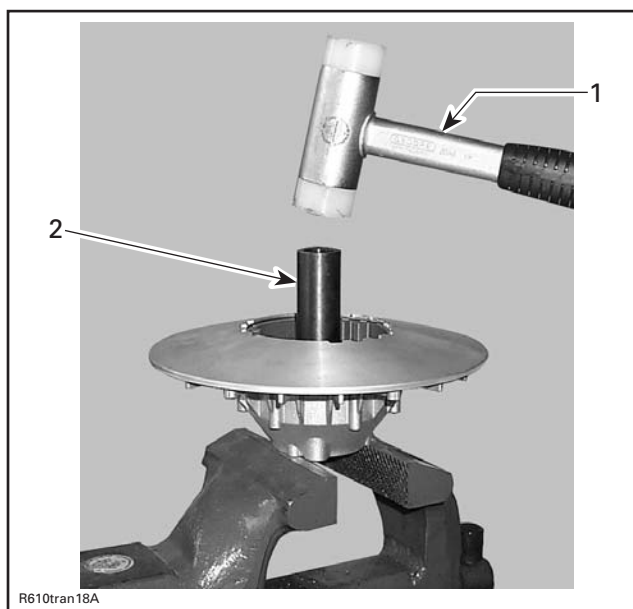
NOTE: The following procedure is not necessary except if ball bearing or shaft must be removed. Refer to *INSPECTION* before proceeding.

Heat ball bearing area up to 100°C (212°F) before removing ball bearing.



1. Ball bearing
2. Shaft
3. Fixed sheave of driven pulley

Use a soft hammer to push shaft with bearing out of fixed sheave.

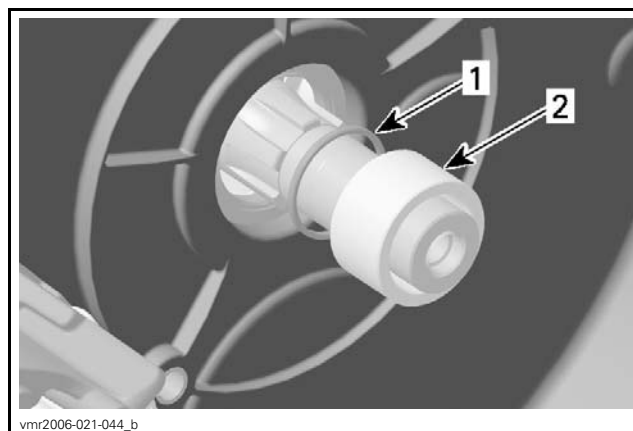


1. Soft hammer
2. Shaft

Remove shaft from ball bearing.

Remove distance sleeve and O-ring from countershaft.

Replace O-ring if brittle, hard or damaged.



1. O-ring
2. Distance sleeve

Driven Pulley Cleaning

Clean the CVT air guide area from contamination.

Using a small brush, paper towel and XPS BRAKES AND PARTS CLEANER (P/N 219 701 776) or XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705), clean all the mounting surfaces and threads as shown.

NOTICE Avoid contact between cleaner and countershaft oil seal or damage may occur.

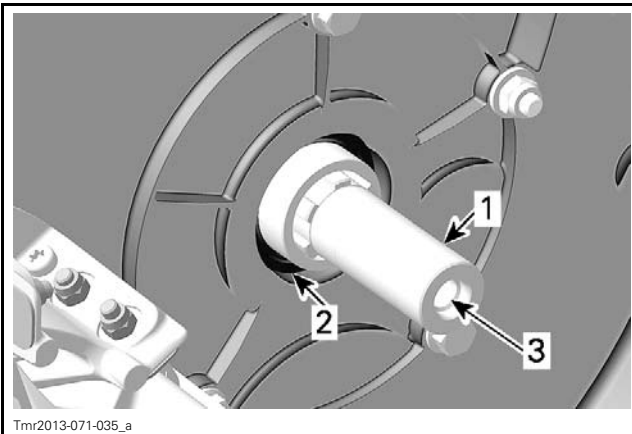
Remove all deposits that have baked on pulley tapered surfaces with medium steel wool and/or sand paper no. 600.

NOTICE Do not use any other type of abrasive.

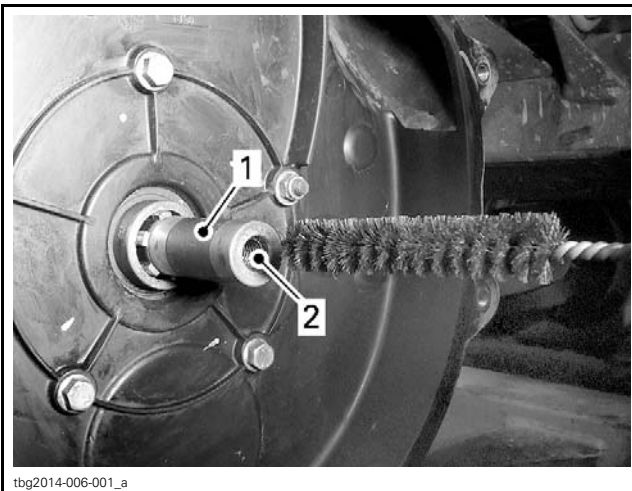
Reclean surfaces after steel wool use.

Blow compressed air on all cleaned parts and surfaces to remove any residue.

NOTICE Mounting surfaces and threads must be free of any oil, cleaner or towel residue.

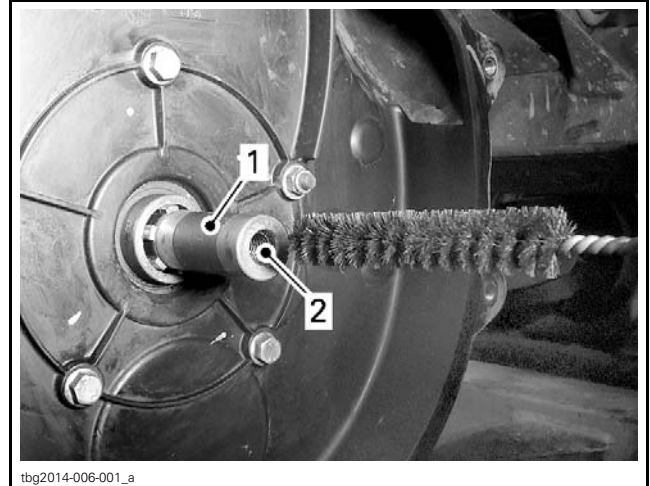


1. Countershaft end
2. Countershaft oil seal
3. Countershaft inner threads



GEARBOX COUNTERSHAFT

1. Countershaft outer surface
2. Countershaft inner threads



GEARBOX COUNTERSHAFT

1. Countershaft outer surface
2. Countershaft inner threads

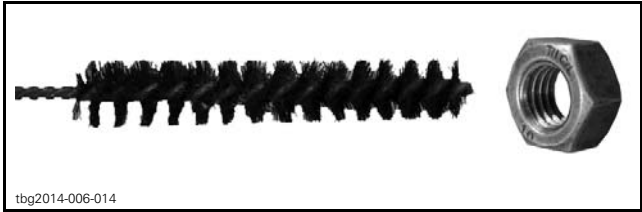


COUNTERSHAFT END OF STUD

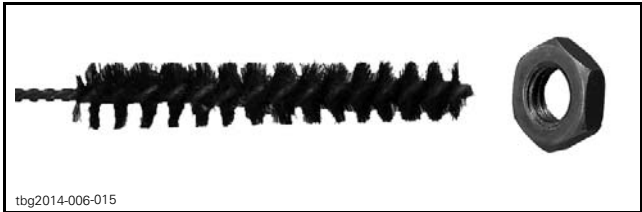
Stud Assembly



STUD END RECEIVING COUNTER NUTS



THREADS OF DRIVEN PULLEY NUT



THREADS OF COUNTER NUT

Driven Pulley Inspection

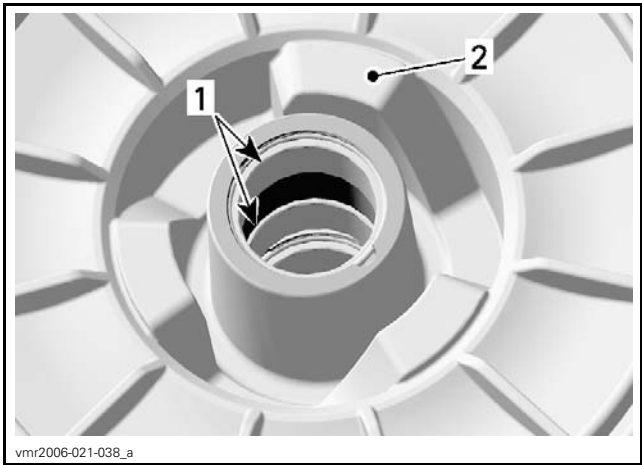
Sliding Sheave

Check sliding sheave for cracks and sliding contact surface for excessive wear. Replace sliding sheave if necessary.

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	
NEW	30.060 mm to 30.100 mm (1.183 in to 1.185 in)
SERVICE LIMIT	30.200 mm (1.189 in)

Fixed Sheave

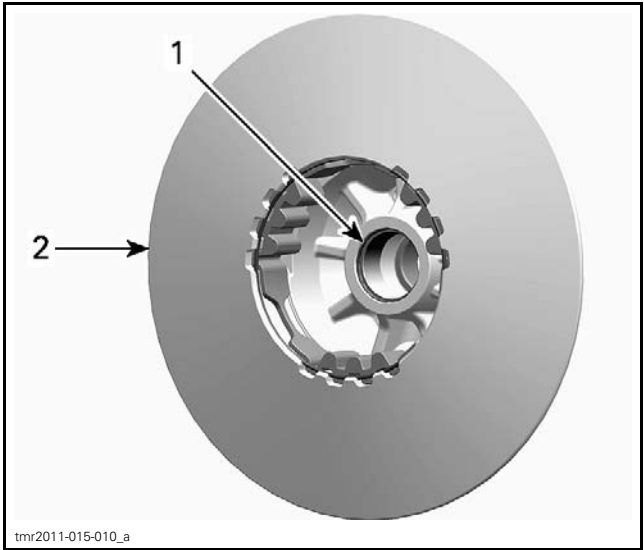
Check fixed sheave for cracks and excessive wear. Replace fixed sheave if necessary.

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.

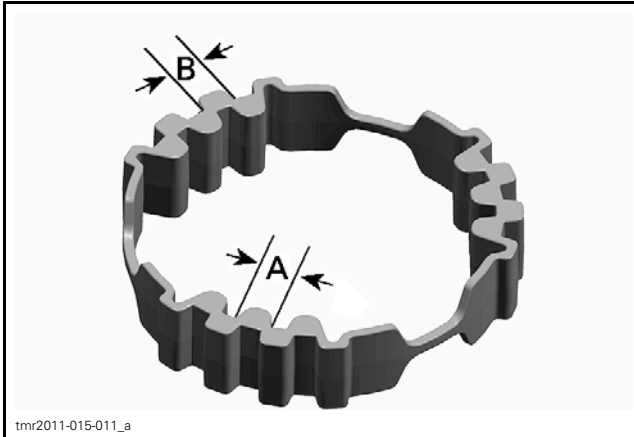
This bushing can not be replaced. Replace fixed sheave if bushing is out of specification. Visually inspect coatings.



1. Bushing
2. Fixed sheave of driven pulley

BUSHING BORE DIAMETER	
NEW	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.

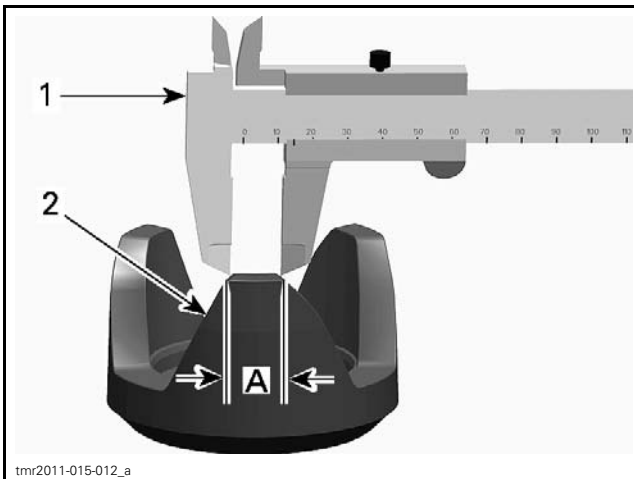


- A. Measurement inside
B. Measurement outside

WEAR ON TEETH BOTH SIDES	
SERVICE LIMIT	7.500 mm (.295 in)

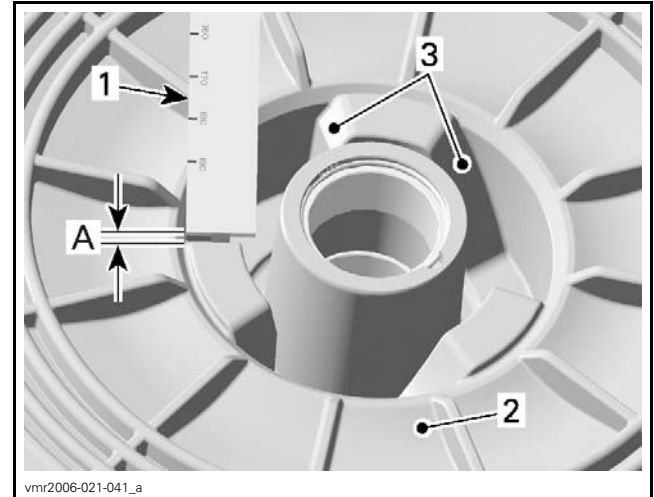
Cam

Check cam for visible damage and wear limit with a caliper.



1. Caliper
2. Contact surface
A. Width to be measured due to wear on contact surface

WIDTH ON TOP SURFACE	
SERVICE LIMIT	9.00 mm (.354 in)

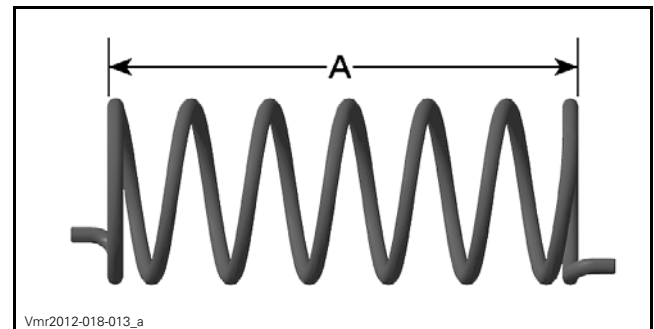


1. Caliper
2. Sliding sheave
3. Contact surface
A. Wear to be measured

WEAR ON CONTACT SURFACE	
SERVICE LIMIT	1.00 mm (.039 in)

Spring

Measure spring free length and squareness. If spring is out of specification, replace by a new.



- CVT DRIVEN SPRING
A. Spring free length

SPRING FREE LENGTH	
SERVICE LIMIT	125 mm (4.921 in)
CLUTCH SPRING SQUARENESS	
SERVICE LIMIT	3.8 mm (.15 in)

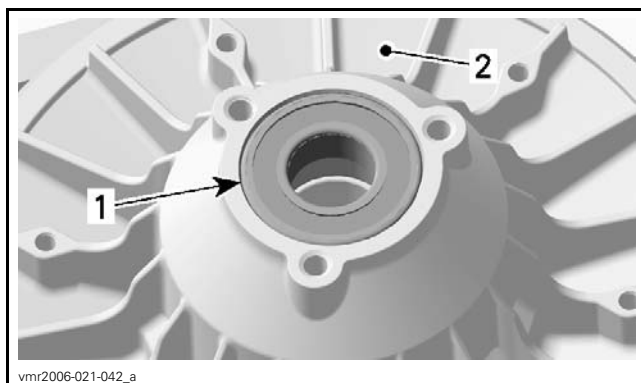
Driven Pulley Assembly

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.

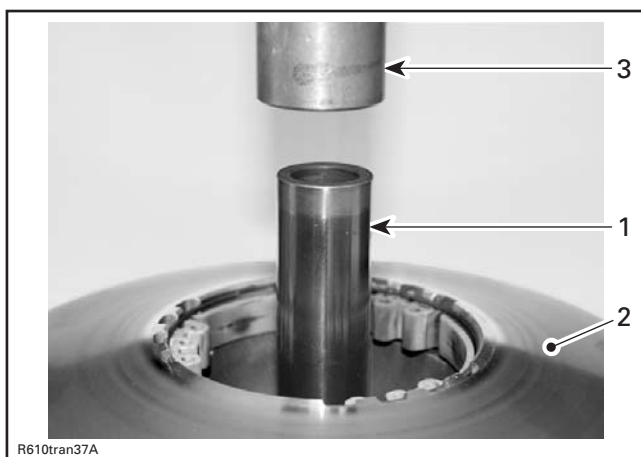
NOTE: Place new ball bearing in a freezer for 10 minutes before installation.

Install ball bearing with the writing on top and push only on the outer ring.



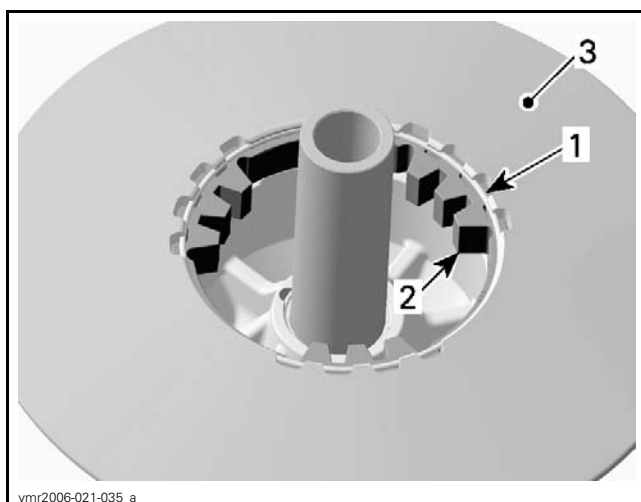
1. Ball bearing
2. Fixed sheave of driven pulley

NOTICE Do not use hammer, use press machine only.



1. Shaft
2. Fixed sheave
3. Press machine

Install torque gear then secure it with retaining ring.



1. Retaining ring
2. Torque gear
3. Fixed sheave of driven pulley

Driven Pulley Installation

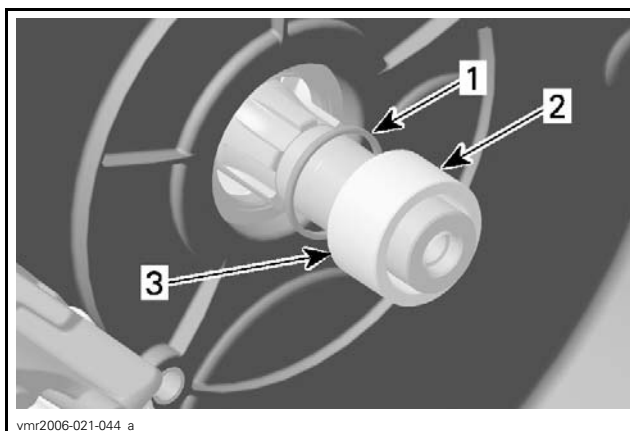
For installation, reverse the removal procedure. Pay attention to the following details.

NOTICE Never use any type of impact wrench at drive pulley removal and installation.

Clean mounting surfaces and parts as described in *CLEANING* above.

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 to gearbox side.

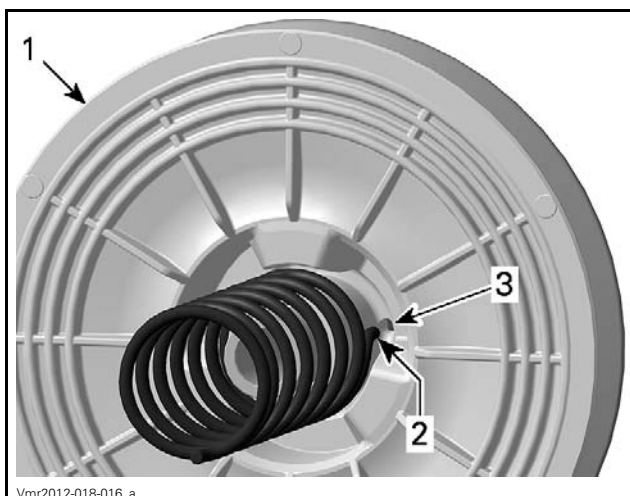


1. O-ring
2. Distance sleeve
3. Chamfered area of distance sleeve

Screw Assembly

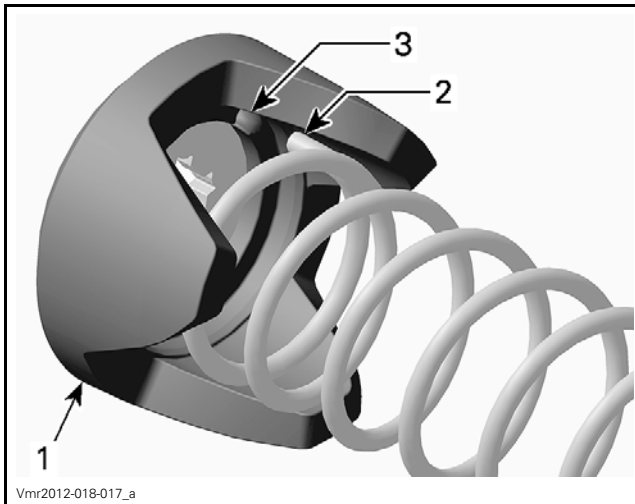
Insert the sliding sheave in the fixed sheave.

Place spring behind sliding sheave and engage spring end in the sliding sheave spring bore.



- 1000 ENGINE**
1. Sliding sheave
 2. Spring end
 3. Spring bore

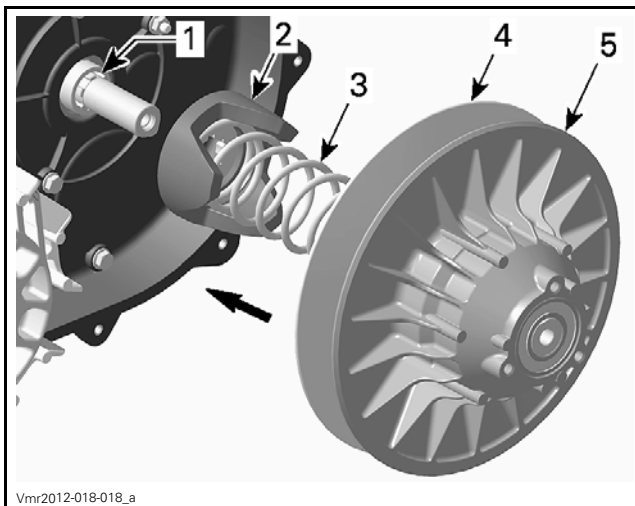
Place cam on the opposite end of the spring and engage the other spring end in the cam spring bore.



1000 ENGINE
 1. Cam
 2. Spring end
 3. Spring bore

Install pre-assembled cam with spring and driven pulley on countershaft end.

NOTICE Cam must engage on countershaft splines.



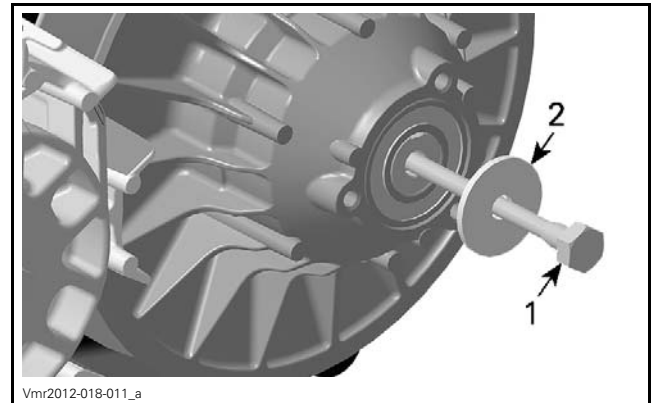
1000 ENGINE
 1. Countershaft splines
 2. Cam
 3. Spring
 4. Sliding sheave
 5. Fixed sheave

With your hand, push the driven pulley onto the shaft to compress the spring.

As you hold the pulley in, install a **NEW** driven pulley screw and thrust washer.

NOTICE This assembly uses a stretch screw. Always install a **NEW** screw.

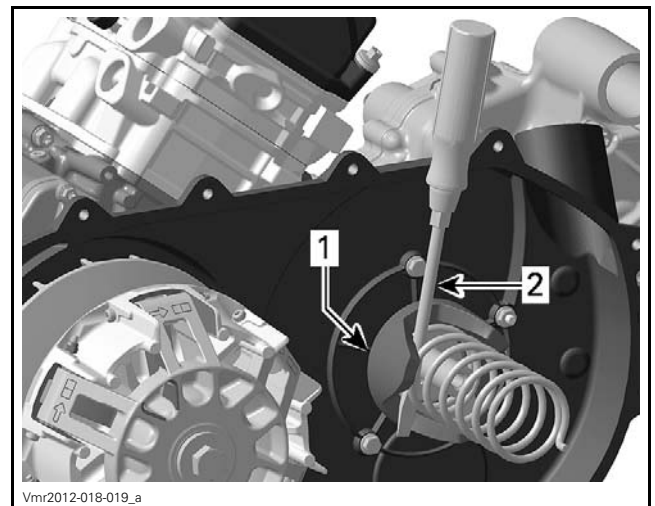
NOTE: Tighten the screw with your hand approximately 3 to 4 turns.



1. Driven pulley screw
 2. Thrust washer

Insert a screwdriver of approximately 5 mm (.197 in) diameter in the cam.

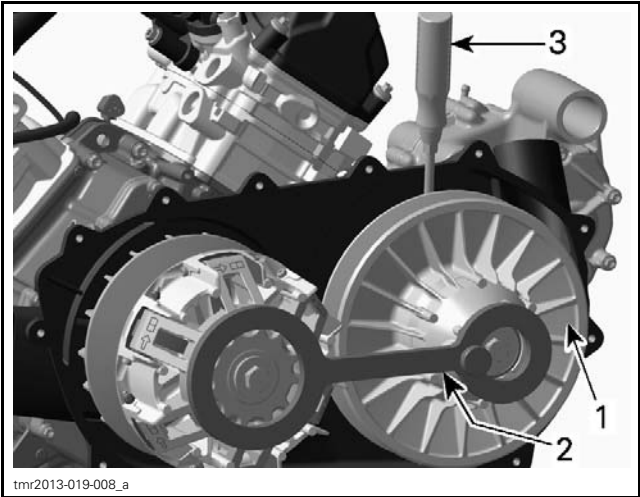
NOTE: For clarity of understanding, some parts not shown in the following illustration.



1000 ENGINE
 1. Cam
 2. Screwdriver, diameter 5 mm (.197 in)

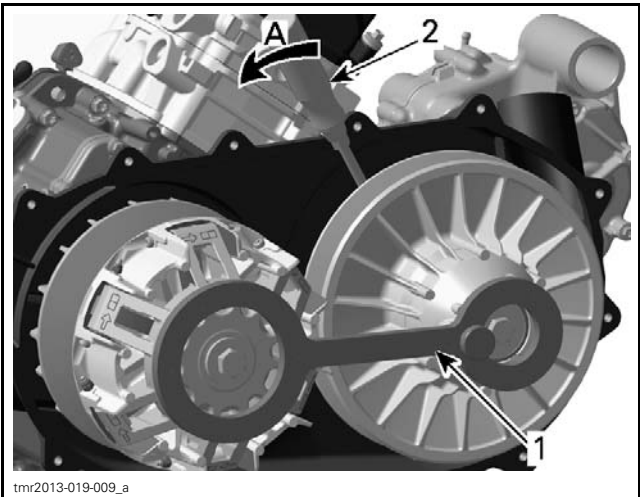
Hold the driven pulley in a fix position.

REQUIRED TOOL	
CLUTCH HOLDER (P/N 529 036 238)	



- 1. Fixed sheave
- 2. Clutch holder
- 3. Screwdriver

Turn the screwdriver approximately 20° counter-clockwise until cam engages in the driven pulley sliding sheave and hold it in this position (spring preload).

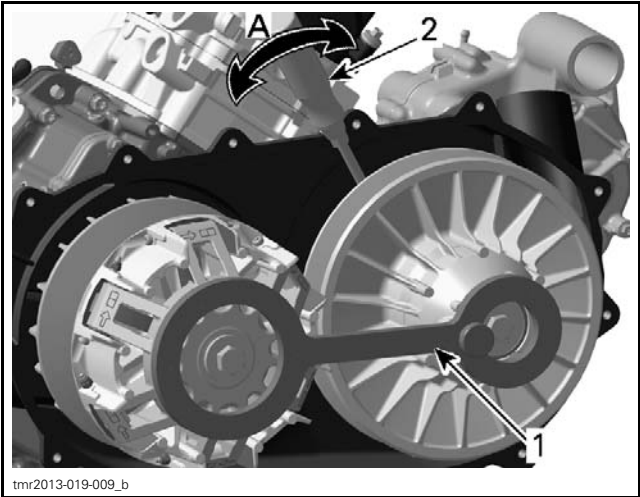


- 1. Clutch holder
- 2. Screwdriver
- A. 20° turn

Using a socket and extension, hand tighten the driven pulley screw.

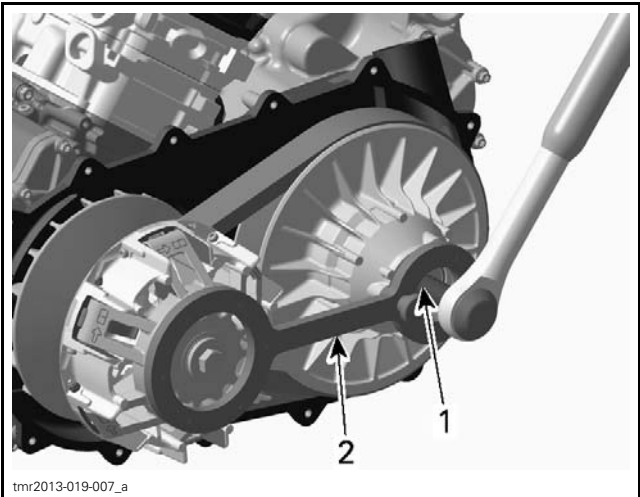
NOTE: Do not apply specified torque at this time. Move the screwdriver back and forth to check cam for free movement.

NOTICE A cam not correctly engaged will cause damage to the driven pulley and cam.



- 1. Clutch holder
- 2. Screwdriver
- A. Cam freedom of movement

Tighten driven pulley screw as specified.



- 1. Driven pulley screw
- 2. Clutch holder

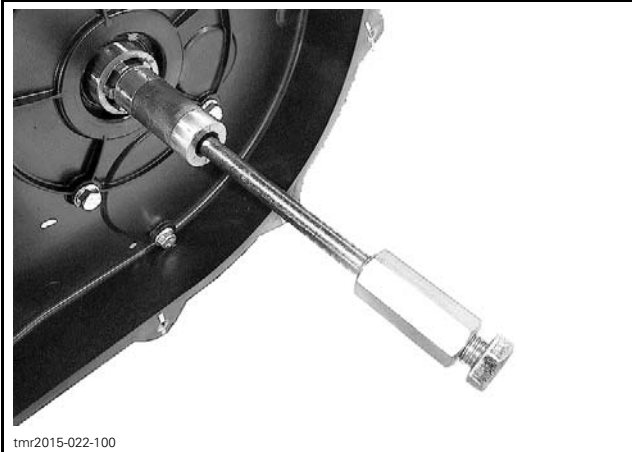
TIGHTENING SEQUENCE (DRIVEN PULLEY SCREW)	
STEP 1	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)
STEP 2	180° ± 5°

Remove service tool.

Stud Assembly

Hand tighten the stud in the countershaft. Install the tightening tool on the stud.

REQUIRED TOOL	
DRIVEN PULLEY STUD TOOL (P/N 529 036 360)	



Block countershaft.

REQUIRED TOOL	
COUNTERSHAFT RETAINER TOOL (P/N 529 036 312)	



Tighten the stud to specification.

TIGHTENING TORQUE	
Stud	45 N•m ± 2 N•m (33 lbf•ft ± 1 lbf•ft)

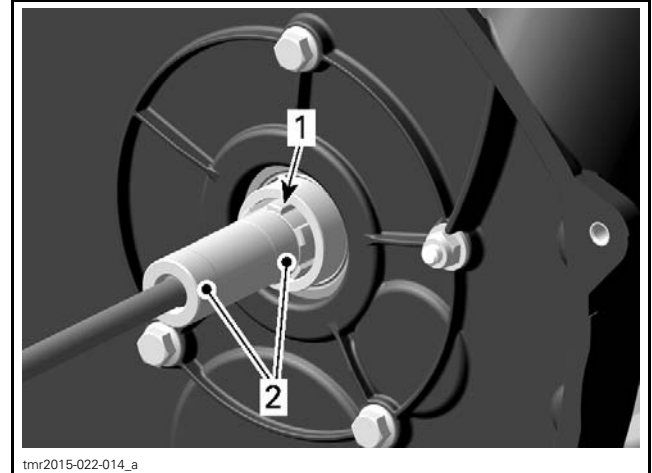
Remove the tightening tool from the stud.

Remove countershaft retainer tool.

Lubricate:

- Countershaft splines
- Countershaft outer surface.

SERVICE PRODUCT	
Countershaft splines and countershaft outer surface	LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070)

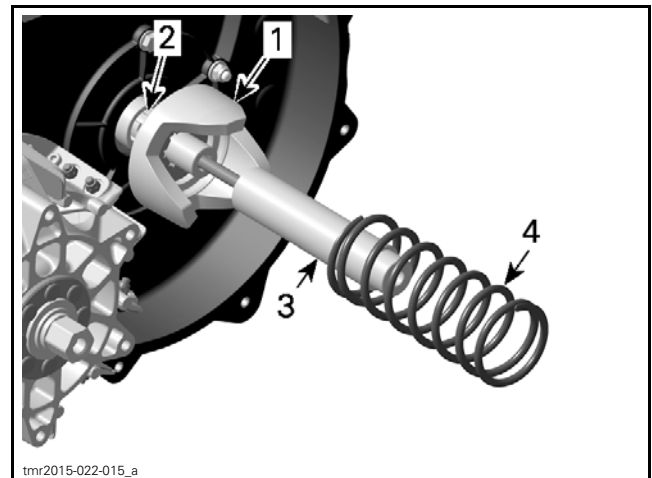


1. Countershaft splines
2. Countershaft outer surface

Install:

- Cam
- Shaft
- Spring.

NOTICE Cam splines must engage on countershaft splines.



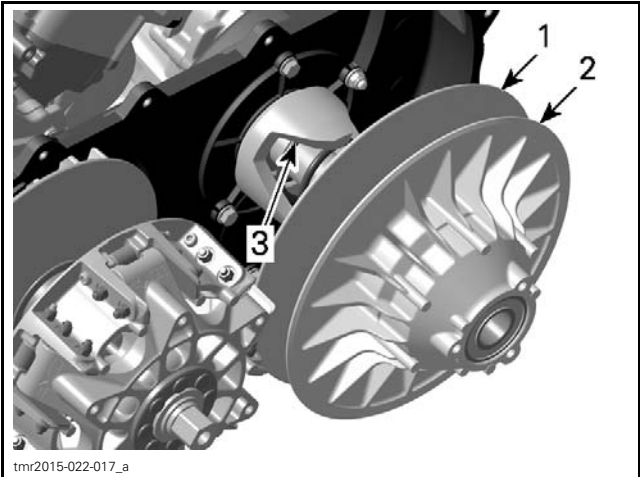
1. Cam
2. Countershaft splines
3. Shaft
4. Spring

Insert the sliding sheave in the fixed sheave.

Align sliding sheave of driven pulley with cam.

NOTICE Sliding sheave must engage on cam.

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))



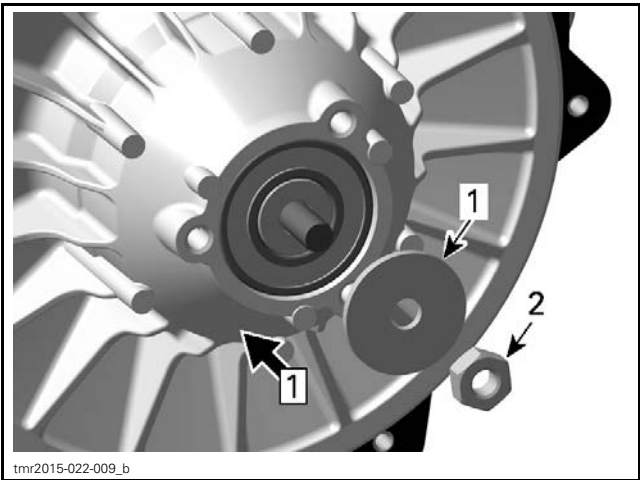
- 1. Sliding sheave
- 2. Fixed sheave
- 3. Cam

Push the driven pulley onto the shaft to compress the spring.

NOTICE A cam not correctly engaged will cause damage to the driven pulley and cam.

As you hold the pulley in, install thrust washer and a **NEW** driven pulley nut.

NOTE: Finger tighten the driven pulley nut sufficiently so that the cam remains engaged.



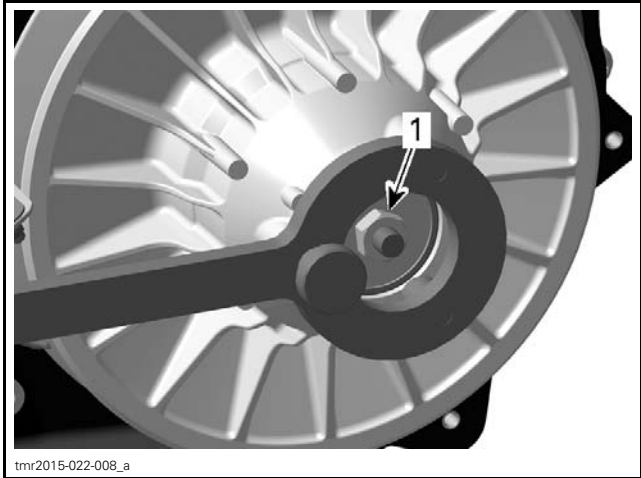
Step 1: Push

- 1. Thrust washer
- 2. **NEW** driven pulley nut

Tighten driven pulley nut as specified.

REQUIRED TOOL	
CLUTCH HOLDER (P/N 529 036 238)	

TIGHTENING TORQUE		
Driven pulley nut	STEP 1	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)
	STEP 2	180° ± 5°

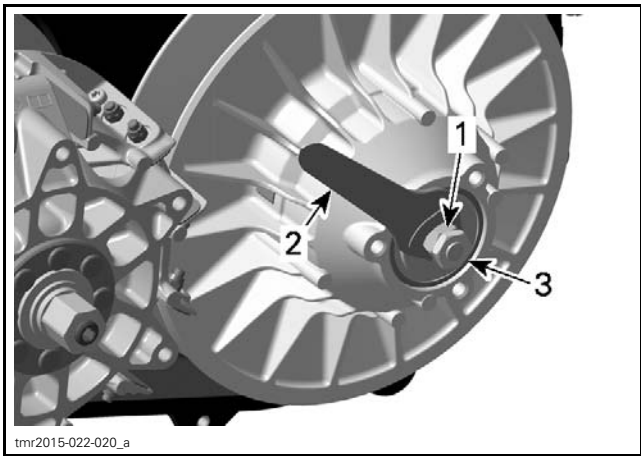


- 1. Driven pulley nut

Remove service tool.

Hold driven pulley nut using a spanner and tighten the **NEW** counter nut to specification.

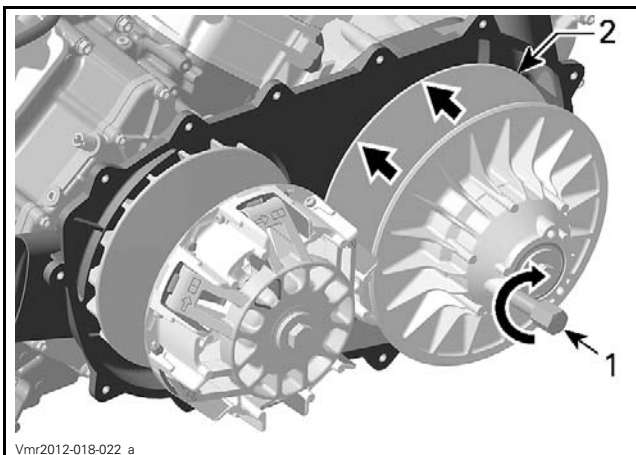
TIGHTENING TORQUE	
Counter nut	35 N•m ± 1 N•m (26 lbf•ft ± 1 lbf•ft)



- 1. Driven pulley nut
- 2. Spanner
- 3. Counter nut

Install drive belt. Refer to *DRIVE BELT* in this subsection.

REQUIRED TOOL	
PULLER/LOCKING TOOL (P/N 529 036 098)	



1. Pulser/locking tool
2. Sliding sheave

NOTE: If driven pulley sheaves can to be opened when the service tool is screwed in, the cam is not correctly engaged in the sliding sheave.

CVT AIR GUIDE

CVT Air Guide Removal

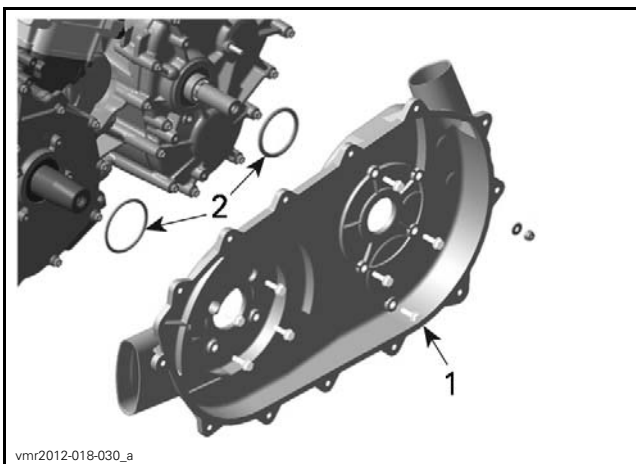
Remove the *DRIVE PULLEY* and the *DRIVEN PULLEY*.

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.

COOLING SYSTEM

SERVICE TOOLS

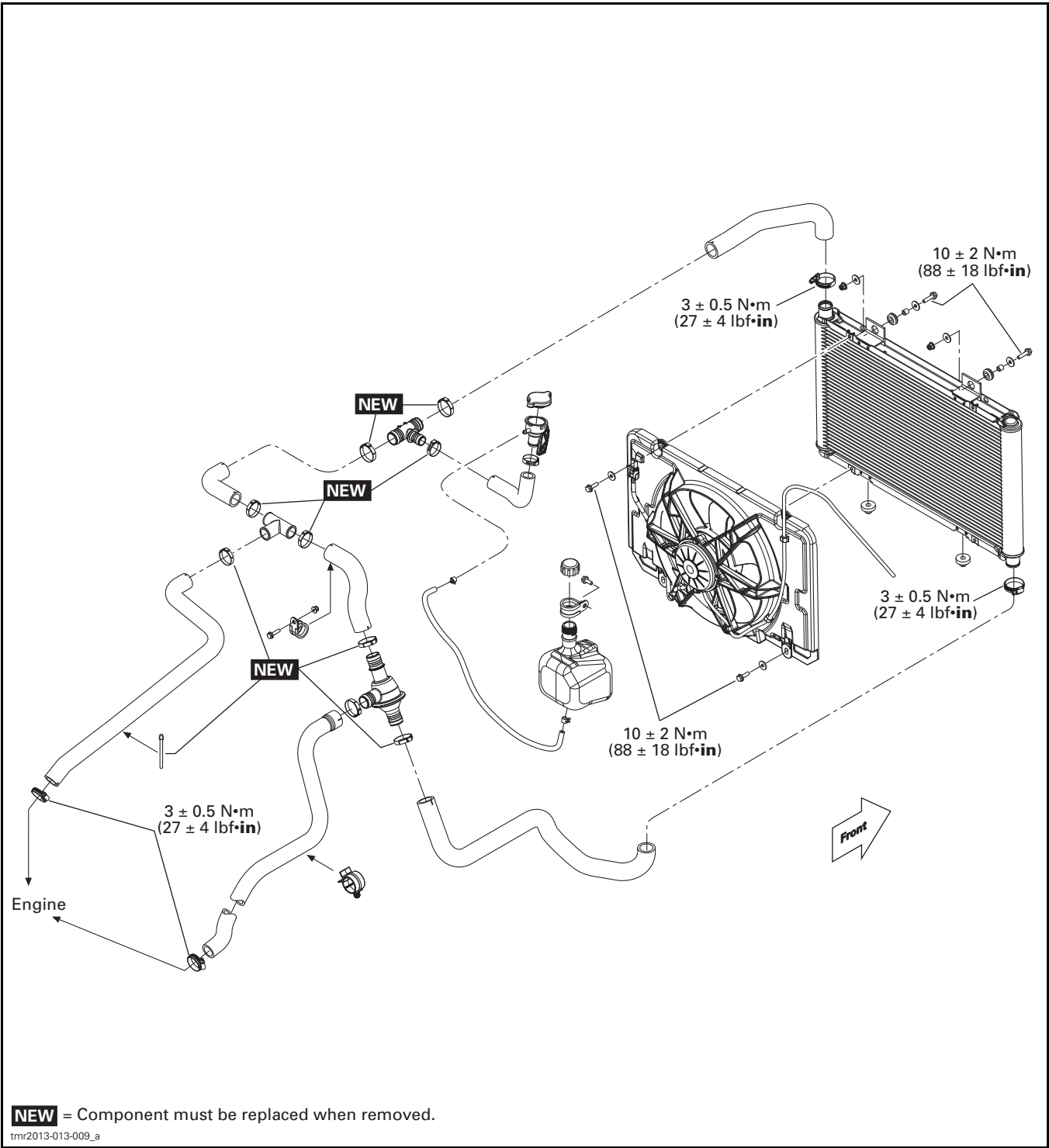
Description	Part Number	Page
BLIND HOLE PULLER KIT	529 036 056	18
HANDLE	420 877 650	19
LARGE HOSE PINCHER.....	529 032 500	7-8
OIL SEAL PUSHER.....	529 035 757	19
ROTARY SEAL PUSHER PLATE.....	529 036 130	16
SEAL PUSHER	529 035 766	16, 20

SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	19
LOCTITE 243 (BLUE).....	293 800 060	8

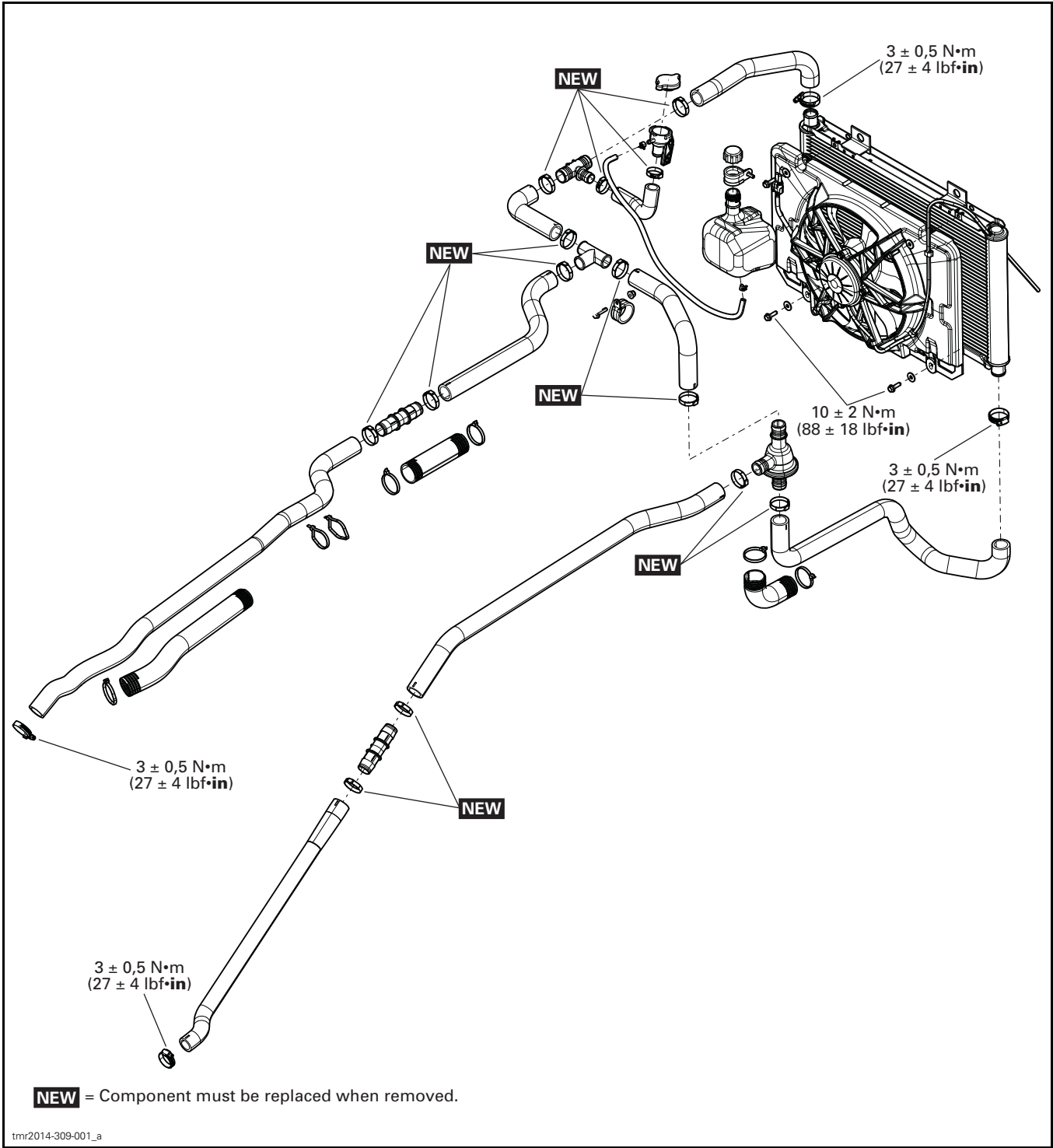
RADIATOR

2-UP Models - 1000 Engine



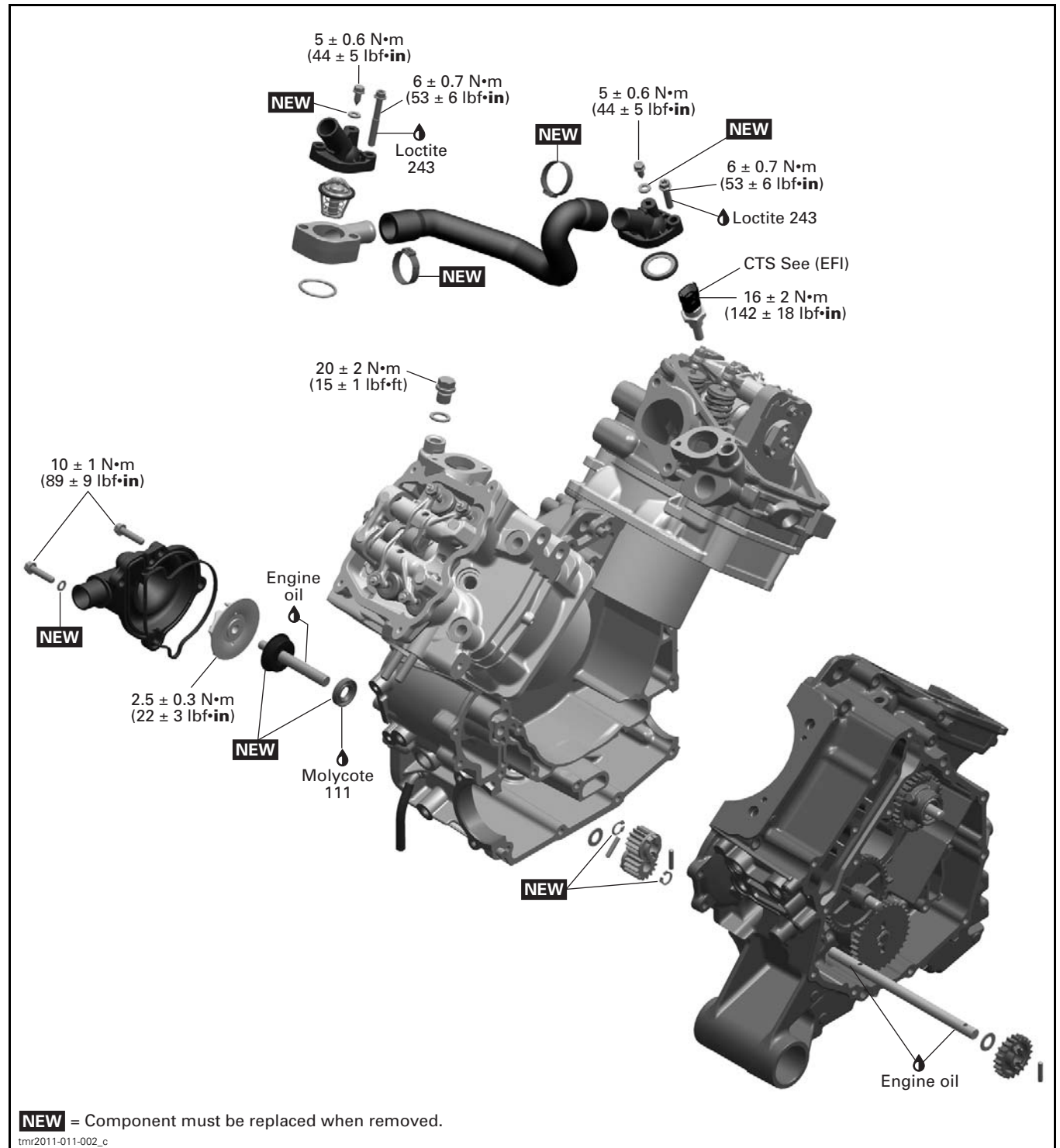
RADIATOR

MAX Models



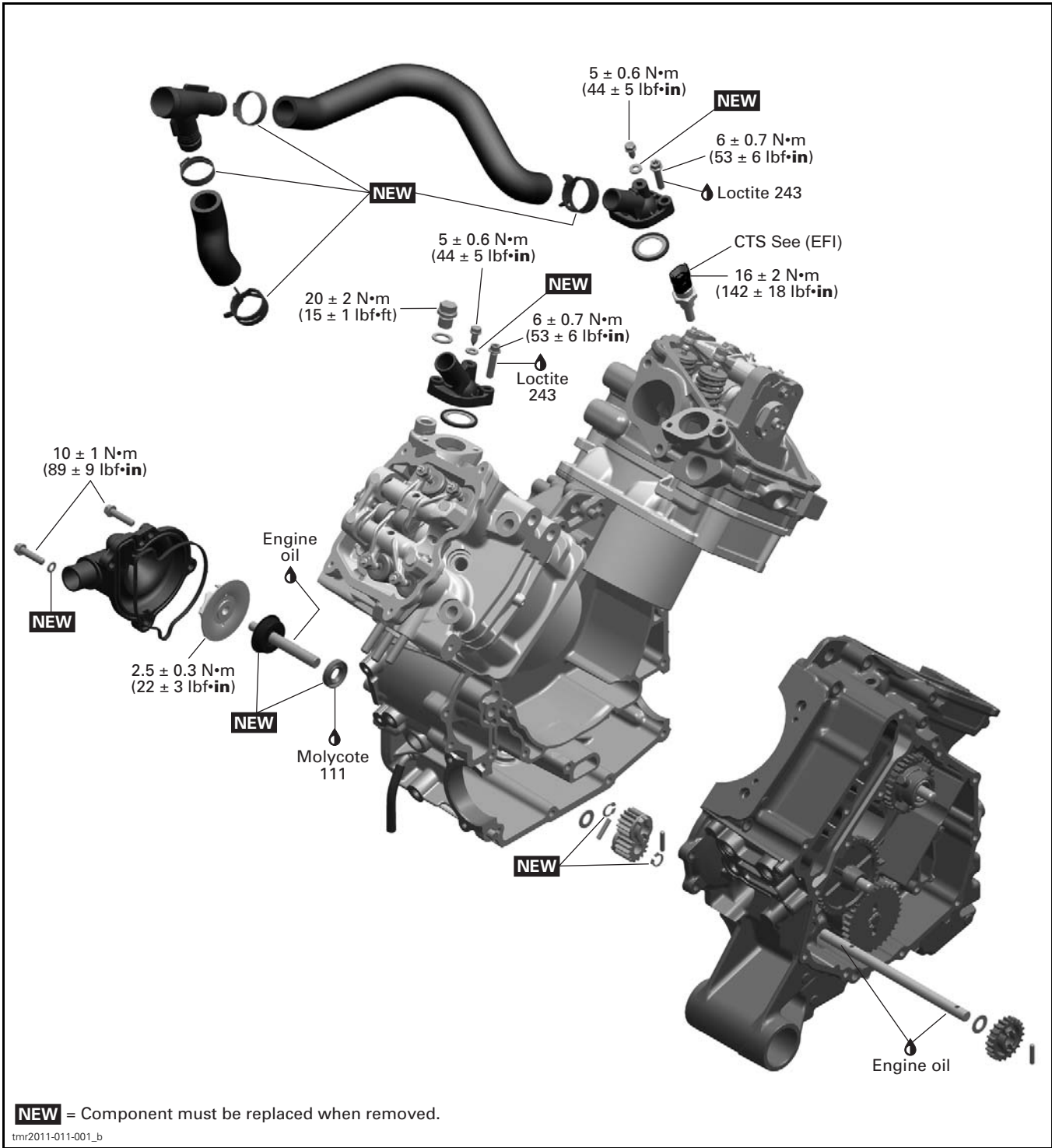
WATER PUMP

800R Engine



WATER PUMP

1000 Engine



NEW = Component must be replaced when removed.

tmr2011-011-001_b

GENERAL

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

PROCEDURES

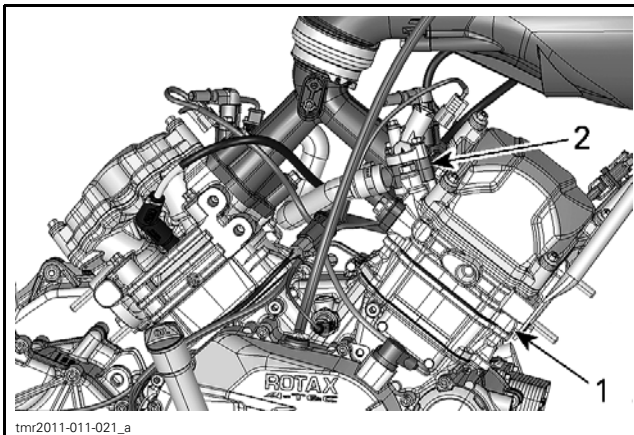
THERMOSTAT

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).

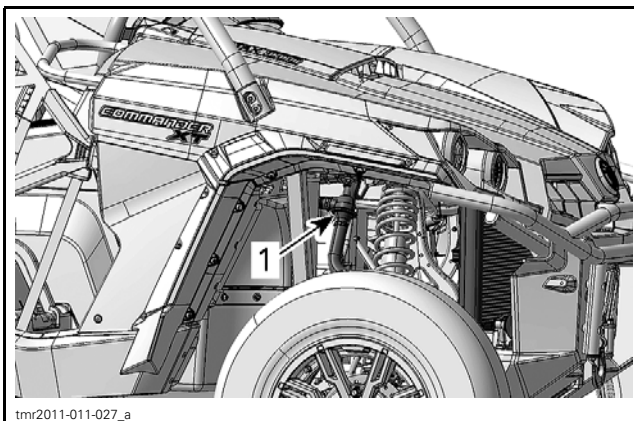


TYPICAL - THERMOSTAT LOCATION 800R MODELS

1. Front cylinder
2. Thermostat housing

1000 Models

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



THERMOSTAT LOCATION - RH FRONT WHEEL WELL ACCESS

1. In-line thermostat

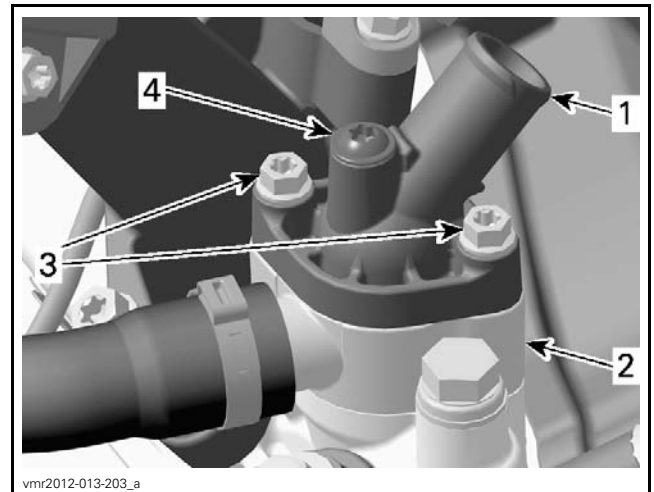
Thermostat Removal

800R Models

1. Install a hose pincher on both radiator hoses.

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

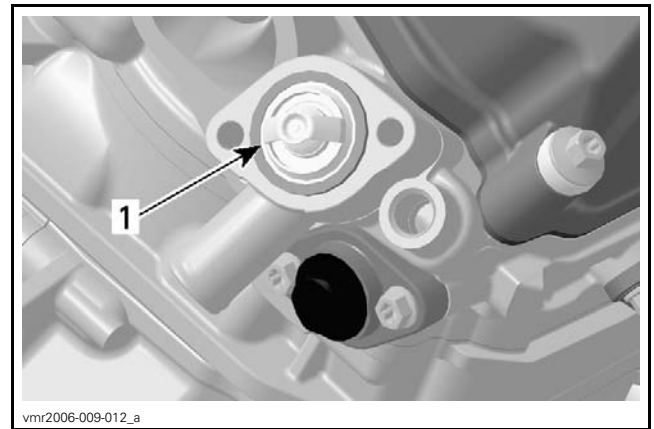
2. Drain remainder of cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Remove thermostat housing screws and remove thermostat cover.



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

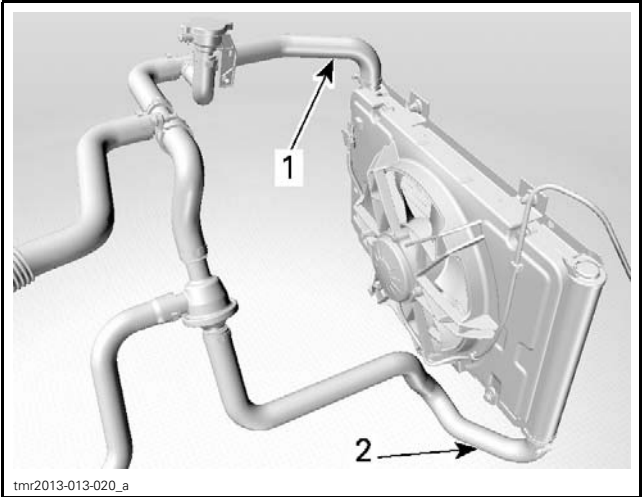
1. Thermostat with gasket

1000 Models

1. Install a hose pincher on both radiator hoses.

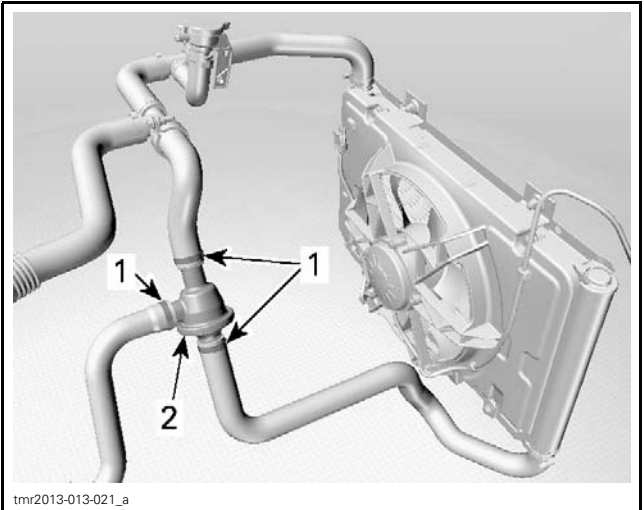
Subsection XX (COOLING SYSTEM)

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



1. Install hose pincher from LH side
2. Install hose pincher from RH side

2. Drain remainder of cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Remove Oetiker clamps that secure hoses to thermostat.
4. Remove thermostat.



1. Clamps
2. 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	TIGHTENING 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 MAINTENANCE PROCEDURES* subsection.

NOTICE The cooling system must be bled as specified.

Check for coolant leaks.

RADIATOR

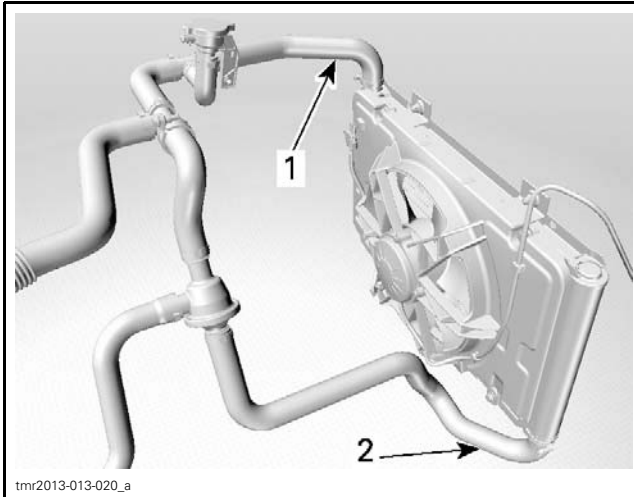
Radiator Inspection

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 hose pincher on both radiator hoses.

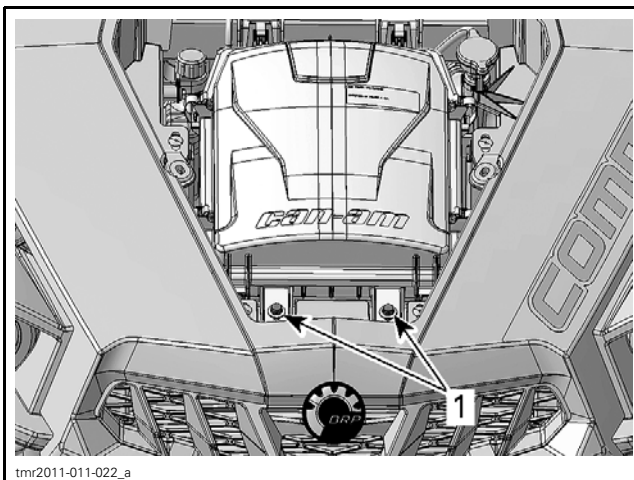
REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 529 032 500)	



1. Install hose pincher from LH side
2. Install hose pincher from RH side

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.
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

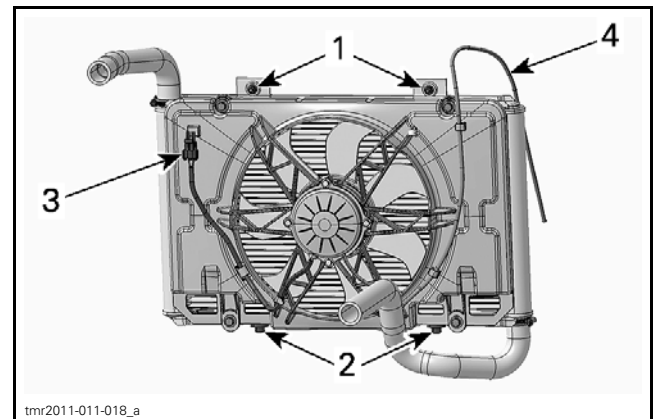
8. Lift radiator and tilt its lower end towards the front of the vehicle.

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 routed as illustrated.

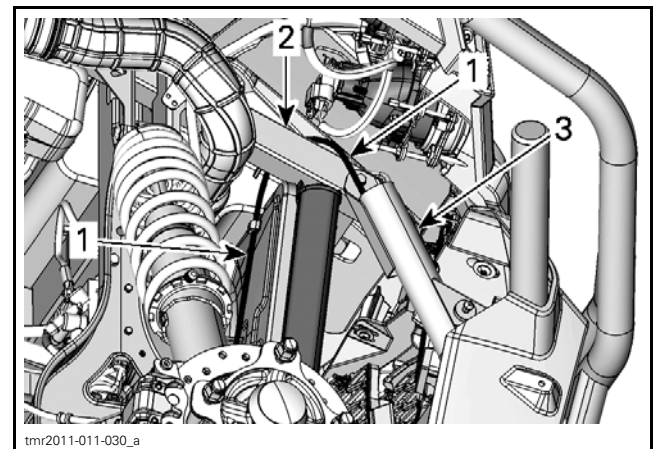


RADIATOR - REAR VIEW

1. Radiator mounting screws
2. Lower mounting bushings
3. Radiator fan electrical connector
4. Fan motor vent hose

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 routed, 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

- 4. Fill radiator with the recommended coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* 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)

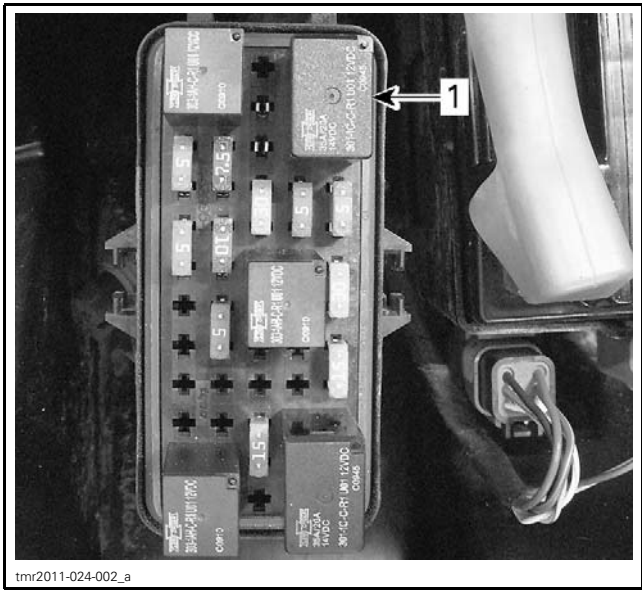
Relay Installation
(Radiator Cooling Fan)

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.

RADIATOR COOLING FAN

Radiator Cooling Fan Operation

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



1. R1: Radiator cooling fan relay

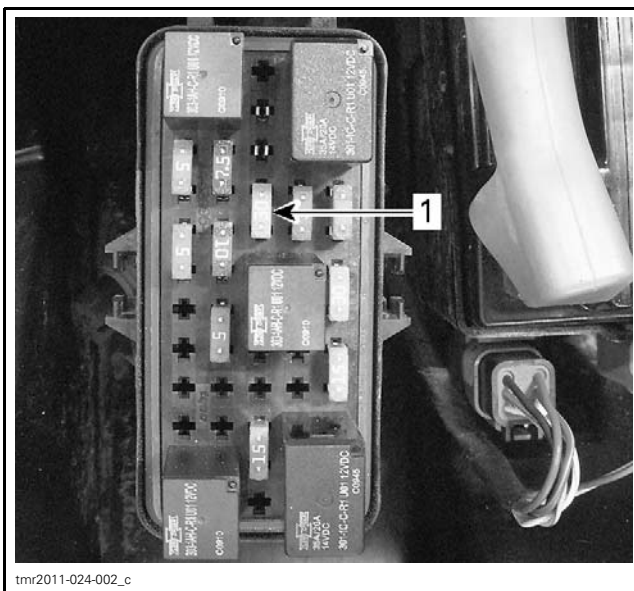
Relay Operation Test
(Radiator Cooling Fan)

The easiest way to check the relay is to remove it and temporarily substitute with the accessory relay. If the radiator cooling fan operates, replace the relay.

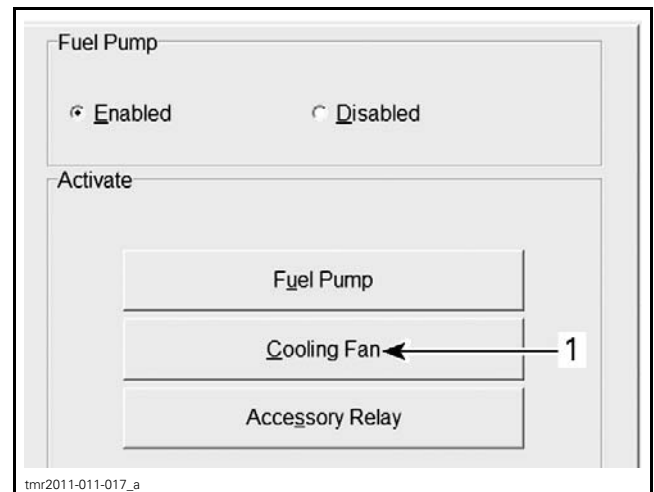
ENGINE TEMPERATURE	INTAKE TEMPERATURE	COOLING FAN	CHECK ENGINE LIGHT	MESSAGE IN MULTIFUNCTION GAUGE	LIMP HOME MODE
—	88°C (190°F)	Turns ON	—	—	—
—	85°C (185°F)	Turns OFF	—	—	—
96°C (205°F)	—	Turns ON	—	—	—
92°C (198°F)	—	Turn OFF	—	—	—
115°C (239°F)	—	ON	Turns ON	- Check engine - Hi Temp	—
118°C (244°F)	—	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.



1. Cooling fan fuse



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.

Radiator Cooling Fan Test

1. Connect the vehicle to B.U.D.S., refer to *COMMUNICATION 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 tab
 - ECM tab
 - Cooling Fan button.

Subsection XX (COOLING SYSTEM)

COOLING FAN TROUBLESHOOTING CHART		
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		
↓		
Fan turns?	NO →	Replace fan Is fan working?
YES ↓		
Check CTS		
↓		
CTS works?	NO →	Replace CTS Is fan working?
YES ↓		
Check wiring harness and connectors		
↓		
Harness and connectors good?	NO →	Repair or replace defective part(s)
YES ↓		
Try a new ECM	→	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

Water Pump Housing Location

It is located on the engine MAG side (RH side of engine).

Water Pump Housing Access

Remove fuel tank. Refer to *FUEL SYSTEM* subsection.

Water Pump Housing Removal

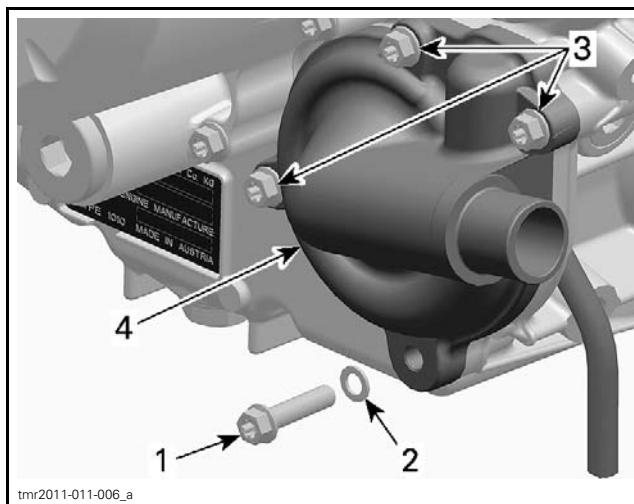
⚠ WARNING

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

Drain cooling system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove radiator outlet hose from water pump housing.

Remove screws retaining water pump housing.

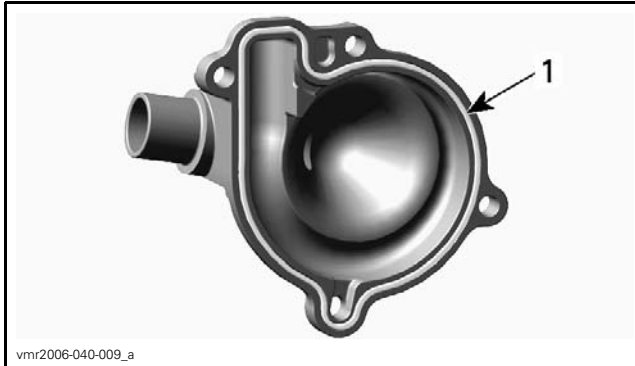


1. Coolant drain plug
2. Sealing ring
3. Screws
4. Water pump housing

Pull water pump housing to remove it.

Water Pump Housing Inspection

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



TYPICAL
1. Gasket

Water Pump Housing Installation

The installation is the opposite of the removal procedure.

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 to specification.

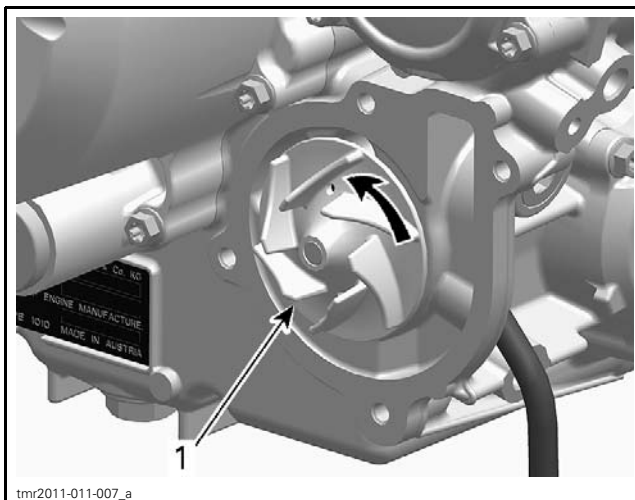
TIGHTENING TORQUE	
Water pump housing screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

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

Use these guidelines to service these parts.

DEFECTIVE PART	ACTION
Rotary seal	Replace: - Rotary seal - Oil seal (assembled engine)
Oil seal	Replace: - Rotary seal - Oil seal (assembled engine)
Water pump shaft	Replace: - Water pump shaft assembly (including rotary seal) - Oil seal (engine disassembled)

NOTICE Rotary seal must be replaced if water pump shaft is to be replaced.

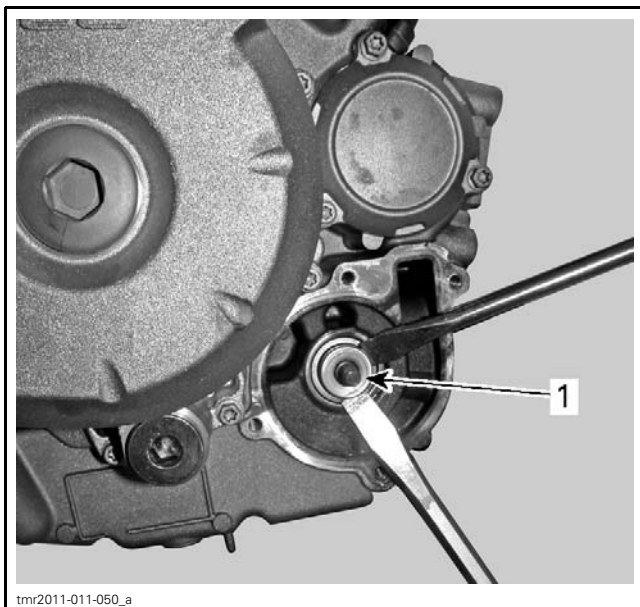
Water Pump Seals Replacement (Assembled Engine)

NOTE: Read and thoroughly understand the entire procedure before starting it.

Seals Removal

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

- Remove the following parts, see procedure in this subsection.
 - *WATER PUMP HOUSING*
 - *WATER PUMP IMPELLER*.
- Carefully pry out inner part of the rotary seal using 2 screwdrivers.

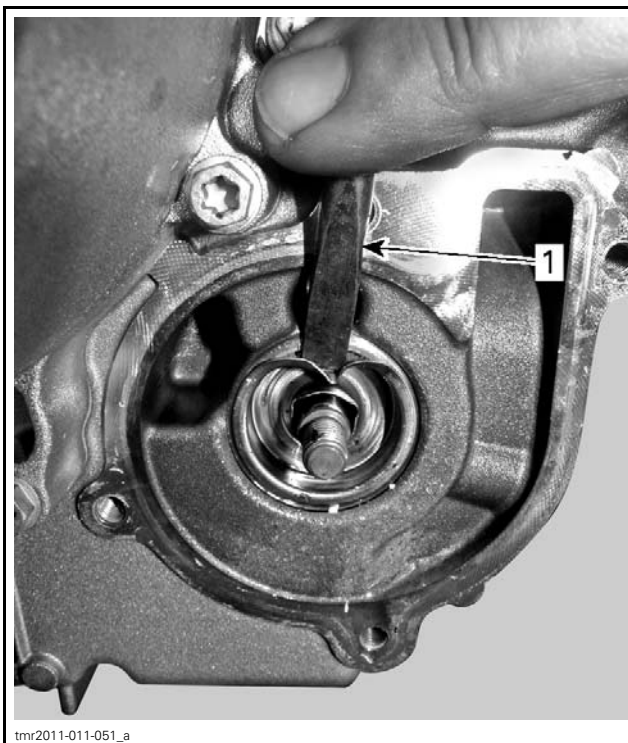


1. Inner part of rotary seal



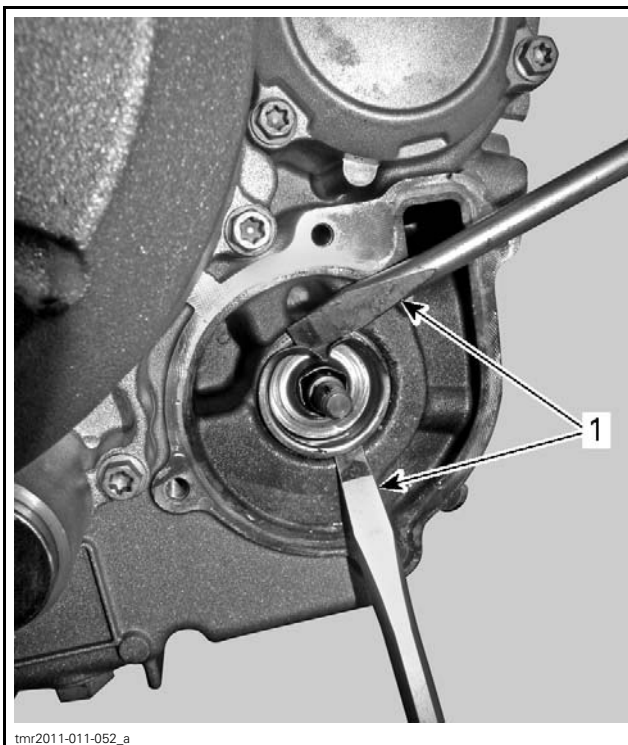
TYPICAL - INNER PART OF ROTARY SEAL REMOVED

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



1. Small chisel

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

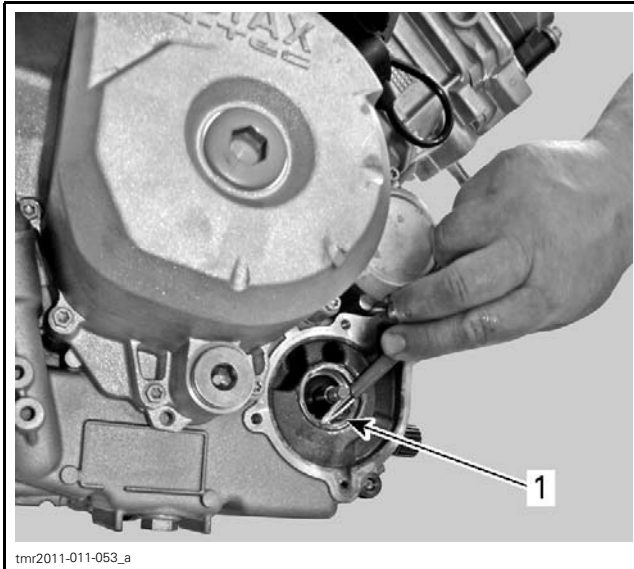


1. Screwdrivers

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

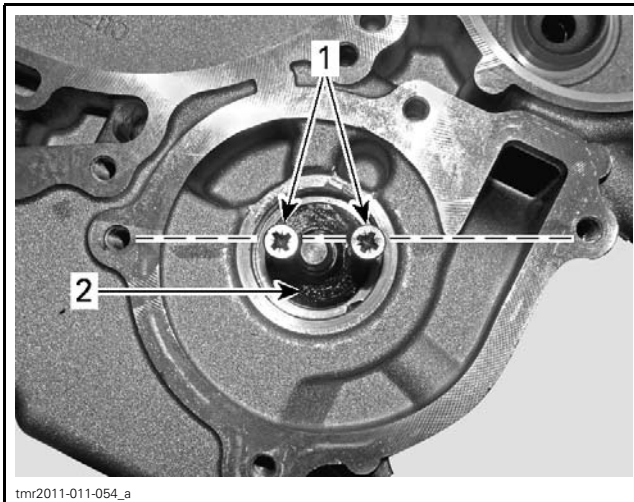
5. Thoroughly remove carefully sealing residue and burr of rotary seal using a scraper.

NOTICE Be careful not to damage water pump shaft.



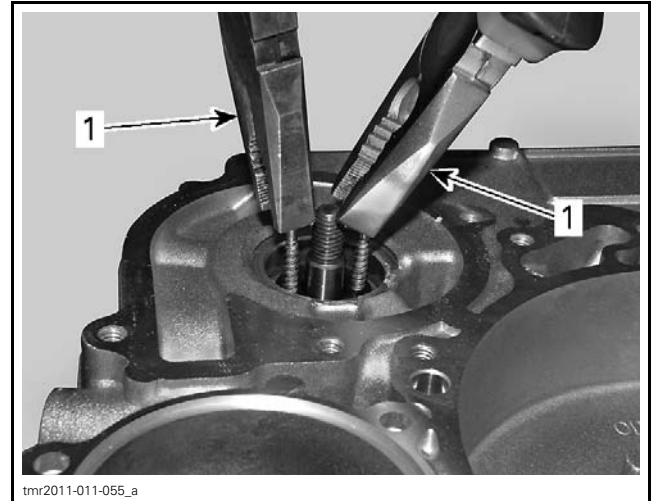
1. Scraper

6. Install 2 wooden screws in the seal.



1. Wooden screws
2. Oil seal

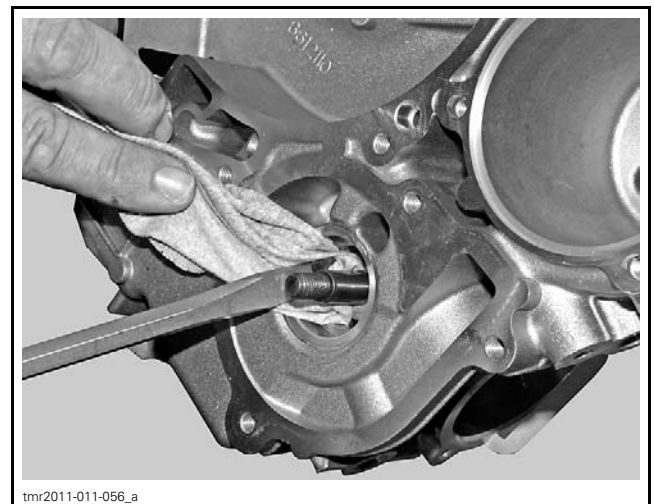
7. Remove oil seal from crankcase by pulling screws with pliers.



1. Pull on screws to remove seal

8. Check water pump shaft axial play. If not adequate, engine must be disassembled to replace the water pump shaft.

9. Clean oil seal seat.

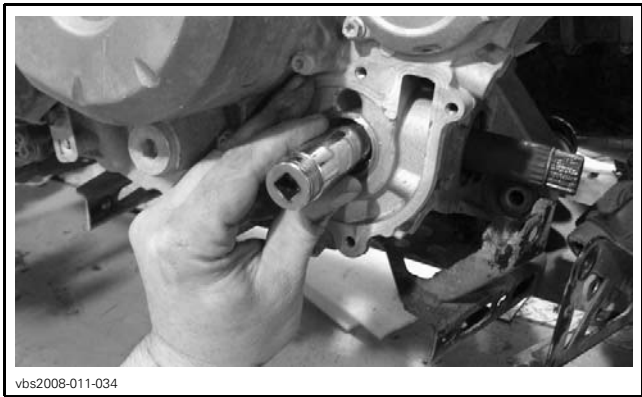


Seals Installation

1. Apply engine oil on water pump shaft.
2. Apply grease to the lips of the oil seal.
3. Carefully install the oil seal over the water pump shaft.
4. Push the oil seal into the water pump cavity.

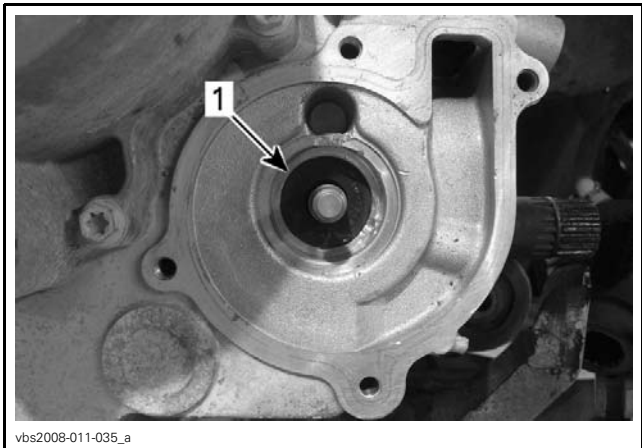
REQUIRED TOOL

17 mm (11/16 in) deep socket



OIL SEAL INSTALLATION

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



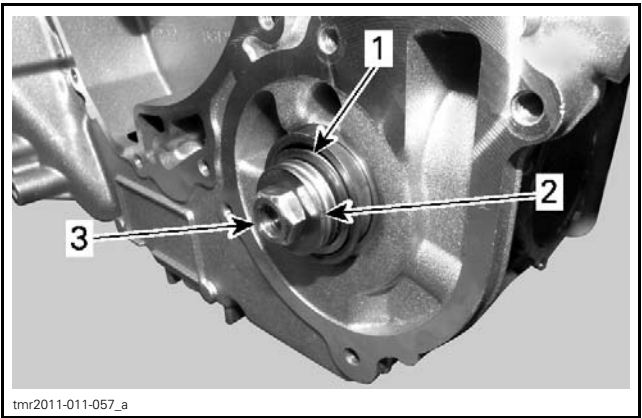
TYPICAL

1. Oil seal properly seated

6. Apply engine oil on water pump shaft.
7. 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.

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



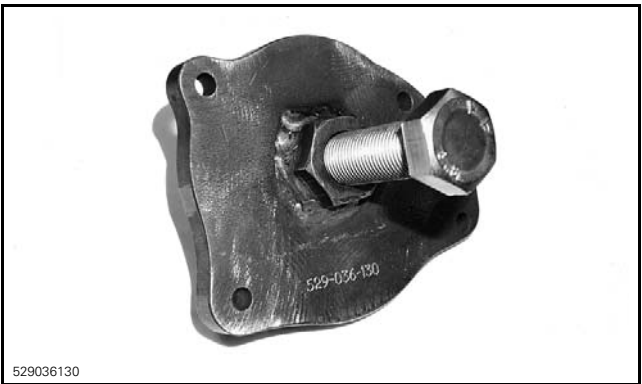
1. Rotary seal
2. M8 robust flat washer (P/N 420 227 935)
3. M8 x 1.25 nut (P/N 233 281 414)

11. Remove M8 nut.

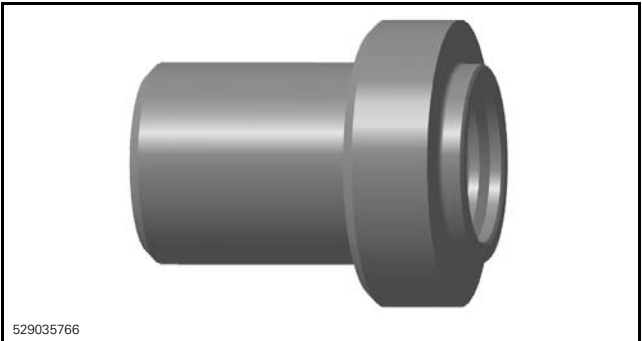
NOTE: The robust M8 flat washer remains on water pump shaft.

12. Install rotary seal installation tools on crankcase as follows.

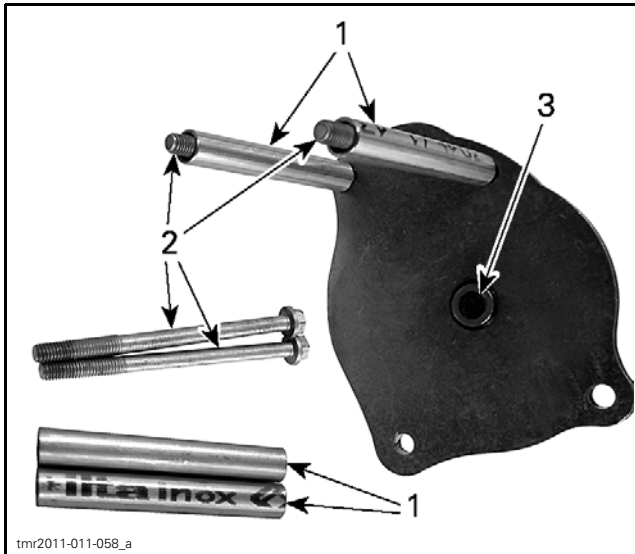
REQUIRED TOOLS
ROTARY SEAL PUSHER PLATE (P/N 529 036 130)
4x M6 x 85 screws (P/N 420 440 347)
4x tubes 70 mm (2.75 in)
SEAL PUSHER (P/N 529 035 766)



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



SEAL PUSHER (P/N 529 035 766)



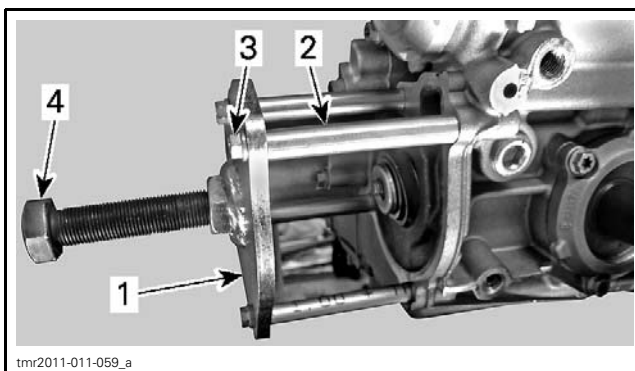
ROTARY SEAL PUSHER PLATE ASSEMBLY

1. 4 x tubes (70 mm (2.75 in) length)
2. 4 x screws M6 x 85
3. Plane surface on pusher bolt

NOTE: Make sure pusher bolt has a plane surface.

- 12.1 Apply a little grease at the end of tool pusher bolt.
- 12.2 Ensure that pusher bolt is completely unscrewed.
- 12.3 Install rotary seal pusher plate on crankcase by tightening M6 screws.

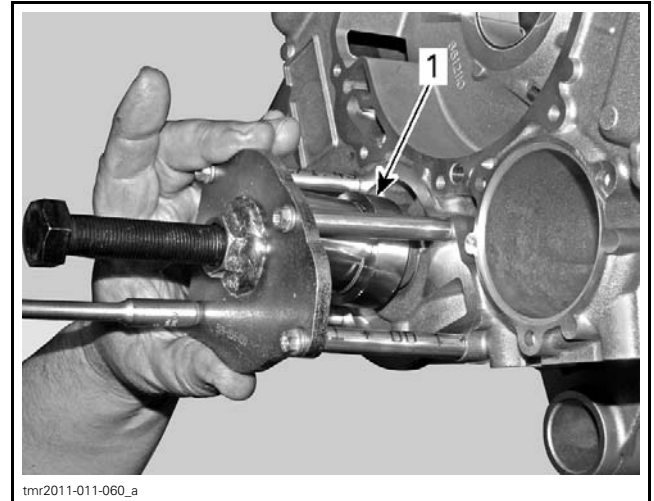
NOTICE Do not use pneumatic or electric tools for tightening screws.



ROTARY SEAL PUSHER PLATE INSTALLATION

1. Rotary seal pusher plate
2. Tube (70 mm (2.75 in) length)
3. M6 x 85 screw
4. Pusher bolt

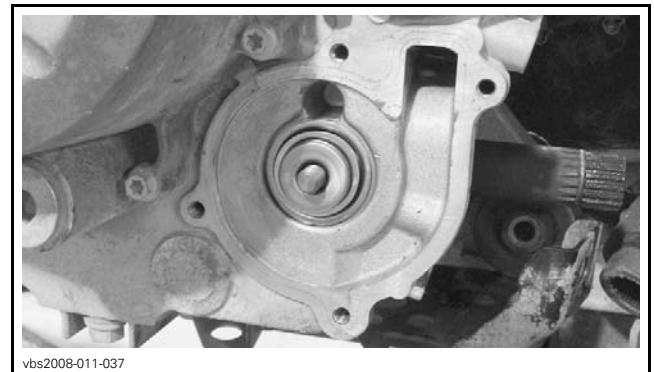
- 12.4 Install seal pusher between rotary seal pusher plate and water pump shaft.



SEAL PUSHER INSTALLATION

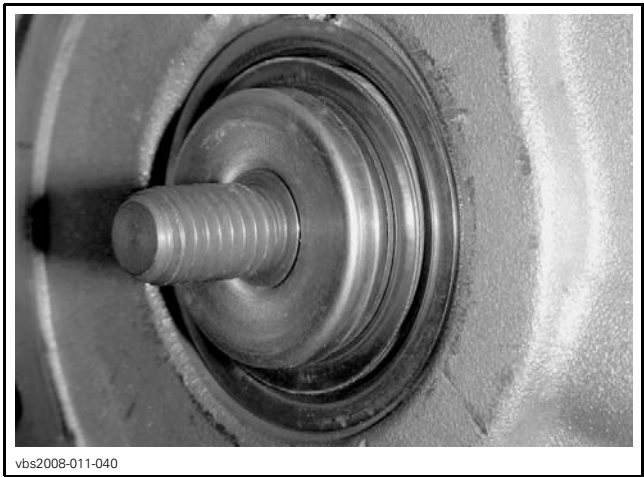
1. Seal pusher aligned with pusher bolt

- 12.5 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 rotary seal installation tools from crankcase.
- Repeat the steps 9 to 15 until rotary seal is completely seated in the crankcase.
16. Remove tools from crankcase.



ROTARY SEAL PROPERLY SEATED ON CRANKCASE

17. Carry out the final adjustment of the water pump shaft as follows.
 - 17.1 Install M8 x 1.25 nut (P/N 233 281 414) onto water pump shaft.
 - 17.2 Carefully thread M8 nut until the rotary seal is flush with the end of water pump shaft threads.



WATER PUMP SHAFT PROPERLY ADJUSTED WITH ROTARY SEAL

NOTICE The water pump shaft must be properly adjusted with rotary seal. The water pump shaft must move freely while pushing it toward the crankcase.

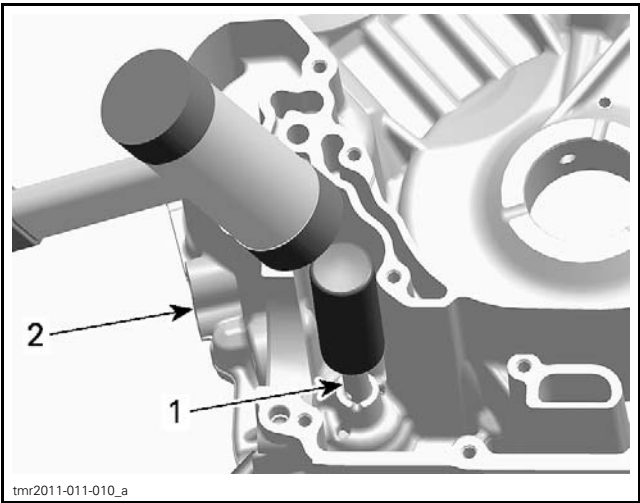
- 18. Install the following parts, see procedure in this subsection.
 - WATER PUMP IMPELLER
 - WATER PUMP HOUSING.
- 19. Refill and bleed cooling system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
- 20. Check cooling system for leaks.

Water Pump Shaft and Seals Replacement (Disassembled Engine)

Water Pump Shaft and Seals Removal

- 1. Remove the following parts:
 - WATER PUMP HOUSING
 - WATER PUMP IMPELLER
 - WATER PUMP GEARS.
- 2. Push out water pump shaft with inner portion of rotary seal from inside of crankcase MAG side.

REQUIRED TOOL
Soft hammer

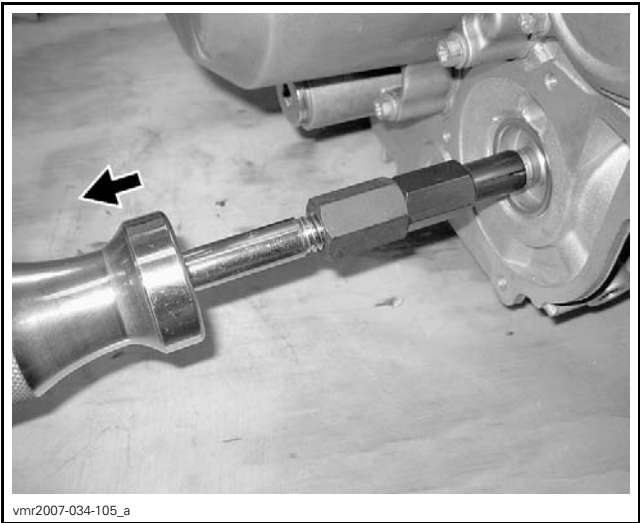


- 1. Water pump shaft
- 2. Crankcase MAG side

3. Remove outer part of rotary seal.

REQUIRED TOOL	
BLIND HOLE PULLER KIT (P/N 529 036 056)	

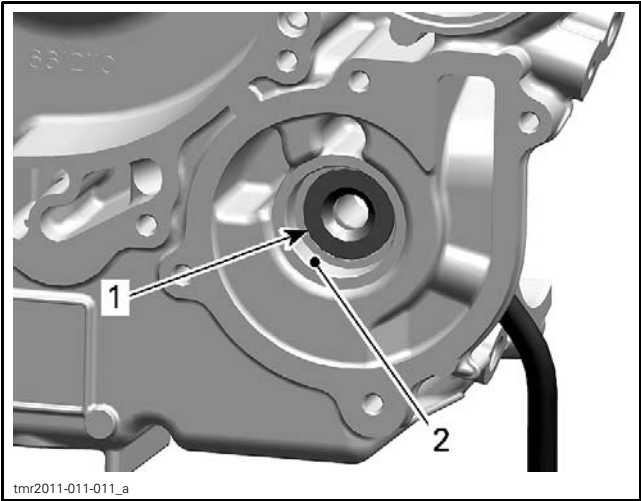
4. Install expander snugly against outer part of rotary seal and pull seal out.



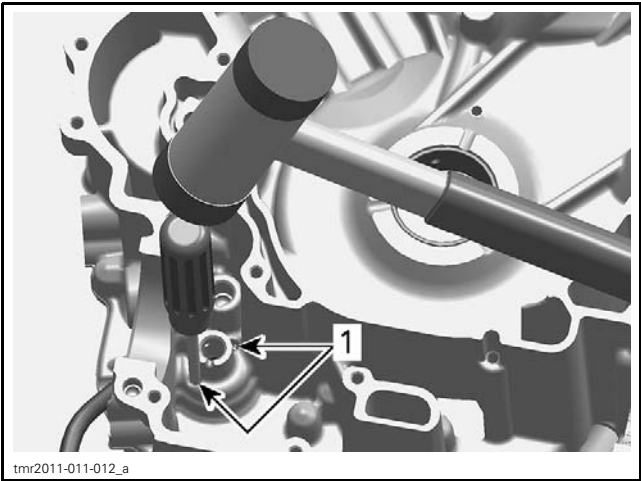
TYPICAL

5. 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 seal



OIL SEAL REMOVAL - VIEW FROM INSIDE CRANKCASE MAG SIDE

1. Orifices for oil seal removal

Water Pump Shaft and Seals Installation

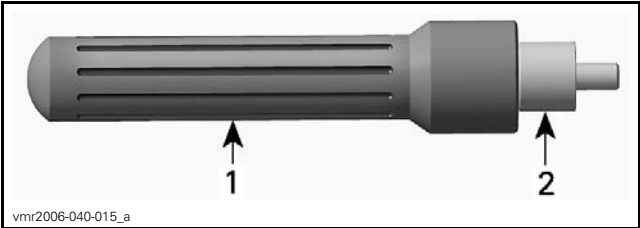
The installation is the reverse of the removal procedure. However, pay attention to the following. Use tightening torque values specified in the exploded view.

NOTE: Never apply oil on the press fit area of the oil seal and rotary seal.

Clean rotary seal surface of any old sealant.

Install oil seal.

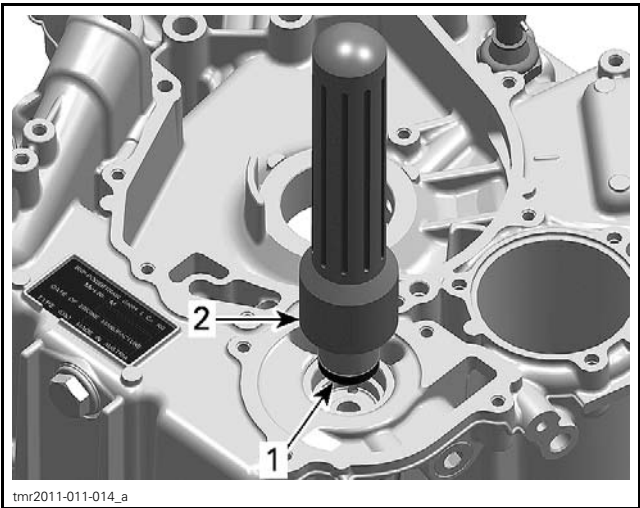
REQUIRED TOOL
OIL SEAL PUSHER (P/N 529 035 757)
HANDLE (P/N 420 877 650)



1. Handle
2. Pusher

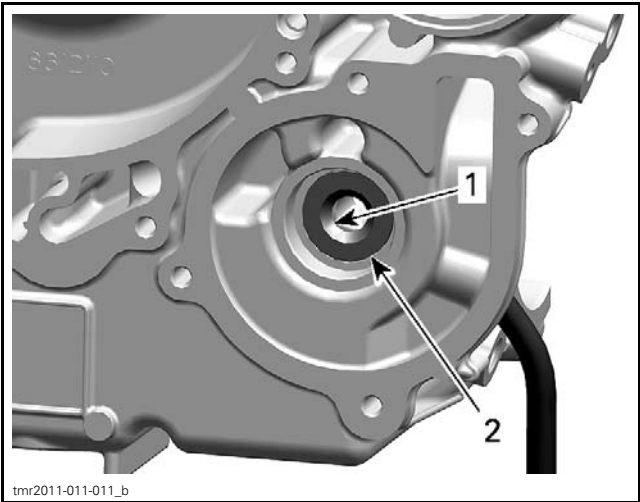
When installing the oil seal on the pusher, make sure the sealing lip points outwards.

Push NEW oil seal in place.



1. 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.

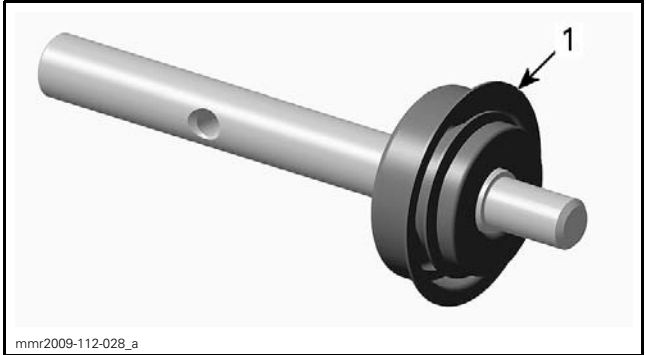


1. Sealing lip
2. Oil seal properly installed

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

Slide NEW water pump shaft assembly into crankcase.

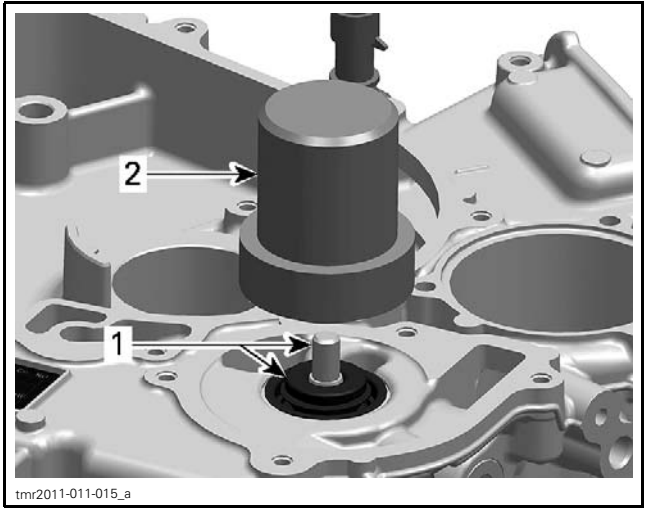
REQUIRED TOOL	
SEAL PUSHER (P/N 529 035 766)	



1. Surface where rotary seal is pushed by tool

Water Pump Shaft Assembly

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

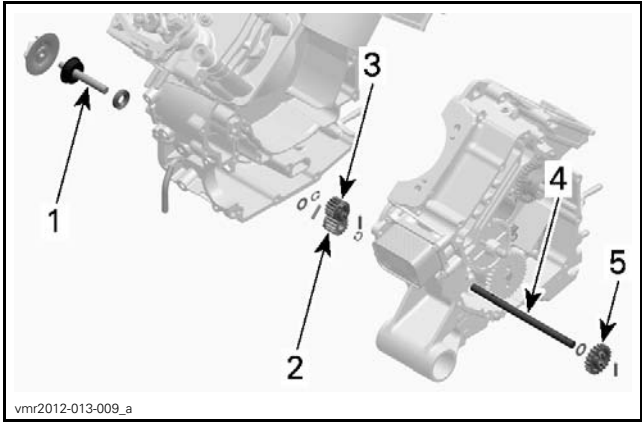


1. Water pump shaft with rotary seal
2. Water pump seal installer

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

WATER PUMP GEARS

Water Pump Gears Identification

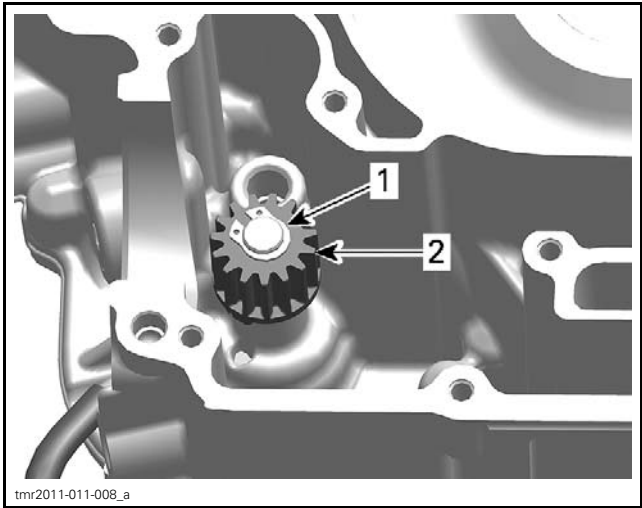


1. Water pump shaft
2. Water pump gear
3. Water pump intermediate drive gear
4. Water pump intermediate shaft
5. Water pump drive gear (See BOTTOM END subsection)

Water Pump Gears Inspection

Water Pump Gear

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

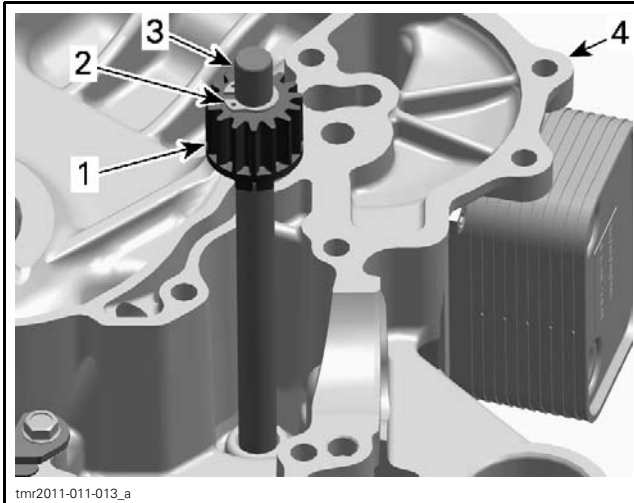


CRANKCASE MAG SIDE

1. Circlip
2. Water pump gear

Water Pump Intermediate Drive Gear

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



tmr2011-011-013_a
CRANKCASE PTO SIDE

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

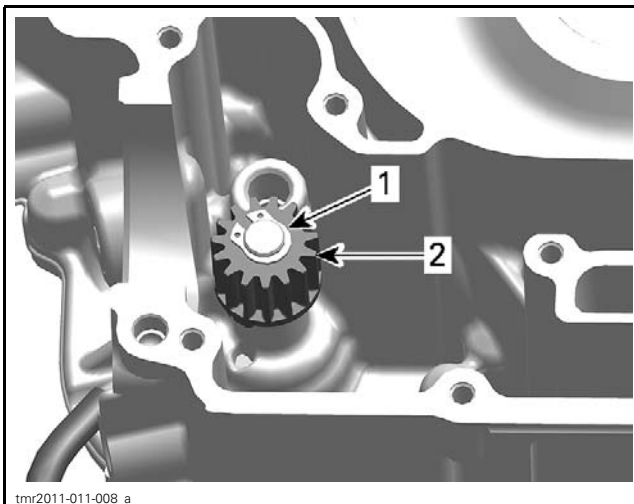
Water Pump Drive Gear

See *BOTTOM END* subsection.

Water Pump Gears Removal

Water Pump Gear

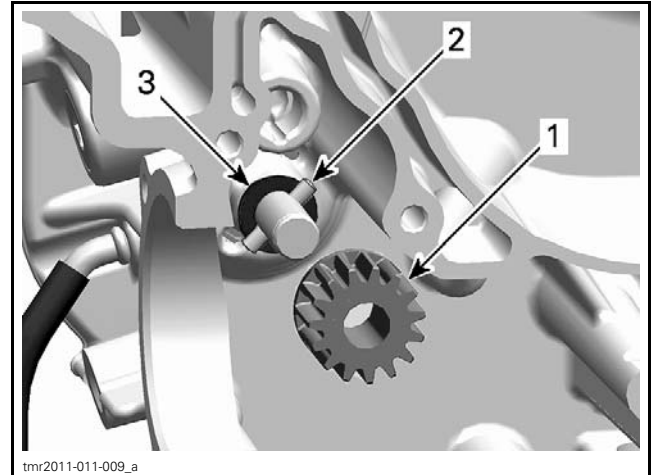
1. Remove circlip retaining water pump gear and discard it.



tmr2011-011-008_a
CRANKCASE MAG SIDE

1. Circlip
2. Water pump gear

2. Remove the following parts:
 - Water pump gear
 - Needle pin
 - Thrust washer.

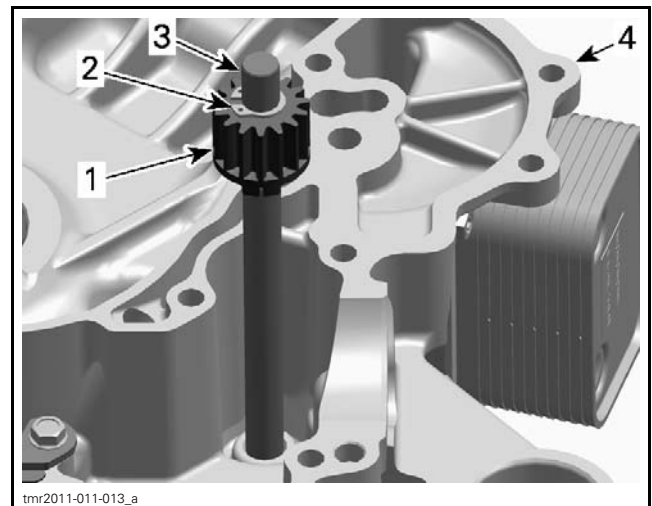


tmr2011-011-009_a
CRANKCASE MAG SIDE

1. Water pump gear
2. Needle pin
3. Thrust washer

Water Pump Intermediate Drive Gear

1. Remove circlip retaining water pump intermediate drive gear and discard it.



tmr2011-011-013_a
CRANKCASE PTO SIDE

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

2. Remove the following parts:
 - Water pump intermediate drive gear
 - Needle pin.

Water Pump Drive Gear

See *BOTTOM END* subsection.

Water Pump Gears Installation

Water Pump Gear

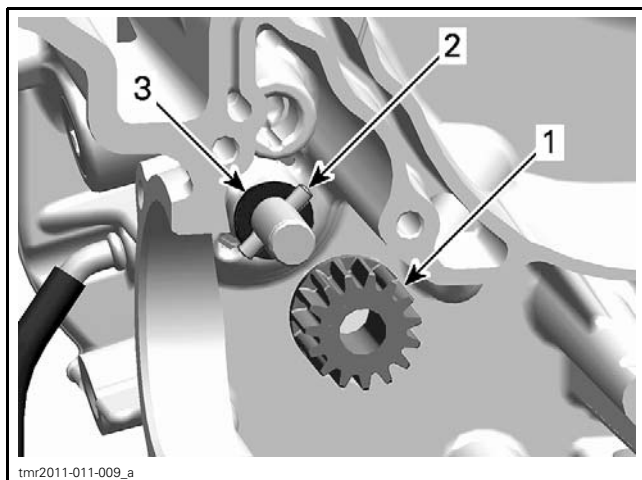
Install the following parts on water pump shaft.

- Thrust washer

Subsection XX (COOLING SYSTEM)

- Needle pin
- Water pump gear.

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

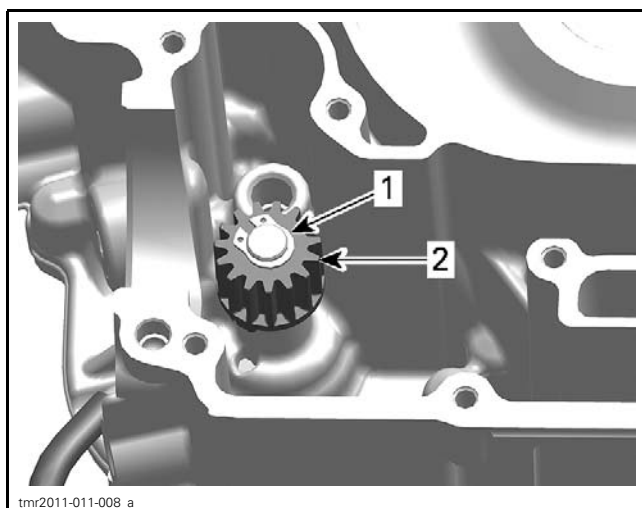


1. Water pump gear
2. Needle pin
3. Thrust washer

NOTE: Ensure water pump gear snaps properly onto needle pin.

Install **NEW** circlip to retain water pump gear.

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



1. Circlip
2. Water pump gear

Water Pump Intermediate Drive Gear

Install the following parts on water pump intermediate shaft.

- Needle pin
- Water pump intermediate drive gear.

Install **NEW** circlip to retain water pump intermediate drive gear.

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

Water Pump Drive Gear

See *BOTTOM END* subsection.

ELECTRONIC FUEL INJECTION (EFI)

SERVICE TOOLS

Description	Part Number	Page
DIGITAL INDUCTION TACHOMETER	529 014 500	2
ECM ADAPTER TOOL.....	529 036 166	5, 16, 18–21, 24
FLUKE 115 MULTIMETER	529 035 868	5, 11, 16, 19–20, 24
OETIKER PLIERS.....	295 000 070	13

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	21
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	24–25
XPS SYNTHETIC GREASE.....	293 550 010	18

GENERAL

WARNING

Fuel is flammable and explosive under certain conditions.
 Ensure work area is well ventilated.
 Do not smoke or allow open flames or sparks in the vicinity.
 Fuel lines remain under pressure at all times.
 Always proceed with care and use appropriate safety equipment when working on pressurized fuel system.
 Wipe off any fuel spillage.
 Do not allow fuel to spill on hot engine parts and/or on electrical connectors.
 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.

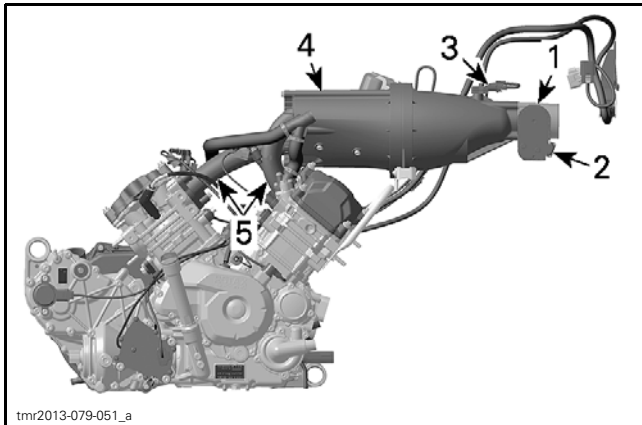
After it passes through the air filter, an air duct (intake adapter) is used to channel the air to the throttle body.

Throttle Body

The throttle body is mounted on the front end of the plenum, aft of the air filter housing.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

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 body
2. ETA and TPS
3. MAPTS (Manifold Air Pressure Temperature Sensor)
4. Plenum
5. Air intake manifolds

Fitted on the throttle body, an electronic 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.

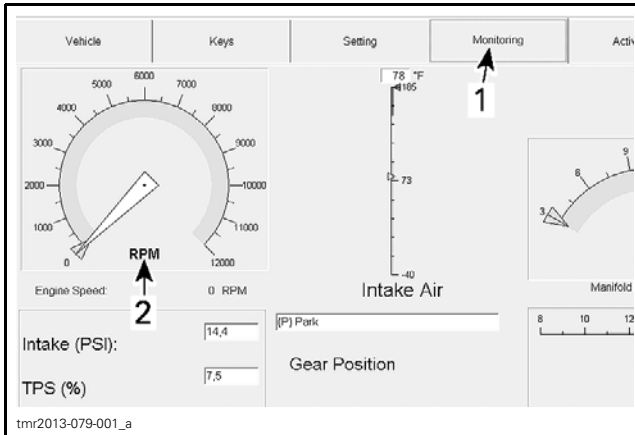


vmr2006-014-054
VERIFYING ENGINE RPM USING A DIGITAL INDUCTION TACHOMETER

The engine RPM may also be verified using the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

In B.U.D.S., select the following:

- **Read Data** button
- **Monitoring** tab
- **ECM** tab.



VERIFYING ENGINE RPM USING B.U.D.S.

1. Monitoring 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.

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:

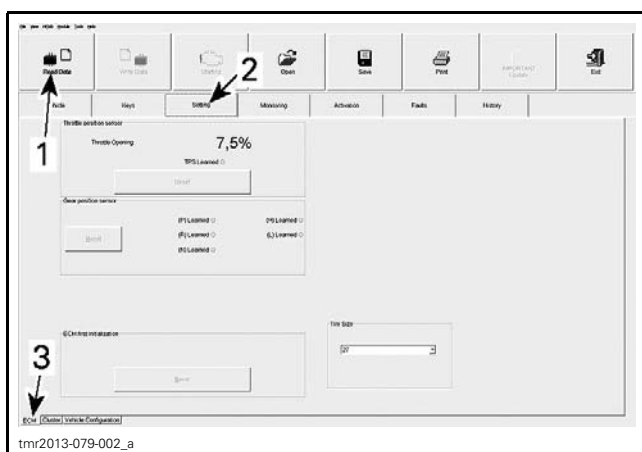
- TAS (Throttle Accelerator Sensor)
- TPS (Throttle Position sensor)
- GBPS (Gearbox Position Sensor).

This reset **must** be carried out whenever the ECM has been replaced.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

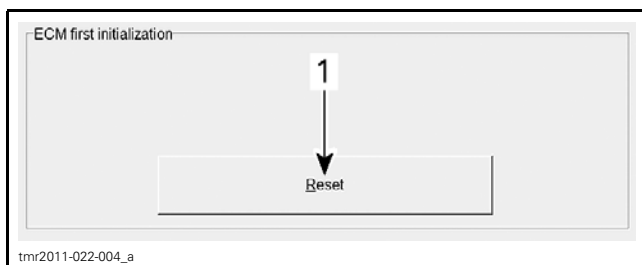
This reset **may** be carried out whenever any of the following components have been replaced instead of their respective reset procedures:

- 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** tab
 - **ECM** tab.



1. **Read Data** button
2. **Setting** tab
3. **ECM** tab

3. In the **ECM first initialization** field, click on the **Reset** button.



ECM FIRST INITIALIZATION

1. **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.

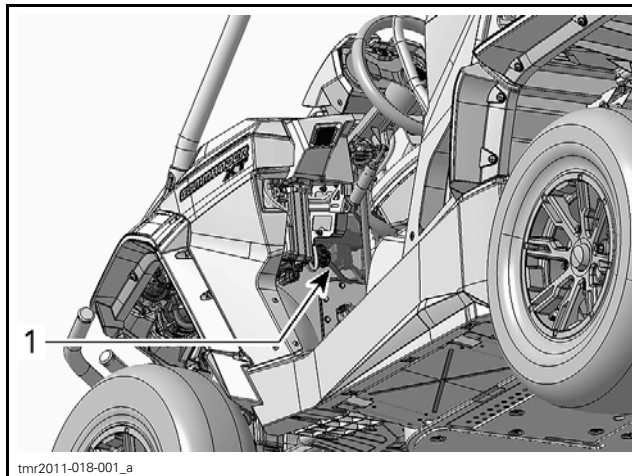
5. Check for fault codes.

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.



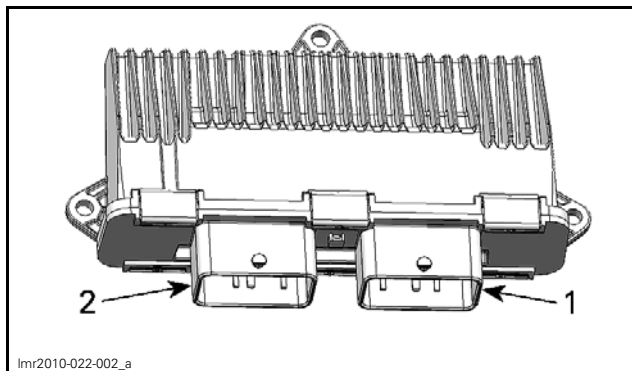
TYPICAL - ECM LOCATION

1. **ECM** location

ECM Connector Identification

There are 2 connectors connected to the ECM:

- Engine harness connected to ECM-A
- Vehicle system control harness connected to ECM-B.



1. **Connector A**
2. **Connector B**

The ECM connectors have 48 pins.

NOTE: For connector information, cleaning and probing, refer to *CONNECTOR INFORMATION* subsection.

ECM 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

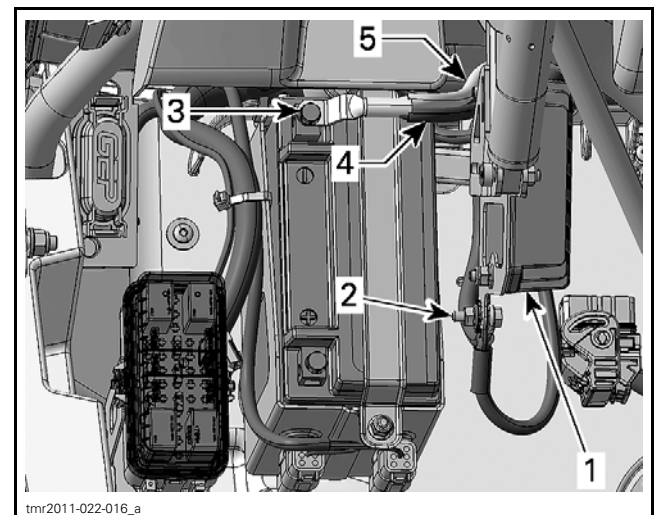
1. Disconnect connector "B" from ECM.
2. Install the ECM ADAPTER TOOL (P/N 529 036 166) on ECM-B connector.
3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Ω .
4. Probe adapter terminals as per following table.

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
3. Negative (-) battery post
4. Battery ground wire
5. Engine ground wire

ECM Removal

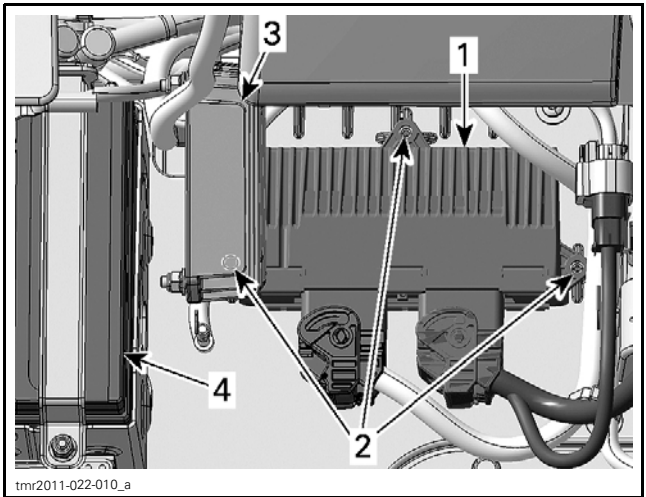
NOTE: If a new ECM is to be installed, first read the procedures in *ECM REPLACEMENT* in this subsection.

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.



- 1. ECM
- 2. Retaining screws
- 3. Voltage regulator/rectifier
- 4. Battery

ECM Installation

Reverse removal procedure however, pay attention to the following.

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 REPLACEMENT* 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 INITIALIZATION* as it may resolve the problem.

If the ECM is replaced, data must be manually entered into the new ECM.

ECM Manual Data Entry

There are 2 possible methods to collect the required information. The 1st being the easiest:

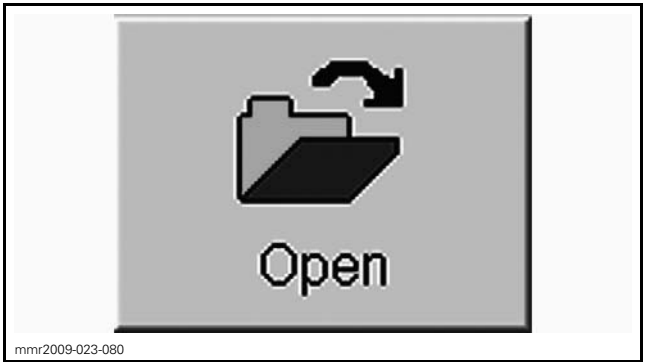
- 1. Use B.U.D.S. to obtain the data from a saved .mpem file on your PC computer.
- 2. Collect the information from the vehicle and BOSSWeb.

1st Collecting Method: Obtaining the Data from a Saved .mpem File

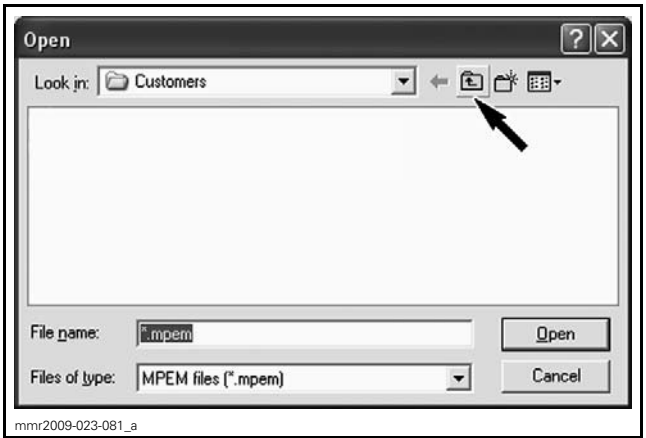
- 1. Use the B.U.D.S.

NOTE: It is not necessary to perform any connection. The PC computer can be used alone.

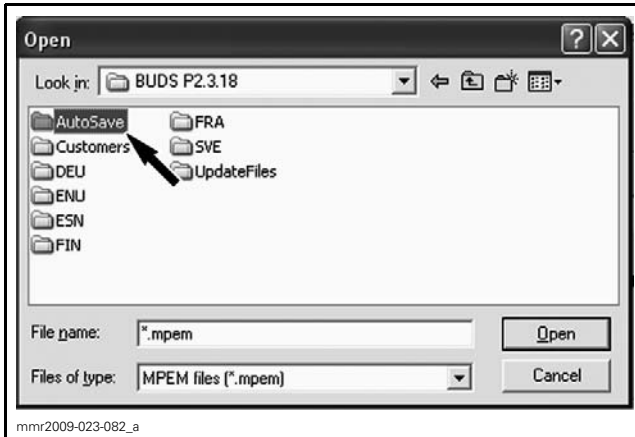
- 2. In B.U.D.S., click on the **Open** button.



3. Click once on the **Folder Up** button in the Open box.

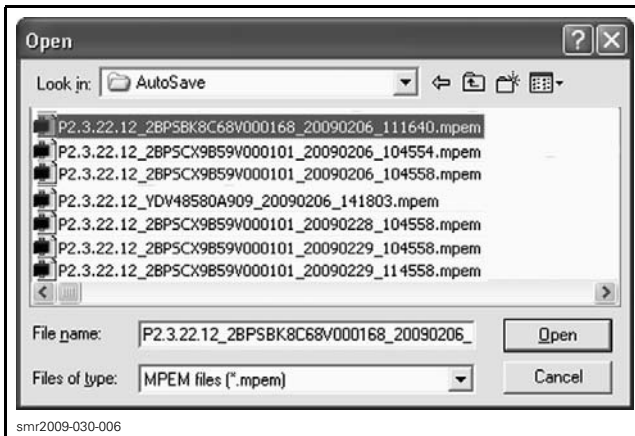


Double click on the **AutoSave** folder.



NOTE: You may have to go to another AutoSave folder from a previous version of B.U.D.S.

4. Choose the latest file saved for this specific vehicle.



IMPORTANT: Be sure to use the file that specifically matches the vehicle you are servicing.

NOTE: The file name structure is as follows:

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

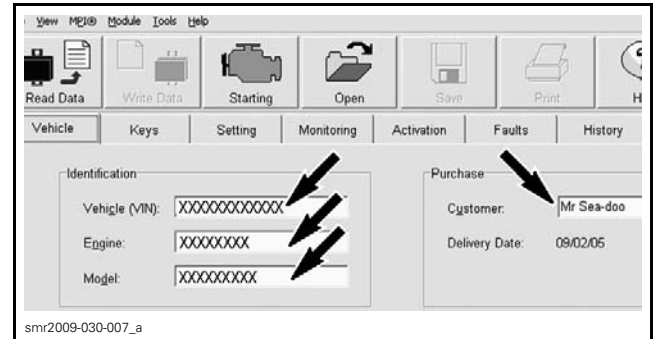
VIN: 2BPSBK8C68V000168

Date: 2009 02 06

Hour: 11h 16m 40s

5. Select the **Vehicle** tab and record (write down) the following information.

1. Vehicle serial number
2. Engine serial number (without the leading "M")
3. Vehicle model number
4. Customer name.

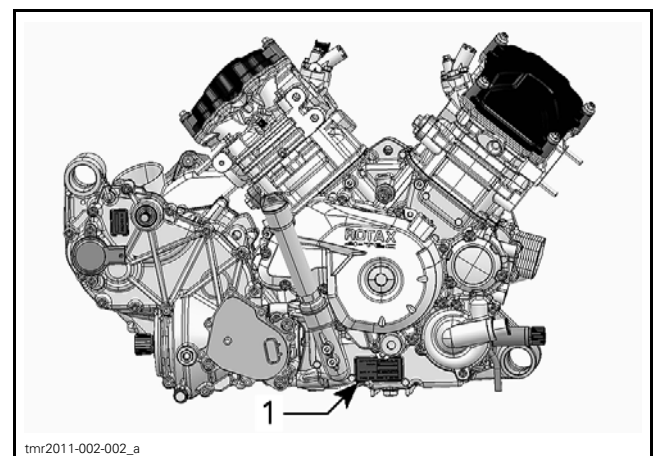


VEHICLE TAB

6. Enter recorded data in ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM.*

2nd Collecting Method: Collect the Information from the Vehicle and BOSSWeb

1. Record engine serial number.



TYPICAL - RH SIDE OF ENGINE

1. Engine serial number

2. Record the following numbers using BOSSWeb. Look in **Sales** menu and choose **Unit History**.

1. Vehicle serial number
2. Vehicle model number
3. Customer name.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

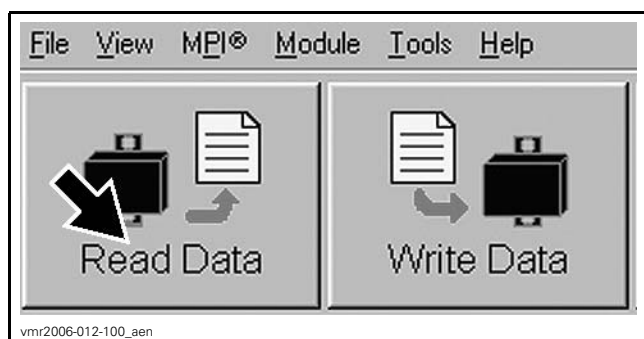


SALES, UNIT HISTORY

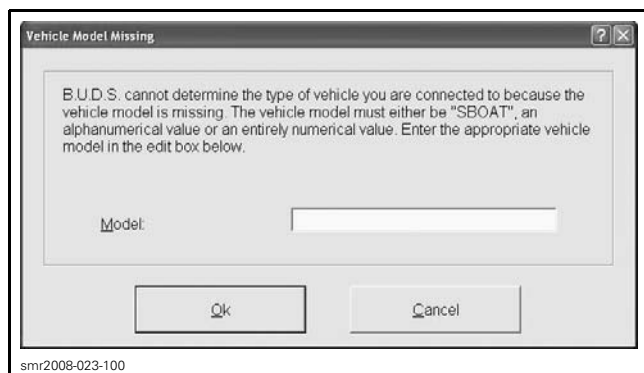
3. Enter the recorded data in the new ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM*.

Entering the Collected Information Into the ECM

1. Use the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* sub-section.
2. Turn ignition key to ON position.
3. In B.U.D.S., click the **Read Data** button to read the new ECM.

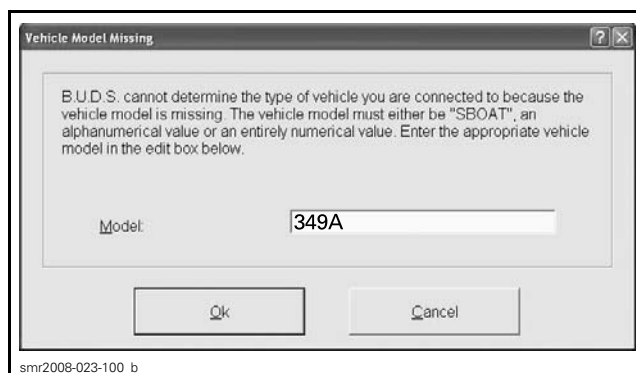


The following screen window will pop up.

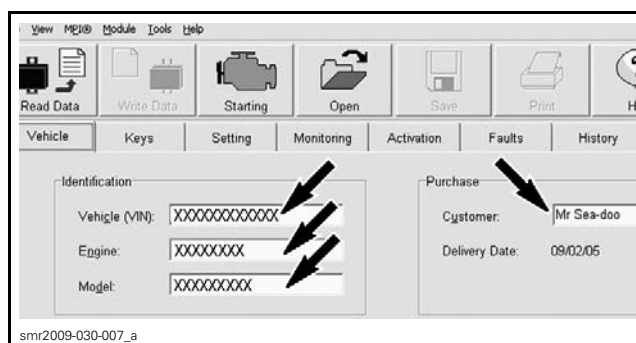


4. Enter the vehicle model number.

NOTICE Enter only the appropriate product model number as obtained when gathering the information.

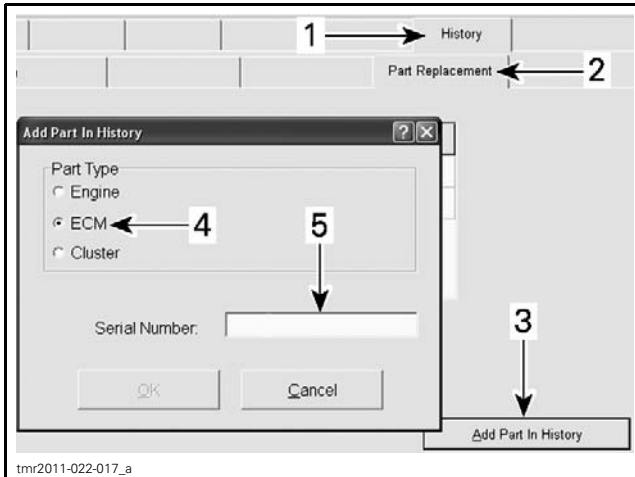


5. Select the **Vehicle** tab and enter the information you recorded previously.
 1. Vehicle serial number
 2. Engine number (do not enter the "M" at the beginning of the engine number)
 3. Customer name.



VEHICLE TAB

6. Click on the following tabs:
 - History
 - Part Replacement
 - Add Part in History.
7. Enter the old ECM serial number in the **Add Part In History** window.

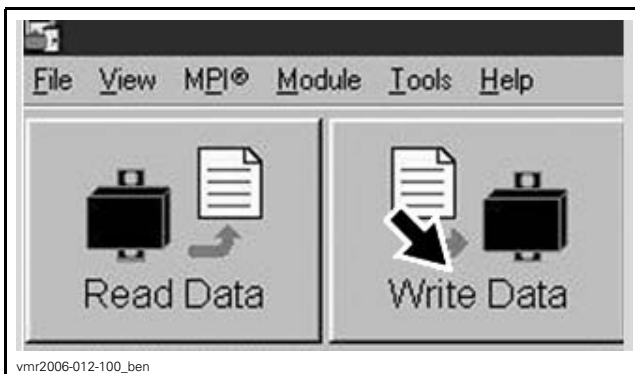


ADDING PART IN HISTORY

1. History tab
2. Part Replacement tab
3. Add part in history button
4. 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. Set the proper options in the following pages:
 - ECM
 - Cluster
 - Vehicle configuration.
10. Click on the **Write Data** button.



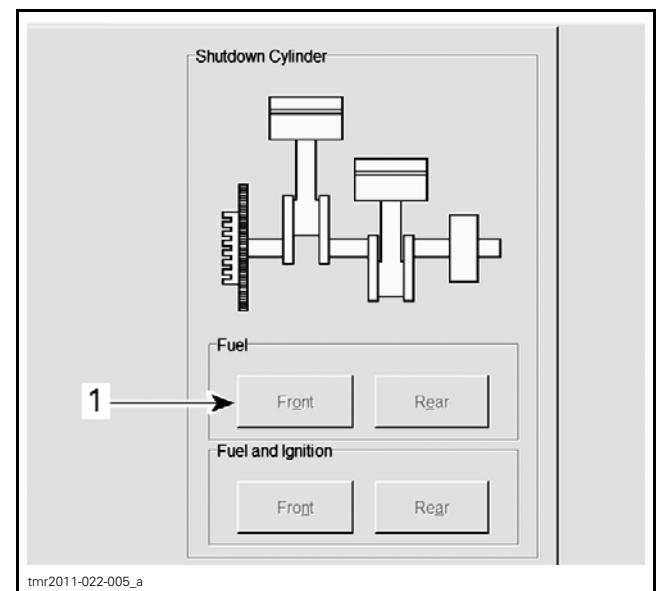
11. Perform the *ECM FIRST INITIALIZATION* reset.
12. Program the vehicle ignition keys into the new ECM, refer to *DIGITAL ENCODED SECURITY SYSTEM (D.E.S.S.)* subsection.
13. Reinstall any remaining removed parts.

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** tab
 - **ECM** tab.
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.

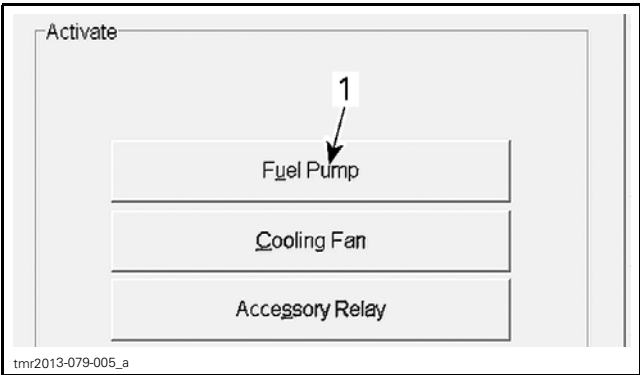
If the engine RPM does not drop momentarily when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to *FUEL INJECTOR 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.

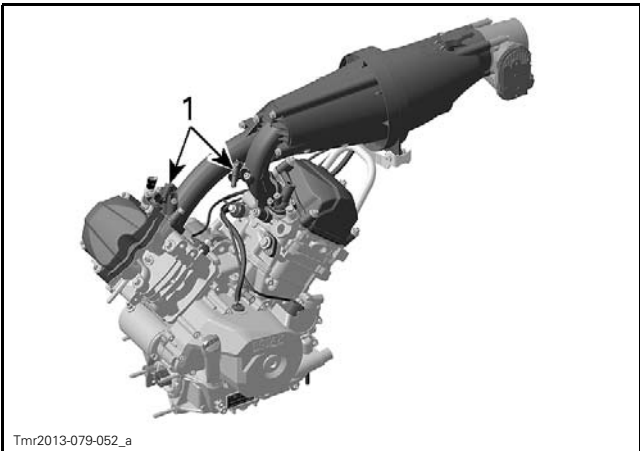
NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine and prevent a potential backfire due to fuel accumulation in engine.

- 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 tab.
- 5. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.



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. 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.
- 11. The maximum fuel pressure drop between injectors should not exceed the following specification:

MAXIMUM FUEL PRESSURE DROP ALLOWED BETWEEN FUEL INJECTORS
10 kPa (1.5 PSI)

If pressure drop of any fuel injector is greater than the specification, replace injector then repeat the test.

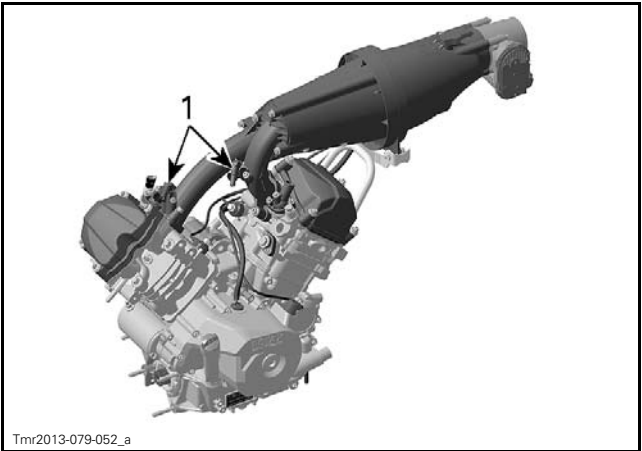
- 12. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
- 13. Remove fuel pressure gauge and reinstall removed parts.

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.



TYPICAL
1. Click on injector to activate

You should hear the injector functioning.
This will validate the injector mechanical and electrical operation.

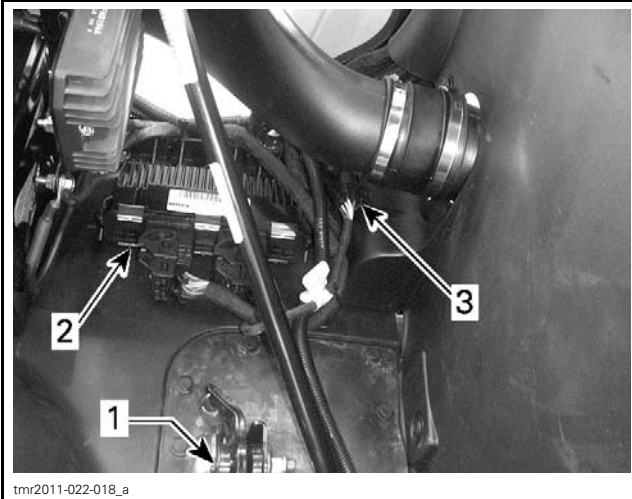
If the injector does not function, carry out the *FUEL INJECTOR RESISTANCE TEST*.

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

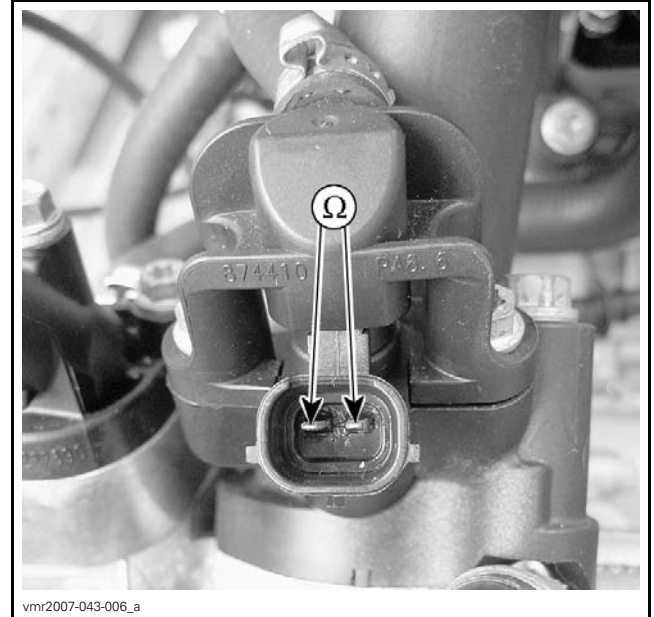
1. Accelerator pedal (not visible)
2. ECM
3. HIC connector

Using a FLUKE 115 MULTIMETER (P/N 529 035 868), check resistance value between terminals as follows.

FUEL INJECTOR RESISTANCE TEST AT HIC CONNECTOR			
INJECTOR	HIC CONNECTOR	ECM CONNECTOR "A"	RESISTANCE @ 20°C (68°F)
FRONT	D	A-J1	11.4 - 12.6 Ω
REAR		A-K1	

If resistance value obtained is incorrect, remove injector connector and check resistance value between injector pins as follows.

FUEL INJECTOR RESISTANCE TEST AT INJECTOR CONNECTOR			
INJECTOR	INJECTOR PIN		RESISTANCE @ 20°C (68°F)
FRONT	1	2	11.4 - 12.6 Ω
REAR			



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.

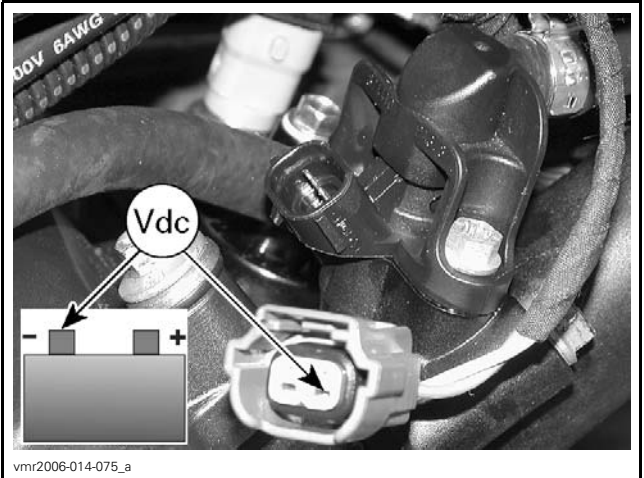


TYPICAL

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	INJECTOR CONNECTOR		MEASUREMENT
	WIRE		
FRONT	VIOLET/ BLUE	Battery ground	Battery voltage
REAR			



TYPICAL

NOTICE When probing, be careful to avoid enlarging connector pins. For this type of connector, back probes should be used.

If supply voltage is not good, check continuity between fuse F5 and injector (see *WIRING DIAGRAMS*).

NOTE: Probe fuse exactly as shown. This validates fuse at the same time.

Use a multimeter and set it to Ω . Read resistance.

CYLINDER	INJECTOR CIRCUIT		MEASUREMENT
	WIRE		
FRONT	VIOLET/ BLUE	Fuse F5	Close to 0 Ω
REAR			

If continuity is good, check relay and wiring from battery.

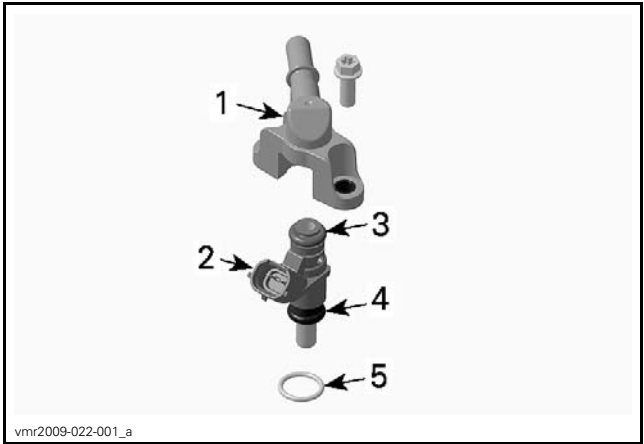
If continuity is faulty, check fuse and if OK, repair/replace wiring going to injector.

If supply voltage is good, check ground circuit between injector and ECM (see *WIRING DIAGRAMS*).

- If ground circuit is faulty, repair/replace wiring and connectors.
- If ground circuit is good, refer to *ECM REPLACEMENT*.

Fuel Injector Removal

To remove the injector, first remove the fuel rail refer to *FUEL RAIL* for the procedure.



TYPICAL - FUEL RAIL ASS'Y

- 1. Fuel rail
- 2. Fuel injector
- 3. Injector top O-ring
- 4. Injector bottom O-ring
- 5. Manifold O-ring

Then pull fuel injector out of the fuel rail.

Fuel Injector Installation

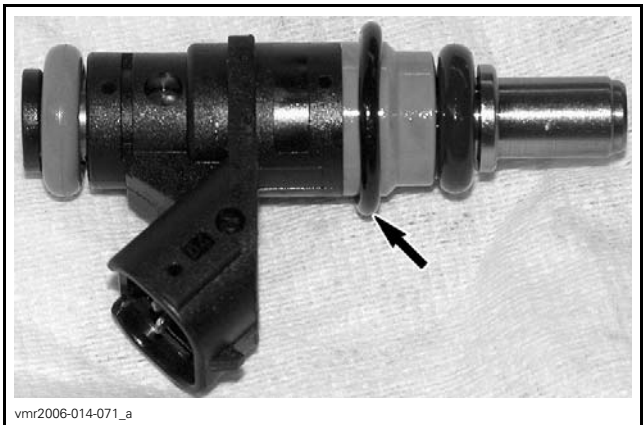
For the installation, reverse the removal procedure. Pay attention to the following details.

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

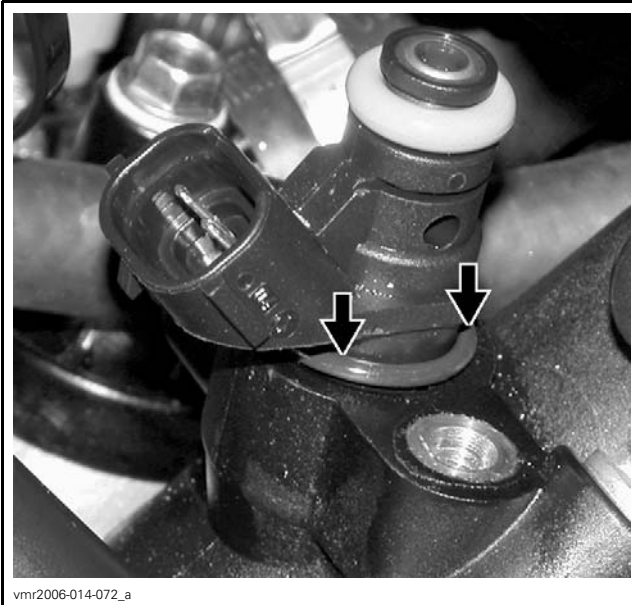
Position the manifold O-ring on injector as in following illustration.



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.



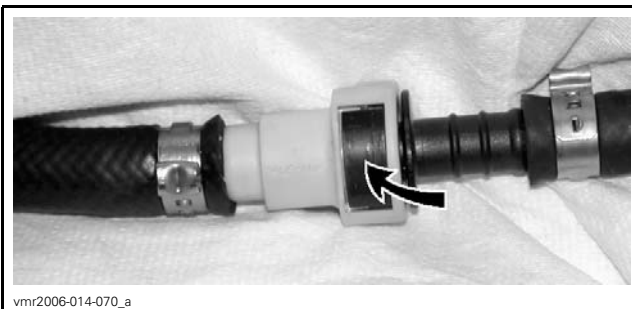
Firmly push injector until it bottoms out.
Reinstall fuel rail.

FUEL RAIL

Fuel Rail Replacement

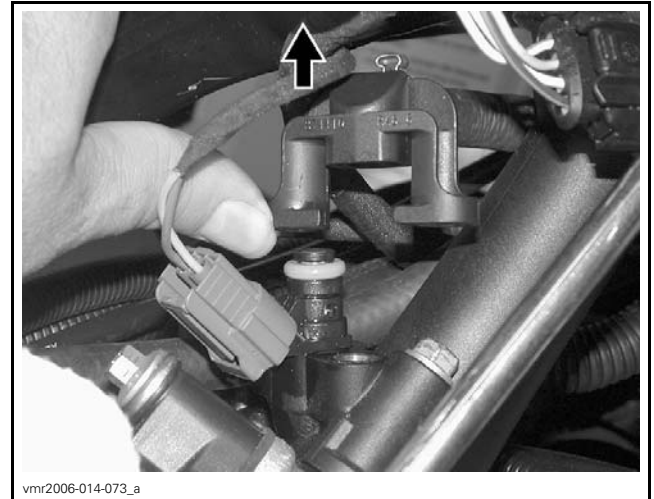
Fuel Rail Removal

1. Wrap a rag around the inlet hose and release the quick fitting.



TYPICAL

2. Unscrew rail retaining screws.
3. 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.

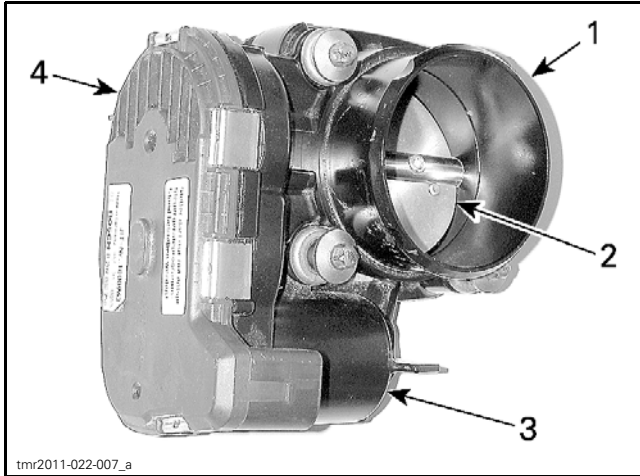
FUEL RAIL INSTALLATION	
INJECTOR O-RINGS	RETAINING SCREW TORQUE
NEW (Lubricate with engine oil)	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

⚠ WARNING

Perform a fuel pressure test and ensure that there is no leak. Refer to *FUEL TANK AND FUEL PUMP*. Run engine and check for leaks.

THROTTLE BODY

Throttle Body Description



1. Throttle body
2. Throttle plate
3. Electronic throttle actuator (electric motor inside)
4. 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 INTAKE MEDIC or an equivalent.

NOTICE Only use an appropriate throttle body cleaner that will not damage O-rings and EFI sensors.

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.

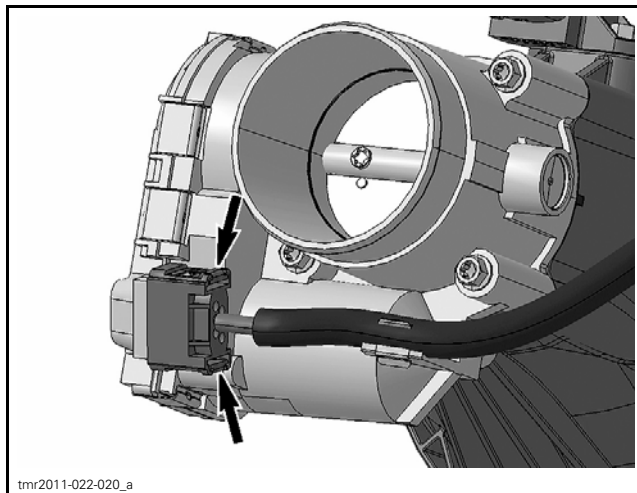
7. To remove residual dirt, spray cleaner on throttle plate and on bore.

8. Reinstall removed parts.

Throttle Body Removal

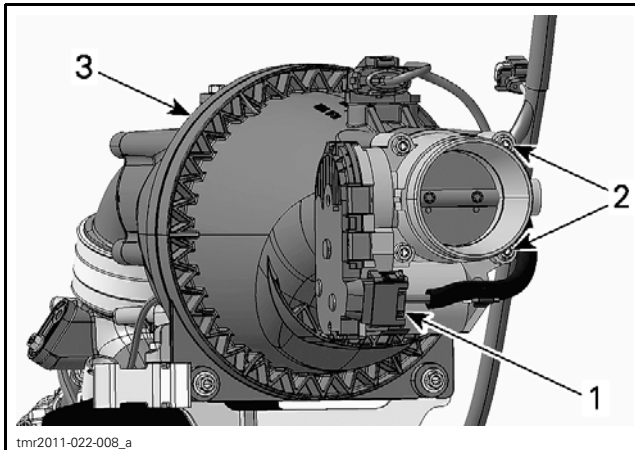
1. Disconnect air inlet hose from throttle body.
2. Disconnect throttle body connector.

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.

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

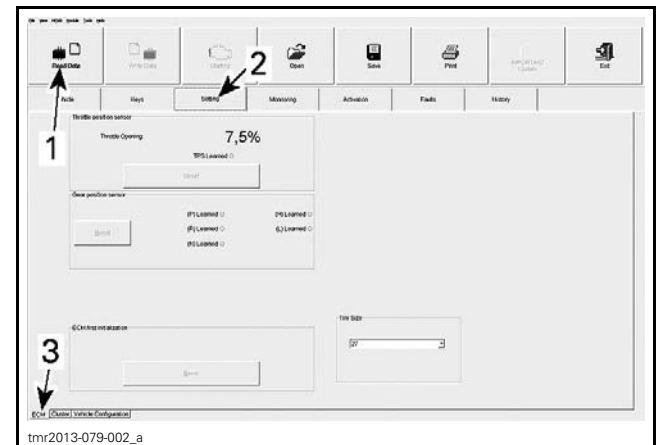
NOTE: The TPS initialization procedure **must** be carried out whenever the throttle body is replaced, unless an ECM first initialization reset is carried out.

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.

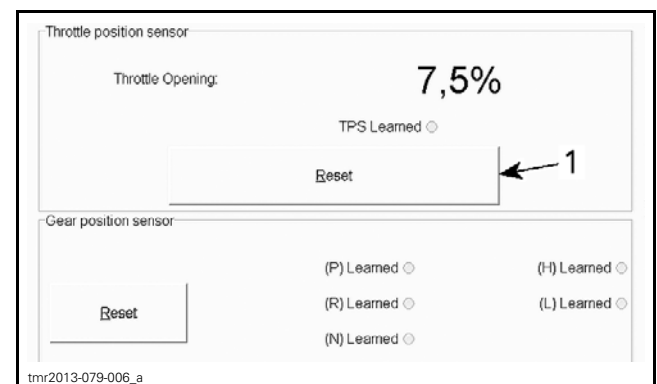
NOTICE An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.

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 tab
 - ECM tab.



1. Read Data button
2. Setting tab
3. ECM 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

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

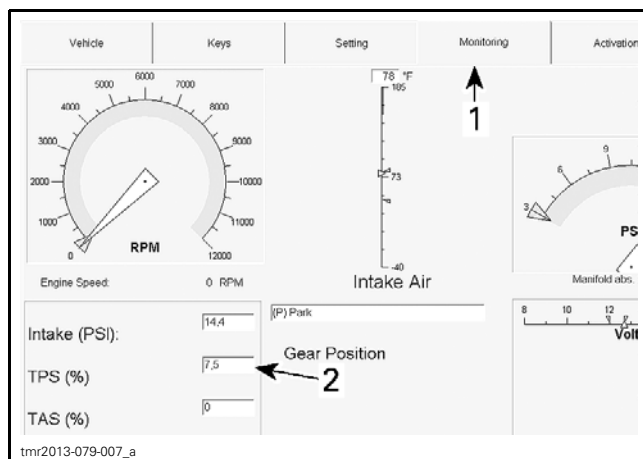
A message will be displayed if the operation is successful.

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.

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** tab
 - **ECM** tab.
5. Slowly and regularly move the accelerator pedal.
6. Observe the Throttle Opening indication movement in B.U.D.S.



1. Monitoring 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.

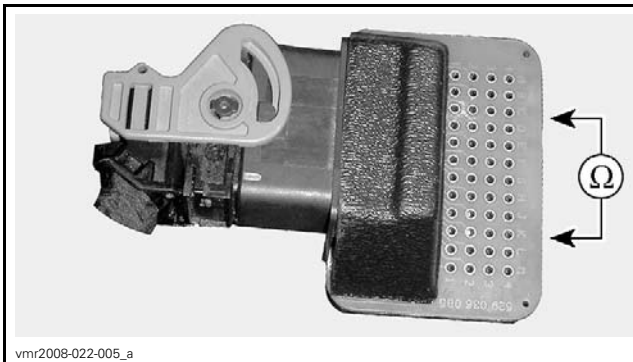
TPS Resistance Test

1. Ensure the throttle body connector is properly connected.
2. 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 Ω .
4. Probe circuit as per following table while using your hand to manually move throttle plate.

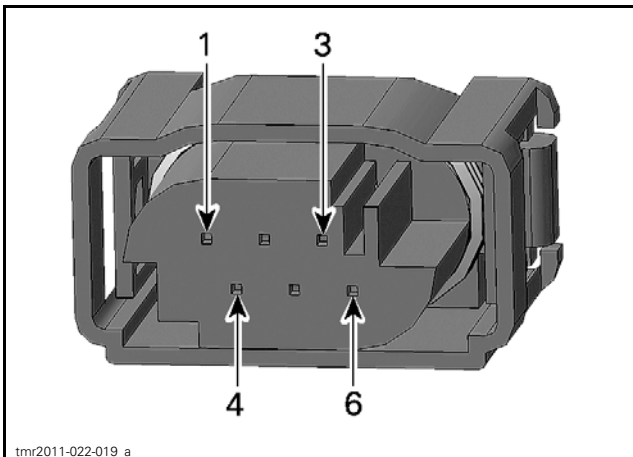
Commentaire rédaction: SVP ne pas laisser cette table se séparer. Sinon c'est la confusion.

ECM ADAPTER		FULLY CLOSED THROTTLE PLATE ⁽¹⁾		FULLY OPEN THROTTLE PLATE	
		RESISTANCE (Ω)			
PIN		MIN.	MAX.	MIN.	MAX.
A-A2	A-K4	875	1625	875	1625
A-A2	A-K3	954	1934	228	585
A-A2	A-F3	254	634	980	1983
A-K3	A-K4	228	585	954	1934
A-K3	A-F3	1385	2315	1385	2315
A-K4	A-F3	980	1983	254	634

(1) To obtain the fully closed position, it is necessary to push against the throttle plate in the throttle body with your hand and hold it in this position for the measurement.



If any resistance value is incorrect, check wire continuity between ECM and throttle body before assuming the TPS is at fault. Refer to *WIRING DIAGRAM* subsection.

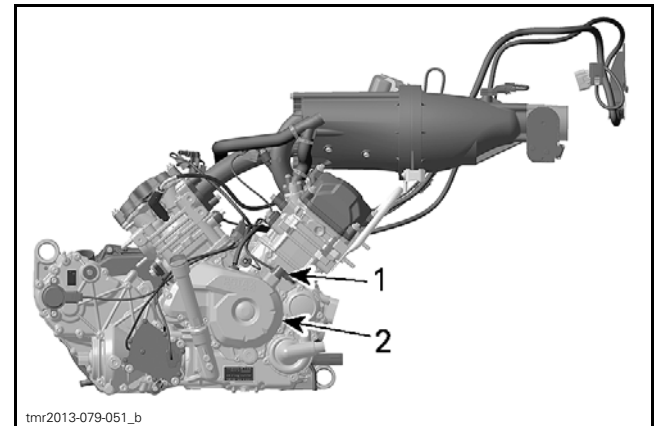


THROTTLE BODY CONNECTOR PIN-OUT

TPS Replacement

Carry out a *THROTTLE POSITION SENSOR INITIALIZATION* procedure as detailed in *THROTTLE BODY* of this subsection.

CRANKSHAFT POSITION SENSOR (CPS)

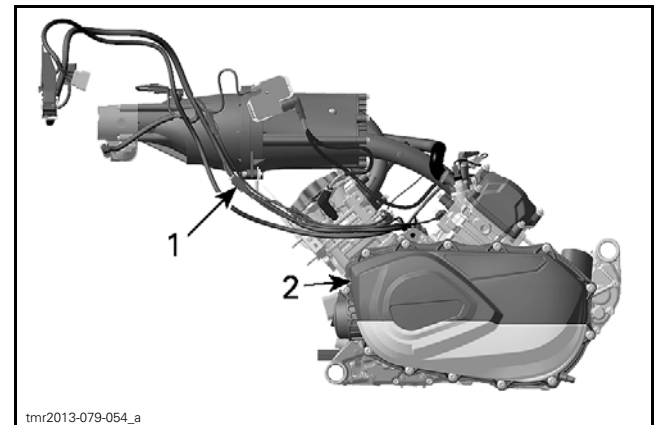


1. CPS
2. Magneto cover

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.



TYPICAL - LH SIDE OF VEHICLE

1. CPS connector location
2. CVT cover

Probe terminals as per following table.

CPS CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
1	2	700 - 900 Ω

If resistance is not within specifications, replace the CPS.

If resistance tests good, **reconnect** the CPS connector and disconnect the connector “A” on the ECM.

Install ECM-A connector on ECM ADAPTER TOOL (P/N 529 036 166).



Using a multimeter, recheck resistance as per table.

ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-H1	A-K2	700 - 900 Ω

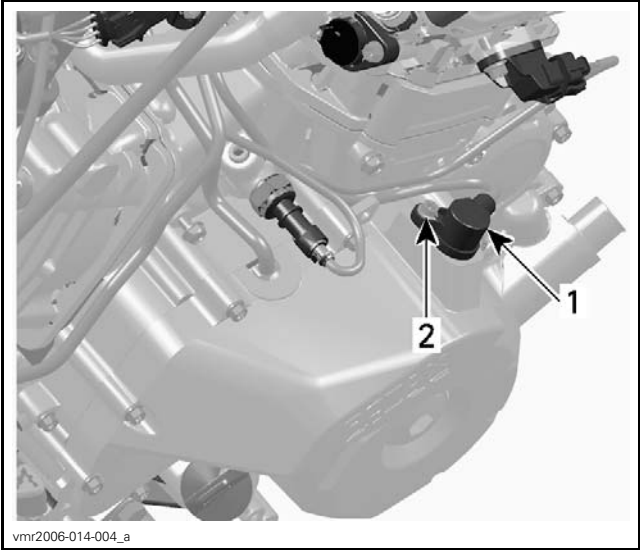
If resistance value is correct, refer to *ECM REPLACEMENT*.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CPS.

CPS Replacement

Disconnect CPS connector and cut harness locking tie.

Remove CPS retaining screw and pull up on CPS to remove it.

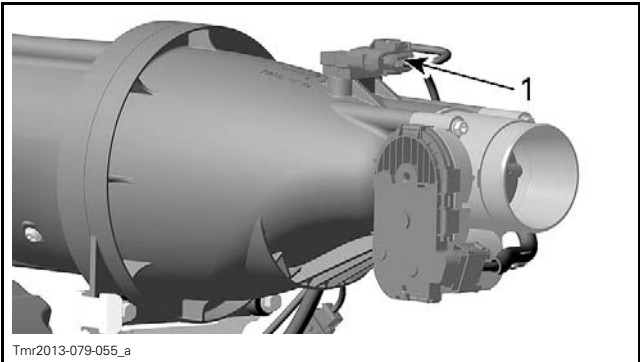


TYPICAL
1. CPS
2. Retaining screw

Install new CPS and secure harness with a new locking tie.

CPS INSTALLATION	
O-RING	PRODUCT
	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.

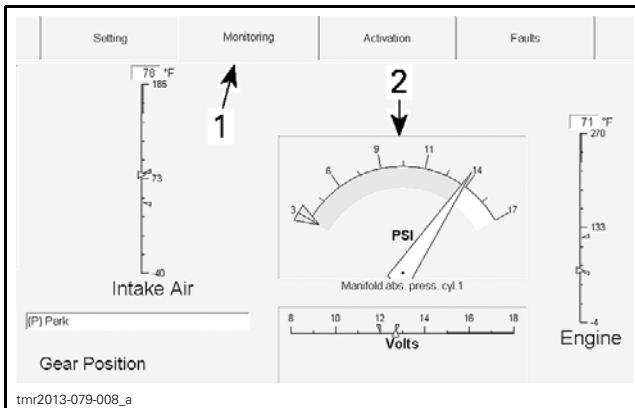
MAPTS Pressure Function

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 tab
 - ECM tab.



1. Monitoring 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 ± 3.4 kPa (.5 PSI).

MAPTS PRESSURE FUNCTION QUICK TEST			
RESULT	SERVICE ACTION		
NO READING	Circuit Continuity Test of MAPTS Pressure Function	MAPTS Input Voltage Test	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 CONNECTOR		MEASUREMENT
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 FUNCTION)*.

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	Close to 0 Ω
Pin G4	Pin 4	
Pin H2	Pin 1	

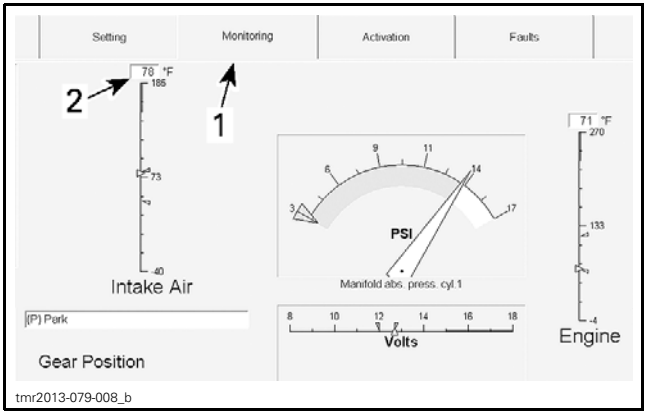
If resistance is not within specification, repair or replace the wiring harness between ECM connector and the MAPTS.

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 tab
 - ECM tab.
- 3. Look for the **Intake Air** temperature reading while the engine is stopped.



- 1. Monitoring 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 measure the same ambient air temperature.

If there is no reading, carry out a *MAPTS RESISTANCE 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.

MAPTS		MEASUREMENT
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.

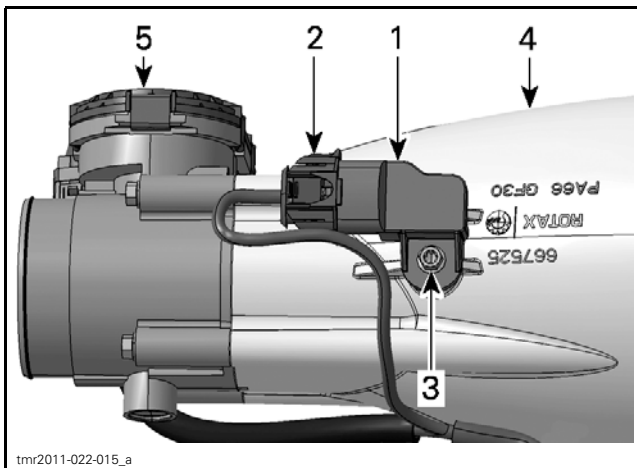
ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-H2	A-H3	2280 - 2740

MAPTS TEMPERATURE SENSOR TEST RESULTS			
RESULT	SERVICE ACTION		
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)

MAPTS CIRCUIT CONTINUITY TEST (TEMPERATURE FUNCTION)		
ECM-A	MAPTS CONNECTOR	RESISTANCE VALUE
Pin H2	Pin 1	Close to 0 Ω
Pin H3	Pin 2	

MAPTS Replacement



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.

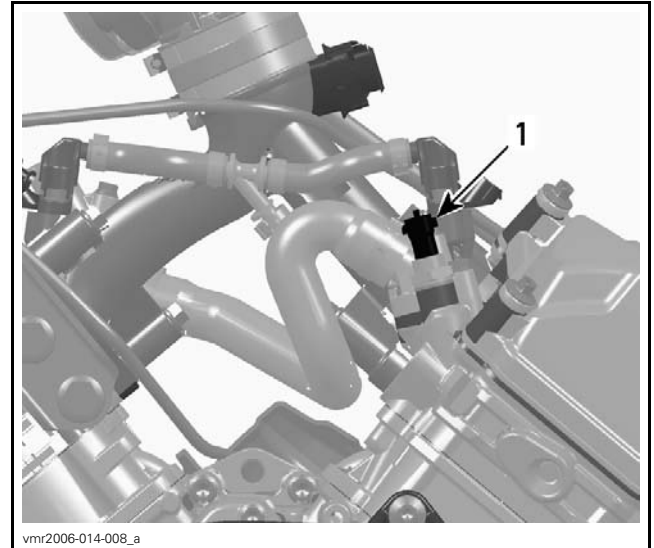
TORQUE	PRODUCT
6 N•m $\pm$ 0.7 N•m (53 lbf•in $\pm$ 6 lbf•in)	LOCTITE 243 (BLUE) (P/N 293 800 060)

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.



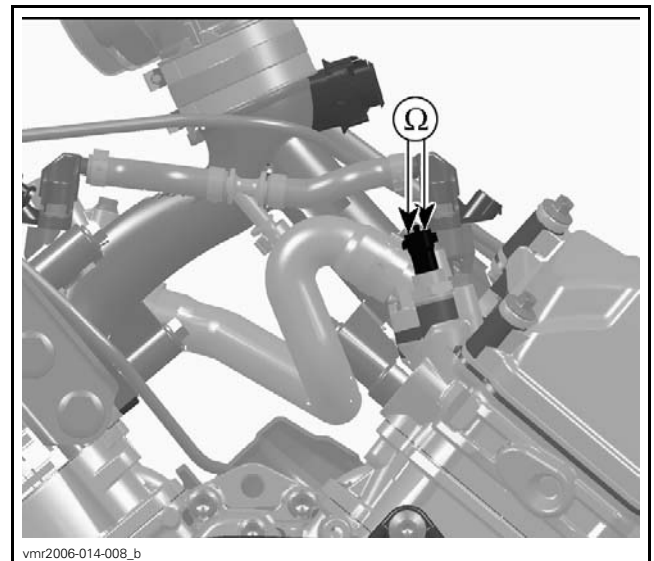
LH SIDE OF THE ENGINE, REAR CYLINDER

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 SENSOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
1	2	2280 - 2740



CHECK SENSOR RESISTANCE

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).



3. Using a multimeter, recheck resistance from the ECM connector as per table.

ECM "A" CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A1	J2	2280 - 2740

If resistance value is correct, refer to *ECM REPLACEMENT*.

If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the CTS.

CTS Replacement

- 1. Disconnect CTS connector and remove CTS.
- 2. Install the new CTS and torque as specified.

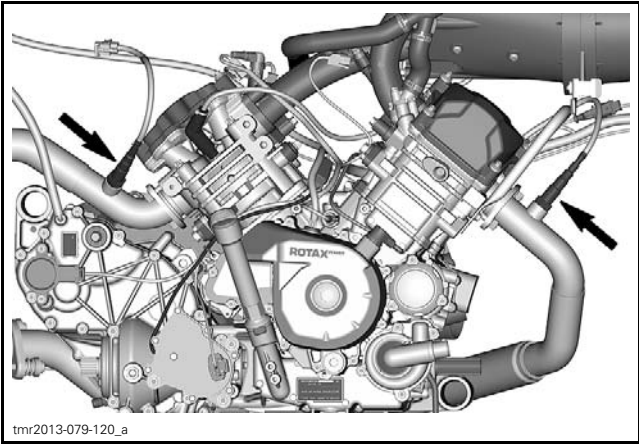
CTS TORQUE
16 N•m ± 2 N•m (142 lbf•in ± 18 lbf•in)

- 3. Reinstall remaining removed parts.
- 4. Refill and bleed the cooling system, refer to *COOLING SYSTEM* subsection.

HEATED OXYGEN SENSOR (HO₂S)

Oxygen Sensor Location

This vehicle is equipped with 2 heated oxygen sensors (HO₂S): One sensor is located on each exhaust pipe, near the engine cylinders.



HEATED OXYGEN SENSORS

Oxygen Sensor and Connector Access

The cylinder 1 (front) oxygen sensor and its connector are accessible when removing the right and left lateral console panels.

The cylinder 2 (rear) oxygen sensor and its connector are accessible when removing the central console panel.

Oxygen Sensor General Precautions

Take the following precautions to avoid sensor malfunction:

- Do not use any product on sensor probe.
- Do not expose sensor to water, oil, windshield cleaner, anticorrosion oil, grease, terminal cleaner, etc.
- Do not drop or use an oxygen sensor that has been dropped.
- Do not use any compound on sensor threads unless labeled as compatible with oxygen sensor.
- Do not use impact wrench or conventional socket type wrench to install sensor.
- Do not allow sensor or wire to touch exhaust system or any other hot component.
- Do not route sensor wires to create tension in the wires. This could cause faults or sensor malfunction.

Oxygen Sensor Troubleshooting

Always use B.U.D.S. to check for fault codes. Carry out service actions.

In B.U.D.S., also check oxygen sensor voltage and refer to following table.

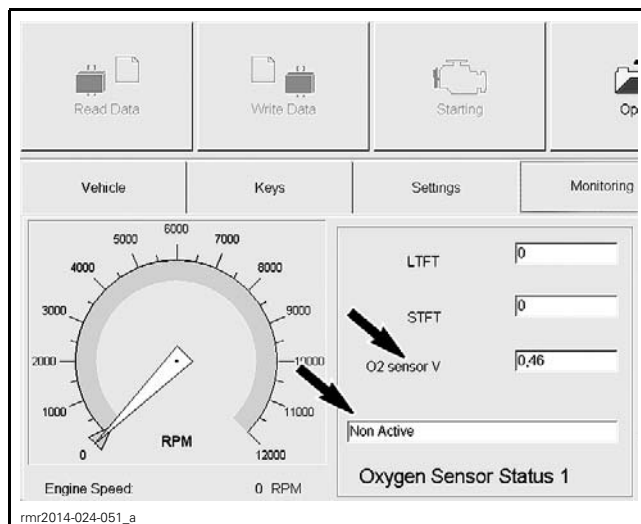
OXYGEN SENSOR VOLTAGE IN B.U.D.S.	
VOLTAGE READING	CONDITION
Varies 0.1 to 0.8 Volts	Normal oxygen sensor operation in closed loop

OXYGEN SENSOR VOLTAGE IN B.U.D.S.	
VOLTAGE READING	CONDITION
<u>Constant 0.45 Volts</u>	<u>Oxygen sensor circuit open</u>
<u>Constant low voltage</u>	<u>Indicates fuel mixture too lean,</u> <u>possible oxygen sensor fault,</u> <u>possible fuel system fault,</u> <u>possible air leak</u>
<u>Constant high voltage</u>	<u>Indicates fuel mixture too rich,</u> <u>possible fuel system fault,</u> <u>possible fuel canister problem</u>

Testing the Oxygen Sensor

Testing the Oxygen Sensor Using B.U.D.S.

1. Using the latest applicable B.U.D.S. version, monitor the oxygen sensor.
2. Click on **Monitoring** tab, then on **ECM** tab.
3. Start engine.
4. Observe the **O₂ sensor V** and **Oxygen Sensor Status** indications in B.U.D.S.



OXYGEN SENSOR VOLTAGE AND STATUS INDICATIONS

If a fault code related to an oxygen sensor is active, the oxygen sensor indicator will **not** turn on. The fault code(s) need(s) to be solved first.

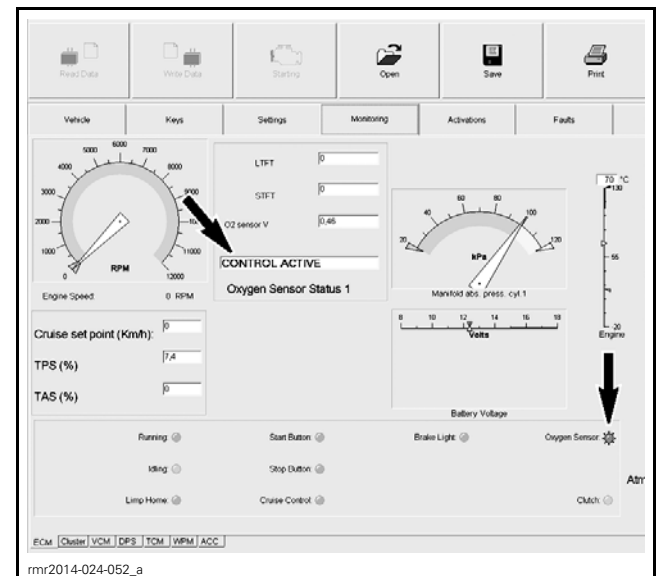
When a properly functioning oxygen sensor circuit is first initiated, the oxygen sensor heats up and the ECM is operating in a closed loop control mode. The status of the oxygen sensor circuit will change from "Init" to "Active" as it progresses

through a series of steps. These steps may be viewed on the **ECM Monitoring** page of B.U.D.S. in the **Oxygen Sensor Status** window.

NOTE: The steps listed in the following sensor status table may not all be displayed, and may vary from one time to the next. The steps displayed will depend on the engine operating status and oxygen sensor operating status.

LIST OF OXYGEN SENSOR STATUS INDICATIONS
<u>Init</u>
<u>Heating Active</u>
<u>Control Active</u>
<u>Error</u>

When the oxygen sensor reaches the "Active" state, it becomes operational and its indicator will turn on in B.U.D.S.



NOTE: At room temperature (approximately 21°C (70°F)), the engine needs to run for approximately 15 seconds before the oxygen sensor becomes **CONTROL ACTIVE** and its indicator light turns on in B.U.D.S.

If a sensor status does not change or does not reach the **CONTROL ACTIVE** state, or the oxygen sensor indicator light does not come on, try a new oxygen sensor.

NOTE: Before replacing a sensor, check wiring, terminals and sensor condition.

Subsection 02 (ELECTRONIC FUEL INJECTION (EFI))

Testing for Oxygen Sensor Input Voltage

NOTE: This test validates the heater element circuit.

1. Ensure main power relay (R2) is installed in fuse box 1.
2. Disconnect the oxygen sensor connector.
3. Turn ignition switch ON.
4. Using a multimeter set to Vdc, read the input voltage provided to the sensor heater.

REQUIRED TOOLS	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

<u>OXYGEN SENSOR CONNECTOR (HARNESS SIDE)</u>		<u>MEASUREMENT</u>
<u>PIN</u>		
<u>C</u>	<u>Battery ground</u>	<u>Battery voltage</u>

If Input voltage is good, refer to *TESTING THE RESISTANCE OF THE OXYGEN SENSOR HEATER* and *TESTING FOR OXYGEN SENSOR CIRCUIT CONTINUITY*.

If input voltage is not good, test the continuity of the power circuit from fuse F4 in fuse box 1. Refer to the applicable *WIRING DIAGRAM* for details.

If input voltage wire continuity is at fault, repair or replace wiring or connector.

Testing the Resistance of the Oxygen Sensor Heater

Test the resistance value of the oxygen sensor between the sensor pins as follows.

OXYGEN SENSOR PIN		RESISTANCE @ 20°C (68°F)
C	D	Approximately 7 - 11 Ω

If reading is not within specification, replace the oxygen sensor.

Testing for Oxygen Sensor Circuit Continuity

NOTE: This test validates the heater element circuit and the sensor circuits.

1. Remove main power relay (R2) in fuse box 1. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.

2. Disconnect ECM-B connector and install it on the ECM adapter tool. Refer to *ECM CONNECTOR ACCESS* in *ENGINE CONTROL MODULE (ECM)* in this subsection.

3. Using a multimeter set to "Ω", test for continuity between the oxygen sensor harness connector and the ECM adaptor as per following tables.

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

OXYGEN SENSOR CIRCUIT CONTINUITY TEST		
OXYGEN SENSOR PIN	ECM CONNECTOR "B"	RESISTANCE @ 20°C (68°F)
A	J1	Close to 0 Ω
B	D2	
D	L2	

If a resistance value is NOT as specified, repair or replace the wiring and connectors.

Replacing the Oxygen Sensor

1. Remove main power relay (R2) in fuse box 1. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.

⚠ CAUTION Exhaust system and oxygen sensor may be hot. To avoid possible injury, allow exhaust system components time to cool before proceeding.

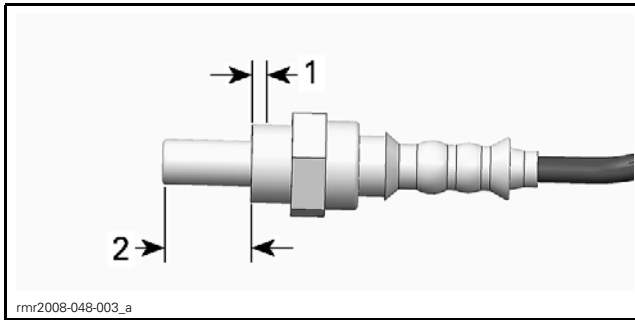
2. Disconnect oxygen sensor connector.
3. Cut locking tie securing oxygen sensor harness.
4. Unscrew oxygen sensor from exhaust pipe.

NOTICE Handle oxygen sensor with clean hands. Oxygen sensor probe must remain free of oil, grease, antiseize lubricant and any other foreign matter that could affect its operation.

If a new oxygen sensor is installed, its threads are already coated with an anti-seize product. Sensor is ready for installation.

If the same oxygen sensor is installed, apply LOC-TITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on its first two threads.

NOTICE Always use a product that is oxygen sensor safe.



TYPICAL

1. Apply antiseize lubricant first two threads
2. Must be free of any product

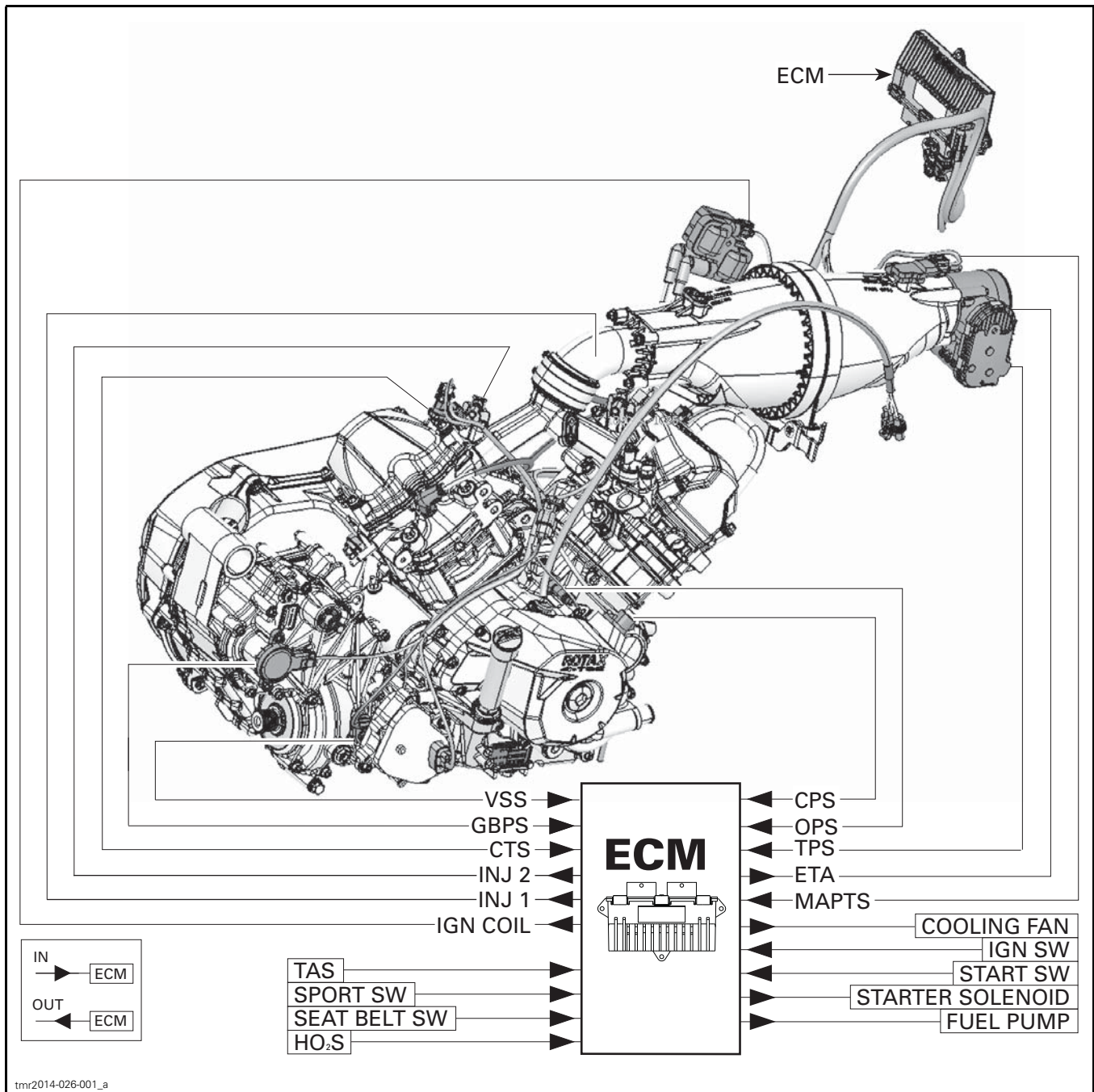
NOTICE Do not apply any antiseize lubricant to the sensor probe as it could affect its operation.

5. Screw sensor in exhaust pipe.

TIGHTENING TORQUE	
Oxygen sensor	$50 \text{ N}\cdot\text{m} \pm 10 \text{ N}\cdot\text{m}$ $(37 \text{ lbf}\cdot\text{ft} \pm 7 \text{ lbf}\cdot\text{ft})$ $\pm$ LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070)

6. Install all other removed parts.

ENGINE MANAGEMENT SYSTEM (EMS)



COOLING FAN
CPS = Crankshaft Position Sensor
CTS = Cooling Temperature Sensor
ECM = Engine Control Module
ETA = Electric Throttle Actuator
FUEL PUMP
GBPS = Gear Box Position Sensor
HO₂S (Heated Oxygen Sensor)
IGN COIL = Ignition coil
IGN SW = Ignition switch
IN = Input
INJ 1 = Injector 1

INJ 2 = Injector 2
MAPTS = Manifold Air Pressure/Temperature Sensor
OPS = Oil Pressure Switch
OUT = Output
SEAT BELT SWITCH
SPORT SWITCH
START SWITCH
STARTER SOLENOID
SW = Switch
TAS = Throttle Accelerator Sensor
TPS = Throttle Position Sensor
VSS = Vehicle Speed Sensor

GENERAL

SYSTEM DESCRIPTION

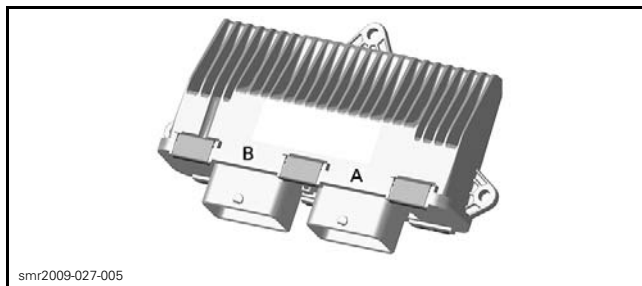
A highly advanced engine management system (EMS) is used to ensure a high power output with cleaner combustion.

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.

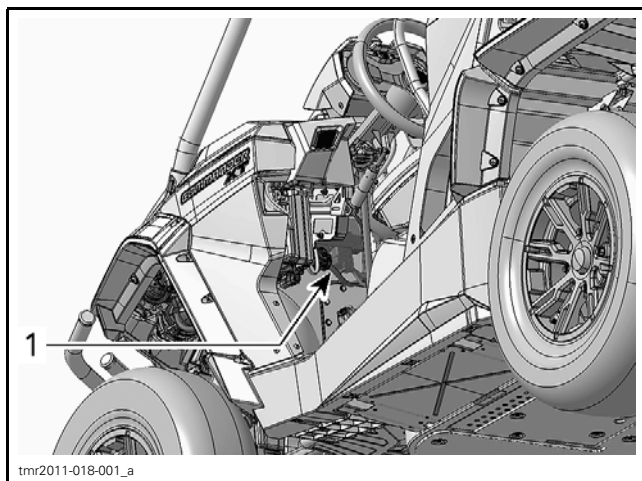
NOTE: For further information related to these systems, refer to the applicable subsection.

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 *DIAGNOSTIC 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

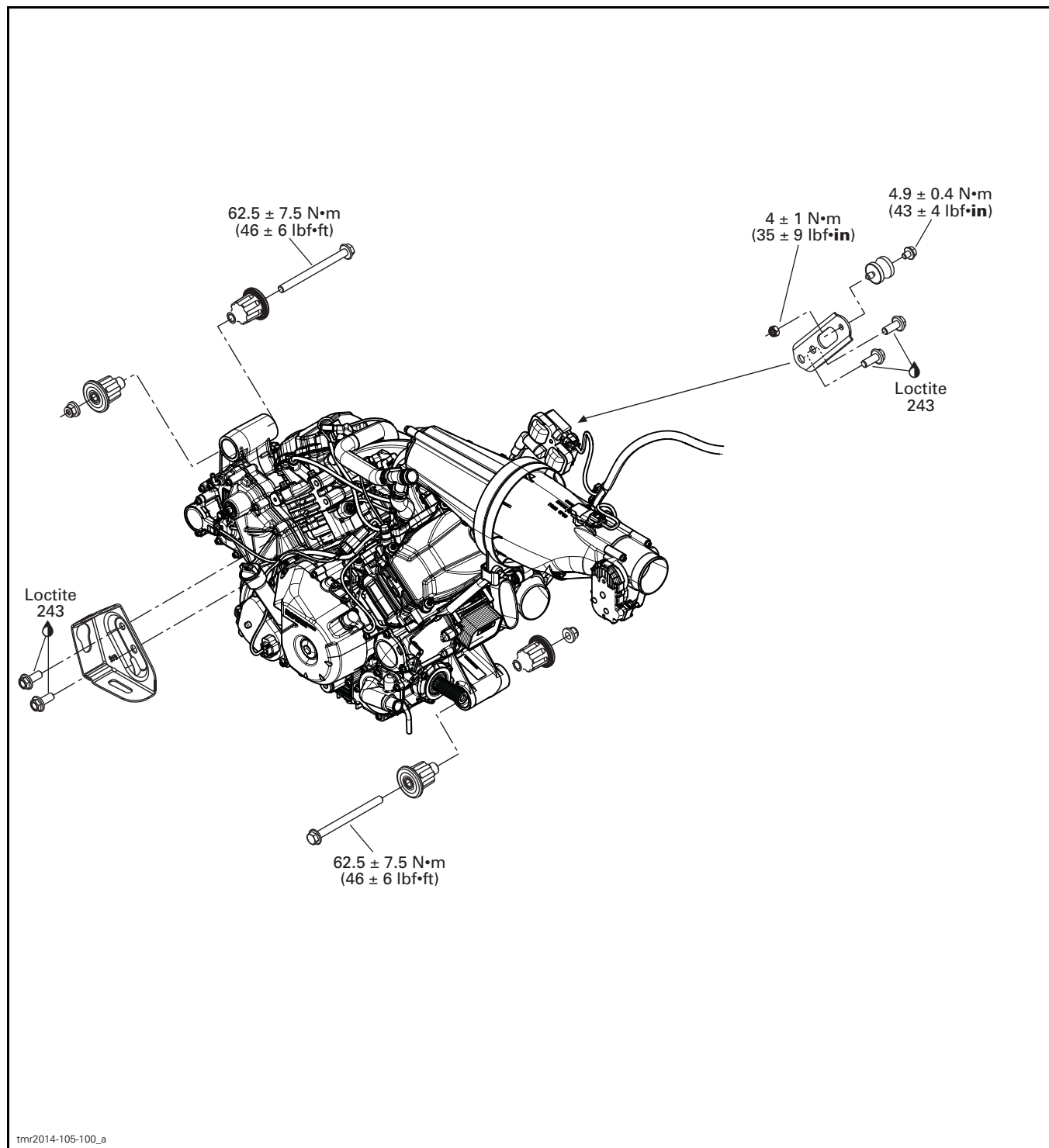
The ECM may automatically put the engine in LIMP HOME MODE using default parameters when certain major faults are detected. LIMP HOME MODE may also be manually engaged

under certain fault conditions. For more information, refer to *DIAGNOSTIC SYSTEM AND FAULT CODES*.

ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING TOOL	529 036 022	3



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 *INTRODUCTION* subsection.
3. Remove seats.
4. Remove battery cover and battery. Refer to *CHARGING SYSTEM* subsection.
5. Disconnect voltage regulator/rectifier. Refer to *CHARGING SYSTEM* subsection.

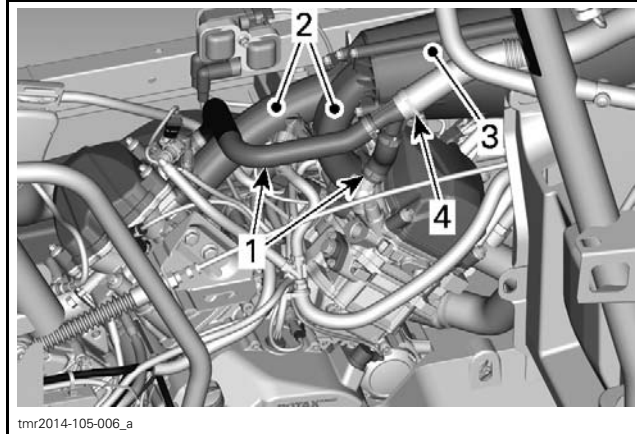
NOTICE Always unplug battery cables exactly in the specified order, the BLACK (-) cable first.

6. Refer to *BODY* subsection and remove the following plastic parts:
 - Upper and lower consoles
 - Rear upper and lower consoles
 - Front LH and RH lateral console panels
 - Rear LH and RH lateral console panels
 - LH rear floor panel
7. Drain engine oil. Refer to *ENGINE OIL CHANGE* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.

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

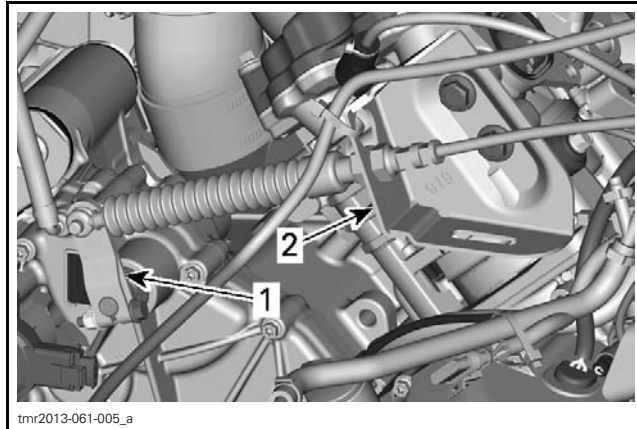
8. Drain the engine coolant. Refer to *ENGINE COOLANT REPLACEMENT* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.
9. Remove thermostat cover from rear cylinder head while carefully lifting the thermostat cover.

10. Disconnect both engine coolant hoses.
11. Disconnect throttle body connector.
12. Remove the plenum with the air intake manifolds and throttle body. Refer to *INTAKE MANIFOLD*.



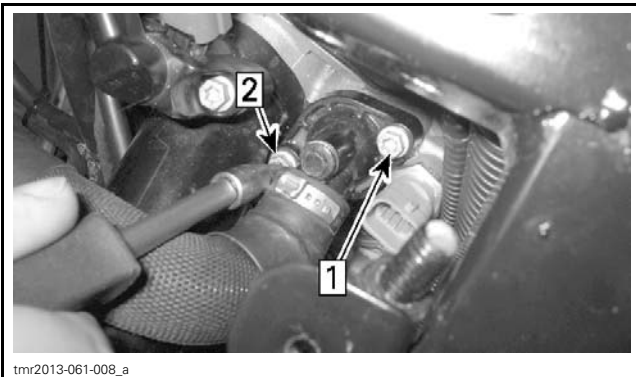
1. Engine coolant hoses
2. Intake manifolds
3. Plenum
4. Disconnect engine coolant hoses here.

13. Remove the shift plate.
14. Remove the shifter cable bracket.



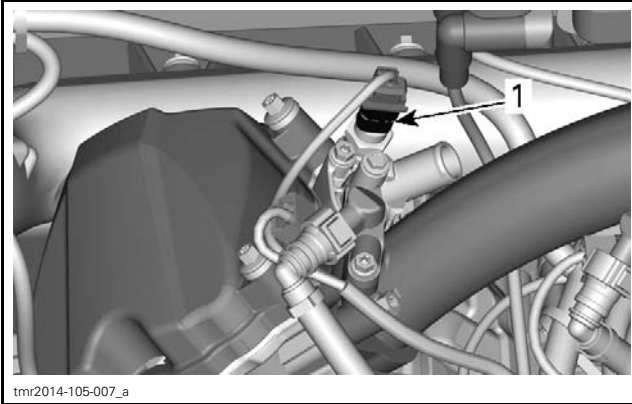
1. Shift plate
2. Shifter cable bracket

15. Remove the front and rear head pipes. Refer to *EXHAUST SYSTEM* subsection.
16. Disconnect the coolant hose at water pump.
17. Disconnect the gearbox vent hose.
18. Remove the CVT outlet duct.
19. Unplug and remove the CTS (coolant temperature sensor).



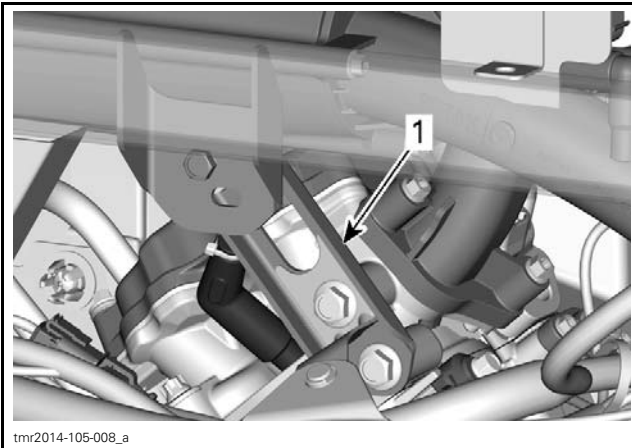
THERMOSTAT COVER ON REAR CYLINDER HEAD

1. First screw to remove
2. Second screw to remove



1. CTS

20. Remove the upper engine support.



1. Upper engine support

21. Disconnect the CVT inlet ducts from the CVT cover.
22. Disconnect the crankcase vent hose.
23. 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)
 - KS (Knock Sensor) of front and rear cylinder
 - Stator
 - 4WD indicator switch.

Lifting Engine

1. Remove front drive shaft extension.

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



TYPICAL

3. Remove retaining screws on rear propeller shaft.
4. Remove the front and rear engine support bolts.
5. Lift engine and move it towards RH side.
6. Gently lower engine on RH rear passenger side.
7. Undo lifting strap and reattach engine lifting tool after passing the strap outside the cage.
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 extension 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 and seats prior to *FINAL ASSEMBLY*.

Final Assembly Procedure

1. Fill engine with the recommended oil and quantity. Refer to *ENGINE OIL CHANGE* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Fill and bleed cooling system. Refer to *ENGINE COOLANT REPLACEMENT* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Check for any leaks.

Subsection 01 (ENGINE REMOVAL AND INSTALLATION)

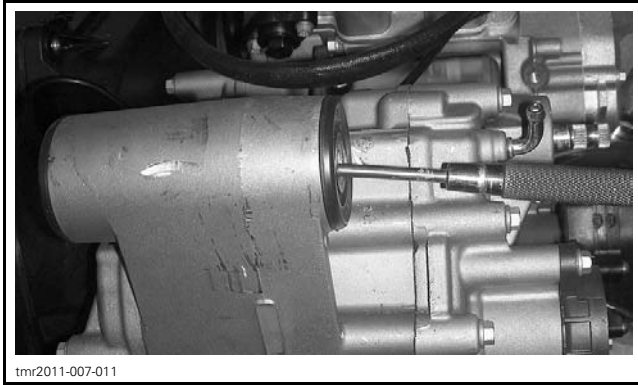
4. Reinstall plastic parts and seats.
5. Test drive vehicle to confirm proper operation.

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.



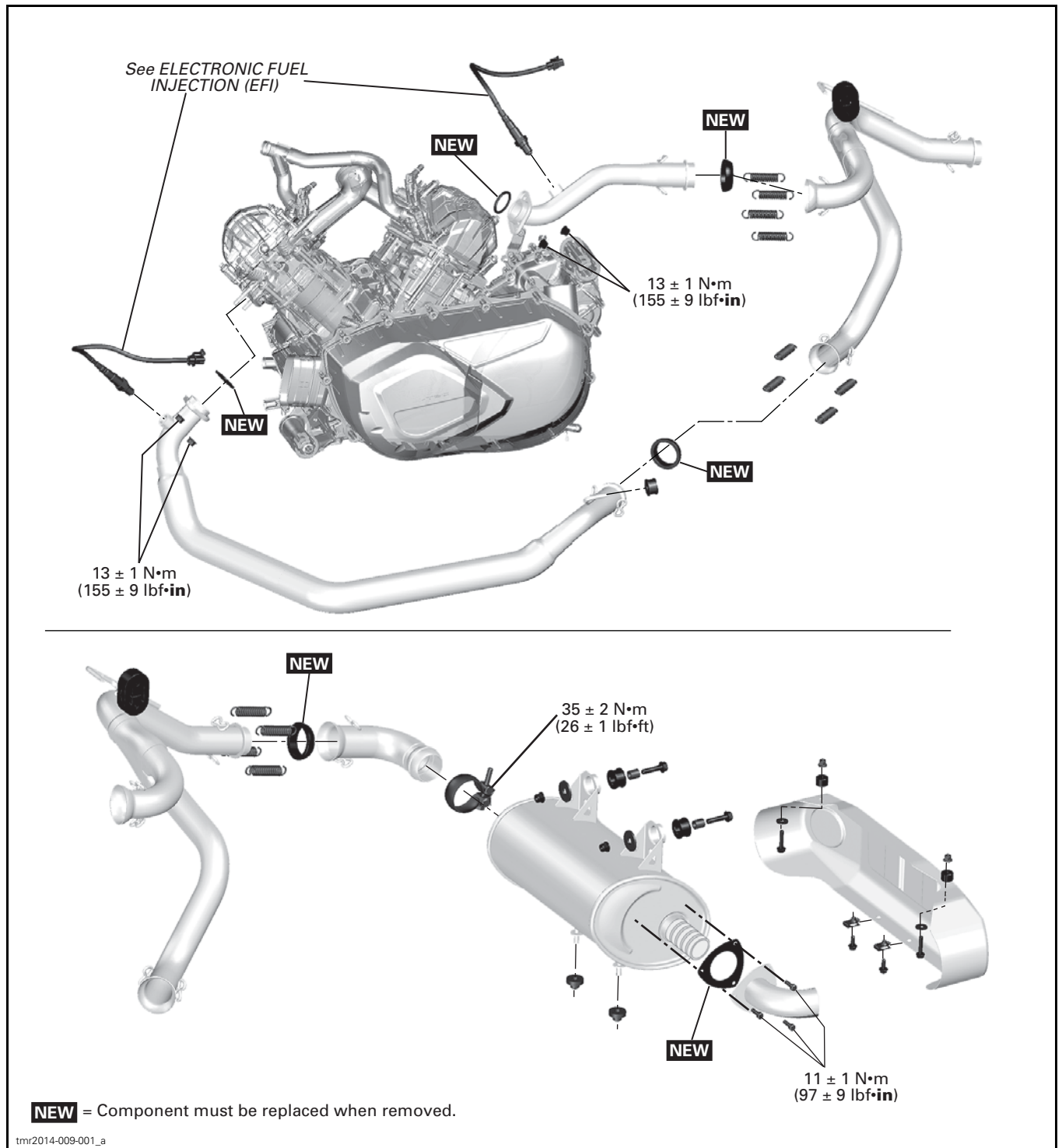
TYPICAL

Engine Mount Installation

The installation is the reverse of the removal procedure.

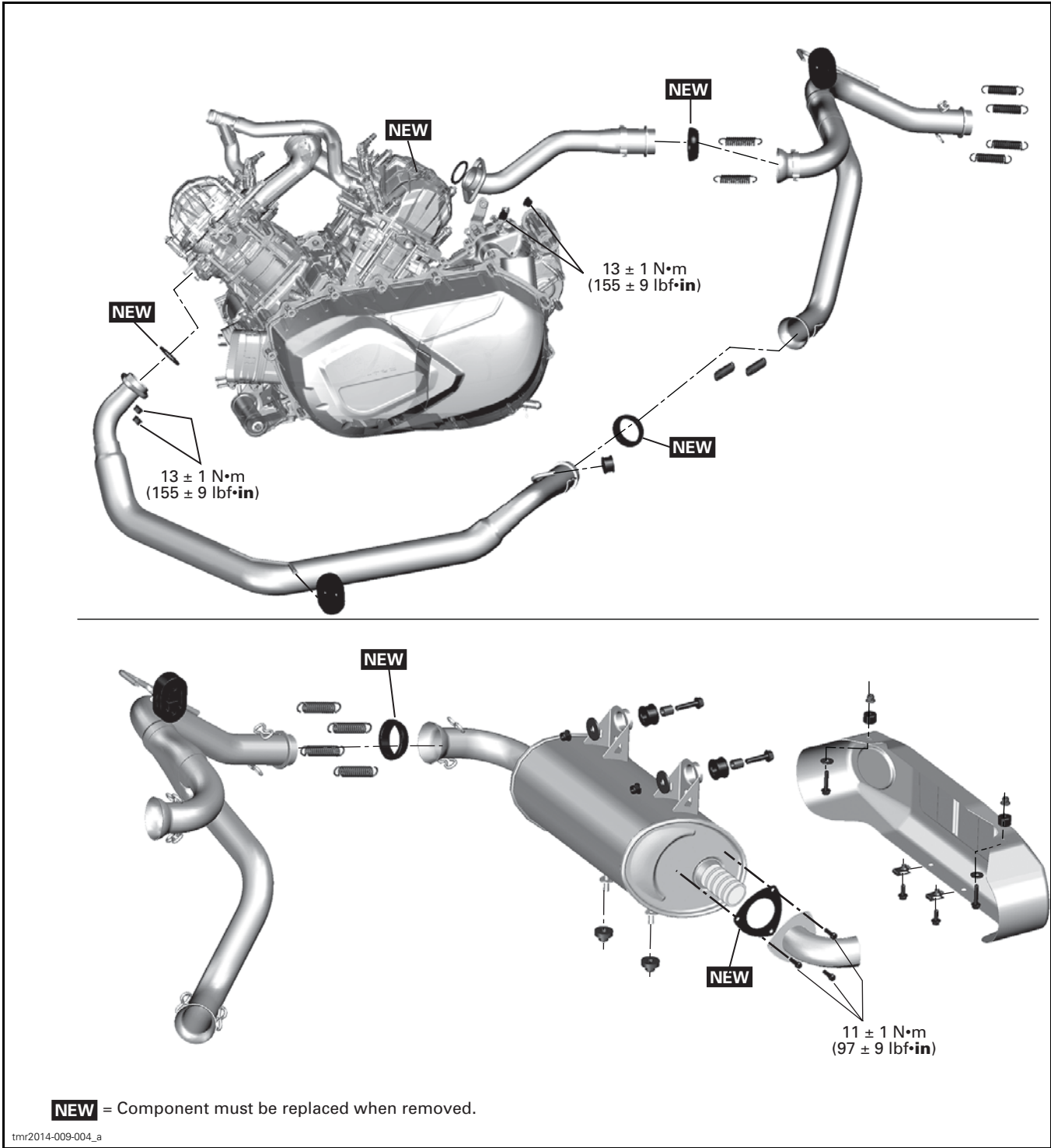
EXHAUST SYSTEM

CAN, USA and Int'l Models



Subsection XX (EXHAUST SYSTEM)

CE Models



GENERAL

WARNING

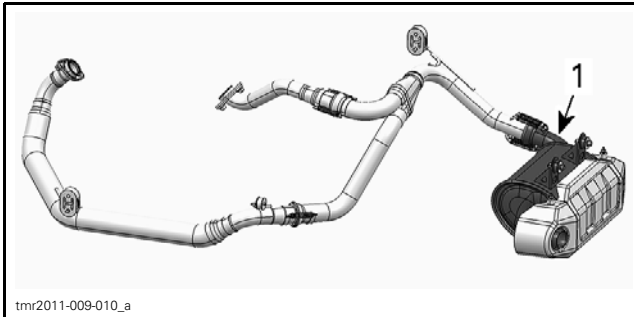
Never touch exhaust system components immediately after the engine has run.

PROCEDURES

SPARK ARRESTER

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

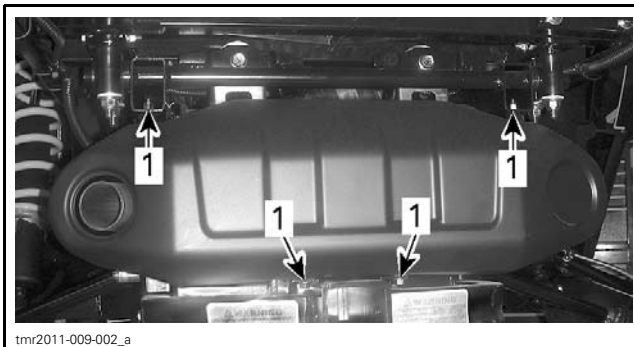
MUFFLER



1. Muffler

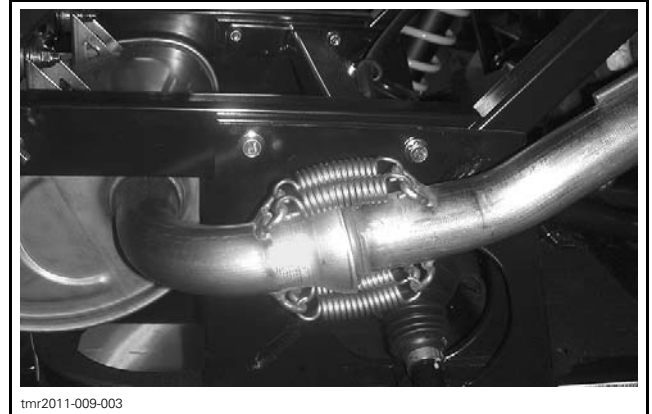
Muffler Removal

1. Remove the muffler cover.

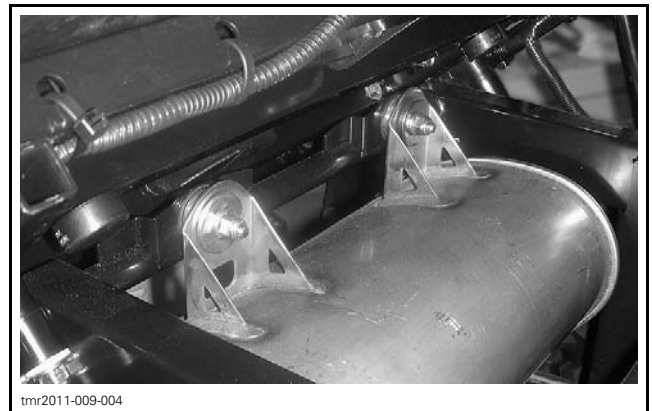


1. Muffler cover bolts

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.

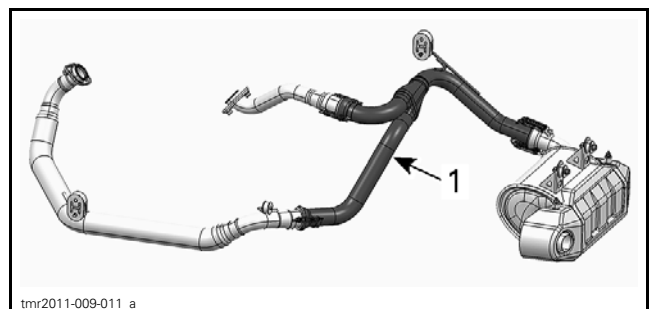
Muffler Inspection

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

Muffler Installation

For installation refer to *EXHAUST SYSTEM INSTALLATION SEQUENCE* procedure.

"Y" EXHAUST PIPE



1. "Y" exhaust pipe

Subsection XX (EXHAUST SYSTEM)

"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

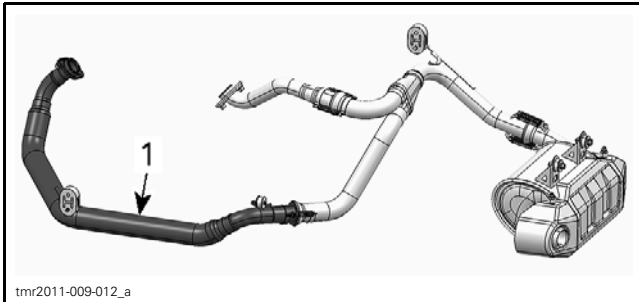
Check "Y" exhaust pipe for cracks, bending or other damages. Replace if need.

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

"Y" Exhaust Pipe Installation

For installation refer to *EXHAUST SYSTEM INSTALLATION SEQUENCE* procedure.

HEAD PIPE (FRONT CYLINDER)



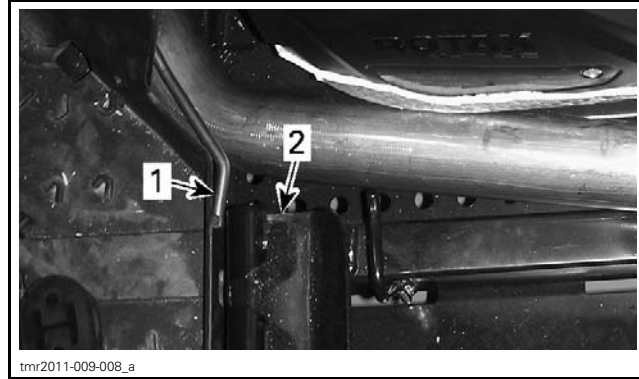
1. Front head pipe

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.
3. Remove front head pipe from vehicle according to following sub-steps:

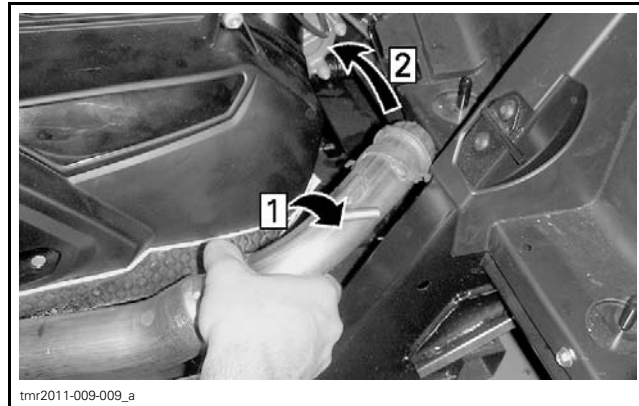
NOTE: The space to remove the front head pipe is limited. When the head pipe is positioned correctly as shown, it can be removed easily without force.

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



1. 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

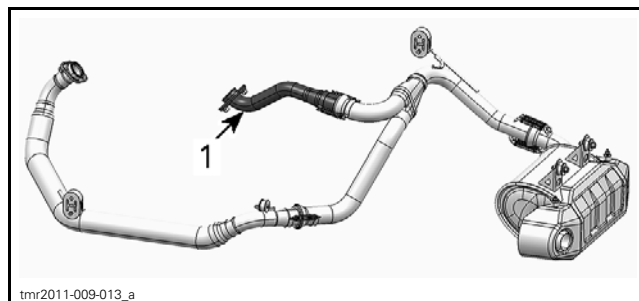
Check head pipe for cracks, bending or other damages. Replace if need.

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

Front Head Pipe Installation

For installation refer to *EXHAUST SYSTEM INSTALLATION SEQUENCE* procedure.

HEAD PIPE (REAR CYLINDER)



1. Rear head pipe

Rear Head Pipe Removal

- Remove the following parts:
 - Springs from "Y" exhaust pipe
 - RH lateral console panel, refer to *BODY* sub-section
 - Head pipe nuts.
- Remove head pipe from the vehicle.
- 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

For installation refer to *EXHAUST SYSTEM INSTALLATION SEQUENCE* procedure.

EXHAUST SYSTEM INSTALLATION SEQUENCE

When a part of the exhaust system needs to be removed, a specific sequence must be met during the installation to avoid leaks or damaging parts.

CAN, USA and Int'l Models

- Tighten muffler retaining bolts.

TIGHTENING TORQUE	
Muffler retaining bolts	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

- Install front and rear head pipes to cylinder heads. Finger tight retaining nuts.

NOTICE During front head pipe installation, a minimum gap of 10 mm (3/8 in) between head pipe and frame must be kept. Use any M10 or M12 screw as a gauge.

- Insert the front head pipe hook into the anti-vibration rubber.
- Install the muffler inlet elbow to the muffler using the clamp. Tighten clamp just enough to be able to rotate the elbow.
- Position the "Y" exhaust pipe by installing gaskets (3x), springs (12x) and inserting the head pipe hook into rubber support.
- Align front and rear head pipes, "Y" exhaust pipe and inlet elbow.

NOTE: During the alignment of pipes, make sure to keep joints all with springs straight as possible, however a slight angle is allowed.

- Tighten head pipe nuts.

TIGHTENING TORQUE	
Head pipe nuts	13 N•m ± 1 N•m (115 lbf•in ± 9 lbf•in)

- Tighten the muffler extension pipe clamp.

TIGHTENING TORQUE	
Muffler extension pipe clamp	35 N•m ± 2 N•m (26 lbf•ft ± 1 lbf•ft)

CE Models

- Tighten muffler retaining bolts.

TIGHTENING TORQUE	
Muffler retaining bolts	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

- Install front and rear head pipes to cylinder heads. Finger tight retaining nuts.

NOTICE During front head pipe installation, a minimum gap of 10 mm (3/8 in) between head pipe and frame must be kept. Use any M10 or M12 screw as a gauge.

- Insert the front head pipe hook into the rubber bushing.
- Position the "Y" exhaust pipe by installing gaskets (3x), springs (8x) and inserting the hanger rod into rubber support.
- Align front and rear head pipes, "Y" exhaust pipe and inlet elbow.

NOTE: During the alignment of pipes, make sure to keep joints all with springs straight as possible, however a slight angle is allowed.

- Tighten head pipe nuts.

TIGHTENING TORQUE	
Head pipe nuts	13 N•m ± 1 N•m (115 lbf•in ± 9 lbf•in)

FRAME (2UP)

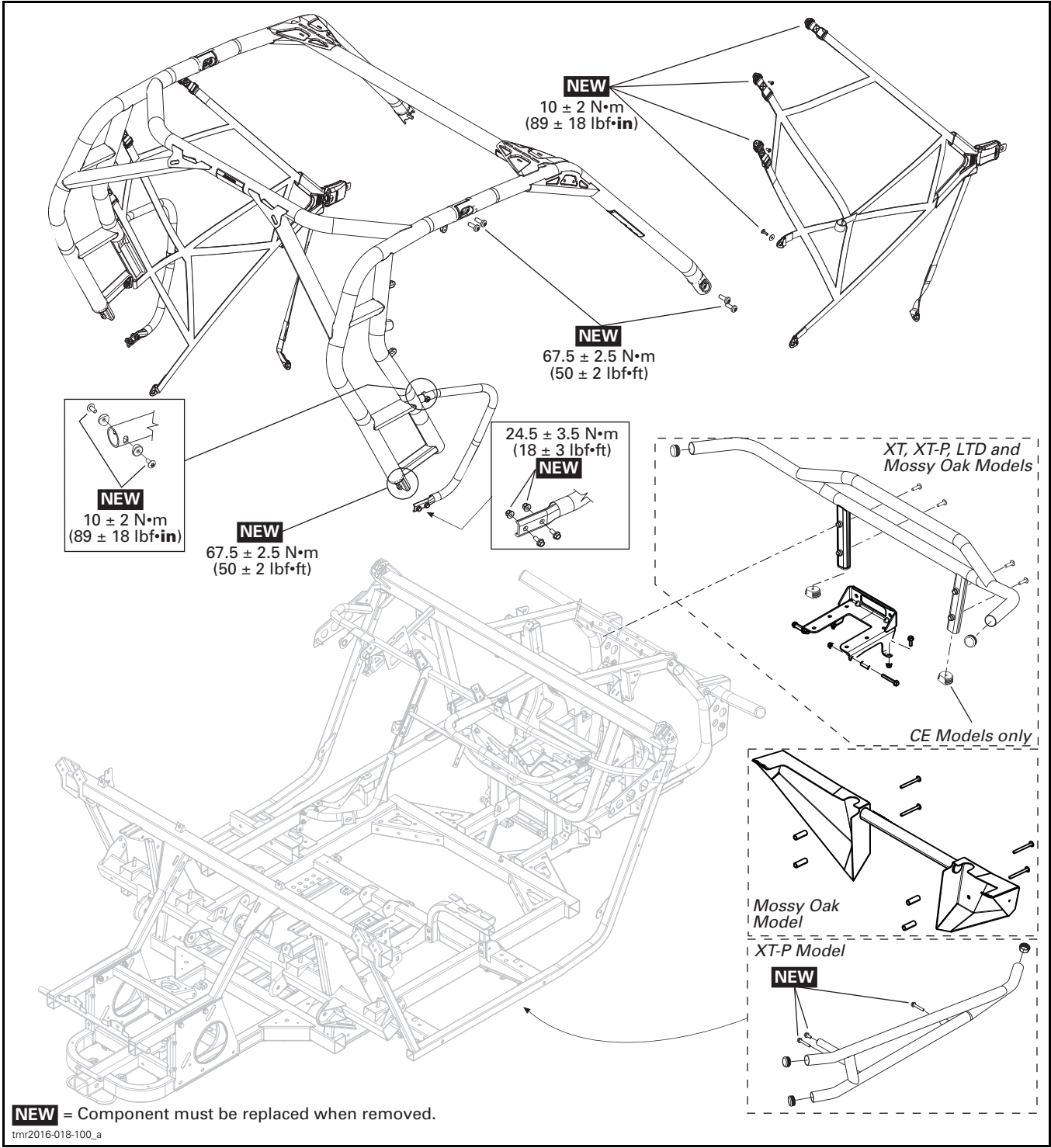
SERVICE TOOLS – OTHER SUPPLIER

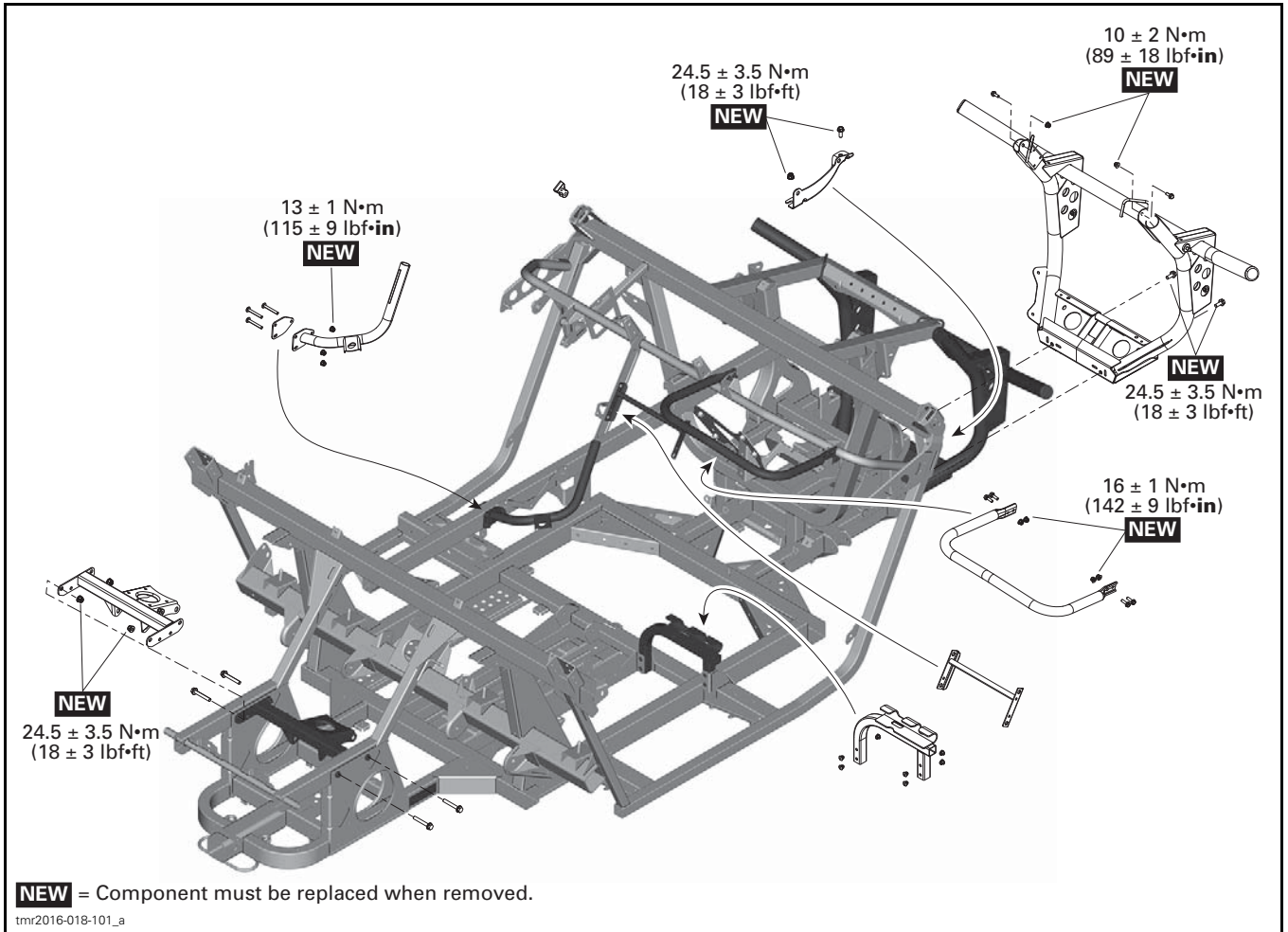
Description	Part Number	Page
BLIND THREADED INSERT INSTALLER.....	model 9600	5

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	4

Subsection XX (FRAME (2UP))





PROCEDURES

CAGE

⚠ 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.

⚠ WARNING

Never drill holes, weld or modify the cage. Since this is an important protection component, any modification might compromise passenger safety.

Cage Removal

1. Tilt rear cargo box.
2. Remove protective net screws from the cage
3. Remove lateral panels.
4. Remove screws at each corner of the cage.
5. Remove cage from the vehicle.
6. Disassemble if required.

Cage Inspection

Check cage for bending, cracks, weld damages or any other damage.

⚠ WARNING

Any damaged cage components must be replaced.

Cage Installation

⚠ 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 10.9 grade fasteners.

1. Loosely assemble the cage.

NOTE: DO NOT TIGHTEN screws until installation is completed.

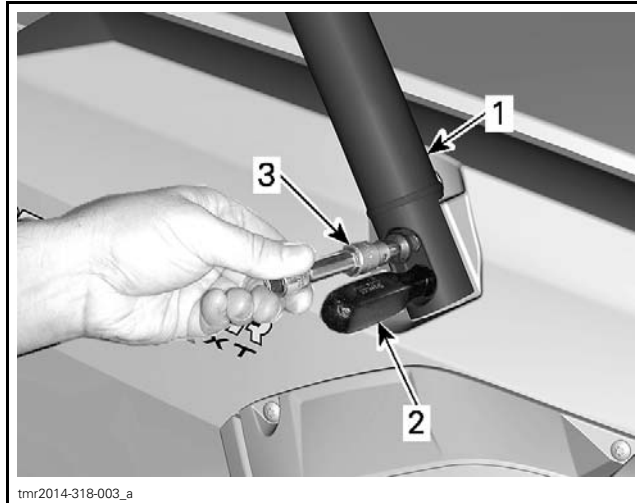
2. Using a hoist, lift the cage assembly over the vehicle and carefully position it on vehicle. Insert the rear of cage first.

NOTE: As an alternate method, one person at each attachment point can position the cage on the vehicle.

⚠ CAUTION To avoid injury or vehicle damages, never handle the cage alone.

3. Loosely install the cage to vehicle.

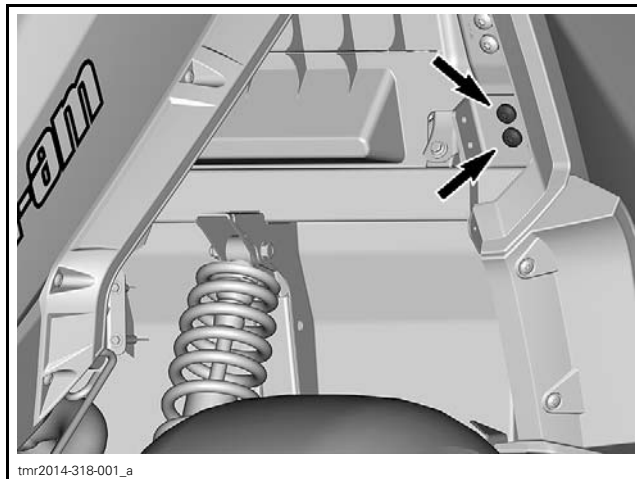
NOTE: Insert a Phillips screwdriver into cage hole and align with the frame hole, then loosely install the top screw. Thereafter, remove screwdriver and install the 2nd screw.



RH FRONT CAGE ATTACHMENT POINT

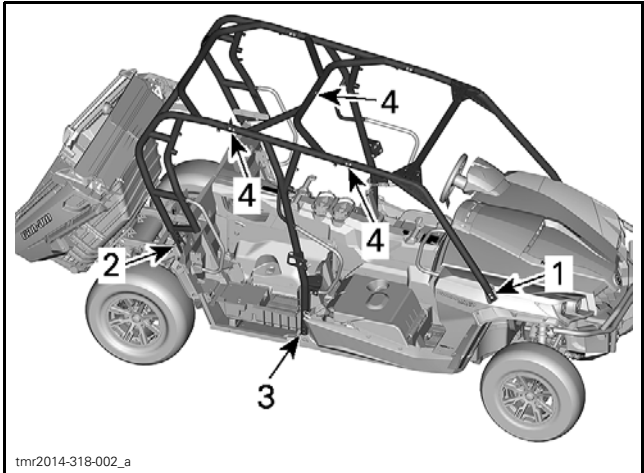
1. Front tube
2. Screwdriver to align holes
3. Installing screw

NOTE: Install rear cage screws from the rear of vehicle, besides top of shock absorbers.



RH REAR CAGE ATTACHMENT POINT

4. Tighten all cage screws in the order illustrated.



TIGHTENING SEQUENCE - MAX MODEL SHOWN

TIGHTENING TORQUE	
M10 x 30 Torx screws	67.5 N•m ± 2.5 N•m (50 lbf•ft ± 2 lbf•ft)

5. Reinstall previously removed parts.

FRAME

Frame Inspection

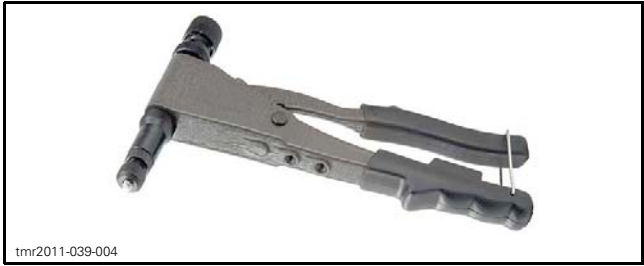
Check frame for bending, cracks, weld damages or any other damage. Replace frame as necessary.

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.

FRAME (MAX)

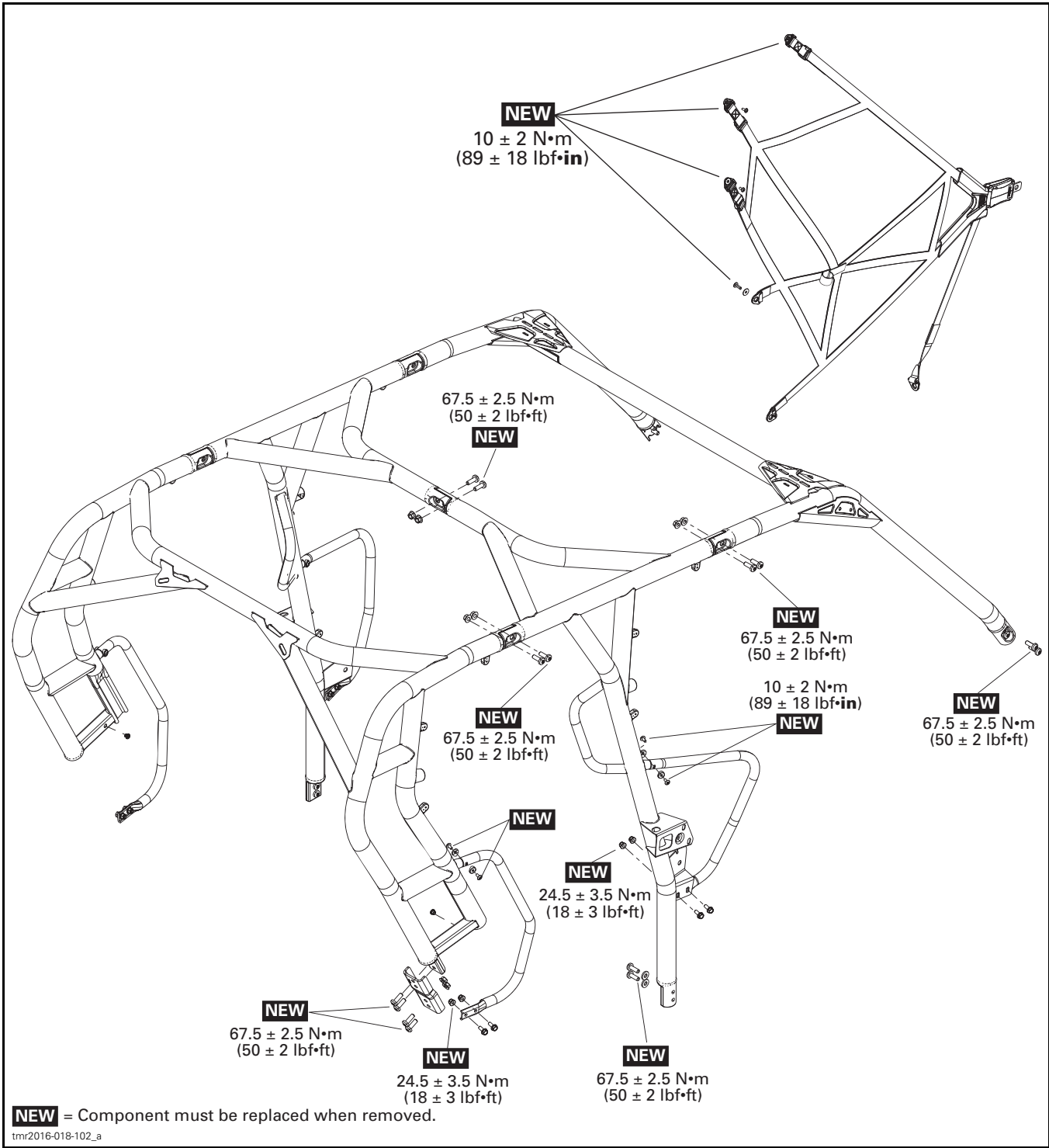
SERVICE TOOLS – OTHER SUPPLIER

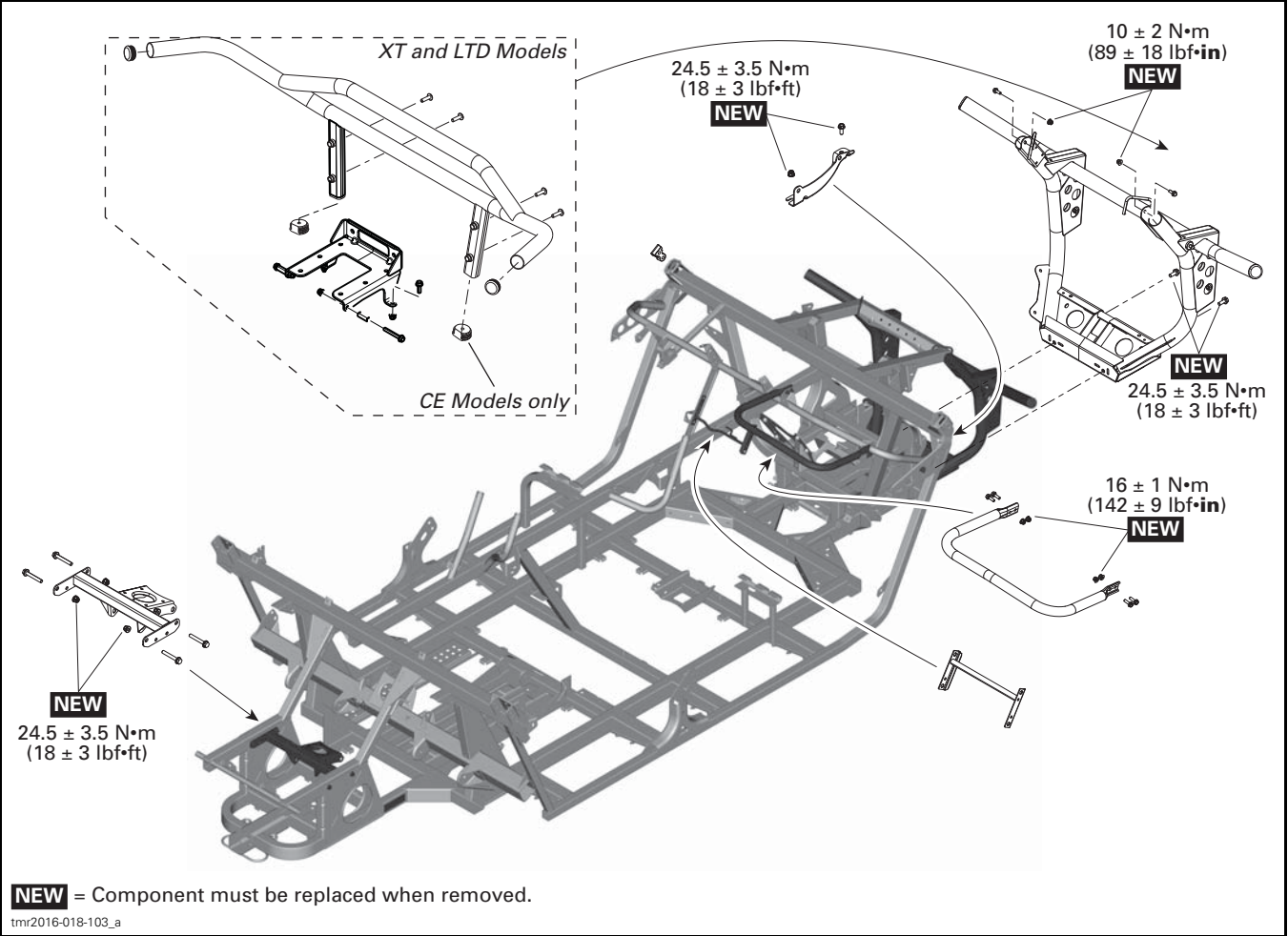
Description	Part Number	Page
BLIND THREADED INSERT INSTALLER.....	model 9600	6

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	4

Subsection XX (FRAME (MAX))





PROCEDURES

CAGE

 **WARNING**

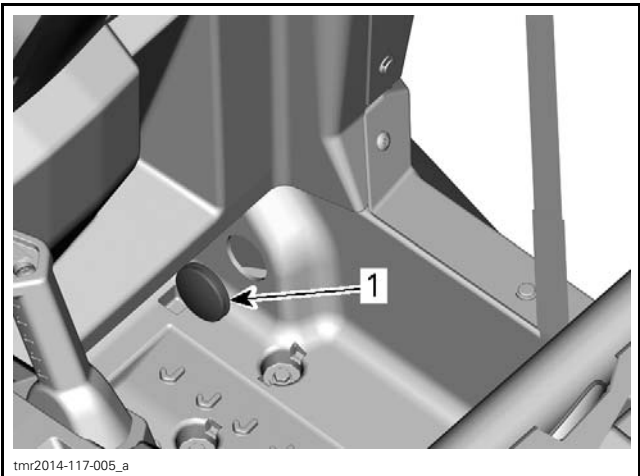
Never modify the mounting points of the shoulder nets and the seat belts. If they are found modified or damaged, contact a BRP service representative.

 **WARNING**

Never drill holes, weld or modify the cage. Since this is an important protection component, any modification might compromise passenger safety.

Cage Removal

- 1. Tilt rear cargo box.
- 2. Remove protective net screws from the cage
- 3. Remove lateral panels.
- 4. Remove plastic cap located just behind front passenger seat and remove screws and washers at the center of vehicle.



1. Plastic cap

- 5. Remove screws at each corner of the cage.
- 6. Remove cage from the vehicle.
- 7. Disassemble if required.

Cage Inspection

Check cage for bending, cracks, weld damages or any other damage.

 **WARNING**

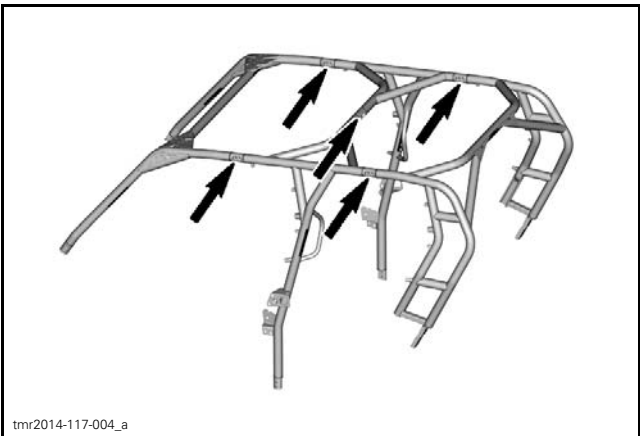
Any damaged cage components must be replaced.

Cage Installation

 **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 10.9 grade fasteners.

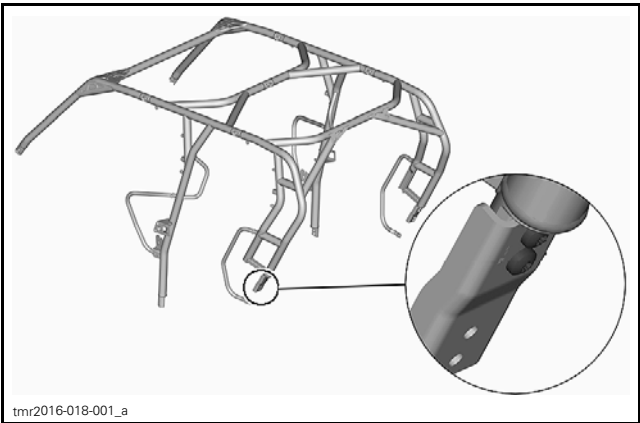
- 1. Loosely assemble the cage.



COMMANDER MAX SHOWN

NOTE: DO NOT TIGHTEN screws until installation is completed.

- 2. Install junctions on the rear of frame if previously removed, and torque to specification.



TIGHTENING TORQUE	
Upper junction screws	67.5 N•m ± 2.5 N•m (50 lbf•ft ± 2 lbf•ft)

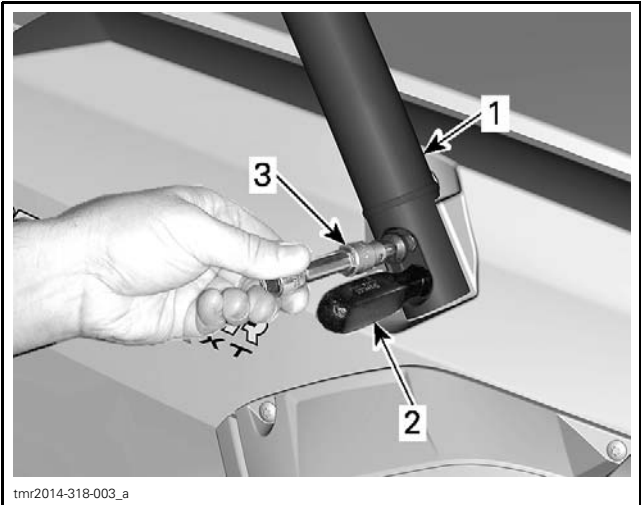
- 3. Using a hoist, lift the cage assembly over the vehicle and carefully position it on vehicle. Insert the rear of cage first.

NOTE: As an alternate method, one person at each attachment point can position the cage on the vehicle.

⚠ CAUTION To avoid injury or vehicle damages, never handle the cage alone.

4. Loosely install the cage to vehicle.

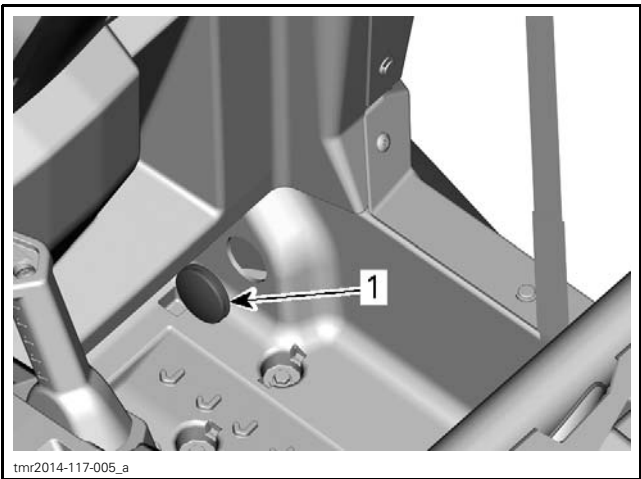
NOTE: Insert a Phillips screwdriver into cage hole and align with the frame hole, then loosely install the top screw. Thereafter, remove screwdriver and install the 2nd screw.



RH FRONT CAGE ATTACHMENT POINT

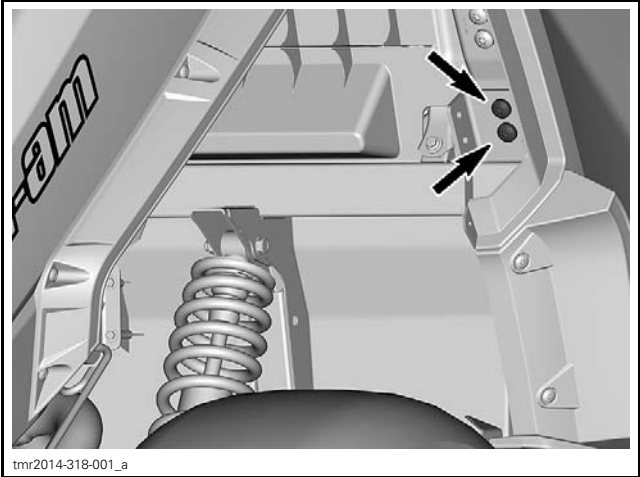
- 1. Front tube
- 2. Screwdriver to align holes
- 3. Installing screw

5. Install screws and washers at the center of vehicle and reinstall plastic caps.



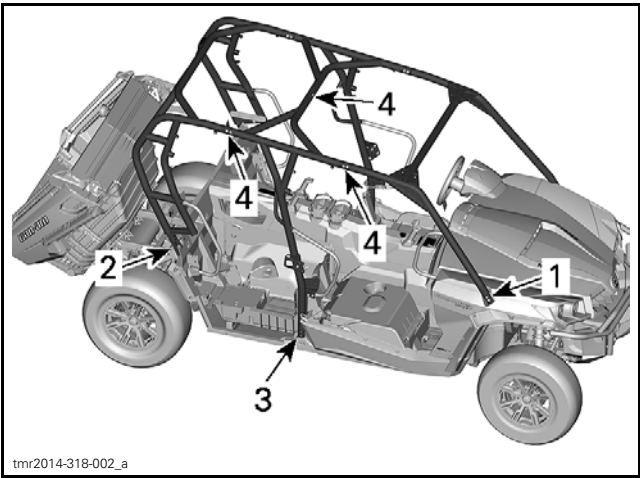
- 1. Plastic cap

NOTE: Install rear cage screws from the rear of vehicle, besides top of shock absorbers.



RH REAR CAGE ATTACHMENT POINT

6. Tighten all cage screws in the order illustrated.



TIGHTENING SEQUENCE - MAX MODEL SHOWN

TIGHTENING TORQUE	
M10 x 30 Torx screws	67.5 N•m ± 2.5 N•m (50 lbf•ft ± 2 lbf•ft)

7. Reinstall previously removed parts.

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.

Subsection XX (FRAME (MAX))

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.

FRONT DRIVE

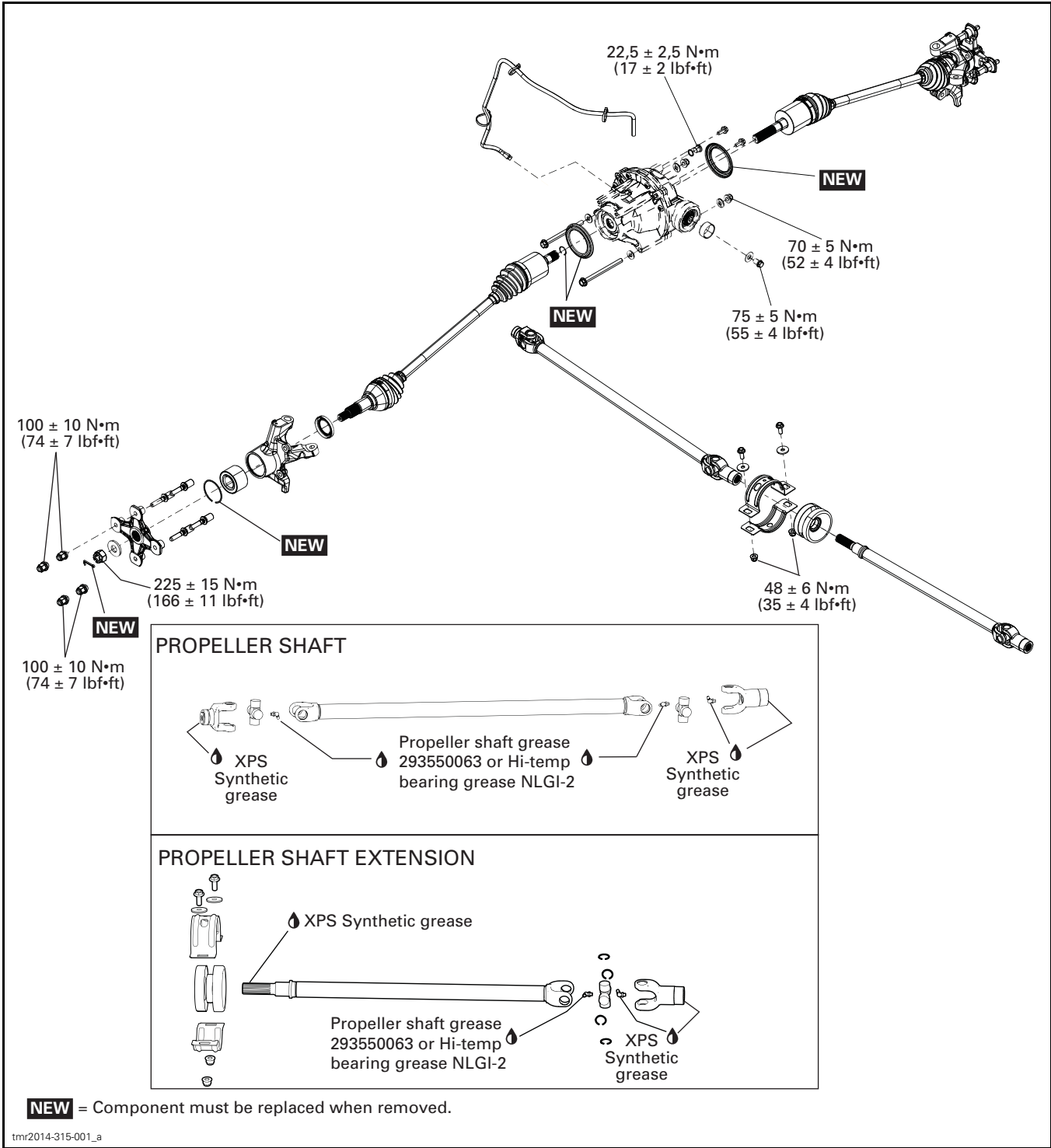
SERVICE TOOLS

Description	Part Number	Page
BACKLASH MEASUREMENT TOOL.....	529 035 665	7
CV BOOT CLAMP PLIER	529 036 120	6
CV JOINT EXTRACTOR.....	529 036 005	6
SPANNER SOCKET	529 035 649	9

SERVICE PRODUCTS

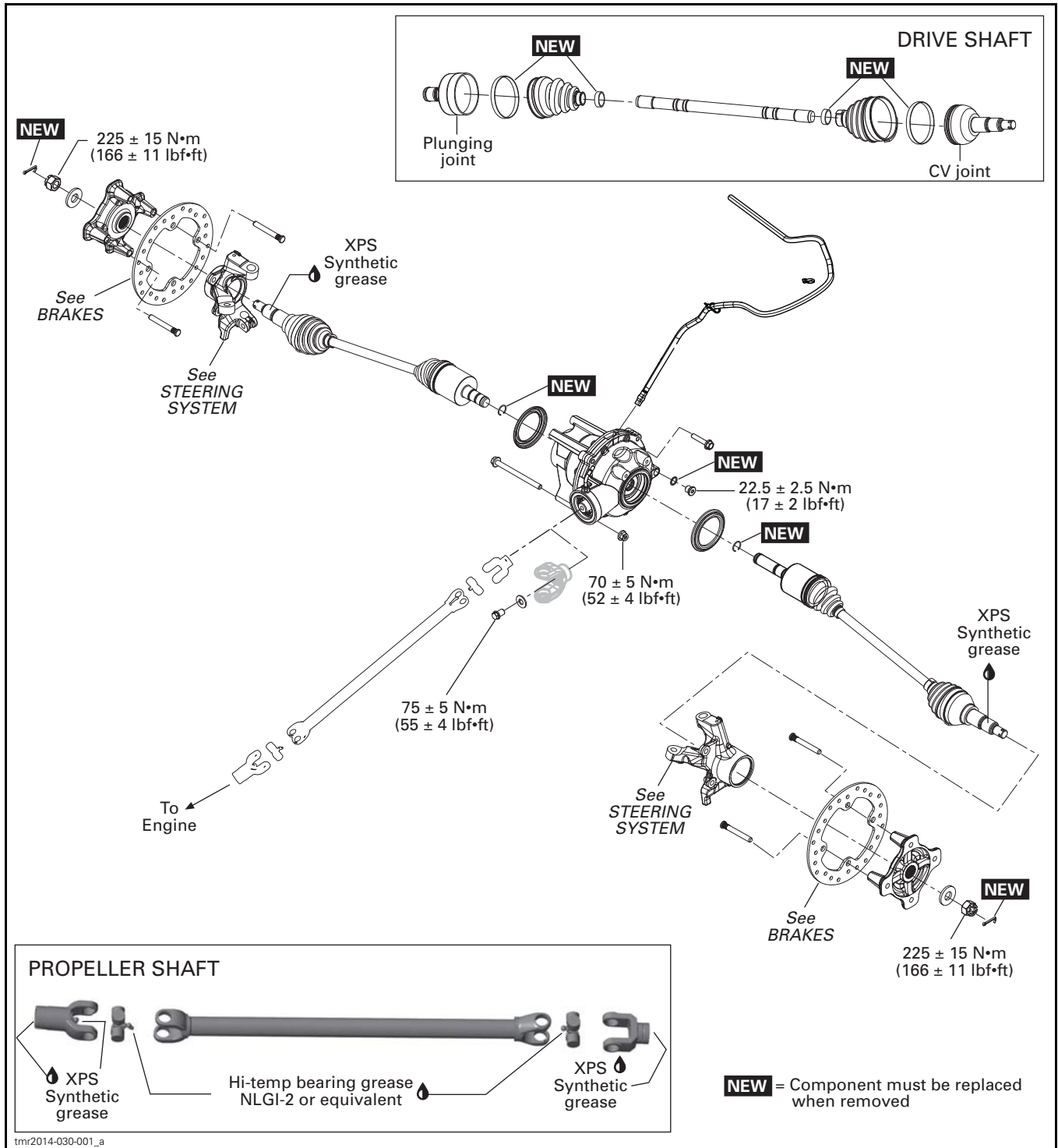
Description	Part Number	Page
LOCTITE 277	293 800 073	10
XPS SYNTHETIC GREASE.....	293 550 010	6, 11

MAX Models

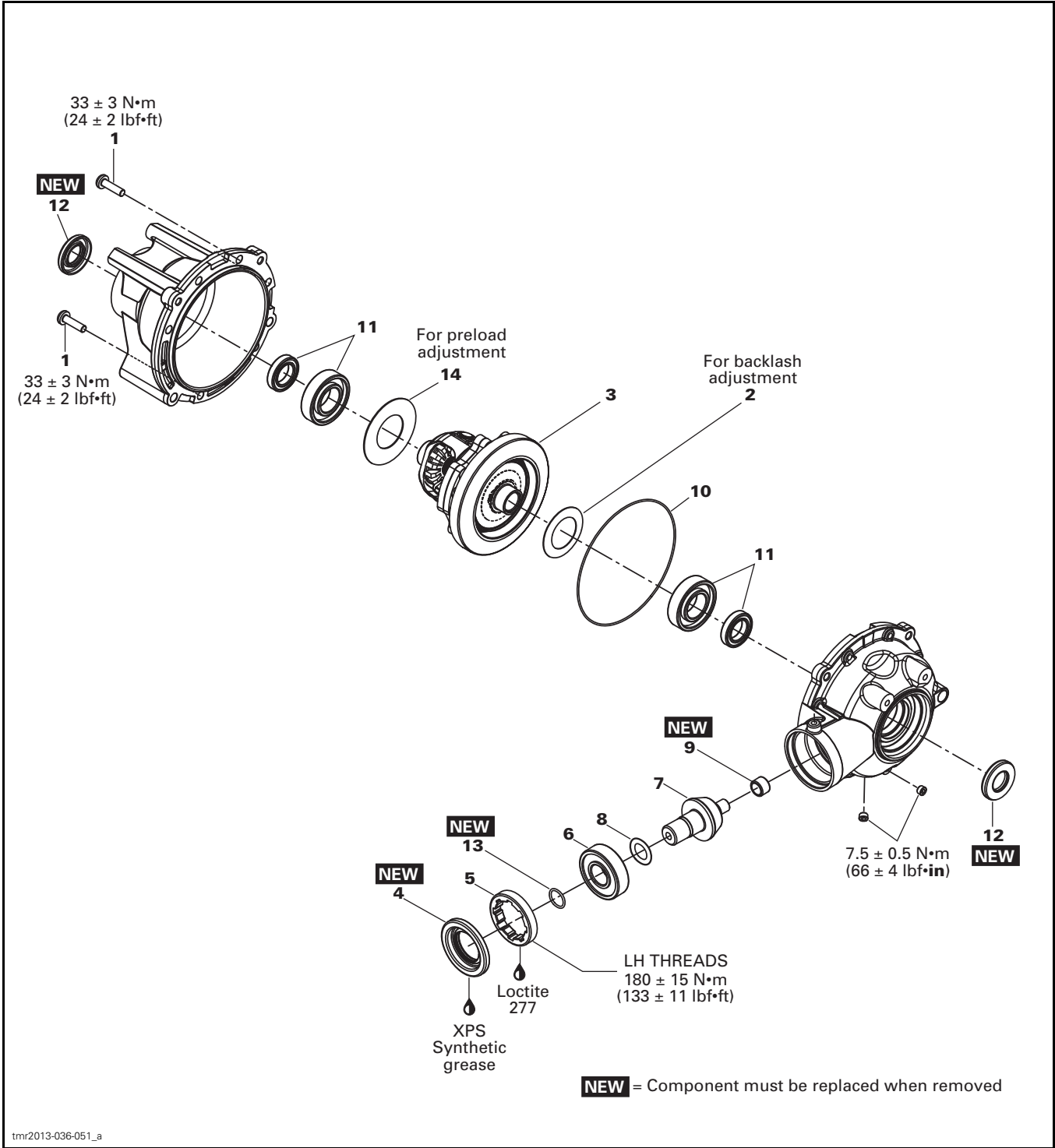


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2-UP Models



Subsection XX (FRONT DRIVE)



GENERAL

The procedure explained below is the same for the RH and LH sides unless otherwise instructed.

SYSTEM DESCRIPTION

When one wheel is spinning above a certain rate faster than the other wheel, the Visco-Lok® system progressively locks the wheels through its multi-plate clutch.

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.

NOTE: If the pump was disassembled, its viscous fluid would be lost and it could not be replaced.

PROCEDURES

WHEEL HUB

Wheel Hub Removal

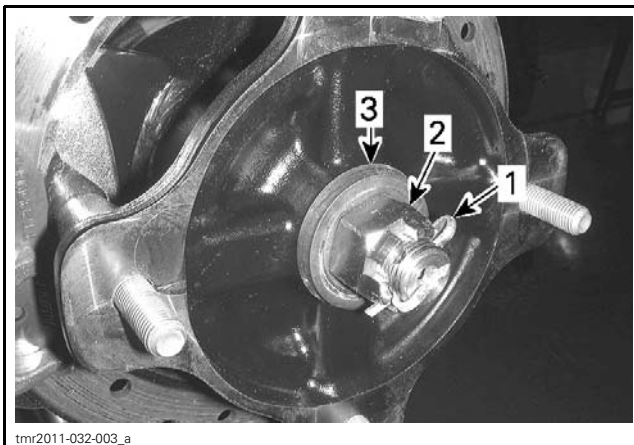
Lift and support vehicle. Refer to *INTRODUCTION* section for proper procedure.

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.



TYPICAL

1. Cotter pin
2. Castellated nut
3. 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

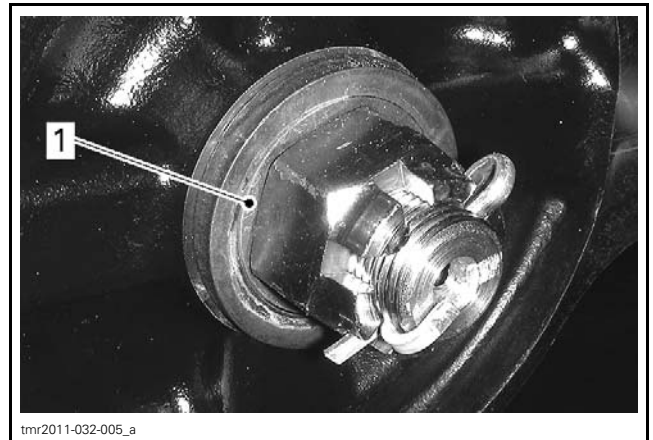
The installation is the reverse of removal procedure. However, pay attention to the following.

Install Belleville washer with its domed side outwards.

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.



1. Domed side here

FRONT DRIVE SHAFT

Front Drive Shaft Removal

Lift and support vehicle. Refer to *INTRODUCTION* section for proper procedure.

Remove the wheel hub, see procedure in this subsection.

Remove the knuckle. Refer to *STEERING SYSTEM* 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*.

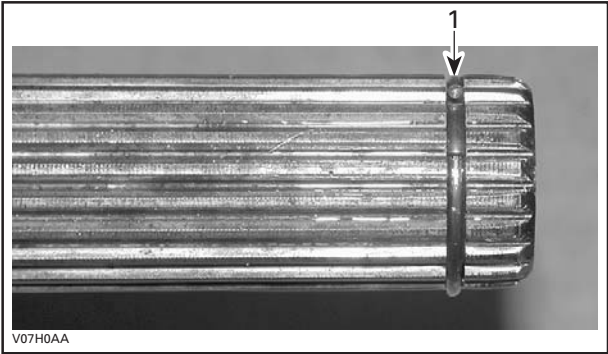
Subsection XX (FRONT DRIVE)

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:

TOOL	
CV BOOT CLAMP PLIER (P/N 529 036 120)	

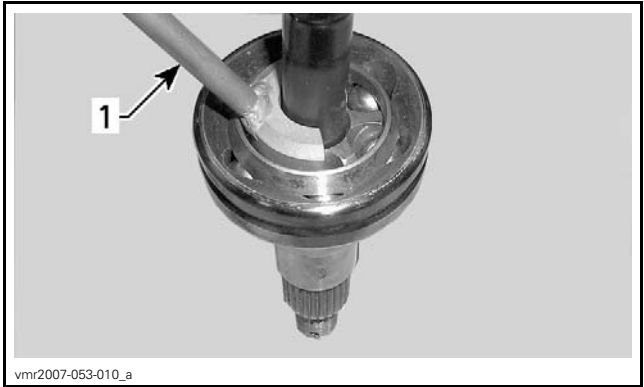
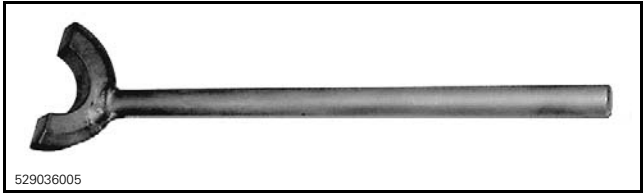
Dislodge the large boot end. Separate the joint from the shaft. Two procedures can be done.

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.



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.

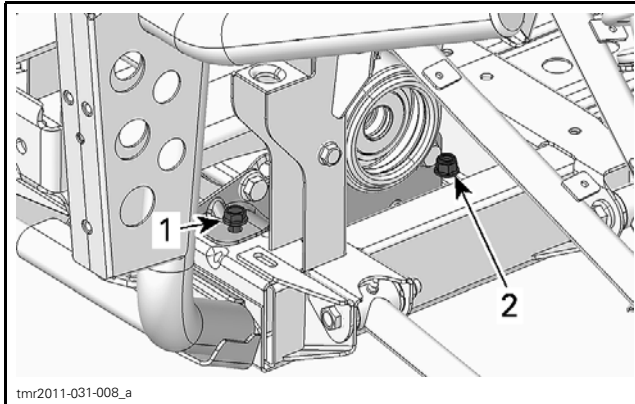
FRONT DIFFERENTIAL

Front Differential Removal

- Drain the differential. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
- Remove both drive shafts. See procedure in this subsection.
- Remove heavy duty front bumper (**XT-P, XT and Limited 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 (Assembled)

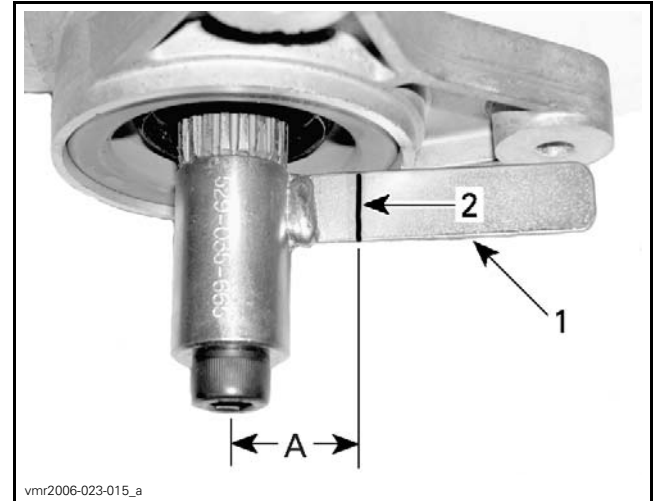
Check if oil seals are brittle, hard or damaged. Replace if necessary.

Backlash Inspection

Using a dial indicator and the BACKLASH MEASUREMENT TOOL (P/N 529 035 665), measure the backlash.

Place the backlash measurement tool at the end of pinion gear.

From center of bolt, measure 25.4 mm (1 in) and scribe a mark on the tab.



1. Tab of backlash measurement tool
 2. Mark on tab
- A. 25.4 mm (1 in)

Position the dial indicator tip against the tab at a 90° angle and right on the previously scribed mark.

Gently, move the tab back and forth. Note the result.



Rotate pinion gear 1/2 turn and check backlash again. Note the result.

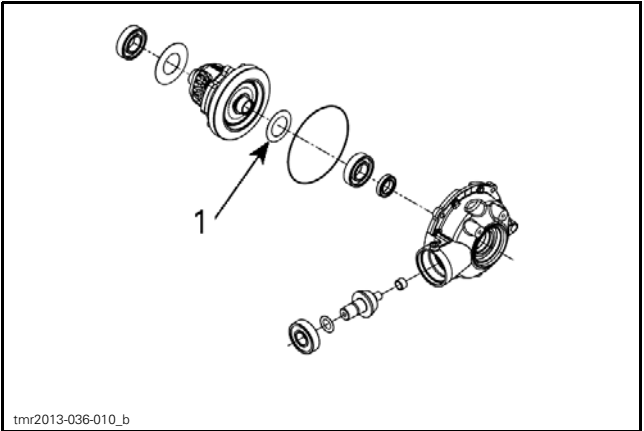
Rotate pinion gear 1 turn and check backlash again.

BACKLASH SPECIFICATION
0.05 mm (.002 in) to 0.36 mm (.014 in)

If backlash is out of specification, split front differential housing and adjust shim thickness as per following guideline.

Subsection XX (FRONT DRIVE)

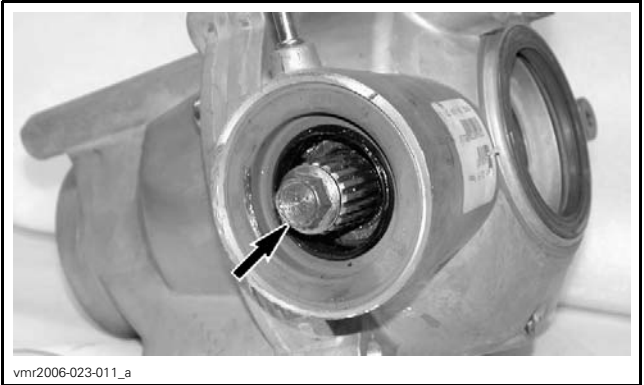
BACKLASH ADJUSTMENT GUIDELINE	
BACKLASH MEASUREMENT	WHAT TO DO
Below 0.05 mm (.002 in)	Add shim(s) and recheck backlash
Above 0.36 mm (.014 in)	Remove shim(s) and recheck backlash



1. Backlash shim

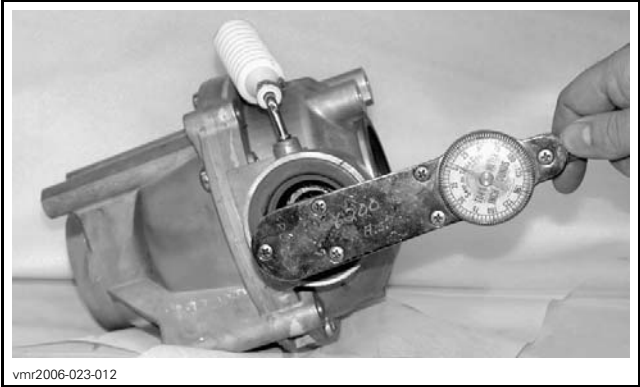
Preload Inspection

Screw the propeller shaft adaptor bolt in pinion gear.



TYPICAL

Using a needle torque wrench, measure the drag torque.

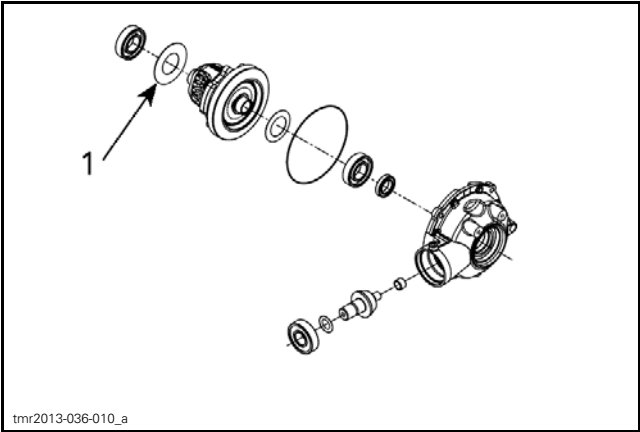


TYPICAL

PRELOAD SPECIFICATION
0.06 N•m (.5 lbf•in) to 0.50 N•m (4 lbf•in)

If preload is out of specification, split front differential housing and adjust shim thickness as per following guideline.

PRELOAD GUIDELINE	
PRELOAD MEASUREMENT	WHAT TO DO
Below 0.06 N•m (.5 lbf•in)	Add shim(s) and recheck preload
Above 0.50 N•m (4 lbf•in)	Remove shim(s) and recheck preload

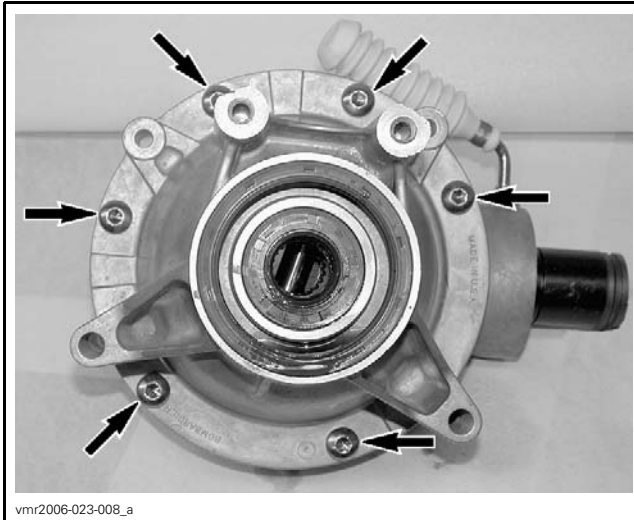


1. Preload shim

Front Differential Disassembly

Visco-Lok Carrier/Ring Gear

Unscrew the differential housing screws no. 1, then separate half housings.



TYPICAL

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 LH 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**. Discard bearing.

The pinion gear and bearing can be easily removed using the following suggested tool:

PART	QTY
Pipe: 89 mm (3-1/2 in) dia. x 127 mm (5 in)	1
Threaded rod: M12 x 1.25 x 178 mm (7 in)	1
M12 x 1.25 nut	3
Flat bar	1

Remove and discard the needle bearing **no. 9**.

Front Differential Assembly

Adjustment is required when any of the following part is changed.

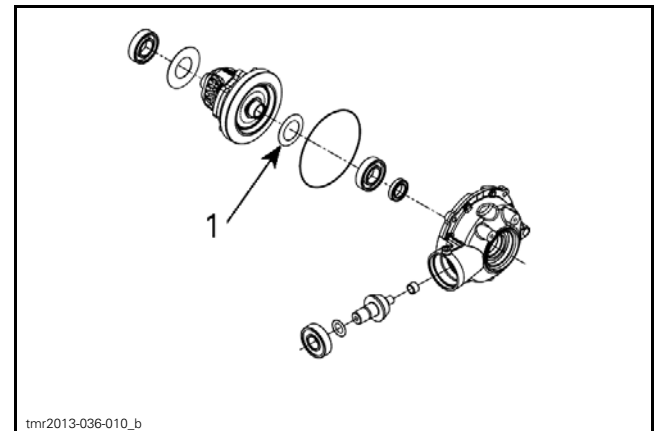
- Pinion gear

- Visco-Lok carrier
- Housing.

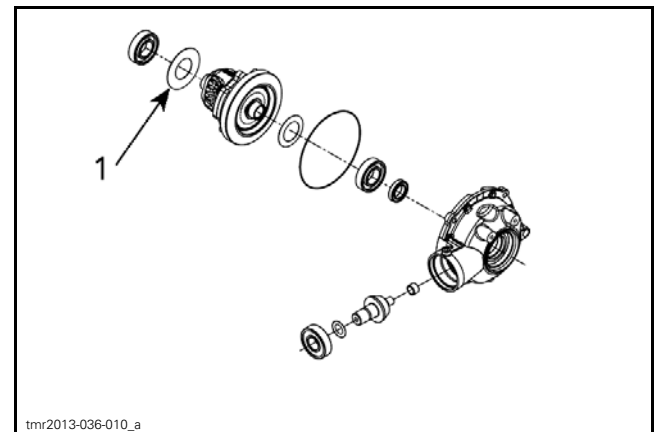
As a preliminary setup, install shims according to the following table.

RECOMMENDED SHIM THICKNESS	
PINION GEAR ⁽¹⁾	1.67 mm $\pm$ 0.04 mm (.066 in $\pm$.002 in)
BACKLASH	0.5 mm (.02 in) (as a preliminary adjustment)
PRELOAD	

(1) The pinion gear shim thickness (**no. 8**) should never be altered. Any adjustment should be done on preload and/or backlash shims (**no. 2** and **no. 14**).



1. Backlash shim



1. Preload shim

Prior to finalizing assembly, proceed in this order:

- Temporarily assemble front differential using recommended torques.
- Do not apply thread locker product.
- Do not install a new pinion nut.
- Check backlash.
- Check preload.

Subsection XX (FRONT DRIVE)

Visco-Lok Carrier/Ring Gear

To assemble, reverse the removal procedure. Pay attention to the following.

Check condition of seal **no. 10**. Replace if damaged.

Install new bearings **no. 11**.

Tighten differential housing screws **no. 1**.

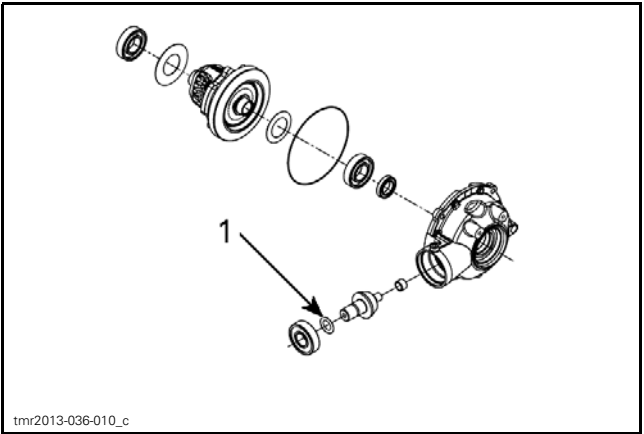
PART	TORQUE
Differential housing screws	33 N•m ± 3 N•m (24 lbf•ft ± 2 lbf•ft)

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**.



1. Shim no.8

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 (LH THREADS)	180 N•m ± 15 N•m (133 lbf•ft ± 11 lbf•ft)

Lubricate oil seal **no. 4**.

Finalize assembly:

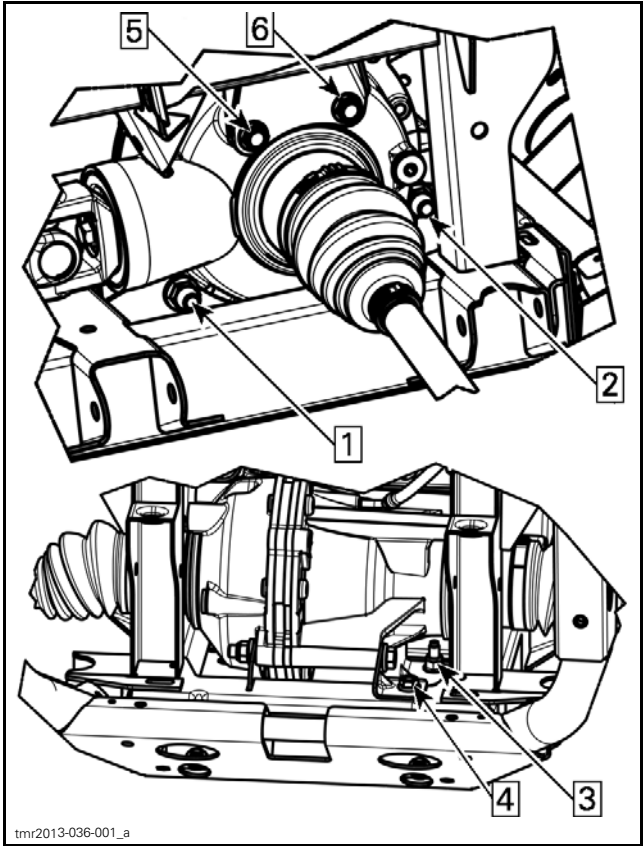
- Apply thread locker products where applicable.
- Torque fasteners as per tables.

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.

Tighten front differential nuts as per following sequence.



TOP ILLUSTRATION: RH SIDE VIEW
BOTTOM ILLUSTRATION: FRONT VIEW

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 PROCEDURES* subsection.

FRONT PROPELLER SHAFT

Front Propeller Shaft Removal

2-UP Models

Remove the RH lateral console panel.

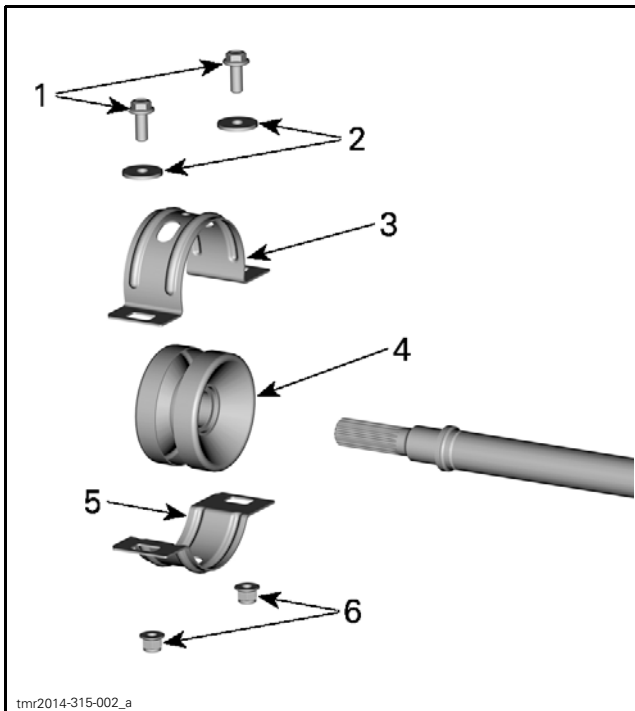
Remove propeller shaft screws on differential.
Remove lower and upper differential bolts.
Move the differential forwards.
Dislodge the propeller shaft from the engine and differential.
Remove front propeller shaft.

MAX Models

Refer to *BODY* and remove the following parts:

- RH front lateral console panel
- Front grille

Remove propeller shaft screw on differential.
Remove both retaining bolts and nuts securing bearing flange.



DISASSEMBLED FOR CLARITY

1. Retaining bolts to remove
2. Washers
3. Bearing upper flange
4. Bearing
5. Bearing lower flange
6. Retaining nuts to remove

Pull up bearing flange to disengage both propeller shaft and propeller shaft extension.

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.

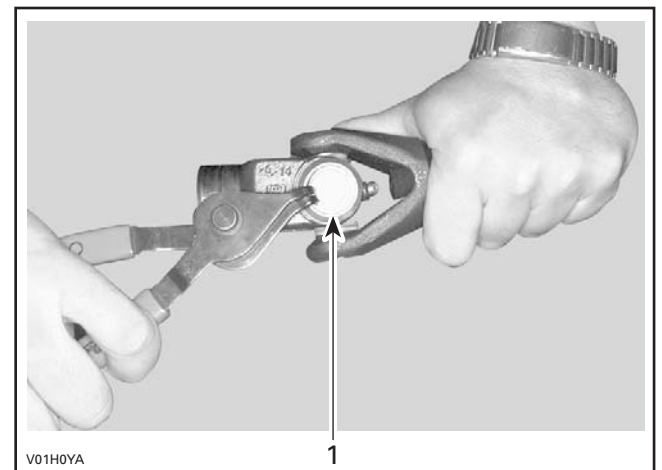
Apply XPS SYNTHETIC GREASE (P/N 293 550 010) where needed.

PARTS	TORQUE
Propeller shaft screw (differential side)	75 N•m ± 15 N•m (55 lbf•ft ± 11 lbf•ft)
Bearing flange retaining screws (MAX models)	48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

PROPELLER SHAFT U-JOINTS

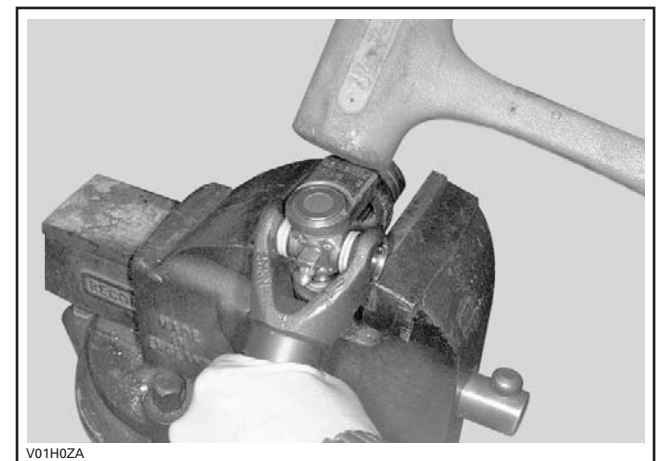
Propeller Shaft U-Joint Removal

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.

Subsection XX (FRONT DRIVE)

Remove U-joint cross.

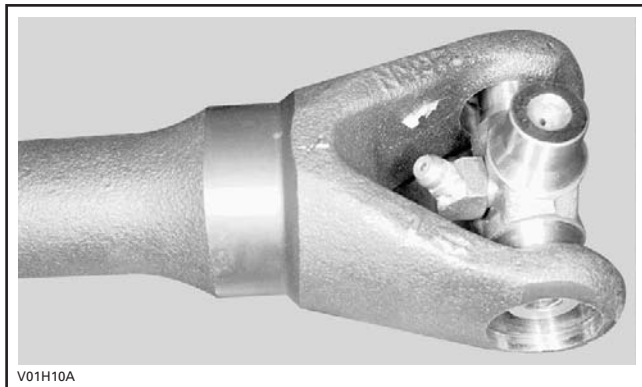
Propeller Shaft U-Joint Installation

Install new U-joint in inner yoke.

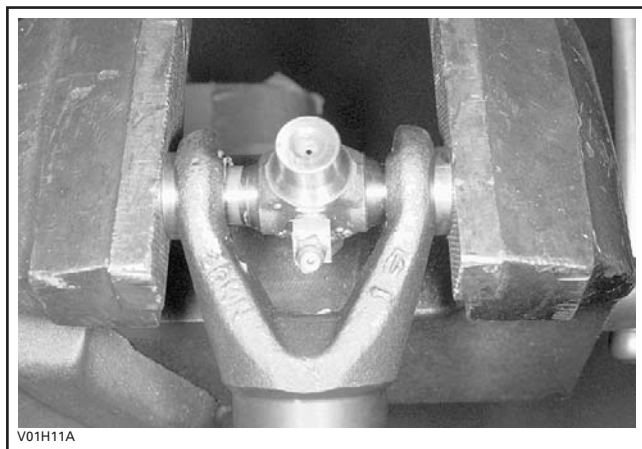
NOTE: Position propeller shaft U-joint as shown for proper grease fitting location.

Install snap ring.

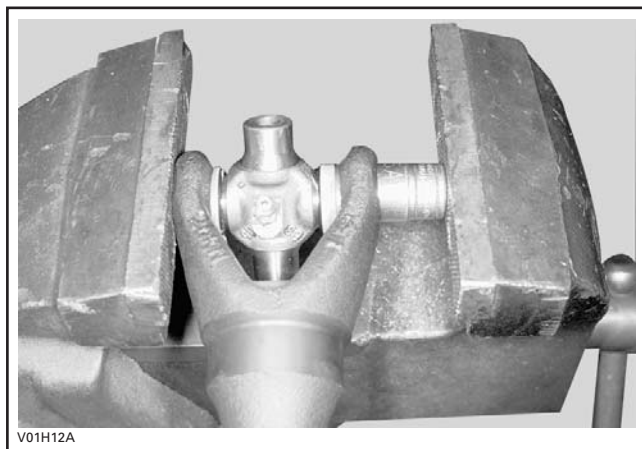
Grease U-joints. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.



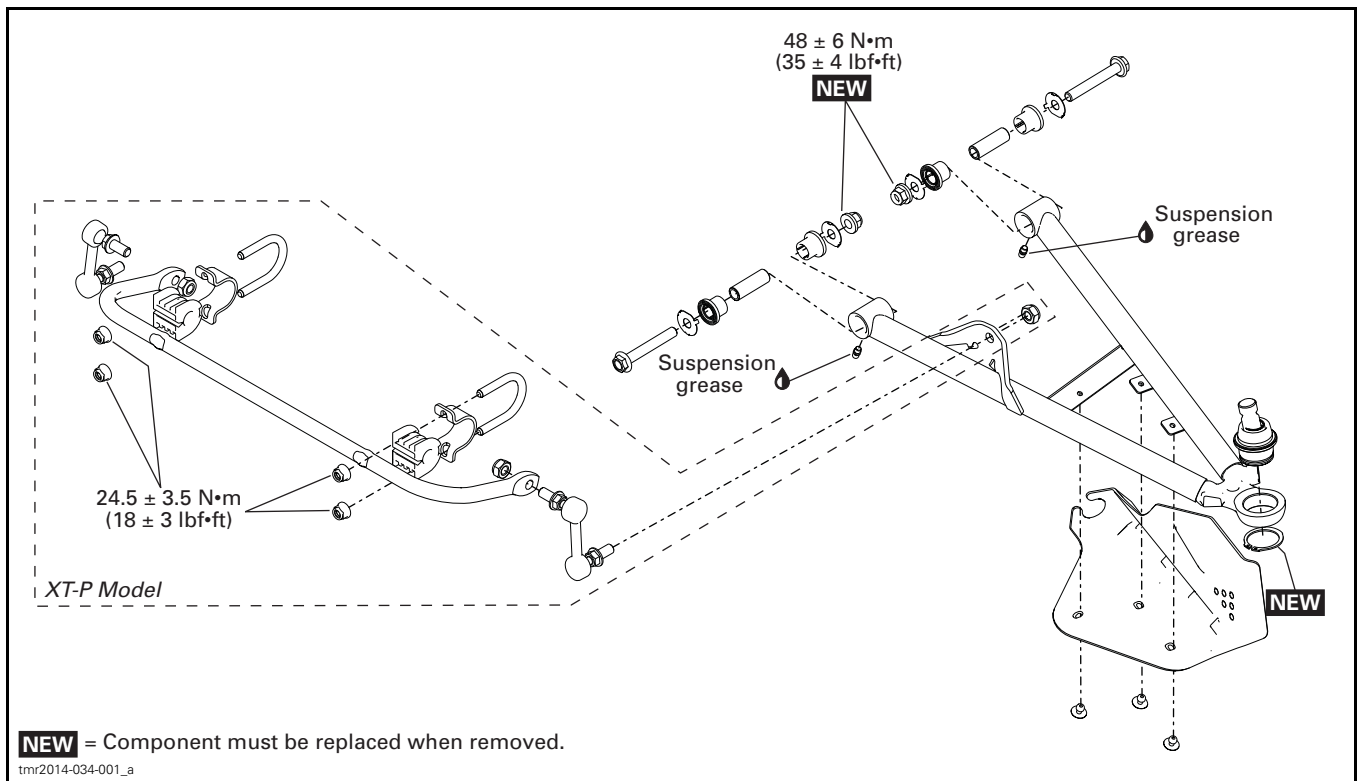
Install bearing caps. Use a vise to insert bearing caps.



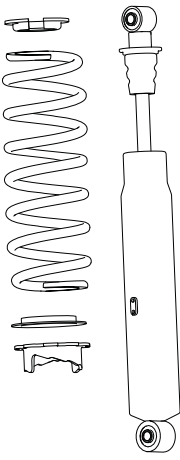
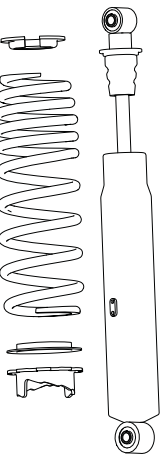
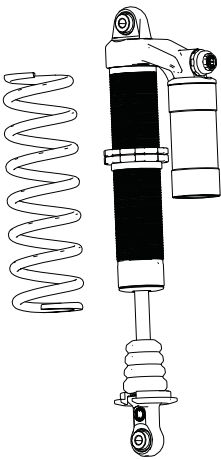
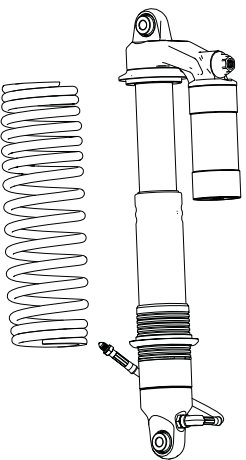
Using a suitable pusher, fully seat bearing cap on one side.

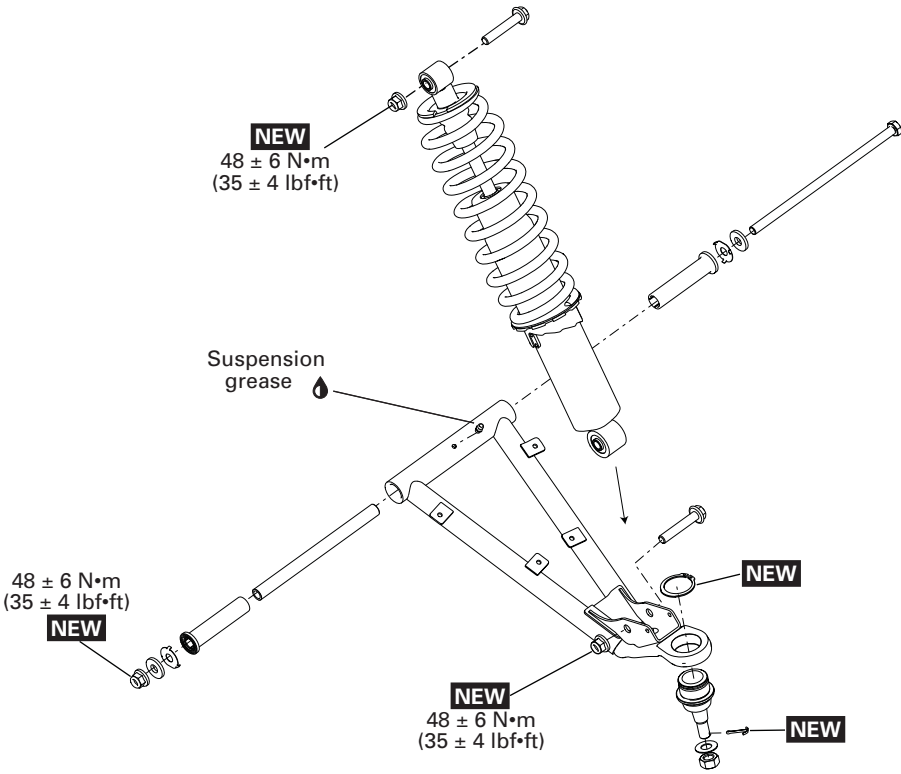


FRONT SUSPENSION



UPPER SUSPENSION ARM

 <i>STD Model</i>	 <i>DPS, XT and Mossy Oak Models</i>	 <i>XT-P and MAX LTD Models</i>	 <i>LTD Model</i>
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NEW
48 ± 6 N•m
(35 ± 4 lbf•ft)

Suspension grease

48 ± 6 N•m
(35 ± 4 lbf•ft)
NEW

NEW
48 ± 6 N•m
(35 ± 4 lbf•ft)

NEW

NEW

NEW = Component must be replaced when removed.

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GENERAL

The procedure explained below is the same for the RH and LH sides unless otherwise noted.

On vehicles equipped with air controlled suspension (ACS), refer to *AIR CONTROLLED SUSPENSION (ACS)* section.

ADJUSTMENT

SUSPENSION FACTORY SETTINGS

For adjustment procedures, refer to *REAR SUSPENSION* subsection.

REAR SUSPENSION FACTORY SETTINGS		
ADJUSTMENT	MODEL	FACTORY SETTING
Spring preload	Commander XT-P	96.3 mm (3.79 in)
	Commander MAX LTD	50.8 mm (2 in)
	Commander LTD	N/A
Compression damping (low speed)	Commander XT-P and Commander MAX LTD	12 $\pm$ 1 clicks counterclockwise from full stop
	Commander LTD	10 $\pm$ 1 clicks counterclockwise from full stop
Compression damping (high speed)	Commander XT-P and Commander MAX LTD	12 $\pm$ 1 clicks counterclockwise from full stop
Rebound damping	Commander XT-P and Commander MAX LTD	12 $\pm$ 1 clicks counterclockwise from full stop

PROCEDURES

SHOCK ABSORBER

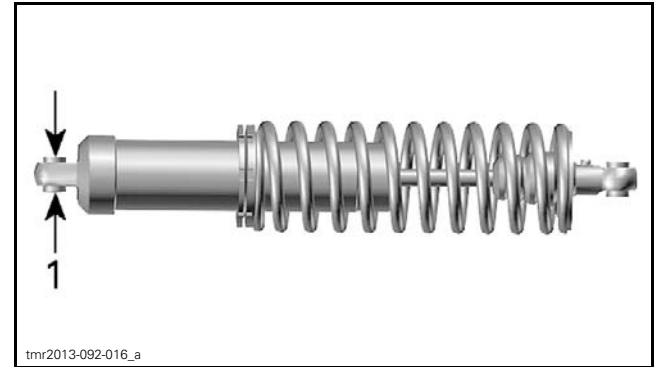
Shock Absorber Removal

1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
2. Remove bolts and nuts retaining shock absorber.
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 Spherical Bearing

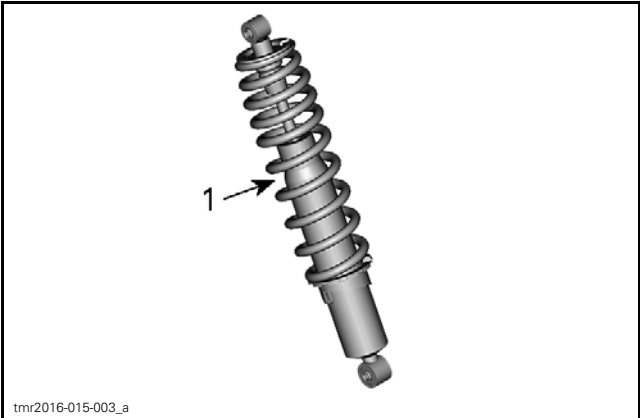
For shock absorber spherical bearings inspection, cleaning and replacement, refer to *SUSPENSION* in *PERIODIC MAINTENANCE PROCEDURE* subsection.

Shock Absorber Installation

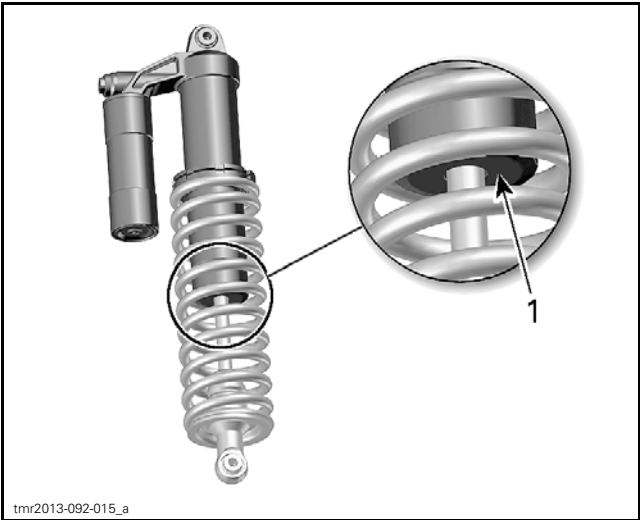
The installation is the reverse of the removal procedure. However, pay attention to the following.

Make sure to install the proper type of shock absorber. The P/N is located:

- On the shock body, near the cap, for oil shocks.
- On the lower cap for HPG shocks.

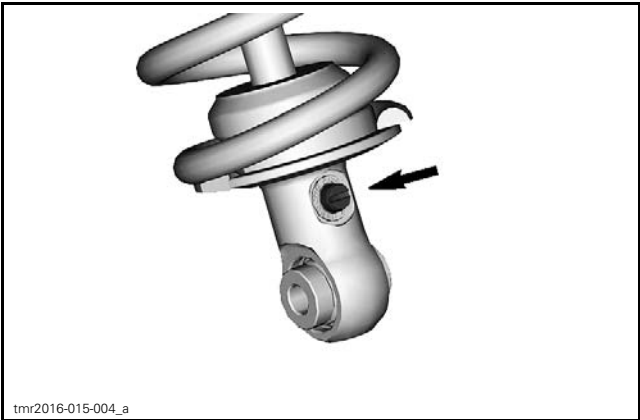


TYPICAL - OIL SHOCK ABSORBER
1. Shock P/N



TYPICAL - HPG SHOCK ABSORBER
1. Shock P/N

Install the shock with the rebound adjuster towards rear.



TIGHTENING TORQUE	
Shock absorber nut	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.

STABILIZER BAR (XT-P MODEL)

Stabilizer Bar Removal

1. Remove upper link nuts.
2. Remove U-clamp nuts.
3. Remove stabilizer bar from vehicle.

Stabilizer Bar Inspection

Check stabilizer bar for cracks, bending or other damages.

Replace if necessary.

Stabilizer Bar Installation

The installation is the reverse of the removal procedure.

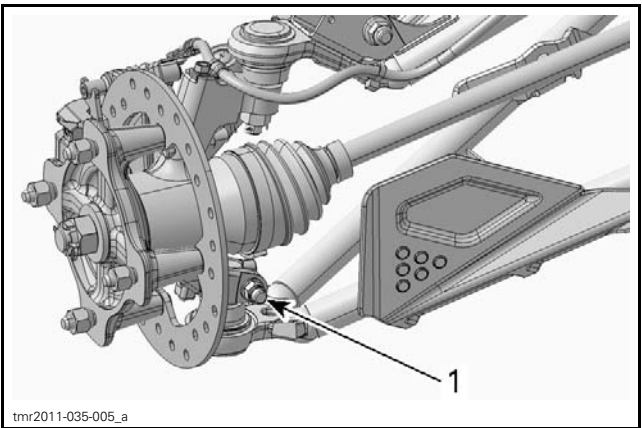
LOWER SUSPENSION ARM

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.

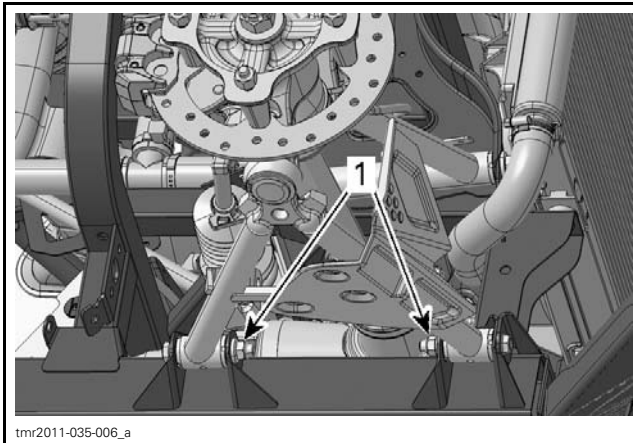
NOTE: For XT-P model, disconnect stabilizer bar from suspension arm.

3. Remove bolt and nut securing lower ball joint to knuckle.



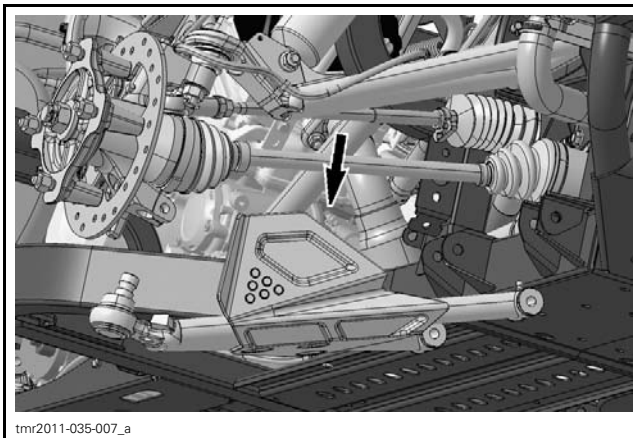
1. Ball joint nut

4. Remove bolts and nuts securing suspension arm to frame.



1. Suspension arm nuts

5. Remove suspension arm.



MOVE DOWNWARDS

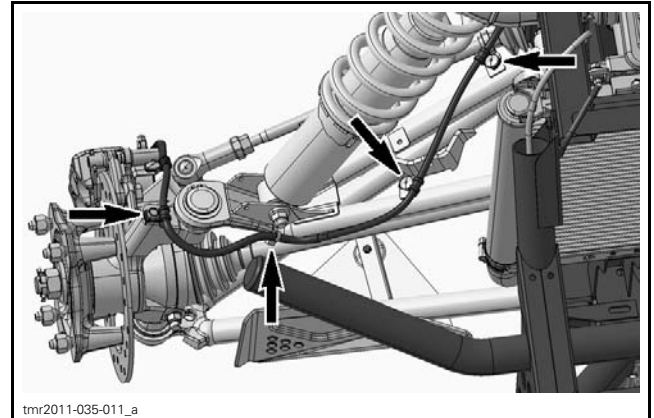
Lower Suspension Arm Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

UPPER SUSPENSION ARM

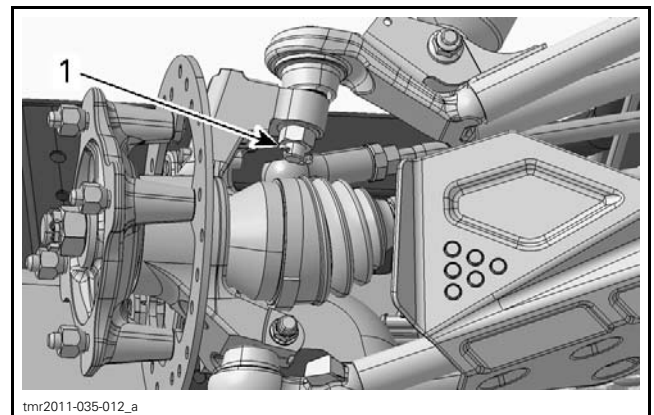
Upper Suspension Arm Removal

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.



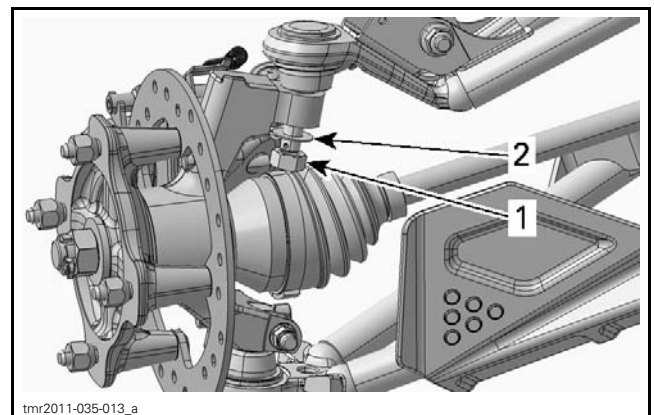
BRAKE HOSE FASTENERS (4X)

4. Remove and discard cotter pin retaining ball joint.



1. Ball joint cotter pin

5. Remove ball joint nut and washer.



1. Ball joint nut
2. 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.

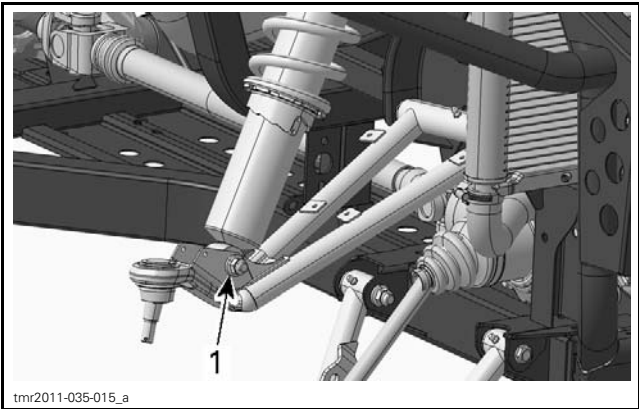
Subsection XX (FRONT SUSPENSION)

NOTICE Never hit on suspension arm to avoid to damage it permanently.



CAREFULLY HIT ON KNUCKLE SIDE

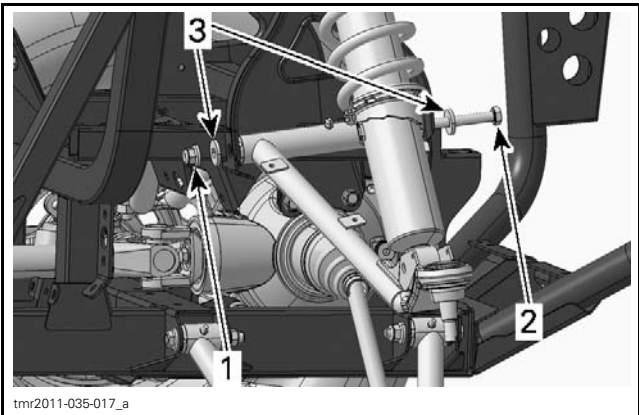
8. Remove bolt and nut securing suspension arm to shock absorber.



1. Shock absorber nut

9. Remove radiator from vehicle. Refer to *RADIATOR* in *COOLING SYSTEM* subsection.

10. Remove fasteners securing suspension arm to frame.



1. Suspension arm pivot nut
2. Suspension arm pivot bolt
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.

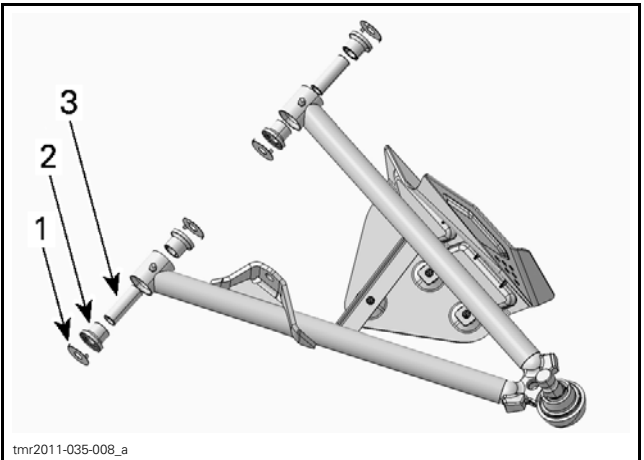
Install a new cotter pin to secure ball joint nut. Both end of cotter pin must be folded.

TIGHTENING TORQUE	
Shock absorber nuts	48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

SUSPENSION ARM BUSHINGS

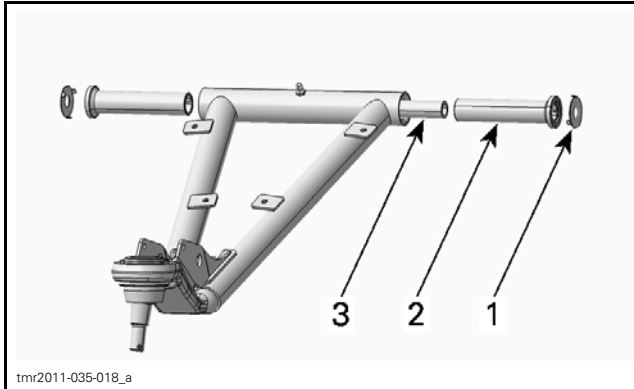
Suspension Arm Bushings Removal

1. Remove wear plates, cushions and inner bushing from suspension arm.



LOWER SUSPENSION ARM

1. Wear plate
2. Cushion
3. Inner bushing



UPPER SUSPENSION ARM

1. Wear plate
2. Cushion
3. Inner bushing

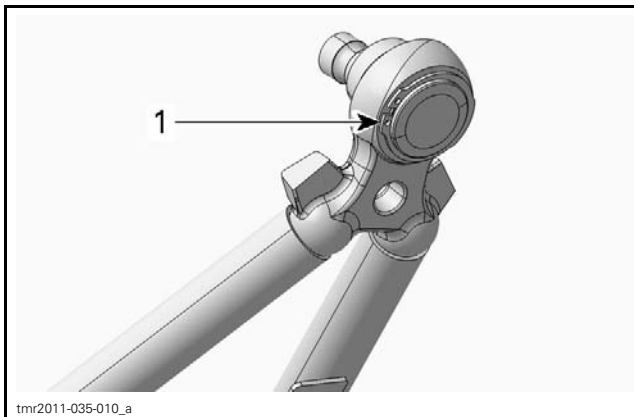
Suspension Arm Bushings Installation

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

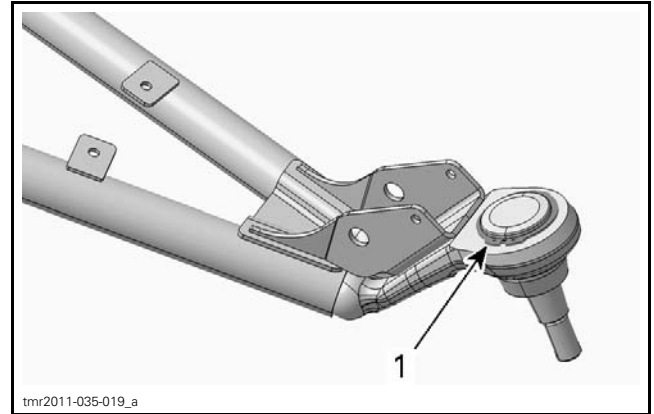
Ball Joint Removal

1. Remove suspension arm from vehicle. Refer to *SUSPENSION ARM REMOVAL* in this subsection.
2. Remove circlip from ball joint.



LOWER BALL JOINT

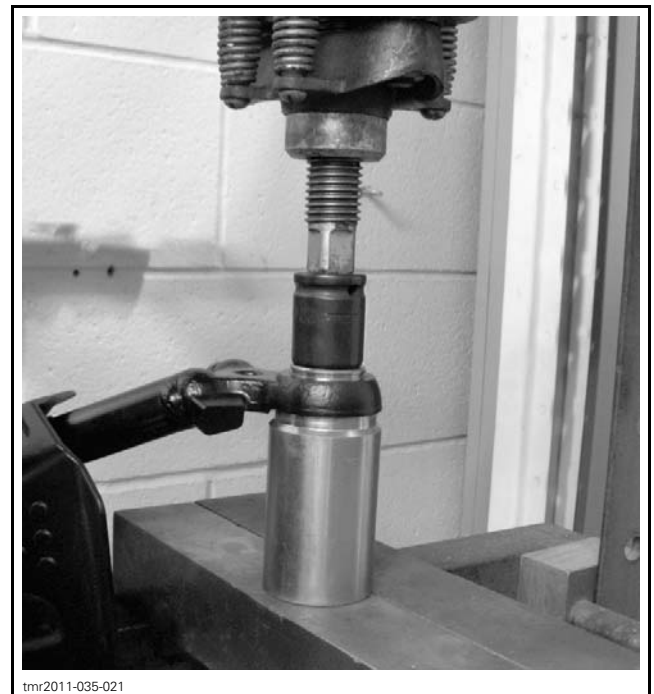
1. Circlip



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.

FUEL TANK AND FUEL PUMP

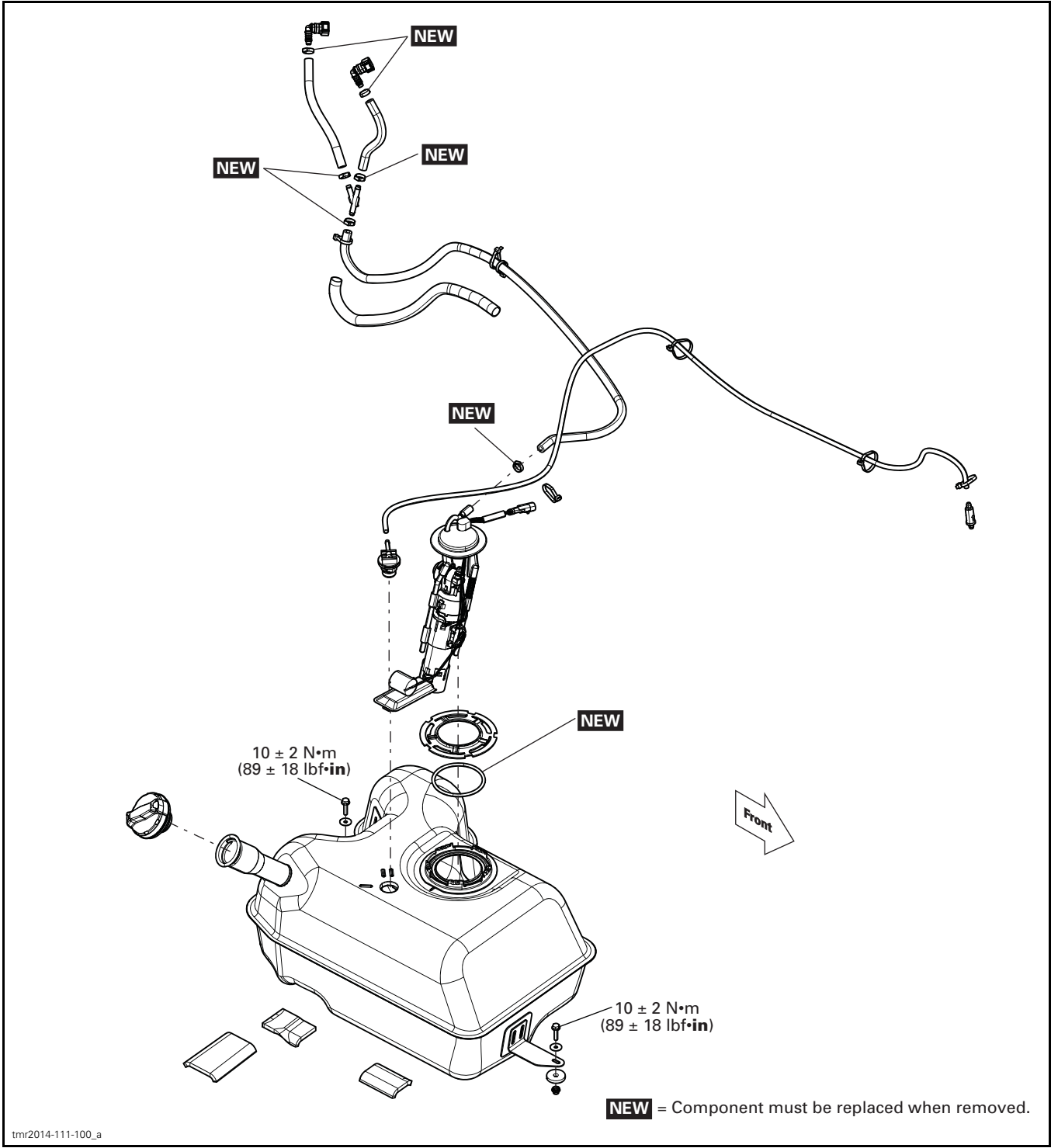
SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	11
FLUKE 115 MULTIMETER	529 035 868	10
FUEL HOSE ADAPTER.....	529 036 023	5
OETIKER PLIER.....	295 000 070	8
PRESSURE GAUGE.....	529 035 709	5
VACUUM/PRESSURE PUMP	529 021 800	4, 15

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBE	TP88	10

Subsection XX (FUEL TANK AND FUEL PUMP)



GENERAL

⚠ WARNING

Fuel is flammable and explosive under certain conditions. Ensure work area is well ventilated. Do not smoke or allow open flames or sparks in the vicinity.

⚠ WARNING

Always disconnect battery prior to working on the fuel system.

⚠ WARNING

Always proceed with care and use appropriate safety equipment when working on pressurized fuel system. Wear safety glasses.

⚠ 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.

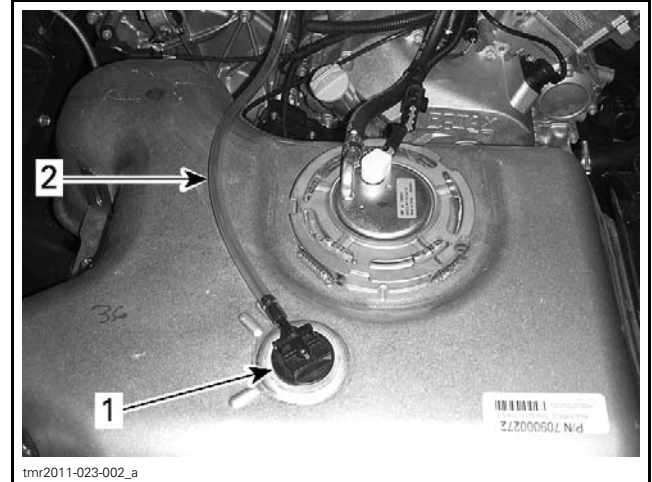
Cover the fuel hose connections with an absorbent shop rag and carefully disconnect them to minimize spilling.

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.

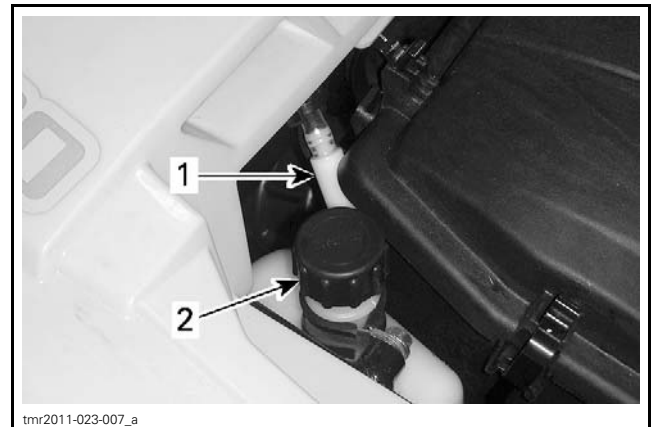


1. Vent valve
2. Air inlet hose

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.



1. Fuel tank vent breather filter
2. Cooling system expansion tank

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.

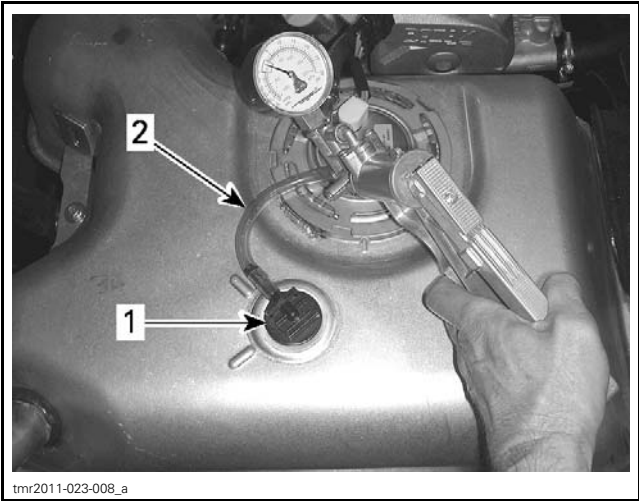
INSPECTION

FUEL TANK LEAK TEST

 **WARNING**

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.



1. Fuel tank vent valve
2. Vent hose to vacuum/pressure pump

PRESSURE	TIME WITHOUT PRESSURE DROP
14 kPa (2 PSI)	3 minutes

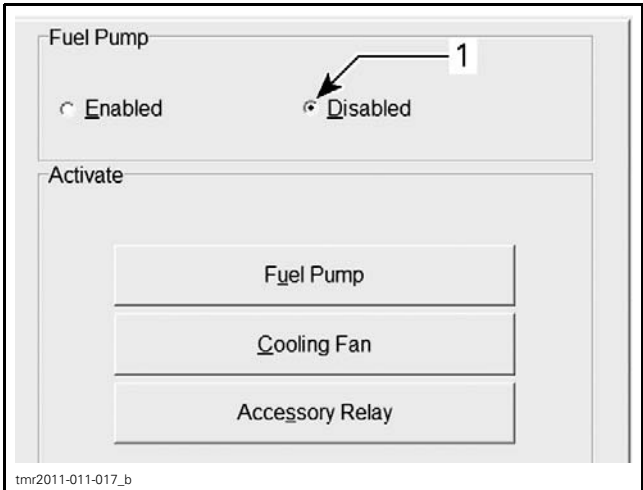
If pressure drops, locate fuel leak(s) and repair or replace leaking component(s).
NOTE: In case of fuel tank leak, do not attempt repair. Fuel tank must be replaced.

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.
3. 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**.



1. Click here to disable the fuel pump

5. Release fuel pressure by running engine until it runs out of gas.
6. Remove the following items, refer to the *BODY* subsection.
 - Passenger seat
 - Fuel tank cover
 - RH lateral console panel.
7. 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).

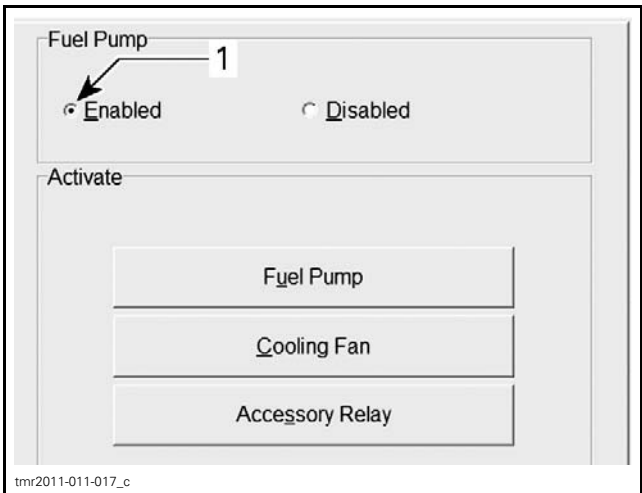


PRESSURE GAUGE



T-FITTING

9. Using B.U.D.S., reactivate fuel pump by selecting **Enabled**.



1. Click here to disable the fuel pump

10. Turn ignition key ON and observe fuel pressure.

FUEL PRESSURE	350 kPa $\pm$ 10 kPa (51 PSI $\pm$ 1 PSI)
---------------	--

NOTE: Valid at 12 V $\pm$ 0.1 V.

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.

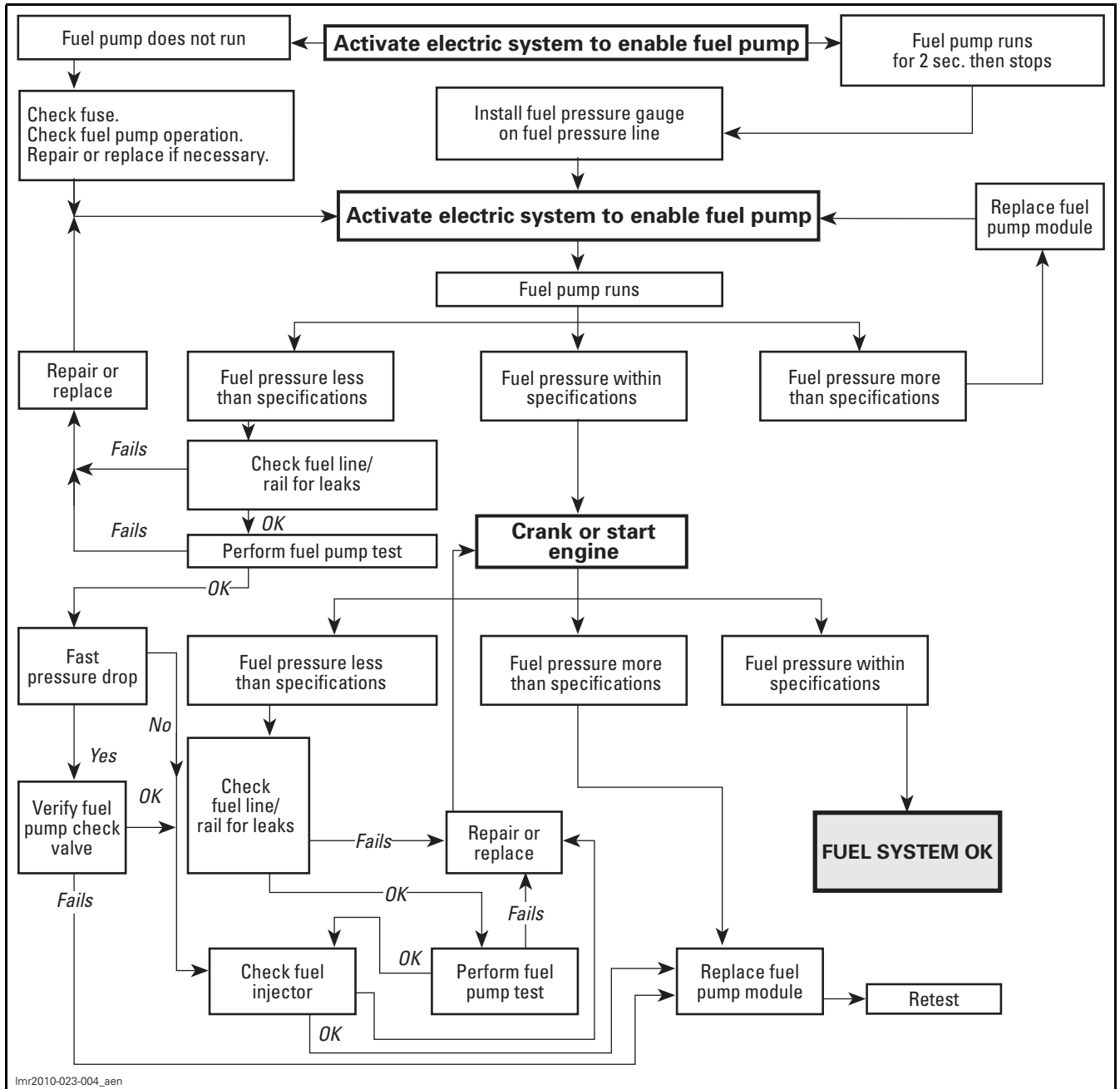
Subsection XX (FUEL TANK AND FUEL PUMP)

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



PROCEDURES

FUEL HOSE AND OETIKER CLAMPS

Fuel Hose Replacement

When replacing fuel hoses, be sure to use hoses and clamps as available from BRP parts department. This will ensure continued proper and safe operation.

 **WARNING**

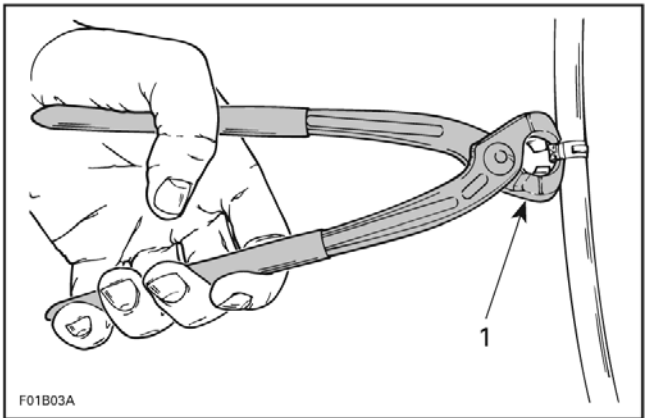
Use of fuel lines other than those recommended by BRP may compromise fuel system integrity.

 **WARNING**

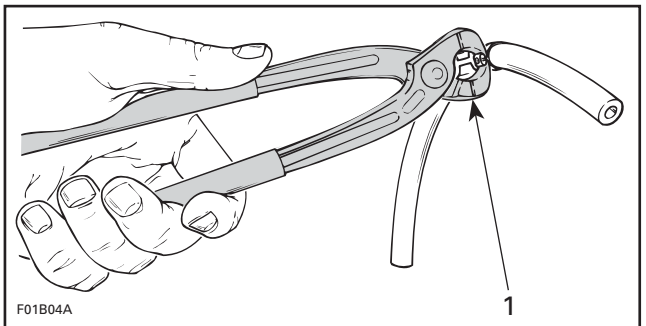
Whenever removing a hose in the fuel system, always use new Oetiker clamps at assembly. Then validate fuel system tightness by performing a fuel pressure test.

Oetiker Clamp Replacement

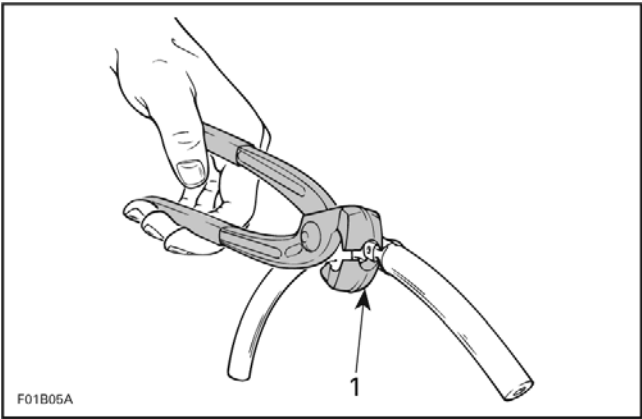
To secure or cut Oetiker clamps on fuel lines, use OETIKER PLIER (P/N 295 000 070).



1. Cutting clamp



1. Securing clamp



1. Securing clamp in limited access

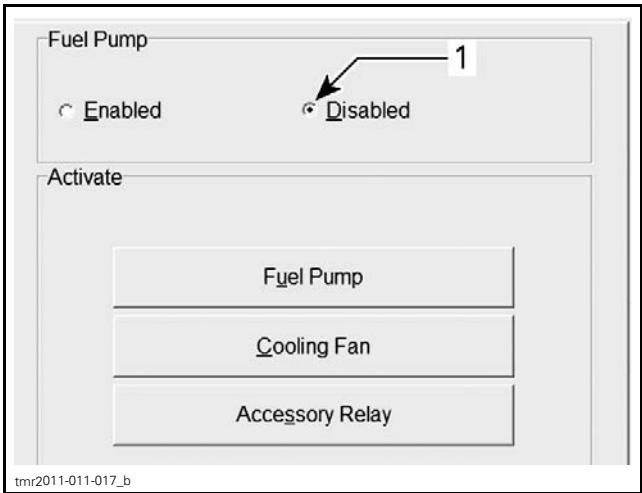
FUEL TANK

Fuel Tank Draining

Remove fuel tank cap and siphon gas into an approved fuel container.

Fuel Tank Removal

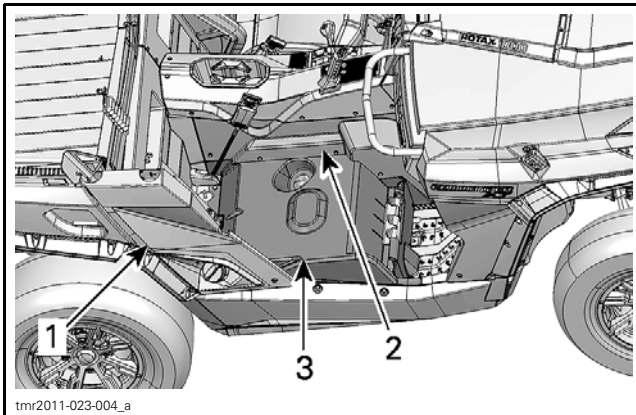
1. Drain fuel tank. Refer to *FUEL TANK DRAINING* above in this subsection.
2. Connect the vehicle to the applicable B.U.D.S. software version.
3. In B.U.D.S., select the following to disable the fuel pump:
 - Read Data button
 - Activation page tab
 - ECM page tab
 - Fuel pump Disabled.



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 SYSTEM* subsection.

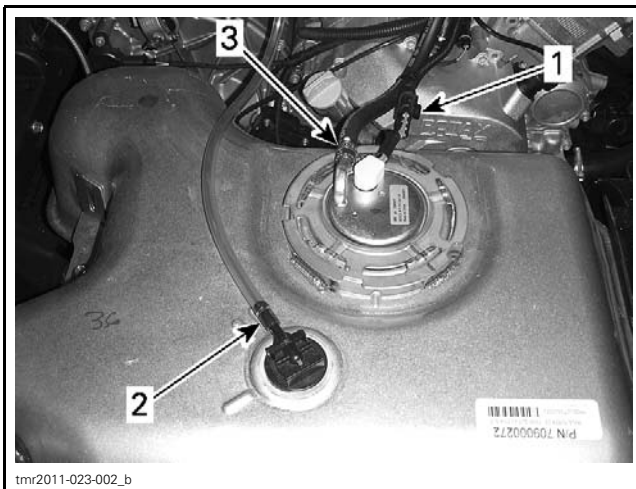
6. Remove RH passenger seat, refer to the *BODY* subsection.
7. Refer to *BODY* subsection and remove the body parts indicated in the following illustration.



TYPICAL

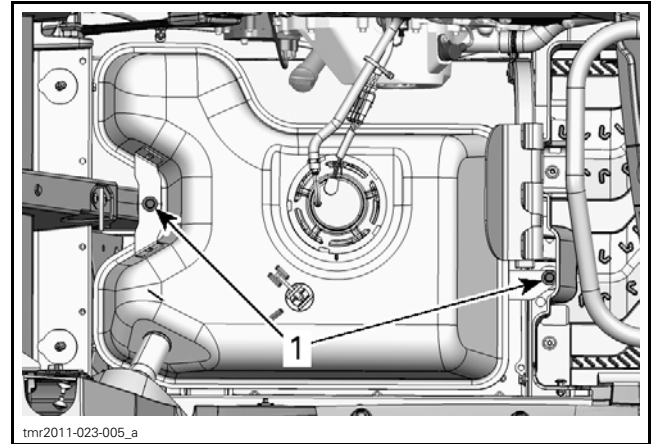
1. RH Lateral body panel
2. RH side panel on the console
3. Fuel tank cover panel

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.

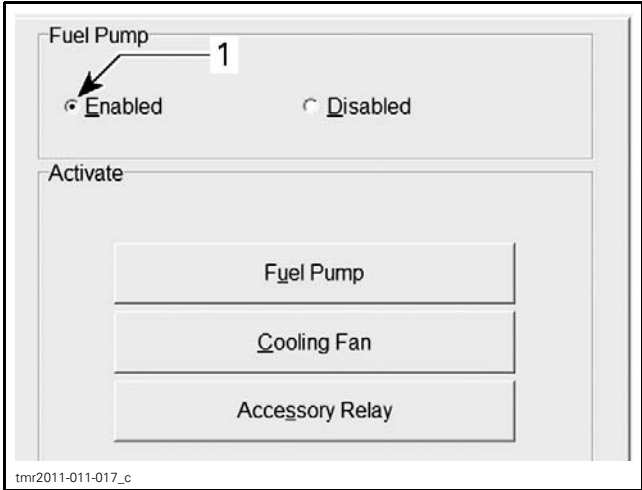
NOTE: Verify the 3 rubber pads located under the fuel tank are properly fixed to the fuel tank. If pad is missing, install a new one.

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 XX (FUEL TANK AND FUEL PUMP)



1. Click here to enable 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

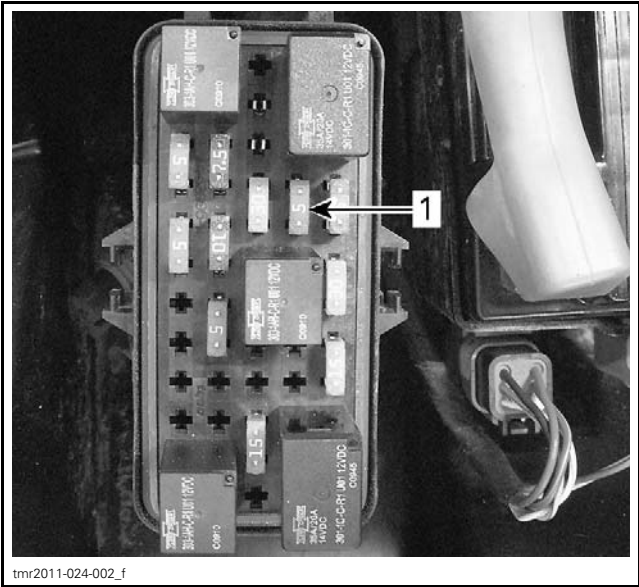
Refer to *INSPECTION* in this subsection.

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 PROBES		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.
2. Remove connector B from the ECM and connect it to the ECM ADAPTER TOOL (P/N 529 036 166).



3. Set multimeter to Ω .
4. Measure fuel pump resistance as follows.

FUEL PUMP RESISTANCE TEST (AT ECM AND FUSE)		
TEST PROBES		RESISTANCE Ω @ 20°C (68°F)
Fuse box contact 5D	ECM B-M1	Approximately 2 Ω

If resistance test failed, disconnect fuel pump connector and measure resistance at fuel pump connector.

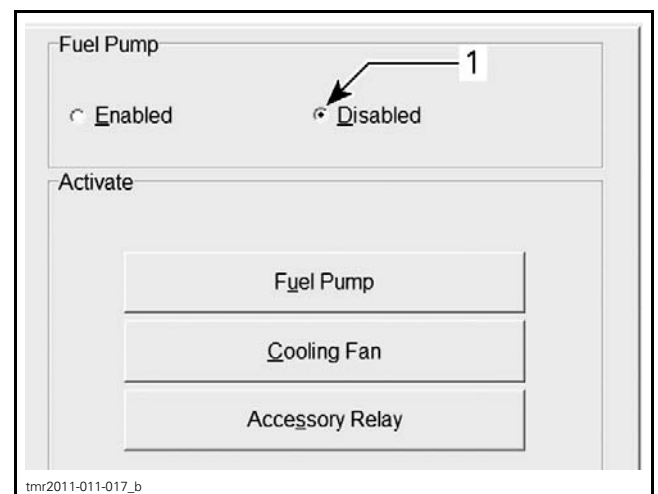
FUEL PUMP RESISTANCE TEST (AT FUEL PUMP CONNECTOR)	
Pins 1 and 2	Approximately 2 Ω

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.

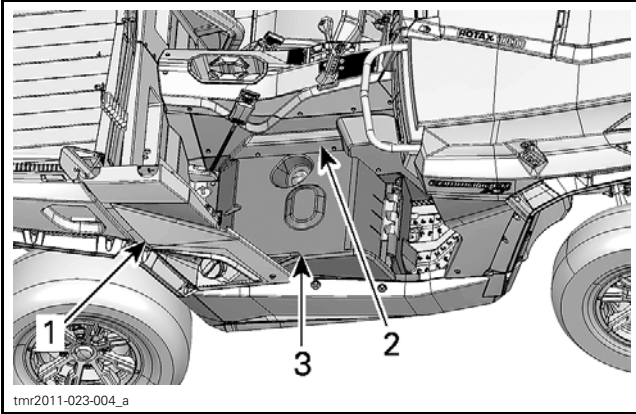
Fuel Pump Removal

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.



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.

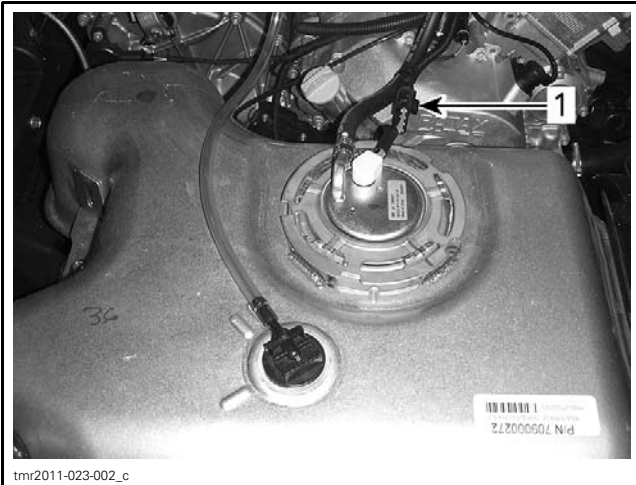
Subsection XX (FUEL TANK AND FUEL PUMP)



TYPICAL

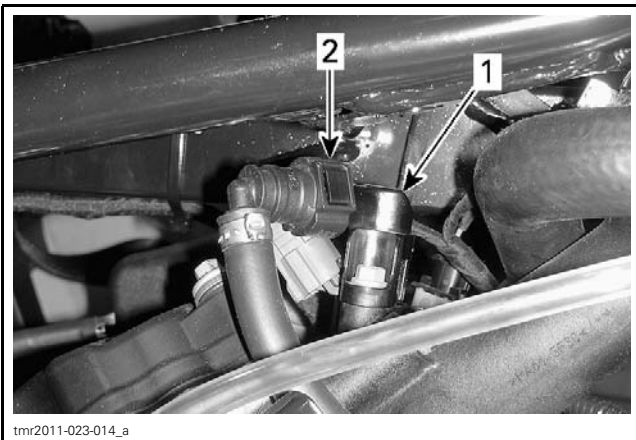
1. RH Lateral body panel
2. RH side panel on the console
3. Fuel tank cover panel

4. Disconnect fuel pump electric connector.



1. Fuel pump connector

5. Disconnect high pressure fuel hose at fuel rails (2 disconnects).

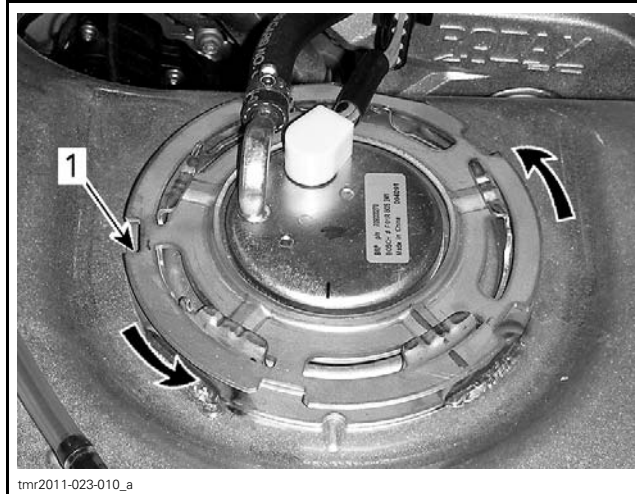


1. Fuel rail (1 each cylinder)
2. High pressure fuel hose disconnect ((1 each cylinder)

6. Using a soft face hammer and a brass drift in the notched portion of the locking ring, remove fuel pump locking ring.

⚠ 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.

⚠ 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.

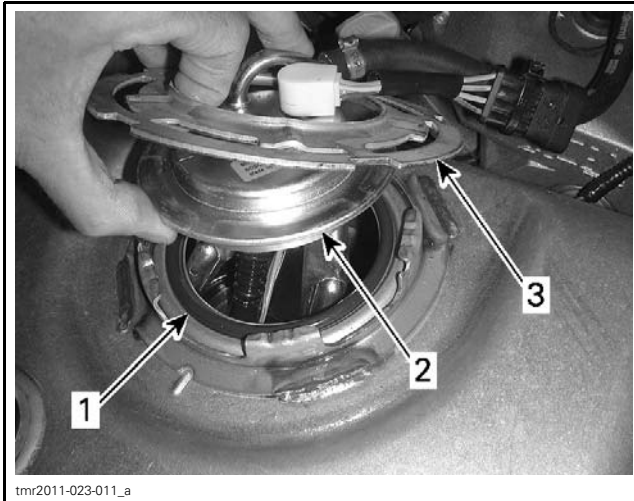
8. Discard gasket ring.

Fuel Pump Installation

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

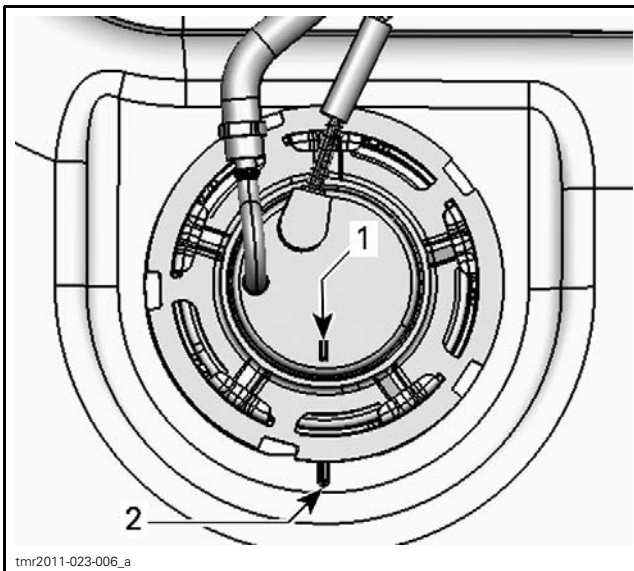
⚠ CAUTION Manipulate fuel pump with care.

1. Install a **NEW** gasket ring.
2. Place gasket so that it is located between pump and tank mounting surface.



1. Gasket ring here
2. Fuel pump flange
3. Pump locking ring

3. Pay attention to pump orientation as in following illustration.

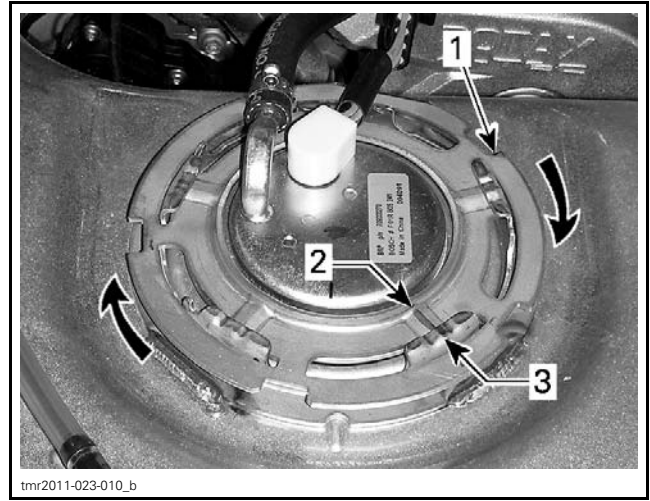


1. Fuel pump index
2. Fuel tank pump index

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.

⚠ WARNING

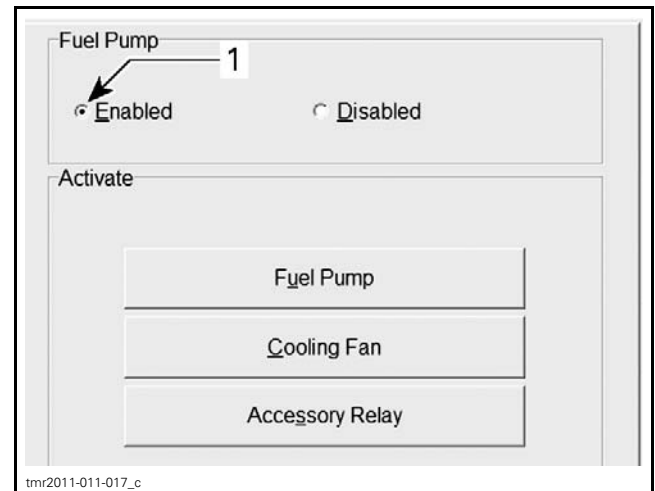
Fuel vapors are flammable and explosive under certain conditions. Use only non-sparking tools. Ensure pump locking ring is fully engaged.



FUEL PUMP LOCKING RING INSTALLATION

1. Notch in locking ring
2. Raised portion in locking ring (5 places)
3. Lock position on tank flange (5 places)

7. Using B.U.D.S., enable the fuel pump.



1. Click here to enable the fuel pump

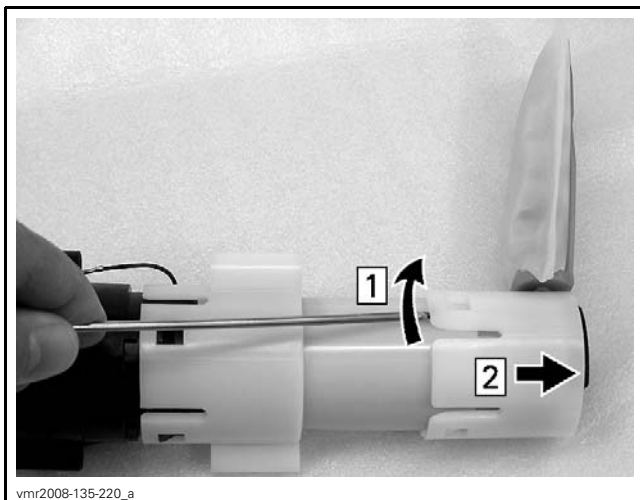
8. Refuel tank and ensure there are no leaks by performing a **FUEL TANK LEAK TEST** and a **FUEL PRESSURE TEST** as described in this subsection.

9. Check fuel level sender operation.

Fuel Pump Strainer Replacement

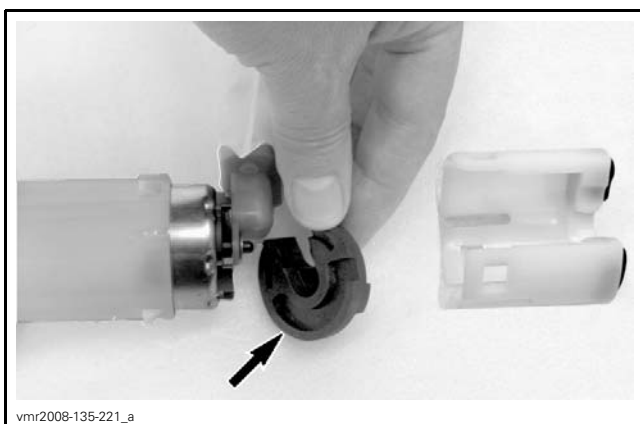
1. Remove **FUEL PUMP**, see **FUEL PUMP REMOVAL** procedure in this subsection.
2. Unlock 3 tabs on plastic ring.

Subsection XX (FUEL TANK AND FUEL PUMP)



Step 1: Lift these tabs to unlock ring
Step 2: Pull ring off pump inlet

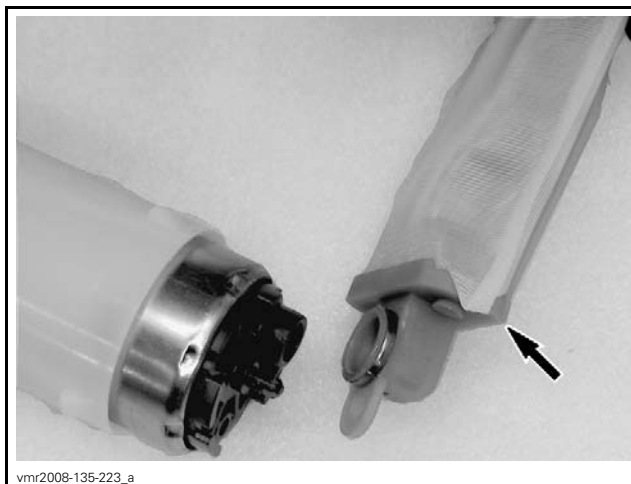
3. Remove rubber pad.



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.

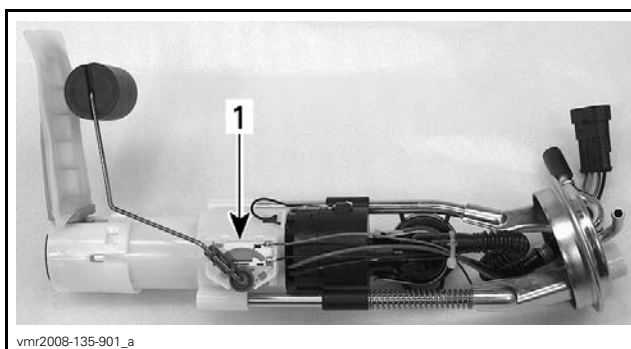
6. Insert the new strainer on fuel pump making sure to press it in tightly against pump face.

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.



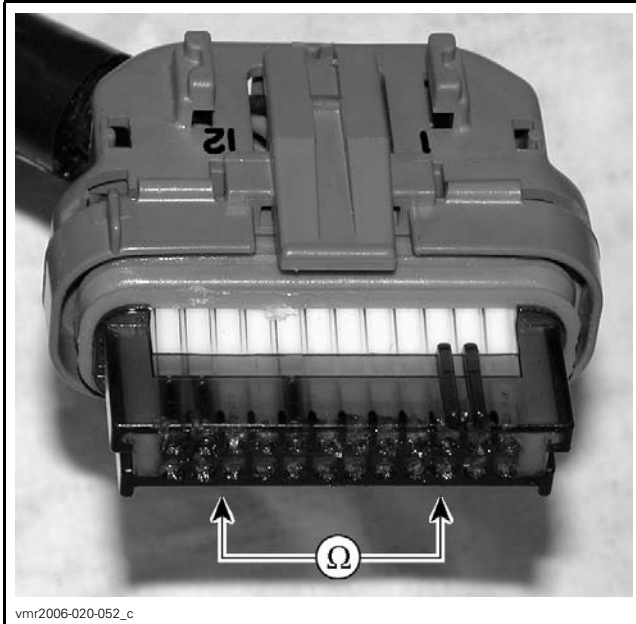
TYPICAL - FUEL PUMP

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 Ω .
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	Pins 4 and 21	5 $\Omega \pm 1$
Empty		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 SENDER 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

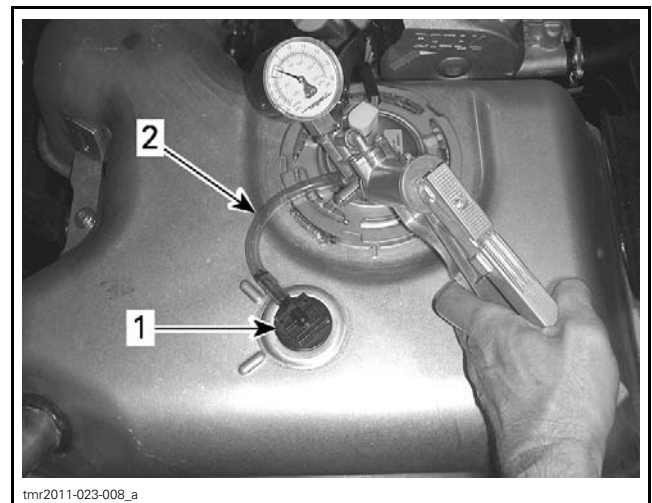
Replace fuel pump. See fuel pump removal and installation procedures in this subsection.

FUEL TANK VENT VALVE

Fuel Tank Vent Valve Test

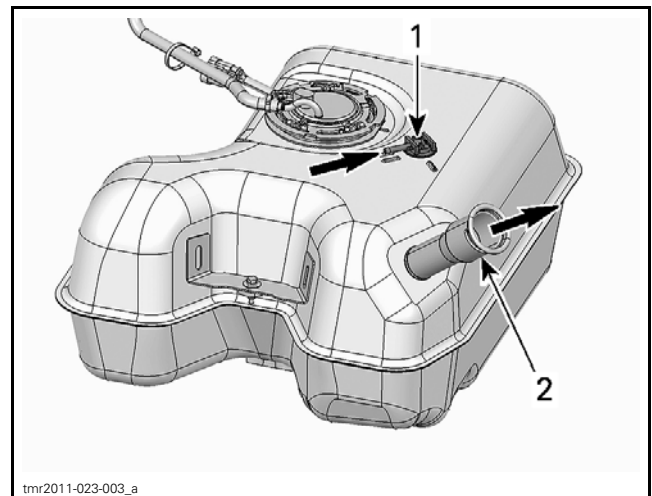
Test for Normal Operation

1. Disconnect vent hose from fuel tank vent valve.
2. 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

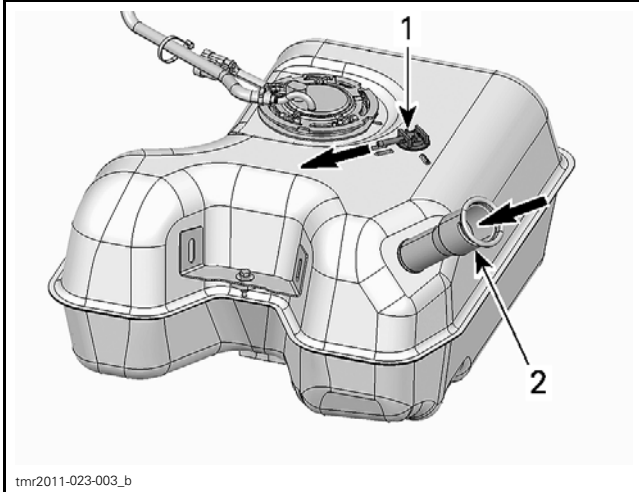
3. Remove fuel tank cap.
4. Set vacuum/pressure pump to **PRESSURE** and activate pump. The gauge on the pump **should not change in reading**; air should flow through the vent valve and fuel tank freely.



1. Air flows freely in through vent valve
2. Air flows out of fuel tank

Subsection XX (FUEL TANK AND FUEL PUMP)

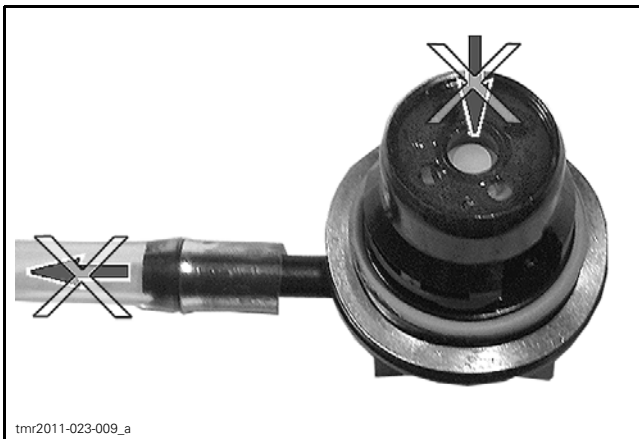
5. Set vacuum/pressure pump to **VACUUM** and activate pump. The **gauge should not change in reading**; air should flow through the vent valve and fuel tank freely.



1. Air is drawn out freely through vent valve
2. 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.

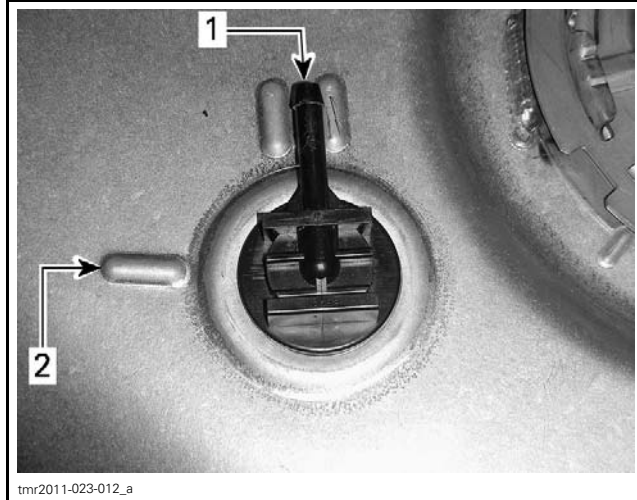


VALVE DOES NOT LET AIR PASS OUT UPSIDE DOWN

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.

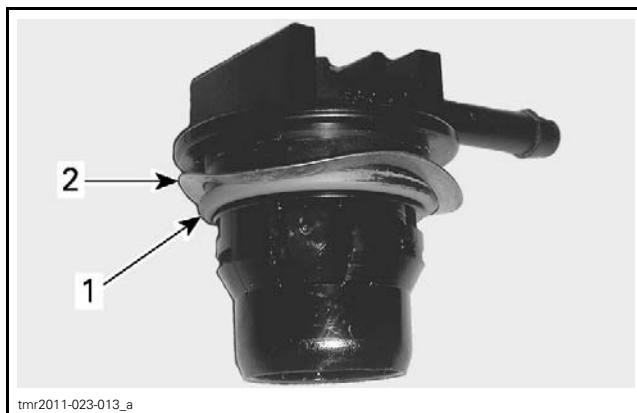
Fuel Tank Vent Valve Removal and Installation

1. When removing or installing the fuel tank vent valve, pay attention to the following:
 - Valve lock position index (dual)
 - Valve unlock position index.



1. Lock position index (dual)
2. Unlock position index

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.



1. O-ring seal
2. 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.

SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair the 2016 Can-Am™ Commander™.

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 in this manual 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.

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

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

WARNING

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

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

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

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

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

Always observe common shop safety practice.

Unless otherwise noted, the engine must be stopped and the tether cord must be removed prior to perform any services.

Torque wrench tightening specifications must be strictly adhered to. Use the torque values and service products as in the exploded views or in the procedures when noted.

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

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

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

We strongly recommend that any services be carried out and/or verified by a highly skilled professional mechanic.

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.

INTRODUCTION

INTRODUCTION

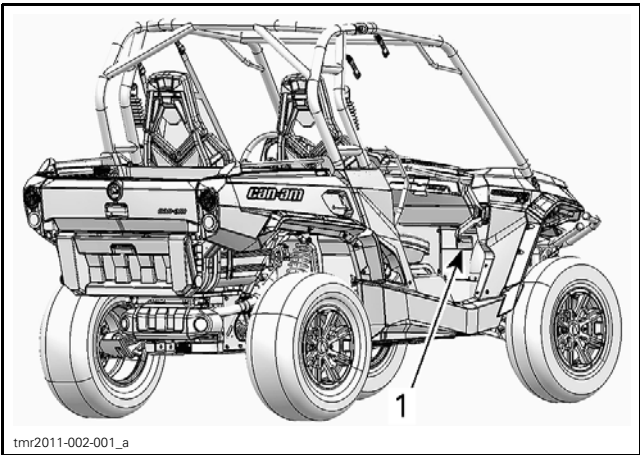
The information and component/system descriptions contained in this manual are correct at time of writing. BRP however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured.

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

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

VEHICLE INFORMATION

VEHICLE IDENTIFICATION NUMBER (VIN)



TYPICAL
1. VIN (Vehicle Identification Number) location

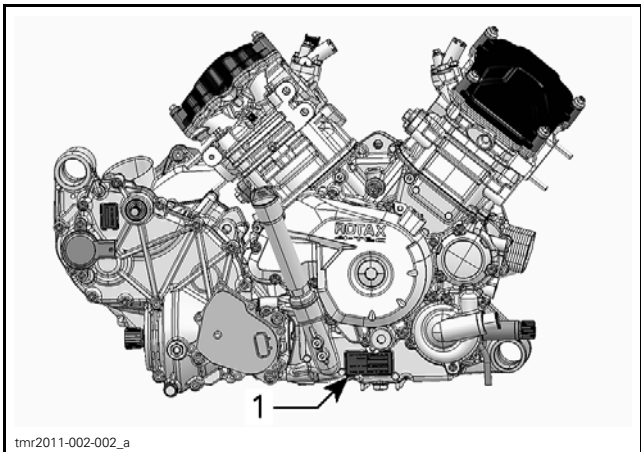
The VIN (Vehicle Identification Number) decal is located under the glove box on the passenger side.

VIN Decal Description



TYPICAL — VEHICLE IDENTIFICATION NUMBER LABEL
1. VIN (Vehicle Identification Number)
2. Model number
3. Manufacturing date

ENGINE IDENTIFICATION NUMBER (EIN)

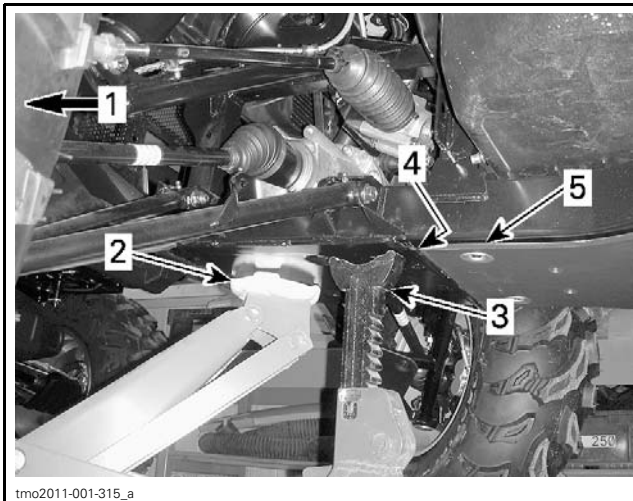


TYPICAL - RH SIDE OF ENGINE
1. Engine Identification Number (EIN)

LIFTING AND SUPPORTING THE VEHICLE (2-UP MODELS)

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.

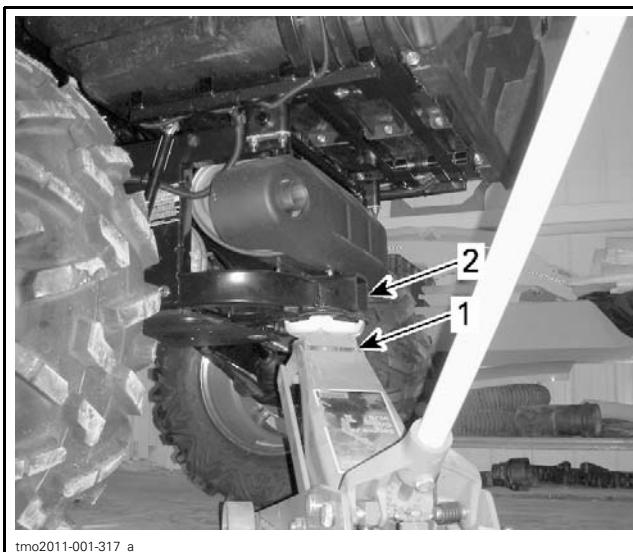


1. Front of vehicle
2. Hydraulic jack
3. Jack stand
4. Lip for center skid plate
5. Center skid plate

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

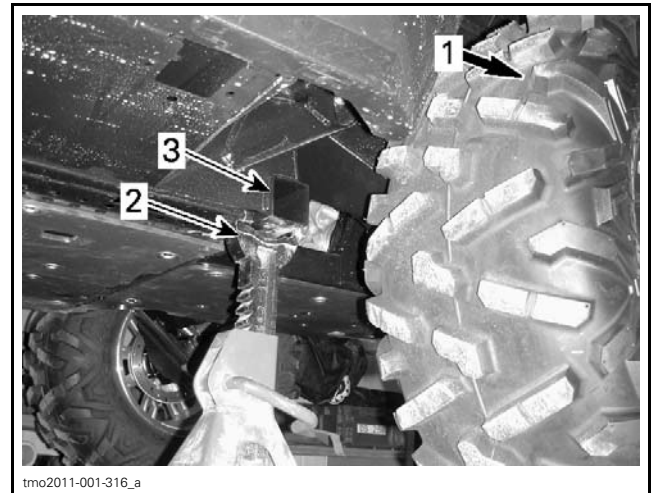
Rear of Vehicle

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

5. 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

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

LIFTING AND SUPPORTING THE VEHICLE (MAX MODELS)

To lift your vehicle, you must be on a flat and non slippery ground. Make sure the wheel jack base gives a good support. Remove all debris that could cause the wheel jack to tip over.

⚠ WARNING

- Do not allow anyone in the vehicle while it is being lifted.

Front of Vehicle

Place vehicle on a flat non slippery ground.

Ensure vehicle shift lever is set to PARK.

Place wheel jack on one of the identified points shown in the following images.

Install two jack stands before lowering wheel jack. Ensure vehicle is supported safely.

Rear of Vehicle

Place vehicle on a flat non slippery ground.

Activate 4WD mode.

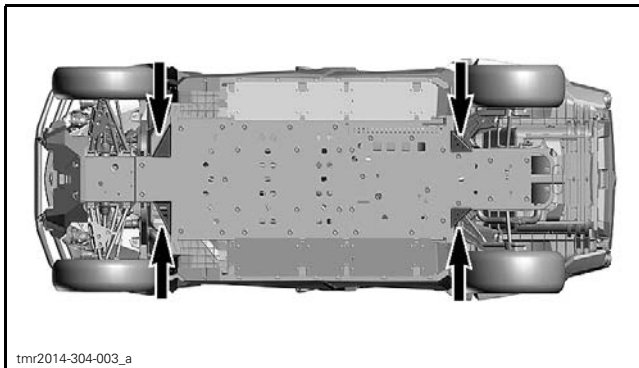
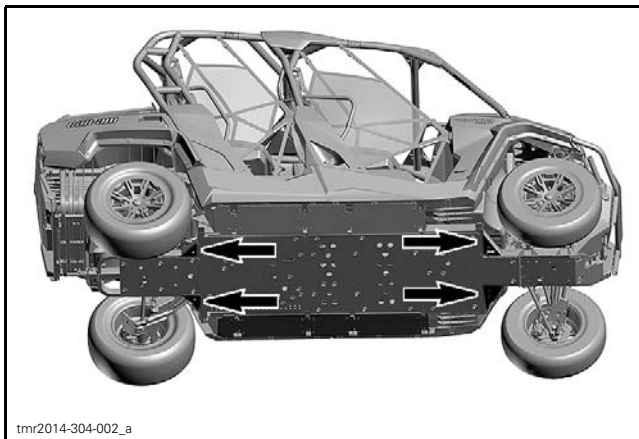
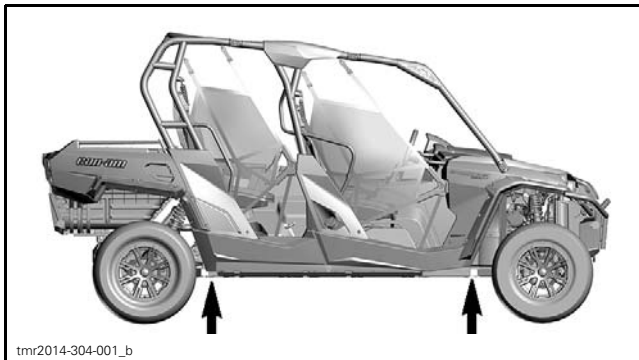
Ensure vehicle shift lever is set to PARK.

Place wheel jack on one of the identified points shown in the following images.

Install two jack stands before lowering wheel jack. Ensure vehicle is supported safely.

INTRODUCTION

Identification of lifting points



LIFTING THE VEHICLE WITH A LIFTING TABLE (MAX MODELS)

Roll vehicle above lifting table.

Install two 4 x 4 horizontally across vehicle as close as possible to lifting points. Refer to *IDENTIFICATION OF LIFTING POINTS* in this subsection.

NOTICE Ensure 4 x 4 are as close to lifting points as possible.

Lift vehicle using table.

NOTE: If repositioning of vehicle is needed, lift either front or rear of vehicle using the lower portion of applicable bumper.

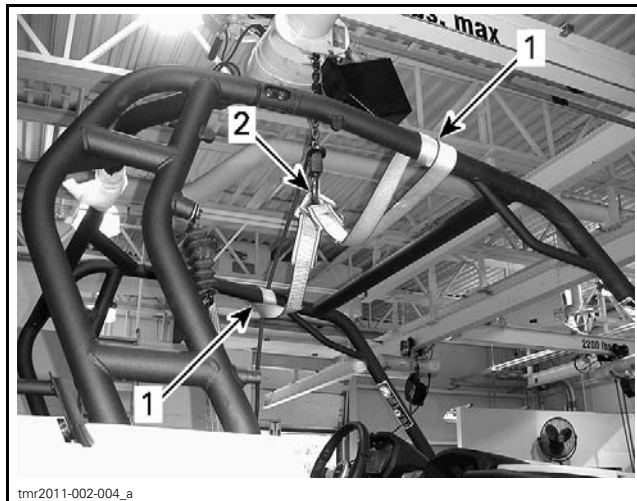
⚠ WARNING

- Do not allow anyone in the vehicle while it is being lifted.

HOISTING THE VEHICLE (2-UP MODELS)

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.



1. Lifting strap around horizontal side tubes (top)
2. Hoist hook

⚠ WARNING

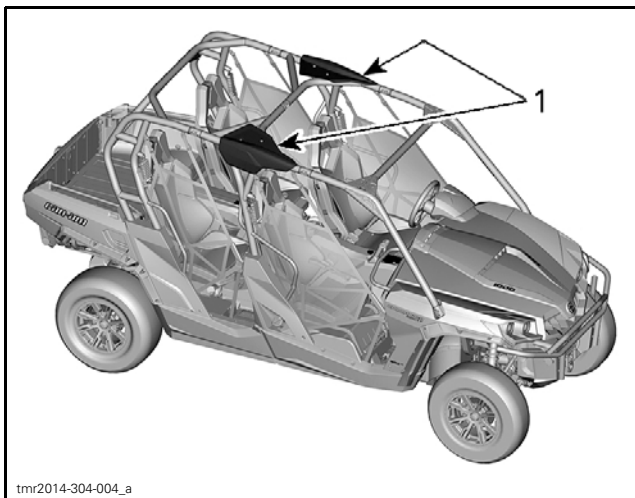
- Ensure hoist and lifting strap are rated for lifting the total vehicle weight. Refer to applicable manufactures instructions.
- Ensure lifting strap is in good condition before lifting vehicle.
- Do not allow anyone in the vehicle or under any portion of the vehicle while it is suspended by a hoist.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

HOISTING THE VEHICLE (MAX MODELS)

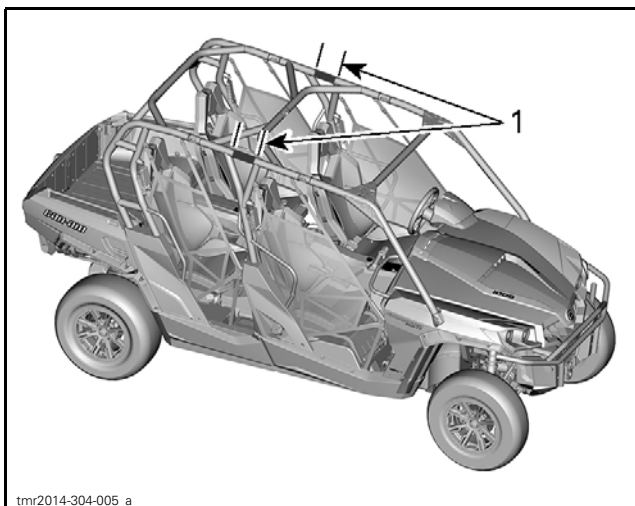
The vehicle may be lifted off the ground by the cage using a hoist and a lifting strap.

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

Remove both cage covers.



1. Cage covers



1. Lifting strap at the center of the middle section, around horizontal side tubes (top)

⚠ 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 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.
3. 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 trailers with the winch.

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

5. Set ACS suspension setting to 1 (softest).
6. Tie down the front wheels to the front of the trailer using tire towing straps.

INTRODUCTION

- 7. Pass a tie-down strap inside each rear wheel.
- 8. Firmly attach the rear wheels tie-down straps to both sides of the rear of the trailer with ratchets.
- 9. 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 certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions. For 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

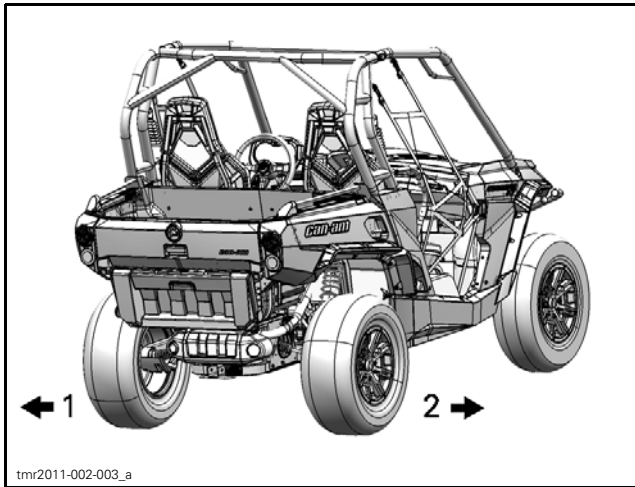
Many of the procedures in this manual are inter-related. Before undertaking any task, you should read and thoroughly understand the entire section or subsection in which the procedure is contained.

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).



TYPICAL

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.

INTRODUCTION

TYPICAL PAGE

Section 06 ENGINE
Subsection 01 (MAGNETO)

Subsection title → **MAGNETO**

Indicates applicable models. → *Models*

Exploded view assists you in identifying parts and their related positions.

NEW indicates that the part must be replaced with a new one. → **NEW**

Illustration number for publishing process. → XXXX0000

Document number for publishing process. → mmr2008-001

Loctite 243

Model

Drop represents a service product to be applied.

Dotted box contains parts applicable to a specific model.

Bold face number is used to identify a part referred to the text.

5 N·m (44 lbf·in)

NOTICE Pay attention to torque specifications. Some of these are in lbf·in instead of lbf·ft. Use appropriate torque wrench.

Page number → 55

TYPICAL PAGE

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

Reference to a specific section or subsection.

Indicates component procedures apply to.

Indicates specific procedure to be carried out.

Section 03 ENGINE
Subsection 09 (MAGNETO SYSTEM)

GENERAL

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

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

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

WARNING

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

PROCEDURES

MAGNETO FLYWHEEL

Magneto Flywheel Cleaning

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

CAUTION: Clean magneto flywheel using only a clean cloth.

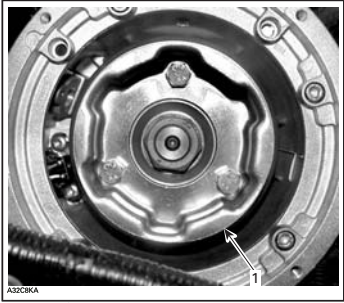
Magneto Flywheel Removal

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

Remove acoustic panel.

Remove rewind starter.

Remove starting pulley no. 2.



TYPICAL
1. Starting pulley

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



TYPICAL

Models

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

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

Call-outs pertaining to above illustration.

Illustration always follows text to which it applies.

Italic bold face type-setting indicates a procedure applicable to a specific model(s).

mmr2008-001
57

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

typical_txt_2008_en

INTRODUCTION

TIGHTENING TORQUE

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

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.

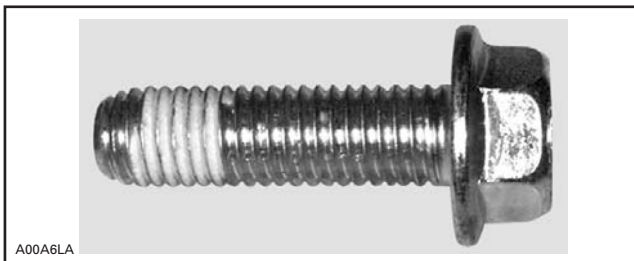
Property class and head markings	4.8 	8.8 9.8 	10.9 	12.9 
Property class and nut markings	5 	8 	10 	12 

FASTENER SIZE	FASTENER GRADE/TORQUE			
	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 – 2 N•m (13 – 18 lbf•in)	2.5 – 3 N•m (22 – 27 lbf•in)	3.5 N•m - 4 N•m (31 lbf•in - 35 lbf•in)	4 N•m - 5 N•m (35 lbf•in - 44 lbf•in)
M5	3 N•m - 3.5 N•m (27 lbf•in - 31 lbf•in)	4.5 N•m - 5.5 N•m (40 lbf•in - 49 lbf•in)	7 N•m - 8.5 N•m (62 lbf•in - 75 lbf•in)	8 N•m - 10 N•m (71 lbf•in - 89 lbf•in)
M6	6.5 N•m - 8.5 N•m (58 lbf•in - 75 lbf•in)	8 N•m - 12 N•m (71 lbf•in - 106 lbf•in)	10.5 – 15 N•m (93 – 133 lbf•in)	16 N•m (142 lbf•in)
M8	15 N•m (133 lbf•in)	25 N•m (18 lbf•ft)	32 N•m (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.

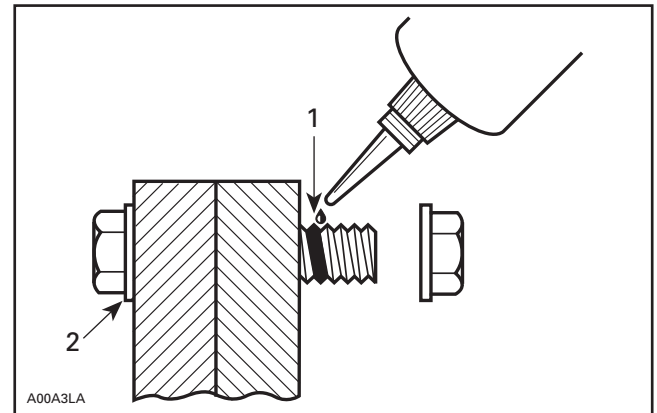
Use a metal brush or a tap to properly clean a threaded hole, then use a solvent. Allow the solvent time to act, approximately 30 minutes, then wipe off. Solvent utilization is to ensure proper adhesion of the product used for locking the fastener.

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.

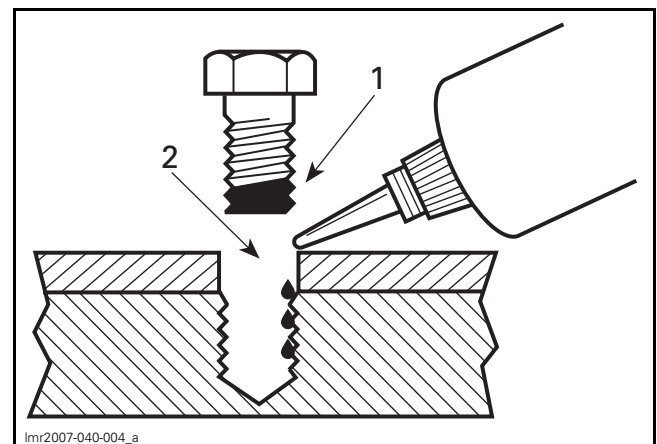
Threadlocker Application for Uncovered Holes (Bolts and Nuts)



1. Apply here
2. Do not apply

1. Clean threads (bolt and nut) with solvent.
2. Apply LOCTITE 7649 (PRIMER) (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



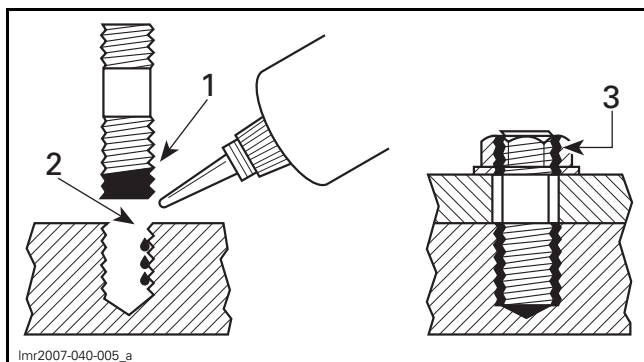
1. On fastener threads
2. On threads and at the bottom of hole

1. Clean threads (bolt and hole) with solvent.
2. Apply LOCTITE 7649 (PRIMER) (P/N 293 800 041) on threads (bolt and nut) and allow to dry for 30 seconds.
3. Choose proper strength Loctite threadlocker.

INTRODUCTION

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

Threadlocker Application for Stud Installation in Blind Holes



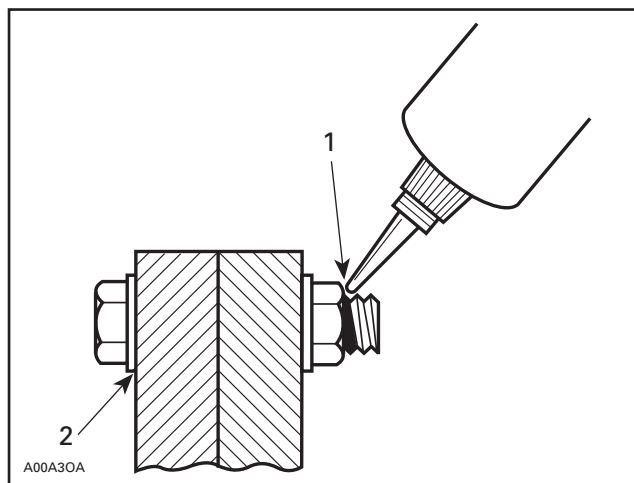
1. On stud threads
2. On threads and in the hole
3. On retaining nut threads

1. Clean threads (stud and hole) with solvent.
2. Apply LOCTITE 7649 (PRIMER) (P/N 293 800 041) on threads and allow to dry.
3. Put 2 or 3 drops of proper strength Loctite threadlocker on female threads and in hole.

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

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

Threadlocker Application for Pre-Assembled Parts

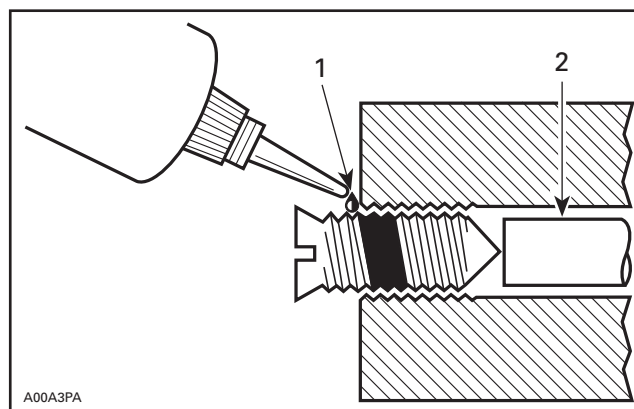


1. Apply here
2. Do not apply

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

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

Threadlocker Application for an Adjustment Screw

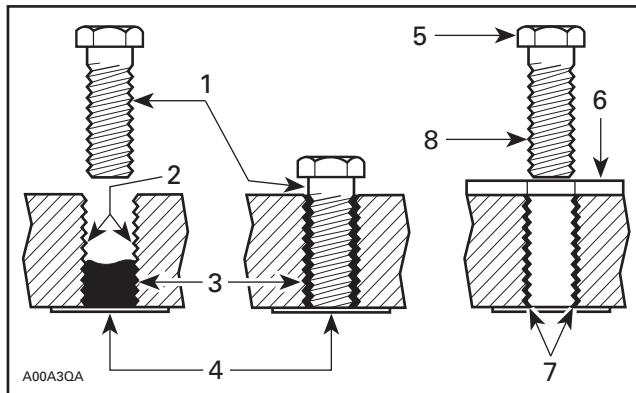


1. Apply here
2. Plunger

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

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

Application for Stripped Thread Repair



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

Standard Thread Repair

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

If a plate is used to align bolt:

1. Apply release agent on mating surfaces.
2. Put waxed paper or similar film on the surfaces.
3. Twist bolt when inserting it to improve thread conformation.

NOTE: NOT intended for engine stud repairs.

Repair of Small Holes/Fine Threads

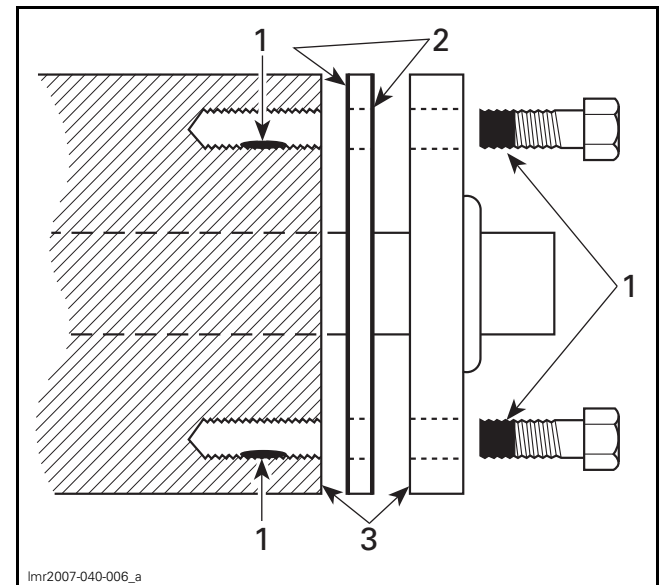
Option 1: Enlarge damaged hole, then follow *STANDARD THREAD REPAIR* procedure.

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

Permanent Stud Installation (Light Duty)

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

Gasket Compound Application



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

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

NOTE: Avoid grinding.

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

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

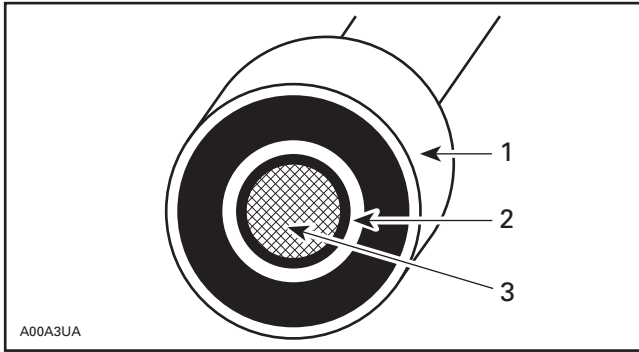
If holes are sunken, apply proper strength Loctite on bolt threads.

6. Tighten as usual.

Threadlocker Application for Mounting on a Shaft

Mounting with a Press

INTRODUCTION



- 1. Bearing
- 2. Proper strength Loctite
- 3. Shaft

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

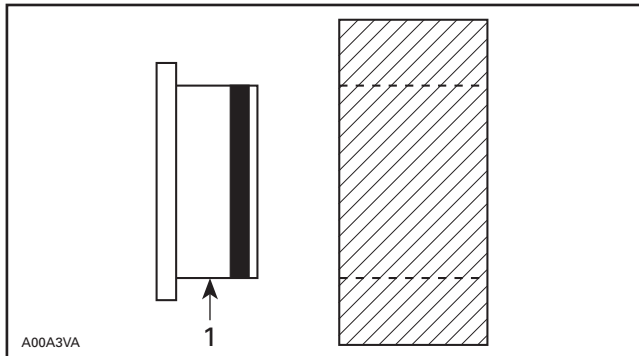
NOTE: Retaining compound is always forced out when applied on shaft.

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

Mounting in Tandem

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

Threadlocker Application for Case-In Components (Metallic Gaskets)



- 1. Proper strength Loctite

1. Clean inner housing diameter and outer gasket diameter.
2. Spray housing and gasket with LOCTITE 7649 (PRIMER) (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.

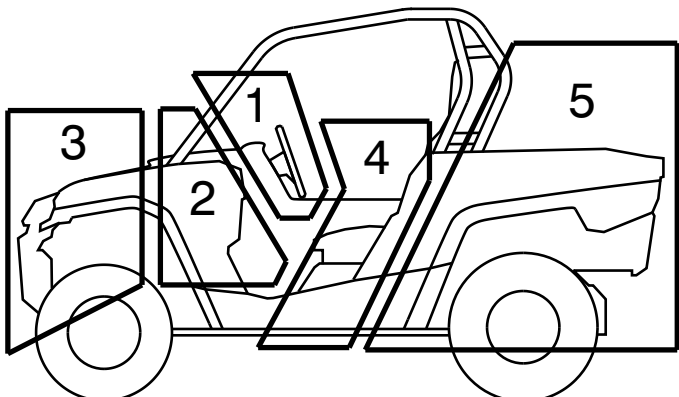
4. Install according to standard procedure.
5. Wipe off excess product.
6. Allow 30 minutes for product to cure.

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.

COMMANDER 2016

GENERAL SYSTEM



STANDARD
USAGE OF
ACCESSORY
CONNECTORS

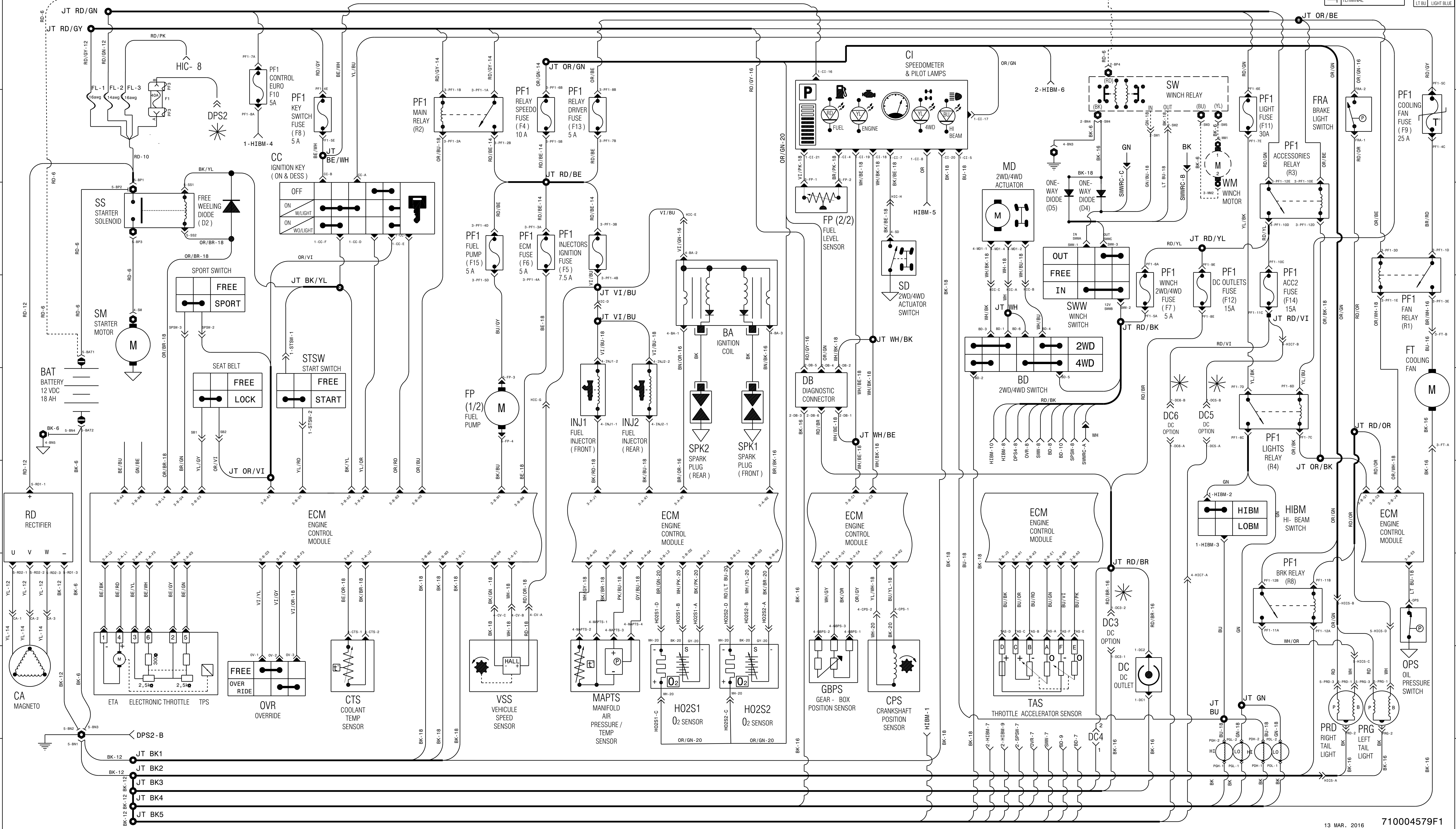
✱ DC3 GPS
DC5 TRUNK BOX
DC6 RADIO
DPS2 SEE DPS SYSTEM DIAGRAM
HIC8 SEE ACS SYSTEM DIAGRAM

TERMINAL IDENTIFICATION				
	NAME	ZONE- CONNECTOR NAME-	TERMINAL #/A	
EX:	CI	1 - CI	- 15	
EX:	CV	4 - CV	- A	
EX:	ME	2 - ME		

ZONE #	ZONE DESCRIPTION
1	STEERING AREA
2	MODULE AREA
3	FRONT OF VEHICLE
4	ENGINE AREA
5	REAR OF VEHICLE

WELDED JOINT	SHRINKED JOINT	CROSSED WIRE	WIRE BUS	SIMPLE CONDUCTOR WIRE	FEMALE TERMINAL	MALE TERMINAL	STEEL LINK (FRAME)	TERMINAL
BE	BE	BU	BU	BU	BU	BU	BU	BU
BR	BR	BR	BR	BR	BR	BR	BR	BR
GN	GN	GN	GN	GN	GN	GN	GN	GN
GY	GY	GY	GY	GY	GY	GY	GY	GY
OR	OR	OR	OR	OR	OR	OR	OR	OR
RD	RD	RD	RD	RD	RD	RD	RD	RD
VI	VI	VI	VI	VI	VI	VI	VI	VI
WH	WH	WH	WH	WH	WH	WH	WH	WH
YL	YL	YL	YL	YL	YL	YL	YL	YL
PK	PK	PK	PK	PK	PK	PK	PK	PK
LT BU	LT BU	LT BU	LT BU	LT BU	LT BU	LT BU	LT BU	LT BU

COLOR CODE	
BE	BEIGE
BU	BLACK
BU	BLUE
BR	BROWN
GN	GREEN
GY	GREY
OR	ORANGE
RD	RED
VI	VIOLET
WH	WHITE
YL	YELLOW
PK	PINK
LT BU	LIGHT BLUE



PERIODIC MAINTENANCE SCHEDULE

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

The following message appears in the gauge after every 50 hours of operation, to remind you of maintenance requirements: **MAINTENANCE SOON**. To erase message, use B.U.D.S.

The maintenance schedule does not exempt the pre-ride inspection.

WARNING

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

Operation in trail riding conditions

Operation in severe riding conditions (dusty or muddy) or carrying heavy loads condition

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

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

Verify and clean engine air filter. Replace as needed

Verify battery connections

Lubricate front and rear propeller shaft joints

Inspect tie rod ends and ball joints for play and boots condition

Lubricate suspension arm bushings

Inspect the drive shaft boots and protectors

Inspect brake pads. Replace as needed

Inspect wheel bearings for abnormal play

Clean exhaust area

Tighten cage fasteners

Tighten beadlock screws (if equipped)

Inspect and clean CVT air filters (service more often in dusty conditions)

Inspect, clean and lubricate front and rear shock absorber spherical bearings (LTD)

EVERY 3 000 KM (2,000 MI) OR 100 HOURS (whichever comes first)

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

Adjust valve clearance

Clean muffler spark arrester

Verify and clean throttle body

Replace fuel vent breather filter

Verify CVT drive belt and clean CVT pulleys

Inspect, clean and lubricate CVT one way bearing

Inspect centrifugal levers and rollers of the drive pulley. Replace as needed

Replace rear shock absorber spherical bearings (LTD)

Inspect every suspension arm bushings and wear plates. Replace as needed

Tighten rear stabilizer bar bolts

Subsection XX (PERIODIC MAINTENANCE SCHEDULE)

EVERY 3 000 KM (2,000 MI) OR 100 HOURS (whichever comes first)
EVERY 1 500 KM (1,000 MI) OR 50 HOURS (whichever comes first)
The following must be performed at least once a year:
Change engine oil and filter
Inspect and clean brake system
Inspect battery condition
Verify steering system for abnormal play
Verify front differential and rear final drive oil level and look for contamination
Verify gearbox oil level and look for contamination

PERFORM AT THE FIRST 3 000 KM (2,000 MI) AND AT 6 000 KM (4,000 MI) THEN FOLLOW THE REGULAR SCHEDULE
PERFORM AT THE FIRST 1 500 KM (1,000 MI) AND AT 3 000 KM (2,000 MI) THEN FOLLOW THE REGULAR SCHEDULE
Replace gearbox oil
Clean the vehicle speed sensor (VSS)

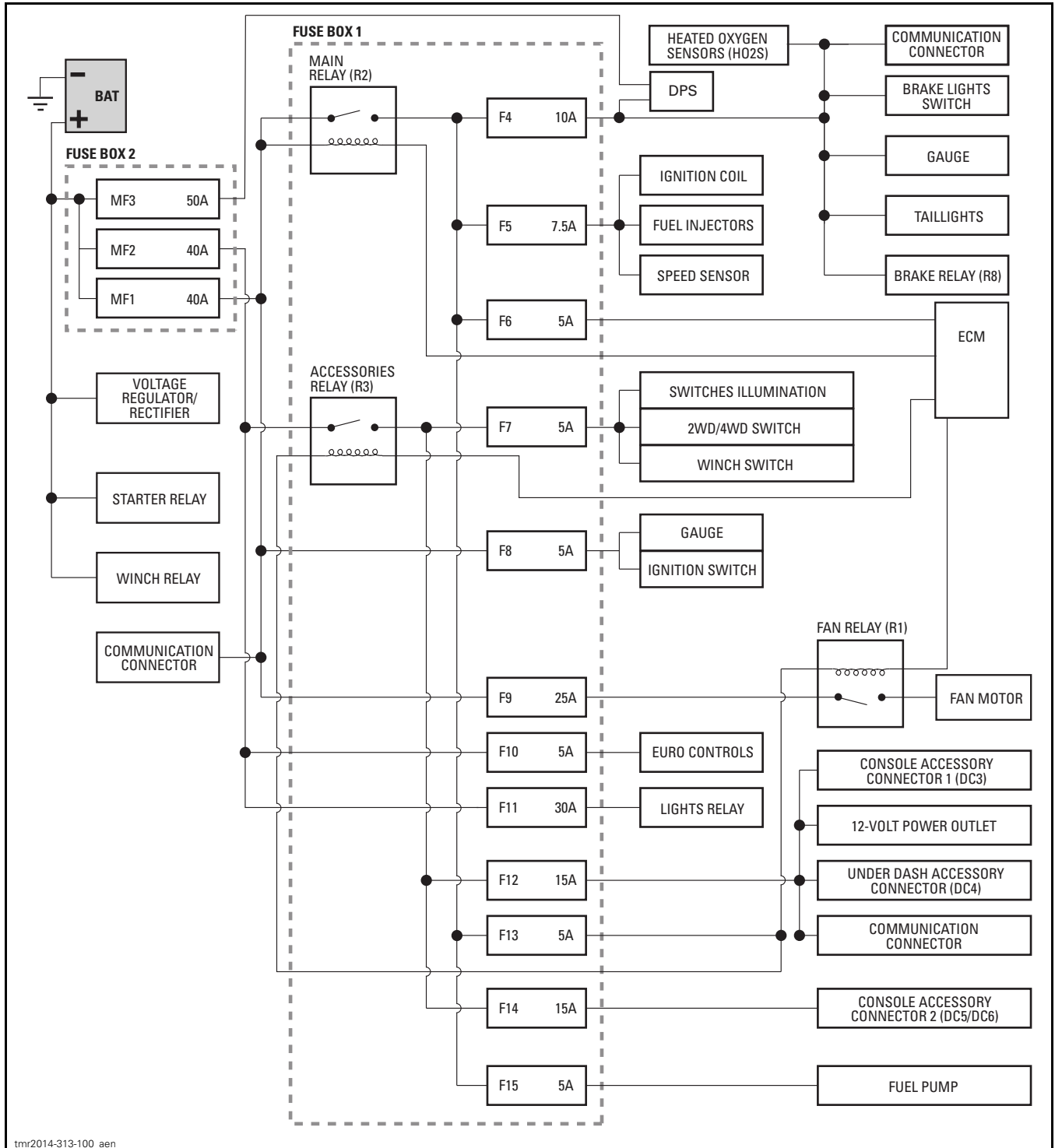
EVERY 6 000 KM (4,000 MI) OR 200 HOURS (whichever comes first)
EVERY 3 000 KM (2,000 MI) OR 100 HOURS (whichever comes first)
Verify the cooling system
Test engine coolant strength
Verify fuel system for leaks
Verify fuel pump pressure
Replace spark plugs
Replace front differential oil
Replace rear final drive oil
Replace gearbox oil
Inspect input and output shaft seals (gearbox, differential and final drive)
Clean vehicle speed sensor
The following must be performed every 2 years:
Replace the brake fluid

EVERY 12 000 KM (8,000 MI) OR 5 YEARS (whichever comes first)
EVERY 6 000 KM (4,000 MI) OR 5 YEARS (whichever comes first)
Replace engine coolant

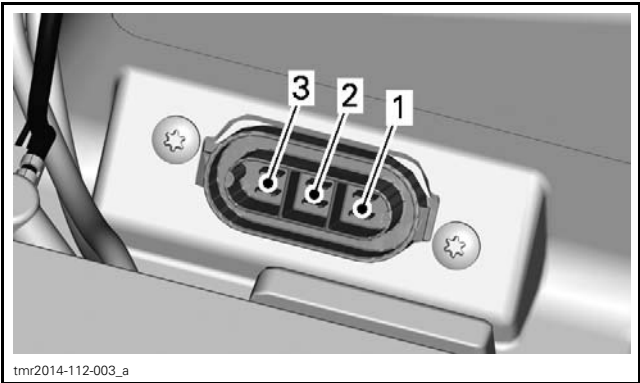
POWER DISTRIBUTION AND GROUNDS

GENERAL

POWER DISTRIBUTION DIAGRAM



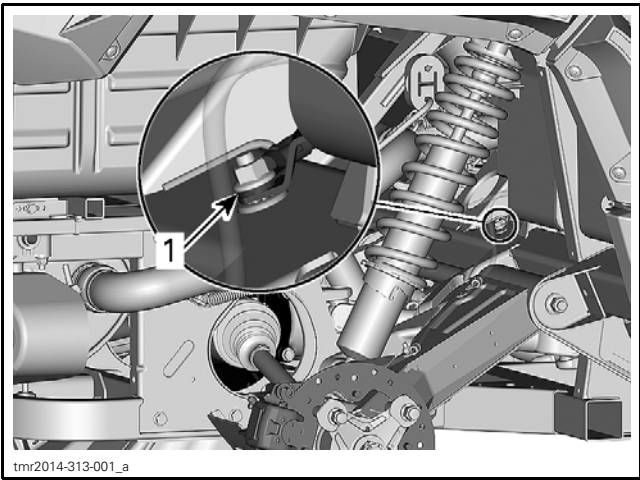
FUSE BOX 2



TYPICAL

FUSE IDENTIFICATION			
Fuse	1	Main	40 A
	2	Accessories	40 A
	3	DPS	50 A

GROUND

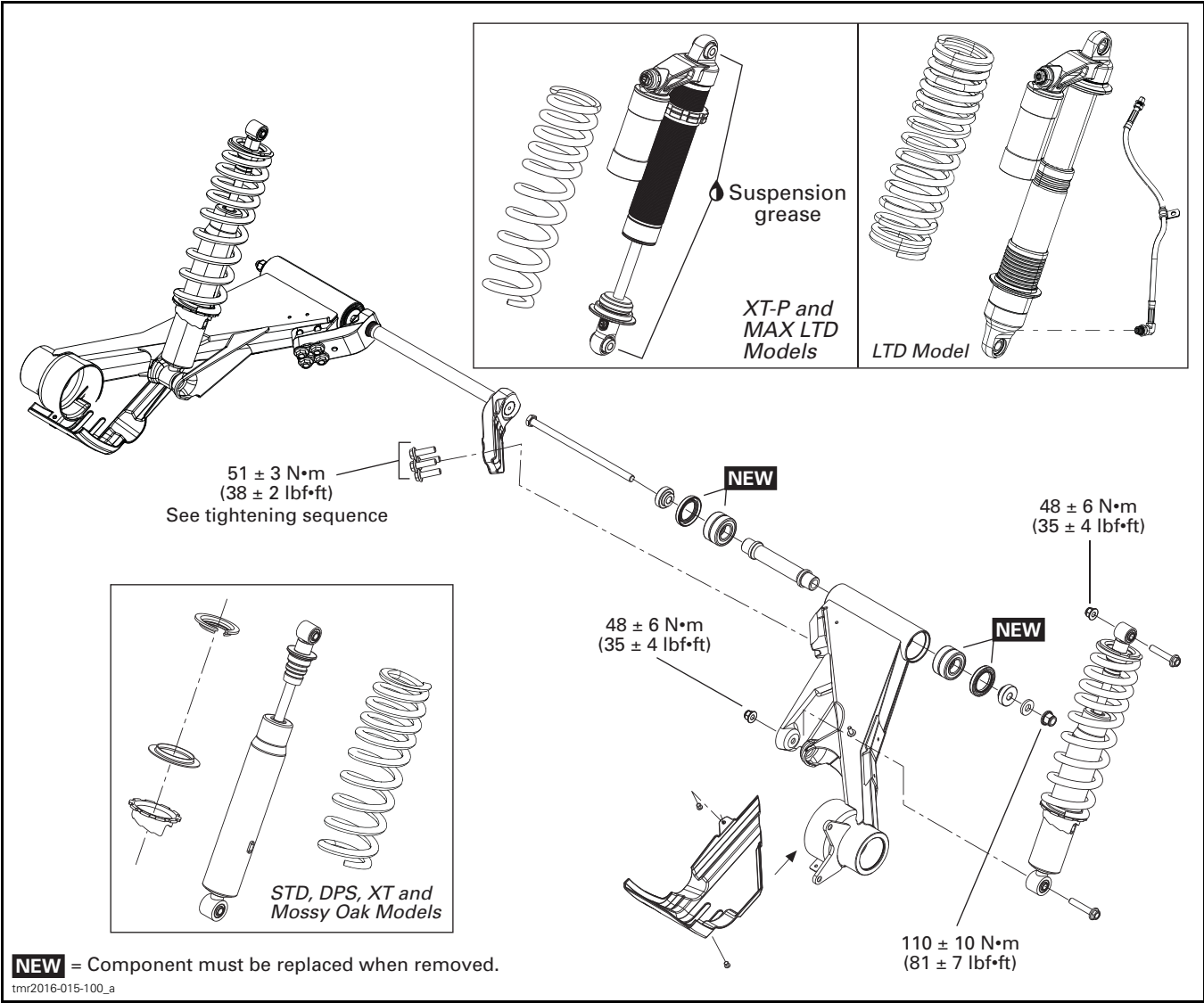


GROUND LOCATION - PARTS REMOVED FOR CLARITY
1. Vehicle ground

REAR SUSPENSION

SERVICE TOOLS

Description	Part Number	Page
SPRING COMPRESSOR	529 036 184	5



GENERAL

The procedure described below is the same for the RH and LH sides, unless otherwise instructed.

On vehicles equipped with air controlled suspension (ACS), refer to *AIR CONTROLLED SUSPENSION (ACS)* section.

ADJUSTMENT

Choice of suspension adjustments vary with vehicle load, personal preference, riding speed and terrain condition.

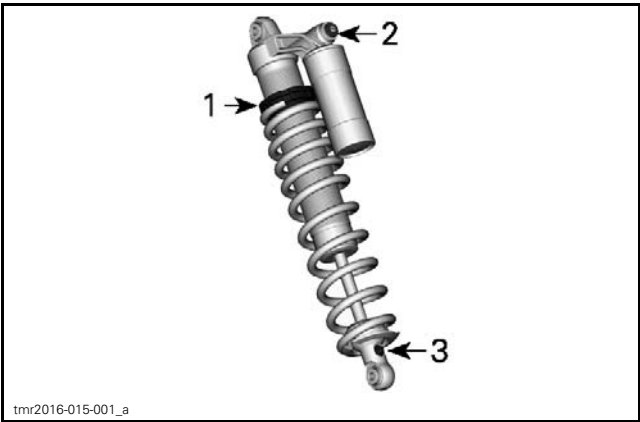
The best way to set up the suspension, is to start from factory settings, then customize each adjustment one at a time.

Front and rear adjustments are interrelated. It may be necessary to readjust the rear shock absorbers after adjusting front shock absorbers for instance.

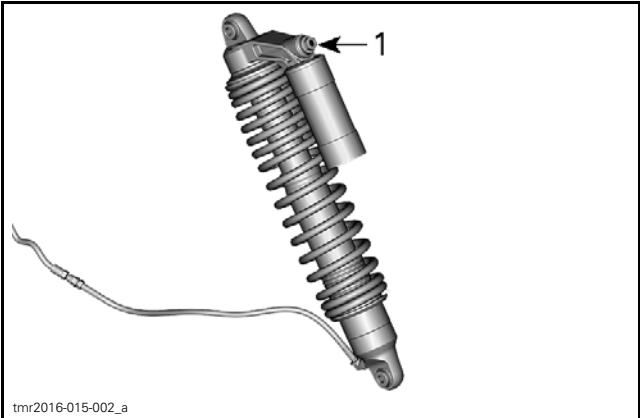
Test run the vehicle under the same conditions; trail, speed, load, etc. Change one adjustment and retest. Proceed methodically until you are satisfied.

Following are guidelines to fine-tune suspension.

ADJUSTMENT LOCATION



XT-P AND MAX LTD MODELS
1. Preload adjustment
2. Low speed and high speed compression damping adjuster
3. Rebound adjuster



LTD MODEL
1. Low speed compression damping adjuster

SUSPENSION FACTORY SETTINGS

For adjustment procedures, refer to *SPRING PRELOAD ADJUSTMENT* and *SHOCK DAMPING ADJUSTMENTS* in this section.

REAR SUSPENSION FACTORY SETTINGS		
ADJUSTMENT	MODEL	FACTORY SETTING
Spring preload	Commander XT-P	45.8 mm (1.8 in)
	Commander MAX LTD	42.9 mm (1.69 in)
	Commander LTD	N/A
Compression damping (low speed)	Commander XT-P and Commander MAX LTD	12 ± 1 clicks counterclockwise from full stop
	Commander LTD	10 ± 1 clicks counterclockwise from full stop
Compression damping (high speed)	Commander XT-P and Commander MAX LTD	12 ± 1 clicks counterclockwise from full stop
Rebound damping	Commander XT-P and Commander MAX LTD	12 ± 1 clicks counterclockwise from full stop

SUSPENSION ADJUSTMENTS

Spring Preload Adjustment

Shorten the spring for a firmer ride and rough riding condition or when pulling a trailer (if equipped with hitch).

Lengthen the spring for a softer ride and smooth riding condition.

WARNING

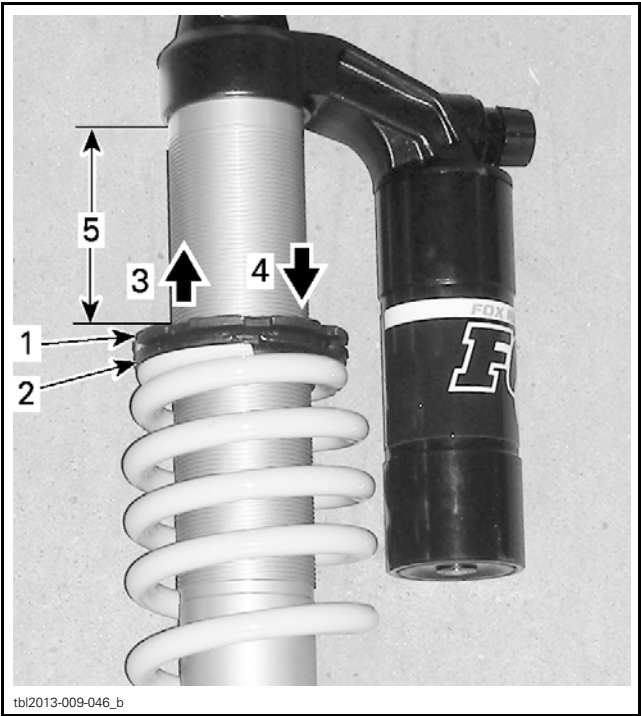
The left and right shock adjustment on front or rear suspension must always be set to the same position. Never adjust one shock only. Uneven adjustment can cause poor handling and loss of stability, which could lead to an accident.

Lift the vehicle. Spring length should be measured without load on the wheels.

Spring length should be equal on both sides.

Adjust by loosening lock ring and turning adjuster ring as desired.

NOTE: Do not increase the spring preload by more than 15 mm (.59 in) over the factory setting.



- TYPICAL**
- 1. Loosen top lock ring
 - 2. Turn adjuster ring as necessary
 - 3. To soften preload
 - 4. To stiffen preload
 - 5. Dimensions to measure

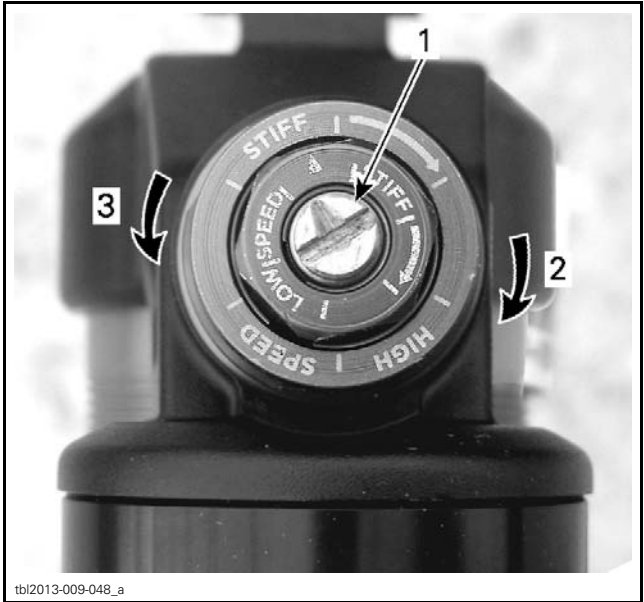
Shock Damping Adjustments

Perform adjustments **one** position (click) at a time. Test run the vehicle under the same conditions. Proceed methodically until you are satisfied.

Low Speed Compression Damping

Low speed compression damping controls how the shock absorber reacts to a low suspension velocity (slow compression strokes, in most cases when riding at lower speeds).

ACTION	RESULT ON BIG BUMPS
Increasing low speed compression damping force	Firmer compression damping (slow compression)
Decreasing low speed compression damping force	Softer compression damping (slow compression)

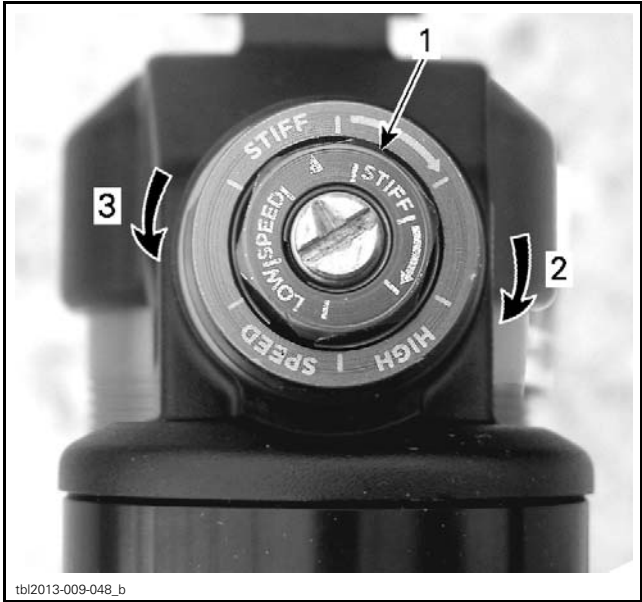


- LOW SPEED COMPRESSION DAMPING**
- 1. Adjustment screw
 - 2. Increases damping (stiffer)
 - 3. Decreases damping (softer)

High Speed Compression Damping

High speed compression damping controls how the shock absorber reacts to a high suspension velocity (quick compression strokes, in most cases when riding at higher speeds).

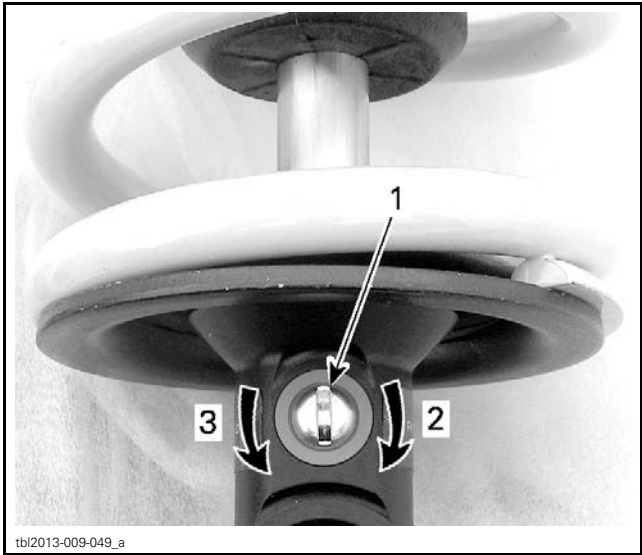
ACTION	RESULT ON SMALL BUMPS
Increasing high speed compression damping force	Firmer compression damping (fast compression)
Decreasing high speed compression damping force	Softer compression damping (fast compression)



HIGH SPEED COMPRESSION DAMPING (USE A 17 MM WRENCH)

- 1. Adjustment screw
- 2. Increases damping (stiffer)
- 3. Decreases damping (softer)

Rebound Damping



- 1. Rebound adjuster
- 2. Increases rebound (stiffer)
- 3. Decreases rebound (softer)

PROCEDURES

SHOCK ABSORBERS

Shock Absorber Removal

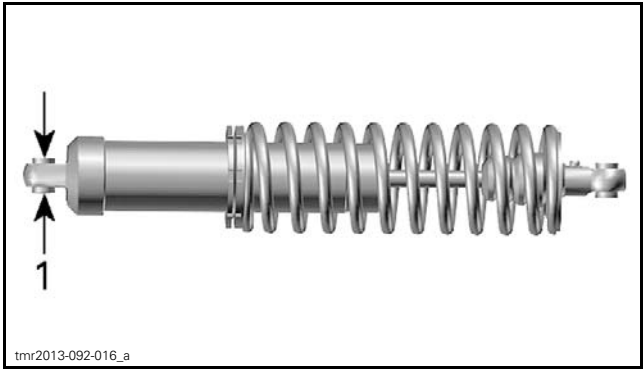
- 1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
- 2. Open cargo box.
- 3. Remove bolts and nuts retaining shock absorber.

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 Spherical Bearing

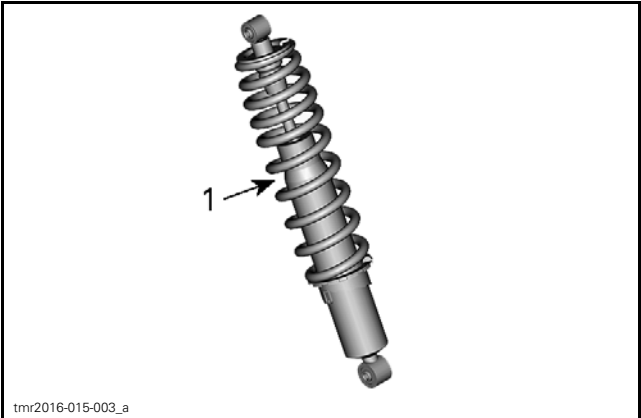
For shock absorber spherical bearings inspection, cleaning and replacement, see *SUSPENSION* in *PERIODIC MAINTENANCE PROCEDURE* subsection.

Shock Absorber Installation

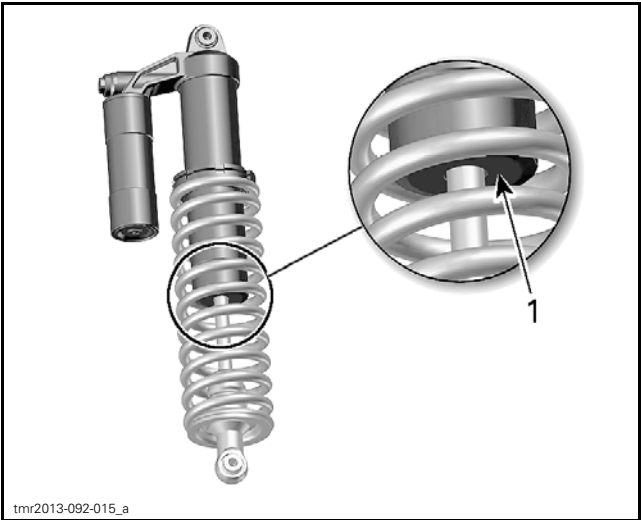
The installation is the reverse of the removal procedure. However, pay attention to the following.

Make sure to install the proper type of shock absorber. The P/N is located:

- On the shock body, near the cap, for oil shocks.
- On the lower cap for HPG shocks.

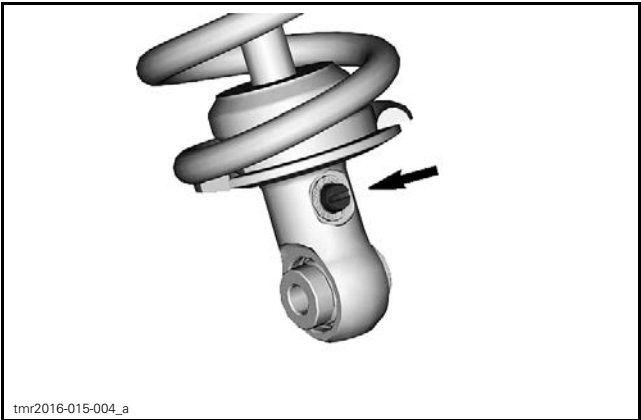


tmr2016-015-003_a
TYPICAL - OIL SHOCK ABSORBER
1. Shock P/N



tmr2013-092-015_a
TYPICAL - HPG SHOCK ABSORBER
1. Shock P/N

Install the shock with the rebound adjuster towards rear.



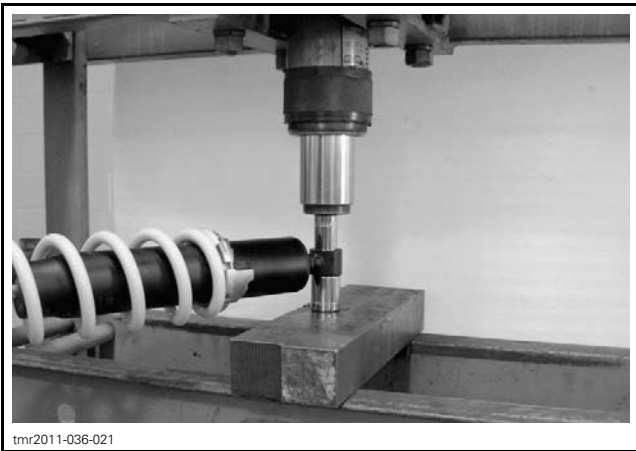
TIGHTENING TORQUE	
Shock absorber nut	48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

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.



tmr2011-036-021
TYPICAL

4. Remove bushing from shock absorber.



tmr2011-036-020
TYPICAL

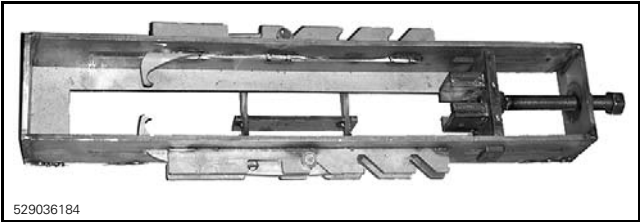
5. Install a new bushing as the reverse of removal.
6. Install shock absorber on vehicle.

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).

Subsection XX (REAR SUSPENSION)



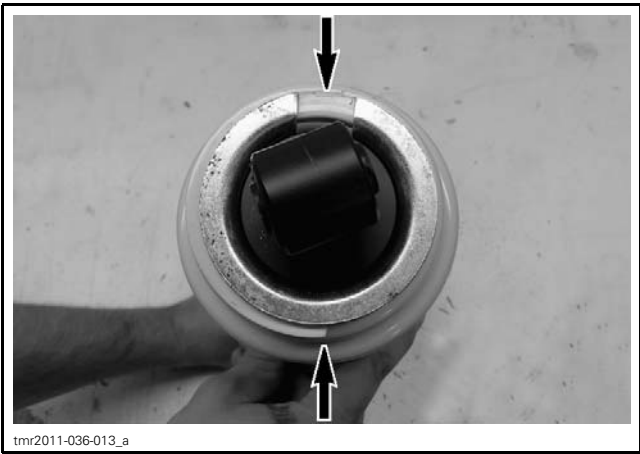
- 3. Place the tool in a vise.
- 4. Position the shock absorber in the tool.
- 5. Install the spring compressor pins.
- 6. Tighten spring remover screw until the spring is sufficiently compressed to remove spring cap.
- 7. Remove spring cap from shock absorber.
- 8. Release spring remover screw.
- 9. 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.

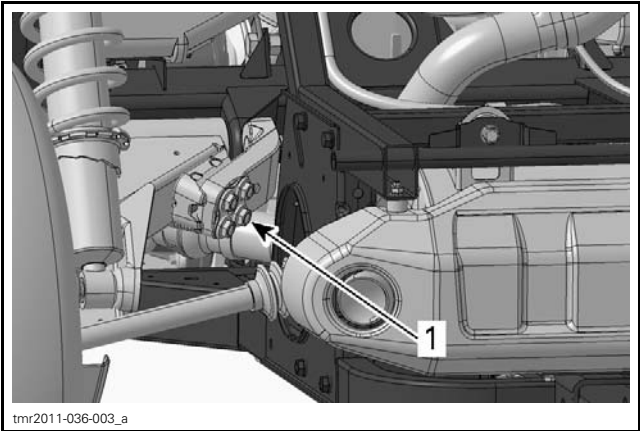


CAP OPENING AT 180°

STABILIZER BAR

Stabilizer Bar Removal

- 1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
- 2. Open cargo box.
- 3. Remove stabilizer bar retaining screws (4 on each side).



1. Stabilizer bar retaining screw

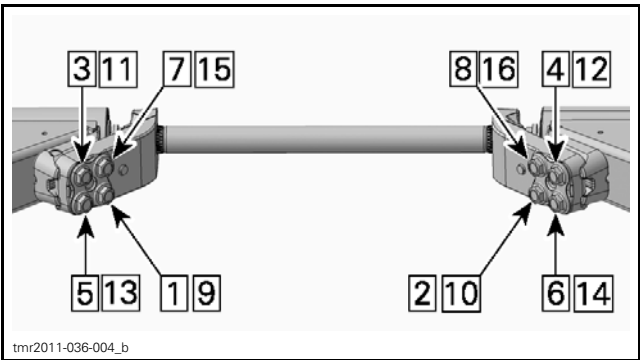
- 4. Remove Stabilizer bar.

Stabilizer Bar Inspection

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

Stabilizer Bar Installation

The installation is the reverse of the removal procedure. However, pay attention to the following.
Install all retaining screws of Stabilizer bar loosely first.
Torque retaining screws of Stabilizer bar according to the following sequence.



STABILIZER BAR TIGHTENING SEQUENCE

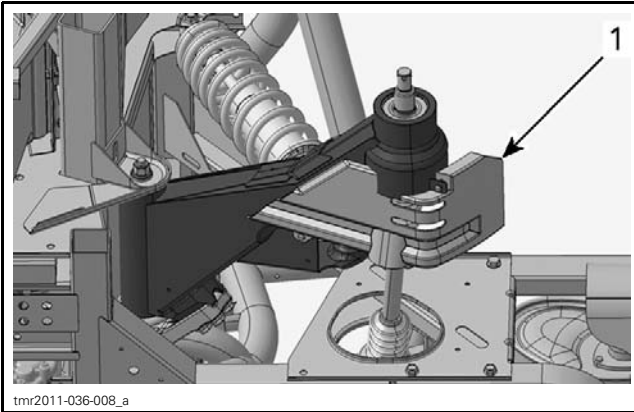
TIGHTENING TORQUE	
Stabilizer bar screws	85 N•m ± 10 N•m (63 lbf•ft ± 7 lbf•ft)

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.

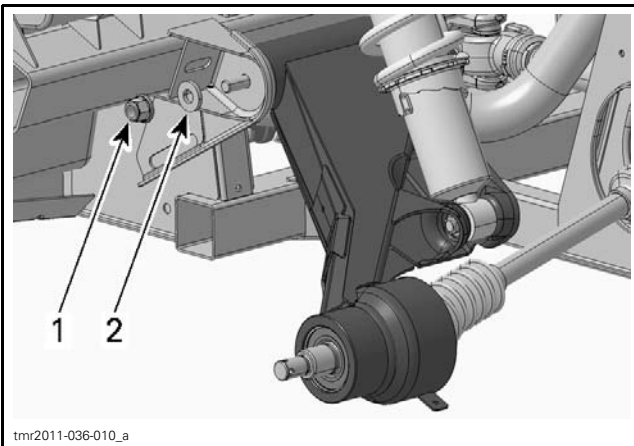
3. Open cargo box.
4. Remove stabilizer bar, refer to *STABILIZER BAR REMOVAL* in this subsection.
5. Remove wheel hub, refer to *REAR DRIVE* subsection.
6. Remove protective plate from trailing arm.



1. Protective plate

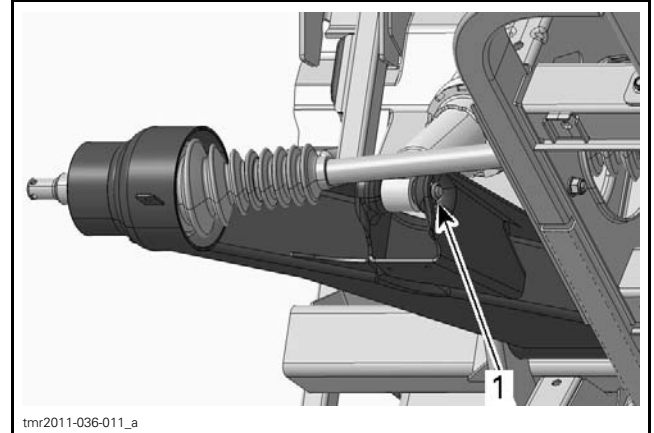
NOTE: If applicable, remove fasteners retaining brake hose to vehicle.

7. Remove nut and washer securing trailing arm pivot.



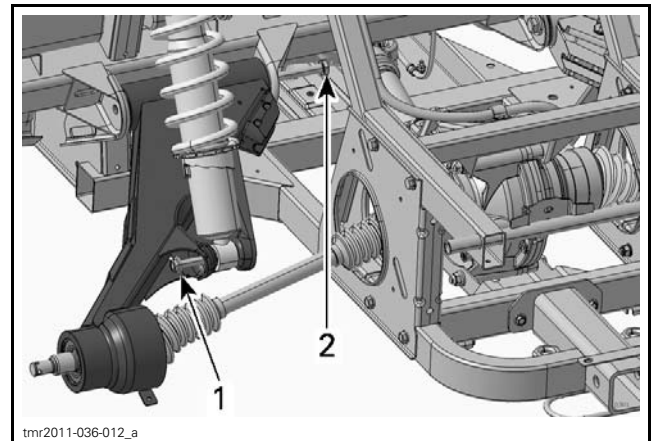
1. Pivot nut
2. Pivot washer

8. Remove lower nut retaining shock absorber.



1. Lower nut

9. Firmly hold trailing arm then remove:
 - Shock absorber lower bolt
 - Trailing arm pivot bolt and washer.



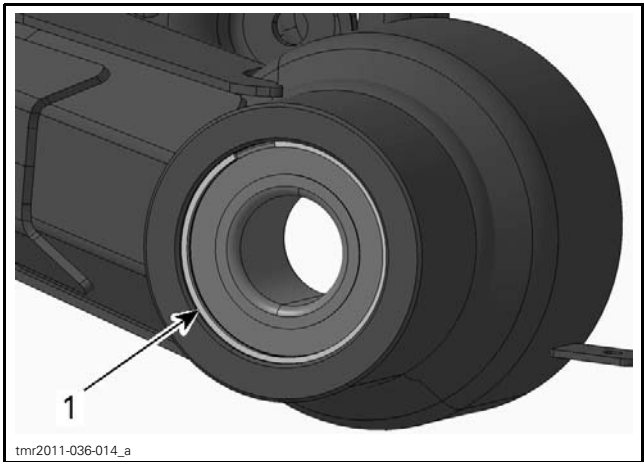
1. Shock absorber lower bolt
2. Trailing arm pivot bolt

10. Remove trailing arm from vehicle.

Trailing Arm Disassembly

Drive Shaft Bearing Removal

1. Remove circlip securing bearing into trailing arm.

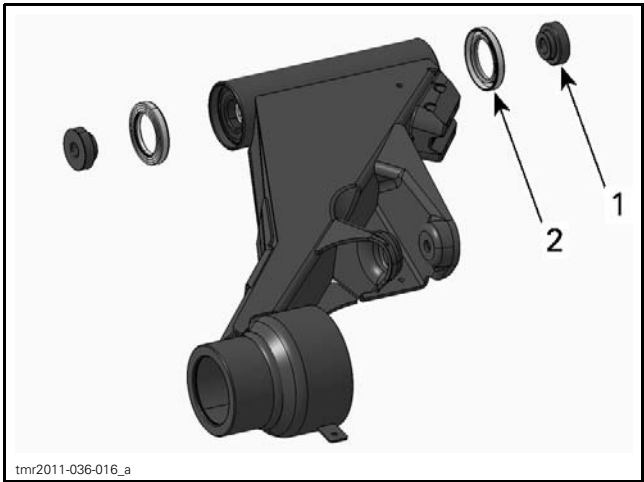


1. Circlip

- 2. Install trailing arm on a press.
- 3. Use an appropriate bearing remover.
- 4. Remove drive shaft bearing from trailing arm.

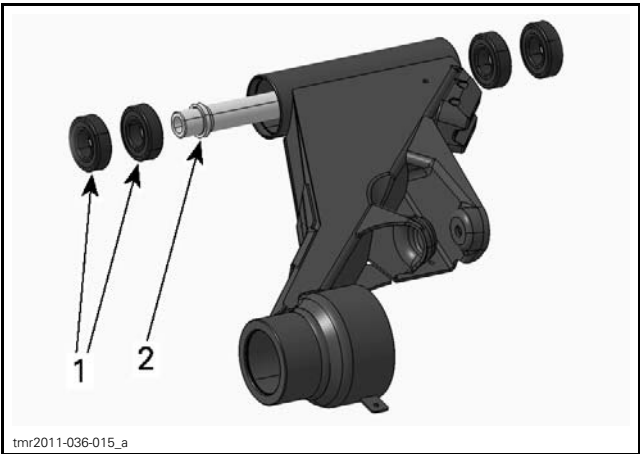
Trailing Arm Pivot Bearing Removal

- 1. Remove both spacers and seals from trailing arm pivot.



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.



1. Pivot bearings
2. 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:

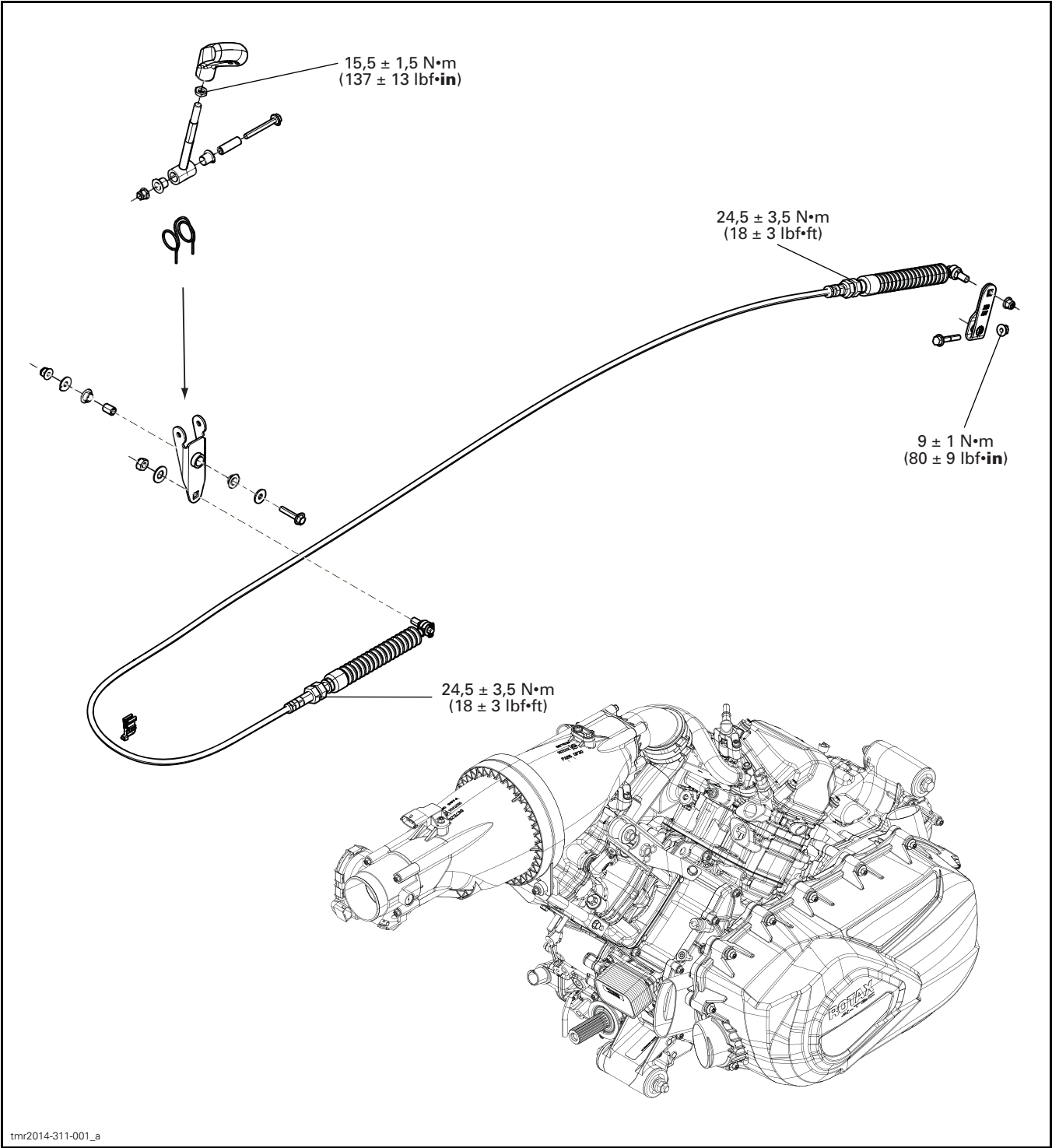
- Pivot bearings
- Seals
- Circlip.

TIGHTENING TORQUE	
Trailing arm pivot nut	110 N•m ± 10 N•m (81 lbf•ft ± 7 lbf•ft)

SHIFTER

SERVICE TOOLS

Description	Part Number	Page
TRANSMISSION ADJUSTMENT TOOL	529 036 252	3



PROCEDURES

SHIFT LEVER

Shift Lever Access

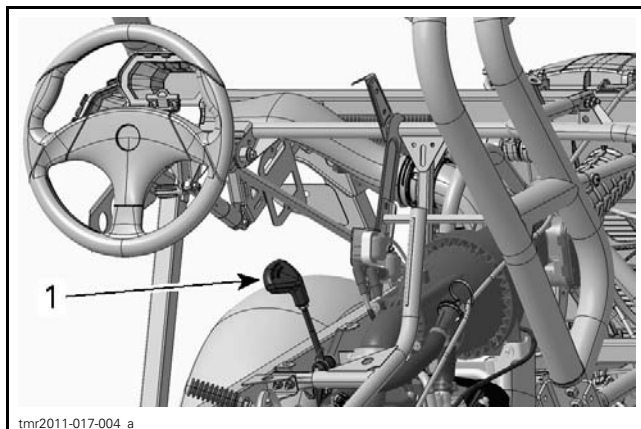
1. Refer to *BODY* subsection and remove the following components:

- Seats
- Lower console
- RH and LH lateral console panels.

NOTE: Move upper console upwards to access to lower console.

Shift Lever Removal

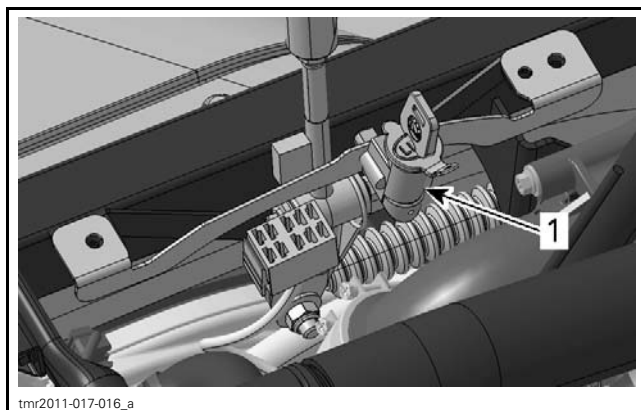
1. Place vehicle on a level surface.
2. Place shift lever in **NEUTRAL** position.
3. Secure vehicle using wheel blocks.
4. Unscrew shift lever handle.



TYPICAL

1. Shift lever handle

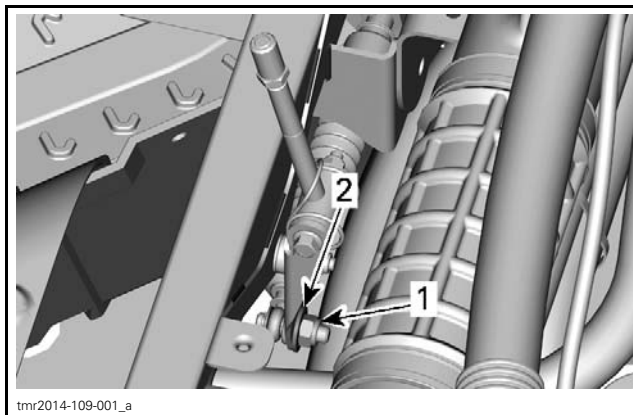
5. On **CE models**, remove locking device from vehicle.



CE MODELS

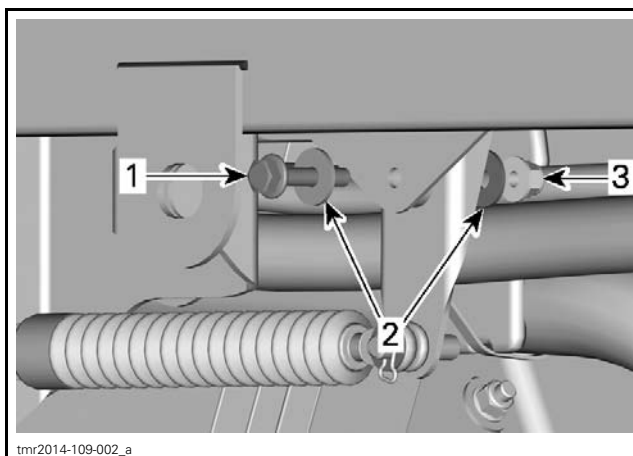
1. Locking device

6. Detach shifter cable from shift lever by removing nut and washer.



1. Shift lever nut
2. Shift lever washer

7. Remove shift lever pivot bolt, washers and nut.



1. Shift lever pivot bolt
2. Shift lever pivot washers
3. Shift lever pivot nut

8. Remove shift lever.

Shift Lever Inspection

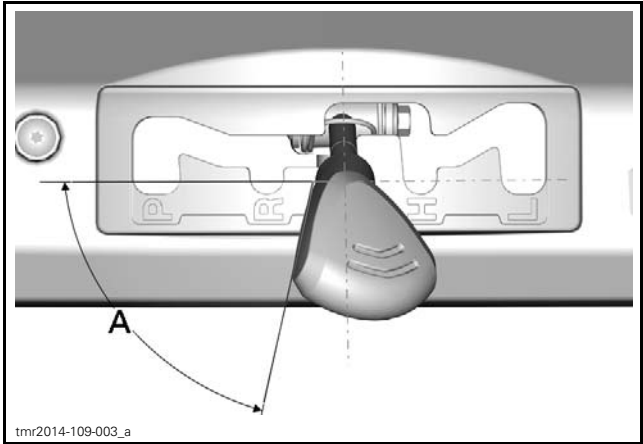
Check shift lever for bending or cracks.

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.



SHIFT LEVER HANDLE ANGLE
A. 78° ± 5°

Tighten shift lever handle nut to specification.

SHIFT LEVER HANDLE NUT	
Tightening torque	15.5 N•m ± 1.5 N•m (137 lbf•in ± 13 lbf•in)

Adjust shifter cable, refer to *SHIFTER CABLE ADJUSTMENT* in this subsection.

SHIFTER CABLE

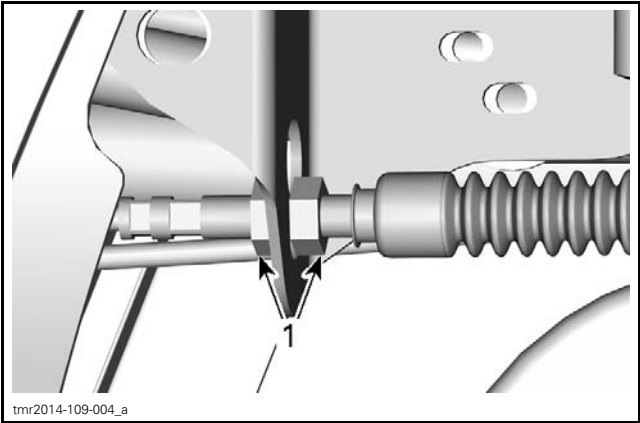
Shifter Cable Adjustment

REQUIRED TOOLS		
TRANSMISSION ADJUSTMENT TOOL (P/N 529 036 252)		
T1	Shift Lever Locking Tool (included in P/N 529 036 252)	
T2	Shift Plate Locking Tool (included in P/N 529 036 252)	

1. Place shift lever in **NEUTRAL** position.

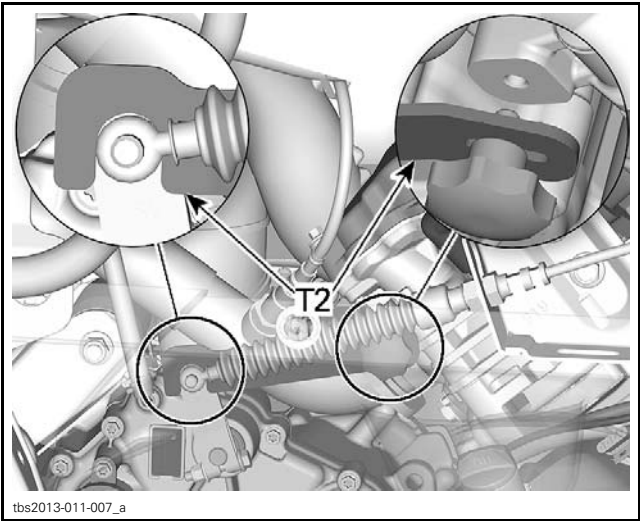
NOTICE Move vehicle back and forth to ensure gearbox is set in neutral position.

2. Secure vehicle using wheel blocks.
3. Remove body parts as required. Refer to *SHIFT LEVER ACCESS* in this subsection.
4. Loosen shift lever end cable adjustment nuts.



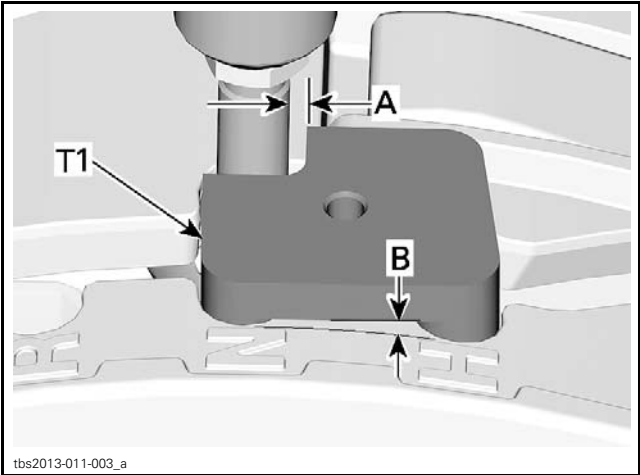
1. Adjustment nuts

5. Rock forward and backward the shift plate on the gearbox to ensure it is well centered in the "N" position.
6. Using the shift plate locking tool **no. T2**, lock shift plate with and screwed the knob in the rear cylinder head.



7. Insert the shift lever locking tool **no. T1** in shift lever indicator to lock shift lever in place. Leave a gap of 2 mm to 3 mm (5/64 in to 1/8 in) between locking tool and shift lever.

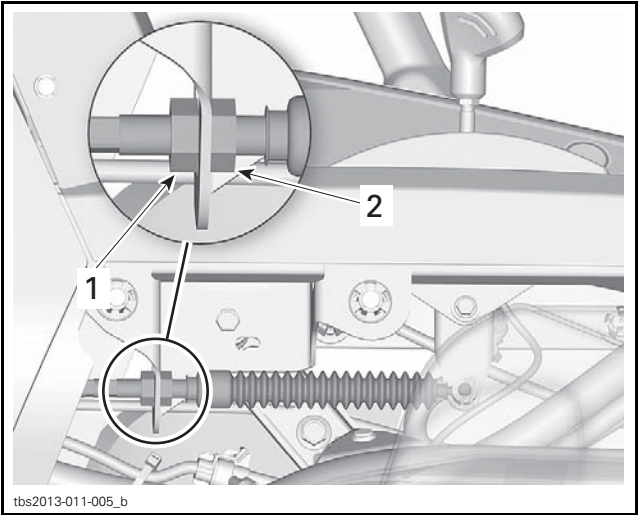
Subsection 13 (SHIFTER)



A. Gap between shift lever and locking tool
B. Normal angle between shift lever indicator and locking tool

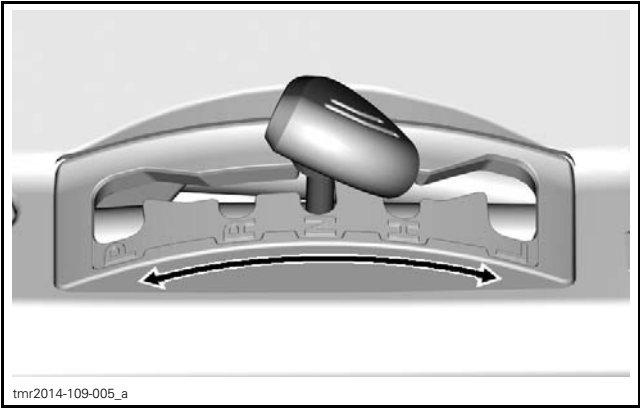
8. Tighten the cable front adjustment nut by hand until gap between shift lever and locking tool disappear.
9. Tighten second adjustment nut to specification.

CABLE FRONT ADJUSTMENT NUT	
Tightening torque	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)



TYPICAL
1. Tighten to remove the gap
2. Torque to specification

10. Remove shift plate locking tool **no. T2**.
11. Remove shift lever locking tool **no. T1**. It should be easy to do. If not, repeat tightening sequence with less pressure from the shift lever on the locking tool.
12. Shift transmission to R, L, P,H and back to N.
13. Verify maximum free play in cable. Shift lever should move from P to L without high restriction (only spring load restriction).



14. Reinstall all removed parts. Start engine, select P-R-N-H and L to ensure the transmission shifts into every gear.

⚠ WARNING

After adjustment, make sure that PARK position works properly.

STORAGE PROCEDURE

SERVICE PRODUCTS

Description	Part Number	Page
BRP HEAVY DUTY CLEANER	293 110 001	3
XPS ALL PURPOSE CLEANER	219 701 709	2
XPS FUEL STABILIZER.....	413 408 601	1
XPS LUBE.....	293 600 016	2-3
XPS STORAGE OIL (EXCEPT U.S. COUNTRY)	413 711 600	1
XPS STORAGE OIL (U.S. COUNTRY ONLY)	413 711 900	1

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 XPS FUEL STABILIZER (P/N 413 408 601) 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 STORAGE OIL (EXCEPT U.S. COUNTRY) (P/N 413 711 600)
XPS 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

2-UP Models

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

Close CVT cover.

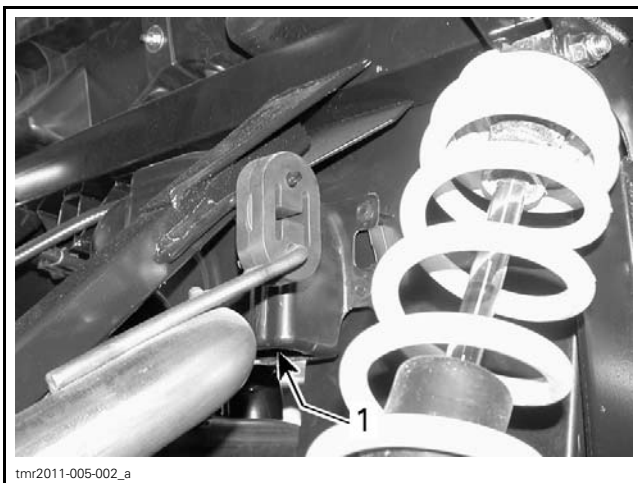
Block CVT outlet with a rag.

Subsection XX (STORAGE PROCEDURE)

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



1. Tilted cargo box



1. CVT outlet

MAX Models

Remove drive belt. Refer to *CVT*.

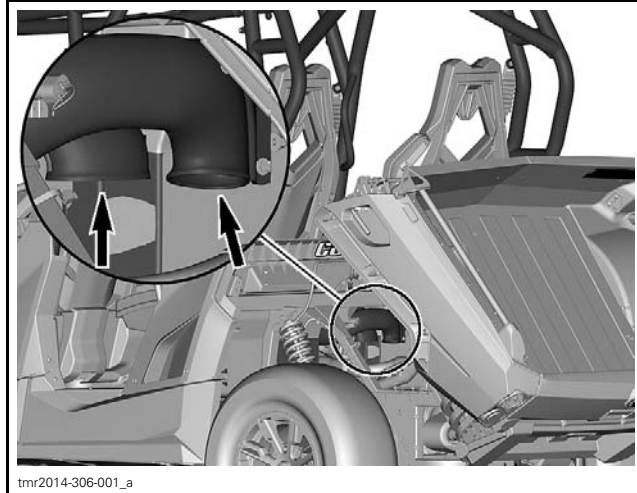
Inspect and clean pulleys.

Protect pulleys by spraying XPS LUBE (P/N 293 600 016) on pulley faces.

NOTE: Do not reinstall drive belt.

Close CVT cover.

Block rear CVT inlets with a rag.



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 ALL 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.

COMMANDER MAX

ENGINE			
Engine type		800R	ROTAX® 810, 4-stroke, 2 cylinders (V-twin), liquid cooled
		1000	ROTAX® 1010, 4-stroke, 2 cylinders (V-twin), liquid cooled
Valvetrain			4 valves/cylinder (mechanical adjustment), Single Over Head Camshaft (SOHC) with timing chain
Bore			91 mm (3.58 in)
Stroke		800R	61.5 mm (2.42 in)
		1000	75 mm (2.95 in)
Displacement		800R	799 cm³ (48.8 in³)
		1000	976 cm³ (59.6 in³)
Compression ratio		800R	10.3:1
		1000	10.5:1
Maximum HP RPM		800R	7250 RPM
		1000	7000 RPM
Exhaust system			Spark arrestor approved by USDA Forest Service
Air filter			Corrugated synthetic paper
Intake valve opening			5° BTDC
Intake valve closing		800R	45° ABDC
		1000	60° ABDC
Exhaust valve opening		800R	55° BBDC
		1000	65° BBDC
Exhaust valve closing		800R	5° ATDC
		1000	5° BTDC
Valve clearance		Intake	0.06 mm to 0.14 mm (.0024 in to .0055 in)
		Exhaust	0.11 mm to 0.19 mm (.0043 in to .0075 in)
Valve stem diameter	Intake	New	4.966 mm to 4.980 mm (.1955 in to .1961 in)
		Service limit	4.930 mm (.1941 in)
	Exhaust	New	4.956 mm to 4.970 mm (.1951 in to .1957 in)
		Service limit	4.930 mm (.1941 in)
Valve out of round		New	0.005 mm (.0002 in)
		Service limit	0.06 mm (.0024 in)
Valve guide diameter		New	4.998 mm to 5.018 mm (.1968 in to .1976 in)
		Service limit	5.050 mm (.1988 in)
Valve spring free length		New	40.81 mm (1.607 in)
		Service limit	39.00 mm (1.535 in)
Valve seat contact width	Intake	New	1.05 mm to 1.35 mm (.041 in to .053 in)
		Service limit	1.8 mm (.071 in)
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)
		Service limit	2 mm (.079 in)
Rocker arm bore diameter		New	12.036 mm to 12.050 mm (.4739 in to .4744 in)
		Service limit	12.060 mm (.4748 in)

Subsection 01 (COMMANDER MAX)

ENGINE				
Rocker arm shaft diameter			New	12.000 mm to 12.018 mm (.4724 in to .4731 in)
			Service limit	11.990 mm (.472 in)
Piston diameter			New	90.950 mm to 90.966 mm (3.5807 in to 3.5813 in)
			Service limit	90.900 mm (3.5787 in)
Piston/cylinder clearance			New	0.027 mm to 0.057 mm (.0011 in to .0022 in)
			Service limit	0.100 mm (.0039 in)
Piston ring type			1st	Upper compression ring, rectangular
			2nd	Lower compression ring, tapered face
			3rd	Oil scraper ring
Ring end gap	Rectangular		New	0.20 mm to 0.40 mm (.008 in to .016 in)
	Tapered face			0.20 mm to 0.40 mm (.008 in to .016 in)
	Oil scraper ring			0.20 mm to 0.70 mm (.008 in to .028 in)
	Rectangular		Service limit	0.60 mm (.024 in)
	Tapered face			0.70 mm (.028 in)
	Oil scraper ring			1.00 mm (.039 in)
Ring/piston groove clearance	Rectangular		New	0.03 mm to 0.07 mm (.0012 in to .0028 in)
	Tapered face			0.02 mm to 0.06 mm (.0008 in to .0024 in)
	Oil scraper ring			0.01 mm to 0.18 mm (.0004 in to .0071 in)
	Rectangular		Service limit	0.15 mm (.0059 in)
	Tapered face			0.15 mm (.0059 in)
	Oil scraper ring			0.25 mm (.0098 in)
Cylinder bore			New	90.993 mm to 91.007 mm (3.5824 in to 3.583 in)
Cylinder taper			Maximum New	0.038 mm (.0015 in)
			Service limit	0.090 mm (.0035 in)
Cylinder out of round			Maximum New	0.015 mm (.0006 in)
			Service limit	0.020 mm (.0008 in)
Camshaft main bearing journal	Timing 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)
	Spark plug side		New	21.959 mm to 21.980 mm (.8645 in to .8654 in)
			Service limit	21.950 mm (.8642 in)
Camshaft main bearing journal bore	Timing 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)
	Spark plug side		New	22.000 mm to 22.021 mm (.8661 in to .867 in)
			Wear limit	22.040 mm (.8677 in)
Camshaft lobe	Intake valve	800R	New	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)
			Service limit	32.870 mm (1.2941 in)
		1000	New	32.960 mm to 33.160 mm (1.2976 in to 1.3055 in)
			Service limit	32.940 mm (1.2969 in)
	Exhaust valve	800R	New	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)
			Service limit	32.930 mm (1.2965 in)
		1000	New	32.860 mm to 33.060 mm (1.2937 in to 1.3016 in)
			Service limit	32.840 mm (1.2929 in)
Crankshaft main bearing journal diameter (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)

ENGINE			
Crankshaft radial play (MAG/PTO side)		Service limit	0.07 mm (.0028 in)
Crankshaft bearing journal diameter (in PTO cover)		New	34.004 mm to 34.020 mm (1.3387 in to 1.3394 in)
		Service limit	33.998 mm (1.3385 in)
Crankshaft radial play (PTO cover bearing)		Service limit	0.10 mm (.0039 in)
Crankshaft axial play		New	0.200 mm to 0.500 mm (.0079 in to .0197 in)
		Service limit	0.600 mm (.0236 in)
Crankshaft pin diameter	800R	New	40.009 mm to 40.025 mm (1.5752 in to 1.5758 in)
		Service limit	39.990 mm (1.5744 in)
	1000	New	41.986 mm to 42.010 mm (1.653 in to 1.6539 in)
		Service limit	41.967 mm (1.6522 in)
Crankshaft deflection	MAG/ PTO side	New	0.050 mm (.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 diameter	800R	Service limit	40.100 mm (1.579 in)
	1000		42.100 mm (1.6575 in)
Connecting rod big end radial play		Service limit	0.09 mm (.0035 in)
Connecting rod big end axial play	800R	New	0.200 mm to 0.500 mm (.008 in to .02 in)
		Service limit	0.600 mm (.024 in)
	1000	New	0.250 mm to 0.550 mm (.0098 in to .0217 in)
		Service limit	0.600 mm (.024 in)
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	22.010 mm to 22.020 mm (.8665 in to .8669 in)
		Service limit	22.050 mm (.8681 in)
Piston pin diameter	800R	New	19.996 mm to 20.000 mm (.7872 in to .7874 in)
		Service limit	19.980 mm (786.614 in)
	1000	New	21.996 mm to 22.000 mm (865.984 in to 866.142 in)
		Service limit	21.980 mm (.8654 in)
Connecting rod/piston pin clearance (radial play)		Service limit	0.080 mm (.0031 in)
LUBRICATION SYSTEM			
Type		Wet sump	
Oil filter		Replaceable cartridge oil filter	
Engine oil pressure		Minimum	350 kPa (51 PSI) at 6000 RPM
Engine oil	Capacity (oil change with filter)		2 L (2.1 qt (U.S. liq.))
	Recommended		For the summer season, use XPS synthetic blend oil (summer grade) (P/N 293 600 121). For the winter season, use XPS synthetic oil (all climate) (P/N 293 600 112). If not available, use a 5W 40 motor oil that meets the requirements for API service classification SM, SL or SJ.

Subsection 01 (COMMANDER MAX)

COOLING SYSTEM			
Coolant	Type		Ethyl glycol/water mix (50% coolant, 50% water). Use premixed coolant sold by BRP (P/N 219 702 685) or coolant specifically designed for aluminum engines
	Capacity	800R	4.6 L (1.22 U.S. gal.)
		1000	5 L (1.32 U.S. gal.)
Thermostat	Starts to open		65°C (149°F)
	Fully open	800R	75°C (167°F)
		1000	88°C (190°F)
Radiator cap opening pressure			110 kPa (16 PSI)

TRANSMISSION			
Type		CVT (Continuously Variable Transmission)	
Engagement RPM		1800 ± 100 RPM	
Drive belt width	Service limit		30.00 mm (1.181 in)
Governor cup roller outer diameter	New		13.70 mm to 13.80 mm (.539 in to .543 in)
	Service limit		8.5 mm (.335 in)
Governor cup roller inner diameter	New		8.05 mm to 8.15 mm (.317 in to .321 in)
	Service limit		9.00 mm (.354 in)
Centrifugal lever pivot bolt diameter	New		6.078 mm to 6.100 mm (.239 in to .24 in)
	Service limit		6.000 mm (.236 in)
Centrifugal lever bore diameter	New		6.035 mm to 6.078 mm (.2376 in to .2393 in)
	Service limit		6.300 mm (.248 in)
Drive pulley sliding half centrifugal lever pivot bolt bore diameter	New		6.113 mm to 6.171 mm (.241 in to .243 in)
	Service limit		6.300 mm (.248 in)
Drive pulley sliding half large bushing	New		55.000 mm to 55.040 mm (2.165 in to 2.167 in)
	Service limit		55.200 mm (2.173 in)
Drive pulley sliding half small bushing	New		32.000 mm to 32.040 mm (1.26 in to 1.261 in)
	Service limit		32.200 mm (1.268 in)
Drive pulley spring free length	800R	Service limit	85 mm (3.346 in)
	1000		105 mm (4.134 in)
Drive pulley spring free squareness		Service limit	4 mm (.157 in)
Spring sleeve length	New		9.2 mm to 9.4 mm (.362 in to .37 in)
	Service limit		9.0 mm (.354 in)
Driven pulley sliding half bushing	New		30.060 mm to 30.100 mm (1.183 in to 1.185 in)
	Service limit		30.200 mm (1.189 in)
Driven pulley sliding fixed bushing	New		30.060 mm to 30.100 mm (1.183 in to 1.185 in)
	Service limit		30.200 mm (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			
Type	Dual range (HI-LO) with park, neutral and reverse		
Gear ratios	Angle drive sub-transmission	37/15 = 2.467	
	Intermediate	45/40 = 1.125	
	High	36/27 = 1.333	
	Low	44/19 = 2.316	
	Reverse	34/12 = 2.833	
Overall gear ratios	High	3.7	
	Low	6.426	
	Reverse	7.863	
Gearbox oil	Capacity	450 ml (15 U.S. oz)	
	Recommended	XPS synthetic gear oil (P/N 293 600 140) or a 75W140 API GL-5 synthetic gear oil	
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 claw thickness	New	4.95 mm to 5.05 mm (.195 in to .199 in)	
	Service limit	4.80 mm (.189 in)	
Shift fork claw thickness (high, low and reverse gear shift fork)	New	5.10 mm to 5.20 mm (.201 in to .205 in)	
	Service limit	5.00 mm (.197 in)	
Width of shift fork engagement groove	New	5.30 mm to 5.40 mm (.209 in to .213 in)	
	Service limit	5.50 mm (.217 in)	
Diameter free pinions	New	29.000 mm to 29.013 mm (1.1417 in to 1.1422 in)	
	Service limit	29.015 mm (1.1423 in)	
Intermediate gear shaft	New	24.987 mm to 25.000 mm (.9837 in to .9843 in)	
	Service limit	24.977 mm (.983 in)	
Countershaft	MAG side	New	19.977 mm to 19.990 mm (.7865 in to .787 in)
		Service limit	19.973 mm (.7863 in)
	CVT side	New	24.977 mm to 24.990 mm (.9833 in to .9839 in)
		Service limit	24.970 mm (.9831 in)
Main shaft	Free pinion bearing	New	24.987 mm to 25.000 mm (.9837 in to .9843 in)
		Service limit	24.984 mm (.9836 in)
	Bearing journal MAG/CVT side	New	16.980 mm to 16.991 mm (.6685 in to .6689 in)
		Service limit	16.976 mm (.6683 in)

ELECTRICAL SYSTEM			
Magneto generator output		625 W @ 6000 RPM	
Stator resistance (20°C (68°F))		0.15 to 0.30 Ω	
Ignition system type		IDI (Inductive Discharge Ignition)	
Ignition timing		Not adjustable	
Spark plug	Quantity	2	
	Make and type	NGK DCPR8E	
	Gap	0.7 mm to 0.8 mm (.028 in to .031 in)	

Subsection 01 (COMMANDER MAX)

ELECTRICAL SYSTEM			
Engine RPM limiter setting	Forward	8000 RPM	
	Reverse	20 km/h to 25 km/h (12 MPH to 16 MPH) (8000 RPM with Override)	
Battery	Type	Maintenance free	
	Voltage	12 volts	
	Nominal rating	18 A•h	
	Power starter output	0.7 KW	
Headlight	High	2 x 60 W	
	Low	2 x 60 W	
Taillight		2 x 5/21 W	
Fuses	– Main	MF1	16 awg
	– Main accessories	MF2	14 awg
	– DPS	MF3	40 A
	– Brake lights switch – Gauge – Taillights – Brake relay	F4	10 A
	– Ignition coils – Fuel injectors – Speed sensor	F5	7.5 A
	– Engine control module (ECM)	F6	5 A
	– Winch (XT model) – 4WD actuator	F7	5 A
	– Ignition switch – Clock – Gauge – Starter solenoid	F8	5 A
	– Fan motor	F9	25 A
	– Lights relay	F11	30 A
	– Connectors (DC3 and DC4) – 12 V power outlet – Communication connector	F12	15 A
	– Relays coils (R1 and R3)	F13	5 A
	– Accessories (DC5 and DC6)	F14	15 A
	– Fuel pump	F15	5 A
FUEL SYSTEM			
Fuel delivery	Type	Electronic Fuel Injection (EFI), 54 mm throttle body with iTC (Intelligent Throttle Control), 1 injector per cylinder	
Fuel pump	Type	Electrical (in fuel tank)	
	Operating pressure	350 kPa (51 PSI)	

FUEL SYSTEM		
Idle speed		1250 RPM $\pm$ 100 (not adjustable)
Fuel	Type	Regular unleaded gasoline
	Minimum Octane rating	87 Pump Posted AKI (92 RON)
Fuel tank capacity		37.8 L (10 U.S. gal.)
Fuel remaining when low fuel light turns ON		$\pm$ 12 L (3.2 U.S. gal.)

DRIVE SYSTEM		
Front drive		Visco-Lok [†] OE front differential
Front drive ratio		3.6:1
Rear drive		Spiral bevel gear/final drive
Rear drive ratio		3.6:1
Front differential oil	Capacity	500 ml (17 U.S. oz)
	Recommended	XPS synthetic gear oil (P/N 293 600 043) or synthetic gear oil 75W90 API GL-5
Rear final drive oil	Capacity	280 ml (9.5 U.S. oz)
	Recommended	XPS Synthetic gear oil (P/N 293 600 140) or a 75W 140 API GL-5 synthetic gear oil
CV joint grease		CV GREASE (P/N 293 550 062)
Propeller shaft grease		PROPELLER SHAFT GREASE (P/N 293 550 063)

STEERING	
Type	Rack and pinion
Steering wheel	Adjustable tilt steering
Turning radius	550 cm (217 in)
Total toe (vehicle on ground)	0° $\pm$ 0.2°
Camber angle (vehicle on ground)	0.7° positive
Tie-rod maximum length unengaged threads	N/A

FRONT SUSPENSION			
Suspension type			Double suspension-arm with dive-control geometry
Suspension travel			254 mm (10 in)
Shock absorber	Qty		2
	Type	DPS XT	Oil
		LTD	HPG shock with piggyback reservoir. Dual speed compression damping and rebound damping adjustments
Spring free length			Refer to spring chart
Preload adjustment type		DPS XT	5 spring preload settings
		LTD	Threaded

REAR SUSPENSION	
Suspension type	Torsional Trailing A-arm Independent (TTA) with external stabilizer bar
Suspension travel	254 mm (10 in)

Subsection 01 (COMMANDER MAX)

REAR SUSPENSION			
Shock absorber	Qty		2
	Type	DPS XT	Oil
		LTD	HPG shock with piggyback reservoir. Dual speed compression damping and rebound damping adjustments
Spring free length			Refer to spring chart
Preload adjustment type		DPS XT	5 spring preload settings
		LTD	Threaded

BRAKES		
Front brake	Qty	2
	Type	220 mm ventilated disc brakes with hydraulic twin-pistons calipers
Rear brake	Qty	2
	Type	214 mm ventilated disc brakes with hydraulic twin-piston calipers
Brake fluid	Capacity	260 ml (8.8 U.S. oz)
	Type	DOT 4
Caliper		Floating
Brake pad material		Metallic
Minimum brake pad thickness		1 mm (.04 in)
Minimum brake disc thickness		4 mm (.157 in)
Maximum brake disc warpage		0.2 mm (.01 in)

TIRES		
Pressure	Front	Maximum: 124 kPa (18 PSI) Minimum: 97 kPa (14 PSI)
	Rear	Maximum: 179 kPa (26 PSI) Minimum: 97 kPa (14 PSI)
Minimum tire thread depth		3 mm (0.11 in)
Size	Front	27 x 9 x 14 (in)
	Rear	27 x 11 x 14 (in)

WHEELS		
Type		Cast Aluminum
Size	Front	14 x 7 (in)
	Rear	14 x 8.5 (in)
Wheel nuts torque		100 N•m ± 10 N•m (74 lbf•ft ± 7 lbf•ft)

CHASSIS	
Cage type	50 mm (2 in) diameter, high strength steel, ROPS-approved cage

DIMENSION		
Overall length	DPS	377.3 cm (148.5 in)
	XT	380.2 cm (149.7 in)
	LTD	
Overall width	DPS	148.9 cm (58.6 in)
	XT	158.7 cm (62.5 in)
	LTD	

DIMENSION			
Overall height			193 cm (76 in)
Wheel base			269.4 cm (106.1 in)
Wheel track	Front	DPS XT	125.7 cm (49.5 in)
		LTD	127.6 cm (50.2 in)
	Rear		121.9 cm (48 in)
Ground clearance		DPS XT	27.9 cm (11 in)
		LTD	25.4 cm (10 in)
WEIGHT AND LOADING CAPACITY			
Dry weight			708 kg (1,561 lb)
Weight distribution		Front/rear	45/55
Cargo box capacity	Total		272 kg (600 lb)
	Upper		181 kg (400 lb)
	Lower		272 kg (600 lb)
Total vehicle load allowed (including driver, passenger, all other loads and added accessories)	DPS XT		526 kg (1,160 lb)
	LTD		503 kg (1,109 lb)
Gross vehicle weight rating	DPS		1 295 kg (2,855 lb)
	XT		1 314 kg (2,897 lb)
	LTD		1 328 kg (2,928 lb)
Towing capacity			680 kg (1,500 lb)
Hitch support			50.8 mm (2 in) x 50.8 mm (2 in)

PERIODIC MAINTENANCE PROCEDURES

SERVICE PRODUCTS

Description	Part Number	Page
PROPELLER SHAFT GREASE	293 550 063	3
XPS 4-STROKE SYNTH. BLEND OIL (SUMMER)	293 600 121	2
XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE)	293 600 112	2
XPS BRAKES AND PARTS CLEANER (CAN)	219 701 776	3
XPS BRAKES AND PARTS CLEANER (USA)	219 701 705	3
XPS SYNTHETIC GEAR OIL (75W 140)	293 600 140	3

GENERAL

This subsection provides:

- Fluid level verifications
- Maintenance procedures.

The following systems should be serviced according to the *PERIODIC MAINTENANCE SCHEDULE*.

PROCEDURES

ENGINE (LUBRICATION SYSTEM)

Engine Oil Change

Place vehicle on a level surface.

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

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

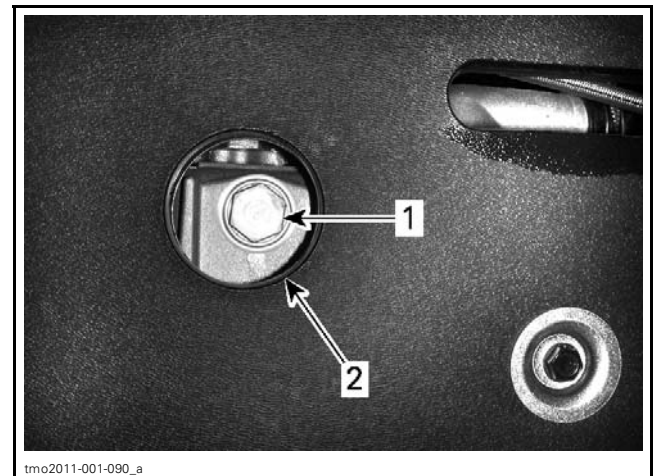
Ensure vehicle is on a level surface.

Remove dipstick.

Place a drain pan under the engine drain plug area.

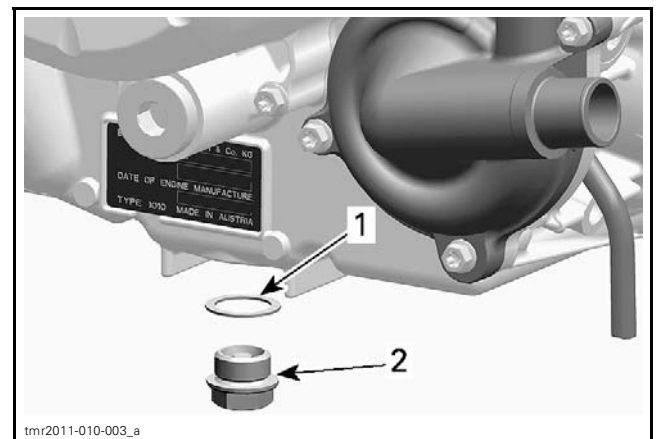
Clean the drain plug area.

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.

Subsection 03 (PERIODIC MAINTENANCE PROCEDURES)

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

Install and tighten drain plug to the specified 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 REPLACEMENT* in this subsection.

Refill engine with recommended engine oil.

ENGINE OIL CAPACITY	
2 L (2.11 qt (U.S. liq.))	

RECOMMENDED ENGINE OIL	
SEASON	TYPE
Summer	XPS 4-STROKE SYNTH. BLEND OIL (SUMMER) (P/N 293 600 121)
Winter	XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112)

If recommended XPS oil is not available, use a 4-stroke SAE 5W40 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.

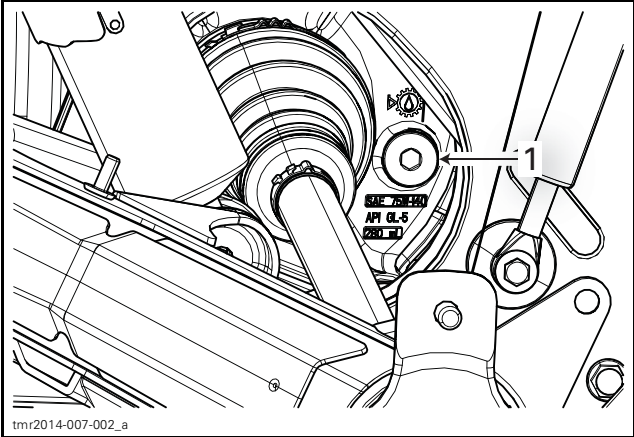
DRIVE SYSTEM

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

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

Reinstall filler plug.

FILLER PLUG	
Tightening torque	16.5 N•m ± 2.5 N•m (146 lbf•in ± 22 lbf•in)

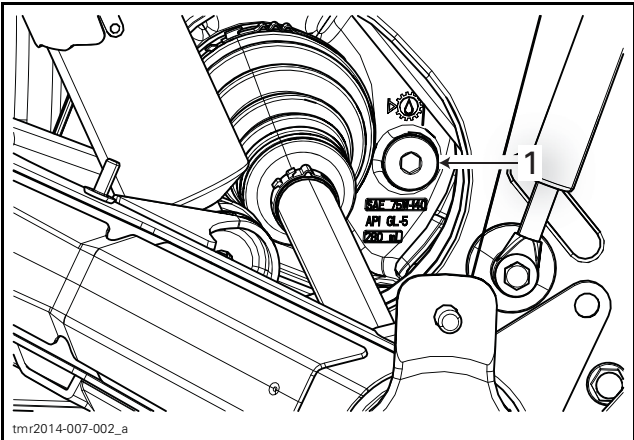
Rear Final Drive Oil Replacement

Ensure vehicle is on a level surface.

Clean filler and drain plug areas.

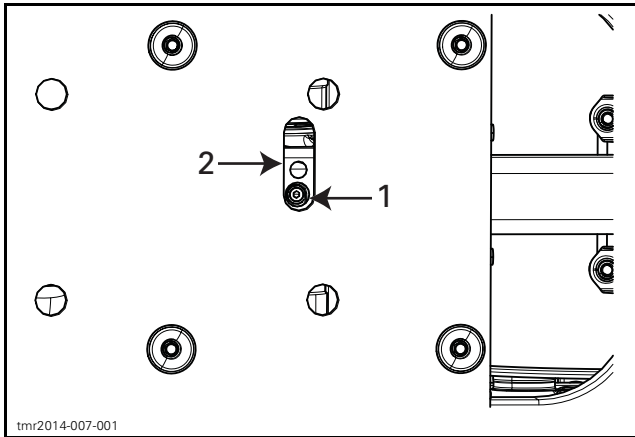
Place a drain pan under rear final drive.

Unscrew filler plug.



LH REAR SIDE OF VEHICLE
1. Filler plug

Remove drain plug.



VIEW FROM UNDER VEHICLE

1. Drain plug
2. Skid plate

Install drain plug.

DRAIN PLUG	
Tightening torque	2.5 N•m ± 0.5 N•m (22 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	280 ml (9.5 U.S. oz)

Reinstall filler plug.

FILLER PLUG	
Tightening torque	16.5 N•m ± 2.5 N•m (146 lbf•in ± 22 lbf•in)

Propeller Shaft U-Joint Lubrication

PROPELLER SHAFT U-JOINT LUBRICATION
PROPELLER SHAFT GREASE (P/N 293 550 063)

CHASSIS (BRAKES)

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 Caliper

1. Remove calipers then check the following components:
 - Check brake pad pins
 - Check caliper boots 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 BRAKES AND PARTS CLEANER (CAN) (P/N 219 701 776) or XPS BRAKES AND PARTS CLEANER (USA) (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 using an appropriate *BRAKE CALIPER SYNTHETIC GREASE*.

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.

MAINTENANCE SCHEDULE	
1	→ 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 they must buckle properly)
	Replace the engine oil and filter

tmr2011-004-001_a

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.

SPECIAL PROCEDURES

SERVICE PRODUCTS

Description	Part Number	Page
XPS LUBE.....	293 600 016	38

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.

WARNING

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, multifunction gauge and DPS connectors, and open fuse boxes. Check for presence of water. Dry as necessary.

Inspect all lights for water intrusion. Dry as required.

Replace the engine oil (without starting the engine).

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

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).

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.

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.

Replace the ACS air filter.

Section 01 MAINTENANCE

Subsection 06 (SPECIAL PROCEDURES)

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.

LUBRICATION SYSTEM

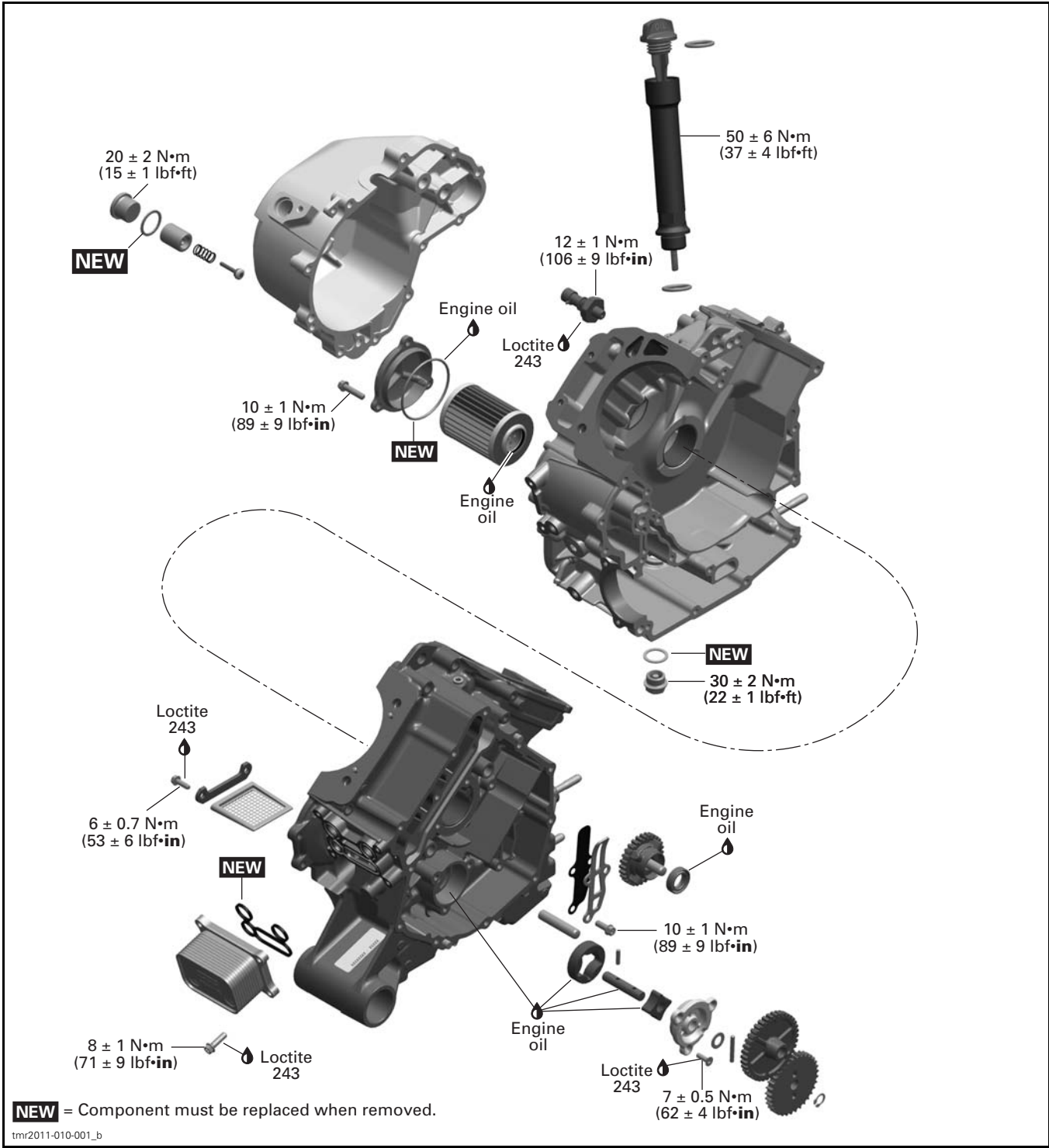
SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE	529 035 652	54
DISCONNECT TOOL	529 035 714	54
PRESSURE GAUGE.....	529 035 709	54

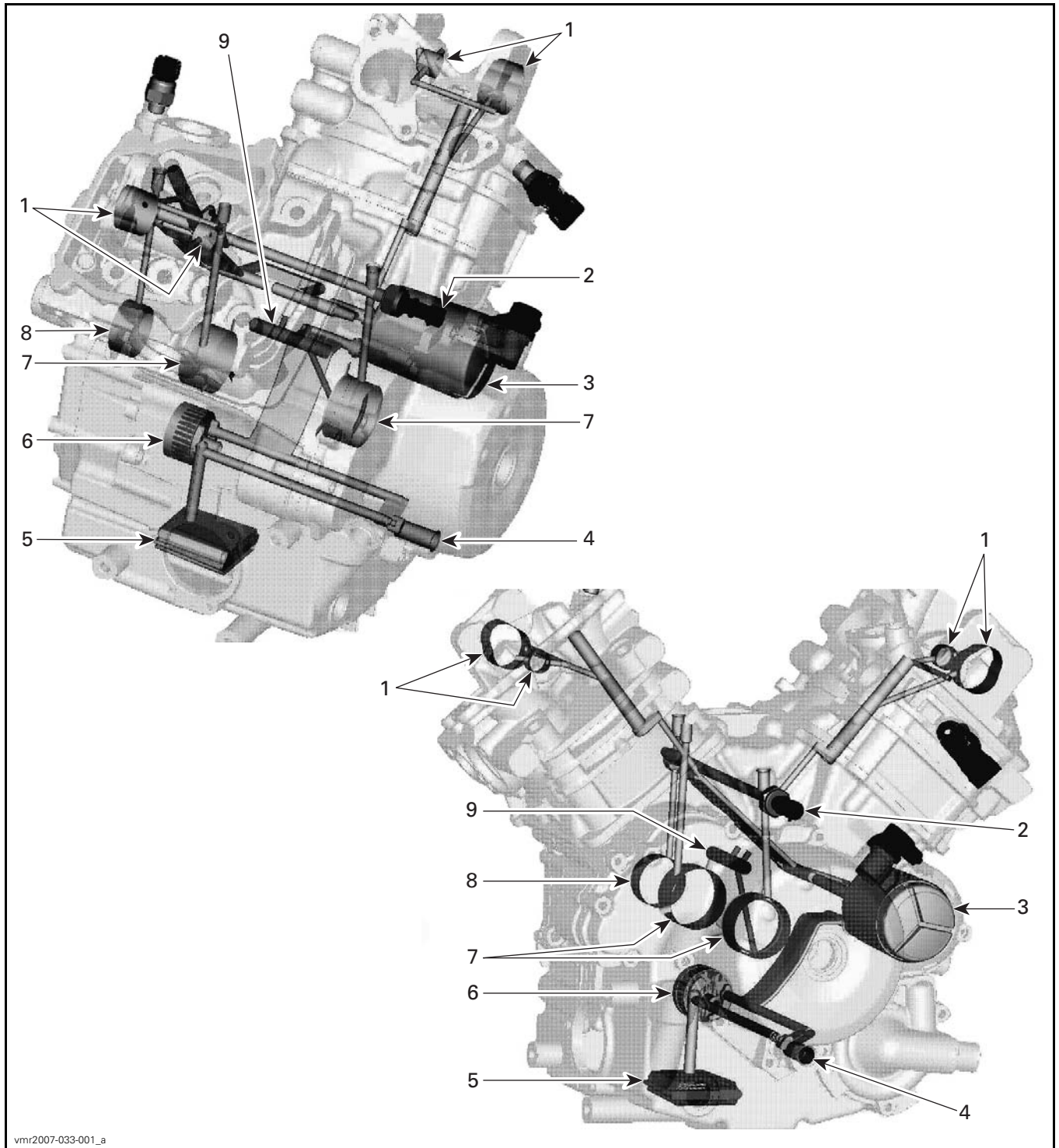
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	56, 60

COMPONENTS



ENGINE LUBRICATION CIRCUIT



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

Section 02 ENGINE, CVT AND GEARBOX

Subsection 04 (LUBRICATION SYSTEM)

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.

Use the pressure gauge with the proper adapter hose.

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

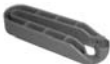
The engine oil pressure should be within the following values.

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 *TROUBLESHOOTING* in this subsection.

Remove oil pressure gauge and adapter hose.

NOTE: To remove adapter hose from oil pressure gauge, use the disconnect tool.

REQUIRED TOOL	
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 *TROUBLESHOOTING* subsection.
 - Check for engine oil leaks. For leak indicator hole, refer to *COOLING SYSTEM INSPECTION* in the *PERIODIC MAINTENANCE PROCEDURES* 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.

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 INSPECTION* in the *PERIODIC MAINTENANCE PROCEDURES* 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 Access

Refer to *BODY* and remove:

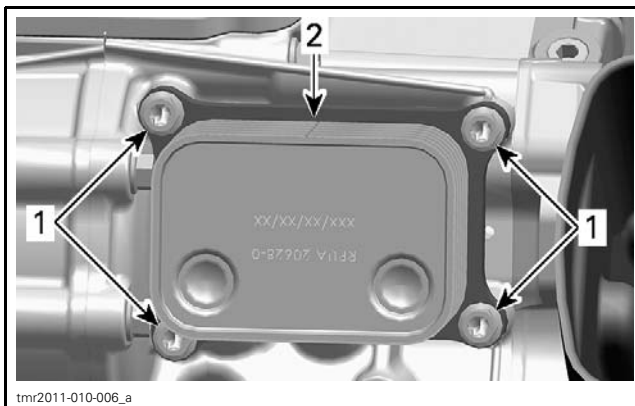
- Upper console
- Lower console
- RH lateral console panel
- RH inner panel
- Fuel tank cowl.

Oil Cooler Removal

Refer to the *PERIODIC MAINTENANCE PROCEDURES* subsection to:

- Drain engine oil.
- Drain engine coolant.

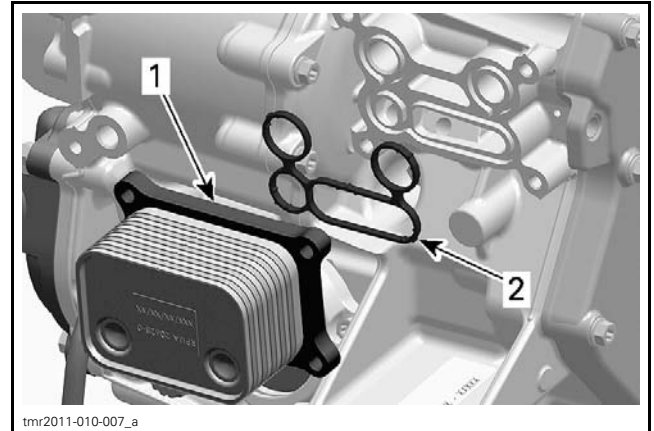
Remove oil cooler retaining screws.



1. Retaining screws
2. Oil cooler

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.

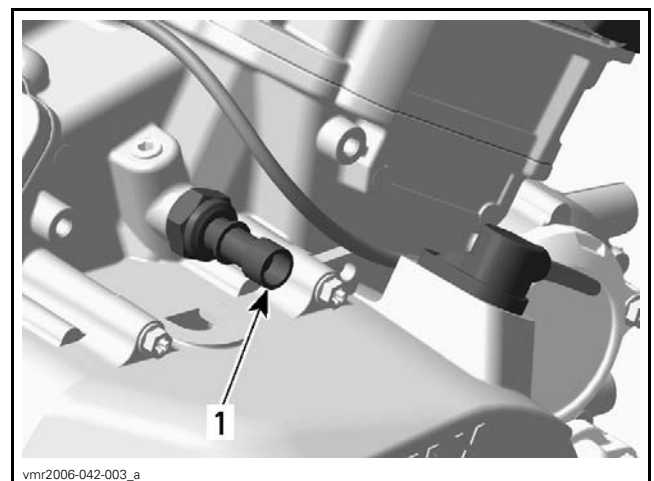
Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection and carry out the following:

- Refill engine oil with recommended oil and at the proper oil level.
- Refill and bleed cooling system.

OIL PRESSURE SWITCH (OPS)

Oil Pressure Switch Location

The oil pressure switch is located at engine MAG side above the magneto cover.



1. Oil pressure switch

Section 02 ENGINE, CVT AND GEARBOX

Subsection 04 (LUBRICATION SYSTEM)

Oil Pressure Switch Access

Refer to *BODY* and remove:

- Upper console
- Lower console
- RH lateral console panel
- RH inner panel
- Fuel tank cowl.

Oil Pressure Switch Activation

The oil pressure switch activates when the engine oil pressure is lower than the operating pressure.

OIL PRESSURE SWITCH OPERATING PRESSURE
30 kPa ± 10 kPa (4.35 PSI ± 1.45 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.

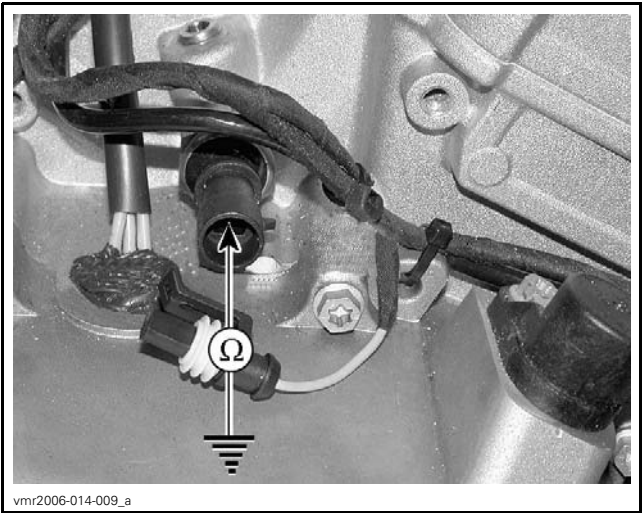
If the engine oil pressure is good perform the oil pressure switch resistance test.

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 30 kPa ± 10 kPa (4.35 PSI ± 1.45 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

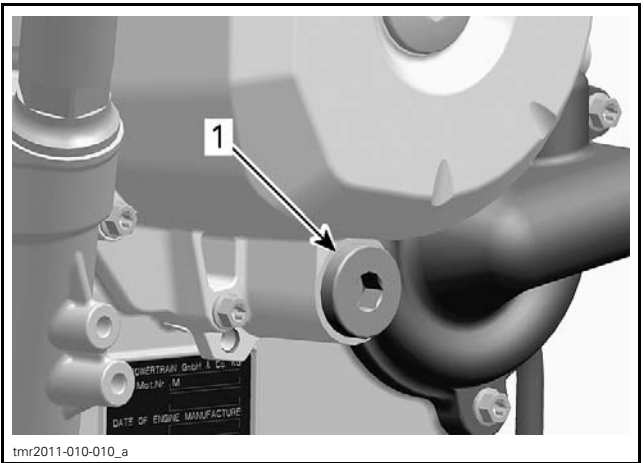
Tighten oil pressure switch to specified torque.

OIL PRESSURE SWITCH	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	12 N•m ± 1 N•m (106 lbf•in ± 9 lbf•in)

ENGINE OIL PRESSURE REGULATOR

Oil Pressure Regulator Location

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



1. Engine oil pressure regulator

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

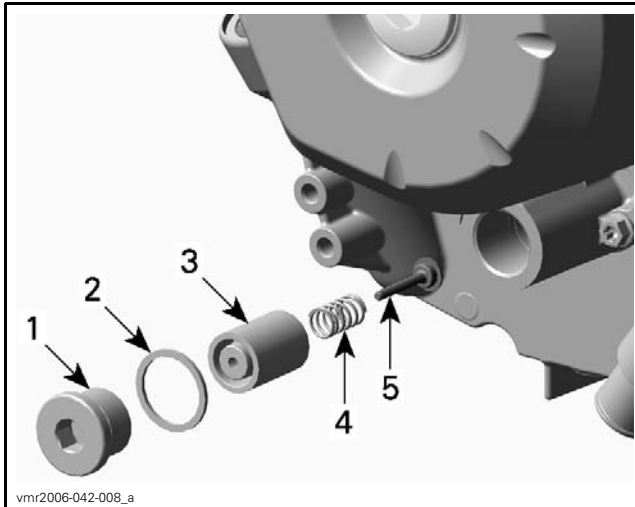
Oil Pressure Regulator Access

Refer to *BODY* and remove:

- Upper console
- Lower console
- RH lateral console panel
- RH inner panel
- Fuel tank cowl.

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

NOTE: Replace worn or damaged components.

Clean bore and thread in the magneto housing from metal shavings and other contaminations.

Oil Pressure Regulator Installation

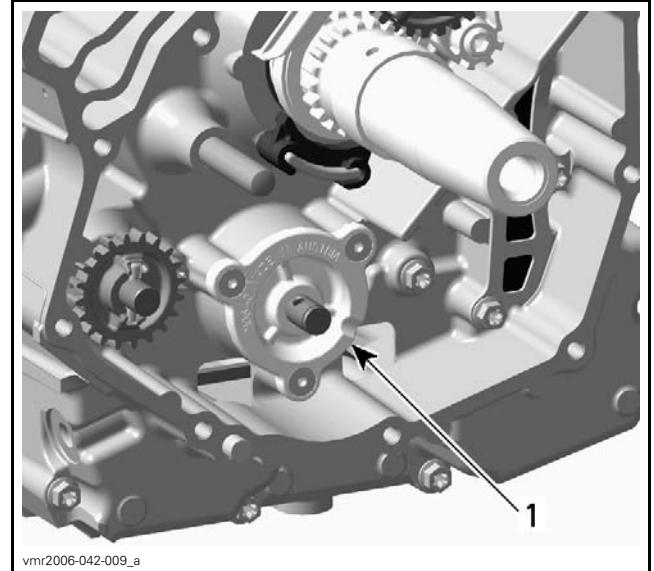
For installation, reverse the removal procedure. Pay attention to the following details.

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

OIL PUMP

Oil Pump Location

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

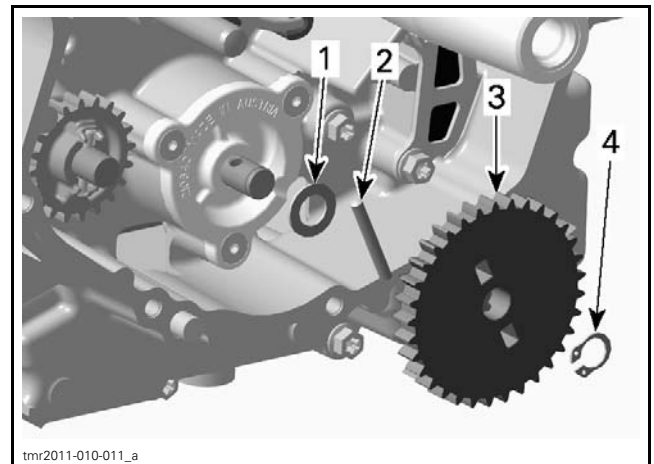


1. Oil pump

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.

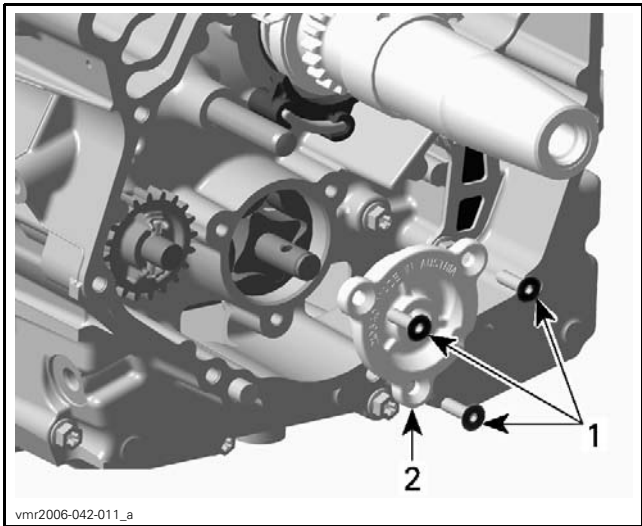


1. Thrust washer
2. Needle pin
3. Oil pump gear
4. Retaining ring

2. Remove oil pump cover screws and pull oil pump cover out.

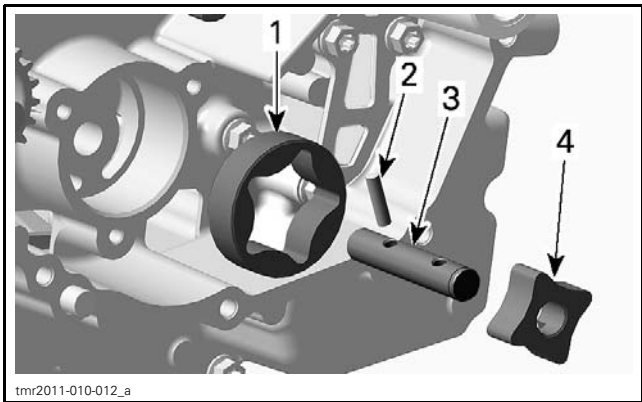
Section 02 ENGINE, CVT AND GEARBOX

Subsection 04 (LUBRICATION SYSTEM)



- 1. Retaining screws
- 2. Oil pump cover

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

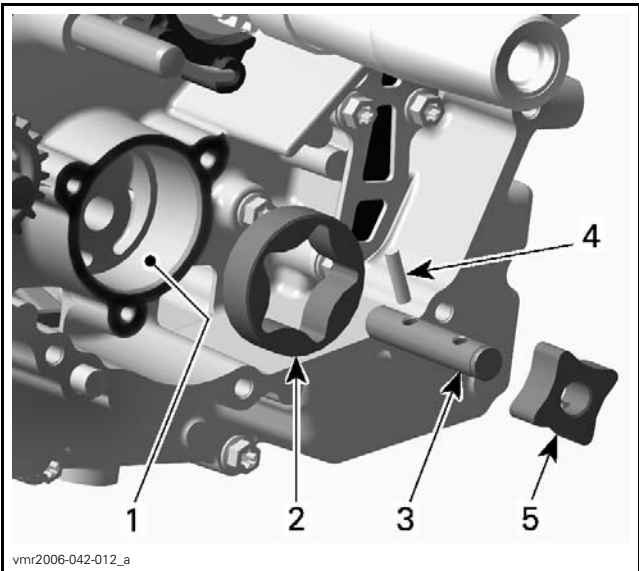


- 1. Outer rotor
- 2. Needle pin
- 3. Oil pump shaft
- 4. Inner rotor

Oil Pump Inspection

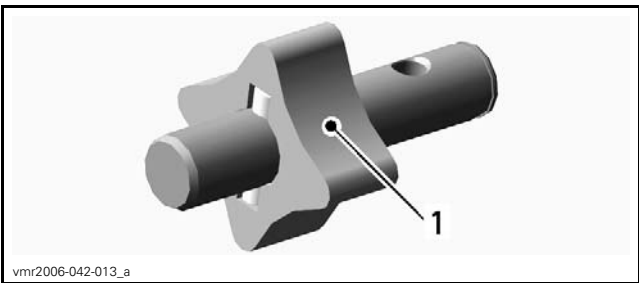
Inspect oil pump and oil pump cover bore for marks, scratches or other damages. Check for scratches in crankcase between outer rotor and oil pump bore. If so, replace damaged parts.

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



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

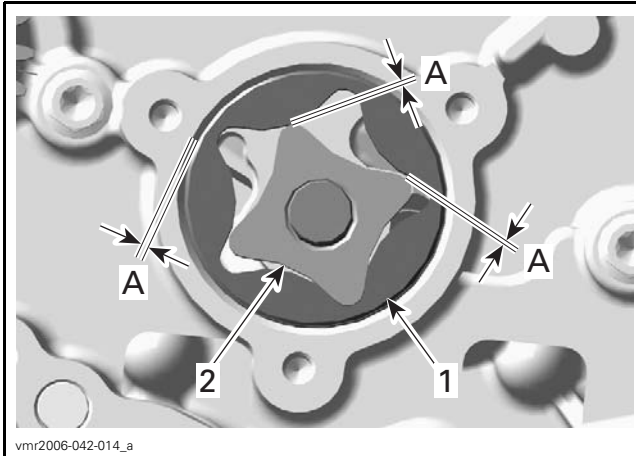
Check inner rotor for corrosion pin holes or other damages. If so, replace oil pump shaft assembly.



- 1. Pittings on the teeth

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

CLEARANCE OF INNER AND OUTER ROTOR	
SERVICE LIMIT	0.25 mm (.0098 in)

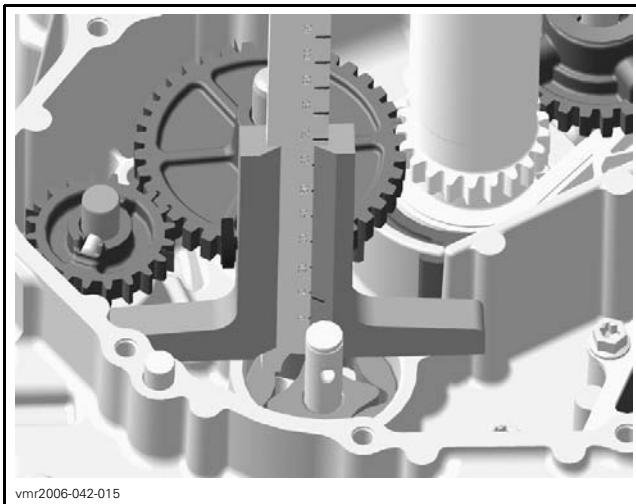


- 1. Outer rotor
- 2. Inner rotor
- A. 0.25 mm (.0098 in)

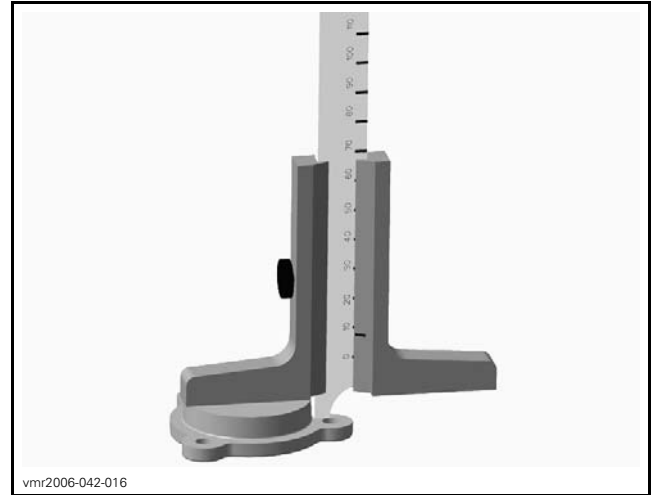
If clearance of inner and outer rotors exceeds the tolerance, replace oil pump rotors. Ensure to also check oil pump cover. If damaged, replace the complete oil pump assembly.

If clearance between outer rotor and its bore in crankcase exceeds the tolerance, replace the complete oil pump rotors 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"

Subtract measurement "B" from measurement "A" to obtain axial clearance.

OIL PUMP AXIAL CLEARANCE	
SERVICE LIMIT	0.2 mm (.0079 in)

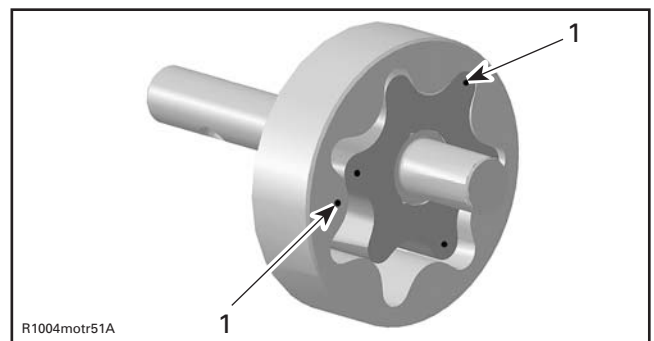
NOTE: When the axial clearance of the oil pump shaft assembly increases, the oil pressure decreases.

Oil Pump Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

NOTE: When installing the oil pump rotors, 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 subsection).

Section 02 ENGINE, CVT AND GEARBOX

Subsection 04 (LUBRICATION SYSTEM)

ENGINE OIL STRAINER

Oil Strainer Location

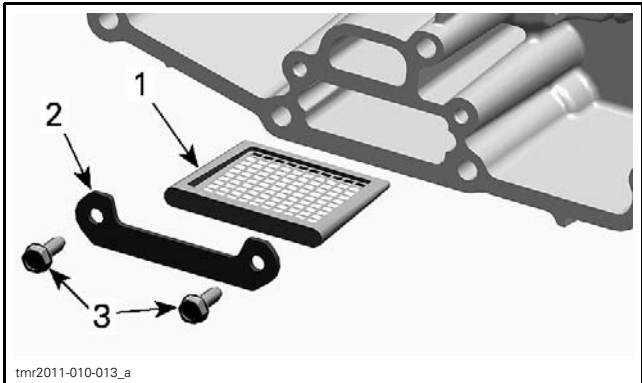
The engine oil strainer is located between both crankcase halves.

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

Oil Strainer Cleaning and Inspection

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

⚠

WARNING

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

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

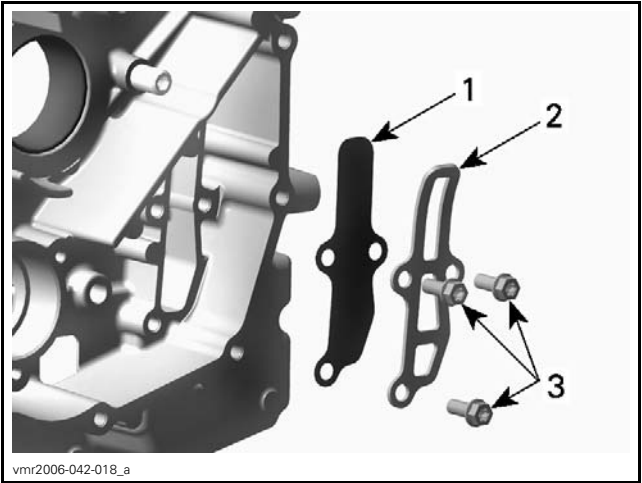
Oil Strainer Installation

The installation is the reverse of the removal procedure.

OIL STRAINER RETAINING SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	6 N•m ± 0.7 N•m (53 lbf•in ± 6 lbf•in)

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 *BOTTOM 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.

REED VALVE RETAINING SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

MAGNETO SYSTEM

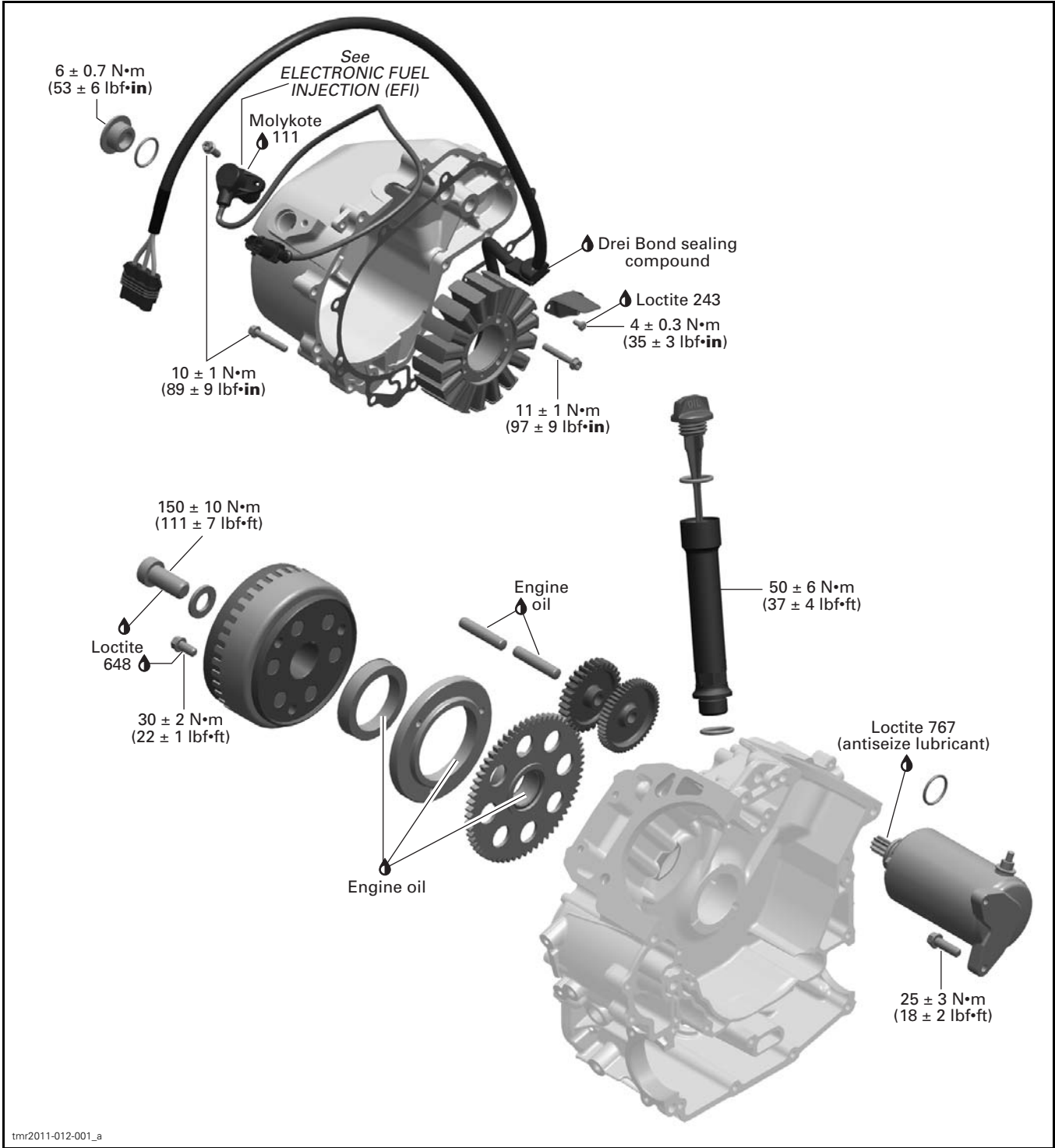
SERVICE TOOLS

Description	Part Number	Page
BACK PROBE TEST WIRES	529 036 063	87
CRANKSHAFT LOCKING BOLT	529 035 617	88
CRANKSHAFT PROTECTOR	529 036 034	88
FLUKE 115 MULTIMETER	529 035 868	86–87
MAGNETO PULLER	529 035 748	88

SERVICE PRODUCTS

Description	Part Number	Page
DREI BOND SEALING COMPOUND	420 297 906	85
LOCTITE 243 (BLUE)	293 800 060	88
LOCTITE 648 (GREEN)	413 711 400	89–90
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	91
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	85
PULLEY FLANGE CLEANER	413 711 809	89

Section 02 ENGINE, CVT AND GEARBOX
Subsection 06 (MAGNETO SYSTEM)



PROCEDURES

MAGNETO COVER

Magneto Cover Access

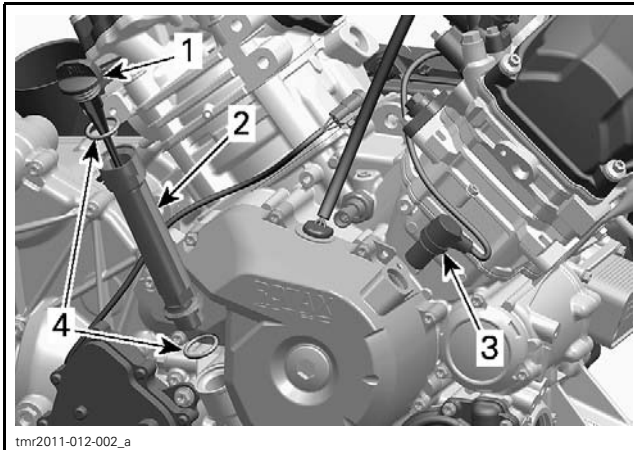
Remove fuel tank, refer to *FUEL TANK AND FUEL PUMP*.

Magneto Cover Removal

Drain engine oil (refer to *PERIODIC MAINTENANCE PROCEDURES* subsection).

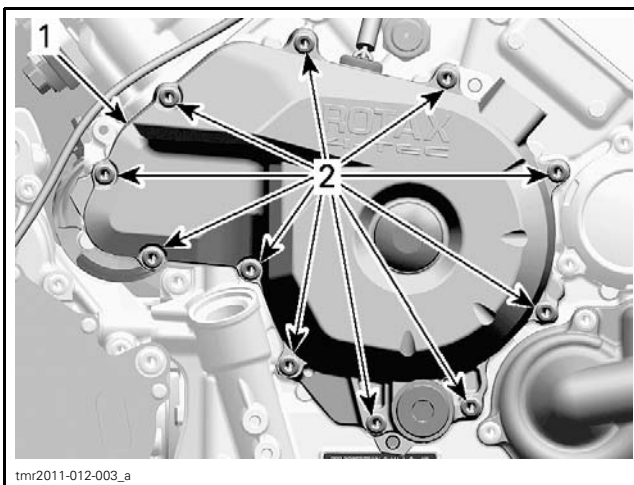
Remove crankshaft position sensor (CPS) and cut tie raps.

Remove dipstick and oil level tube with O-rings.



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.

NOTE: If required, remove stator and harness from magneto cover.

Magneto Cover Inspection and Cleaning

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

NOTE: Clean all metal components in a non-ferrous metal cleaner. Use LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500), or suitable equivalent.

WARNING

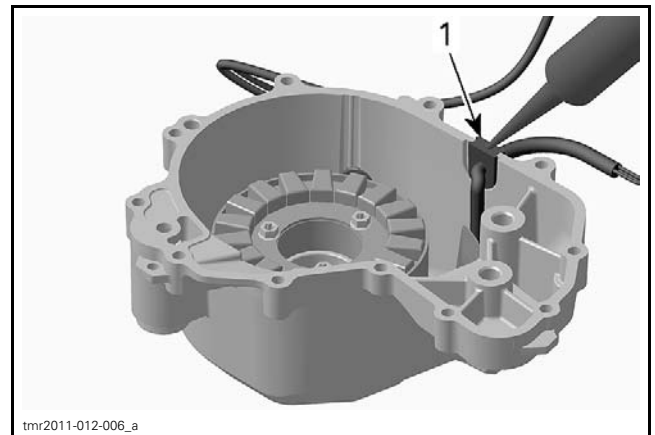
Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

Magneto Cover Installation

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

NOTE: Install a **NEW** magneto cover gasket.

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

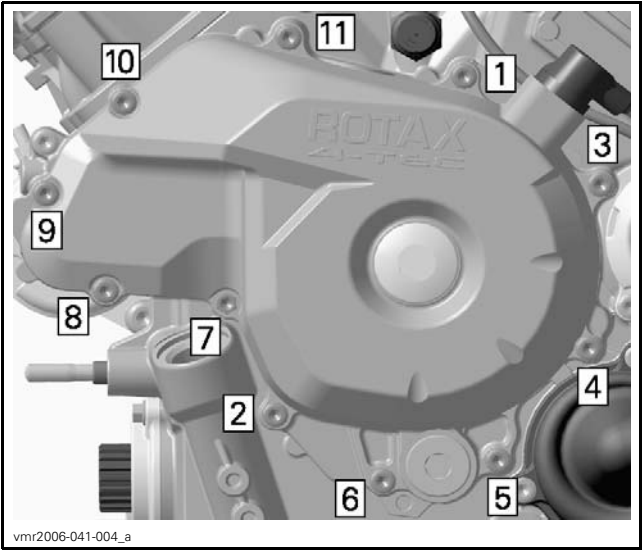


1. Stator cable grommet (apply Drei Bond sealing compound)

Tighten screws using the following sequence.

Section02 ENGINE, CVT AND GEARBOX

Subsection 06 (MAGNETO SYSTEM)



TIGHTENING SEQUENCE

MAGNETO COVER SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Refill engine with recommended oil.

STATOR

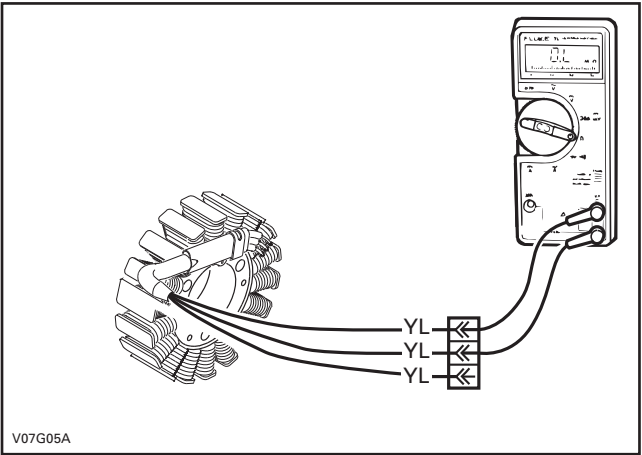
Stator Connector Access

NOTE: The stator is directly connected to the voltage regulator/rectifier.

Stator Static Test: Continuity

1. Disconnect the stator connector from the voltage regulator/rectifier.
2. Check resistance between YELLOW wires.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	
TERMINAL	RESISTANCE @ 20°C (68°F)
1 and 2	0.15 - 0.30 Ω
1 and 3	
2 and 3	



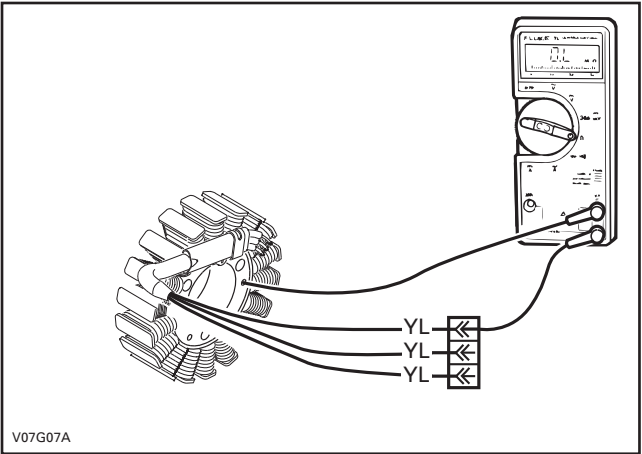
TYPICAL

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

Stator Static Test: Insulation

1. Disconnect the stator connector from the voltage regulator/rectifier.
2. Connect multimeter between any YELLOW wire (on stator connector) and engine ground.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	
TEST PROBES	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and engine ground	Infinite (open circuit)



TYPICAL

3. 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.
4. Re-plug connectors properly.

Stator Dynamic Test: AC Voltage Output

1. Disconnect stator connector at voltage regulator/rectifier.
2. Start engine.
3. Check AC voltage output as follow:

REQUIRED TOOL	
BACK PROBE TEST WIRES (P/N 529 036 063)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

4. Read voltage as per following table.

TEST ENGINE SPEED	TERMINAL	VOLTAGE
4000 RPM	1 and 2	15 Vac MINIMUM
	1 and 3	
	2 and 3	

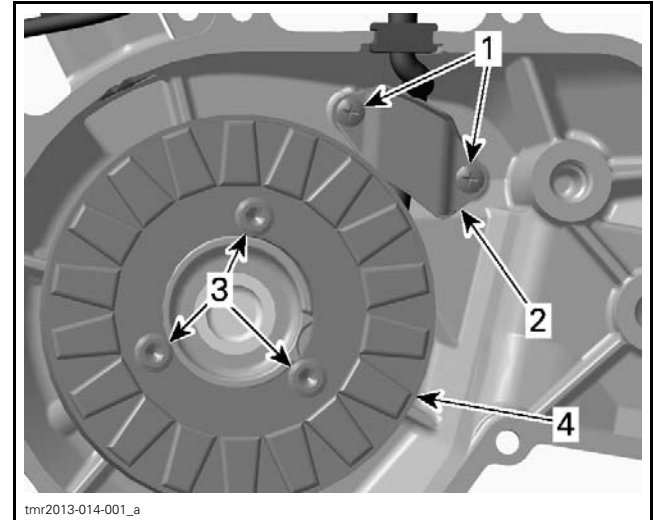
5. If voltage is lower than specification, replace stator.
6. Re-plug connectors properly.

Stator Removal

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

Remove screws securing the wire holding strip.

Remove stator retaining screws then the stator.



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

Stator Inspection

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

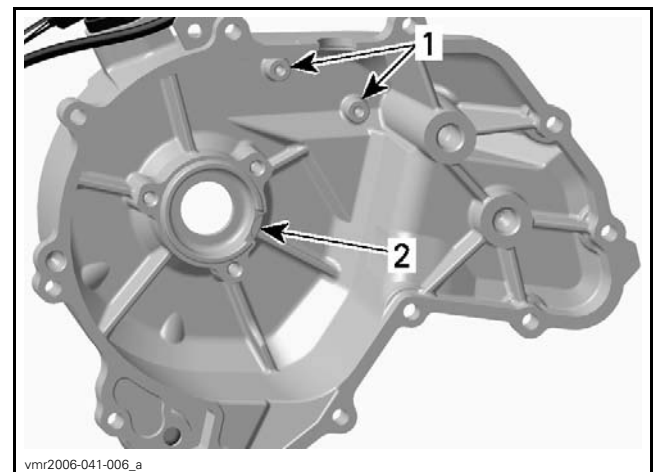
Check if stator wires are brittle, hard or otherwise damaged.

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).



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

Section 02 ENGINE, CVT AND GEARBOX
Subsection 06 (MAGNETO SYSTEM)

HOLDING STRIP SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	4 N•m ± 0.5 N•m (35 lbf•in ± 4 lbf•in)

STATOR RETAINING SCREWS	
Tightening torque	11 N•m ± 1 N•m (97 lbf•in ± 9 lbf•in)

ROTOR

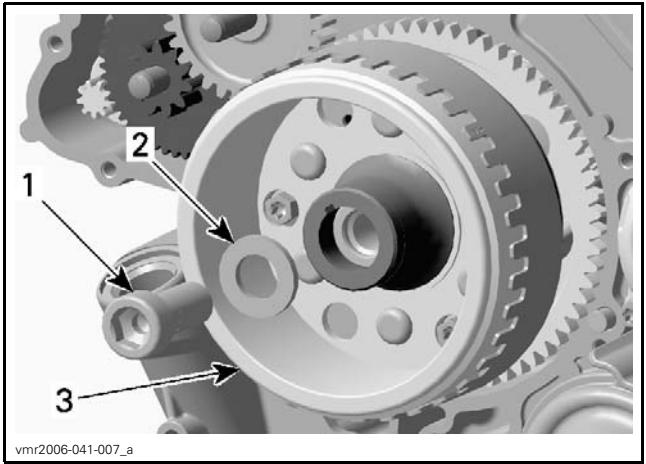
Rotor Removal

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

Lock crankshaft (refer to *CRANKSHAFT LOCKING PROCEDURE* in the *BOTTOM END* subsection).

REQUIRED TOOL	
CRANKSHAFT LOCKING BOLT (P/N 529 035 617)	

Heat screw in order to break the Loctite.
Remove screw and washer securing rotor to crankshaft.

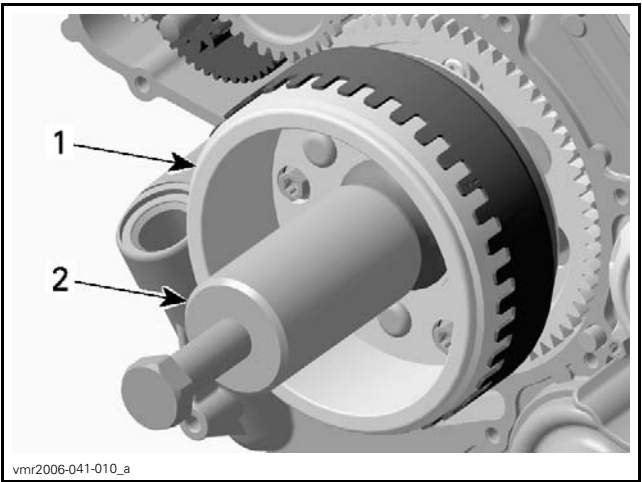


- 1. Screw M16
- 2. Washer
- 3. Rotor

Remove rotor.

REQUIRED TOOL	
MAGNETO PULLER (P/N 529 035 748)	
CRANKSHAFT PROTECTOR (P/N 529 036 034)	

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



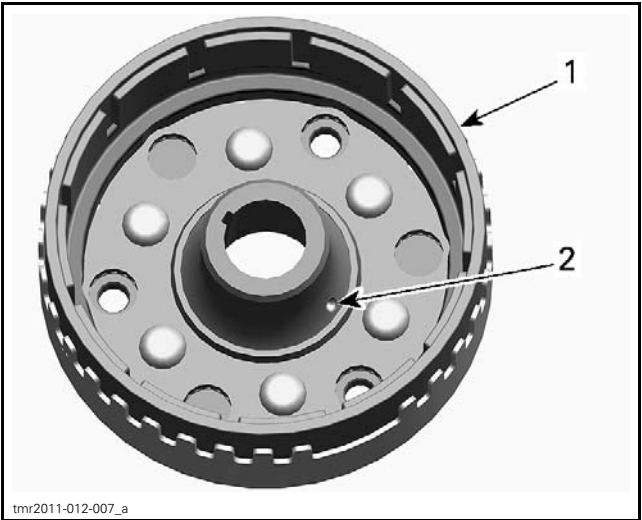
- 1. Rotor
- 2. Magneto puller

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.



- 1. Rotor
- 2. Oil bore

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.

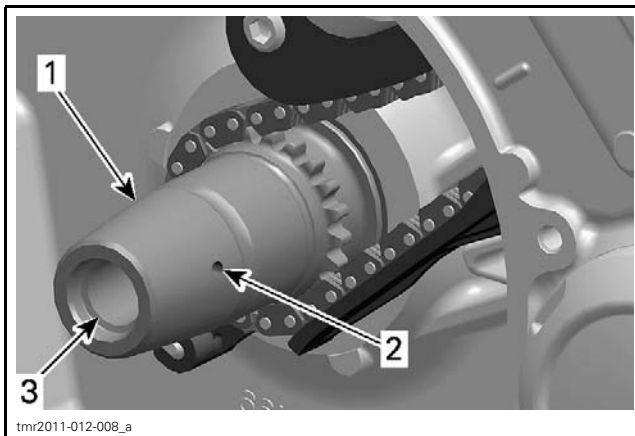
Rotor Installation

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

Use PULLEY FLANGE CLEANER (P/N 413 711 809) to clean following:

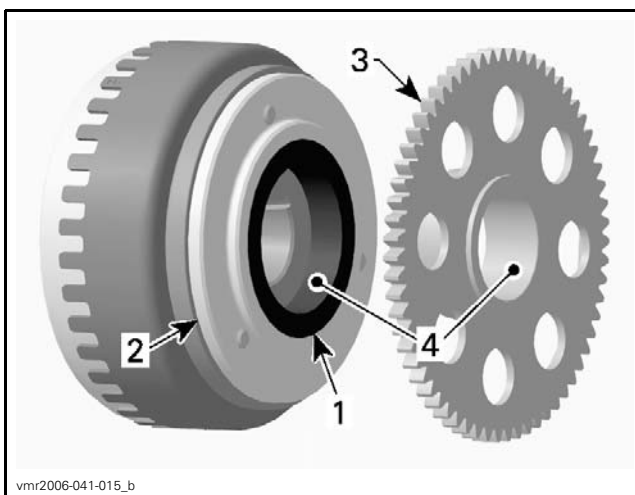
- Crankshaft taper
- Oil passage in crankshaft taper
- Thread in crankshaft
- Rotor taper
- Oil bore in rotor.

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



1. Crankshaft (MAG side)
2. Oil passage
3. Threads

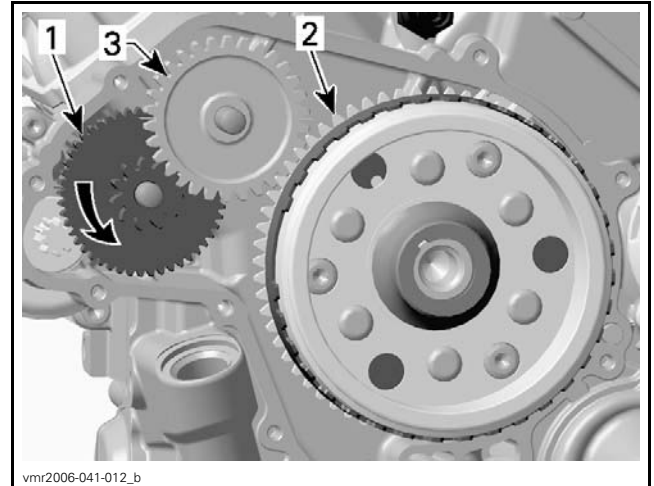
Oil sprag clutch and install sprag clutch gear.



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

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

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



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

ROTOR RETAINING SCREW

Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Tightening torque	150 N•m ± 10 N•m (111 lbf•ft ± 7 lbf•ft)

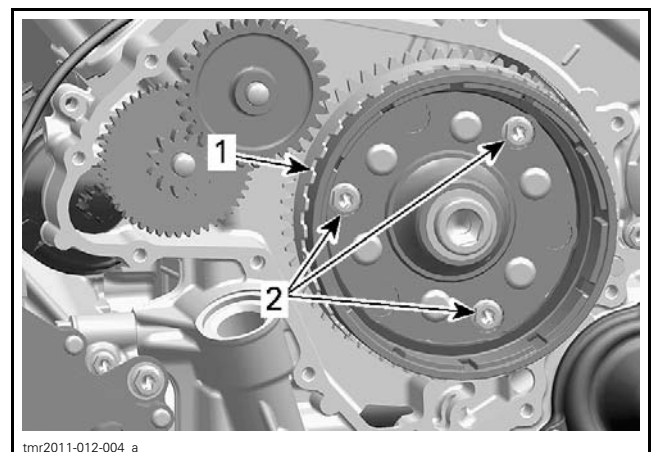
SPRAG CLUTCH

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.



1. Rotor
2. Sprag clutch housing screws

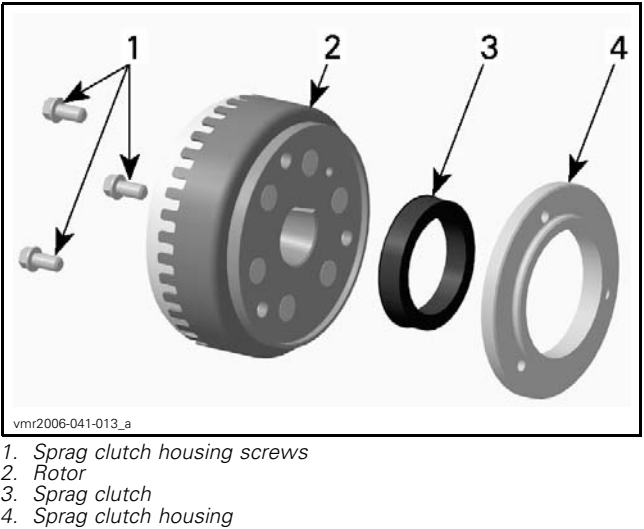
Remove rotor (refer to *ROTOR* in this subsection).

Section 02 ENGINE, CVT AND GEARBOX

Subsection 06 (MAGNETO SYSTEM)

Remove sprag clutch gear.

Remove sprag clutch housing screws and sprag clutch housing.



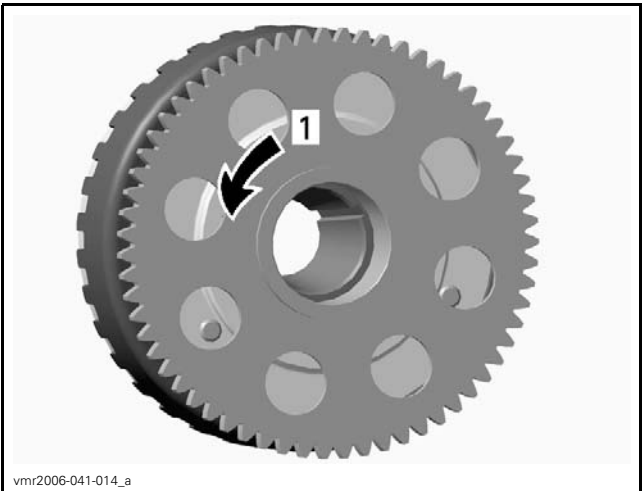
Sprag Clutch Inspection

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

Also check the collar of the sprag clutch gear.

Rotate sprag clutch gear in sprag clutch.

NOTE: Sprag clutch must lock in counterclockwise direction.



SPRAG CLUTCH FUNCTIONAL TEST

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

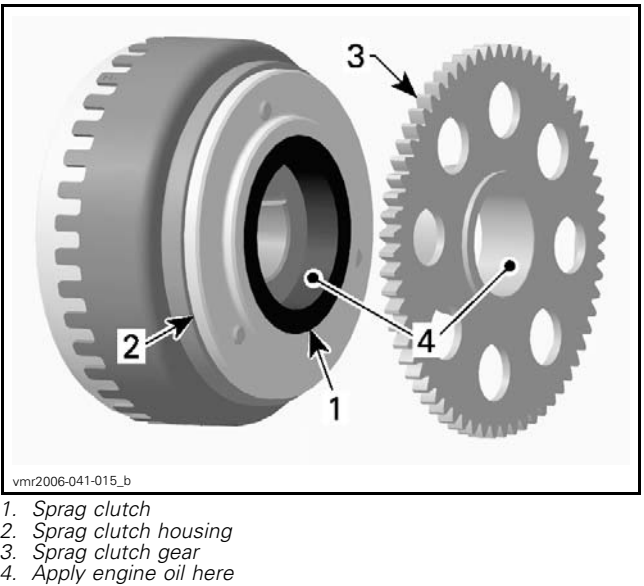
Sprag Clutch Installation

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 sprag clutch gear needle bearing.



Install rotor, refer to *ROTOR* in this subsection.

Tighten sprag clutch housing screws to specification.

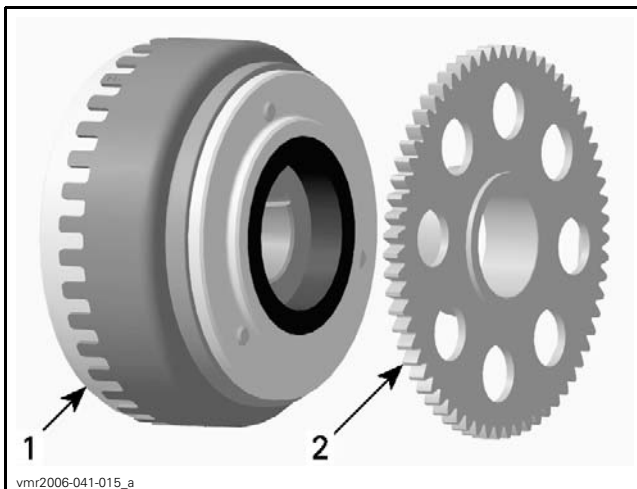
SPRAG CLUTCH HOUSING SCREWS	
Tightening torque	30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

SPRAG CLUTCH GEAR

Sprag Clutch Gear Removal

Remove *ROTOR*. See procedure in this subsection.

Pull sprag clutch gear out of the rotor.

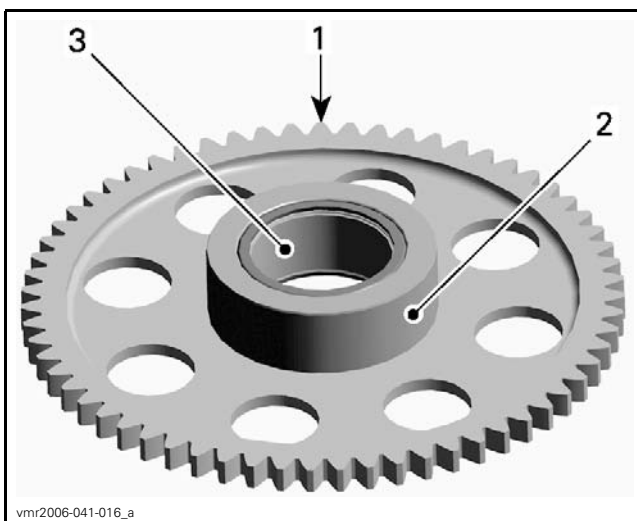


1. Rotor
2. Sprag clutch gear

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.



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

Sprag Clutch Gear Installation

The installation is the reverse of the removal procedure.

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

STARTER DRIVE GEARS

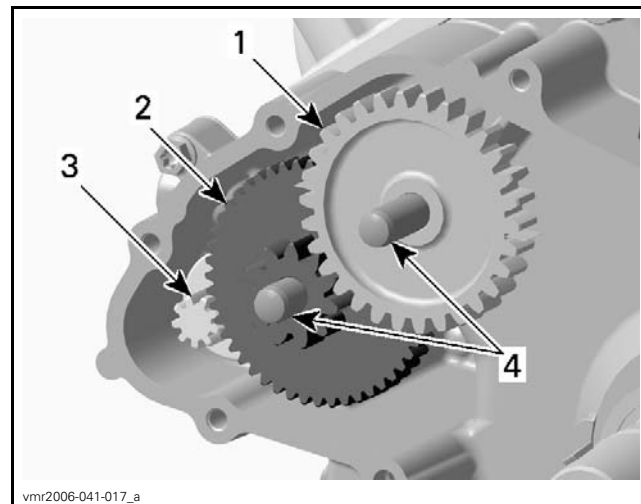
Starter Drive Gear Location

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

Starter Drive Gear Removal

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

Remove location pins, starter double gear and intermediate gear.



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

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.

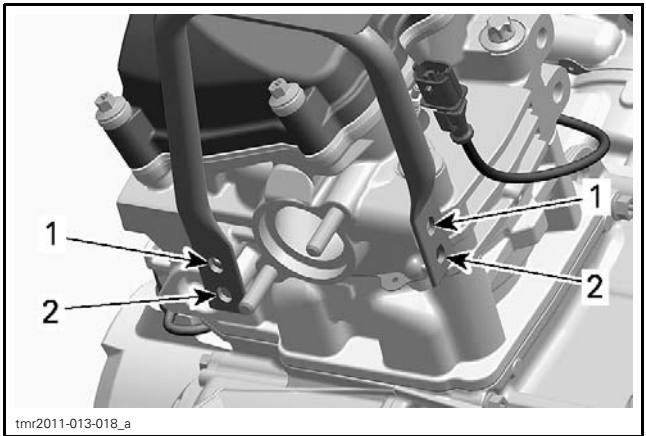


PROCEDURES

PLENUM BRACKET

Plenum Bracket Installation

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



1. Mounting holes for the 1000 engine
2. Mounting holes for the 800R engine

Tighten plenum bracket retaining screws to specification.

PLENUM BRACKET RETAINING SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

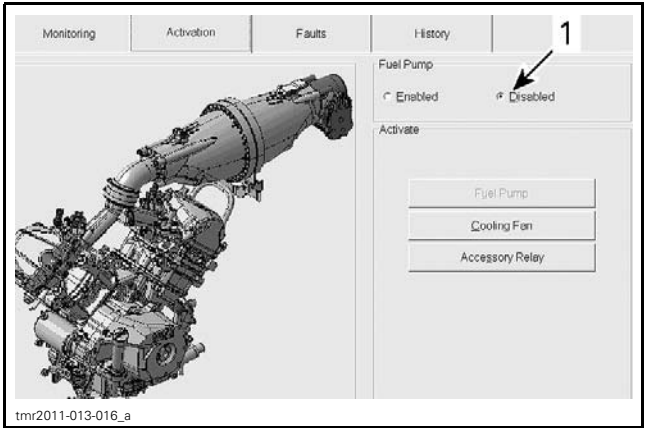
INTAKE MANIFOLD

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.

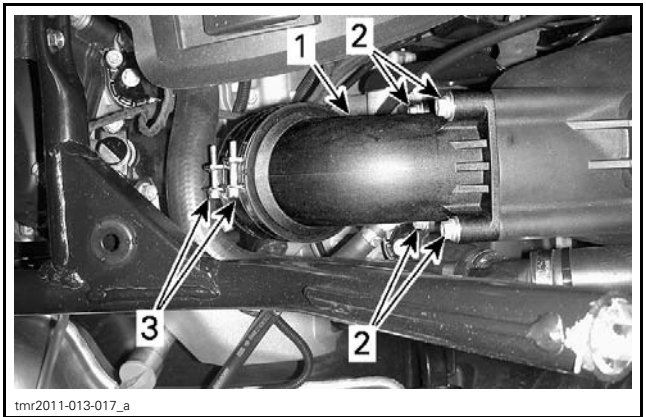


1. Click "Disabled"

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)*.

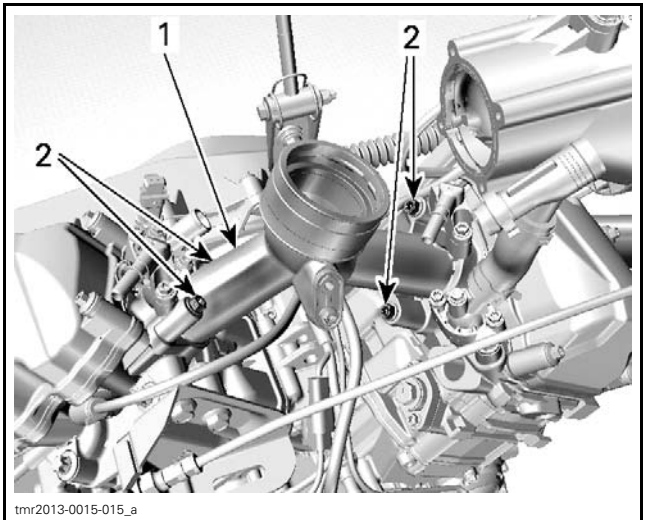
CAUTION The fuel hose may still be under pressure.

4. Disconnect fuel injectors electrical connectors.
5. Remove plenum adapter elbow.



1. Plenum adapter elbow
2. Remove retaining screws
3. Remove clamps

6. Remove intake manifold from engine.



SOME PARTS REMOVED FOR CLARITY
1. Intake manifold
2. Remove retaining screws (x4)

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)

Tighten elbow retaining screws to specification.

ELBOW RETAINING SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Tighten intake manifold clamps to specification.

INTAKE MANIFOLD CLAMPS	
Tightening torque	0.7 N•m ± 0.1 N•m (6 lbf•in ± 1 lbf•in)

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

TOP END

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT	529 035 617	117
ENGINE LEAK DOWN TEST KIT	529 035 661	103
PISTON CIRCLIP INSTALLER.....	529 035 921	121
PISTON CIRCLIP INSTALLER.....	529 036 153	121
PISTON RING COMPRESSOR	529 035 919	117
TDC DIAL INDICATOR	414 104 700	103
VALVE GUIDE INSTALLER	529 036 140	116
VALVE GUIDE REMOVER 5 MM	529 035 924	115
VALVE SPRING COMPRESSOR CUP	529 035 764	112
VALVE SPRING COMPRESSOR	529 035 724	112

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON PLIERS.....	YA 8230	113

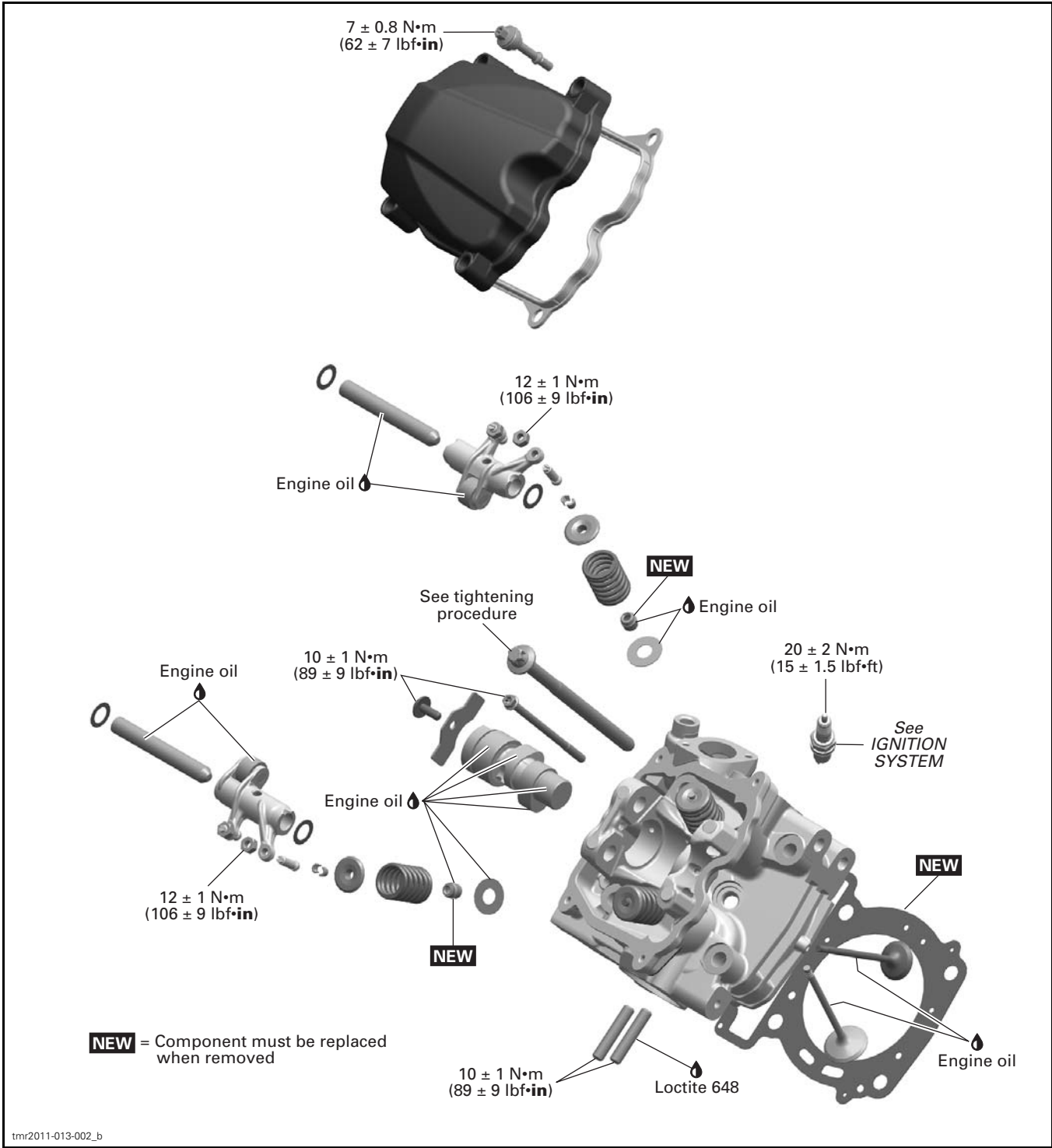
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	116

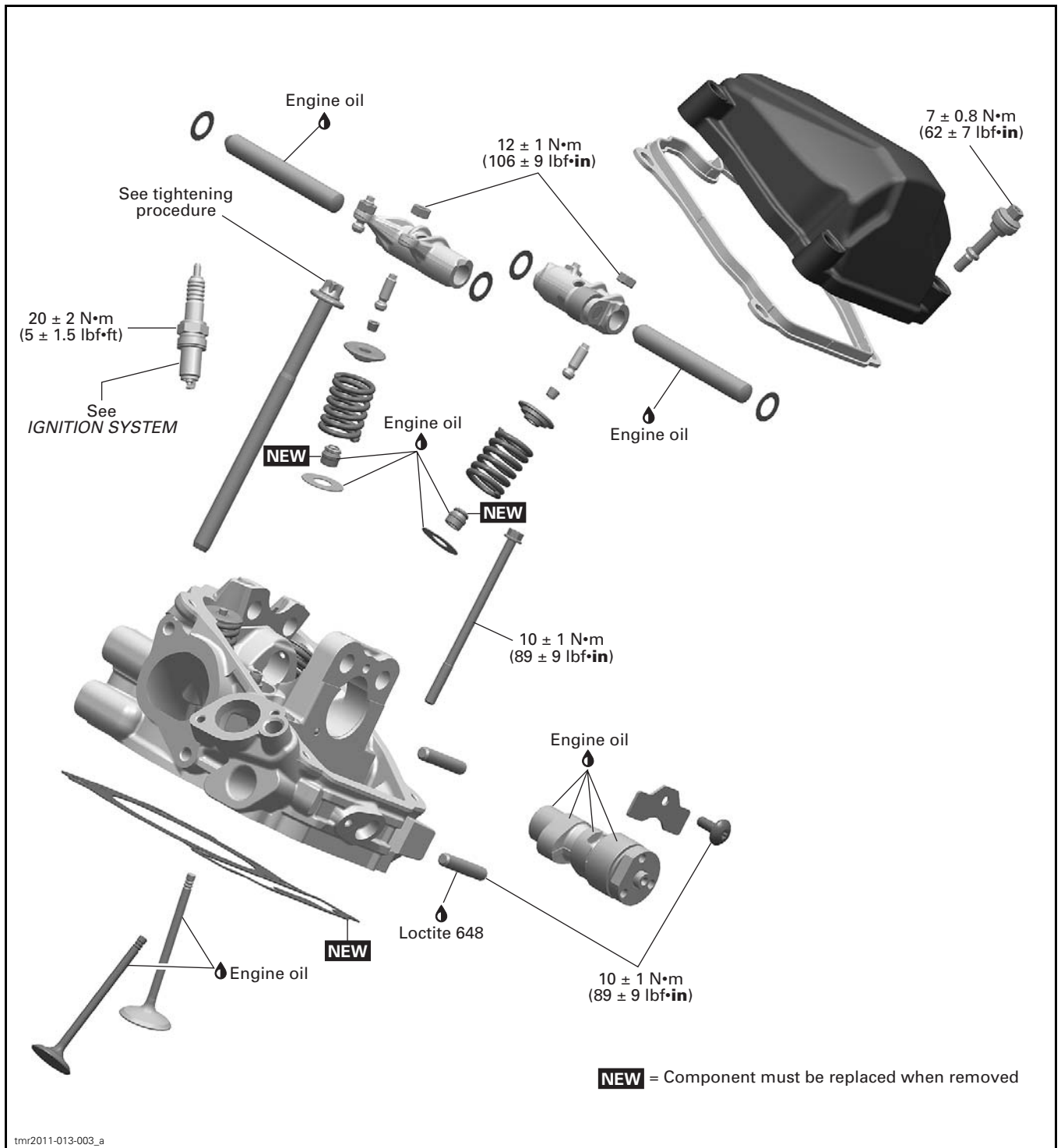
Section 02 ENGINE, CVT AND GEARBOX

Subsection 08 (TOP END)

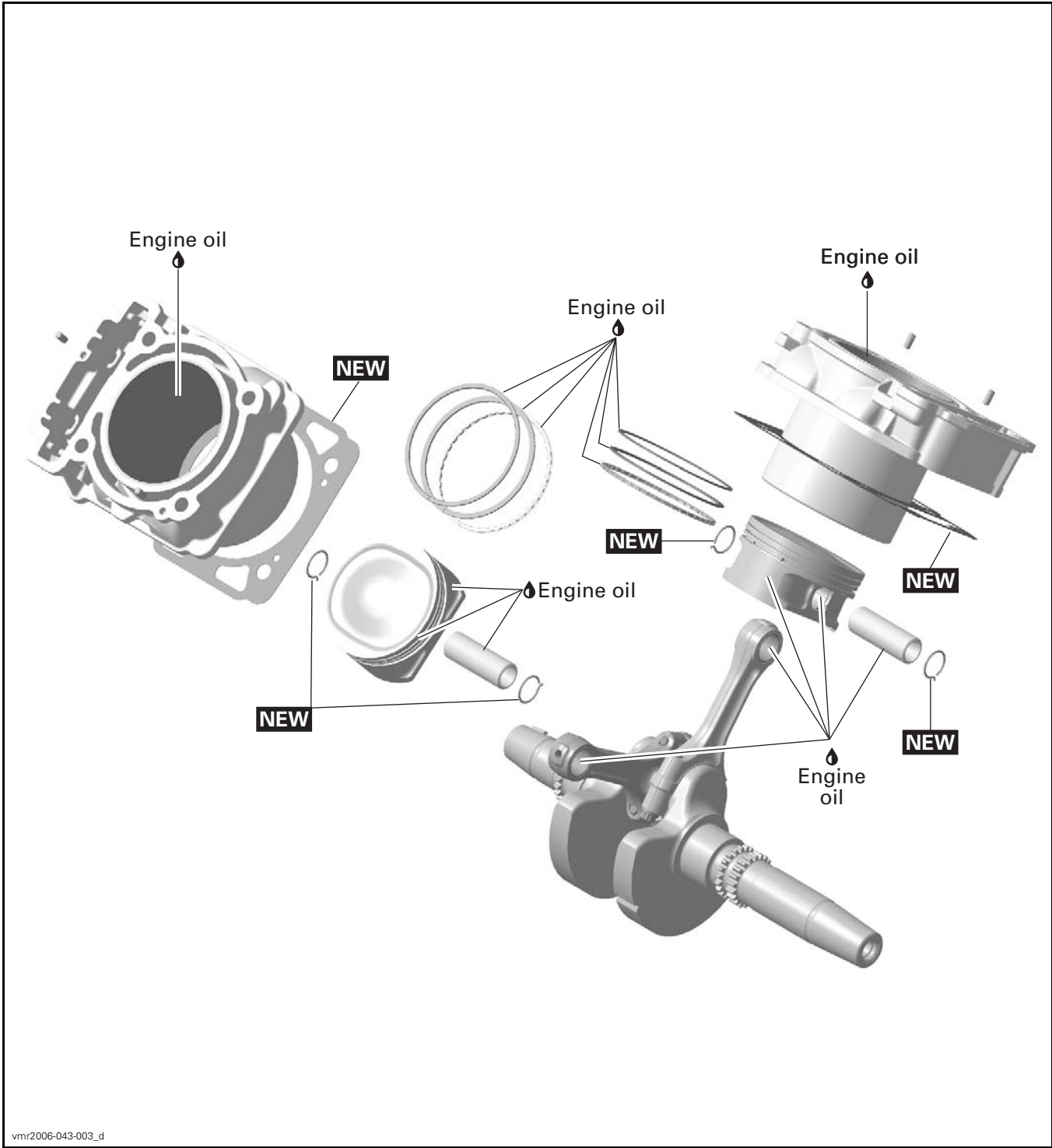
CYLINDER HEAD NO. 1



CYLINDER HEAD NO. 2

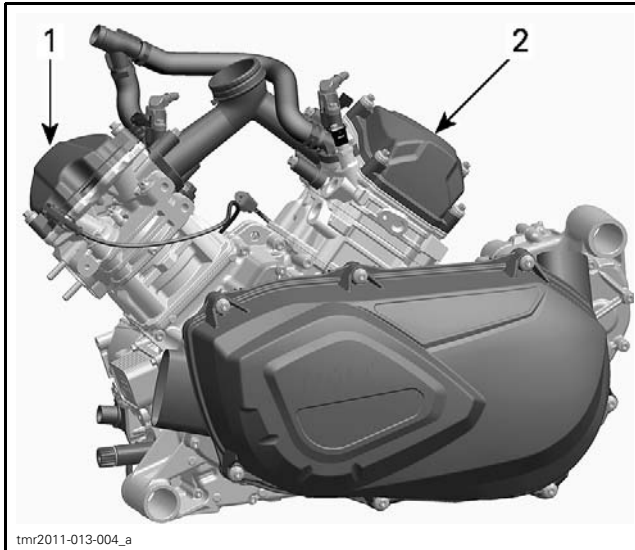


CYLINDERS AND PISTONS



GENERAL

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



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

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

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

IMPORTANT: Note position of parts on disassembly. This may help to find the root cause of a problem. A component that is not replaced should be reinstalled in the same position as originally mounted.

INSPECTION

LEAK TEST

Before performing the cylinder leak test, verify the following:

- Clamp(s) tightness
- Radiator and hoses.

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

⚠ WARNING

Prevent burning yourself on hot engine parts.

Preparation

Disconnect battery.

⚠ WARNING

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

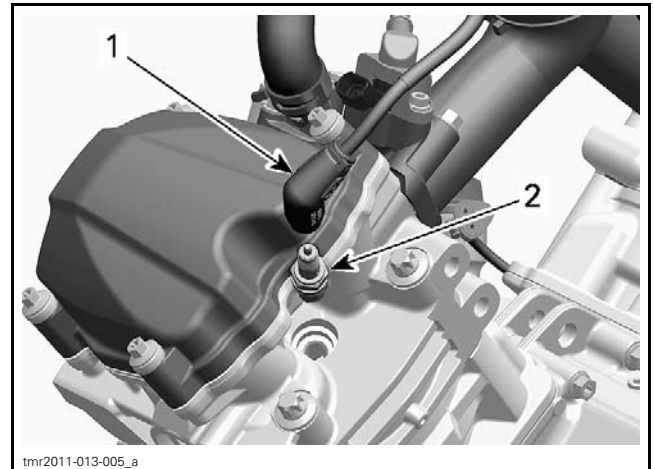
Remove radiator cap.

⚠ WARNING

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

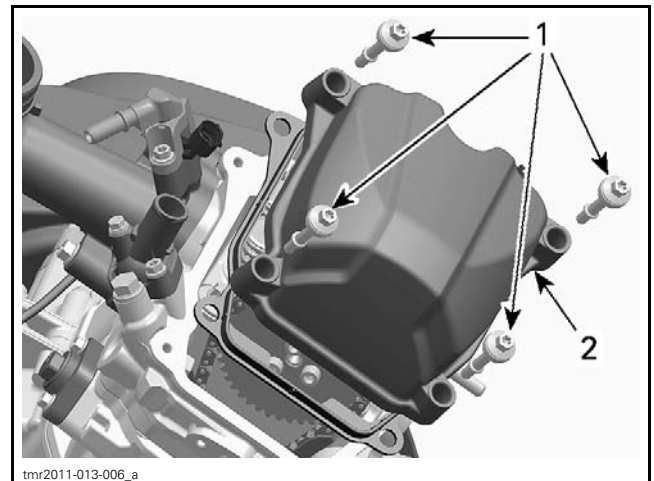
Unplug spark plug cable.

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



1. Spark plug cable
2. Spark plug

Remove valve cover.



1. Valve cover screws
2. Valve cover

Rotate crankshaft until piston is at ignition TDC.

To turn crankshaft, there are two possible procedures.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 08 (TOP END)

First Procedure

Turn the drive pulley.

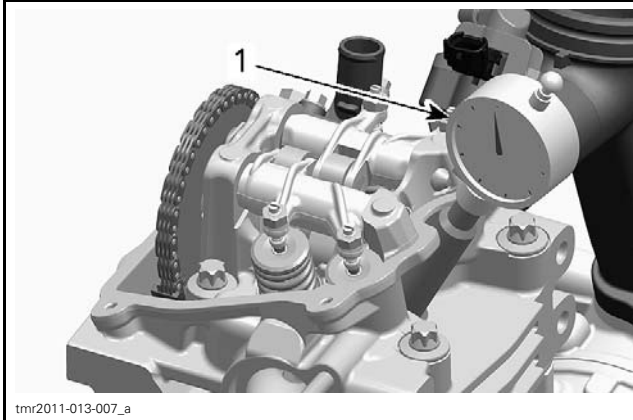
Second Procedure

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.

Set the piston to precisely ignition TDC.

REQUIRED TOOL	
TDC DIAL INDICATOR (P/N 414 104 700)	

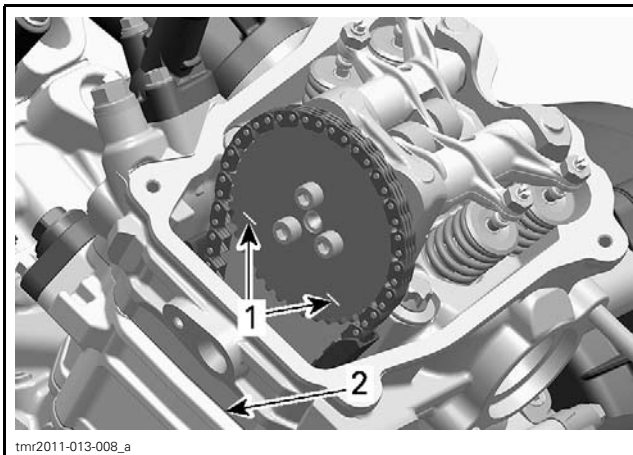


1. Dial gauge

NOTE: If a dial gauge is not available, use a screw-driver 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.



1. Marks on camshaft timing gear
2. Cylinder head base

Leak Test

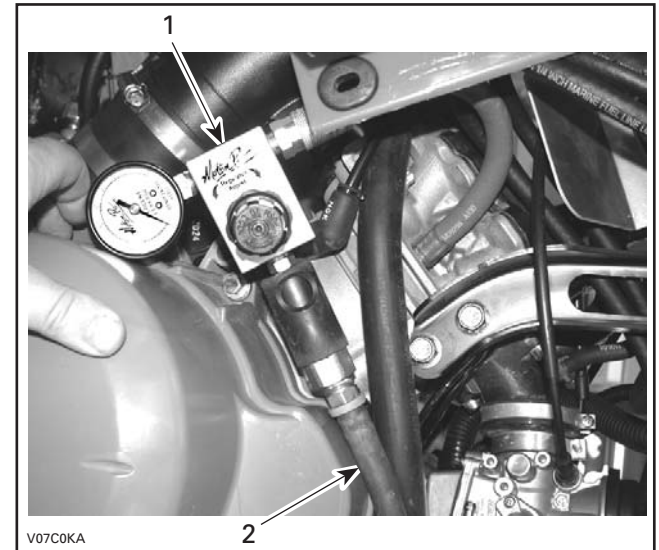
REQUIRED TOOL	
ENGINE LEAK DOWN TEST KIT (P/N 529 035 661)	

Connect leak tester to adequate air supply.
Set needle of measuring gauge to zero.

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

Install gauge adapter into previously cleaned spark plug hole.

Supply combustion chamber with air pressure.



TYPICAL

1. Leak tester
2. Air supply hose

Note the amount or percentage of leakage (depending on tester).

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

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.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 08 (TOP END)

- 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 torque values and use of appropriate products/lubricants. Refer to exploded views in other subsections of this manual as required.

PROCEDURES

VALVE COVER

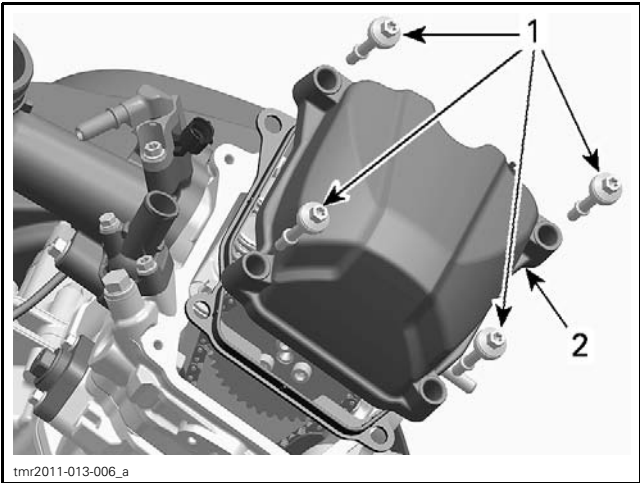
Valve Cover Access

Refer to *BODY* and remove:

- Upper console
- Lower console
- LH and RH lateral console panels.

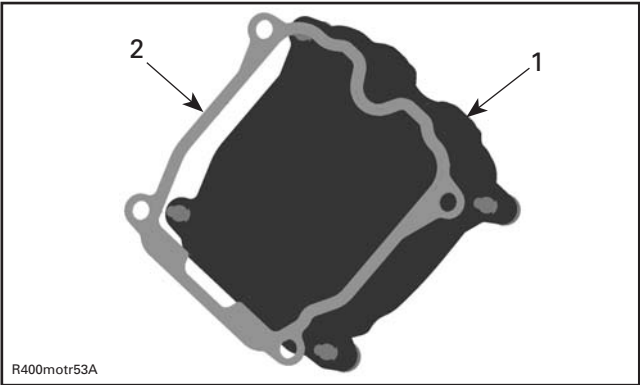
Valve Cover Removal

Remove valve cover screws of valve cover.



1. Valve cover screws
2. Valve cover

Remove valve cover and gasket.



1. Valve cover
2. 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)

ROCKER ARM

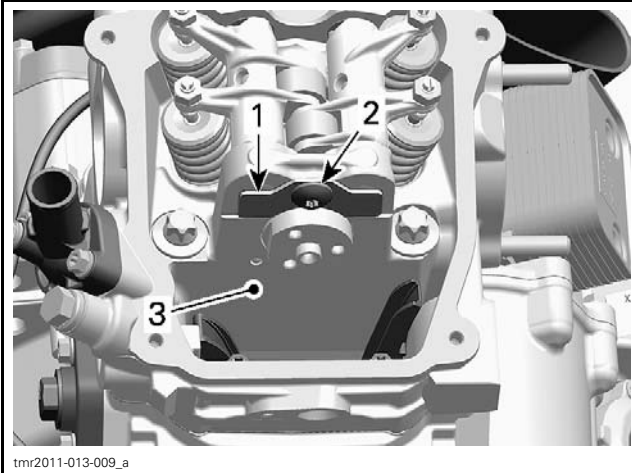
Rocker Arm Removal

Remove valve cover.

Refer to *TIMING CHAIN* subsection and remove the following parts:

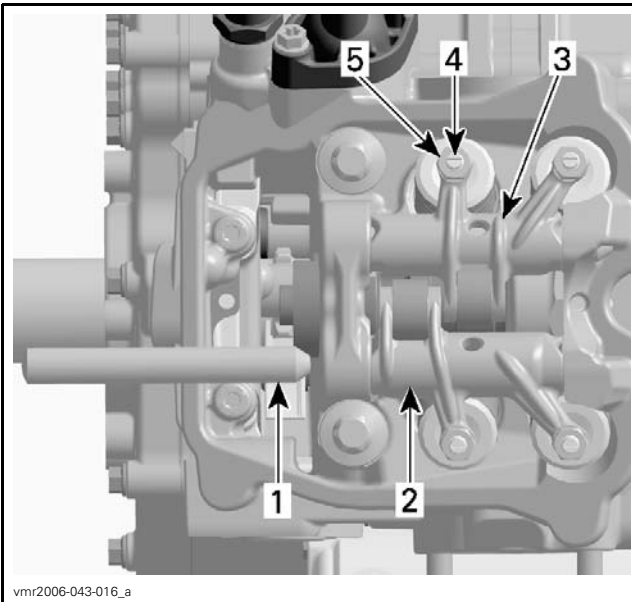
- Timing chain tensioner
- Camshaft timing gear.

Remove pan head screw and camshaft retaining plate.



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

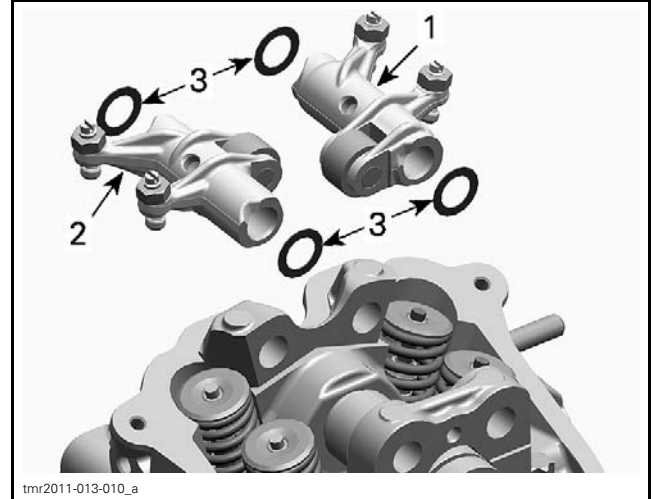
Remove rocker arm shafts.



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

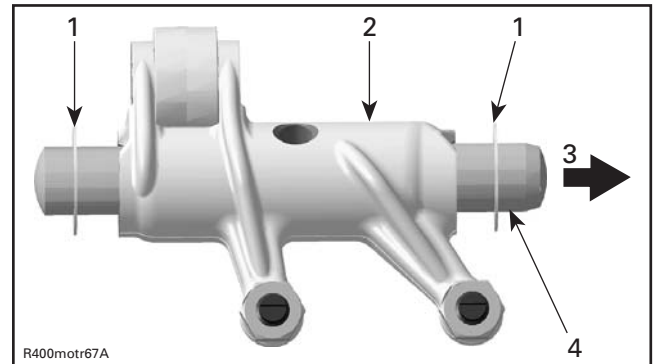
Remove rocker arm assembly (exhaust side and intake side) with adjustment screws and lock nuts.

Remove thrust washers.



1. Rocker arm (exhaust side)
2. Rocker arm (intake side)
3. Thrust washers

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



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

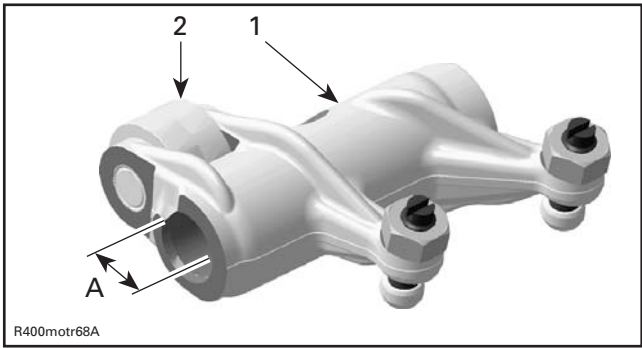
Rocker Arm Inspection

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

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

Section 02 ENGINE, CVT AND GEARBOX

Subsection 08 (TOP END)

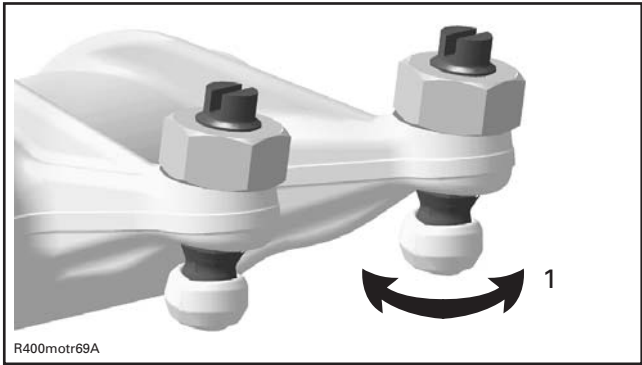


- 1. Rocker arm (exhaust side)
- 2. Roller
- A. Bore for rocker arm shaft

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

ROCKER ARM BORE DIAMETER	
NEW	12.036 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.

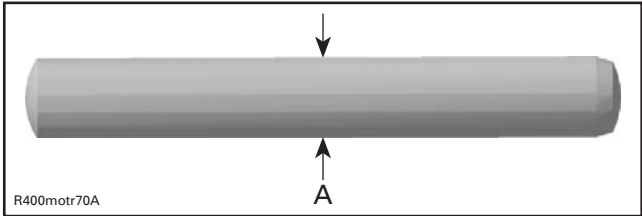


- 1. Free movement of adjustment screw top

Rocker Arm Shaft Inspection

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.

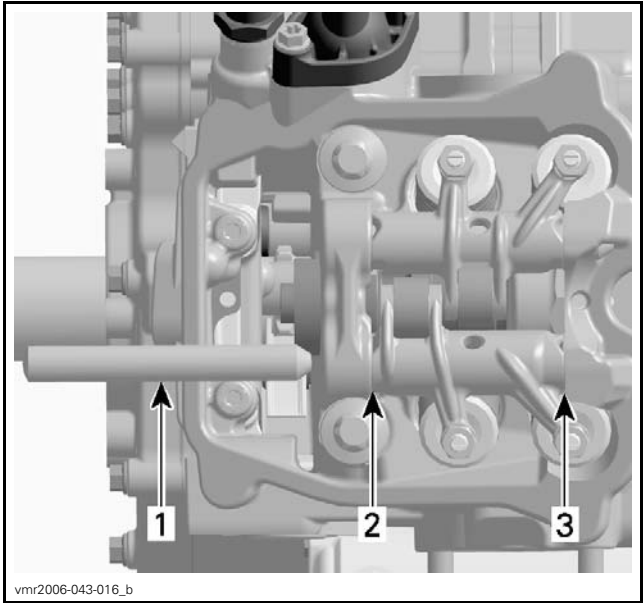
Apply engine oil on rocker arm shaft.

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.



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

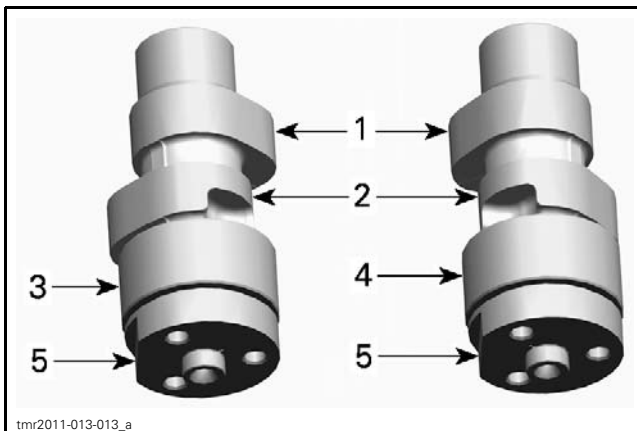
Place the other thrust washer and push rocker arm shaft to end position.

Install the camshaft retaining plate.

Adjust valve clearance, refer to *PERIODIC MAINTENANCE PROCEDURE*.

CAMSHAFT

NOTE: The engine is equipped with two different camshafts.



Camshaft Removal

The removal procedure is the same for both camshafts.

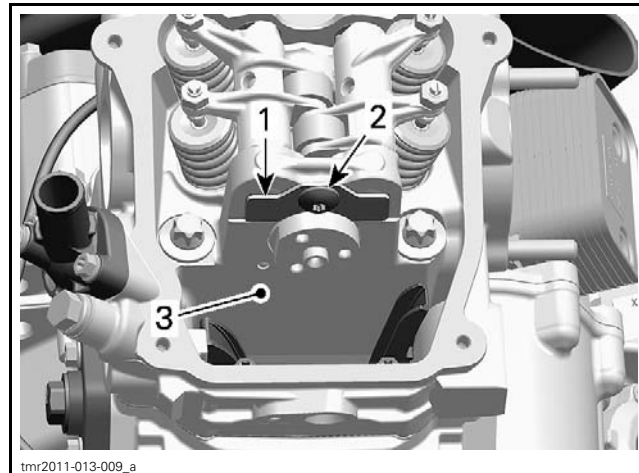
NOTICE Each camshaft is different in design. Thus, it is important not to mix up any parts of the camshaft assembly with that of the other cylinder. Keep parts as a group.

Remove valve cover (see *VALVE COVER* in this subsection).

Refer to *TIMING CHAIN* subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

Remove the camshaft retaining plate.

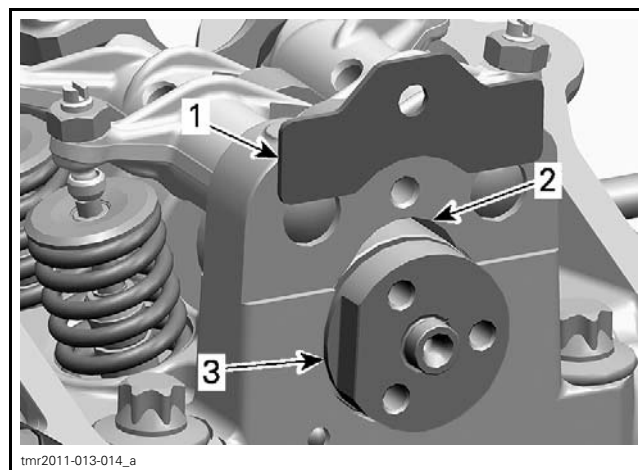


- 1. Camshaft retaining plate
- 2. Pan head screw
- 3. Cylinder head

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

Remove the camshaft.

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



- 1. Camshaft retaining plate
- 2. Area for camshaft lobes
- 3. Camshaft

Camshaft Inspection

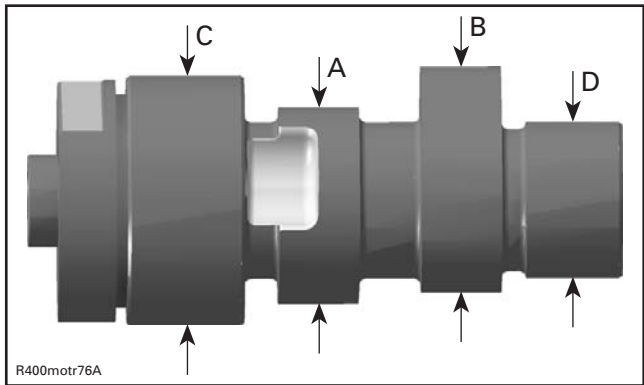
Camshaft Lobe Inspection

Check each lobe for scoring, scuffing, cracks or other signs of wear.

Measure camshaft lobe height using a micrometer.

Section 02 ENGINE, CVT AND GEARBOX

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

CAMSHAFT LOBE (EXHAUST)		
800R ENGINE	NEW	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)
	SERVICE LIMIT	32.930 mm (1.2965 in)
1000 ENGINE	NEW	32.860 mm to 33.060 mm (1.294 in to 1.302 in)
	SERVICE LIMIT	32.840 mm (1.293 in)

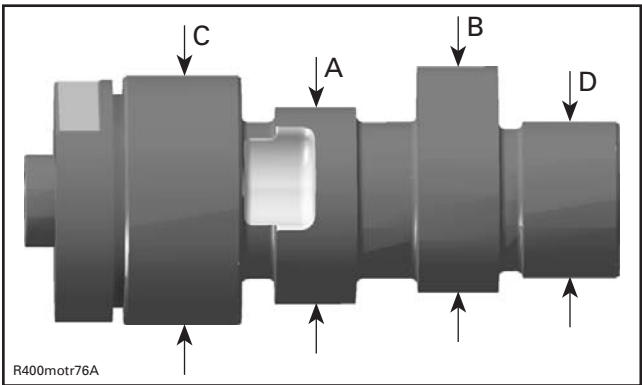
CAMSHAFT LOBE (INTAKE)		
800R ENGINE	NEW	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)
	SERVICE LIMIT	32.870 mm (1.2941 in)
1000 ENGINE	NEW	32.960 mm to 33.160 mm (1.298 in to 1.306 in)
	SERVICE LIMIT	32.940 mm (1.297 in)

Measure camshaft bearing in cylinder head. Refer to *CYLINDER HEAD INSPECTION* in this subsection.

Camshaft Journal Inspection

Check each journal for scoring, scuffing, cracks or other signs of wear.

Measure camshaft journal using a micrometer.



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

CAMSHAFT JOURNAL (TIMING 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)

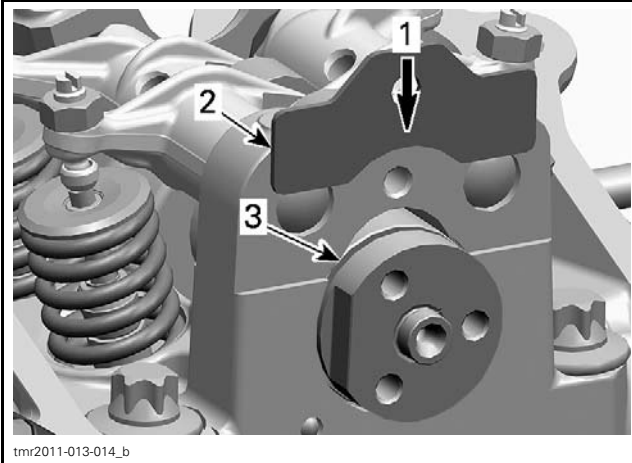
CAMSHAFT JOURNAL (SPARK PLUG SIDE)	
NEW	21.959 mm to 21.980 mm (.8645 in to .8654 in)
SERVICE LIMIT	21.950 mm (.8642 in)

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.



1. Direction of movement
2. Camshaft retaining plate
3. Slot retaining camshaft

For other parts, refer to proper installation procedure.

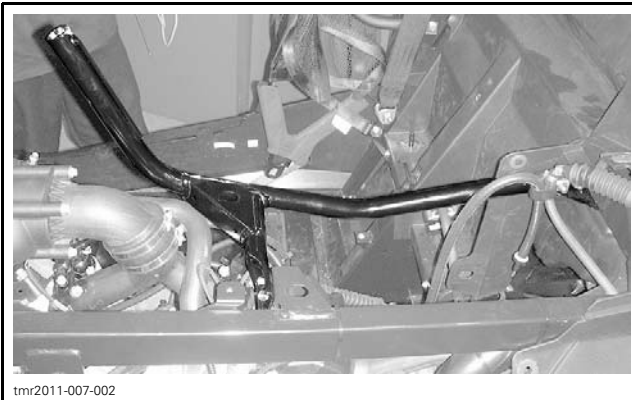
CYLINDER HEAD

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

On cylinder 2, remove the shift cable bracket.

Refer to *INTAKE MANIFOLD* subsection to remove following parts:

- Plenum, for cylinder 1
- Intake manifold.

Cylinder Head Removal

The removal procedure is the same for both cylinder heads.

Drain coolant. Refer to *ENGINE COOLANT REPLACEMENT* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.

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.

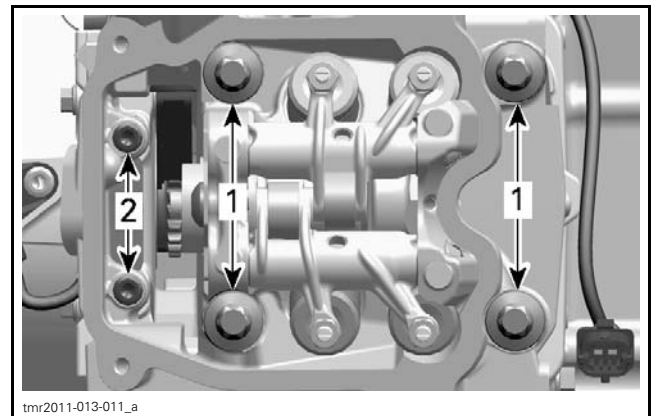
Disconnect temperature sensor connector, located at rear cylinder head.

Remove the valve cover and its gasket (see *VALVE COVER* in this subsection).

Refer to *TIMING CHAIN* subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

First remove the M6 cylinder head screws, then the M10 cylinder head screws.

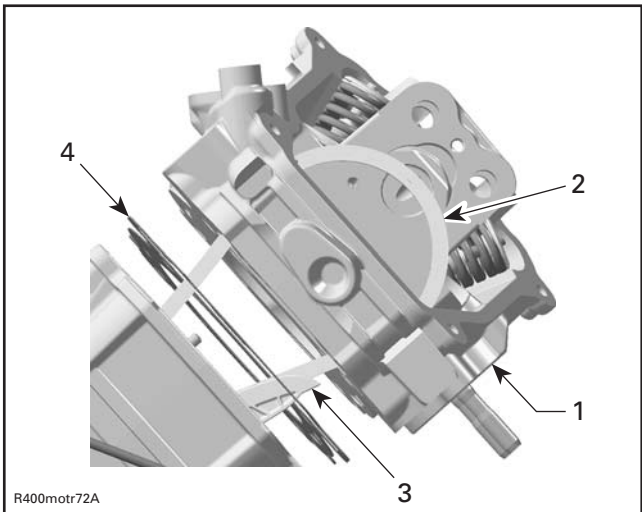


1. Cylinder head screws M10
2. Cylinder head screws M6

Pull up cylinder head.

Remove timing chain guide (fixed).

Remove and discard the cylinder head gasket.



- 1. Cylinder head
- 2. Timing chain
- 3. Chain guide (fixed)
- 4. Cylinder head gasket

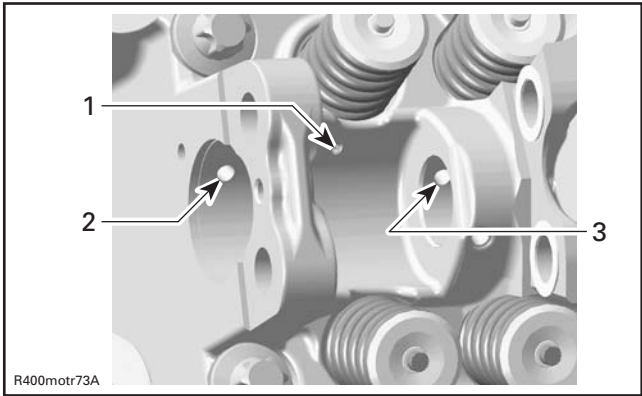
Cylinder Head Inspection

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.

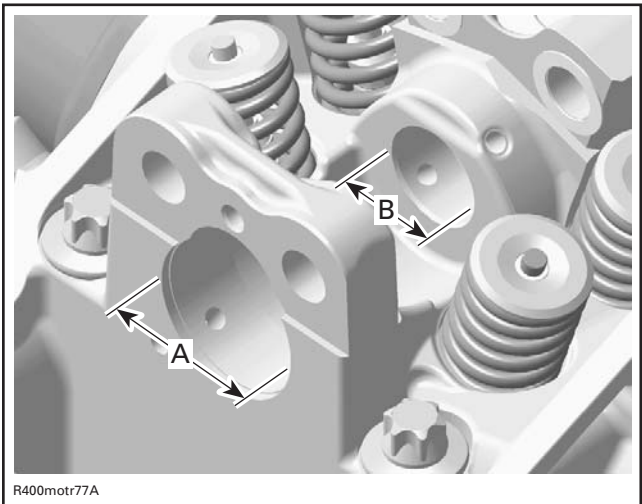
Clean oil support through the cylinder head from contamination.



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

Cylinder Head Camshaft Bearing Inspection

Measure camshaft bearing in cylinder head.



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

CAMSHAFT BEARING (TIMING 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)
CAMSHAFT BEARING (SPARK PLUG SIDE)	
NEW	22.000 mm to 22.021 mm (.8661 in to .867 in)
SERVICE LIMIT	22.040 mm (.8677 in)

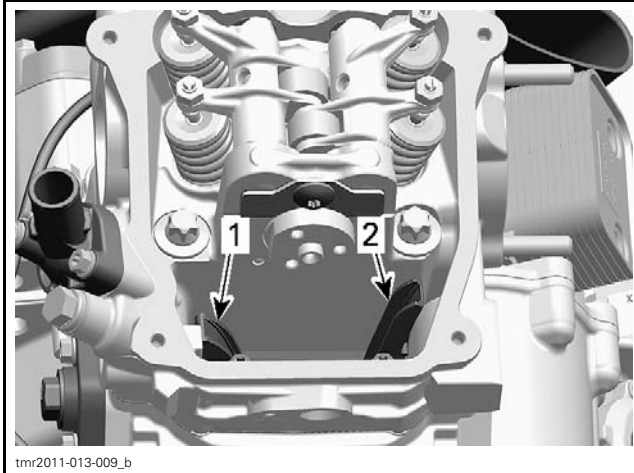
Cylinder Head Installation

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.



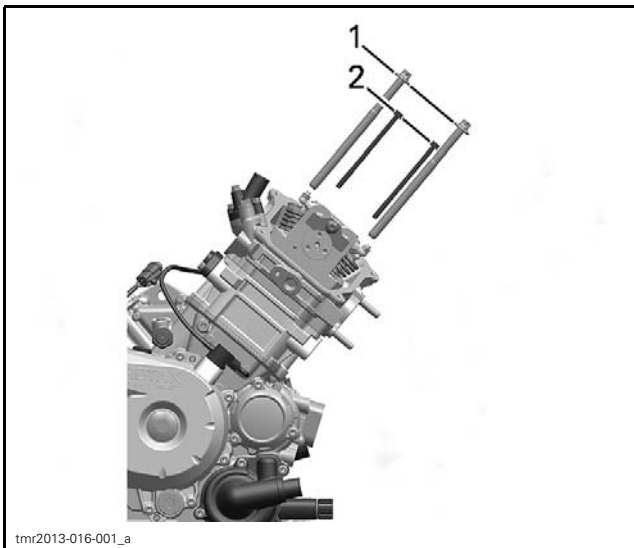
TYPICAL

1. Timing chain guide (tensioner side) mounted in crankcase
2. Timing chain guide (fixed) between cylinder and cylinder head

Install a NEW cylinder head gasket.

Install cylinder head screws in correct position.

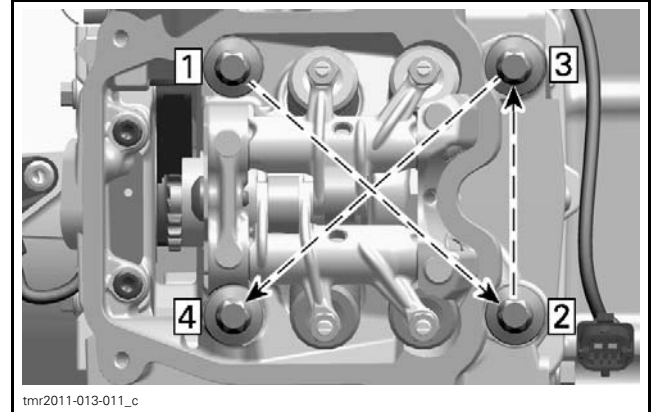
NOTICE Cylinder head screws have different sizes and lengths.



1. Location no. 1
2. Location no. 2

CYLINDER HEAD SCREW IDENTIFICATION		
800R engine	Location no. 1	M10 x 140
	Location no. 2	M6 x 85
1000 engine	Location no. 1	M10 x 159
	Location no. 2	M6 x 105

Tighten M10 cylinder head screws FIRST as per following specifications.

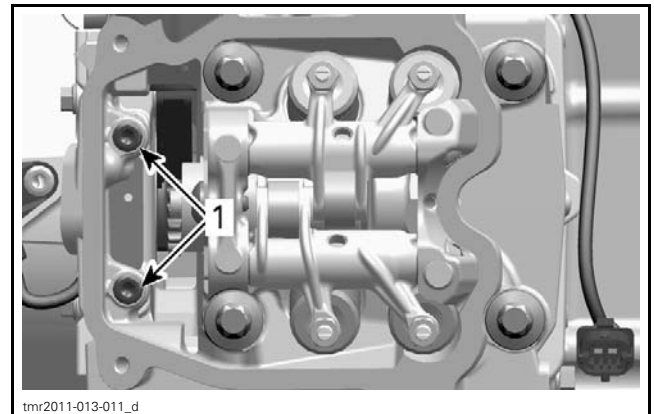


TIGHTENING SEQUENCE - M10 CYLINDER HEAD SCREWS

M10 CYLINDER HEAD SCREWS	
Tightening torque (step 1)	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)

M10 CYLINDER HEAD SCREWS	
Tightening torque (step 2)	180° +/- 5°

Tighten M6 cylinder head screws as per following specification.



1. M6 Screws

M6 CYLINDER HEAD SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Check timing chain guide (tensioner side) for movement.

On cylinder 1, install the plenum bracket, refer to *INTAKE MANIFOLD* subsection.

VALVE SPRINGS

Valve Spring Removal

Refer to following procedures in this subsection to remove:

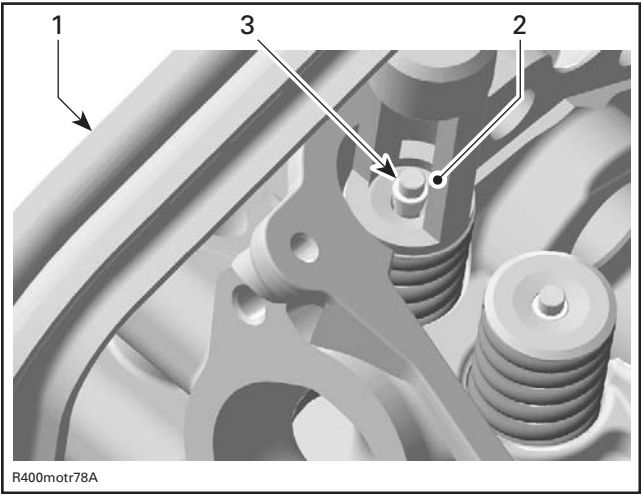
- CAMSHAFT
- CYLINDER HEAD.

Compress valve spring.

REQUIRED TOOL	
VALVE SPRING COMPRESSOR (P/N 529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N 529 035 764)	

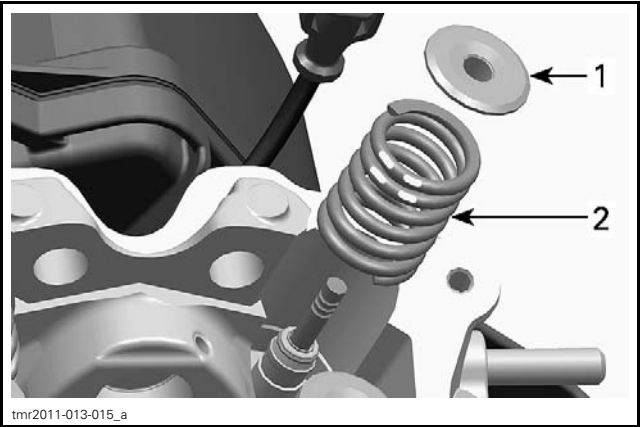
 WARNING

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



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

Remove tools and withdraw valve spring retainer and valve spring.

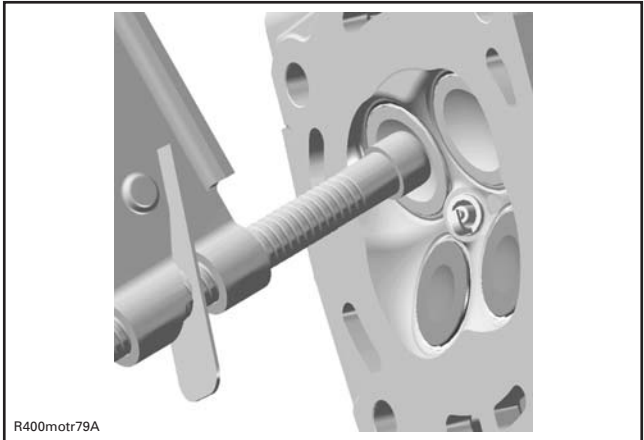


1. Valve spring retainer
2. Valve spring

Valve Spring Inspection

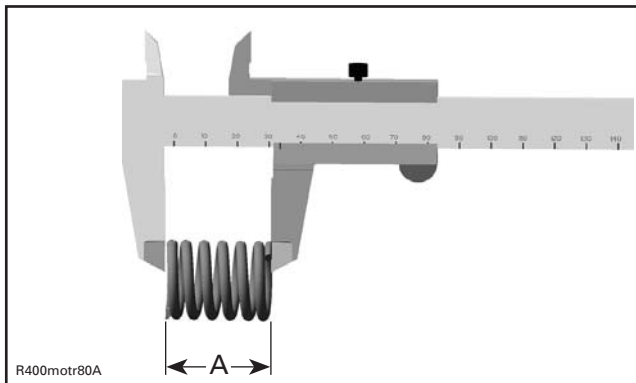
Check valve spring for visible damage. If so, replace valve spring.

Check valve spring for free length and straightness.



LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve cotters.



A. Valve spring length

VALVE SPRING FREE LENGTH	
NEW	40.81 mm (1.607 in)
SERVICE LIMIT	39.00 mm (1.535 in)

Replace valve springs if not within specifications.

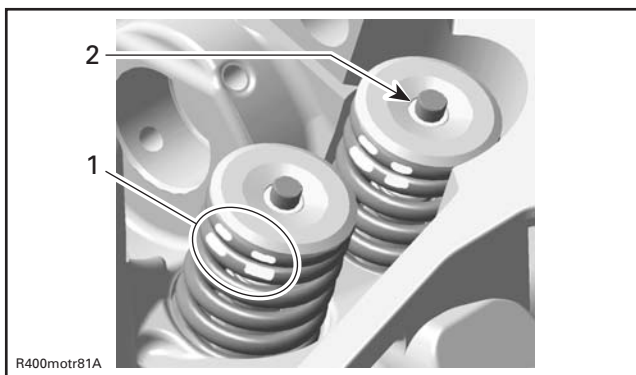
Valve Spring Installation

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.

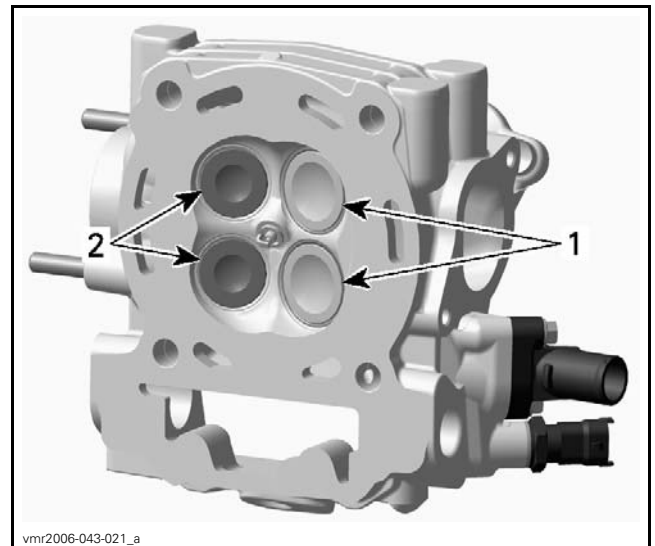
NOTICE An improperly locked valve spring will cause engine damage.

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 valve stem seal and discard it.

REQUIRED TOOL	
SNAP-ON PLIERS (P/N YA 8230)	



Valve Inspection

Whenever valves are removed always inspect valve guides. Refer to *VALVE GUIDES* in this subsection.

Section 02 ENGINE, CVT AND GEARBOX

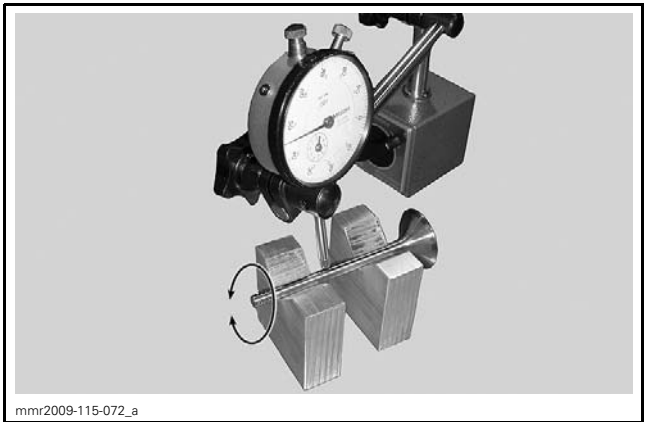
Subsection 08 (TOP END)

Valve Stem Seal

Always install **NEW** seals whenever valves are removed.

Valve

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

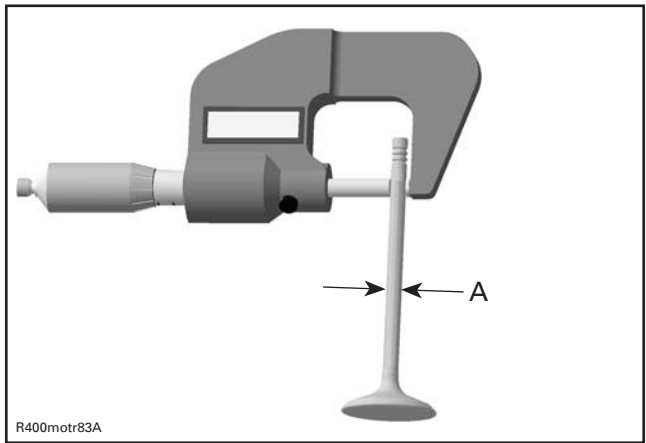


VALVE OUT OF ROUND (INTAKE AND EXHAUST VALVES)	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

Valve Stem

Measure valve stem in three places using a micrometer.

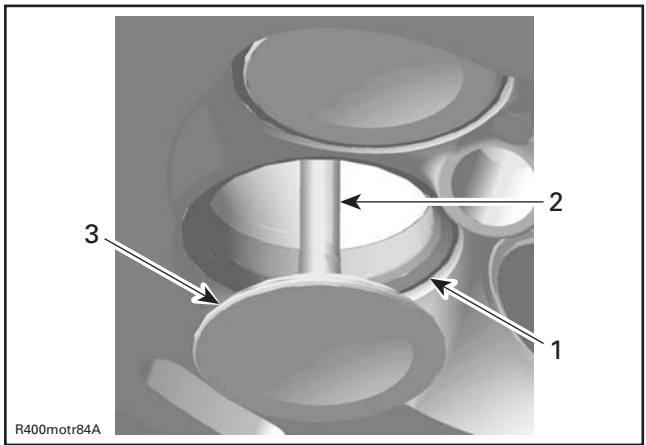
Replace valve if valve stem is out of specification or has other damages such as wear or friction surface.



A. Valve stem diameter

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

Valve Face and Seat



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

Check valve face and seat for burning or pittings and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound to valve face and work valve on its seat with a lapping tool (see *VALVE GUIDES* in this subsection).

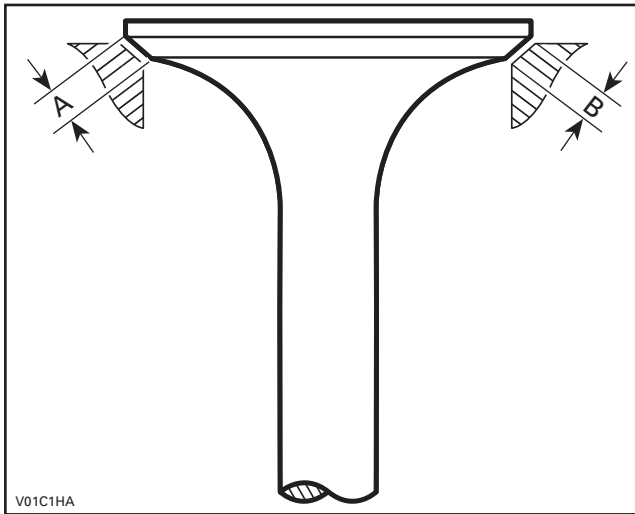
Measure valve face contact width.

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

Measure valve seat width using a caliper.

VALVE SEAT CONTACT WIDTH	
EXHAUST VALVE	
NEW	1.25 mm to 1.55 mm (.049 in to .061 in)
SERVICE LIMIT	2.00 mm (.079 in)
INTAKE 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.



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

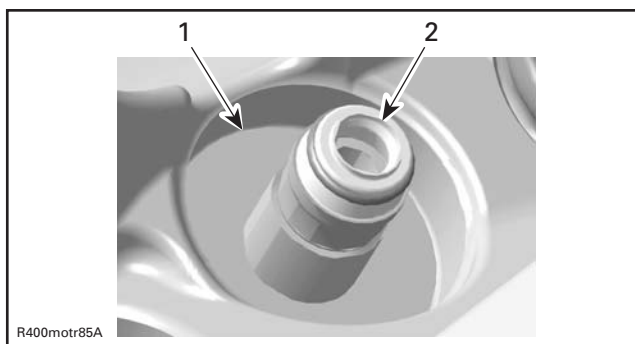
Valve Installation

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

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

Apply engine oil on valve stem and install it.

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



1. Thrust washer
2. Sealing lips of valve stem seal

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE An improperly locked valve spring will cause engine damage.

VALVE GUIDES

Valve Guide Inspection

Always replace valve stem seals whenever valve guides are removed.

Measure valve guide in three places using a small bore gauge.

NOTE: Clean valve guide to remove carbon deposits before measuring.

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

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 Guide Removal

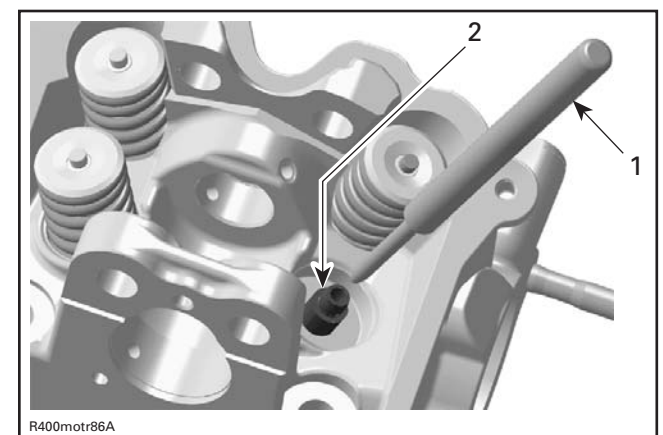
Refer to following procedures in this subsection to remove:

- Cylinder head
- Valves.

NOTE: Clean valve guide area from contamination before removal.

Drive the valve guide out of cylinder head.

REQUIRED TOOL	
Hammer	
VALVE GUIDE REMOVER 5 MM (P/N 529 035 924)	



1. Valve guide remover
2. Valve guide

Valve Guide Installation

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

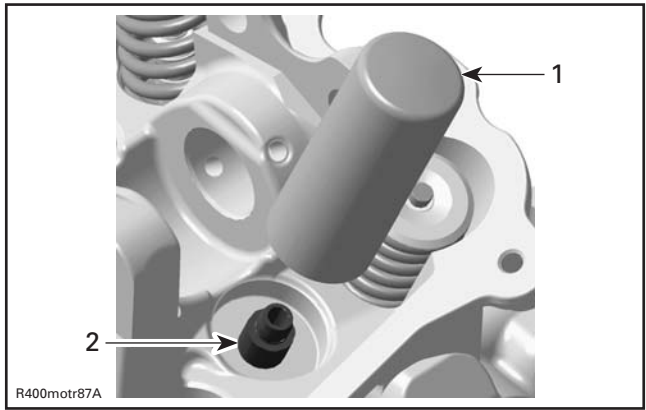
Section 02 ENGINE, CVT AND GEARBOX

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

Install valve guide.

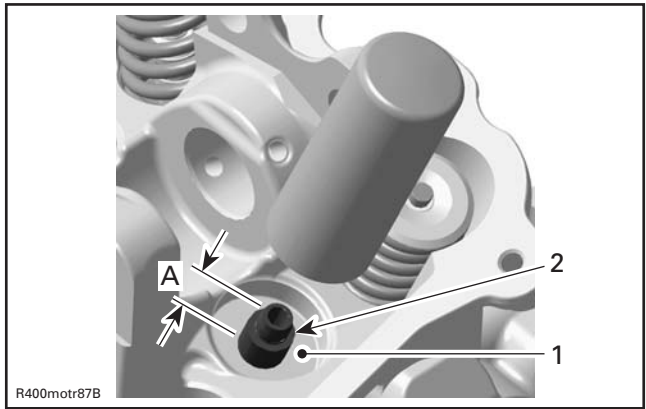
REQUIRED TOOL	
VALVE GUIDE INSTALLER (P/N 529 036 140)	



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.

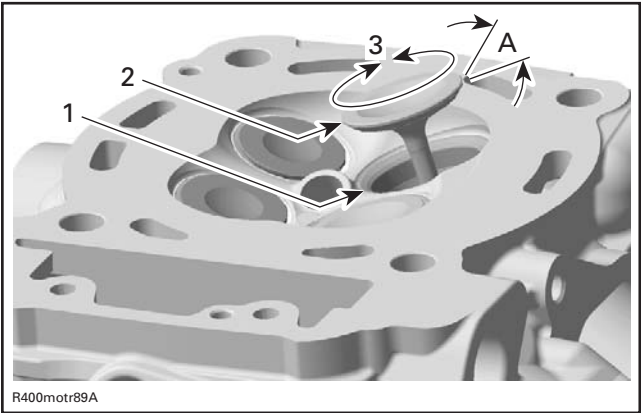
NOTICE Push valve guide in the cold cylinder head as per following illustration.



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

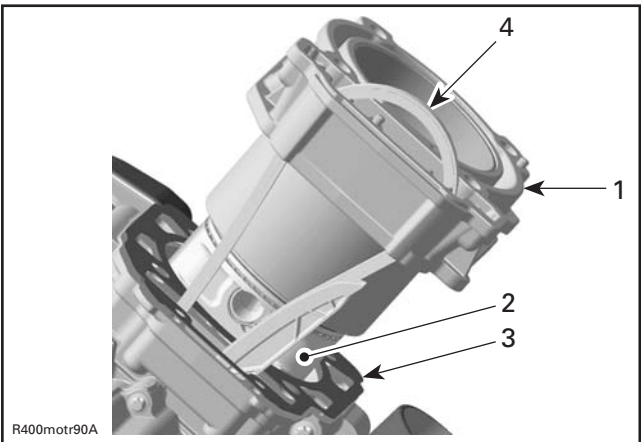
Refer to *TIMING CHAIN* subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

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

Pull cylinder.

Discard cylinder base gaskets.



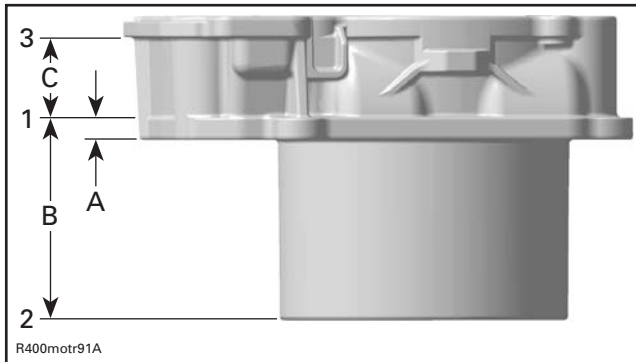
1. Cylinder
2. Piston assembly
3. Cylinder base gasket
4. Camshaft timing chain

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 at 3 recommended positions.



- A. First measurement (from cylinder bottom)
 B. Second measurement
 C. Third measurement

CYLINDER TAPER MEASUREMENTS		
ENGINE	MEASUREMENT	SPECIFICATION
800R engine	A	5 mm (.197 in)
	B	63 mm (2.48 in)
	C	32 mm (1.26 in)
1000 engine	A	5 mm (.197 in)
	B	58 mm (2.283 in)
	C	52 mm (2.047 in)

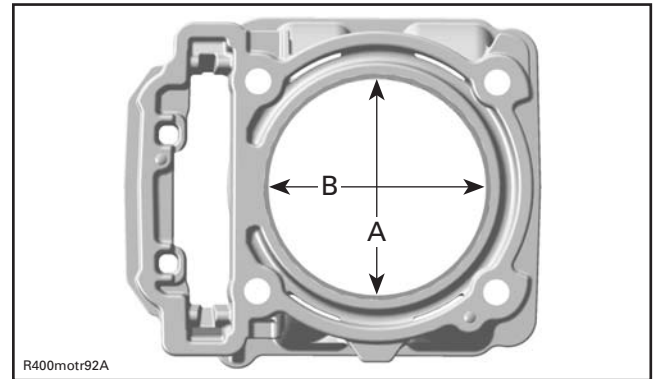
CYLINDER TAPER SPECIFICATION	
NEW (MAXIMUM)	0.038 mm (.0015 in)
SERVICE LIMIT	0.090 mm (.0035 in)

Distance between measurements should not exceed the service limit mentioned above. Otherwise, replace cylinder and piston rings.

Cylinder Out of Round

Measure cylinder diameter in piston axis direction from top of cylinder. Take another measurement 90° from first one and compare.

NOTE: Take the same measuring points like described in *CYLINDER TAPER* above.



- A. Perpendicular to crankshaft axis
 B. Parallel to crankshaft axis

CYLINDER OUT OF ROUND	
NEW (MAXIMUM)	0.015 mm (.0006 in)
SERVICE LIMIT	0.020 mm (.0008 in)

Cylinder Installation

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

NOTICE Always replace cylinder base gasket before installing the cylinder.

NOTE: Make sure piston rings are properly spaced, refer to *PISTON RINGS* in this subsection.

Apply engine oil:

- In the bottom area of the cylinder bore
- On the piston rings
- On the compressor tool.

Compress piston rings.

REQUIRED TOOL	
PISTON RING COMPRESSOR (P/N 529 035 919)	

First mount cylinder 2.

NOTE: The cylinder can not be pushed fully over the piston unless the piston is located at TDC.

Then remove the CRANKSHAFT LOCKING BOLT (P/N 529 035 617).

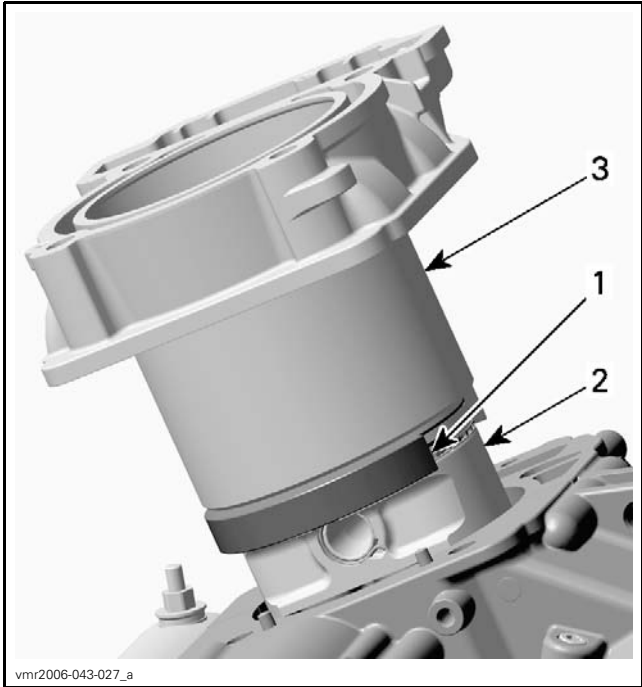
Crank the engine further and position piston 1 at TDC.

Mount cylinder 1.

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

Section 02 ENGINE, CVT AND GEARBOX

Subsection 08 (TOP END)



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

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

NOTE: After both cylinders are installed, turn crankshaft until piston of cylinder 2 is at TDC 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

Refer to following procedures in this subsection to remove:

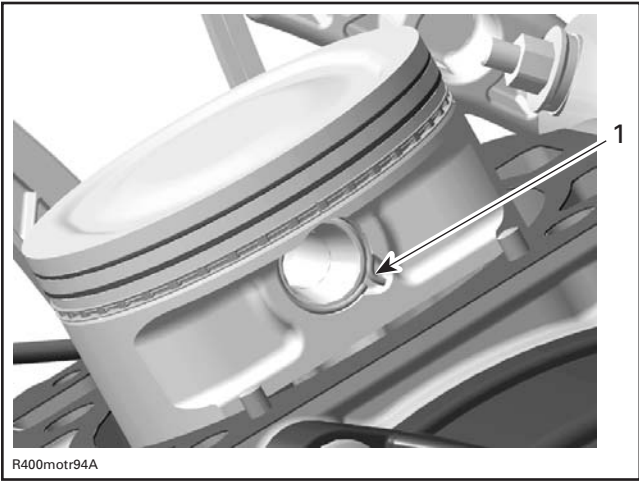
- Cylinder head
- Cylinder.

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

**WARNING**

Piston circlips are spring loaded.

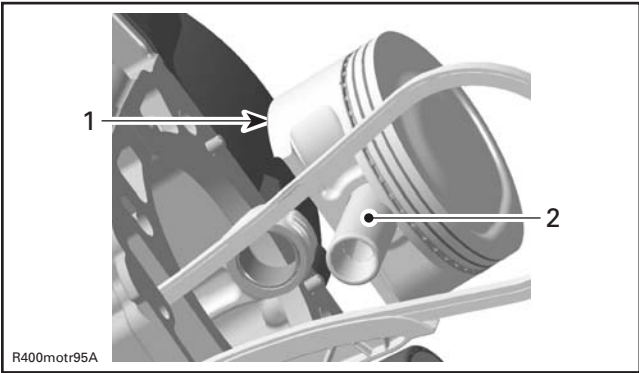
Remove one piston circlip and discard it.



- 1. Piston circlip

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

Push piston pin out of piston.



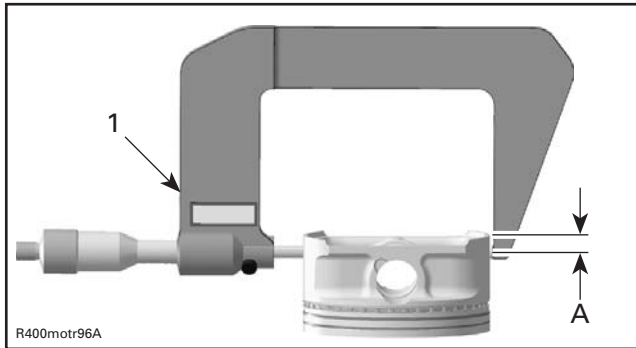
- 1. Piston
- 2. Piston pin

Detach piston from connecting rod.

Piston Inspection

Inspect piston for scoring, cracking or other damages. Replace piston and piston rings if necessary.

Using a micrometer, measure piston at 8 mm (.315 in) perpendicularly (90°) to piston pin.



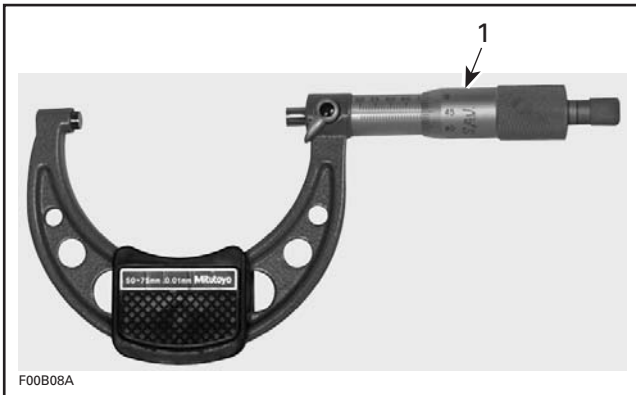
1. Measuring perpendicularly (90°) to piston pin
A. 8 mm (.315 in)

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

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)

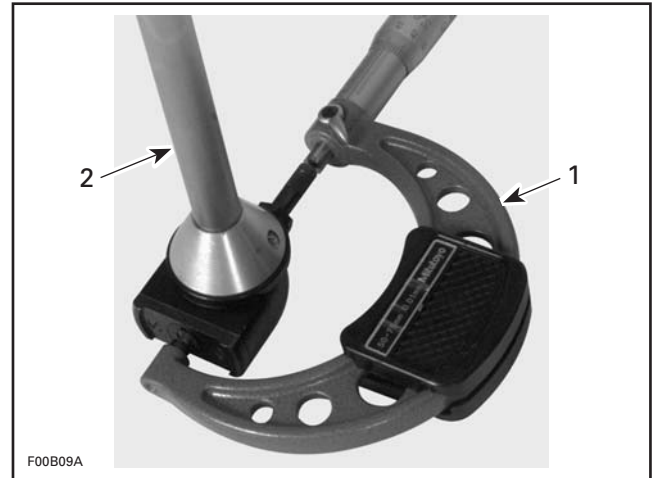
Piston/Cylinder Clearance

Adjust and lock a micrometer to the piston dimension.

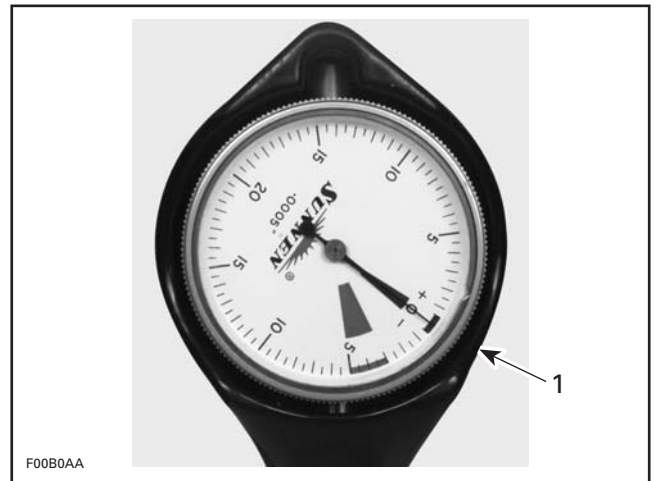


1. Micrometer set to the piston dimension

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



1. Use the micrometer to set the cylinder bore gauge
2. Dial bore gauge



TYPICAL

1. Indicator set to 0 (zero)

Position the dial bore gauge 20 mm (.787 in) above cylinder base, measuring perpendicularly (90°) to piston pin axis.

Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance.

PISTON/CYLINDER CLEARANCE	
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.

Section 02 ENGINE, CVT AND GEARBOX

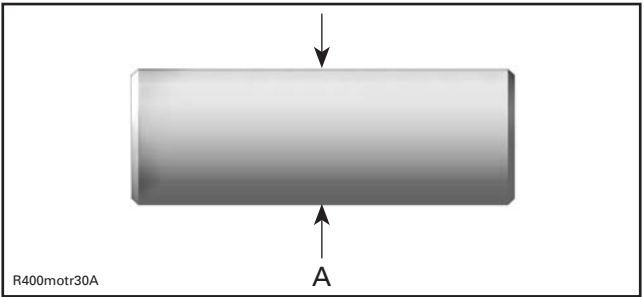
Subsection 08 (TOP END)

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.

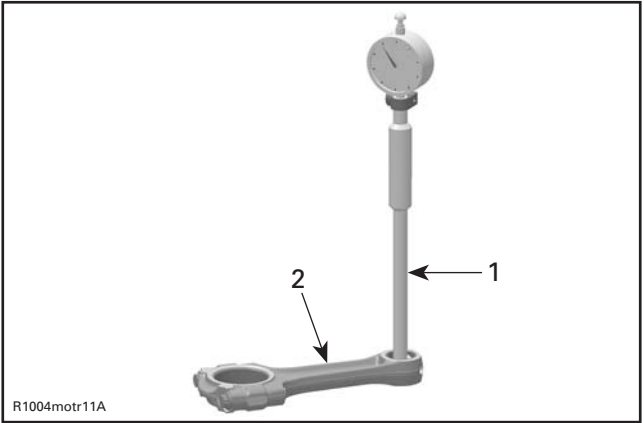


A. Piston pin diameter

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.



- 1. Bore gauge
- 2. 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.

CONNECTING ROD/ PISTON PIN CLEARANCE	
SERVICE LIMIT	0.080 mm (.0031 in)

Piston Installation

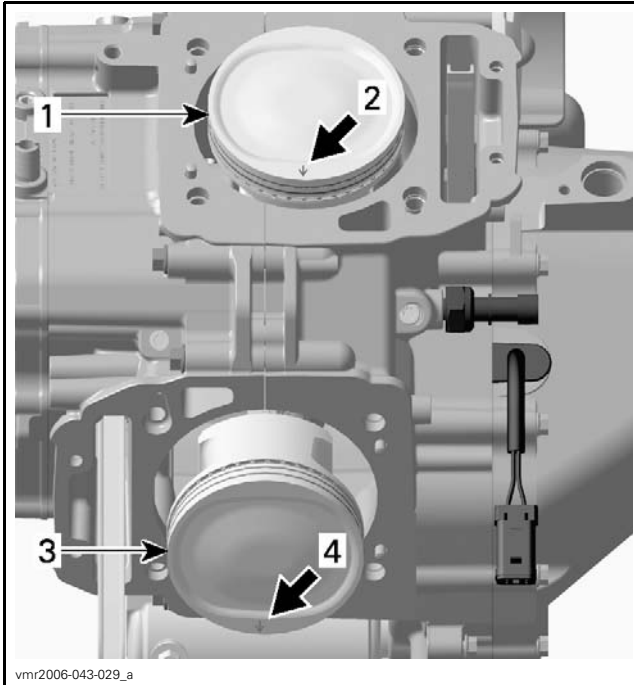
For installation, reverse the removal procedure. Pay attention to the following details.

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.

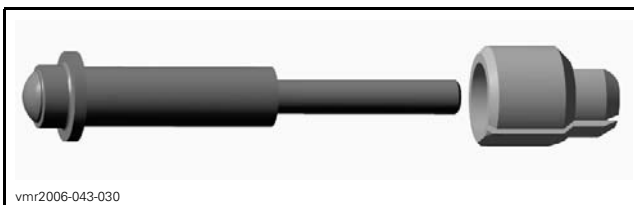
- Front cylinder:** Mark on top of piston must show to intake side.
- Rear cylinder:** Mark on top of piston must show to exhaust side.



1. Piston of cylinder 1
2. Mark on piston must show to intake side of cylinder 1
3. Piston of cylinder 2
4. Mark on piston must show to exhaust side of cylinder 2

Use the piston appropriate circlip installer to assemble the **NEW** piston circlip as per following procedure:

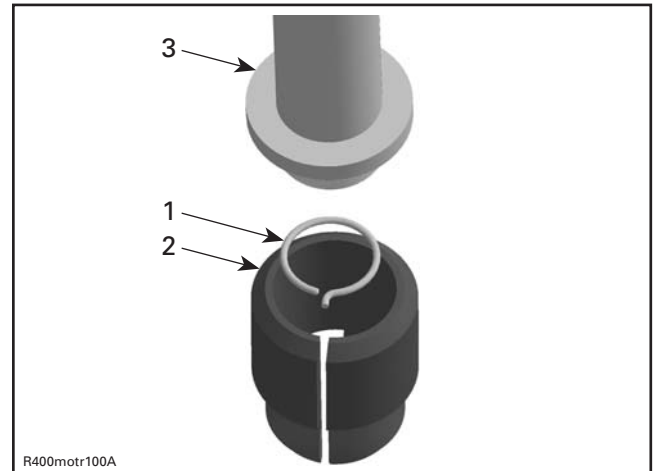
ENGINE TYPE	TOOL
800R	PISTON CIRCLIP INSTALLER (P/N 529 035 921)
1000	PISTON CIRCLIP INSTALLER (P/N 529 036 153)



TYPICAL

NOTICE Always replace disassembled piston circlip(s) by **NEW** ones. Place a rag on cylinder base to avoid dropping the circlip inside the engine.

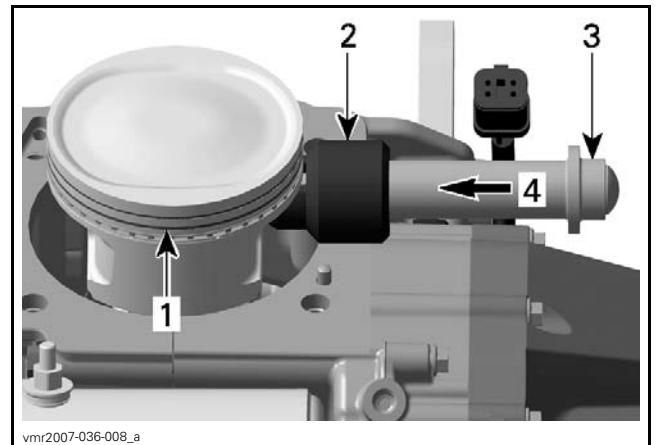
Place circlip in sleeve as per following illustration.



1. Circlip
2. Sleeve
3. Assembly jig from piston clip installer

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

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

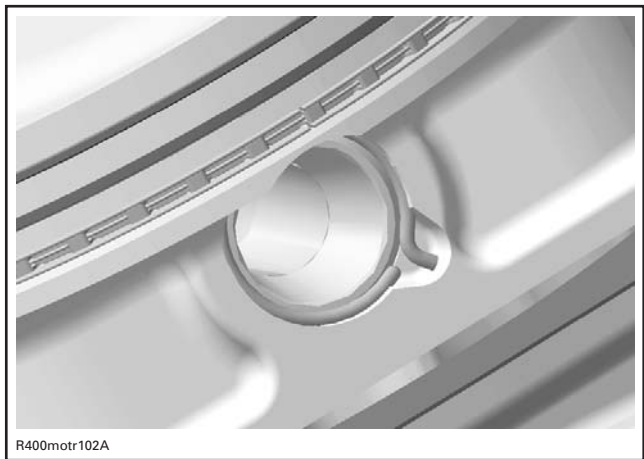


1. Hold piston while pushing circlip in place
2. Sleeve
3. Assembly jig
4. Direction to push circlip

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

Section 02 ENGINE, CVT AND GEARBOX

Subsection 08 (TOP END)



CORRECT POSITION OF THE PISTON CIRCLIP

PISTON RINGS

Ring Removal

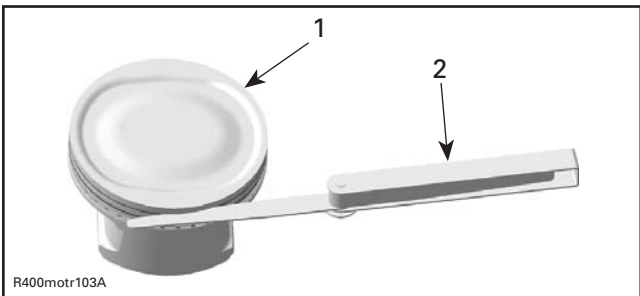
Remove the piston (see *PISTON* in this subsection).

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.

RING/PISTON GROOVE CLEARANCE	
UPPER COMPRESSION RING	
NEW	0.03 mm to 0.07 mm (.0012 in to .0028 in)
SERVICE LIMIT	0.150 mm (.0059 in)
LOWER COMPRESSION RING	
NEW	0.02 mm to 0.06 mm (.0008 in to .0024 in)
SERVICE LIMIT	0.150 mm (.0059 in)
OIL SCRAPER RING	
NEW	0.01 mm to 0.18 mm (.0004 in to .0071 in)
SERVICE LIMIT	0.250 mm (.0098 in)



- 1. Piston
- 2. Feeler gauge

Ring End Gap

RING END GAP	
UPPER COMPRESSION RING	
NEW	0.20 mm to 0.40 mm (.008 in to .016 in)
SERVICE LIMIT	0.60 mm (.024 in)
LOWER COMPRESSION RING	
NEW	0.20 mm to 0.40 mm (.008 in to .016 in)
SERVICE LIMIT	0.70 mm (.028 in)
OIL SCRAPER 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.

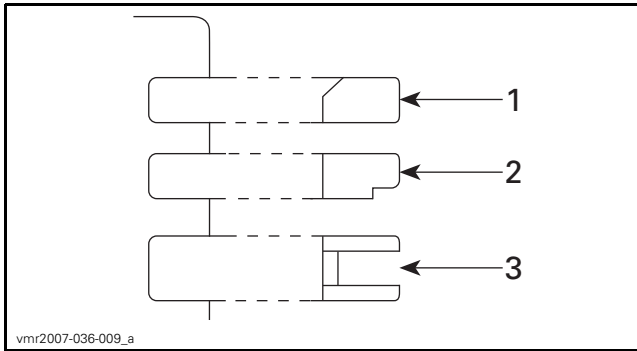
Ring Installation

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

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

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.

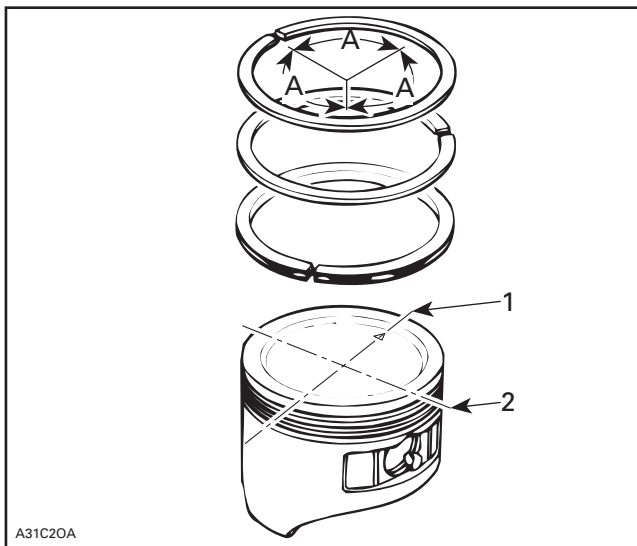


1. Upper compression ring
2. Lower compression ring
3. Oil scraper ring

NOTICE Ensure that top and second rings are not interchanged.

Check that rings rotate smoothly after installation.

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



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

TIMING CHAIN

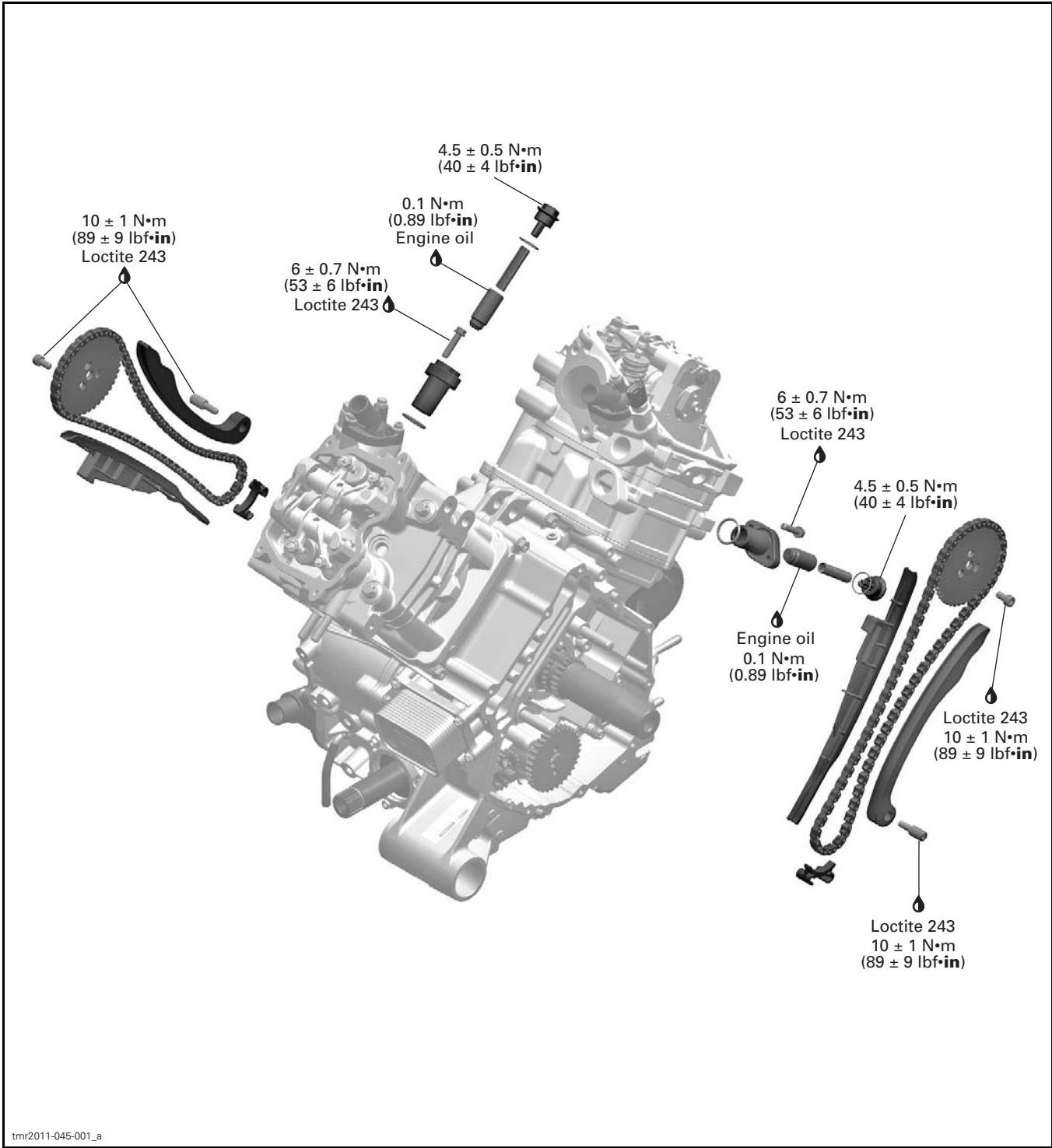
SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT TIMING TOOL.....	529 036 231	129–130
CRANKSHAFT TDC POSITION TOOL.....	529 036 201	133

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	130, 135

TIMING CHAIN



GENERAL

IMPORTANT: Note position of parts on disassembly. This may help to find the root cause of a problem. A component that is not replaced should be reinstalled in the same position as originally mounted.

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.

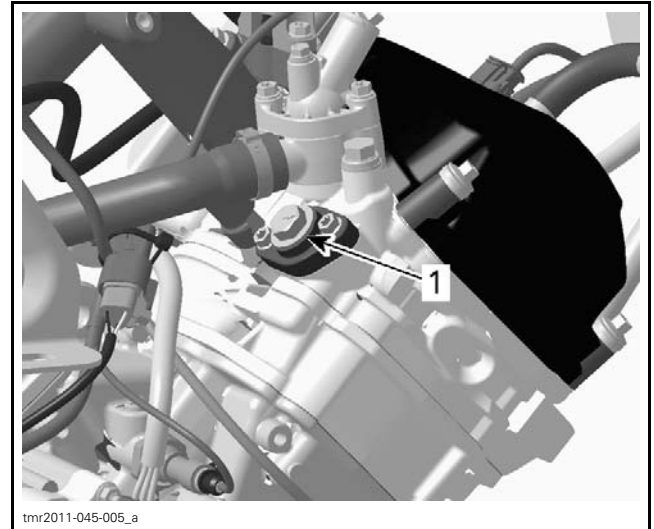
PROCEDURES

TIMING CHAIN TENSIONERS

Timing Chain Tensioner Location

800R Engine

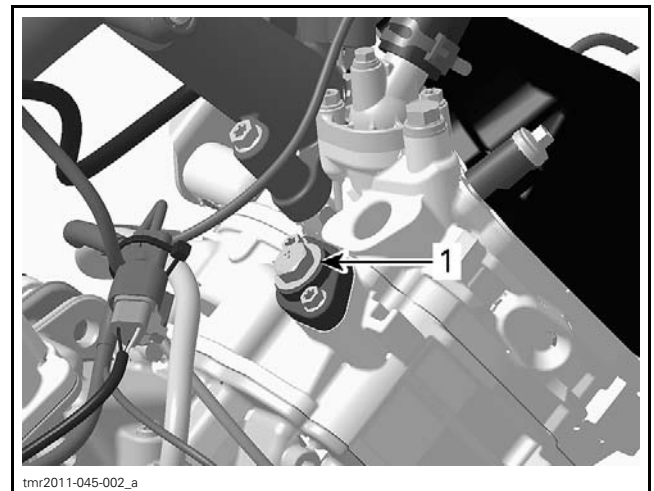
The timing chain tensioner is located in the cylinder head.



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

1000 Engine

The timing chain tensioner is located in the cylinder.



1000 ENGINE - (FRONT CYLINDER SHOWN)
1. Timing chain tensioner

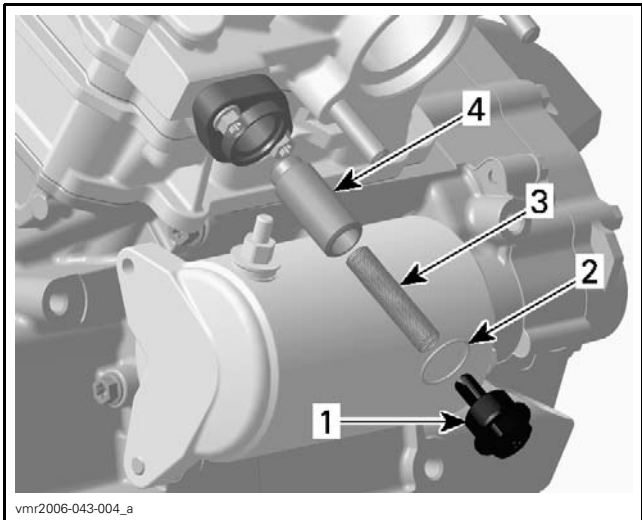
Timing Chain Tensioner Removal

1. Make sure the respective cylinder is set to TDC ignition. Refer to *CAMSHAFT TIMING GEARS* in this subsection.
2. Carefully unscrew chain tensioner plug and release spring tension.

⚠ CAUTION Tensioner is spring loaded.

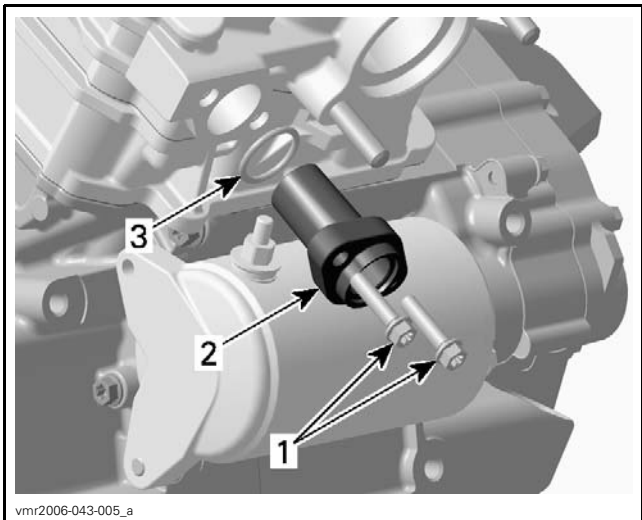
3. Remove:
 - O-ring
 - Spring
 - Chain tensioner plunger.

Section 02 ENGINE, CVT AND GEARBOX
Subsection 09 (TIMING CHAIN)



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

4. Remove:
- Chain tensioner housing retaining screws
 - Chain tensioner housing
 - O-ring.



- 1. Screws
- 2. 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.

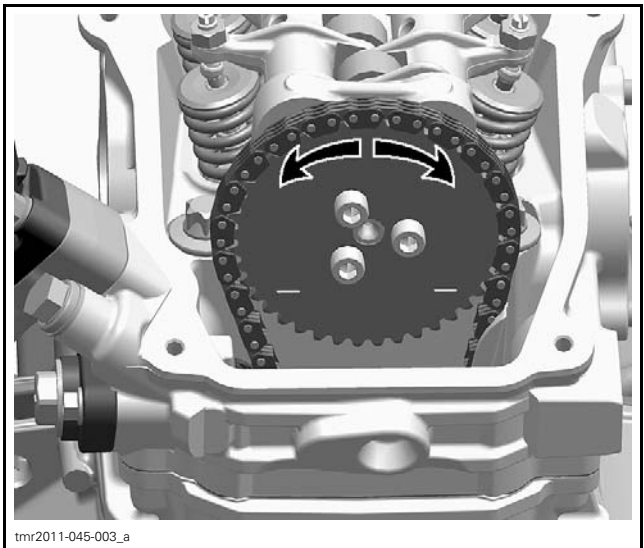
Check if O-rings are brittle, cracked or hard. Replace if necessary.

Check spring condition. Replace if bent, broken or worn.

Timing Chain Tensioner Installation

1. 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

2. Apply engine oil on the plunger before installation.
3. Slightly turn the camshaft timing gear in order to get the timing chain play on the tensioner side.
4. Slightly screw the plunger in until the timing chain allows no more back and forth movement of the camshaft timing gear.
5. 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•in)

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

6. 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 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.

7. 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.

8. Remove locking tool and install all other removed parts.
9. Finally, tighten the plug.

CAMSHAFT TIMING GEARS

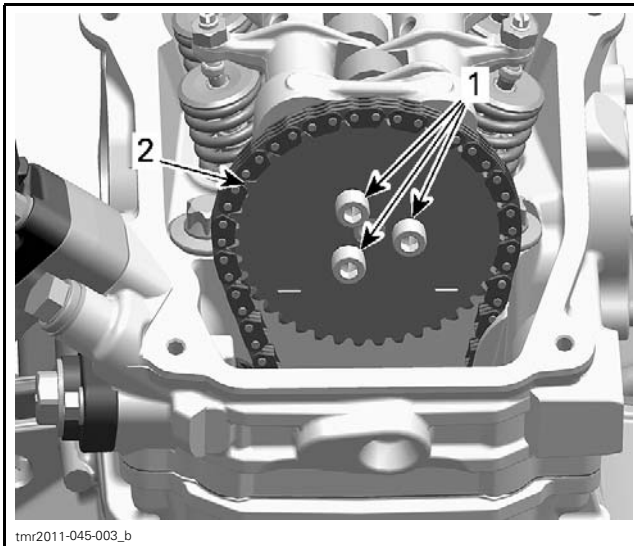
Camshaft Timing Gear Removal

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.



1. Camshaft timing gear retaining screws
2. 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.

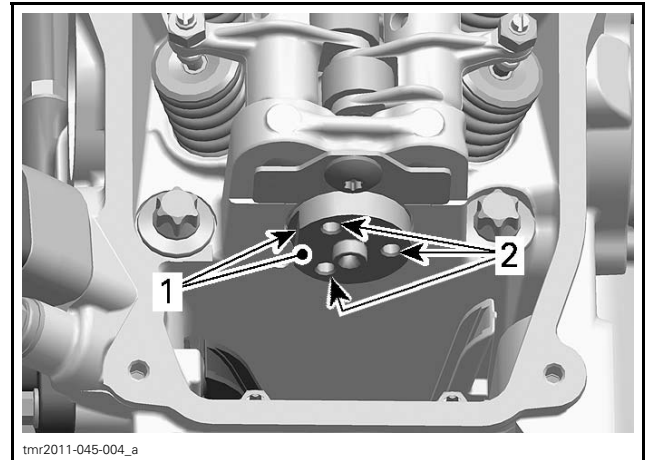
If gear is worn or damaged, replace it as a set with the timing chain.

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

Camshaft Timing Gear Installation

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

1. Clean mating surface and threads of camshaft prior installing camshaft timing gear.

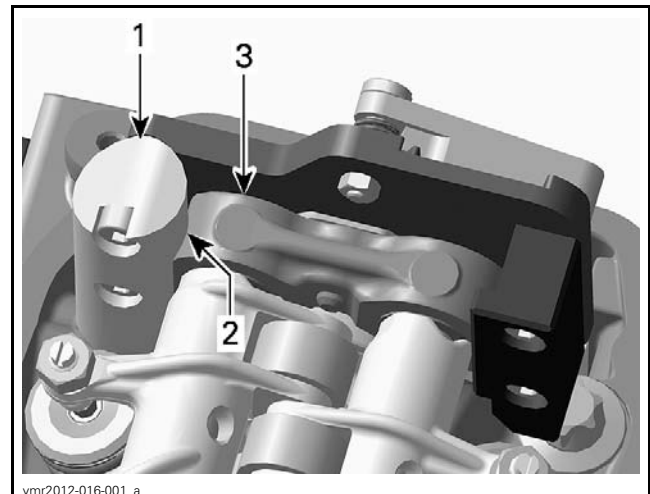


1. Mating surface on camshaft
2. Threads for camshaft screws

2. Crankshaft must be set to TDC ignition position before installing the timing chain, refer to *CAMSHAFT TIMING* in this subsection.
3. Install the camshaft timing tool on the cylinder head.

REQUIRED TOOL	
CAMSHAFT TIMING TOOL (P/N 529 036 231)	

NOTE: Align tube of camshaft adjustment tool properly with machined radius on cylinder head.



CAMSHAFT TIMING TOOL INSTALLED

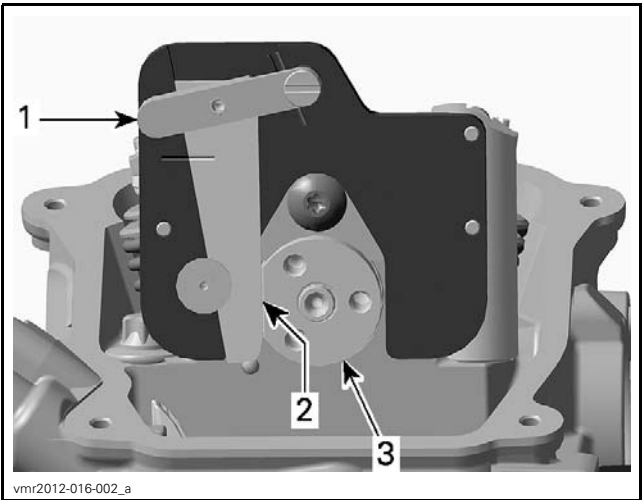
1. Tube (camshaft adjustment tool)
2. Machined radius (camshaft adjustment tool)
3. Cylinder head

Section 02 ENGINE, CVT AND GEARBOX

Subsection 09 (TIMING CHAIN)

4. 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.



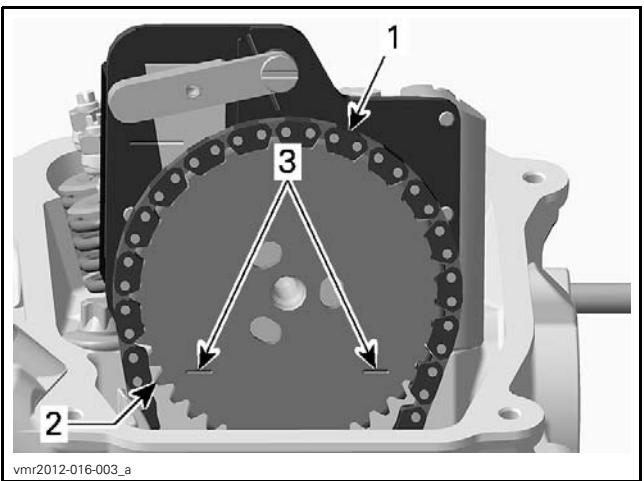
PRESS TOOL LEVER DOWN

- 1. Lever
- 2. 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.

5. Place camshaft timing gear along with the timing chain on the camshaft.

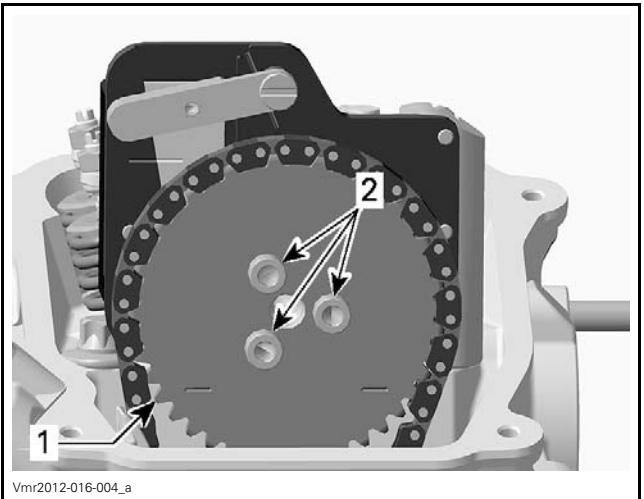
NOTE: The printed marks on the camshaft timing gear must be parallel to the cylinder head base.



- 1. Timing chain
- 2. Camshaft timing gear
- 3. Printed marks on camshaft timing gear

6. Install and adjust timing chain tensioner, refer to *TIMING CHAIN TENSIONER* in this subsection.

7. Install and tighten camshaft timing gear retaining screws to specified torque.



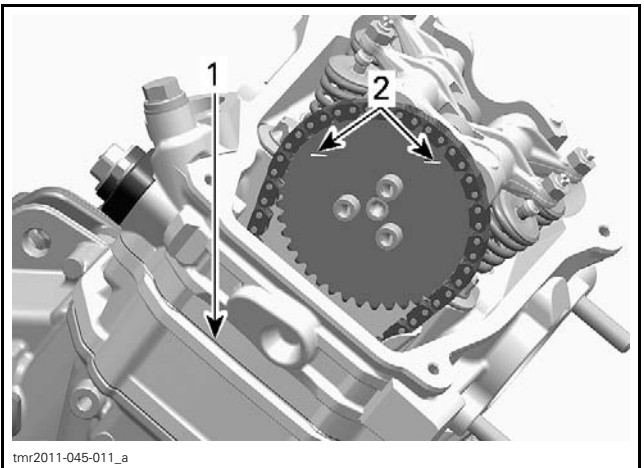
- 1. Camshaft timing gear
- 2. Timing gear retaining screws

CAMSHAFT TIMING GEAR RETAINING SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

8. Remove the CAMSHAFT TIMING TOOL (P/N 529 036 231).

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.

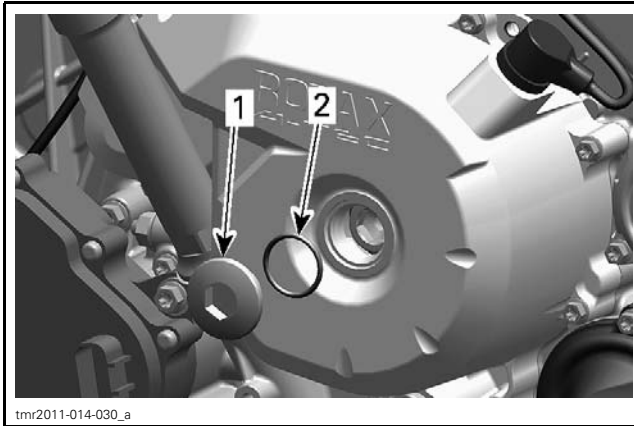


- TYPICAL**
- 1. Cylinder head base
- 2. Marks on timing gear of the opposite cylinder

Camshaft Timing Piston No. 2 (rear)

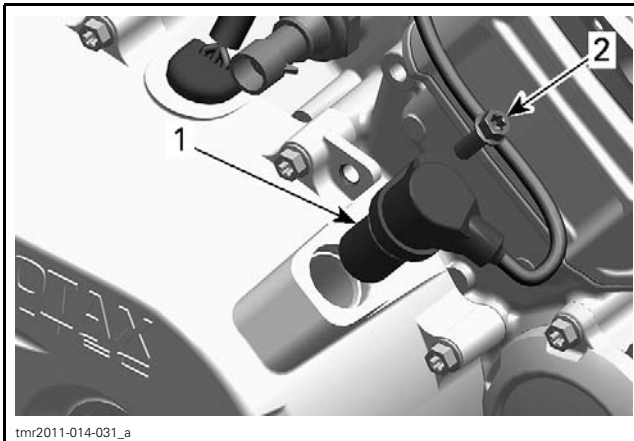
1. Remove spark plugs of both cylinders.

2. Remove valve covers of both cylinders.
3. Remove the plug and O-ring of magneto cover.



1. Plug
2. O-ring

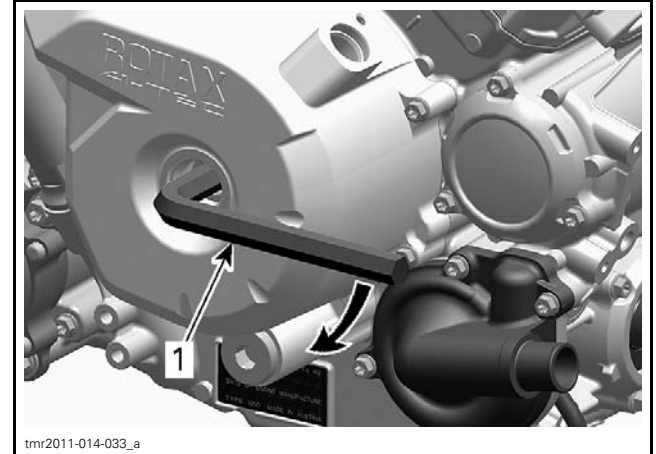
4. Remove the crankshaft position sensor (CPS).



1. CPS
2. Screw

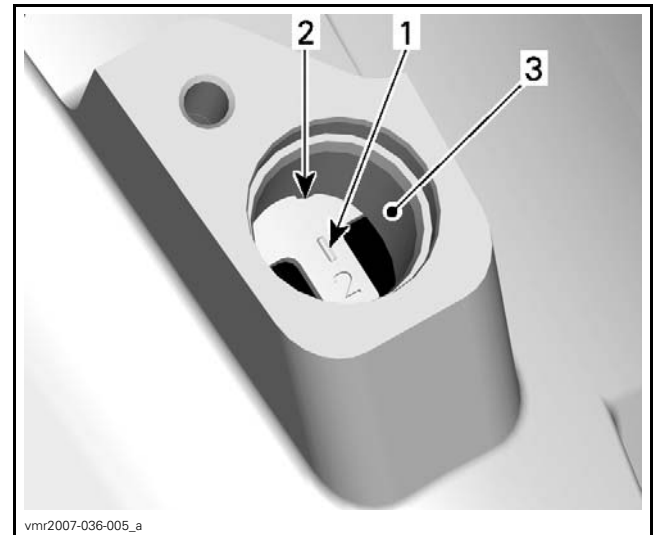
5. Set piston no. 2 to TDC ignition by turning the crankshaft.

REQUIRED TOOL
Allen key 14 mm



1. Allen key 14 mm

- 5.1 The rear piston is at TDC when it's index mark on the magneto flywheel is aligned with notch in the magneto cover.



PISTON NO. 2 AT TDC

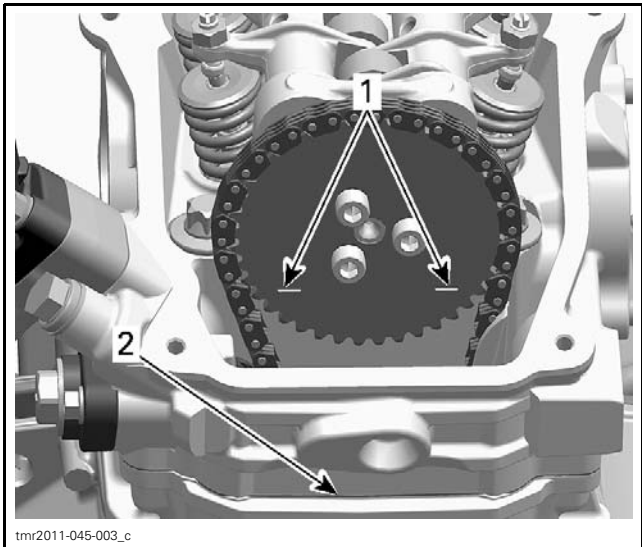
1. Mark "2" on magneto flywheel
2. Notch on magneto cover
3. Crankshaft position sensor location

- 5.2 Confirm printed marks on the camshaft timing gear are parallel to cylinder head base, in the lower position.

NOTE: If printed marks on camshaft timing gear are not as specified, turn crankshaft 360°.

NOTE: In this position the piston is set to TDC ignition.

Section 02 ENGINE, CVT AND GEARBOX
Subsection 09 (TIMING CHAIN)



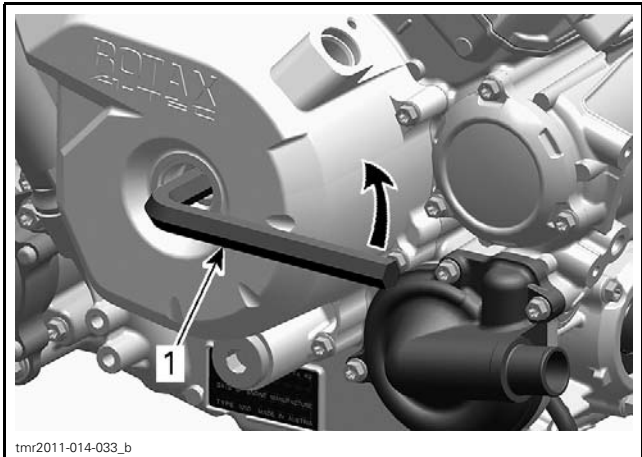
TYPICAL - PISTON AT TDC IGNITION
1. Printed marks on camshaft timing gear
2. Cylinder head base

6. Install the crankshaft TDC position tool to lock crankshaft in position. Refer to *CRANKSHAFT TDC POSITION TOOL* in this subsection.

Camshaft Timing Piston No. 1 (front)

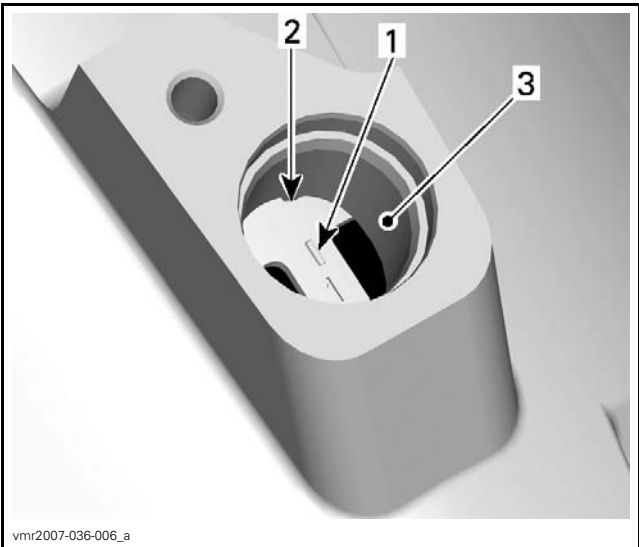
1. Set piston no. 2 (rear) to TDC ignition, see *CAMSHAFT TIMING PISTON NO. 2 (REAR)* in this subsection.
2. Remove crankshaft TDC position tool.
3. To set front piston no. 1 to **TDC ignition** turn crankshaft 280° counterclockwise.

REQUIRED TOOL
Allen key 14 mm



TURN CRANKSHAFT 280° COUNTERCLOCKWISE
1. Allen key 14 mm

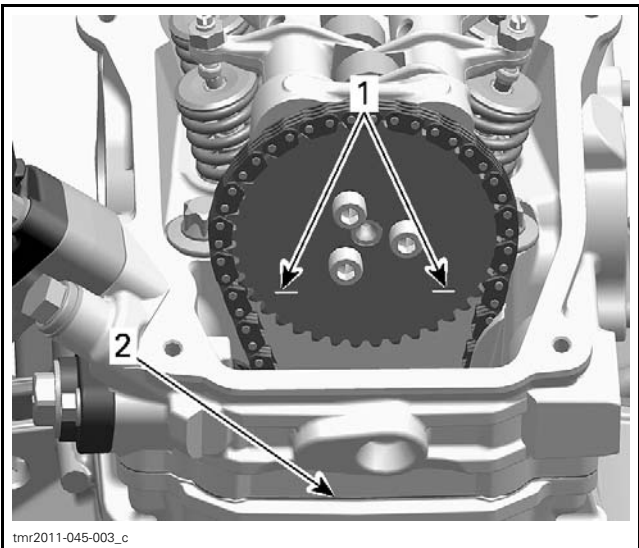
- 3.1 The front piston is at TDC when it's index mark on the magneto flywheel is aligned with the notch in the magneto cover.



CYLINDER 1 AT TDC IGNITION
1. Mark "1" on magneto flywheel
2. Notch on magneto cover
3. Location of crankshaft position sensor

- 3.2 Confirm printed marks on the camshaft timing gear are parallel with cylinder head base, in the lowest position.

NOTE: In this position the piston is set to TDC ignition.

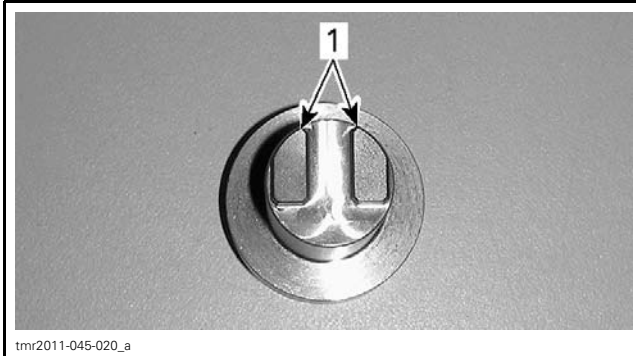


TYPICAL - PISTON AT TDC IGNITION
1. Printed marks on camshaft timing gear
2. Cylinder head base

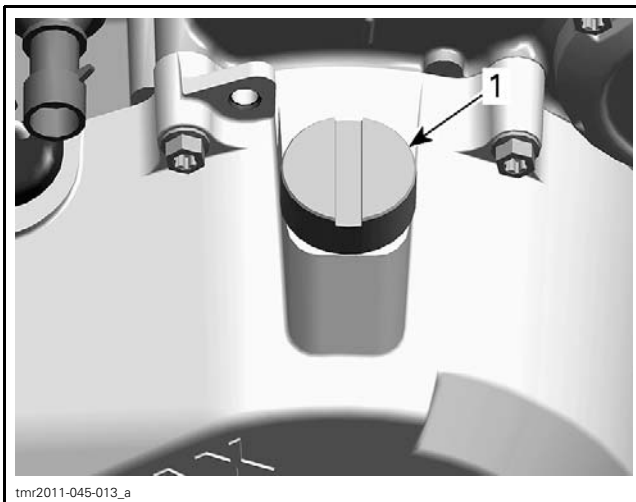
Crankshaft TDC Position Tool Installation
Install tool in magneto cover CPS bore.

REQUIRED TOOL	
CRANKSHAFT TDC POSITION TOOL (P/N 529 036 201)	

NOTE: Make sure to match the teeth on the crankshaft TDC position tool with the magneto rotor.



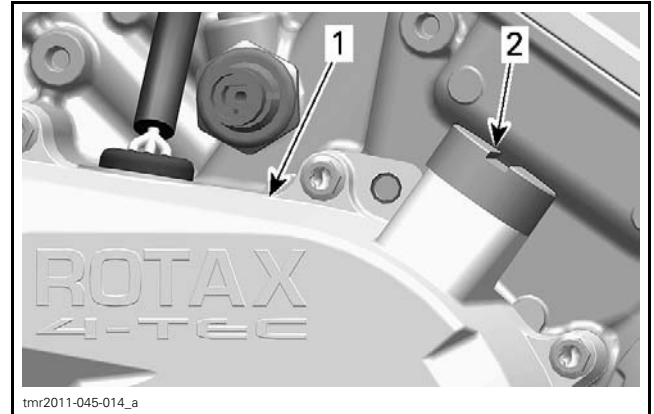
1. Crankshaft TDC position tool teeth (end view)



MAGNETO COVER

1. Crankshaft TDC position tool installed in CPS bore

NOTICE Tool must be fully inserted.



1. Magneto cover
2. TDC position tool

TIMING CHAIN

The engine is equipped with two timing chains.

- MAG side timing chain is located behind the magneto cover.
- PTO side timing chain is located behind the PTO cover.

Timing Chain Removal (MAG 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.

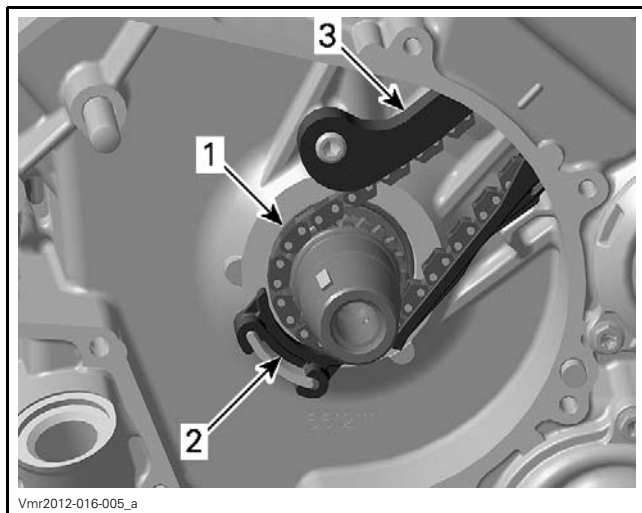
Refer to following procedures in this subsection and remove following parts:

- Chain tensioner
- Camshaft timing gear.

Remove timing chain guide (tensioner side) and lower timing chain guide.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 09 (TIMING CHAIN)



1. Timing chain
2. Lower timing chain guide
3. Timing chain guide (tensioner side)

NOTE: Mark the operating direction of the timing chain and check for excessive radial play before removal. Refer to *TIMING CHAIN INSPECTION*.

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.

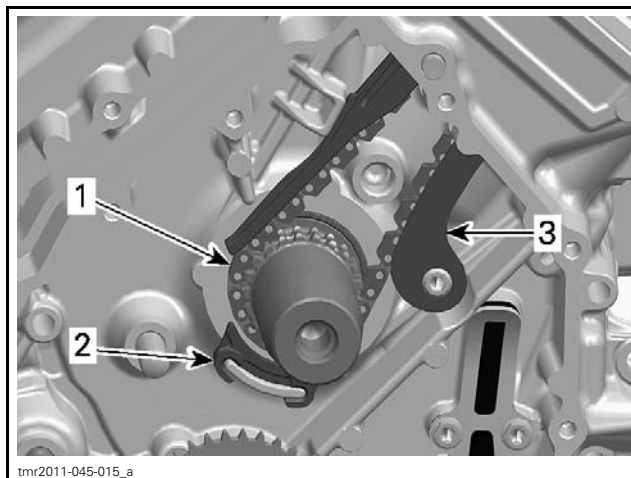
Refer to *TOP END* subsection and remove following parts:

- 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)

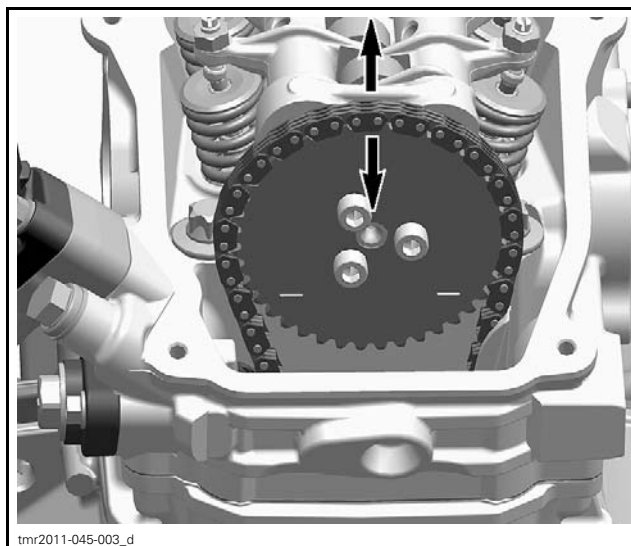
Carefully pull the timing chain sideward and down from the crankcase.

NOTE: Mark the operating direction of the timing chain and check for excessive radial play before removal. Refer to *TIMING CHAIN INSPECTION*.

Timing Chain Inspection

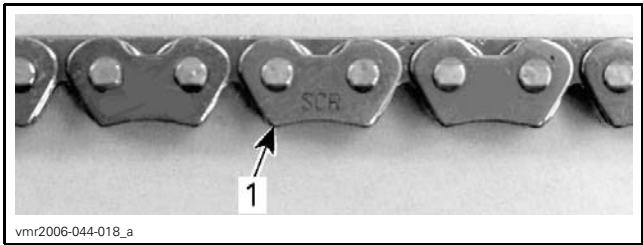
Inspection is the same for both timing chains.

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.

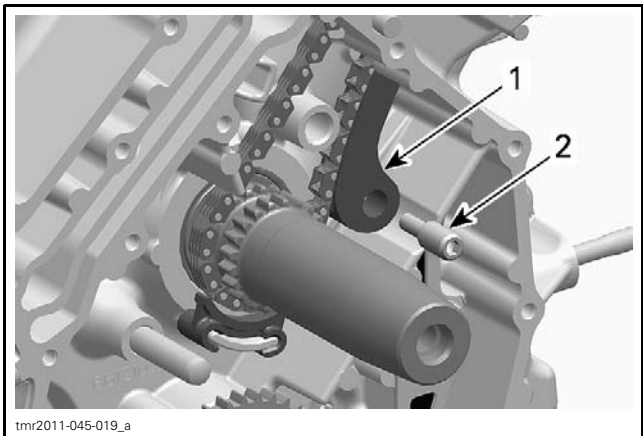
NOTE: Installation is the same for both timing chains.

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.

TIMING CHAIN GUIDE (TENSIONER SIDE)



1. Timing chain guide (tensioner side)
2. 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	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
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	151
CRANKSHAFT LOCKING BOLT	529 035 617	154
DRIVE SHAFT OIL SEAL INSTALLER	529 036 028	143–144
DRIVE SHAFT OIL SEAL PROTECTOR	529 036 029	142
PLAIN BEARING REMOVER/INSTALLER	529 035 917	151
PLAIN BEARING REMOVER/INSTALLER	529 036 032	146
PTO COVER OIL SEAL INSTALLER	529 036 033	145

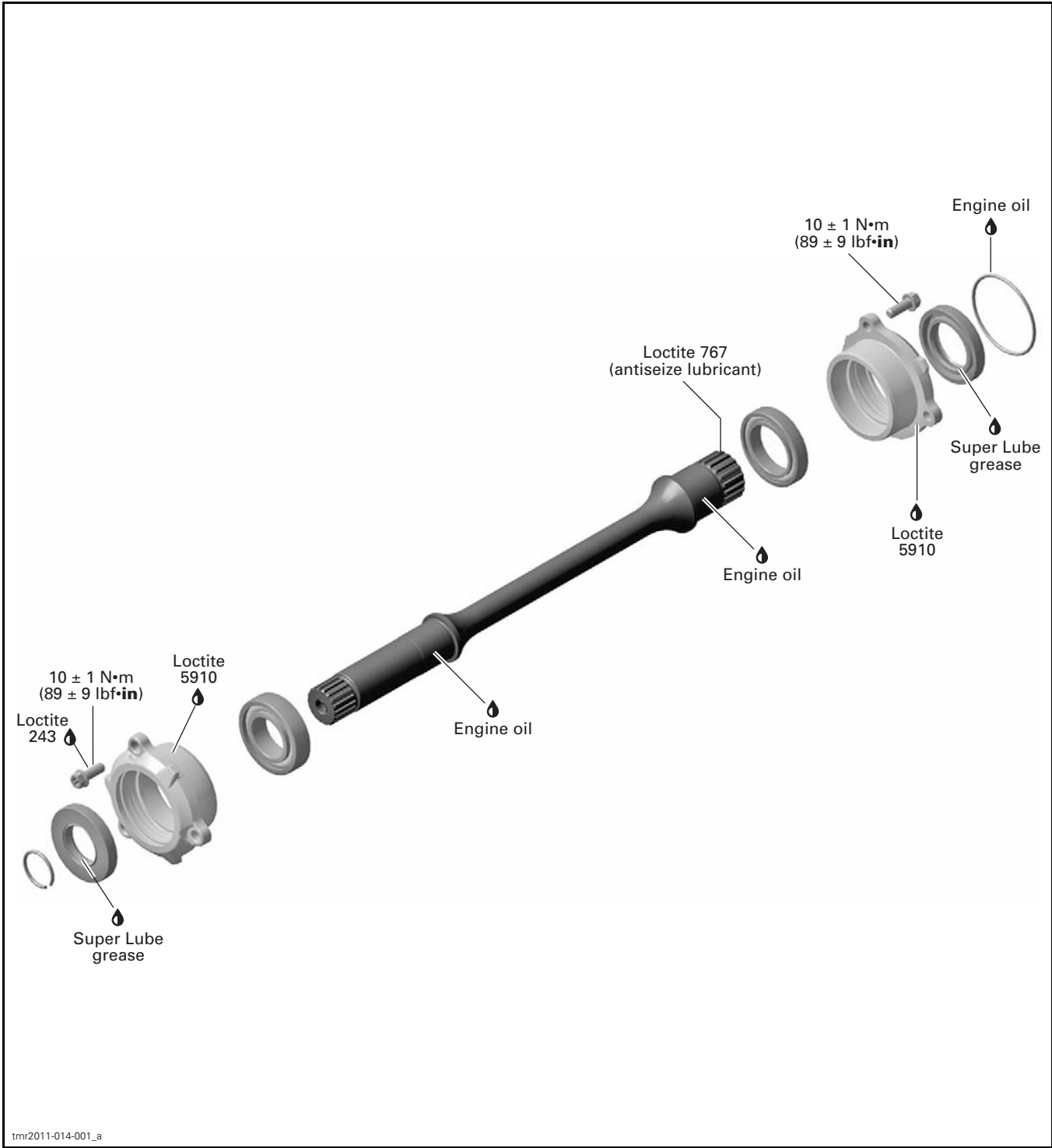
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	143
LOCTITE 5910	293 800 081	142
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	142

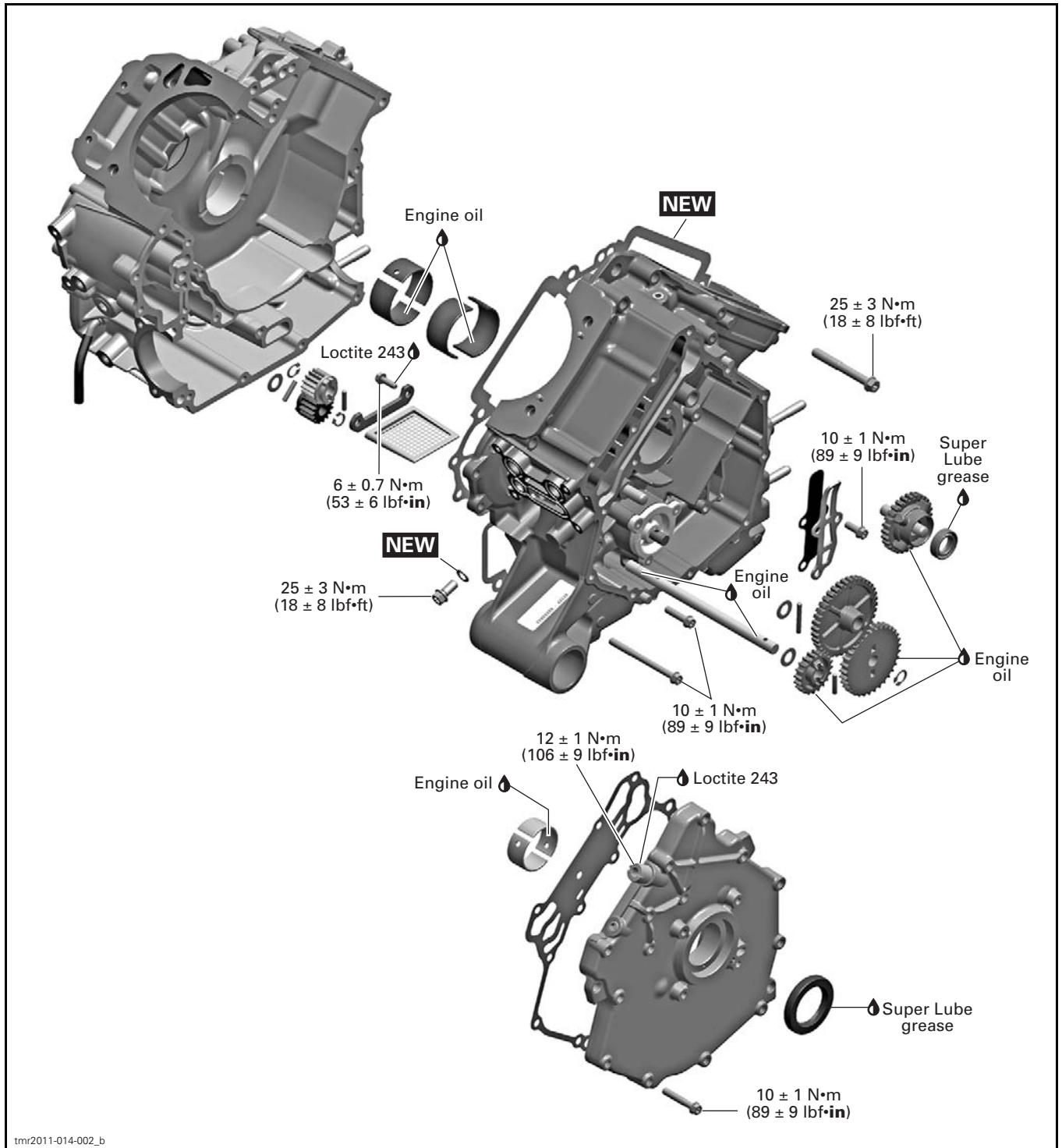
Section 02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)

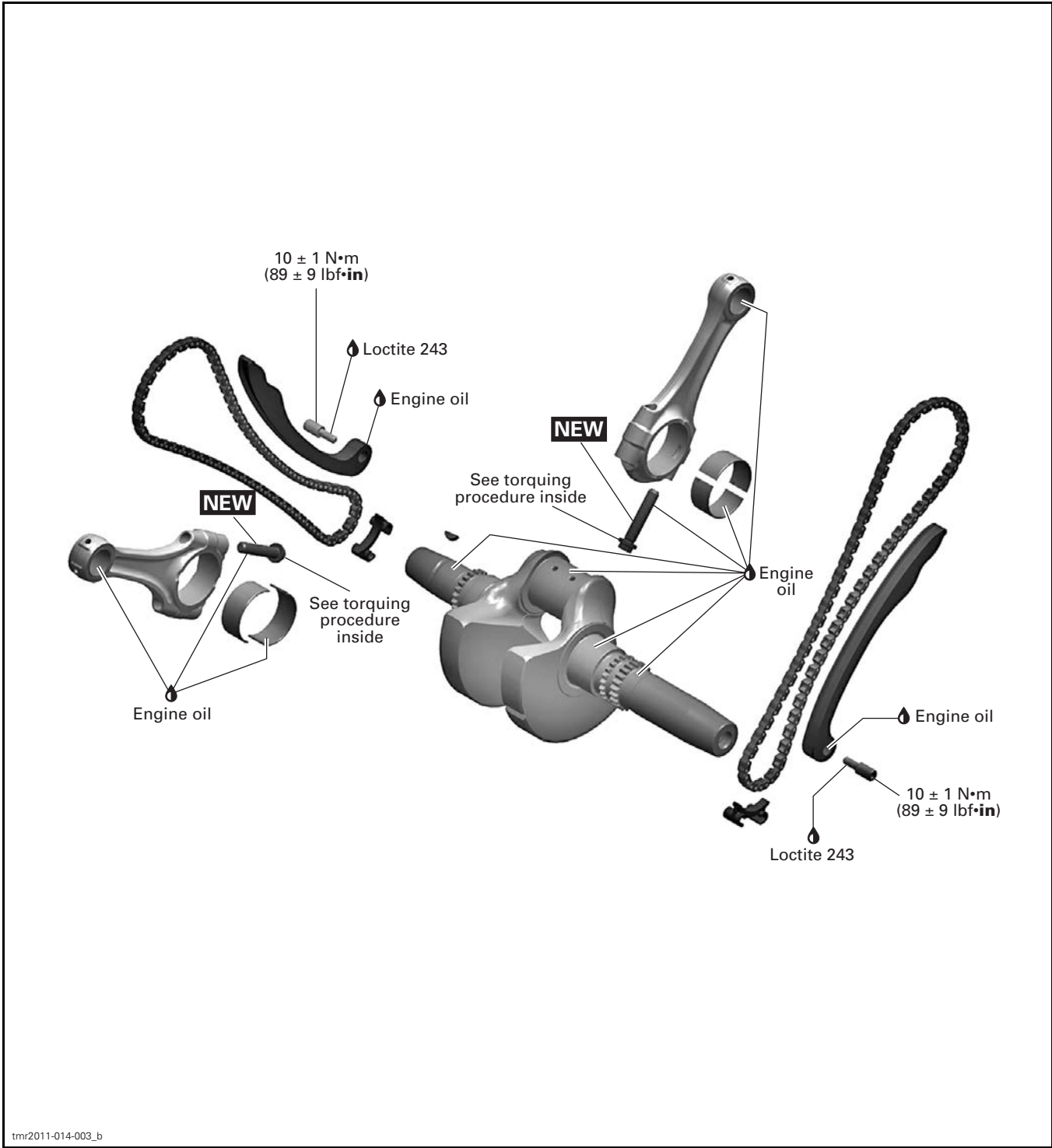
ENGINE DRIVE SHAFT



CRANKCASE AND PTO COVER



CRANKSHAFT



tmr2011-014-003_b

GENERAL

IMPORTANT: Note position of parts on disassembly. This may help to find the root cause of a problem. A component that is not replaced should be reinstalled in the same position as originally mounted.

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.

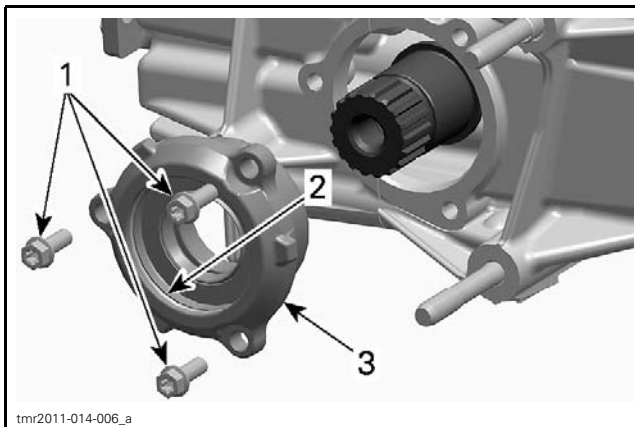
Engine Drive Shaft Removal

Remove the engine. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Rear Bearing Cover Removal

Detach gearbox from engine, refer to *GEARBOX AND 4X4 COUPLING UNIT* subsection.

At rear of engine, remove the bearing cover and its O-ring.

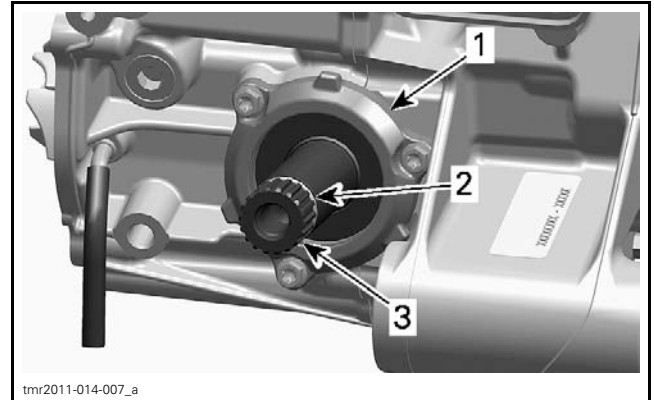


1. Bearing cover screws
2. O-ring
3. Bearing cover gearbox side

Front Bearing Cover Removal

Remove the bearing cover at the front of the engine.

NOTICE Check ends of the circlip for sharp edges or burr before removing the drive shaft, to avoid damaging the oil seal.

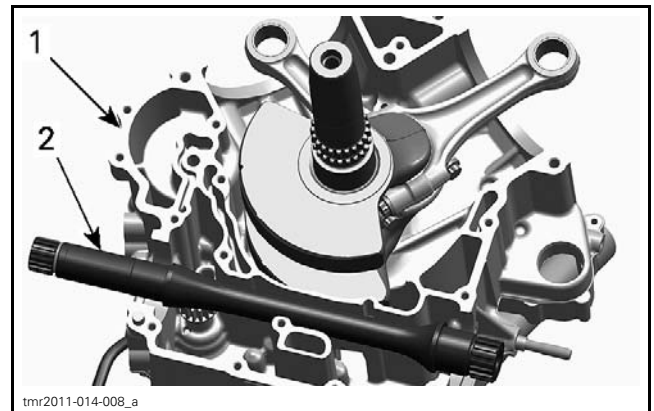


1. Bearing cover front drive side
2. Circlip
3. Drive shaft

Engine Drive Shaft Removal

Split crankcase, refer to *CRANKCASE* in this subsection.

Remove engine drive shaft from the crankcase.



1. Crankcase MAG side
2. Engine drive shaft

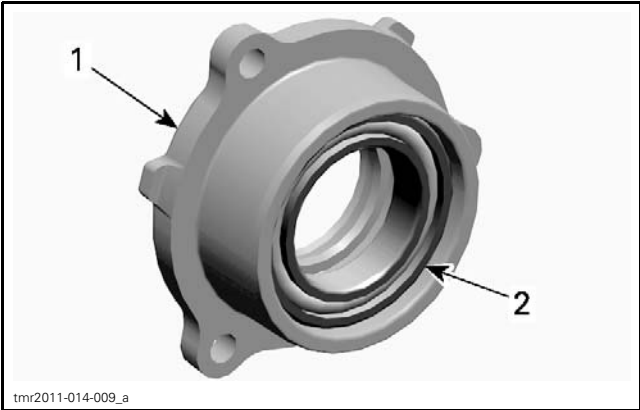
Engine Drive Shaft Inspection

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.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)



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.

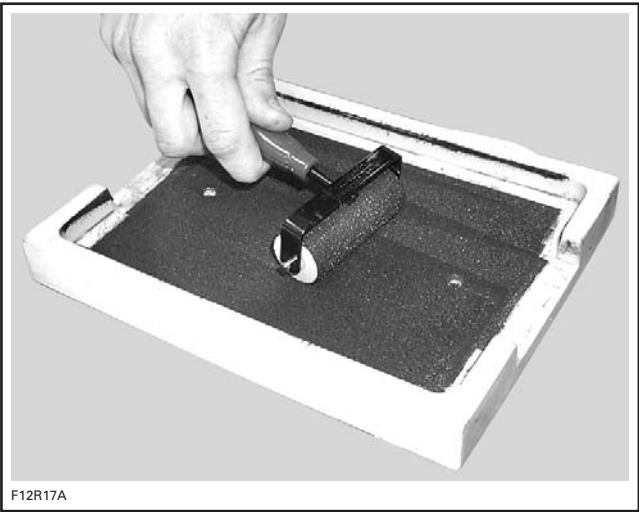
NOTICE Do not wipe with rags. Use a new clean hand towel only.

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.



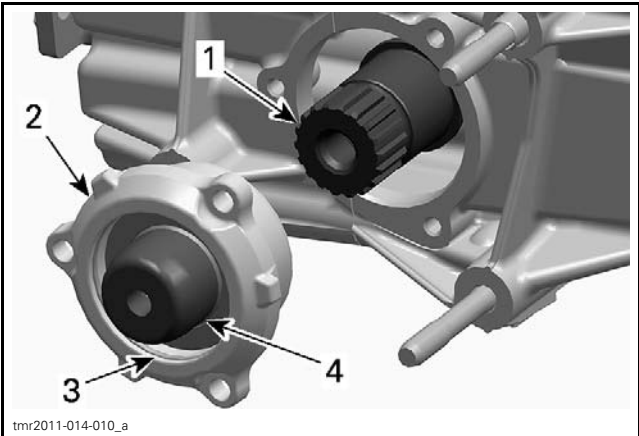
Do not apply in excess as it will spread out inside crankcase.

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).

Rear Bearing Cover Installation

For bearing cover installation on gearbox side, protect the oil seal to avoid damaging the sealing lip.

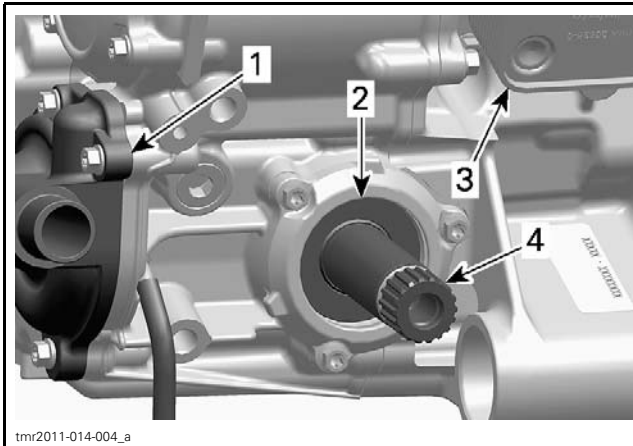
REQUIRED TOOL	
DRIVE SHAFT OIL SEAL PROTECTOR (P/N 529 036 029)	



1. Drive shaft
2. Bearing cover gearbox side
3. O-ring
4. Protection sleeve

REAR BEARING COVER SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Front Bearing Cover Installation



FRONT OF ENGINE
1. Water pump cover
2. Oil seal front side
3. Oil cooler
4. Drive shaft

FRONT BEARING COVER SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Engine Drive Shaft Installation

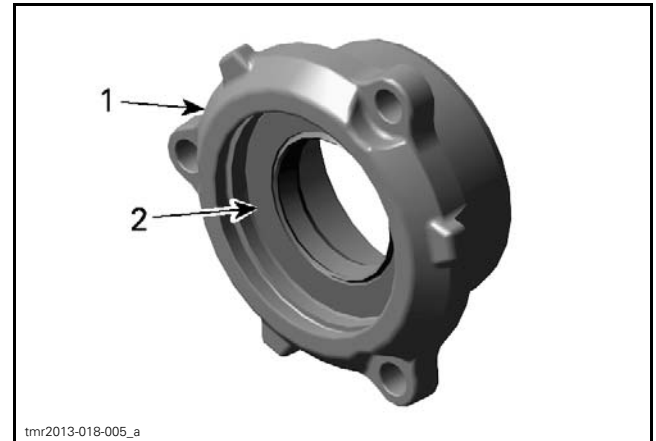
Finally check for axial play of the drive shaft.

FRONT OIL SEAL (ENGINE DRIVE SHAFT)

Front Oil Seal Replacement (Engine Drive Shaft)

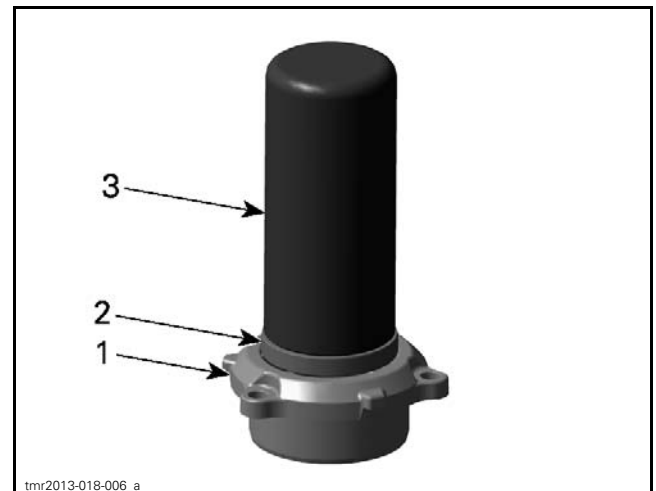
NOTE: The front oil seal can be replaced with the engine installed.

1. Remove front propeller shaft.
2. Remove adapter sleeve between propeller shaft and front engine drive shaft.
3. Remove the front bearing cover, refer to *ENGINE DRIVE SHAFT REMOVAL/INSTALLATION* in this subsection.
4. Remove drive shaft seal from bearing cover.



1. Bearing cover
2. Oil seal

5. Install drive shaft oil seal using the following tool.



1. Bearing cover
2. Oil seal
3. Oil seal installer

REQUIRED TOOL	
DRIVE SHAFT OIL SEAL INSTALLER (P/N 529 036 028)	

6. Reinstall remaining parts in the reverse order of removal.

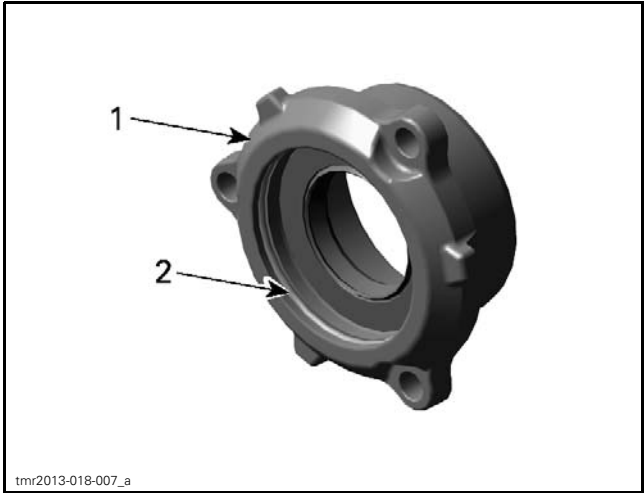
REAR OIL SEAL (ENGINE DRIVE SHAFT)

Rear Oil Seal Replacement (Engine Drive Shaft)

1. Remove rear bearing cover, refer to *ENGINE DRIVE SHAFT REMOVAL/INSTALLATION* in this subsection.
2. Remove drive shaft seal from bearing cover.
3. Remove O-ring from bearing cover.

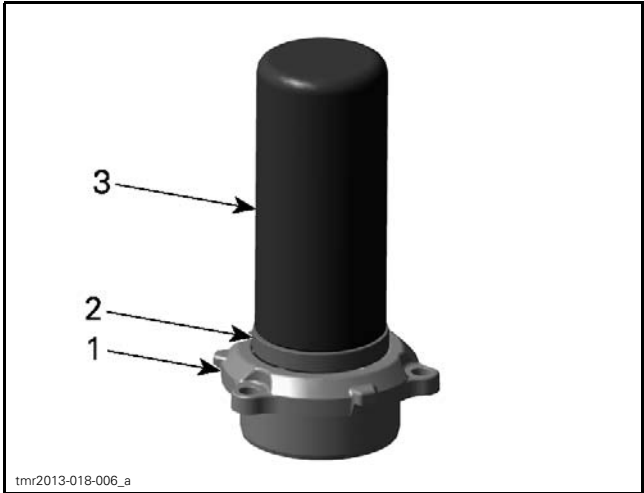
Section02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)



1. Bearing cover
2. O-ring

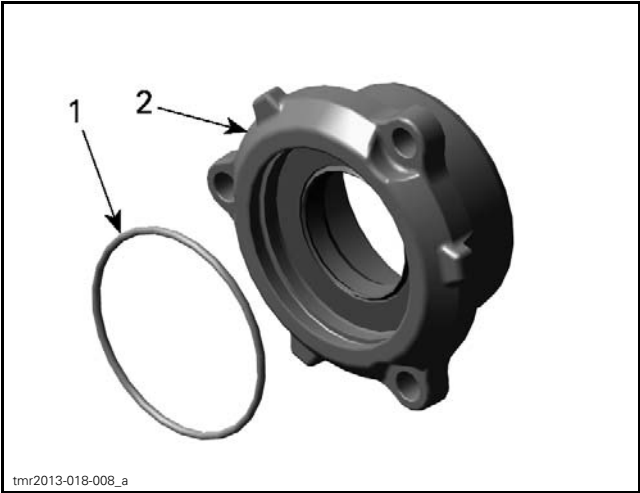
4. Install drive shaft oil seal using the following tool.



1. Bearing cover
2. Oil seal
3. Oil seal installer

REQUIRED TOOL	
DRIVE SHAFT OIL SEAL INSTALLER (P/N 529 036 028)	

5. Install O-ring in rear bearing cover.



1. O-ring
2. Bearing cover

6. Reinstall remaining parts in the reverse order of removal.

PTO COVER OIL SEAL

To replace oil seal it is not necessary to remove engine from vehicle.

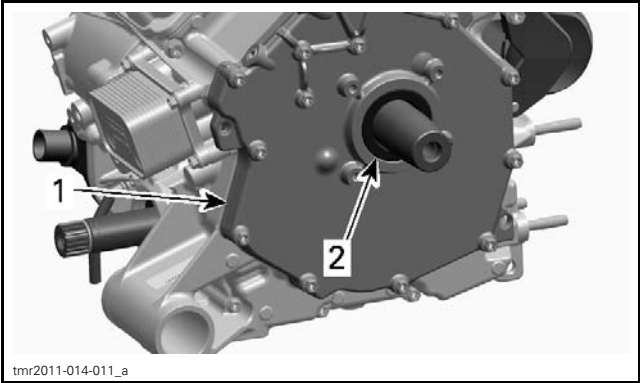
PTO Oil Seal Removal

Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (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 cover
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

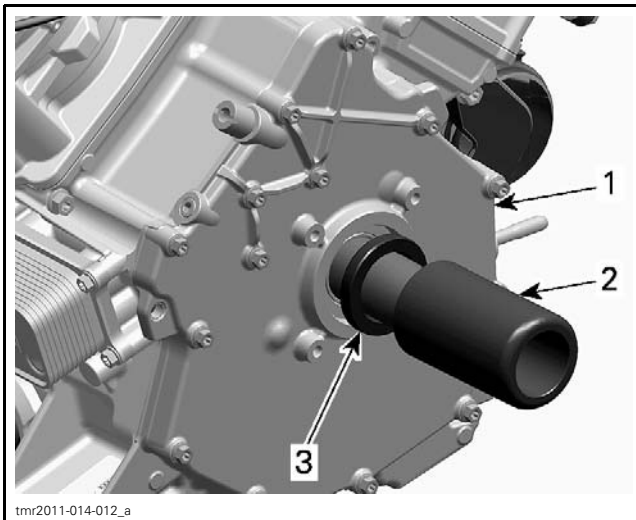
The installation is the reverse of the removal procedure.

Pay attention to the following details.

NOTICE Oil seal must be installed with sealing lip toward the engine.

Push oil seal in place.

REQUIRED TOOL	
PTO COVER OIL SEAL INSTALLER (P/N 529 036 033)	



1. PTO cover
2. Oil seal installer
3. Oil seal

PTO COVER

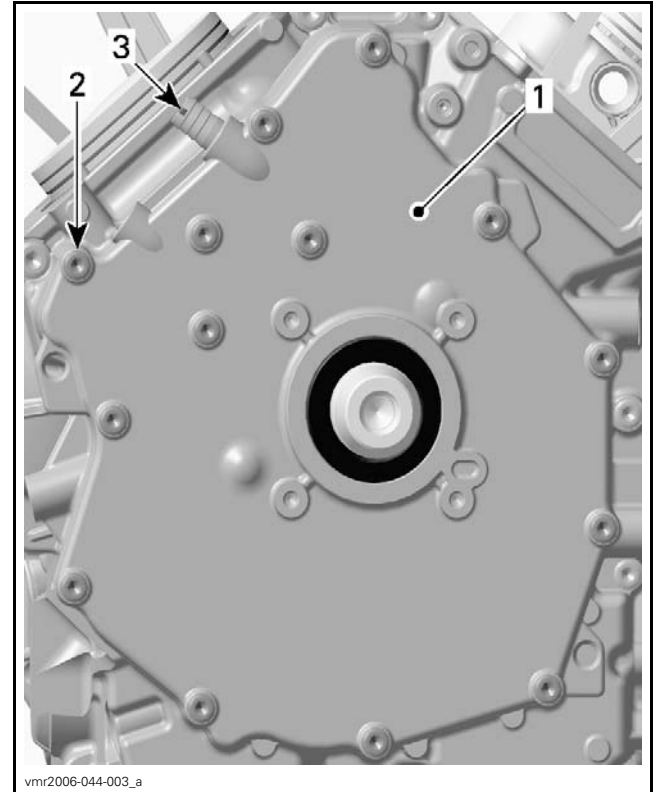
PTO Cover Removal

Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (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.

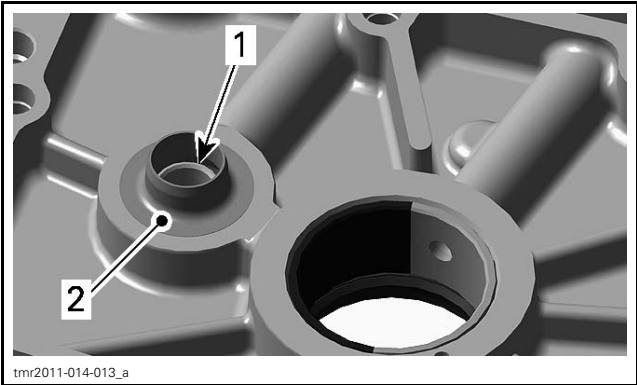
WARNING

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.

Section 02 ENGINE, CVT AND GEARBOX

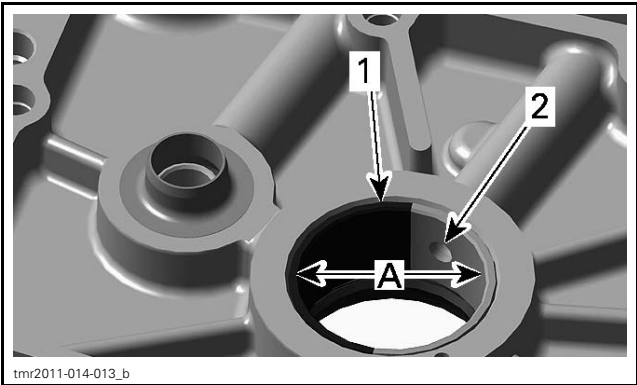
Subsection 10 (BOTTOM END)



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

PLAIN BEARING INSIDE DIAMETER (PTO COVER)	
SERVICE LIMIT	34.120 mm (1.3433 in)

Plain Bearing Replacement (PTO Cover)

Plain Bearing Removal

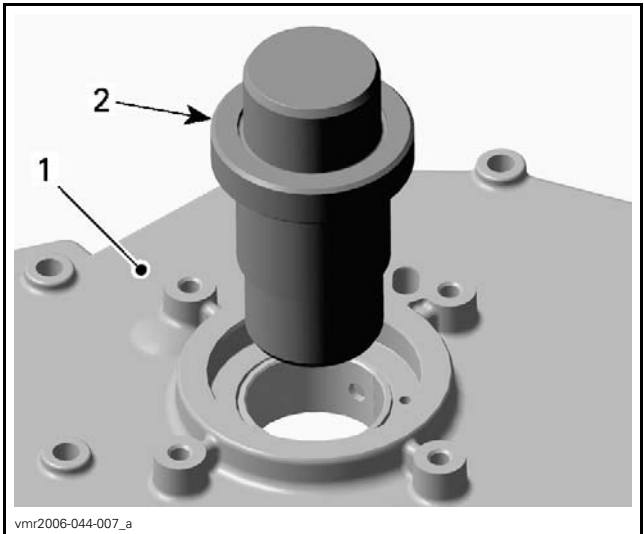
NOTICE Unless otherwise instructed, never use a hammer to install plain bearings. Use a press only.

Carefully remove the PTO oil seal with a screwdriver, without damaging the PTO cover.

Press out the plain bearings from the outside towards the inside.

REQUIRED TOOL	
PLAIN BEARING REMOVER/INSTALLER (P/N 529 036 032)	

The PTO cover has to be supported from below with suitable support with straight surface, in order to prevent damage of the sealing surface.



1. PTO cover
2. Plain bearing remover/installer

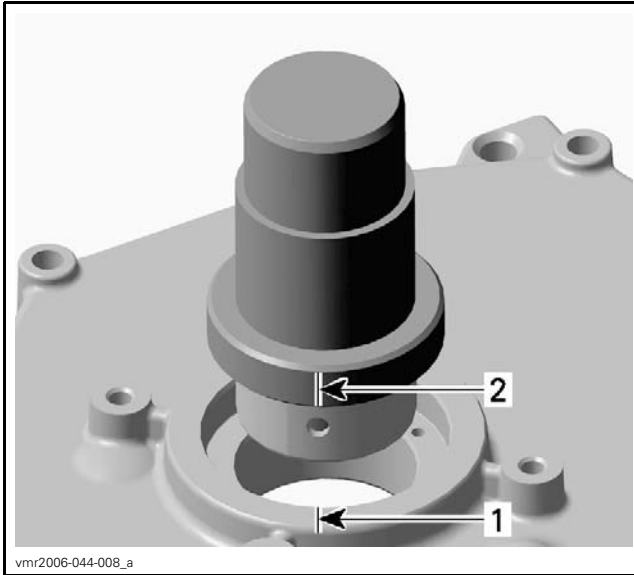
Plain Bearing Installation

NOTE: Do not lubricate plain bearings and/or PTO cover for installation.

Install plain bearings in a cool PTO cover.

REQUIRED TOOL	
PLAIN BEARING REMOVER/INSTALLER (P/N 529 036 032)	

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.

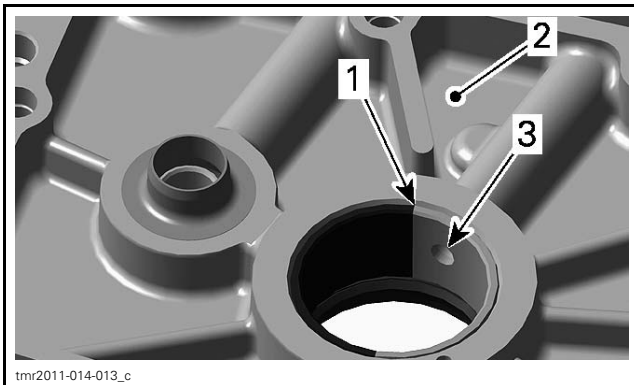


1. Mark position of oil bore on PTO cover
2. Mark position of oil bore on plain bearing remover/installer

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 counter-clockwise direction.



1. Partition
2. PTO cover (inside)
3. Oil bore

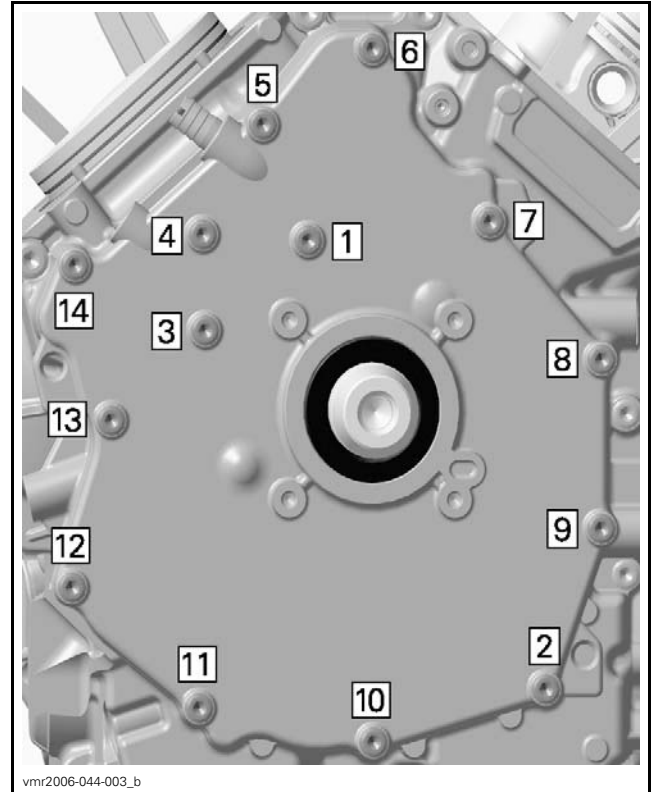
PTO Cover Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

NOTE: At installation, replace PTO cover gasket and oil seal.

Tighten PTO cover screws following the illustrated sequence.



TIGHTENING SEQUENCE

PTO COVER SCREWS	
Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

DRIVE GEARS

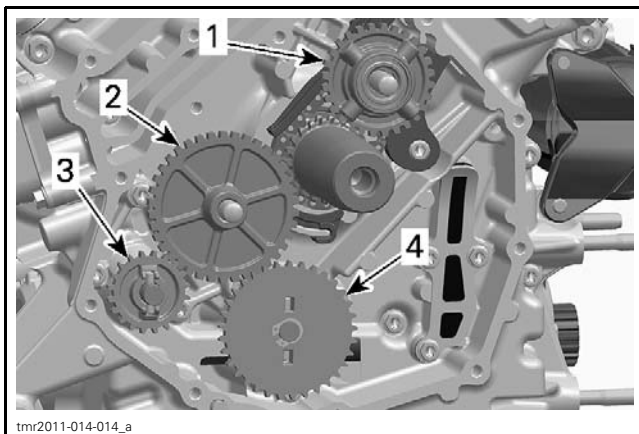
Drive Gears Location

The engine is equipped with a breather gear which prevents engine oil coming out through the breathing system into the air intake system.

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

Section 02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)



1. Breather gear
2. Intermediate gear
3. Water pump drive gear
4. Oil pump drive gear

Drive Gears Removal

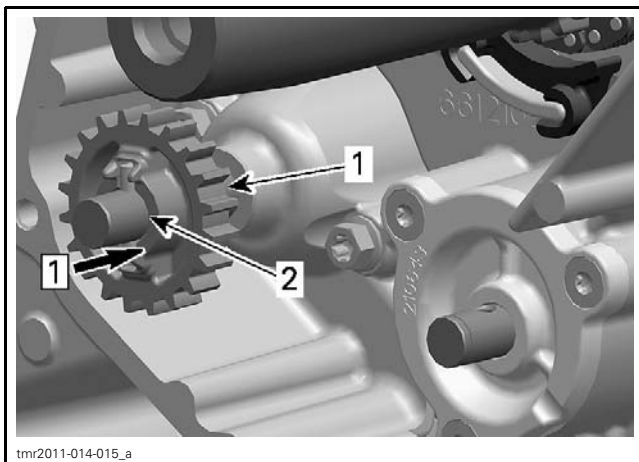
Remove PTO cover (refer to *PTO COVER*).

Withdraw intermediate gear and breather gear.

For oil pump drive gear removal, refer to *OIL PUMP* in the *LUBRICATION SYSTEM* subsection.

To remove water pump drive gear, pull the shaft assembly a bit out and turn it about one teeth until it stays out.

Then push water pump drive gear in.

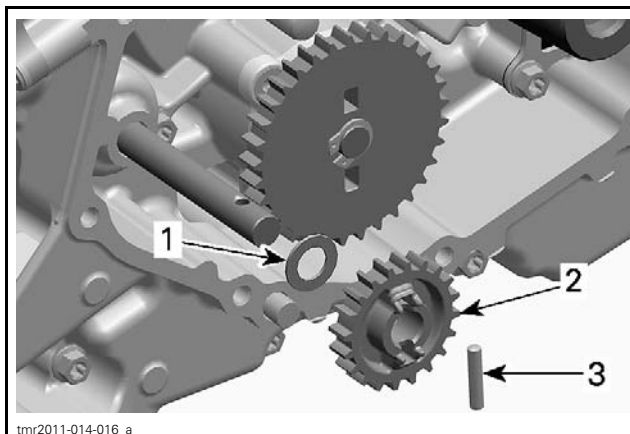


Step 1: Push gear in

1. Water pump drive gear
2. Intermediate shaft

Remove needle pin and pull water pump drive gear out.

Remove thrust washer from intermediate shaft.



1. Thrust washer
2. Water pump drive gear
3. Needle pin

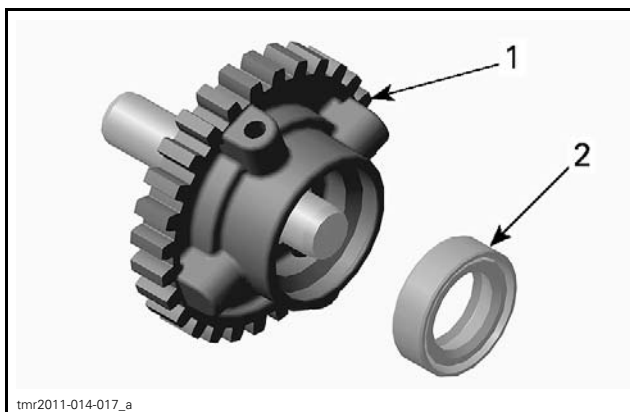
Drive Gears Inspection

Intermediate Gear/Oil Pump Drive Gear/Water Pump Drive Gear

Inspect gears for wear or other damage. Replace if damaged.

Breather Gear

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 Gears Installation

The installation is essentially the reverse of the removal procedure.

Adequately oil the ball bearing of the breather gear.

CRANKCASE

Crankcase Disassembly

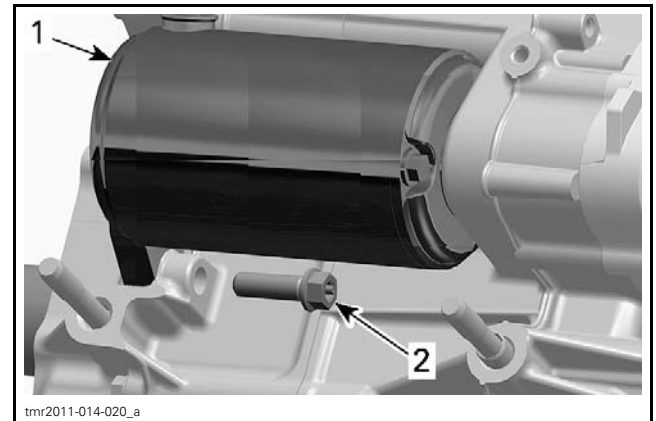
1. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection and:
 - 1.1 Drain cooling system.
 - 1.2 Drain engine oil.
 - 1.3 Drain gearbox oil.
2. Lock crankshaft. Refer to *CRANKSHAFT LOCKING PROCEDURE* in the this subsection.
3. Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection to remove following parts:
 - CVT cover
 - Drive pulley
 - Driven pulley
 - CVT air guide.
4. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
5. Detach gearbox from engine. Refer to *GEARBOX AND 4X4 COUPLING UNIT*.
6. Refer to *MAGNETO SYSTEM* subsection to remove the following parts:
 - Magneto cover
 - 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* subsection to remove following parts:
 - Chain tensioners
 - Camshaft timing gears
 - Timing chains
 - Timing chain guides.
9. Refer to *TOP END* subsection to remove following parts:
 - Front cylinder head
 - Rear cylinder head
 - Cylinders.
10. Refer to *COOLING SYSTEM* subsection to remove following parts:
 - Water pump housing.

11. Refer to *LUBRICATION SYSTEM* subsection 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* subsection).

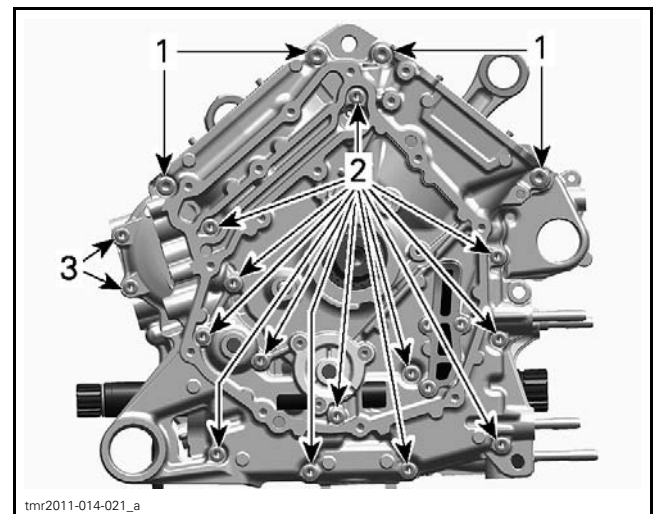
12. Remove electric starter.



1. Electric starter
2. Screw

NOTE: Before splitting the crankcase, measure crankshaft axial play. Refer to *CRANKSHAFT*.

Remove retaining screws of crankcase.

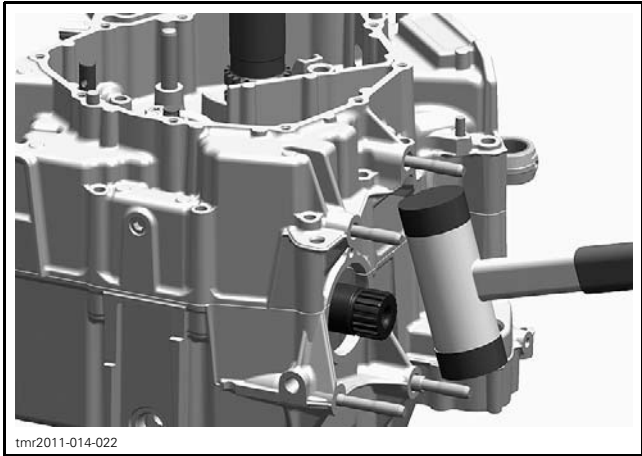


1. Four screws M8 x 65
2. 13 screws M6 x 75
3. Two screws M6 x 25

Carefully split crankcase halves by using a screwdriver and a soft hammer.

Section 02 ENGINE, CVT AND GEARBOX

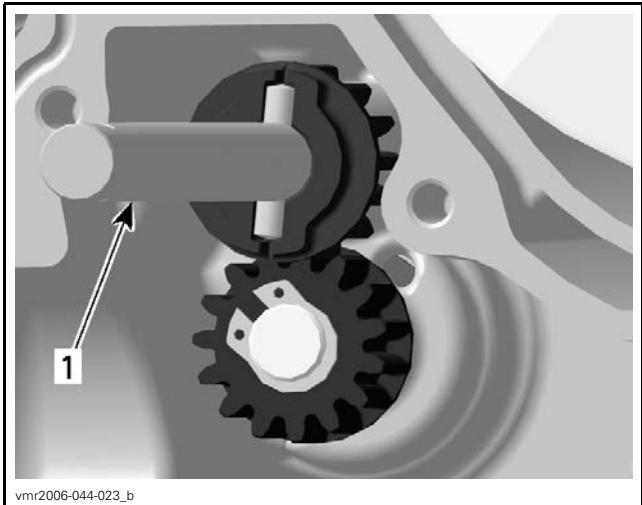
Subsection 10 (BOTTOM END)



NOTE: During disassembly, do not damage the sealing surfaces of the crankcase halves.

Pull crankshaft out of crankcase.

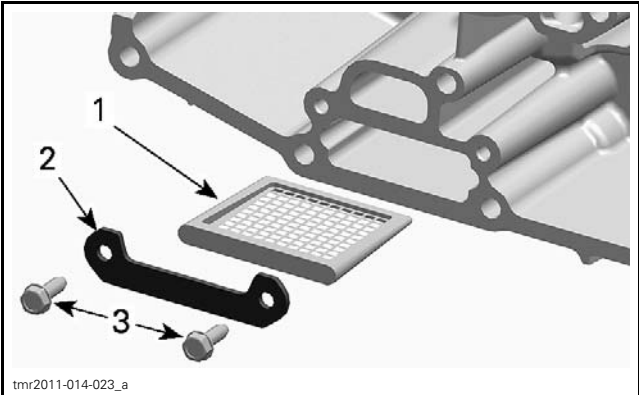
Remove the water pump intermediate shaft.



1. Water pump intermediate shaft

Remove engine oil strainer.

NOTE: Oil strainer removal for inspection and cleaning is recommended. Refer to *LUBRICATION SYSTEM* subsection.



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.

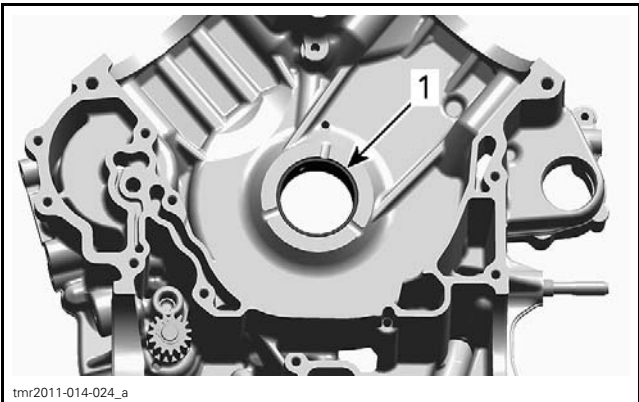
Dry crankcase using compressed air.

Blow the oil supply lines.

Crankcase Inspection

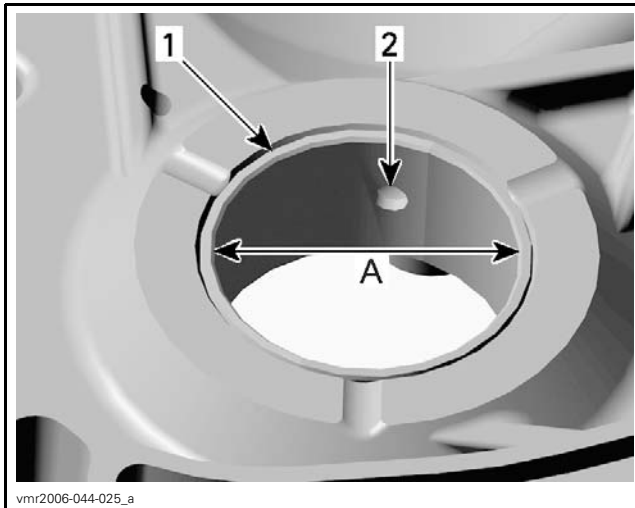
Check crankcase halves for cracks or other damage. Replace if damaged.

Check MAG and PTO plain bearings in for scoring 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

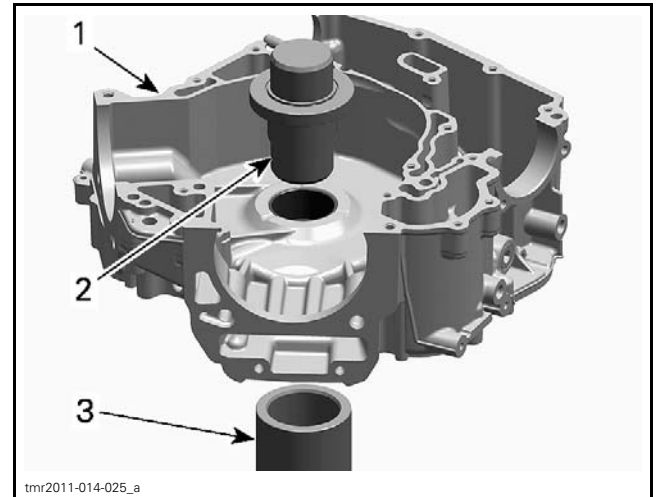
NOTICE Always support crankcase halves properly when plain bearings are removed. Damages to crankcase halves may occur if this procedure is not performed correctly.

NOTE: Always use a press for removal of plain bearings.

Carefully press the plain bearings out, from the crankcase half inside towards the outside.

REQUIRED TOOLS	
CRANKCASE SUPPORT MAG/PTO (P/N 529 036 031)	
PLAIN BEARING REMOVER/INSTALLER (P/N 529 035 917)	

NOTE: During disassembly, make sure not to damage the sealing surfaces of the crankcase halves.



- PUSH PLAIN BEARINGS OUTSIDE**
 1. Crankcase half
 2. Plain bearing remover/installer
 3. Crankcase support sleeve (P/N 529 036 031)

Plain Bearing Installation (Main)

NOTICE Unless otherwise instructed, never use hammer to install plain bearings. Use press only.

NOTE: Place the proper crankcase support sleeve under crankcase halves before installing the plain bearings (refer to *BEARING REMOVAL PROCEDURE*).

Carefully press in the plain bearings in the same direction as during disassembly, from the crankcase inside towards the outside.

During reassembly, make sure not to damage the sealing surfaces of the crankcase halves.

Install plain bearings in a cold crankcase.

NOTE: Do not lubricate plain bearings and/or crankcase for installation.

REQUIRED TOOL	
PLAIN BEARING REMOVER/INSTALLER (P/N 529 035 917)	

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.

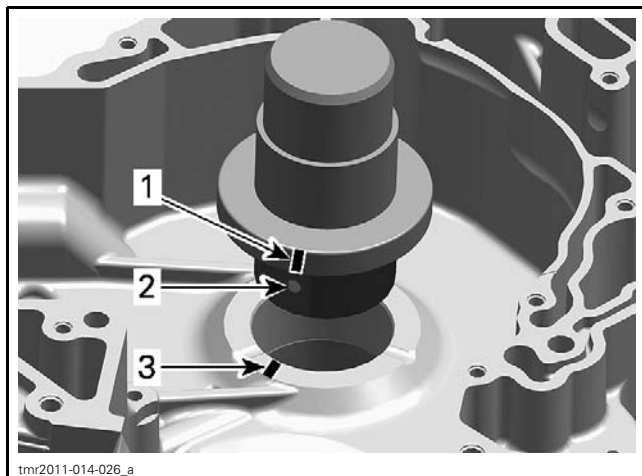
Mark position of plain bearing oil bore on plain bearing remover/installer.

Mark position of oil bore on crankcase half.

Align mark on plain bearing remover/installer with mark on crankcase half.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)

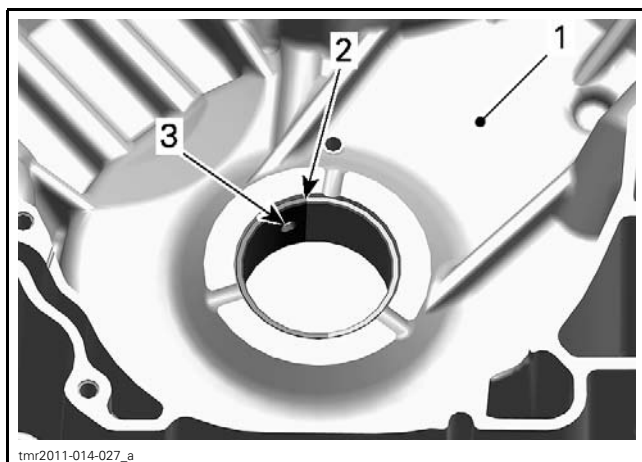


1. Oil bore position marked on plain bearing remover/installer
2. Plain bearing oil bore
3. Oil bore position marked on crankcase

NOTICE Misalignment of the plain bearing and crankcase oil bores will prevent proper oil supply to plain bearings.

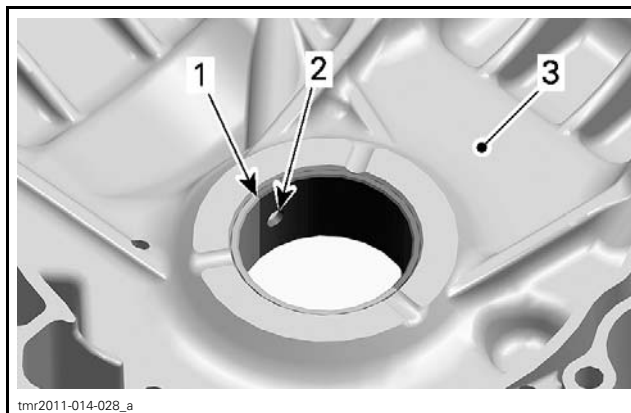
Carefully press in the plain bearings from inside the crankcase towards the outside.

NOTICE The partition of the plain bearings in crankcase half MAG side must be positioned near to oil bore in clockwise direction.



1. Crankcase half MAG (inside surface)
2. Partition
3. 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.

Install a **NEW** crankcase gasket.

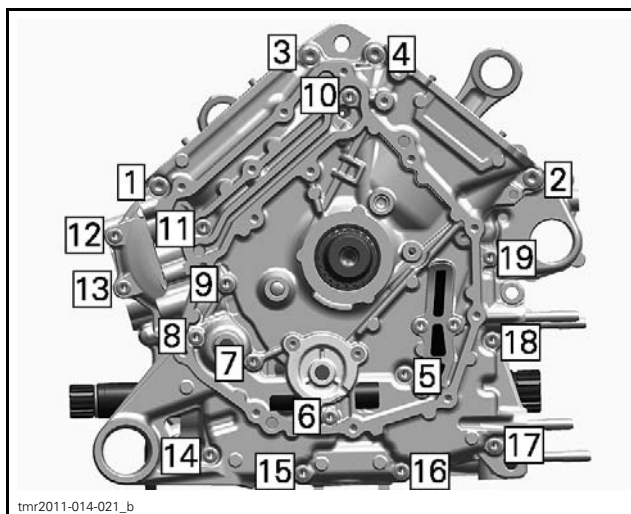
Oil the plain bearings before mounting the crankshaft.

NOTICE Correctly reinstall crankshaft (refer to *CRANKSHAFT*).

Properly reinstall engine oil strainer and screws. Refer to *LUBRICATION SYSTEM* subsection.

Reinstall water pump intermediate shaft and gears. Refer to *WATER PUMP GEARS* in the *COOLING SYSTEM* subsection.

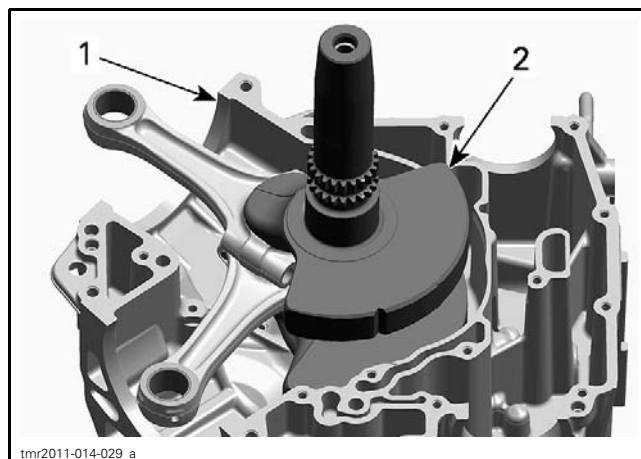
Tightening sequence for screws on crankcase is as per following illustration.



TIGHTENING SEQUENCE

CRANKCASE SCREWS	
Tightening torque - M6	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)
Tightening torque - M8	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)

CRANKSHAFT



1. Crankcase MAG
2. Crankshaft

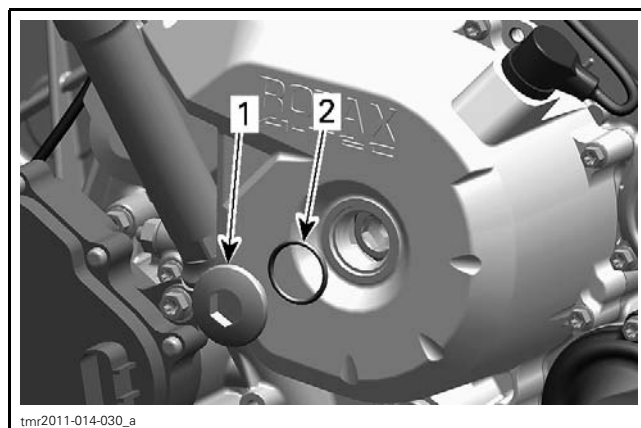
Crankshaft Locking Procedure

NOTE: When crankshaft is locked, the rear piston no. 2 is at TDC. Crankshaft can not be locked at piston no.1 TDC.

NOTICE To see if the rear piston no. 2 is at TDC ignition refer to **CAMSHAFT TIMING GEAR** in the **TIMING CHAIN** subsection.

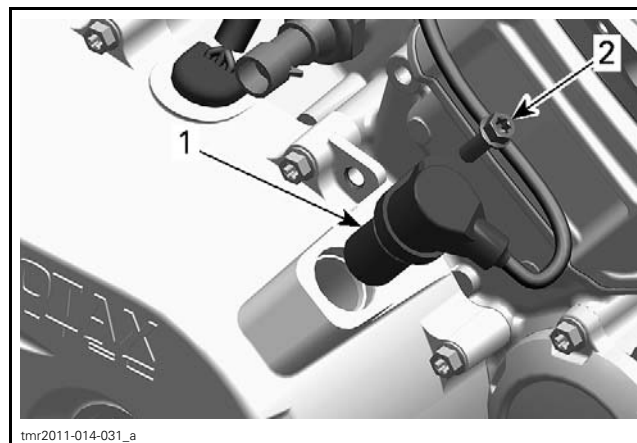
Remove:

1. Spark plug cables and spark plugs of both cylinders.
2. Plug screw and O-ring of magneto cover.



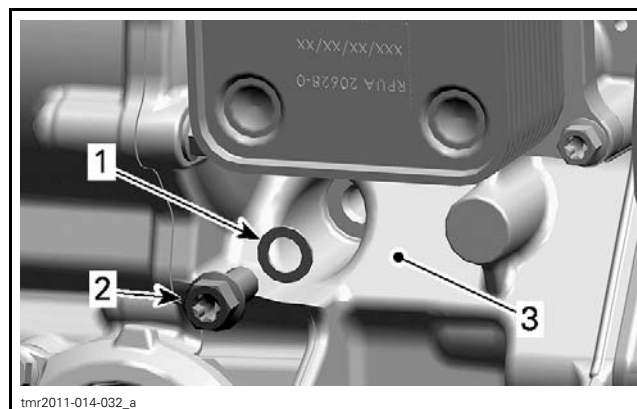
1. Plug screw
2. O-ring

3. Crankshaft position sensor.



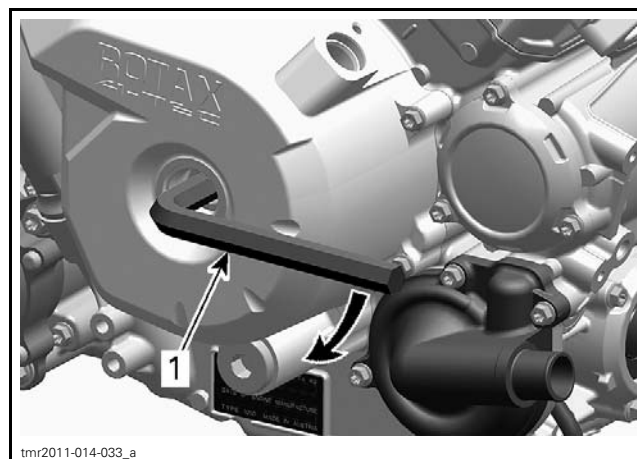
1. Crankshaft position sensor
2. Screw

4. Plug screw and discard sealing ring.



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

Use a 14 mm Allen key to turn crankshaft until piston no. 2 is at TDC.

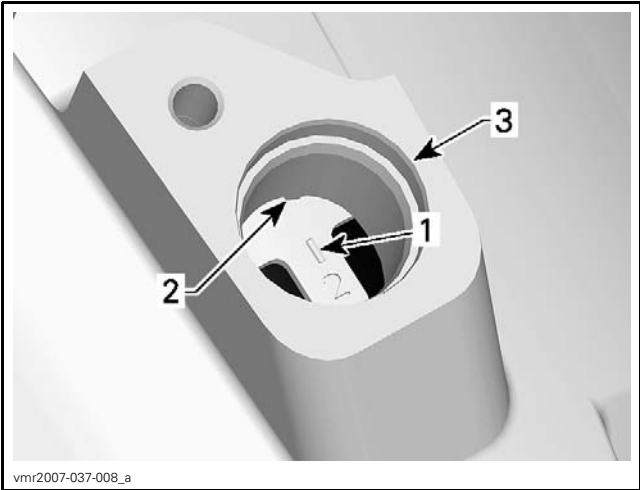


1. Allen key 14 mm

When rear piston is at TDC marks on magneto fly-wheel "2" and on the magneto cover are aligned.

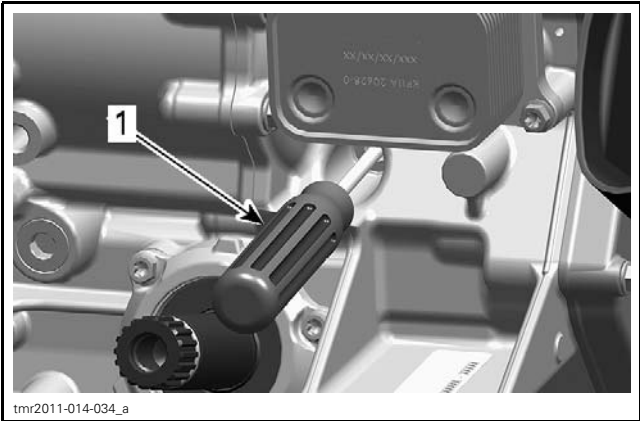
Section 02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)



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

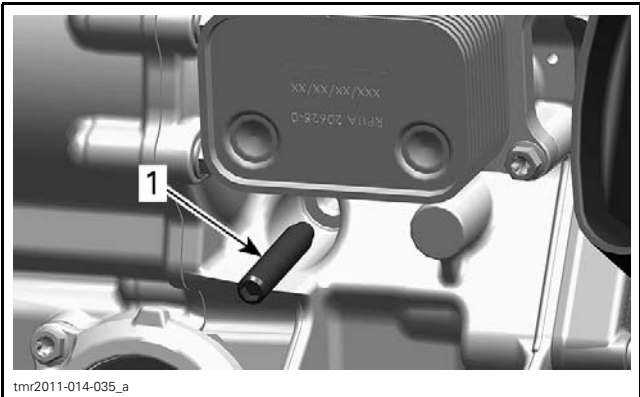
Use a screwdriver to check if the groove in the crankshaft is aligned with the hole.



- 1. Screwdriver

Lock crankshaft.

REQUIRED TOOL	
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

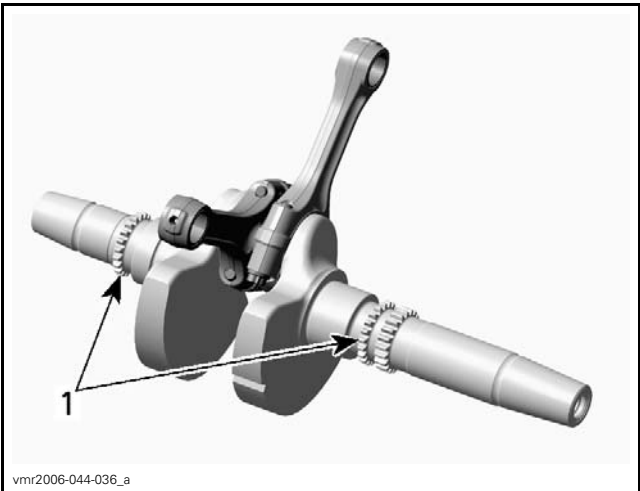
Refer to *CRANKCASE*.

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.

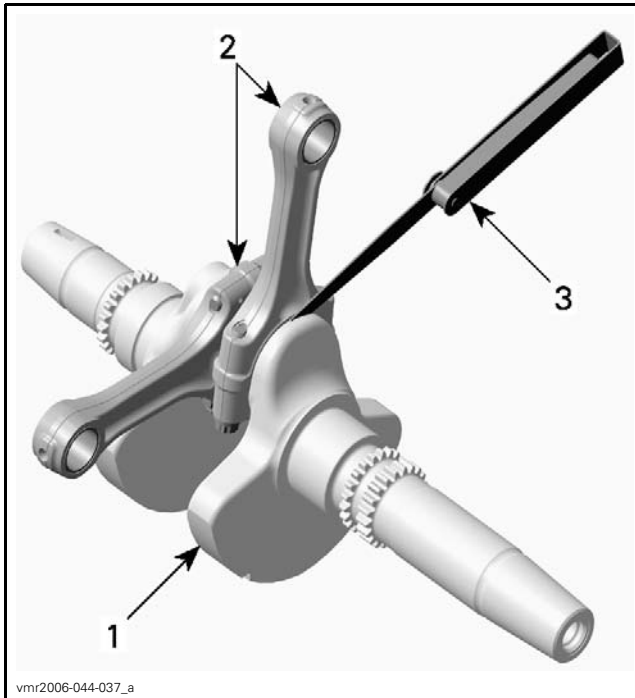
Measure play on PTO end, using a dial indicator.

CRANKSHAFT AXIAL PLAY	
NEW	0.200 mm to 0.500 mm (.008 in to .02 in)
SERVICE LIMIT	0.600 mm (.024 in)

If play is out of specification, replace crankcase and/or crankshaft.

Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between butting face of connecting rods and crankshaft counterweight. If the distance exceeds specified tolerance, replace the crankshaft.



- 1. Crankshaft
- 2. Connecting rods
- 3. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY		
800R ENGINE	NEW	0.200 mm to 0.500 mm (.008 in to .02 in)
	SERVICE LIMIT	0.600 mm (.024 in)
1000 ENGINE	NEW	0.250 mm to 0.550 mm (.01 in to .022 in)
	SERVICE LIMIT	0.600 mm (.024 in)

Connecting Rod/Piston Pin Clearance

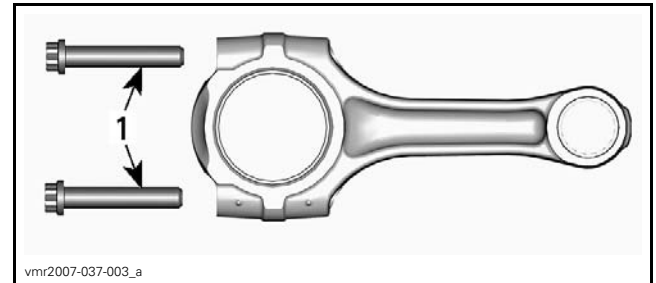
Refer to *TOP END* section.

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).

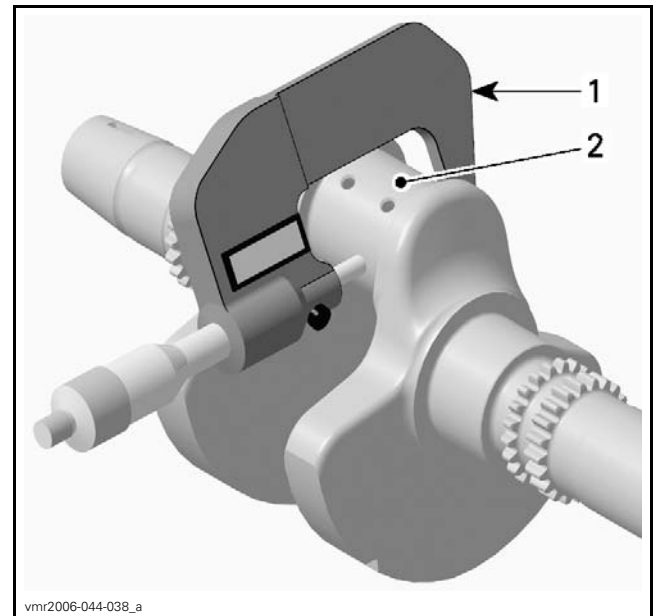
Remove connecting rods from crankshaft.

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

CRANK PIN DIAMETER		
800R ENGINE	NEW	40.009 mm to 40.025 mm (1.5752 in to 1.5758 in)
	SERVICE LIMIT	39.990 mm (1.5744 in)
1000 ENGINE	NEW	41.986 mm to 42.010 mm (1.653 in to 1.6539 in)
	SERVICE LIMIT	41.967 mm (1.6522 in)

If the crank pin diameter is out of specification, replace crankshaft.

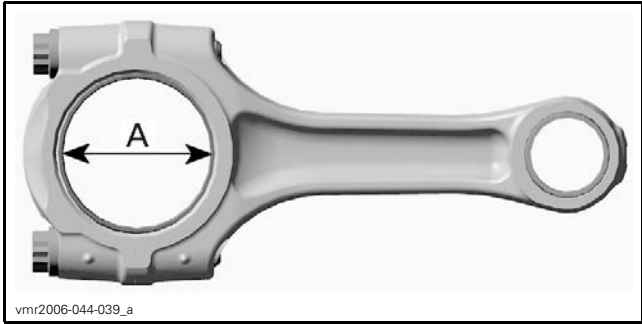
To measure the connecting rod big end diameter, use the OLD connecting rod screws.

Install the OLD plain bearings as they were mounted initially.

Carry out the tightening procedure described in *CRANKSHAFT ASSEMBLY* in this subsection.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)



A. Connecting rod big end plain bearing

CONNECTING ROD BIG END DIAMETER		
800R ENGINE	SERVICE LIMIT	40.100 mm (1.5787 in)
1000 ENGINE		42.100 mm (1.6575 in)

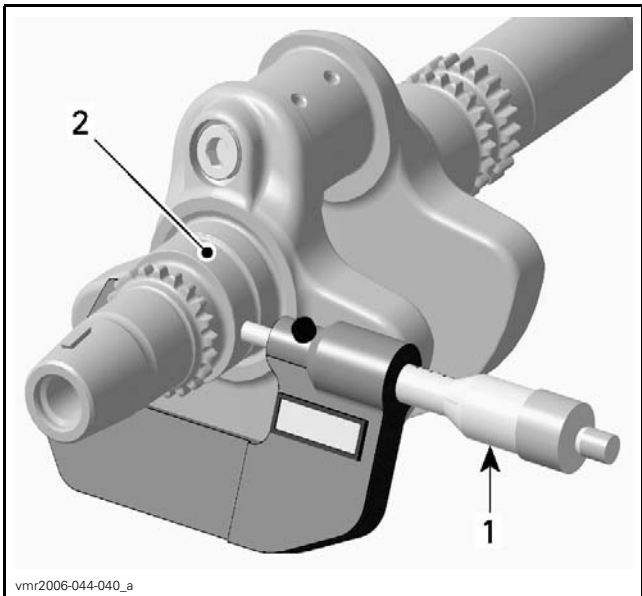
If connecting rod big end diameter is out of specification, replace plain bearings and recheck.

CONNECTING ROD BIG END RADIAL CLEARANCE		
800R/1000 ENGINES	SERVICE LIMIT	0.09 mm (.0035 in)

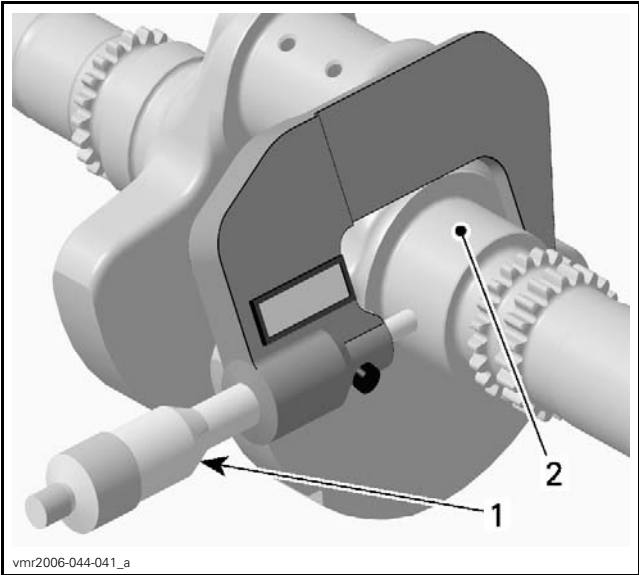
If connecting rod big end radial clearance is out of specification, replace plain bearings and recheck.

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



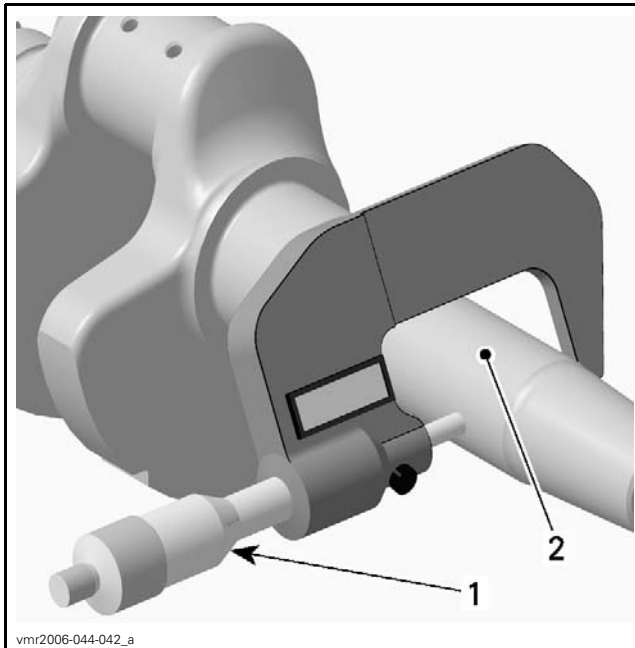
1. Micrometer
2. Crankshaft area for PTO plain bearing

CRANKSHAFT MAIN BEARING JOURNAL DIAMETER (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 RADIAL 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)

CRANKSHAFT JOURNAL DIAMETER (PTO COVER BEARING)	
NEW	34.004 mm to 34.020 mm (1.3387 in to 1.3394 in)
SERVICE LIMIT	33.998 mm (1.3385 in)

CRANKSHAFT RADIAL PLAY (PTO COVER BEARING)	
SERVICE LIMIT	0.10 mm (.0039 in)

If crankshaft journal diameter is out of specification, replace crankshaft.

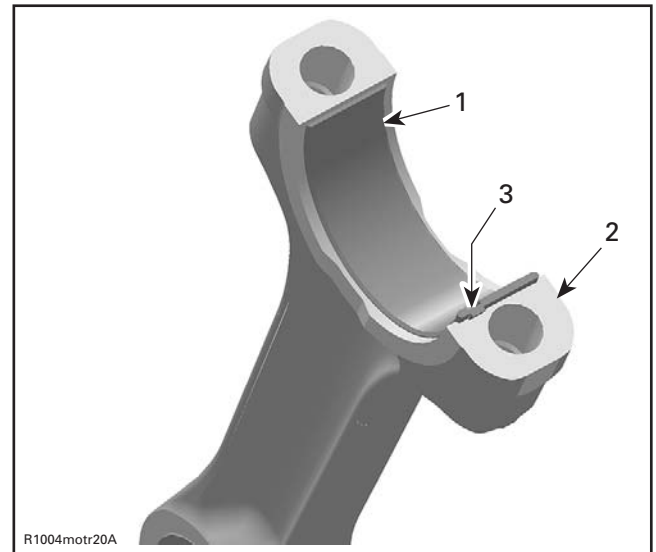
If crankshaft radial play (PTO cover bearing) out of specification, replace plain bearings and recheck.

Crankshaft Assembly

For assembly, reverse the disassembly procedure. Pay attention to following details.

Clean the split surface on both sides (cracked area) carefully with compressed air.

Put plain bearings correctly in place.



1. Half plain bearing of connecting rod big end
2. Split surface of the connecting rod
3. Nose of plain bearing in line with connecting rod groove

Oil the plain bearing surface of the connecting rod and crank pin before installation.

NOTICE Lower cap and rod must match together since there is a cracked surface.

Oil NEW connecting rod screws.

NOTICE Always use NEW connecting rod screws at final assembly. They are not reusable.

Thread screws in the connecting rods, then tighten as per following procedure.

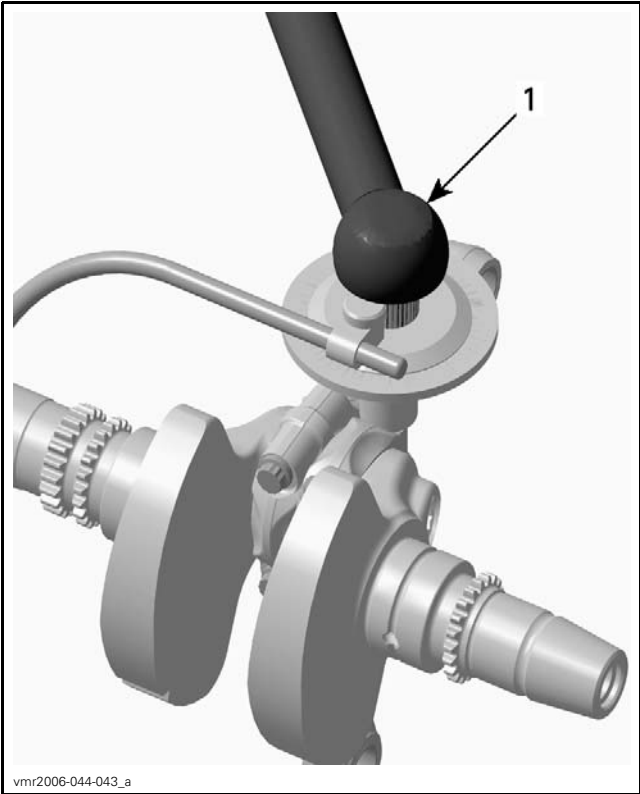
NOTICE Strictly adhere following instructions:

- Do not apply any thread locker.
- The running direction of the big end bearings and of the piston pins must not change.
- Always perform each step on both connecting rod screws before going to the next step.
- Failure to strictly follow procedure may cause connecting rod screws to loosen and lead to severe engine damage.

REQUIRED TOOLS
Torque wrench
Angle torque wrench

Section02 ENGINE, CVT AND GEARBOX

Subsection 10 (BOTTOM END)



1. Angle torque wrench

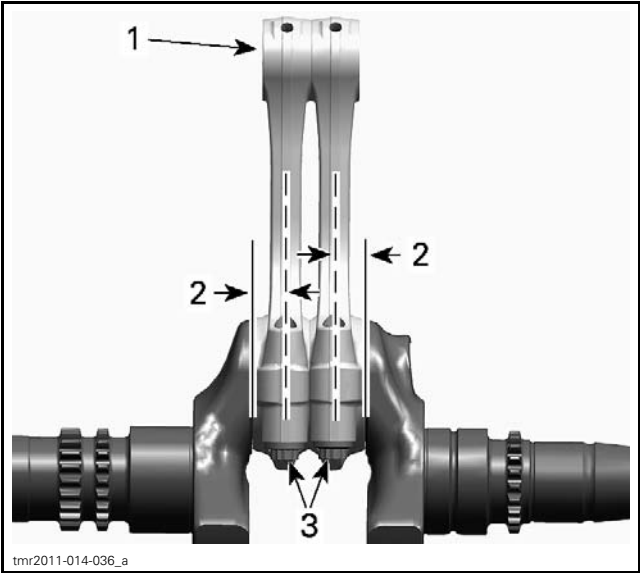
800R Engine:

NOTE: NEW connecting rods can be installed either way.

CONNECTING 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

1000 Engine:

NOTICE Connecting rods are asymmetric. There must be no gap between the small ends when they face each other.



- 1. Connecting rod small ends
- 2. Connecting rod offset
- 3. Connecting rod screws

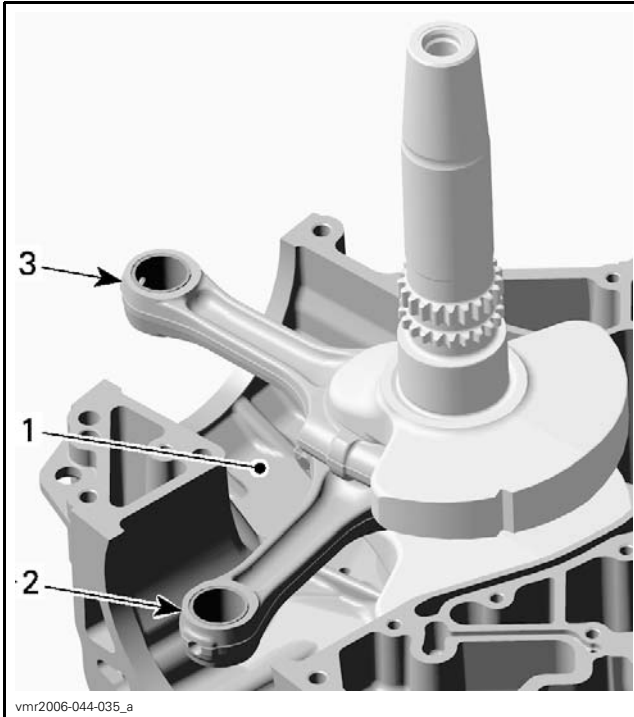
CONNECTING RODS SCREWS TIGHTENING SEQUENCE	
1.	Tighten to 1/2 of specified torque
2.	Tighten to 30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)
3.	Torque by an additional 90 ± 5° turn using an angle torque wrench

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 no. 1.



1. Crankcase half MAG side
2. Connecting rod cylinder 1
3. Connecting rod cylinder 2

GEARBOX AND 4X4 COUPLING UNIT

SERVICE TOOLS

Description	Part Number	Page
BLIND HOLE BEARING PULLER SET.....	529 036 117	199
COUNTERSHAFT OIL SEAL PUSHER	529 036 222	192
ECM ADAPTER TOOL.....	529 036 166	188
FLUKE 115 MULTIMETER	529 035 868	186, 190
HANDLE	420 877 650	192
OIL SEAL INSTALLER (GEARBOX)	529 035 758	192
OIL SEAL INSTALLER	529 036 204	193

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
BACK PROBE TEST WIRES	529 036 063	186, 188

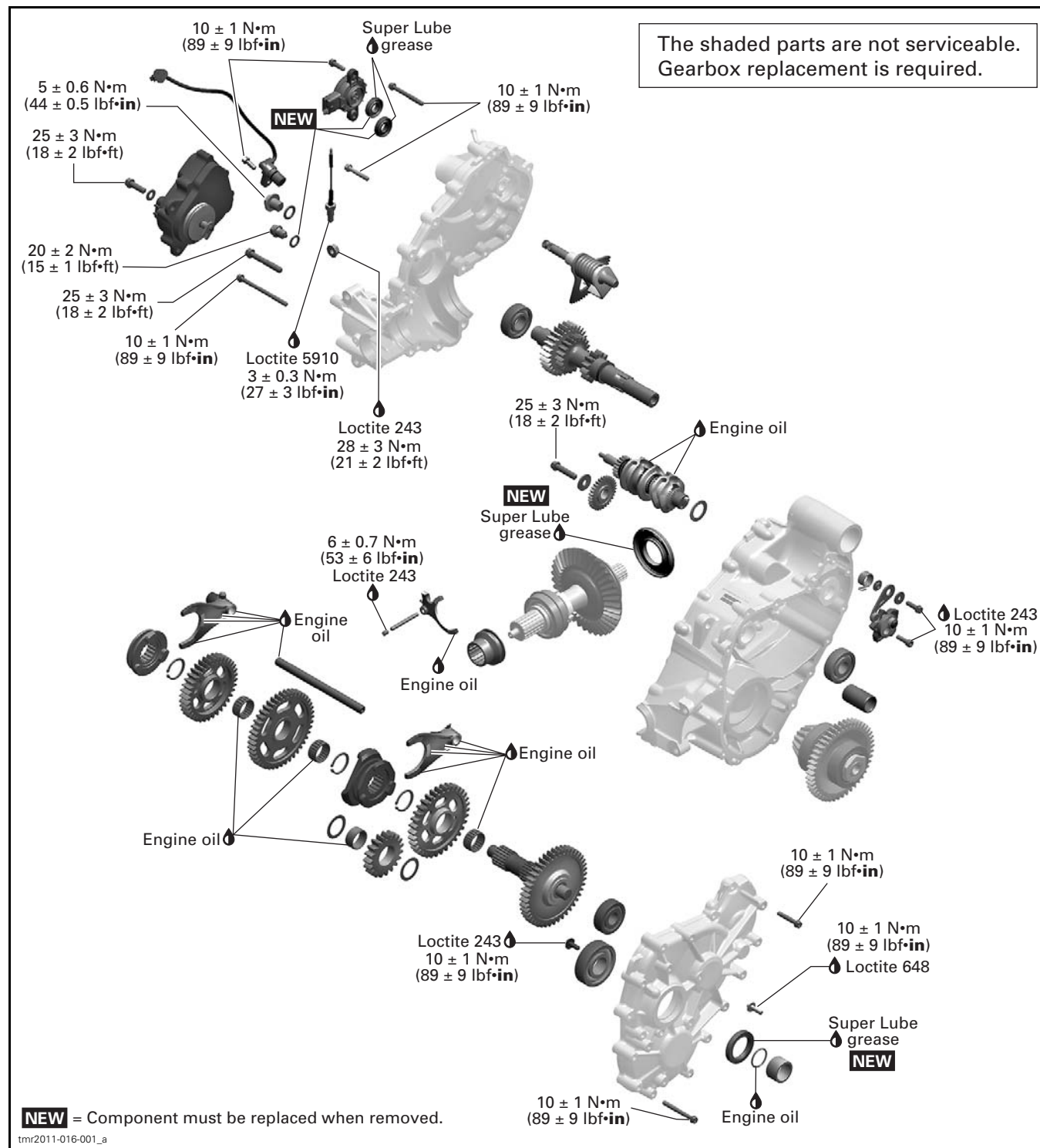
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	189, 205
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	205
SUPER LUBE GREASE.....	293 550 030	187, 190, 193

Section 02 ENGINE, CVT AND GEARBOX

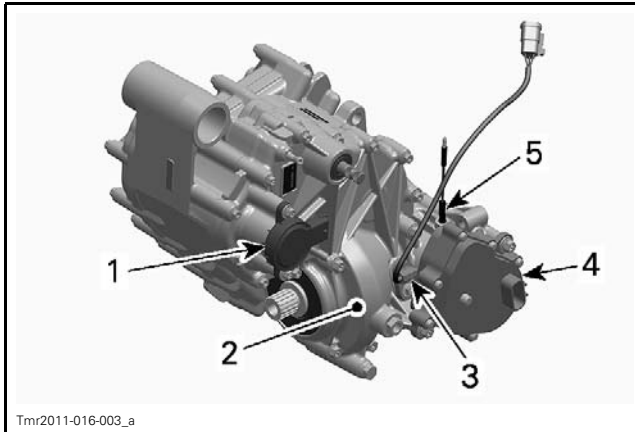
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

GEARBOX COMPONENTS AND 4X4 COUPLING MECHANISM

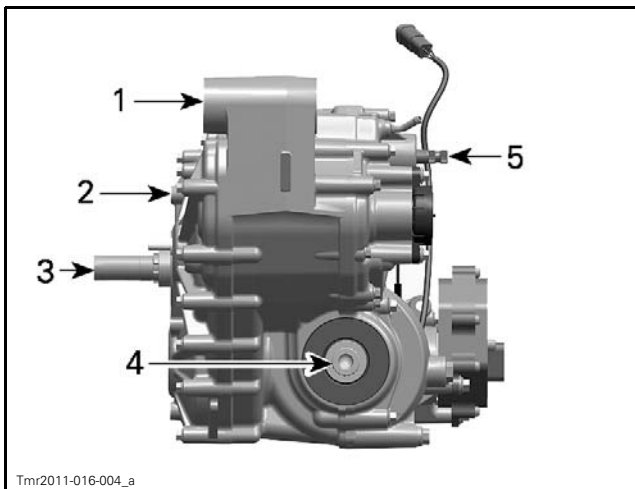


GENERAL

GEARBOX OVERVIEW



- Tmr2011-016-003_a
1. Gearbox position sensor (GBPS)
 2. Right cover
 3. Vehicle speed sensor (VSS)
 4. Actuator
 5. 4WD indicator switch



- Tmr2011-016-004_a
1. Center housing
 2. Left cover
 3. Countershaft
 4. Output shaft
 5. 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.

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

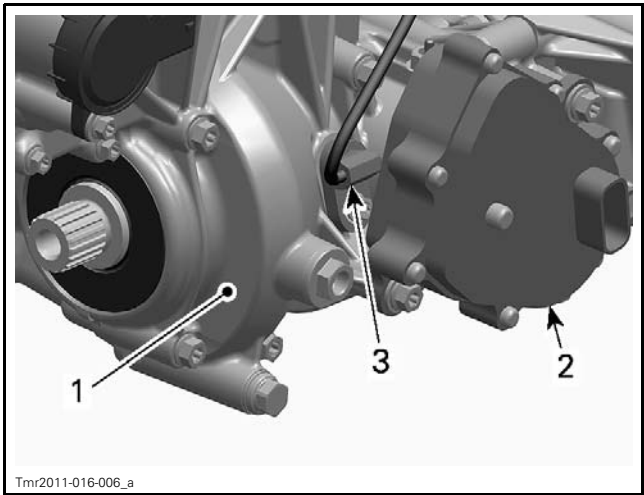
VSS (VEHICLE SPEED SENSOR)

VSS Location

The vehicle speed sensor is located on the right housing of the gearbox behind the actuator.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



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	A	RED
Speed signal (to ECM-A E1)	B	WHITE
Ground (to ECM-A D4)	C	BLACK/GREEN

VSS Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay activated	Fuse 5 of fuse block 1 (from main relay R2)

VSS Input Voltage Test

1. Turn ignition switch ON.
2. Back-probe the VSS connector and measure voltage.

REQUIRED TOOLS	
BACK PROBE TEST WIRES (P/N 529 036 063)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

VSS INPUT 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.

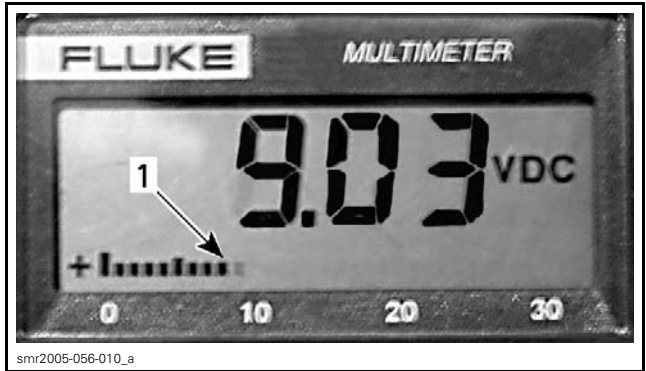
VSS Signal Test

1. Lift rear of vehicle so that rear wheels are off the ground.
2. Set transmission to 2WD and to Neutral.
3. Turn ignition switch ON.
4. Back-probe the VSS connector and measure voltage while slowly rotating rear wheels by hand.

REQUIRED TOOLS	
BACK PROBE TEST WIRES (P/N 529 036 063)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

VSS 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

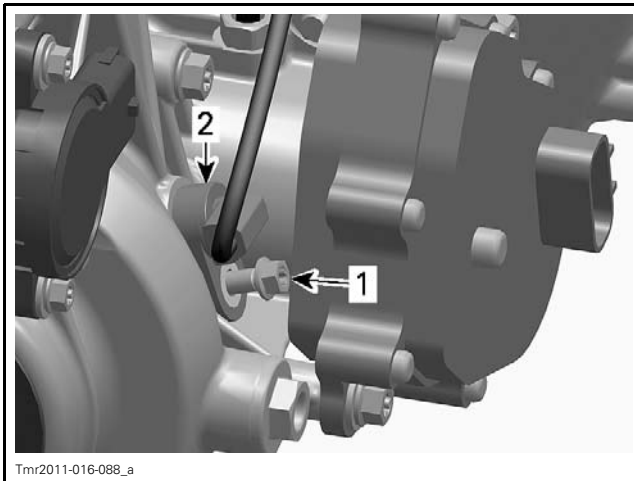
NOTE: Since we measure pulsating voltage, the numeric display will continuously change. The analog display may be easier to follow.



1. Analog display

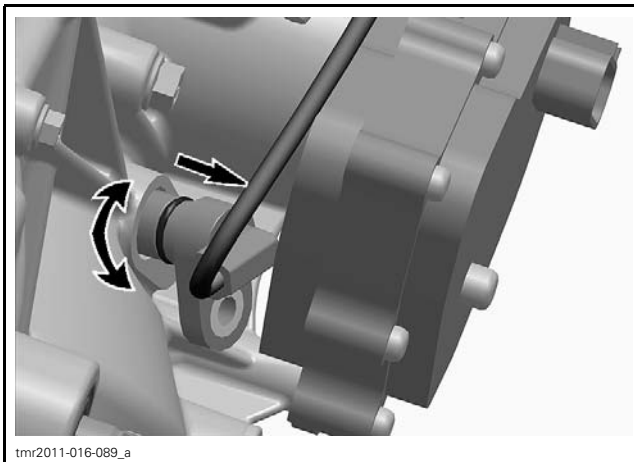
VSS Removal

Remove screw retaining the VSS.



1. Screw
2. VSS

Turn sensor and weave it out of the gearbox right cover.



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

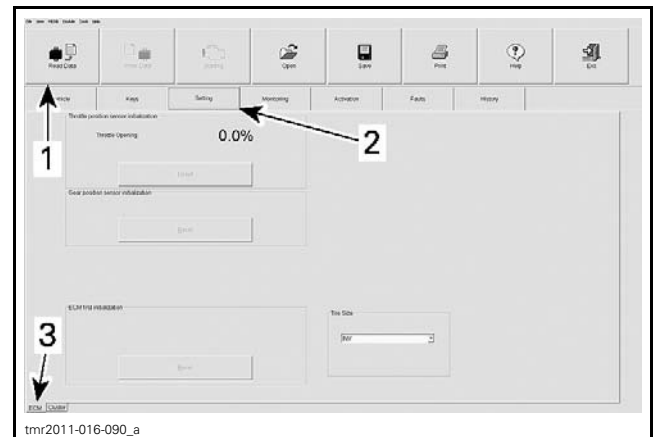
- Shift drum
- GBPS
- ECM.

1. Connect vehicle to the latest applicable version of B.U.D.S. software, refer to *COMMUNICATION 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:

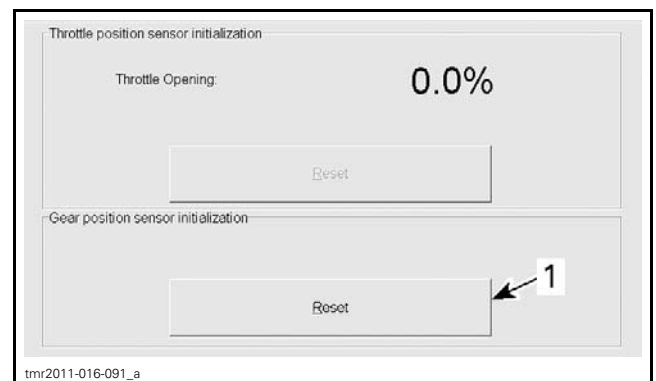
- Read Data button
- Setting page tab
- ECM tab.



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.



GEAR POSITION SENSOR INITIALIZATION

1. Reset button

A message will be displayed if the operation is successful.

Section 02 ENGINE, CVT AND GEARBOX
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

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 NEUTRAL 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

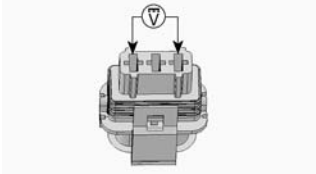
NOTE: Prior to conduct testing, check fault codes in B.U.D.S.

Set shift lever in NEUTRAL position.

Back-probe the GBPS connector.

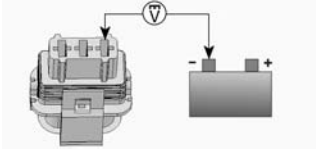
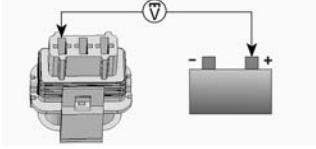
REQUIRED TOOL	
BACK PROBE TEST WIRES (P/N 529 036 063)	

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).

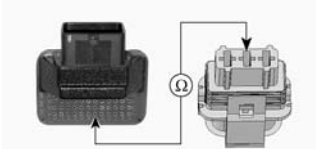
If there is no voltage, check each GBPS input as follows.

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).

MULTIMETER PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
GBPS connector (pin 2) and ECM adapter tool (pin F4) 	Below 1 Ω

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.

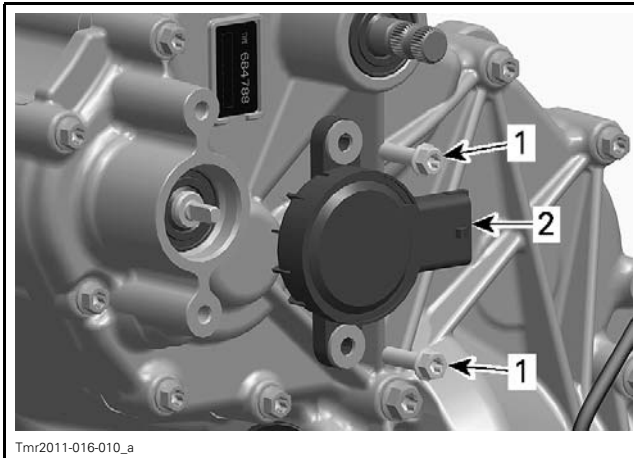
NOTE: The GBPS must be reset.

GBPS Removal

Set shift lever in NEUTRAL position.

Unplug GBPS connector.

Remove screws and withdraw GBPS.



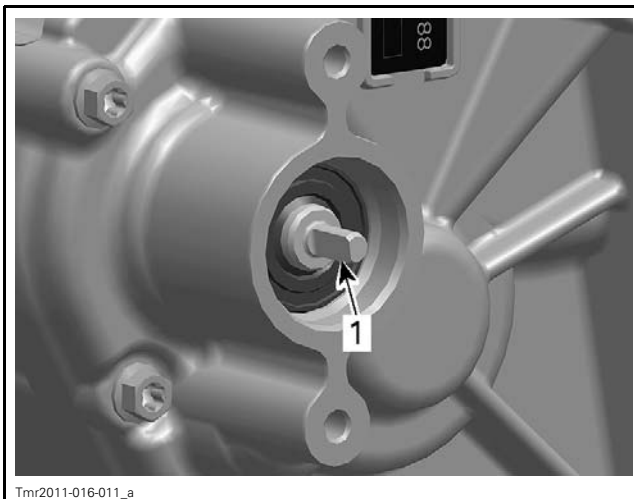
1. Screws
2. Gearbox Position Sensor (GBPS)

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

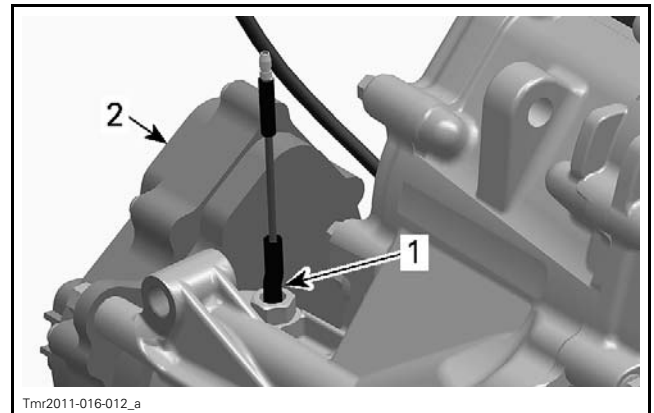
4WD Indicator Switch Access

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 WIRE		RESISTANCE
2WD	BLACK/BEIGE	Engine ground	Infinite (OL)

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

Check if the 2WD/4WD selector works properly.

Unplug actuator connector.

Turn ignition key ON.

Measure voltage as follows.

REQUIRED TOOL			
FLUKE 115 MULTIMETER (P/N 529 035 868)			
SWITCH POSITION	SWITCH WIRE		VOLTAGE
2WD	WHITE/BLUE	WHITE	Battery voltage
4WD	WHITE/BLACK		

If the selector is out of specifications, check wires, connectors and replace the selector if necessary.

If the selector is good, check the vehicle harness.

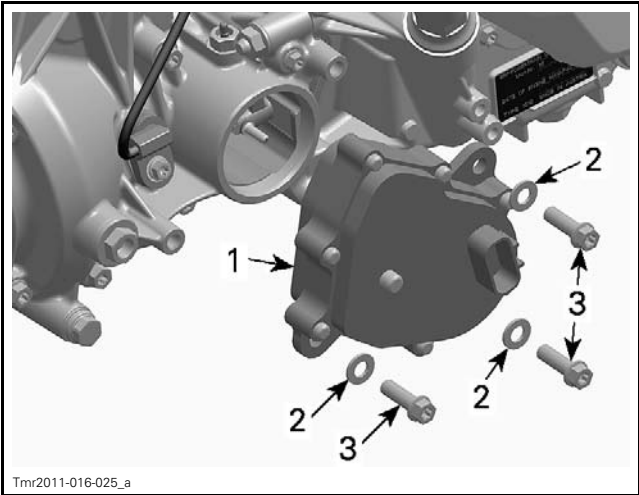
If the vehicle harness is good, replace the actuator.

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.

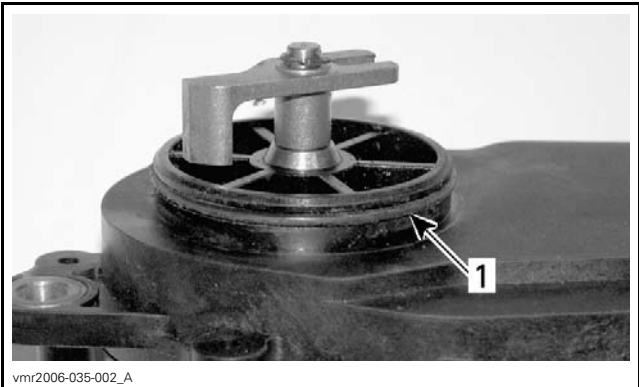


- 1. Actuator
- 2. Washer
- 3. Screw

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.

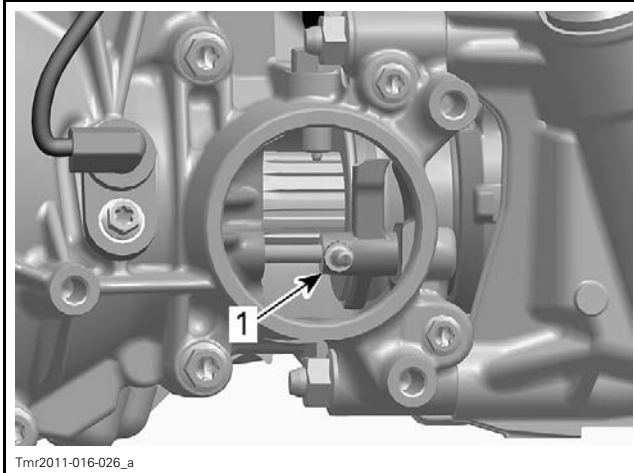


- 1. Actuator O-ring

Ensure coupling fork is in 4WD position (toward the front of vehicle).

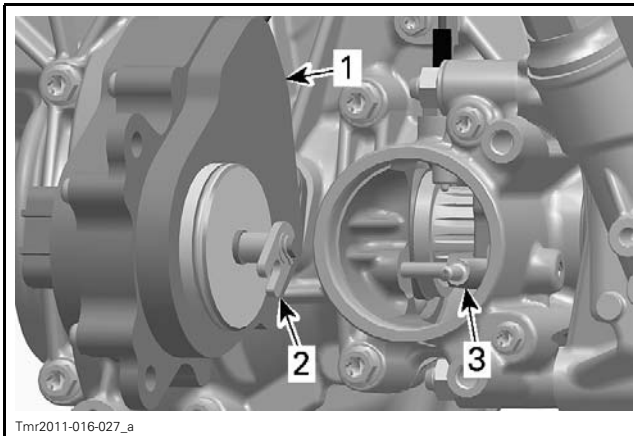
Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



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.



1. Actuator
2. 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.

ACTUATOR SCREWS	
Tightening torque	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:

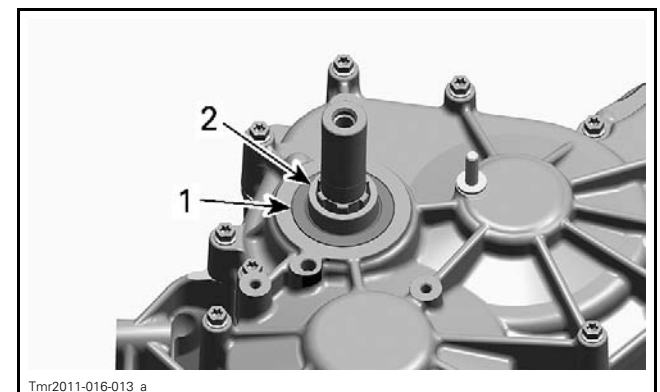
- Check bearings behind each oil seal for contamination and/or metal shavings.
- Check oil seal running surfaces for scratches.

Countershaft Oil Seal

To replace the countershaft oil seal, remove:

- Drive and driven pulleys
- CVT air guide.

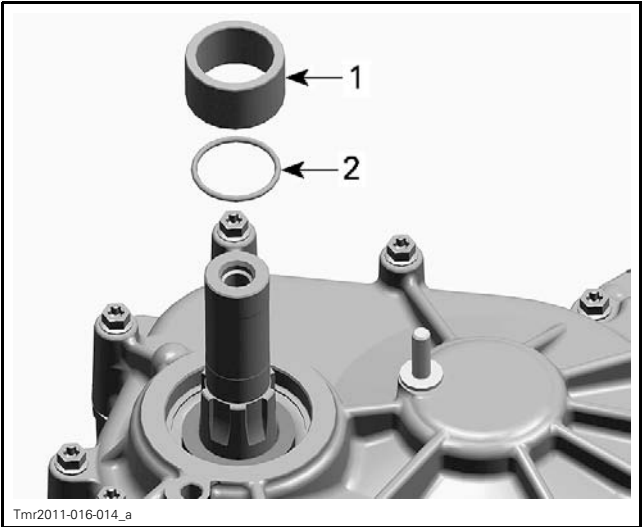
NOTE: When oil seal is removed also inspect O-ring behind distance sleeve.



1. Countershaft oil seal
2. Distance sleeve

Section 02 ENGINE, CVT AND GEARBOX

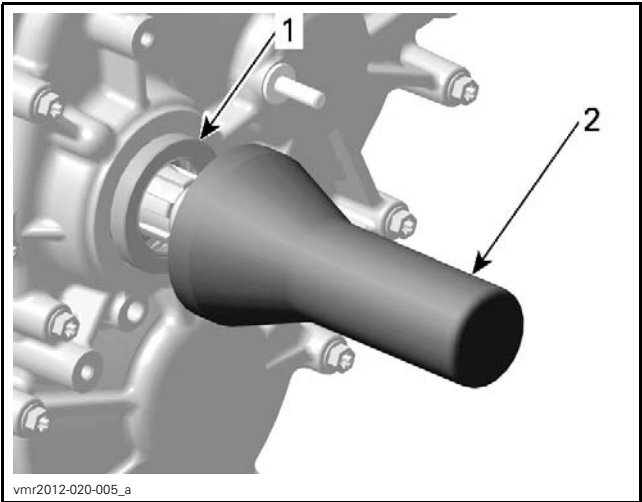
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



1. Distance sleeve
2. O-ring

Install countershaft oil seal.

REQUIRED TOOL	
COUNTERSHAFT OIL SEAL PUSHER (P/N 529 036 222)	



1. Countershaft oil seal
2. 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 following tools for shift shaft oil seal installation.

REQUIRED TOOL	
OIL SEAL INSTALLER (GEARBOX) (P/N 529 035 758)	
HANDLE (P/N 420 877 650)	

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.

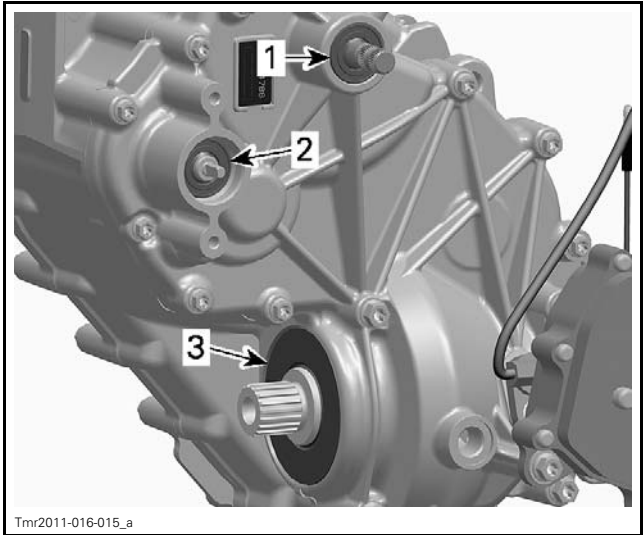
Output Shaft Oil Seal

To replace the output shaft oil seal, proceed as follows:

Remove propeller shaft screw from gearbox output shaft.

Remove rear final drive bolts.

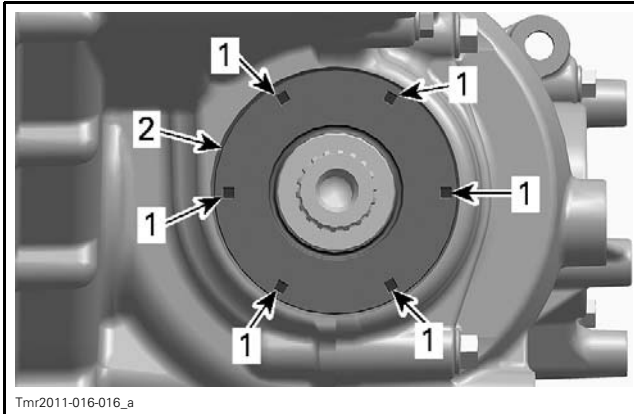
Move the rear final drive rearward to dislodge the propeller shaft from the gearbox output shaft.



1. Shift shaft oil seal
2. 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.



1. Marked areas for removal
2. Output shaft oil seal

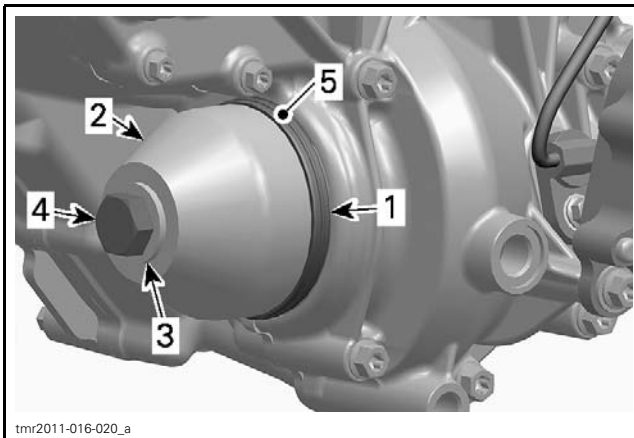
Before beginning the installation ensure gearbox is set to PARK position.

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 and install it using the following tools.

REQUIRED TOOLS AND PARTS	
OIL SEAL INSTALLER (P/N 529 036 204)	
Flat washer (P/N 250 200 102)	
M12 x 1.25 x 35 hexagonal screw	



1. Output shaft oil seal
2. Oil seal installer
3. Flat washer (P/N 250 200 102)
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.

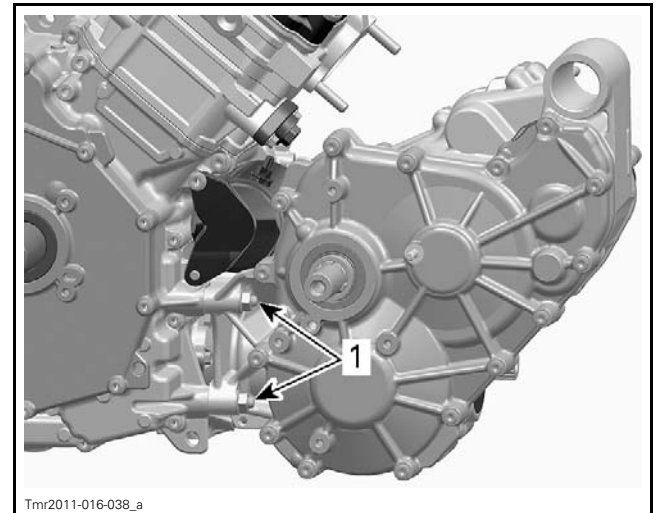
Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection to remove following parts:

- CVT cover
- Drive and driven pulleys
- CVT air guide.

Drain gearbox. Refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove *ACTUATOR*, see procedure in this subsection.

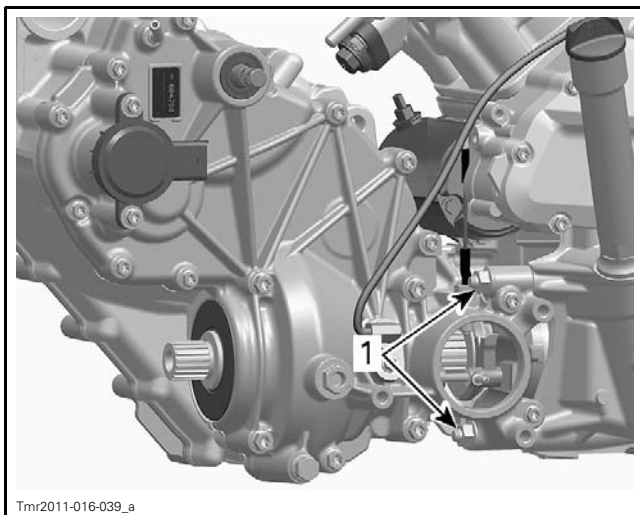
Unscrew the four (4) nuts that attach the gearbox to the engine.



LH SIDE OF ENGINE
 1. Nut M8

Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



RH SIDE OF ENGINE

1. Nut M8

Pull gearbox to separate it from engine.

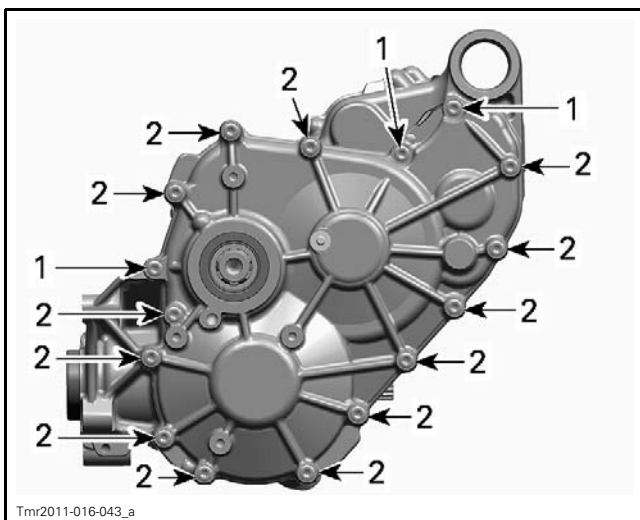
Gearbox Disassembly

NOTE: During gearbox disassembly, inspect the condition of each part closely.

Gearbox Left Cover

Set gearbox to NEUTRAL position.

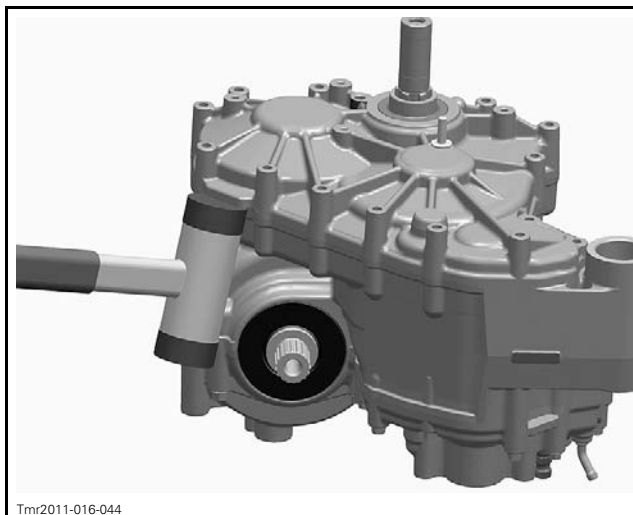
Unscrew all bolts retaining the gearbox left cover.



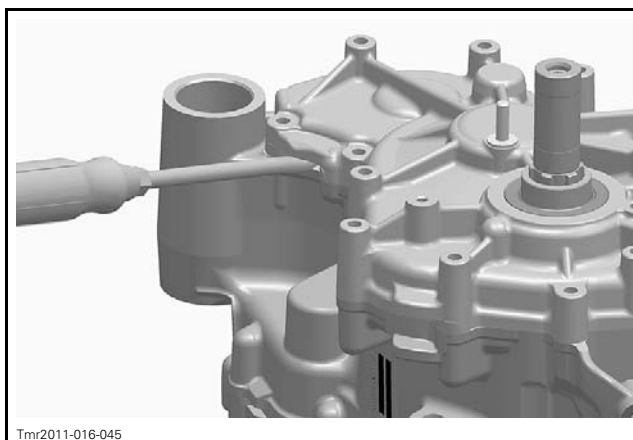
1. 3 screws M6 x 35
2. 13 screws M6 x 55

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

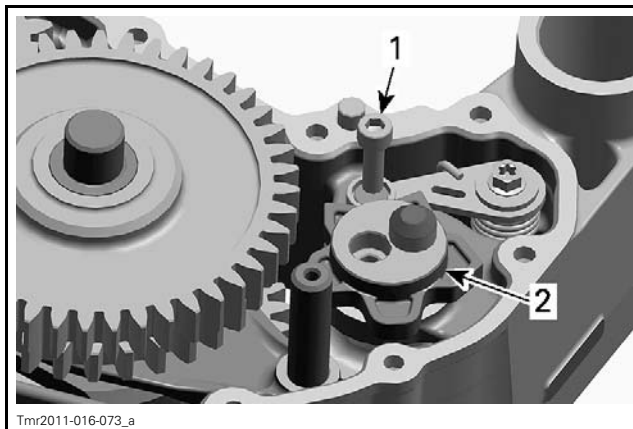


POSITION FOR BIG FLAT SCREWDRIVER

Index Lever and Index Washer

Set gearbox to NEUTRAL position.

Remove screw retaining the index washer to the shift drum.

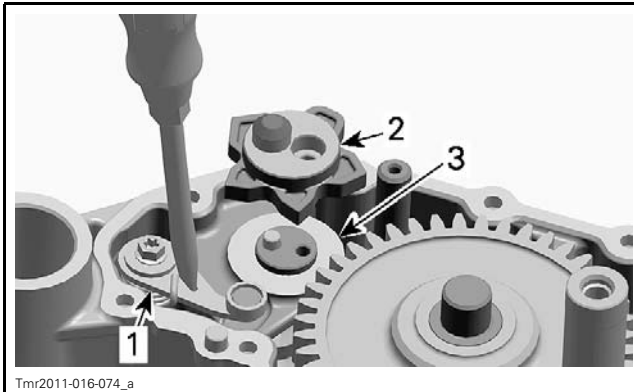


1. Screw
2. Index washer

Section 02 ENGINE, CVT AND GEARBOX

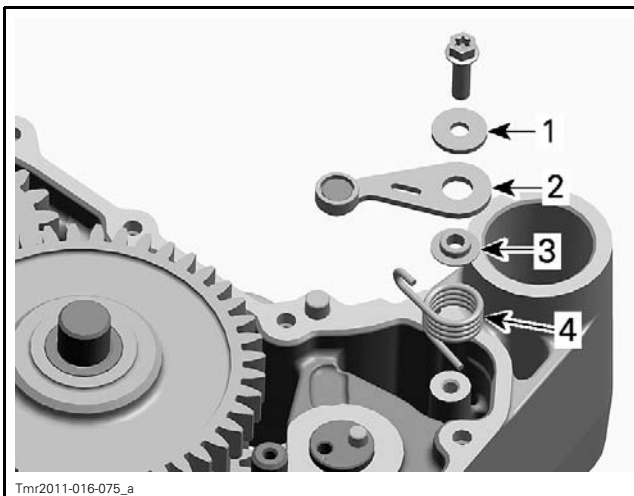
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

Insert a flat screwdriver in the slot of index lever. Turn screwdriver clockwise and remove index washer.



1. Index lever
2. Index washer
3. Shift drum

Remove the index lever with washer, step ring and spring.

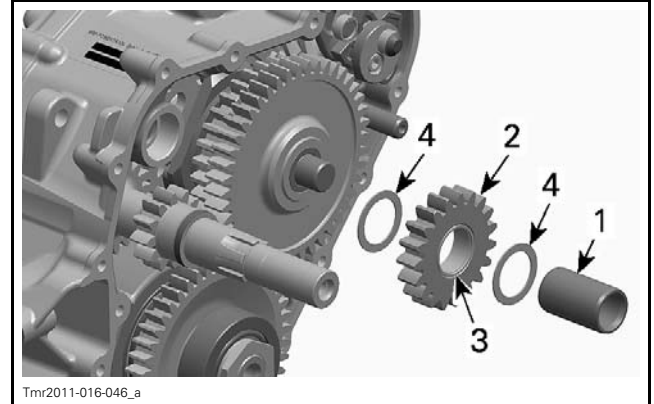


1. Washer
2. Index lever
3. Step ring
4. Index spring

Main Shaft and Shift Forks

Remove bearing pin, reverse intermediate gear and thrust washers.

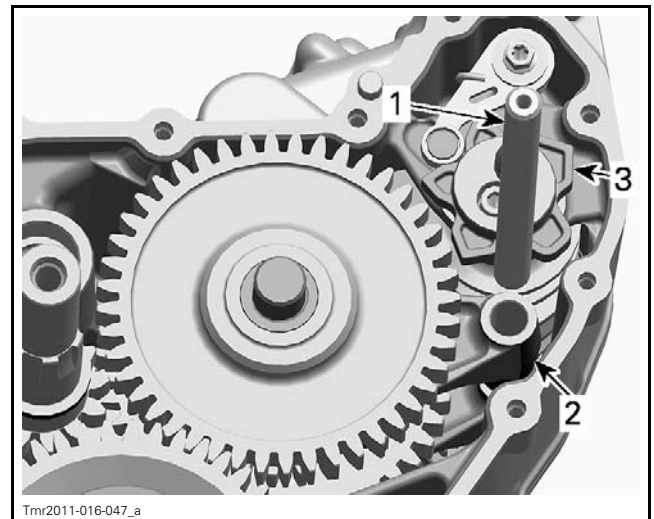
NOTE: Take care not to lose lower thrust washer during removal.



1. Bearing pin
2. Reverse intermediate gear
3. Needle bearing
4. Thrust washers

Remove shift fork shaft.

Disengage shift forks from shift drum.

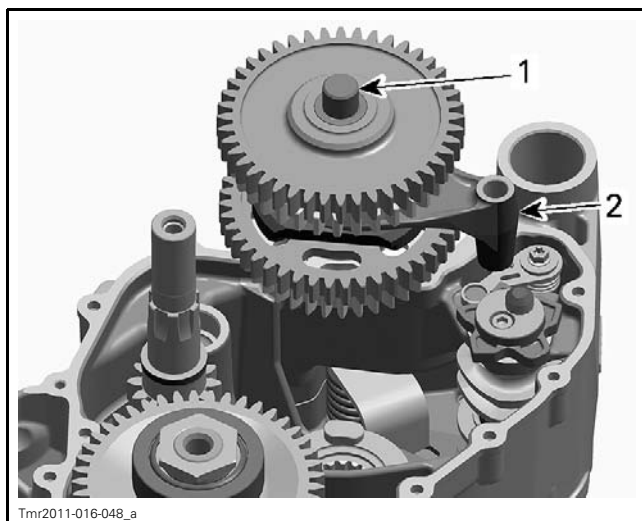


1. Shift fork shaft
2. Shift fork
3. Shift drum

Remove main shaft assembly with shift fork.

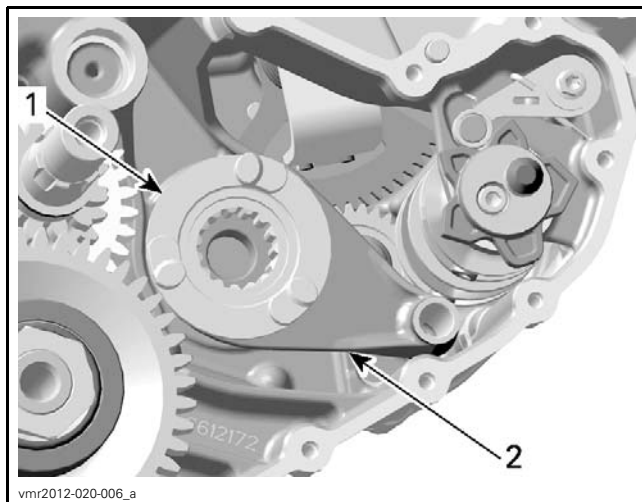
Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



1. Main shaft assembly
2. Shift fork

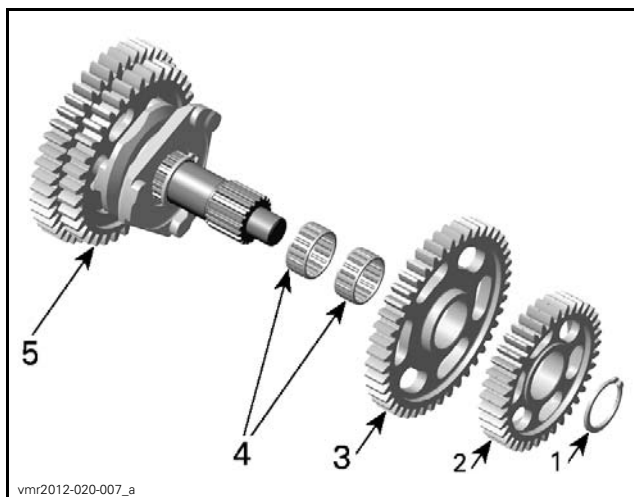
Remove shifting sleeve (HIGH range gear) and shift fork.



1. Shifting sleeve (HIGH range gear)
2. Shift fork

When required, remove from main shaft assembly:

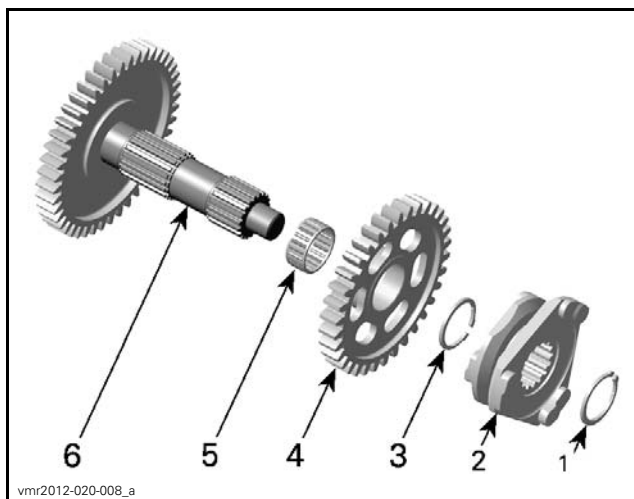
- Snap ring (discard)
- HIGH range gear
- LOW range gear
- Needle bearings.



1. Snap ring
2. Free pinion (HIGH range gear)
3. Free pinion (LOW range gear)
4. Needle bearing
5. Main shaft assembly

Remove from main shaft assembly:

- Snap ring (discard)
- Shifting sleeve (LOW/REVERSE range gear)
- Snap ring (discard)
- REVERSE range gear
- Needle bearing.



1. Snap ring
2. Shifting sleeve (LOW/REVERSE range gear)
3. Snap ring
4. Free pinion (REVERSE range gear)
5. Needle bearing
6. Main shaft assembly

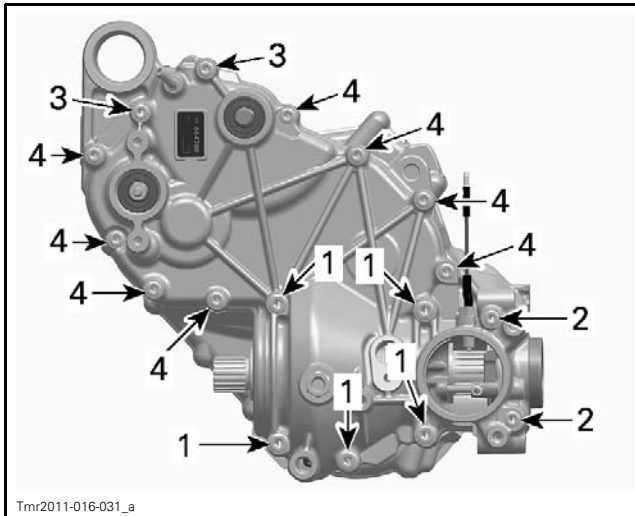
Gearbox Right Cover

Remove *ACTUATOR* and *GBPS (GEARBOX POSITION SENSOR)*, see procedures in this subsection.

Unscrew all bolts retaining the gearbox right cover.

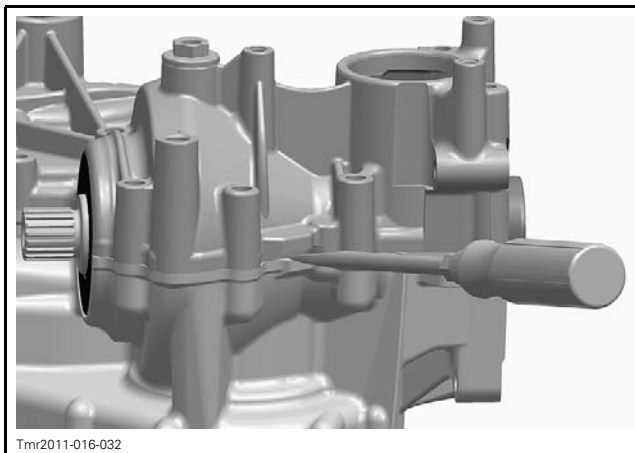
Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

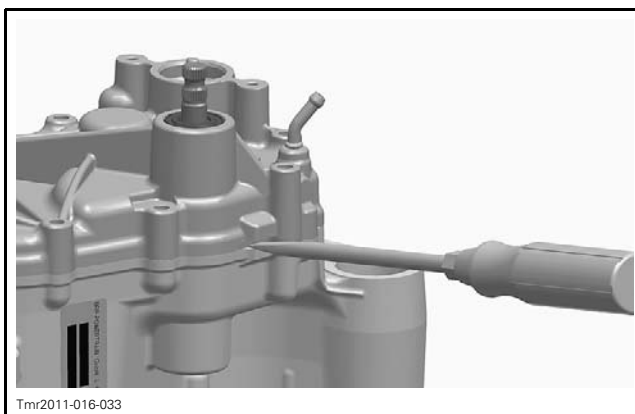


1. 5 screws M8 x 55
2. 2 screws M6 x 85
3. 2 screws M6 x 55
4. 8 screws M6 x 35

To remove cover, use 2 big screwdrivers.



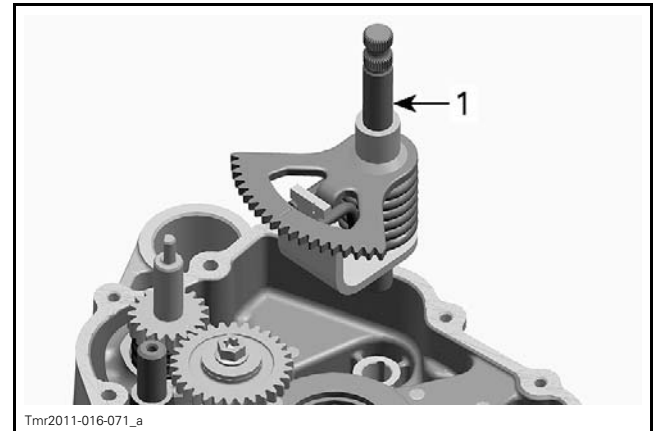
POSITION FOR BIG FLAT SCREWDRIVER



POSITION FOR BIG FLAT SCREWDRIVER

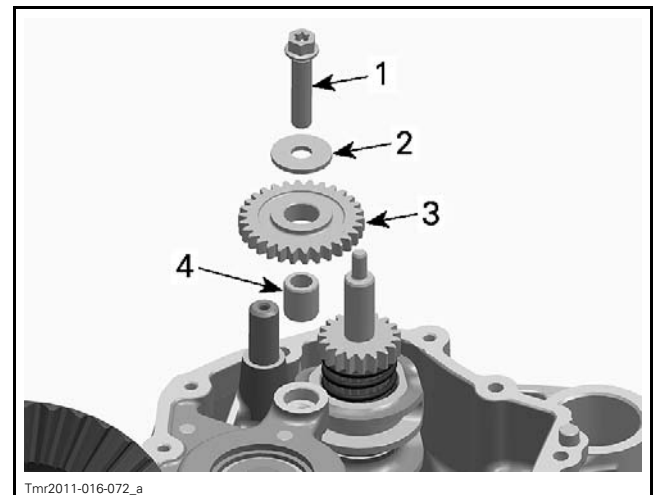
Shift Shaft and Shift Drum

Withdraw shift shaft assembly.



1. Shift shaft assembly

Remove screw retaining the shifting intermediate gear.



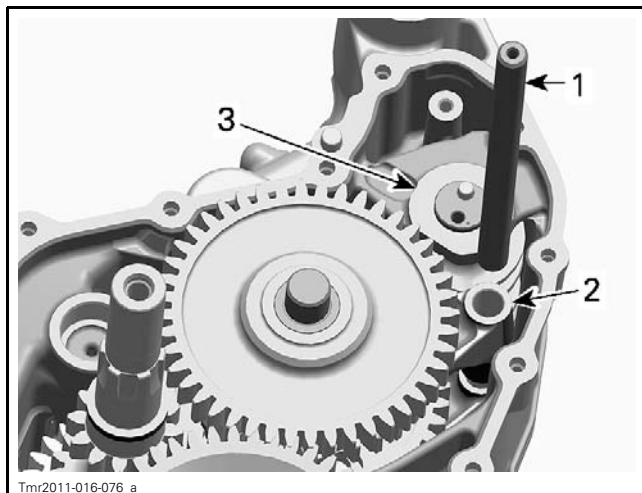
1. Screw
2. Washer
3. Intermediate gear
4. Dowel pin

Remove shift fork shaft.

Disengage shift forks from shift drum.

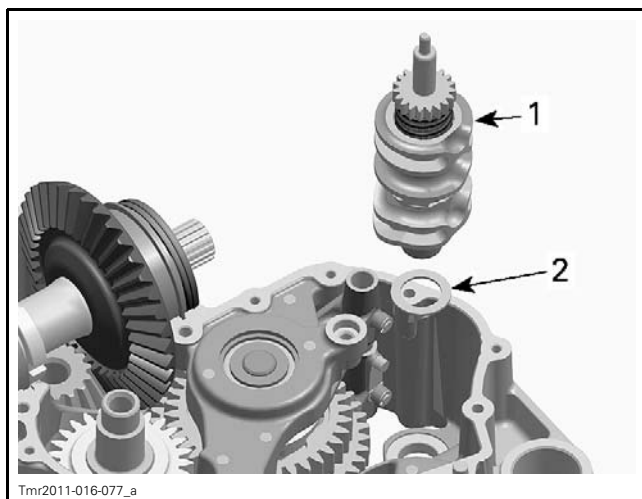
Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



1. Shift fork shaft
2. Shift fork
3. Shift drum

Remove shift drum and thrust washer.

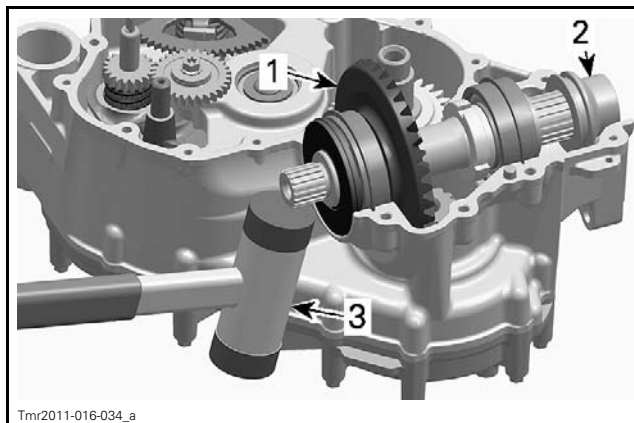


1. Shift drum
2. Thrust washer

Output Shaft and 4X4 Coupling Mechanism

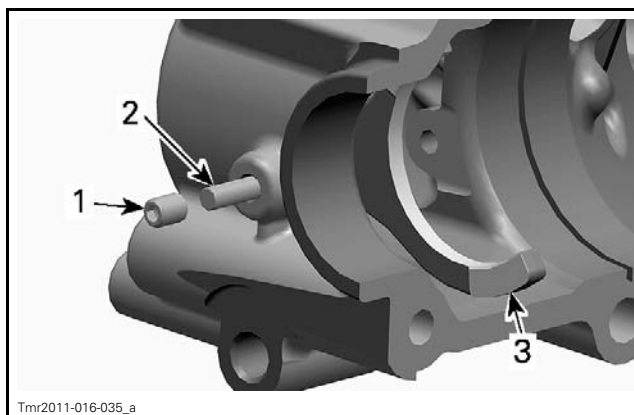
Remove output shaft from center housing and withdraw 4X4 coupling sleeve.

NOTICE Use a soft hammer to remove output shaft.



1. Output shaft
2. 4X4 coupling sleeve
3. Soft hammer

Remove set screw, coupling fork shaft and coupling fork from right cover.

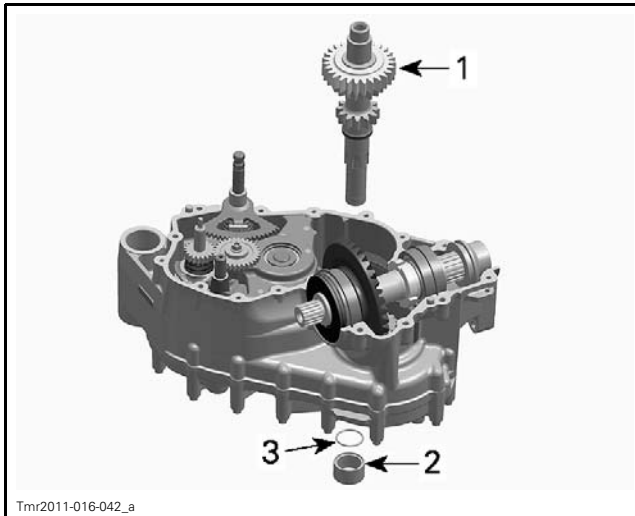


1. Set screw
2. Coupling fork shaft
3. Coupling fork

Countershaft

Use a soft hammer to push out countershaft from gearbox CVT side.

Remove distance sleeve and O-ring.



1. Countershaft
2. Distance sleeve
3. O-ring

Gearbox Bearings

If necessary heat housing up to 100°C (212°F) before removing ball bearings.

⚠ WARNING

Clean oil, outside and inside, from housing before heating.

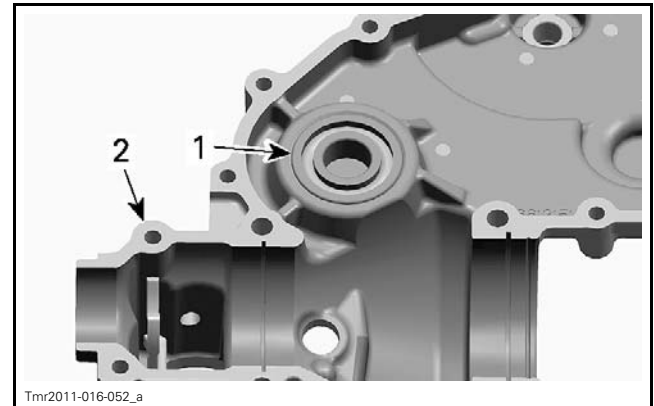
NOTICE Always support gearbox housings properly when ball bearings are removed. Housing damages may occur if this procedure is not performed correctly.

To remove ball bearings of countershaft (right cover) and main shaft (left cover) use following tool.

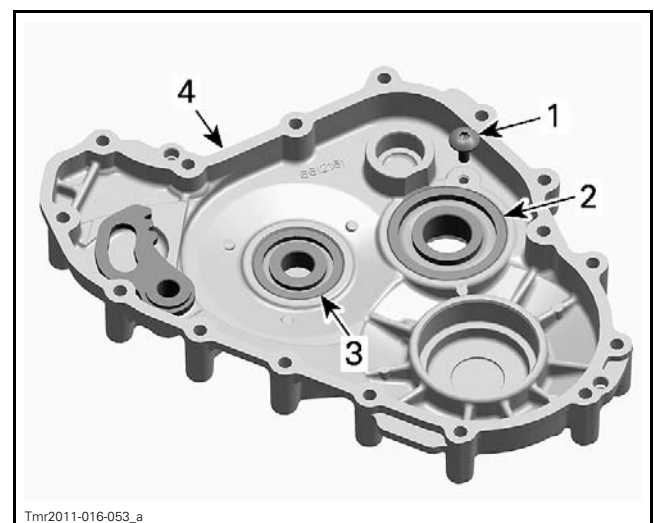
REQUIRED TOOL	
BLIND HOLE BEARING PULLER SET (P/N 529 036 117)	

Remove screw securing the countershaft bearing in the left cover.

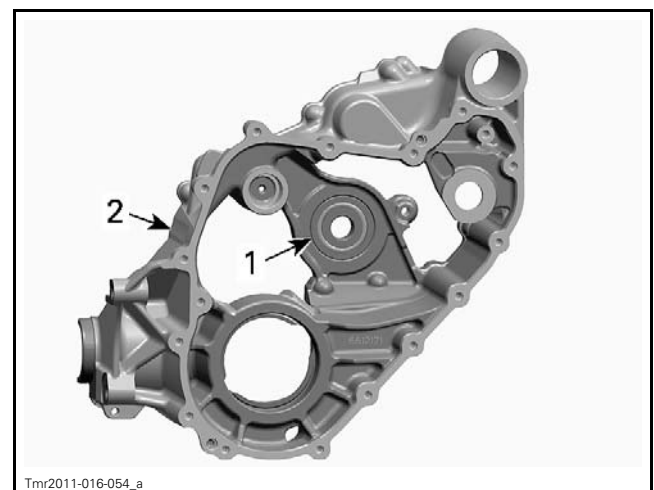
For ball bearings of countershaft (left cover) and main shaft (center housing) push with a suitable puller from outside in.



1. Ball bearing countershaft
2. Right cover



1. Screw
2. Ball bearing countershaft
3. Ball bearing main shaft
4. Left cover



1. Ball bearing main shaft
2. Center housing

Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

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

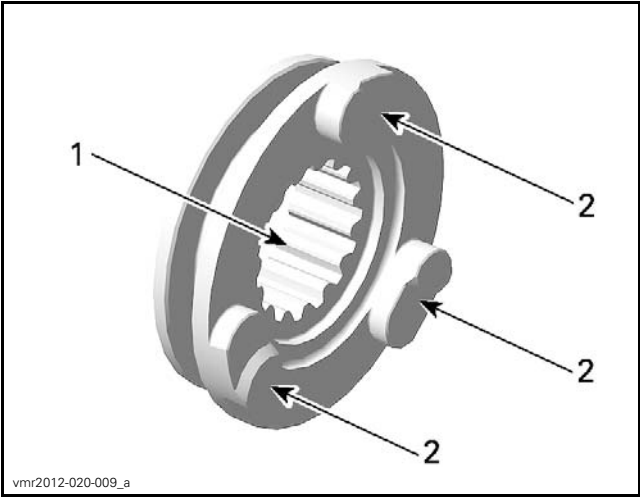
Check if ball bearings turn freely and smoothly.

Check all bearings, bearing points, tooth flanks and taper grooves.

Free Pinions

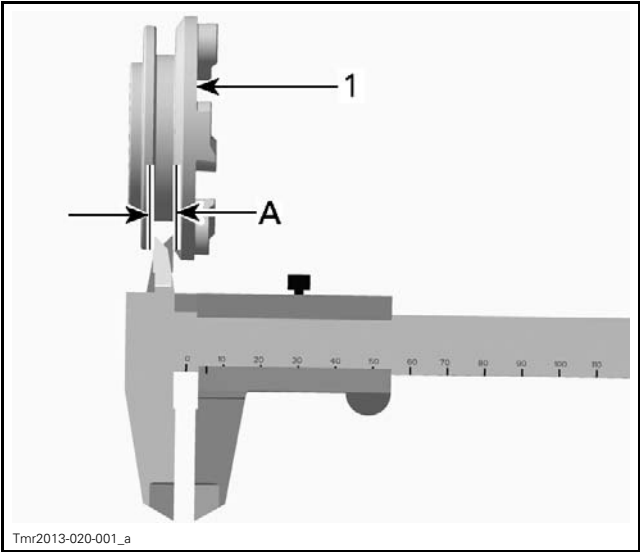
NOTE: Always replace snap rings and use special pliers to install them.

Check free pinions for wear.

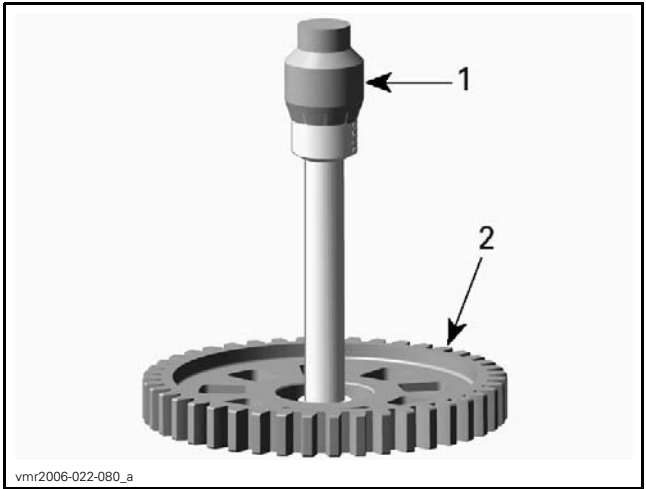


TYPICAL
1. Inner splines
2. Engagement dogs

Measure the width of shift fork engagement groove.



TYPICAL
1. Shifting sleeve
A. Width of shift fork engagement groove



TYPICAL
1. Micrometer
2. Free pinion

DIAMETER 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.

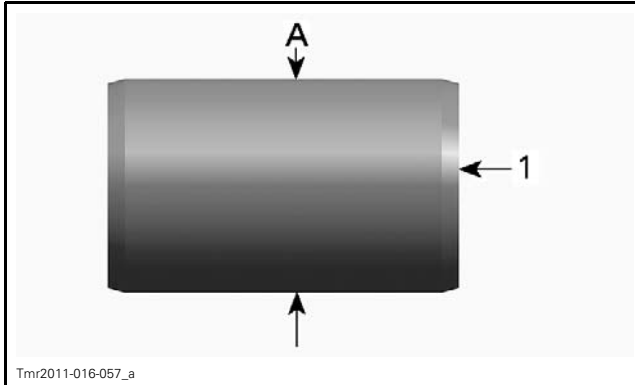
WIDTH OF SHIFT FORK ENGAGEMENT GROOVE	
NEW	5.30 mm to 5.40 mm (.209 in to .213 in)
SERVICE LIMIT	5.50 mm (.217 in)

Shafts

Check bearing pin of reverse intermediate gear for wear.

Section 02 ENGINE, CVT AND GEARBOX

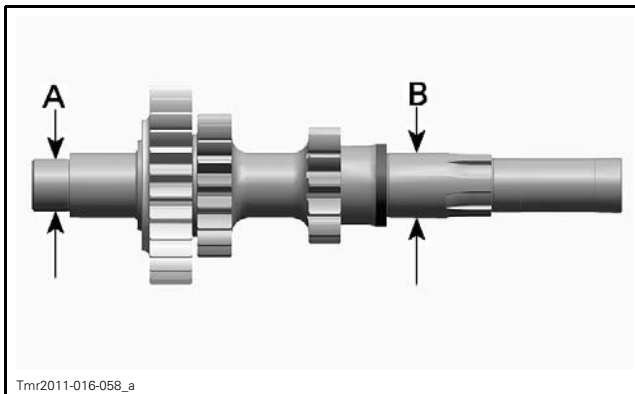
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



1. 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)

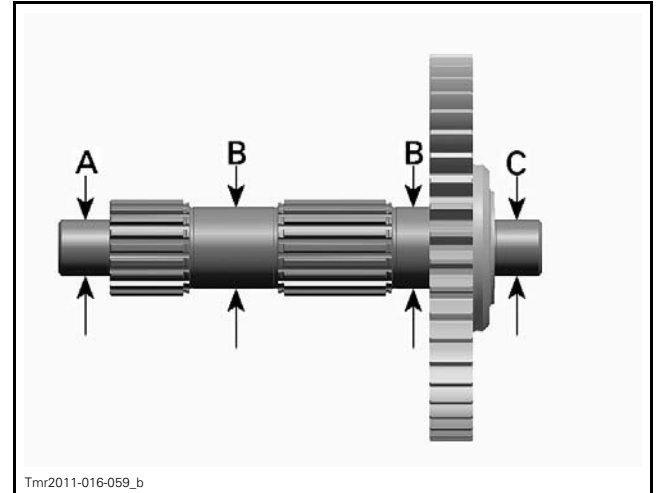
Check countershaft bearing journals for wear.



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

MAIN SHAFT	
FREE PINION BEARING	
NEW	24.987 mm to 25.000 mm (.984 in to .984 in)
SERVICE LIMIT	24.984 mm (.984 in)
BEARING JOURNAL 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.

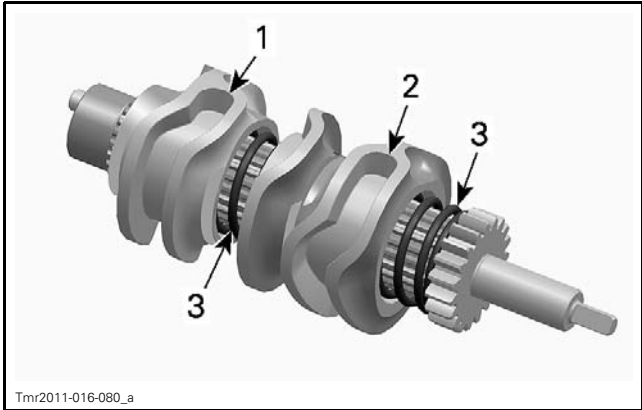
Shift Drum

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.

Section 02 ENGINE, CVT AND GEARBOX
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



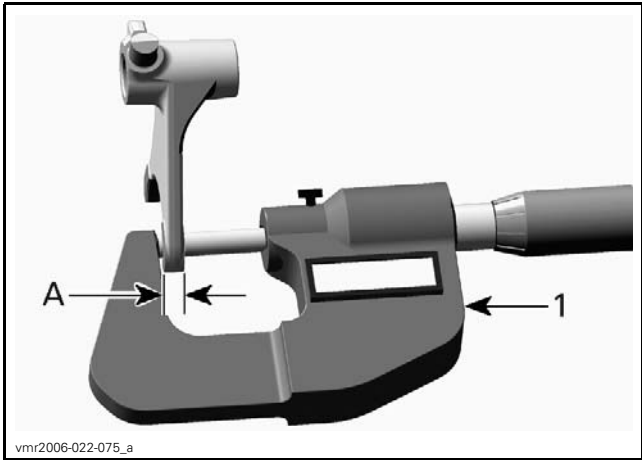
1. Track for the low/reverse range gear shift fork
2. Track for the high range gear shift fork
3. Springs

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.



1. Micrometer
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.

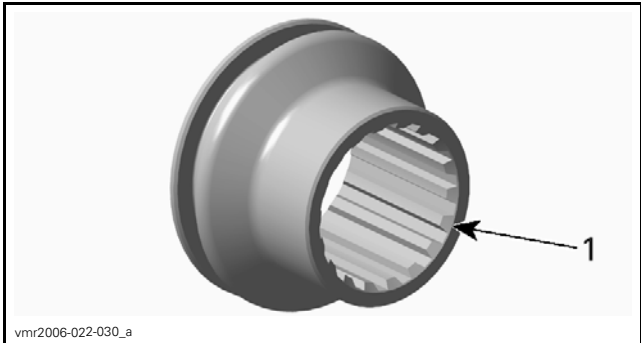
Check output shaft splines for wear or other damages.

Check if the output shaft bearings turn freely and smoothly.

Replace oil seal if brittle, hard or damaged.

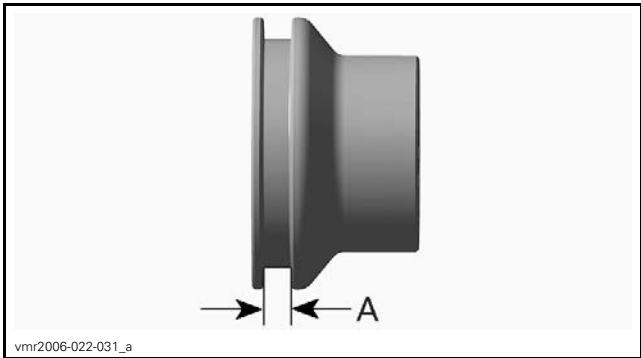
4X4 Coupling Sleeve

Check splines of coupling sleeve for wear or other damages.



1. Inspect splines

Measure the coupling sleeve groove width.



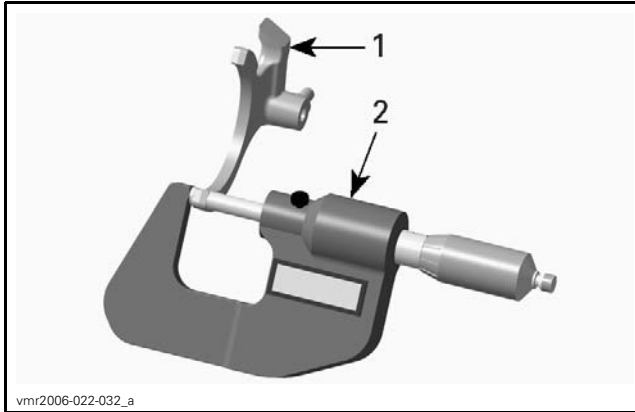
A. Groove width

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.



1. 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.

WARNING

Clean oil, outside and inside, from housing before heating.

Place new bearing in freezer for 10 minutes before installation.

Use a suitable installer for installing ball bearings of countershaft and main shaft.

NOTE: Place gearbox housings on a wood stand before installing ball bearings.

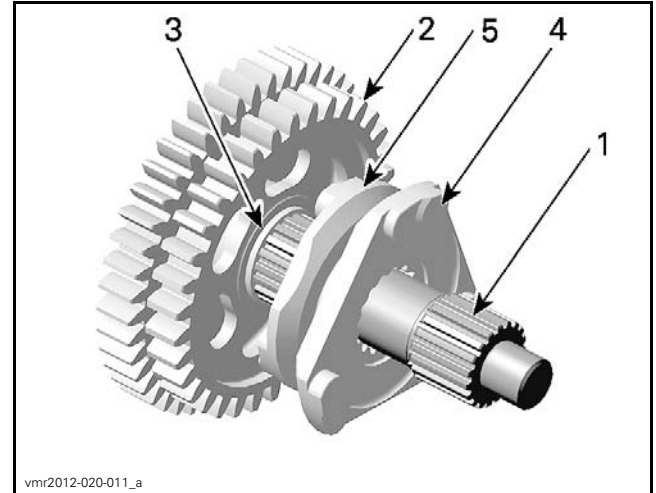
Install new oil seals with the proper installer (refer to *OIL SEALS* in this subsection).

Main Shaft and Shift Forks

Install NEW snap rings.

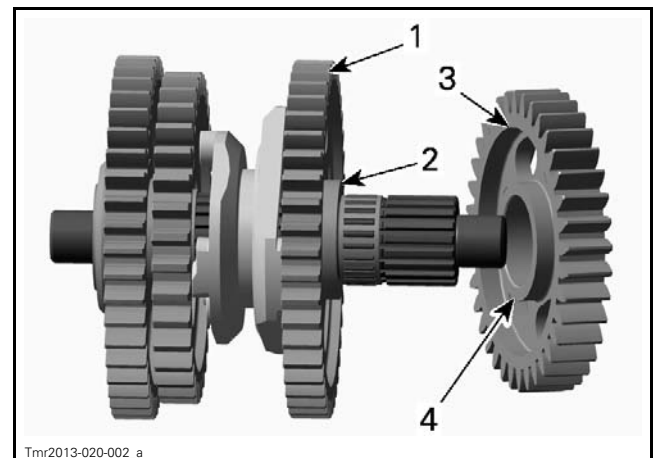
NOTE: Ensure snap rings are installed in the grooves properly.

Install free pinion (REVERSE range gear) and shifting sleeve (LOW/REVERSE range gear) properly.



1. Main shaft
2. Free pinion (REVERSE range gear)
3. Snap ring
4. Shifting sleeve (LOW/REVERSE range gear)
5. Shifting dogs (REVERSE range gear)

Collars of free pinion (LOW range gear) and free pinion (HIGH range gear) must point together.

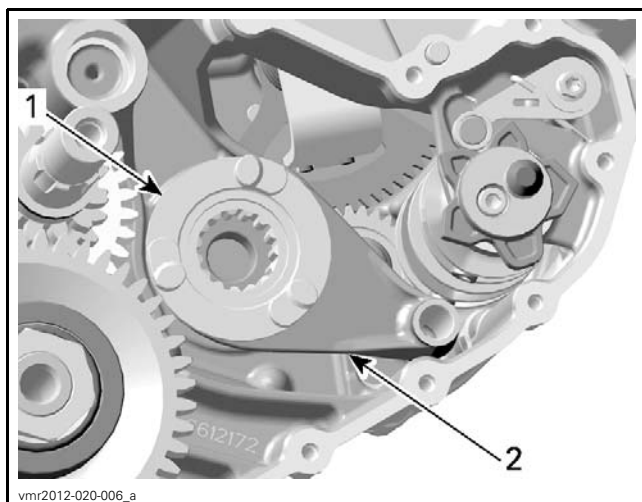


1. Free pinion (LOW range gear), 44 T
2. Collar
3. Free pinion (HIGH range gear), 36 T
4. Collar

Place shifting sleeve (HIGH range gear) with shift fork in the center of on main shaft bearing in center housing.

Section 02 ENGINE, CVT AND GEARBOX

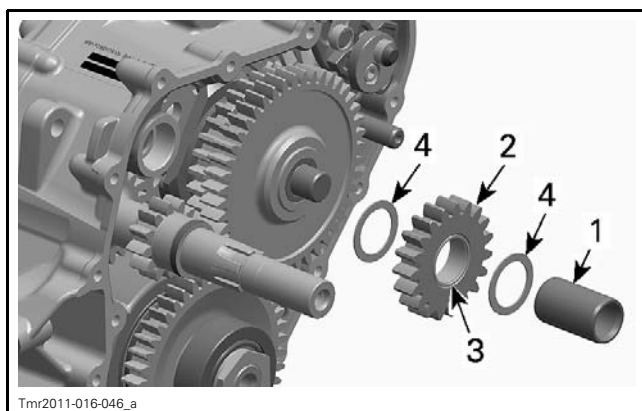
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)



1. Shifting sleeve (HIGH range gear)
2. 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.



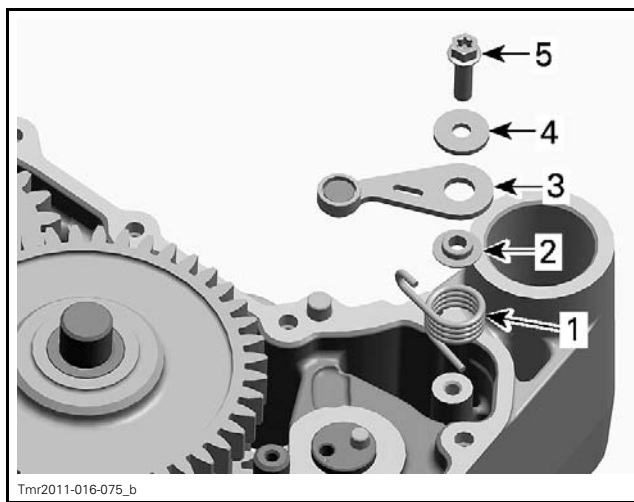
1. Bearing pin
2. Reverse intermediate gear
3. Needle bearing
4. Thrust washers

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

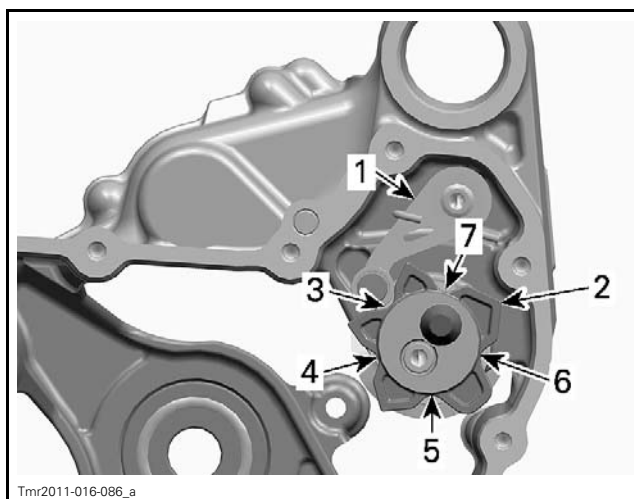
Fit step ring into index lever.



1. Index spring
2. Step ring
3. Index lever
4. Washer
5. 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.



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.

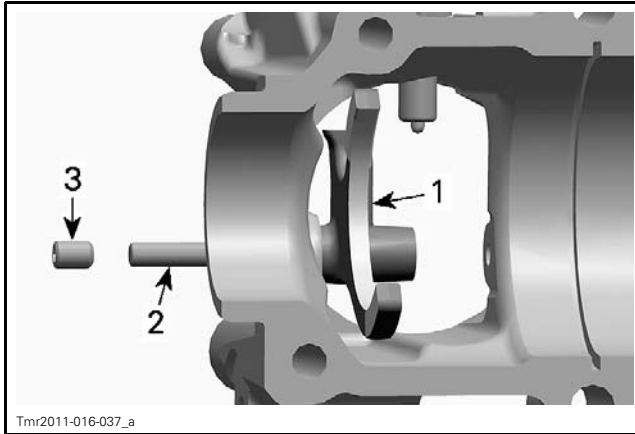
Place the output shaft with oil seal and coupling sleeve into the center housing.

NOTE: If same oil seal is installed, turn oil seal 90° offset to its original position to avoid leakage at housing mating surface.

Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

Install coupling fork, coupling fork shaft and set screw in right cover before applying sealant to the mating surface.

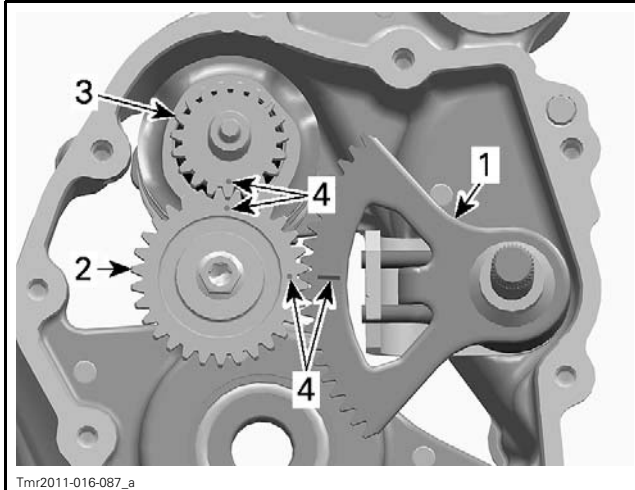


1. Coupling fork
2. Coupling fork shaft
3. Set screw

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.

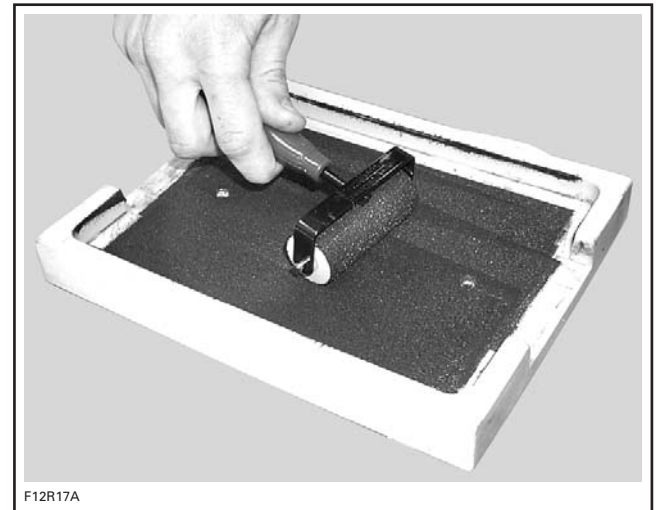
Gearbox housing mating surfaces are best cleaned using a combination of LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

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.



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).

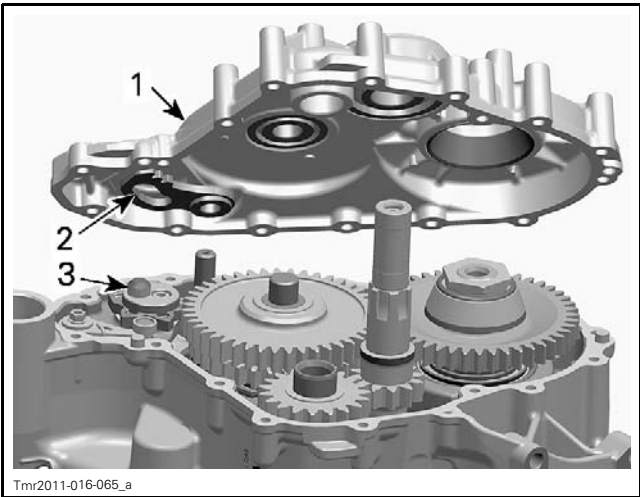
Left Cover

Apply sealing compound on mating surfaces of central housing. Refer to *SEALING COMPOUND APPLICATION*.

Section02 ENGINE, CVT AND GEARBOX

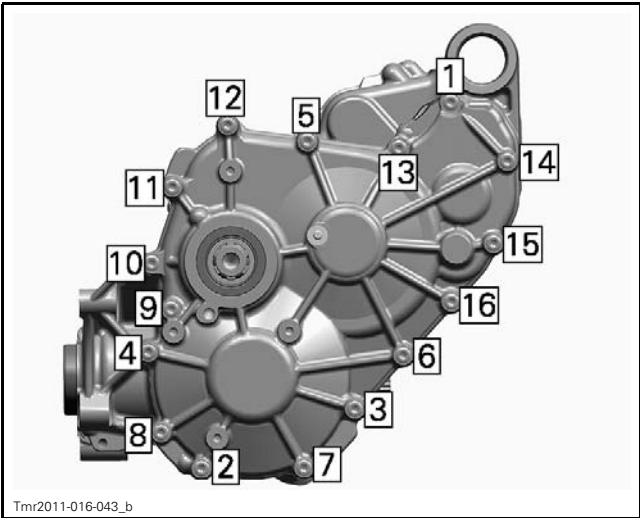
Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

At installation of left cover, engage parking lock lever slot onto index washer pin.



1. Left cover
2. Parking lock lever slot
3. Index washer pin

Install all screws on left cover and tighten them as per following sequence.

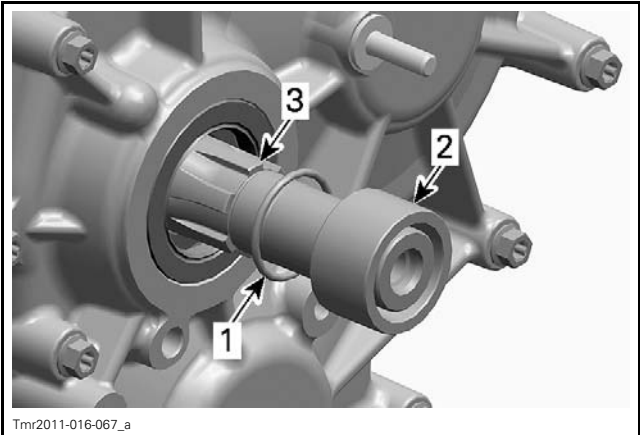


M6 SCREWS - LEFT COVER

Tightening torque	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)
-------------------	--

Install O-ring including distance sleeve on counter-
shaft 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

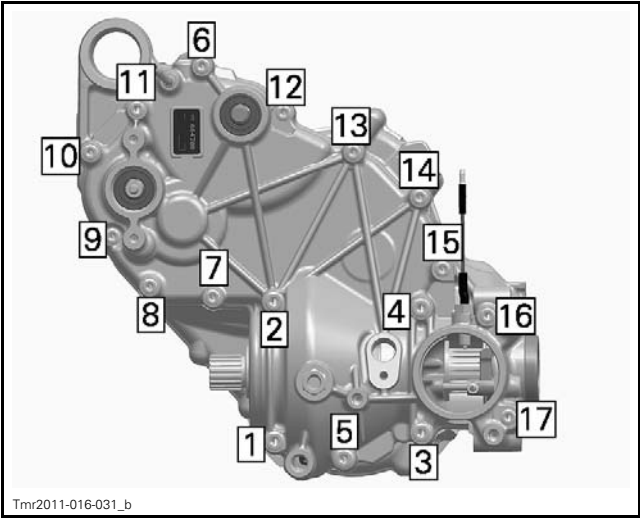
1. O-ring
2. Distance sleeve
3. Countershaft end CVT side

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.



SCREWS - RIGHT COVER

Tightening torque - M6	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)
Tightening torque - M8	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)

Install the actuator, refer to *ACTUATOR*.

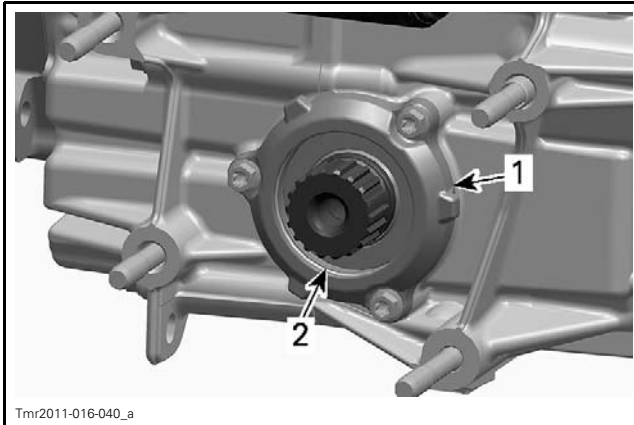
Gearbox Installation

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

Section 02 ENGINE, CVT AND GEARBOX

Subsection 12 (GEARBOX AND 4X4 COUPLING UNIT)

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 *PERIODIC MAINTENANCE PROCEDURES*.

CONTROLLER AREA NETWORK (CAN)

GENERAL

SYSTEM DESCRIPTION

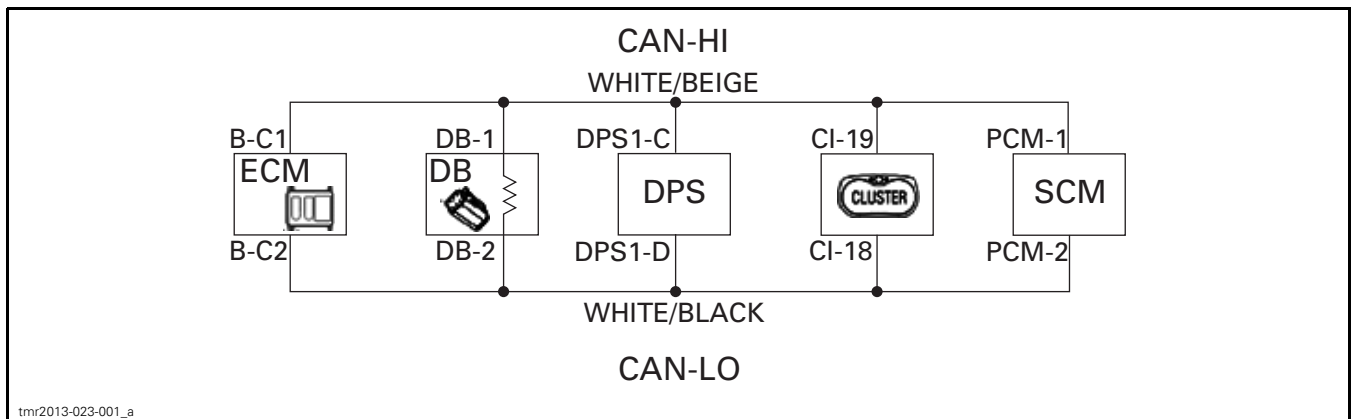
The CAN (Controller Area Network) protocol is an ISO standard for serial data communication.

The CAN bus links the following modules together so that they communicate to interact as required.

- ECM (Engine Control Module)
- Multifunction gauge
- DPS (Dynamic Power Steering)
- SCM (Suspension Control Module).

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 WHITE/BLACK).

If a component or system malfunction is detected, a module may generate a fault code, which it transmits through the CAN bus as a signal. The fault signal may be used for various functions such as triggering the display of an error message in the 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
DPS: Dynamic Power Steering
ECM: Engine Control Module
SCM: Suspension Control Module

DIAGNOSTIC SYSTEM AND FAULT CODES

GENERAL

MONITORING SYSTEM

The Engine Management System (EMS) features a monitoring 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 to be monitored (fuel injectors for example).

The monitoring 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.

Messages in Gauge for Problematic Conditions

If an abnormal condition occurs, the gauge will display one of the following messages. It can be combined with a pilot lamp.

MESSAGE	DESCRIPTION
CHECK ENGINE	All active or previously activated faults that require attention. No engine limitation engaged.
LIMP HOME	Critical faults requiring diagnostic as soon as possible. An engine limitation is engaged and/or the engine behavior is modified.
LO BATT VOLT	Low battery voltage detected by ECM.
HIGH BATT VOLT	High battery voltage detected by ECM.
LOW OIL	Low oil pressure detected by the ECM.
D.E.S.S. KEY NOT RECOGNIZED	D.E.S.S. KEY is not recognized by ECM.
HI TEMP	High temperature detected by the ECM.
ECM CRC ERROR	Error message from ECM.
TPS FAULT	TPS (throttle position sensor) fault, generally followed by a Limp Home message.
BRAKE SWITCH FAULT	Brake signal fault.
ECM NOT RECOGNIZED	Message displayed when the gauge is unable to identify the ECM.
CHECK DPS	Check engine pilot light on. Indicates that the DPS (Dynamic Power Steering) does not work properly. See an authorized Can-Am dealer.

Subsection 04 (DIAGNOSTIC SYSTEM AND FAULT CODES)

MESSAGE	DESCRIPTION
TRANSMISSION SIGNAL FAULT	Gearbox position sensor fault active. "E" is also displayed in the gear display.
PPS FAULT	When one or both sensor of the TAS (throttle accelerator sensor) is/are faulty, erratic or out of range or that the ratio between the two is incorrect, the message will be displayed and the check engine pilot lamp will be lit.
MANUAL LIMP HOME	When the TAS Limp Home (throttle accelerator sensor) is engaged, the message will be displayed.
ACS FAULT	Leak or problem detected in the ACS system.
SUSPENSION PUMP OVERHEAT	ACS compressor overheated. Do not run compressor for more than 2 minutes. Let compressor cool down.

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

Fault Code Categories

A fault code consists of an alphanumeric designator followed by a hexadecimal number of 3 digits. The alphanumeric designator defines the category of the fault code while the hexadecimal number refers to a unique fault.

FAULT CODE CATEGORIES		
ALPHANUMERIC DESIGNATOR	MODULE/ SYSTEM	EXAMPLE OF FAULT CODE
From P0 to P3	Power train and DPS	P0116
From U0 to U3	Communication between module and sensors	U0073

RELATED MODULE AND FAULTS	
MODULE	FAULT CODE CATEGORY
ECM	P and U
DPS	P and U
Cluster	P and U

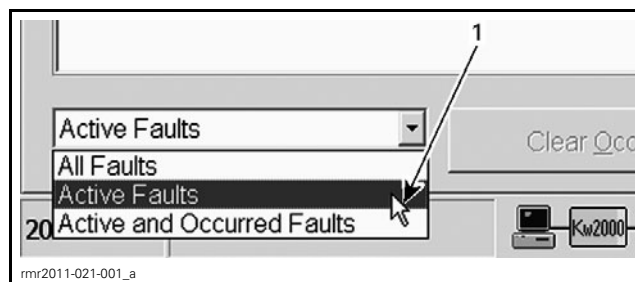
Fault Code States

Fault codes have 3 possible states:

- Active
- Occurred
- Inactive.

Click the **Fault** tab then click on the drop-down list on the LH lower corner.

Choose the fault code state you want to display.



TYPICAL
1. Drop down list

Active Fault Codes

An active fault code is an indication of a fault that is **currently triggered**.

The active fault may or may not compromise normal operation of the system(s). Service action should be taken to correct the problem that caused the fault code.

Once the fault condition(s) of the active fault is no longer present, its state will change to "occurred".

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.

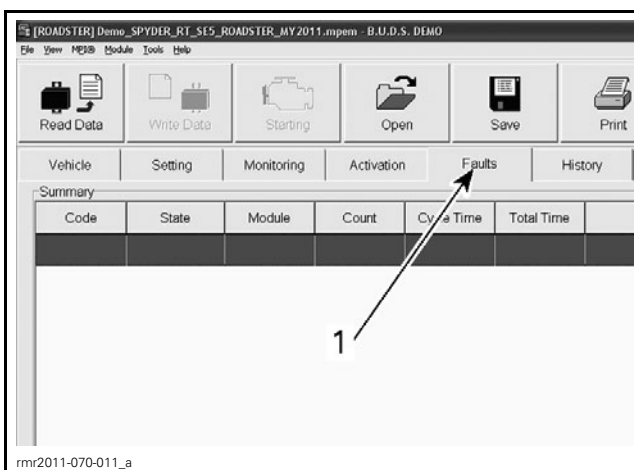
An occurred fault may also be generated when disconnecting and reconnecting a component, replacing a burnt fuse, when the software update of an electronic module has been carried out, or may be due to a momentary high or low voltage.

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.

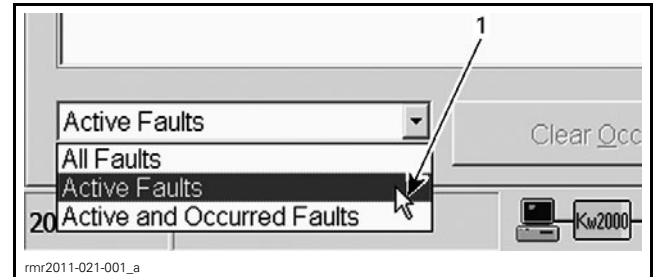
How to Read Fault Codes Using B.U.D.S. Software

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.



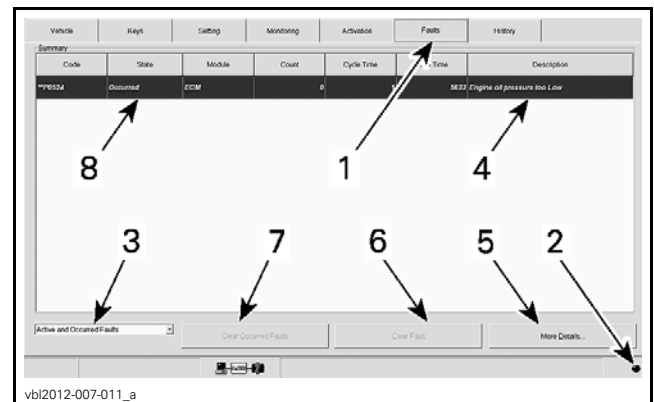
1. Fault tab

4. Click on the drop-down list on the LH lower corner.
5. Choose the fault state to display.



1. Drop down list

FAULT STATE	INFORMATION
All faults	Display all possible faults regardless of state
Active faults	Display only faults matching this state Empty area if there is no active fault
Active and occurred faults	Display only faults that have either state Empty area if there is neither active nor occurred fault



FAULT PAGE

1. Fault tab
2. Fault indicator light
3. Fault code state drop box
4. Fault description
5. More Details button
6. Clear Fault button
7. Clear Occurred Faults button
8. Selected fault

FAULT PAGE DESCRIPTION	
ITEM	INFORMATION
Faults tab	Click tab to display the fault page
Fault indicator light	When flashing, it indicates there is active fault(s)
Fault code state drop box	Click drop box to select the type of faults to display
Fault description	Display specific information related to the fault

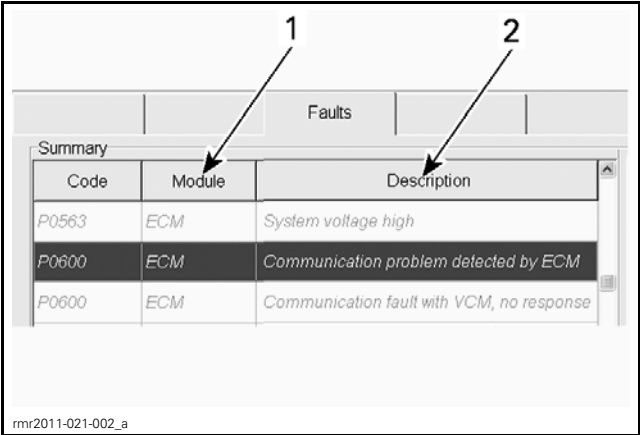
Subsection 04 (DIAGNOSTIC SYSTEM AND FAULT CODES)

FAULT PAGE DESCRIPTION	
ITEM	INFORMATION
More Details button	To display possible causes and service actions related to the selected fault
Clear Occurred Faults button	To clear all occurred faults in related ECU(s)
Selected fault	When a fault is selected, additional information pertaining to that fault will be displayed when clicking the "More details" button. To select a fault, click on the fault with the mouse or use the cursor up or down to scroll to the desired fault

FAULT DESCRIPTION	
COLUMN	INFORMATION
Code	Fault code number. When 2 stars (**) precedes the code, detailed conditions when the fault occurred, can be displayed by clicking the "More details" button
State	Display the fault state (active, occurred, inactive)
Module	Displays the module that reports the fault code. This is the module that detects or has received a message of an anomaly and reports it. List of modules: - Cluster (multifunction gauge) - DPS (dynamic power steering) - ECM (engine control module)
Count	Number of times this fault occurred within the driving cycle. Value: From 0 to 255
Total time	Engine hours when the fault happened. Displayed in hours and minutes format.
Description	Provides a short description of the fault

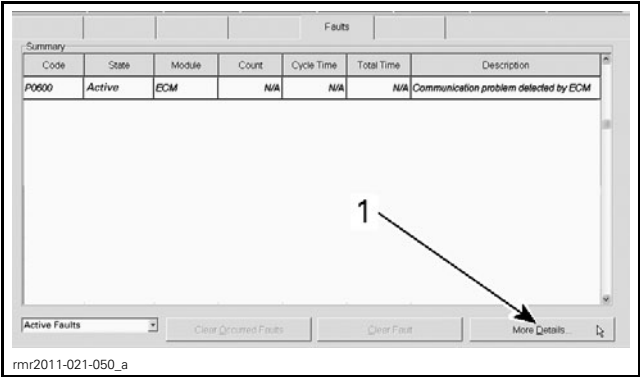
When reading a fault code in B.U.D.S., pay particular attention to which module reports a fault. It is indicated in the **Module** column.

The **Description** column gives a short description of the fault.

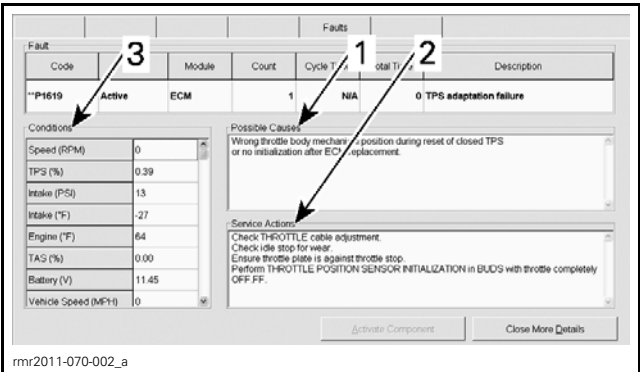


SOME COLUMNS REMOVED FOR CLARITY PURPOSE
1. Module that reports a fault
2. Fault description

Click on the **More Details** button, on the RH lower corner, to display the "Possible Causes" and the "Service Actions" to step further in the diagnosis.



1. Click here



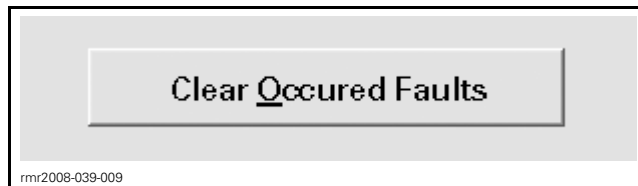
MORE DETAILS PAGE
1. Possible causes related to the selected fault
2. Service actions
3. Operating conditions when fault occurred

MORE DETAILS PAGE DESCRIPTION	
ITEM	INFORMATION
Possible causes	List the possible causes that triggered the fault
Service actions	List the possible actions to perform to solve the fault
Conditions when fault occurred	List the operating conditions of the engine and/or vehicle when the fault was triggered

How to Clear Fault Codes Using B.U.D.S.

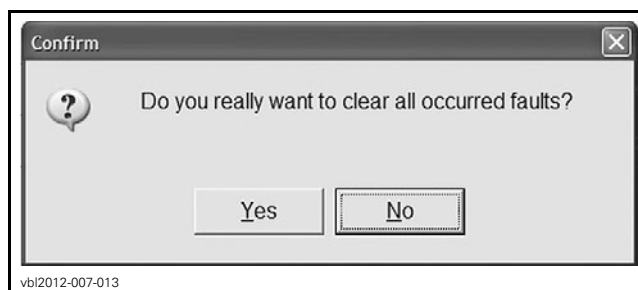
1. Connect vehicle to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Click on the **Read Data** button.
3. Click on the **Faults** tab.

The fault(s) (occurred state only) can be cleared by pressing the **Clear Occurred Faults** or **Clear Fault** buttons in B.U.D.S.



FAULTS PAGE TAB, CLEAR OCCURRED FAULTS

4. Click YES on the following message box.



5. Turn ignition OFF and wait until the message disappears.

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.

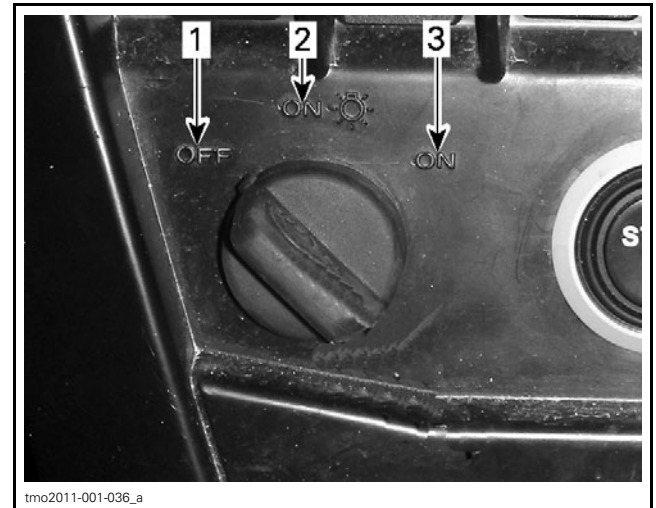
How to Read Fault Codes Using the Multifunction Gauge

NOTE: A fault code must be in an "Active" state to be displayed in the multifunction gauge. B.U.D.S. must be used to read all fault codes states.

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.



1. M (mode) button
2. S (set) button (pressed repeatedly to toggle secondary display)

Subsection 04 (DIAGNOSTIC SYSTEM AND FAULT CODES)



1. 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.



1. 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.

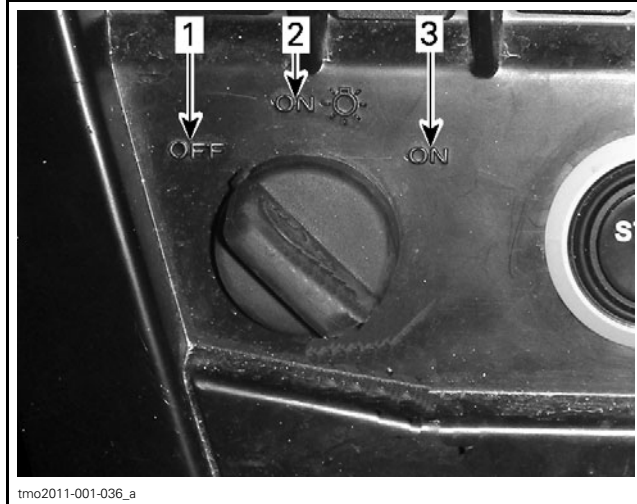
If there are multiple fault codes, the display will cycle through each fault code repeatedly. A maximum of 10 fault codes may be displayed.

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

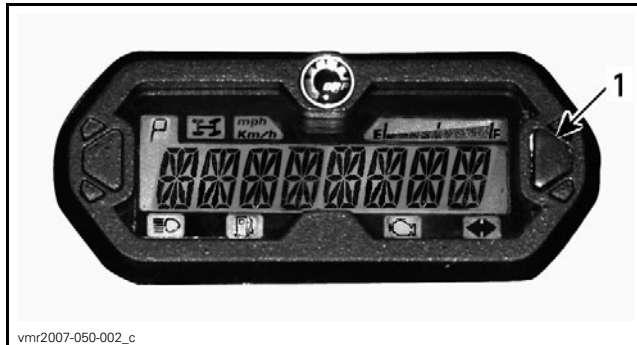
1. Turn ignition key to ON with lights position.



IGNITION SWITCH POSITION

1. 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.



1. Selector button to toggle indication



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.



1. 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 Find Fault Code Descriptions

For the latest fault code table, use the **Info Center** submenu in BOSSWeb and enter the following search criteria:

- Enclose the search within quotes " "
- Enter: "2014 ATV and SSV DTC Table".

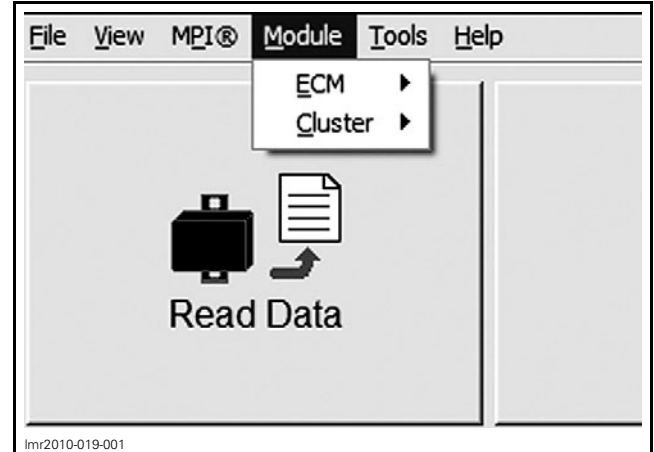
FAULT CODE DIAGNOSTIC

Missing Module

If a module is missing, several fault codes will appear.

To quickly find which module is missing, perform the following:

1. Connect vehicle to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Click on the **Read Data** button.
3. Click **Module** in the menu bar.
4. Look at the list of modules.
5. If a module is not visible, then it is not communicating through the CAN bus (controller area network).



TYPICAL - MODULE SUBMENU LIST

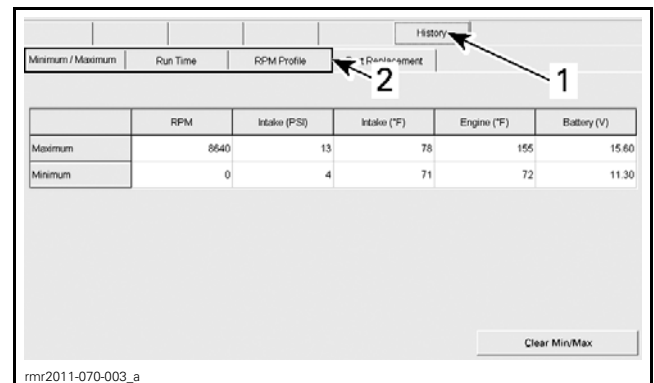
6. Refer to the following table to find the appropriate subsection in this manual to diagnose the missing module.

MISSING MODULE	SECTION TO REFER TO
ECM	<i>ELECTRONIC FUEL INJECTION (EFI)</i>
Cluster	<i>LIGHTS, GAUGE AND ACCESSORIES</i>
ACS	<i>AIR CONTROLLED SUSPENSION (ACS)</i>
DPS	<i>DYNAMIC POWER STEERING (DPS)</i>

Diagnostic Tips

To see the last minute of operating conditions, click on the **History** tab in B.U.D.S.

NOTE: The page displays data whatever there is fault code(s) or not.



1. History tab
2. Additional history pages

Subsection 04 (DIAGNOSTIC SYSTEM AND FAULT CODES)

HISTORY PAGE DESCRIPTION	
ITEM	INFORMATION
Minimum/ Maximum	Display the minimum and maximum values encountered since last clear. Click "Clear Min/Max" to reset the values
Run time	Display the time proportion in what mode the engine was running in
RPM profile	Display the RPM range proportion in which the engine was running in

When a minor fault occurs:

- Turn ignition key OFF.
- Wait 30 seconds.
- Turn ignition key ON.

This should change the fault state from "Active" to "Occurred".

The vehicle should then operate normally.

If a sensor-related fault persists, you may try disconnecting/reconnecting the sensor.

Read the following for a general approach to troubleshoot fault codes (active or occurred).

Subsection 04 (DIAGNOSTIC SYSTEM AND FAULT CODES)

GENERAL GUIDELINES TO SOLVE FAULT CODES	
CONDITION	ACTION
Troubleshooting vehicle	Use B.U.D.S. to: Read fault codes. Display "Active" faults to see components currently not operating normally. Display "Occurred" faults to troubleshoot intermittent problems. Monitor system(s), sensor(s), switches and actual conditions. Activate component(s) for troubleshooting. Set components (resets etc). Know the last minute of operating conditions by using the "History" page. Know the operating conditions, if available, when a fault code occurred by using the "More details" button in the fault page.
New fault(s) appear after a vehicle maintenance or repair	Check sensor connections or mixed up connections. Before vehicle maintenance: Read the electronic modules with B.U.D.S. Save and print the B.U.D.S. file (keep faults option only). After vehicle maintenance: Read the electronic modules with B.U.D.S. Compare the fault code(s) before and after the maintenance using the printed copy and the current B.U.D.S. reading. Investigate only the newly fault codes. Clear all occurred faults in B.U.D.S.
Sensor "Active" fault	Read the fault description in B.U.D.S. Click on the "More Details" button. Look at the "Conditions" when available. Read the "Possible Causes". Apply the "Service Actions".
Low system voltage on one module. Power problem on sensor(s)	Check related fuse(s) and relay. Check related power and ground wires. Check for common power supply to several sensors/modules (refer to <i>POWER DISTRIBUTION AND GROUNDS</i>). NOTE: Some sensors are supplied by the battery while others are supplied by a module.
Low system voltage on several modules (several communication faults will also appear)	Check battery condition and connections. Check related fuse(s) and relay. Check voltage regulator/rectifier.
High system voltage on several modules	A battery charger has likely been used to substitute the vehicle battery. Clear all occurred faults and check again. Check voltage regulator/rectifier.
When all modules report that a module is missing	Check the module that is reported as missing. Check related fuse(s) and relay. Check related power and ground wires.
When several modules are in fault	Search for a common problem such as a faulty sensor.
CAN buss OFF	When several modules and sensors report that a module is missing. A missing module may be reported as CAN bus off by any other module. Check related CAN wires (continuity, short to ground, short between CAN low and high). Check module pins and wiring terminals. Then, the other modules should stop reporting that module is missing.

Subsection 04 (DIAGNOSTIC SYSTEM AND FAULT CODES)

GENERAL GUIDELINES TO SOLVE FAULT CODES	
CONDITION	ACTION
Occurred fault(s)	May have been generated due to a system or component that was momentarily operating outside normal parameters.
	May be generated when disconnecting and reconnecting a component, replacing a burnt fuse, or may be due to a momentary high or low voltage.
	Before being "Occurred", a fault has always been "Active" for a certain time, indicating that an unexpected condition or problem has been present during the driving cycle.
	A frequent momentarily fault or an intermittent fault may never be seen as "Active" in B.U.D.S. while there is still a pending problem. This type of malfunctions can be discovered by looking at the "Occurred" faults and then by evaluating the fault count. As long as a fault is present, it is displayed as "Active".
Fault count (0 - 255)	Low value: Suggests handling problems (connections, terminal contact/ shape etc.). High value: Suggests a frequent and unsolved problem. The problem should be investigated.
Fault conditions (more details button)	Look for abnormal, excessive values.
Hard to find problems	When the basic troubleshooting has been done and the fault code(s) persists, often the problem is related to the wiring harness, connections or electromechanical components. Short to ground, to battery or between wires. Wire splices, chafing, terminal problems (pulled out, bent, out of shape, corroded etc.). Bad contacts in switch or relay.

ECUs share information and their systems may interact with each other. Certain faults may cause more than one ECU to set a fault code or indication (pilot lamp or message) as the failure of some components may affect the operation of several systems.

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 *INTELLIGENT 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.

BRAKE ACTIVATION Fault Message in Gauge

If a brake signal is received continuously for 15 seconds above 5 km/h (3 MPH), a BRAKE 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
- Sport/ECO 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).

Sport/ECO 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. This mode can be activated with all key types.

NOTE: The sport mode is not available in low and reverse gears (ECO mode automatically enabled).

When ECO (fuel economy mode) mode is selected, the fuel consumption is reduced by limiting throttle response and maximum throttle opening to maintain an optimal cruising setting.

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 20 km/h (12 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.

Drive 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 drive 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

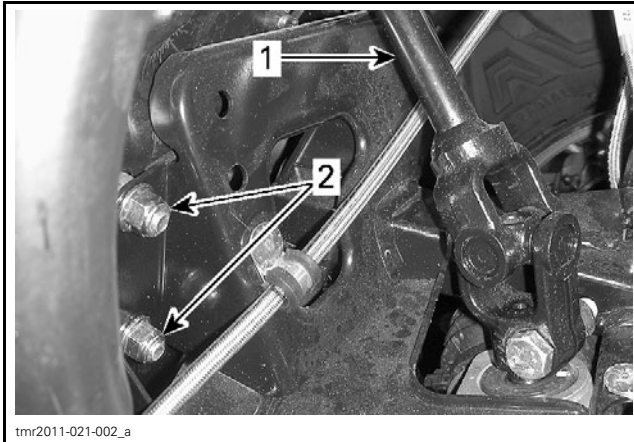
The throttle accelerator sensor (TAS) is a double hall effect sensor that sends a signal to the ECM which is proportional to the accelerator pedal. The redundancy is used for security purposes.

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.



1. 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	B	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.

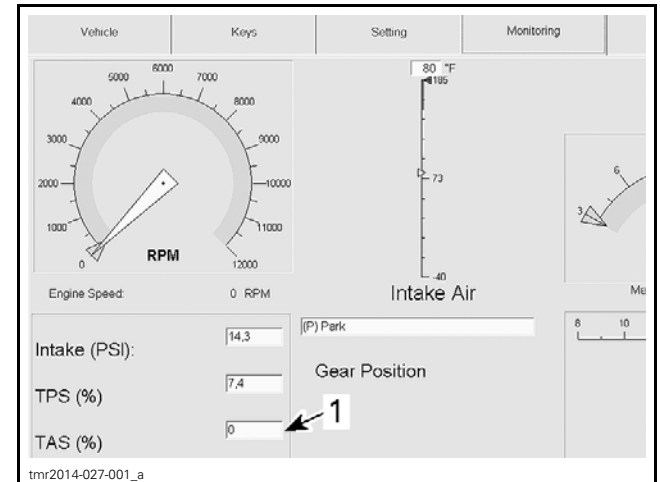
TAS Test with B.U.D.S.

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.zd* subsection.

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.

WIRING HARNESSSES AND CONNECTORS

SERVICE TOOLS

Description	Part Number	Page
CRIMPING TOOL (HEAVY GAUGE WIRE)	529 035 730	293
ECM ADAPTER TOOL.....	529 036 166	291
ECM TERMINAL REMOVER 2.25.....	529 036 175	291
ECM TERMINAL REMOVER 3.36.....	529 036 174	291

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
GM TERMINAL EXTRACTOR.....	12094430	292
SNAP-ON TERMINAL REMOVER TOOL	TT600-4	288

GENERAL

WIRING HARNESS AND SPLICE LOCATION

The wiring harnesses and splice location illustrations are typical. Several variants of the connector types, such as different number of pin cavities, are used on the vehicle. The wiring harnesses and splice location illustrations are stored in the back cover pocket.

PROCEDURES

DEUTSCH CONNECTORS

Deutsch Connector Application

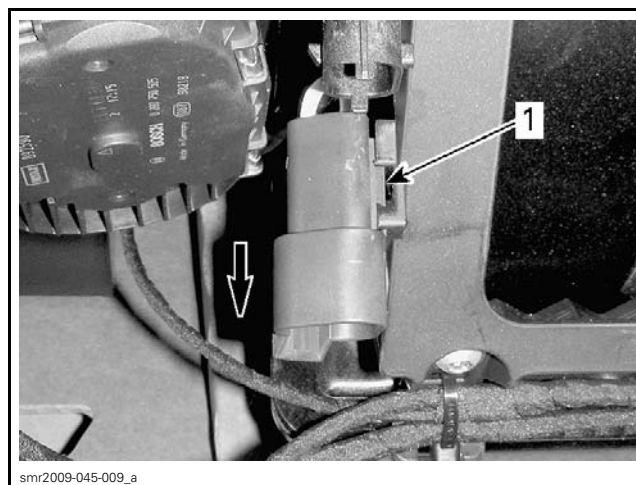
A variety of Deutsch connectors are used on various systems:

- Engine connector
- Magneto connector.

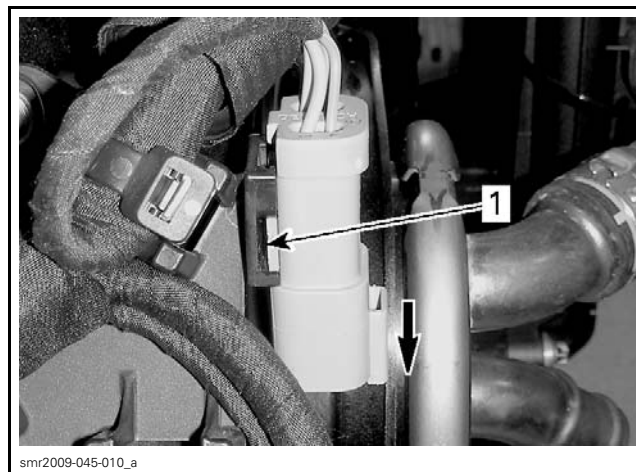
The following procedures may be used on each as they are similar in construction.

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

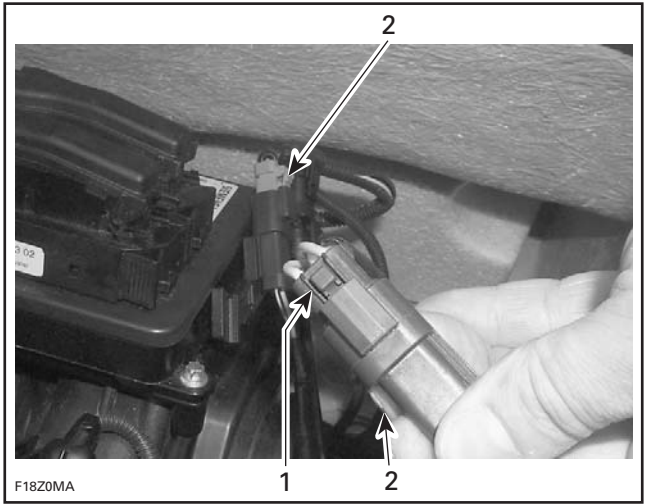


TYPICAL - MALE CONNECTOR REMOVED FOR CLARITY
1. Insert screwdriver here

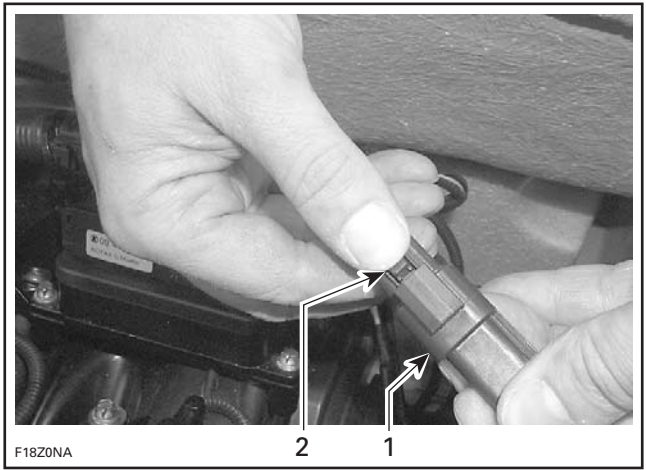
Section 05 ELECTRICAL SYSTEM
Subsection 02 (WIRING HARNESSSES AND CONNECTORS)

Deutsch Connector Disconnect

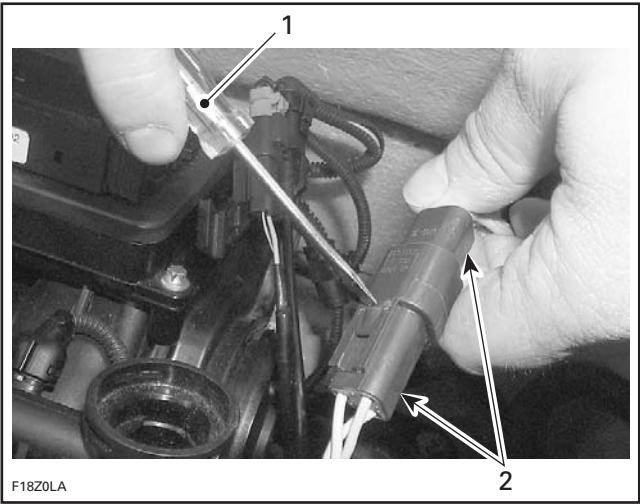
1. To disconnect a Deutsch connector, press the release tab and twist a small flat screwdriver between the male and female housing to disengage and disconnect them.



TYPICAL
1. Release tab
2. Deutsch connector

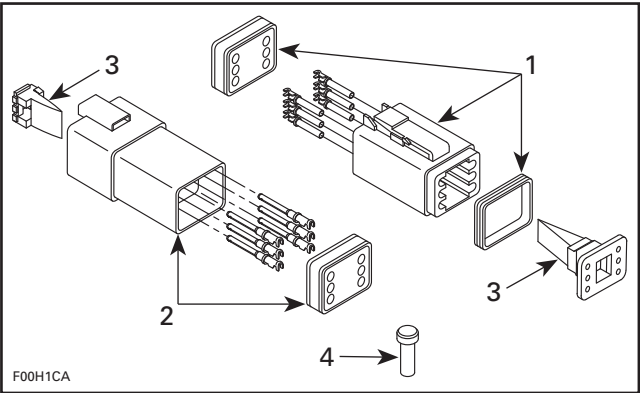


TYPICAL
1. Deutsch connector
2. Press release button



TYPICAL
1. Flat screwdriver
2. Deutsch connector

Deutsch Connector Disassembly and Reassembly



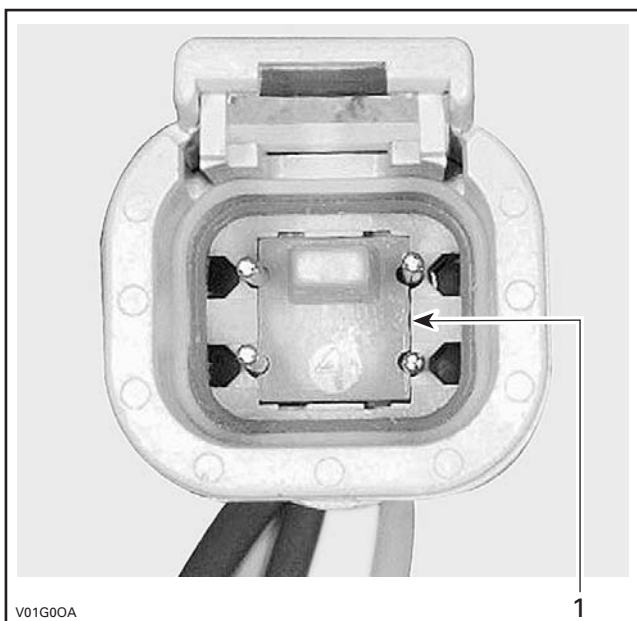
TYPICAL - DEUTSCH CONNECTOR
1. Male connector
2. Female connector
3. Secondary lock
4. Sealing cap

NOTICE Do not apply dielectric grease on terminal inside connector.

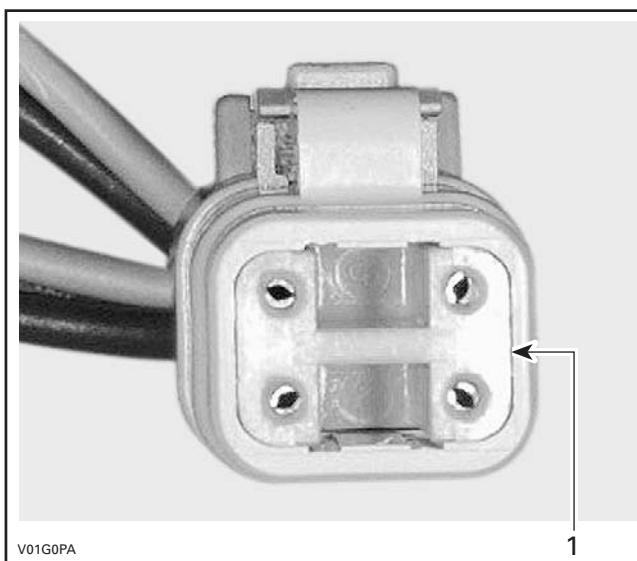
Terminal Removal

To remove terminals from connector, proceed as follows:

1. Using long nose pliers, pull out the secondary plastic lock from between the terminals.



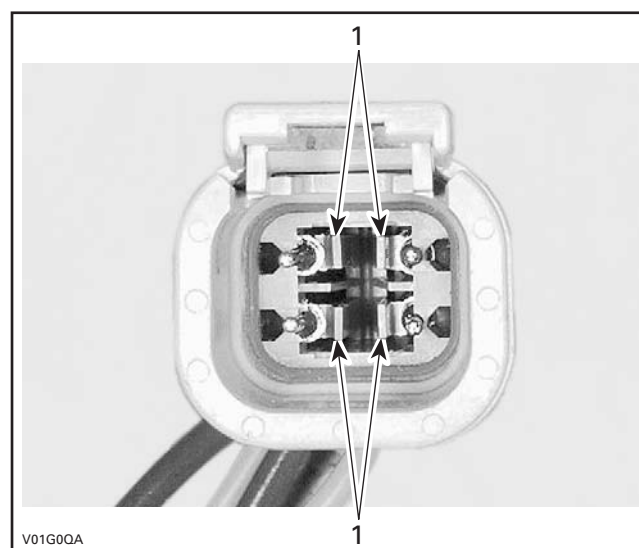
FEMALE CONNECTOR
 1. Female lock



MALE CONNECTOR
 1. Male lock

NOTE: Before pin extraction, push wire forward to relieve pressure on retaining tab.

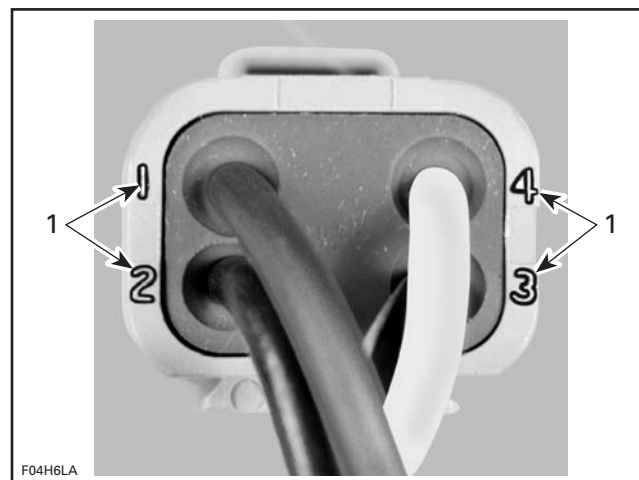
2. Insert a 4.8 mm (.189 in) wide screwdriver blade inside the front of the terminal cavity.
3. Pry the retaining tab away from the terminal while gently pulling the wire and terminal out of the back of the connector.



FEMALE CONNECTOR
 1. Retaining tab

Terminal Insertion

1. For insertion of a terminal, ensure the secondary plastic lock is removed.
2. Insert terminal through the back of the connector in the appropriate position, and push it in as far as it will go. You should feel or hear the terminal lock engage.
3. Pull back on the terminal wire to be sure the retention fingers are holding the terminal.
4. After all required terminals have been inserted, the lock must be installed.



CONNECTOR PIN-OUT
 1. Terminal position identification numbers

PACKARD CONNECTORS

Packard Connector Application

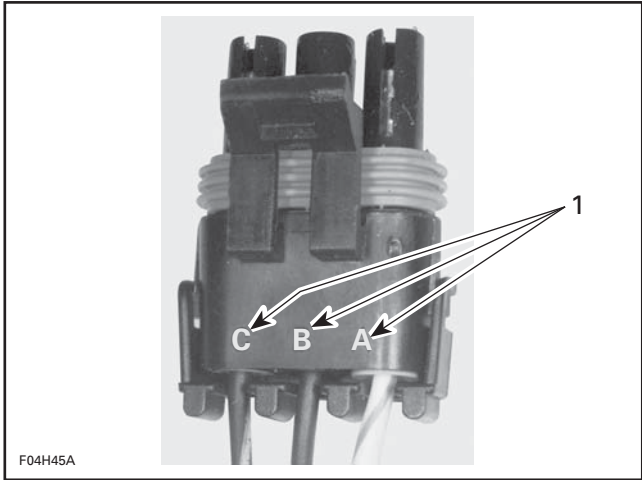
Packard connectors are used to connect:

- Electrical harnesses

Section 05 ELECTRICAL SYSTEM
Subsection 02 (WIRING HARNESSSES AND CONNECTORS)

- Gauges
- VCM
- EFB.

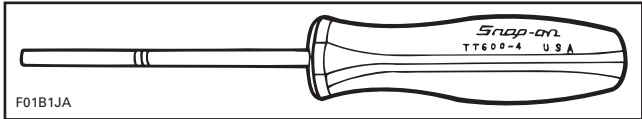
3-Pin Packard Connector



VIEW OF A 3-PIN PACKARD CONNECTOR
1. Identification letters

NOTE: This type of connector also comes in other pin configurations.

To remove a terminal from a 3-pin Packard connector, use the SNAP-ON TERMINAL REMOVER TOOL (P/N TT600-4).

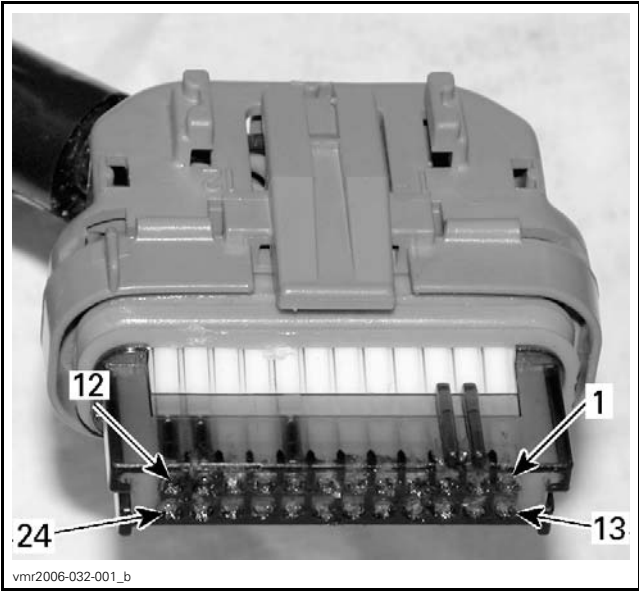
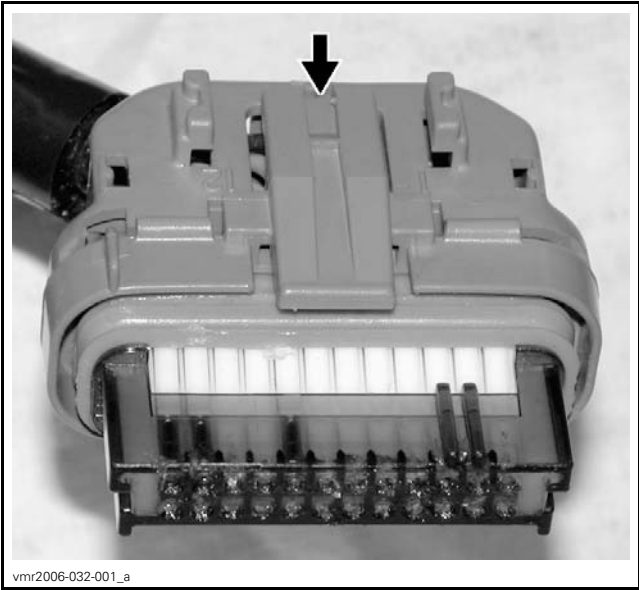


⚠ WARNING

Ensure all terminals are properly crimped on wires and connectors are properly fastened.

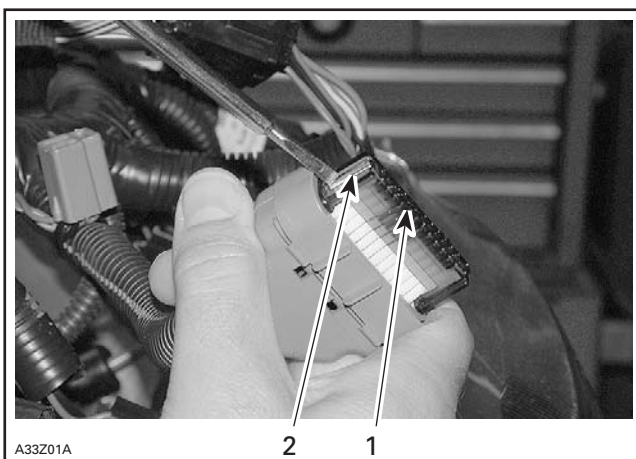
**PACKARD CONNECTOR
(MULTIFUNCTION GAUGE)**

Firmly push down tab and hold to unlock connector while pulling it out.



CONNECTOR PINOUT

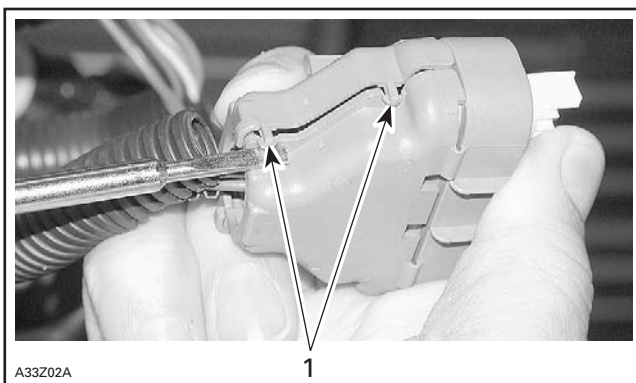
Push on both tabs to remove retainer.



TYPICAL

1. Retainer
2. Tab (one on each side)

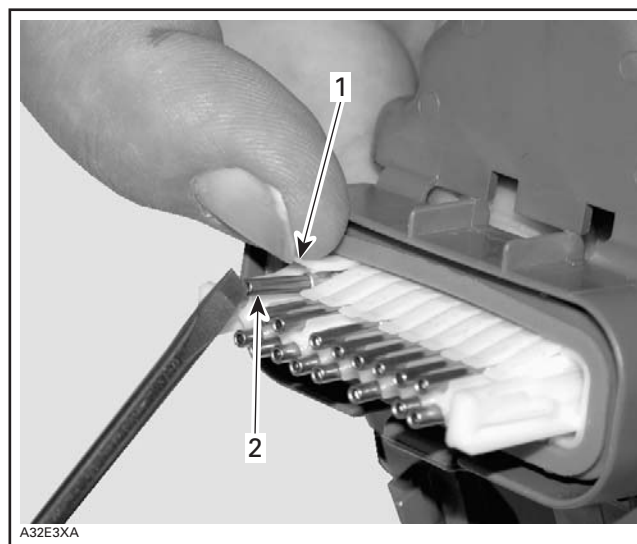
Open housing by lifting 4 tabs.



TYPICAL

1. Tabs (2 on each side)

Lift the top plastic lock of the female terminal to be removed and hold in position. Lift the female terminal to unlock from the housing and push out of housing.



TYPICAL

1. Lift and hold plastic lock
2. Lift to unlock and push out

MOLEX CONNECTOR

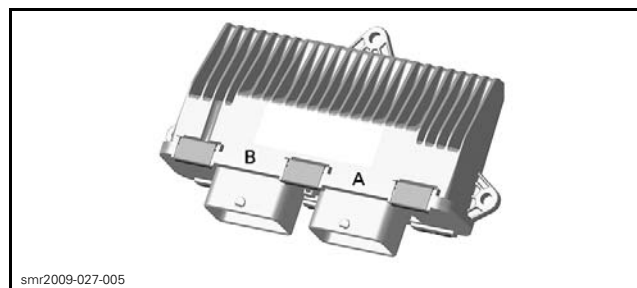
Molex Connector Application

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.



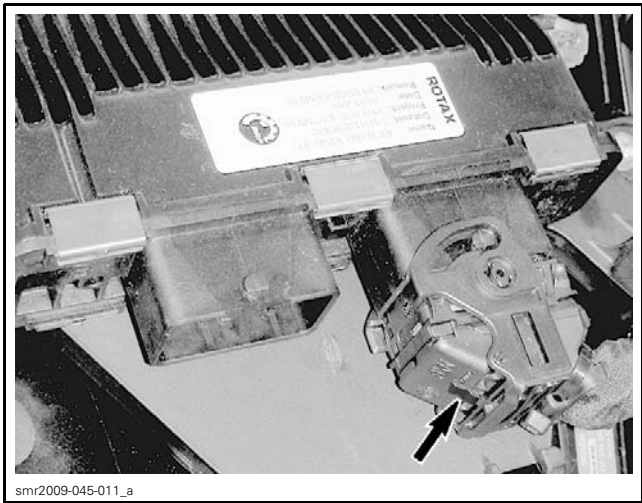
ECM CONNECTORS

Do not apply any product to the pins in the ECM connector.

Connector Removal

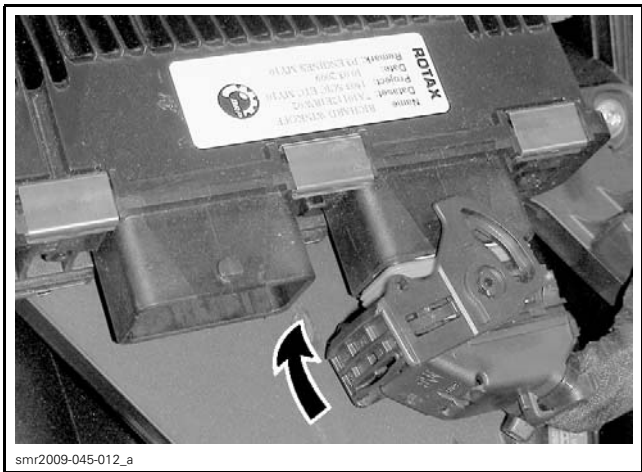
1. To access the ECM, refer to *ELECTRONIC FUEL INJECTION* subsection.
2. Press and hold the locking tab on the connector to be disconnected.

Section 05 ELECTRICAL SYSTEM
Subsection 02 (WIRING HARNESSES AND CONNECTORS)



LOCKING TAB TO PRESS AND HOLD

3. As you hold the locking tab, rotate the connector locking cam until it stops.



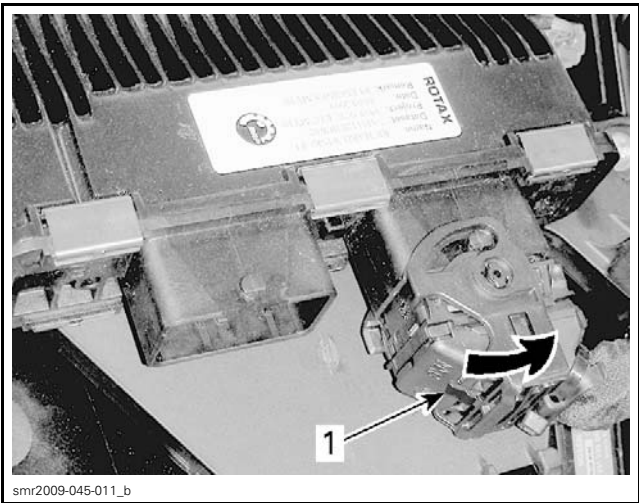
CONNECTOR LOCKING CAM ROTATION TO RELEASE

4. Pull connector off ECM.



CONNECTOR 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.

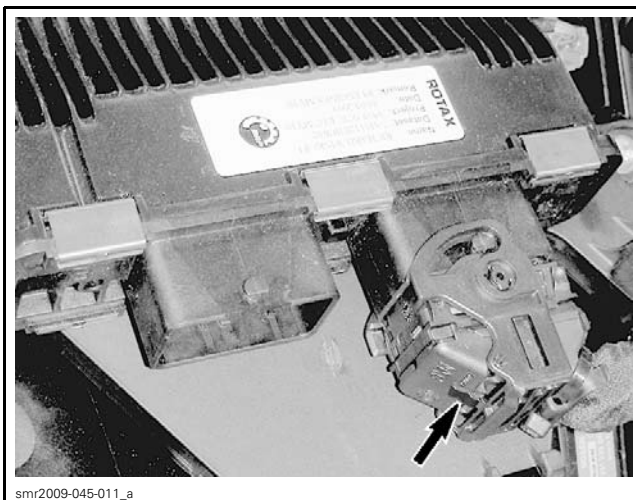


1. Locked here

4. Ensure the locking tab is fully out.

Connector Installation

- 1. Fully open connector locking cam.



LOCKING TAB FULLY OUT

Connector Inspection

Before replacing an ECM, always check electrical connections.

1. Ensure connector locking mechanism is functioning properly.
2. Ensure all wire terminals (pins) are properly locked in the connector.
3. Ensure they are very tight, make good contact with the pins in the ECM.
4. Ensure the pins in the harness connector and the ECM connector are clean, shiny and corrosion-free.
5. Check wiring harness for signs of scoring.

NOTE: A “defective ECM module” could possibly be repaired simply by disconnecting and reconnecting it.

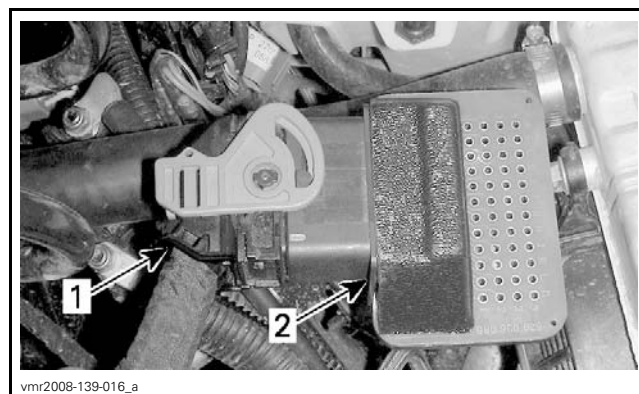
NOTICE Do not apply any lubricant product to the pins of the ECM connector.

Connector Probing

The most recommended and safest method to probe the MOLEX (ECM) connector terminals is to use the ECM ADAPTER TOOL (P/N 529 036 166). This tool will prevent deforming or enlarging of the terminals, which would lead to bad ECM terminal contact creating intermittent or permanent problems.



1. Disconnect the ECM connector to be probed, and reconnect it on the ECM adapter.
2. Probe wire terminals of the circuit to be tested directly in the adapter holes.



TYPICAL
1. ECM connector
2. ECM adapter

NOTICE Never probe directly on the ECM harness connector. This could change the shape or enlarge the terminals and create intermittent or permanent contact problems.

Connector Terminal Removal (Harness Connector)

To remove a signal terminal from the ECM harness connector, use the ECM TERMINAL REMOVER 2.25 (P/N 529 036 175).

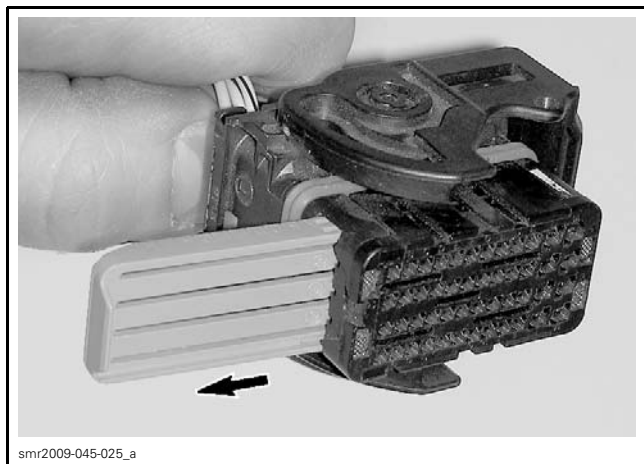
To remove a power terminal, use the ECM TERMINAL REMOVER 3.36 (P/N 529 036 174).

Section 05 ELECTRICAL SYSTEM

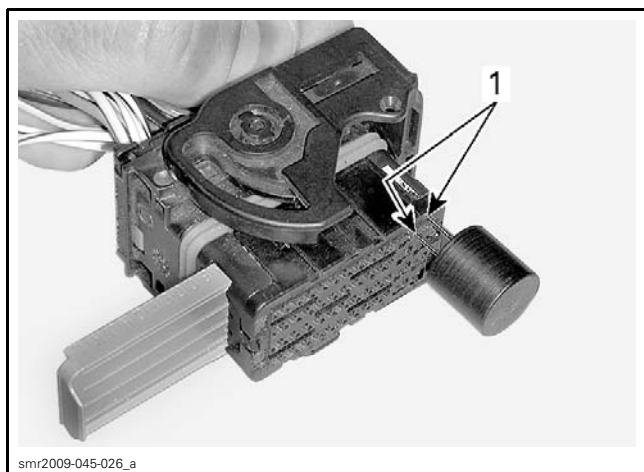
Subsection 02 (WIRING HARNESSSES AND CONNECTORS)



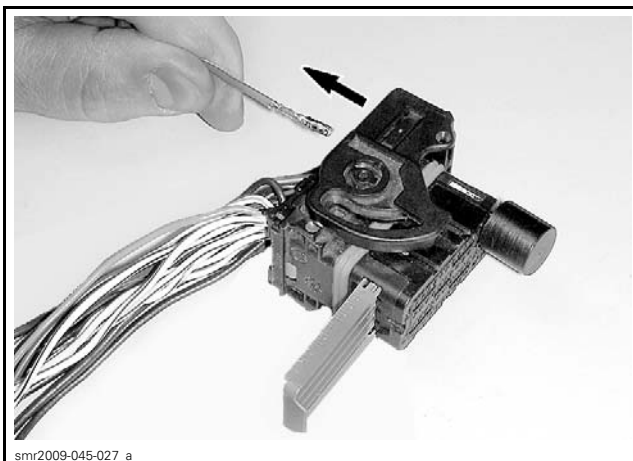
1. Remove rear protector from connector.
2. Pull out the connector lock.



3. Insert tool to unlock terminal.



1. *Unlock here*
4. Gently pull on the wire to extract the terminal out the back of the connector.



NOTICE Before installing wire terminals in the connector, ensure all terminals are properly crimped on wires. After installation of wire terminals in the connectors, ensure they are properly locked by gently pulling on them as if to extract them.

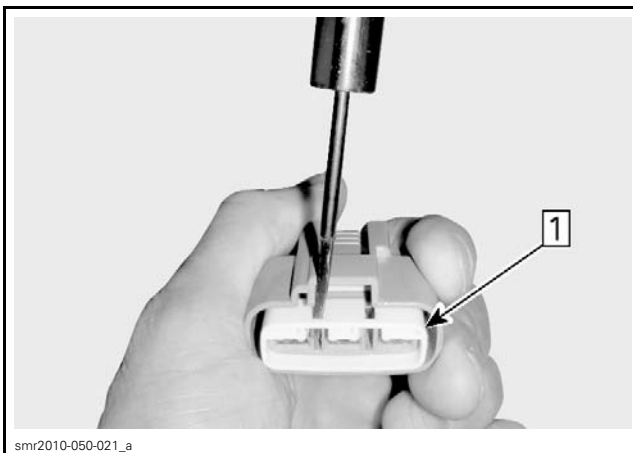
FURUKAWA CONNECTOR

Furukawa Connector Application

Voltage regulator/rectifier.

Terminal Removal

1. Remove the secondary lock (plastic insert).

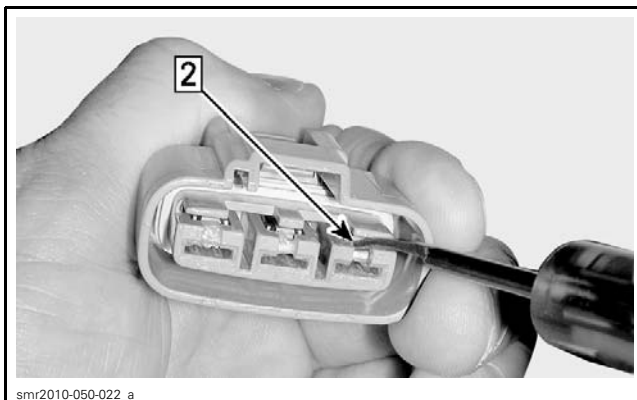


Step 1: Remove the secondary lock

2. Carefully insert the GM TERMINAL EXTRACTOR (P/N 12094430) between the lock and the pin to release the pin.

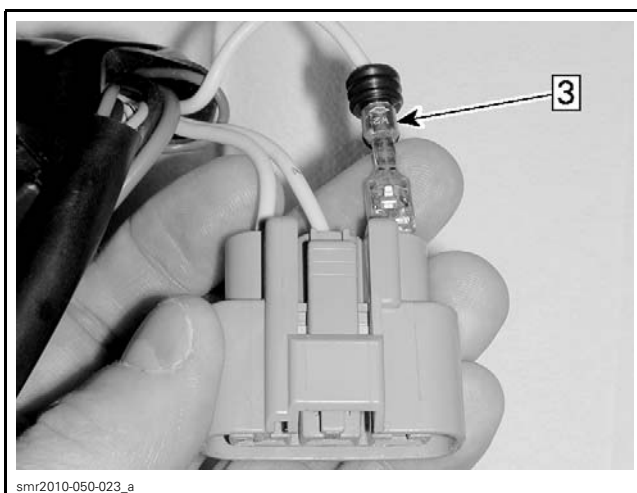


GM TERMINAL EXTRACTOR (P/N 12094430)



Step 2: Insert GM extractor tool (P/N 12094430)

3. Gently pull on the wire to extract the pin out the back of the connector.



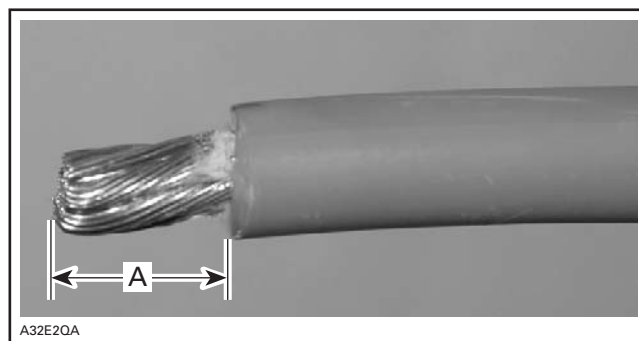
Step 3: Pull wire to extract pin

NOTICE Before installing terminals in the connectors, ensure all terminals are properly crimped on the wires. After installation of the wire terminals in the connectors, ensure they are properly locked by gently pushing on them as if to extract them.

BATTERY AND STARTER CABLE TERMINALS

Cable Crimping

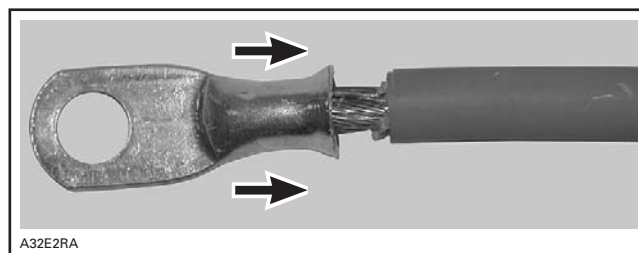
Carefully strip the wire approximately to 10 mm (3/8 in) in length, using a wire stripping tool or sharp blade/knife.



A. 10 mm (3/8 in)

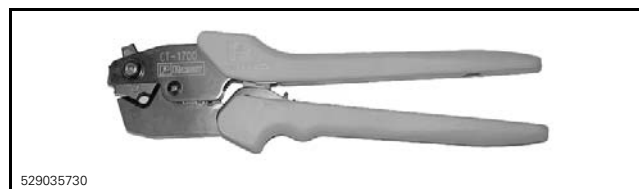
NOTE: Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate *PARTS CATALOG*.



INSTALLATION OF TERMINAL

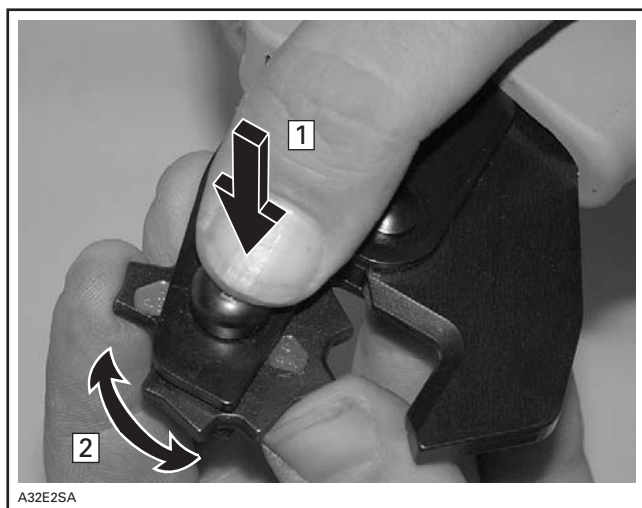
Follow the instructions provided with the CRIMPING TOOL (HEAVY GAUGE WIRE) (P/N 529 035 730) to select the proper position of the tool.



NOTE: Different wires require different crimping pliers settings.

Section 05 ELECTRICAL SYSTEM

Subsection 02 (WIRING HARNESSSES AND CONNECTORS)



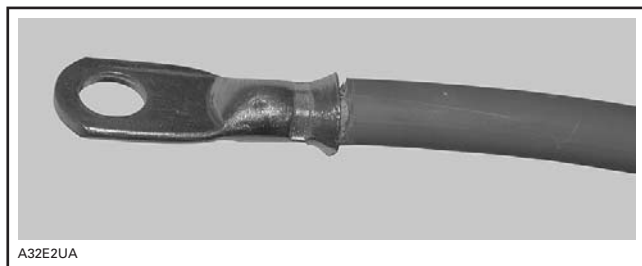
POSITIONING THE CRIMPING PLIERS

Step 1: Press
Step 2: Rotate

After positioning the crimping pliers, crimp the terminal already installed on wire.



CRIMPING OF WIRE



PROPERLY CRIMPED WIRE

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

NOTICE Never weld the wire to the terminal. Welding can change the property of the wire and it can become brittle and break.

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

NOTICE Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.

IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	297
FLUKE 115 MULTIMETER	529 035 868	296

GENERAL

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*.
6. Defective fuel injectors or circuit
 - Check fuel injectors, refer to *ENGINE MANAGEMENT*.

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.
4. Poor engine grounds
 - Check/clean/repair.

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.

Section 05 ELECTRICAL SYSTEM
Subsection 03 (IGNITION SYSTEM)

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)	A	YELLOW/BLUE
12 Vdc input	B	BEIGE/WHITE
Ground (through ECM)	C	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**

8 N•m ± 1 N•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.

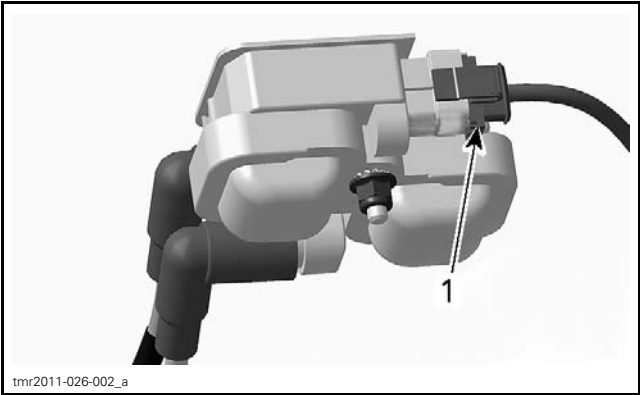
You should hear the spark occurring. In doubt, use an inductive spark tester. If there is no spark, perform the following checks.

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.



1. Ignition coil connector

Turn ignition switch to ON.

Using a the FLUKE 115 MULTIMETER (P/N 529 035 868), read voltage.



IGNITION COIL CONNECTOR	VOLTAGE
Pin 2 with battery ground	Battery 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)	Pin E	A-M1	.3 - .6 Ω
Cylinder 2 (rear)		A-M2	

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* sub-section.

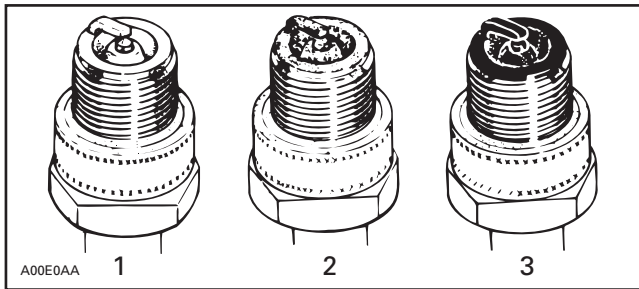
Troubleshooting Fouled Spark Plug

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.

Section 05 ELECTRICAL SYSTEM

Subsection 03 (IGNITION SYSTEM)

Spark Plug Analysis



TYPICAL

1. Overheated (light grey, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, grey, melted coating)

The plug face reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at regular intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

STARTING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	304
FLUKE 115 MULTIMETER	529 035 868	305

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	307

GENERAL

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.
2. Burnt fuse F8 in fuse box 1
 - Check fuse.
3. Defective or discharged battery
 - Test battery, refer to *CHARGING SYSTEM*.
4. Defective ignition switch or circuit
 - Check ignition switch, refer to *IGNITION 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 COUPLING 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 sub-section.
- 5. Defective starter motor
 - Check starter motor, see procedure in this sub-section.

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	1	2	Infinite (OL)
Switch depressed and held			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 SOLENOID 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

1. Disconnect SS2 (ORANGE/BROWN) from solenoid.
2. Turn ignition switch ON.
3. Measure voltage as per following table.

STARTER SOLENOID GROUND 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.

STARTER SOLENOID WINDING RESISTANCE TEST		
TEST PROBES		RESULT @ 20°C (68°F)
Starter solenoid SS1 pin	Starter solenoid SS2 pin	Approximately 5 Ω

If measurement is out of specification, replace solenoid.

Starter Solenoid Voltage Drop Test

Turn ignition key ON.

Section 05 ELECTRICAL SYSTEM

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.



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.

1000 Models

To access starter for removal, remove drive pulley, 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.

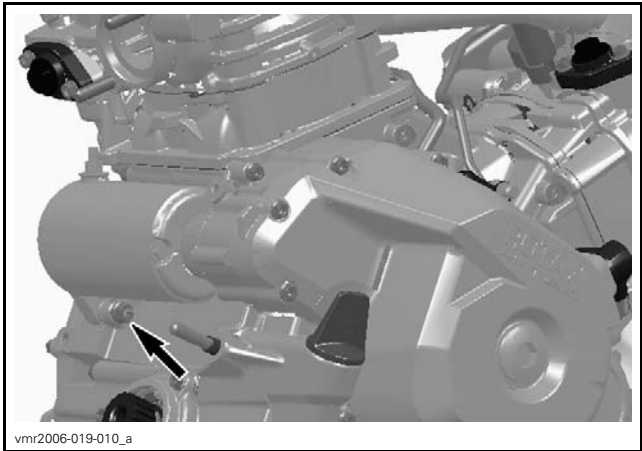
 **WARNING**

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 SCREW TIGHTENING TORQUE	
Starter mounting screw	25 N•m (18 lbf•ft)

Connect the RED (+) cable to the starter and tighten nut and apply specified product.

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.

 WARNING
Always connect RED (+) cable first then BLACK (-) cable last.

Test starter operation.

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 *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection for proper connection instructions.

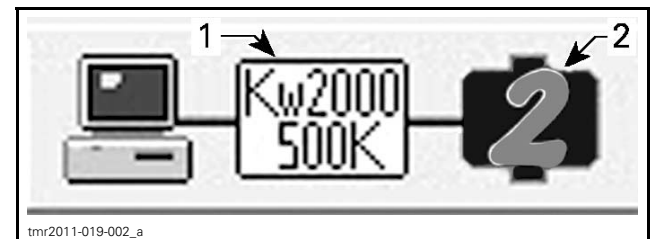
The B.U.D.S. software is designed to allow, among other things, the programming of ignition key(s) and entering customer information.

For more information pertaining to the use of the software B.U.D.S., use its help which contains detailed information on its functions.

⚠ WARNING

If the computer you are using is connected to the 110 Vac power outlet, there is a potential risk of electrocution when working in contact with water. Be careful not to touch water while working with the VCK.

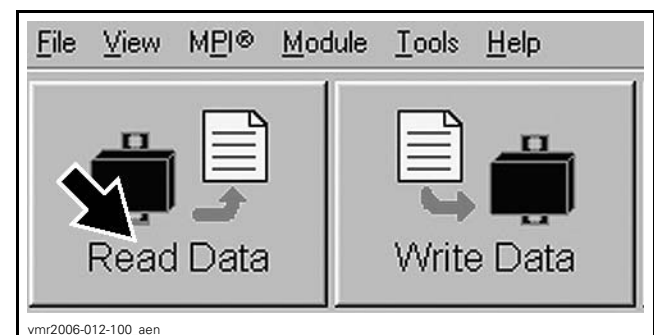
1. Turn ignition switch to ON using any of the key provided with the vehicle. DO NOT start the engine.
2. Start B.U.D.S. and login.
3. Wait during detection setup.
4. Ensure the status bar shows the Kw2000 protocol and the appropriate number of modules to its right according to the vehicle model.



TYPICAL - SUCCESSFUL CONNECTION

1. Connection protocol
2. Number of modules

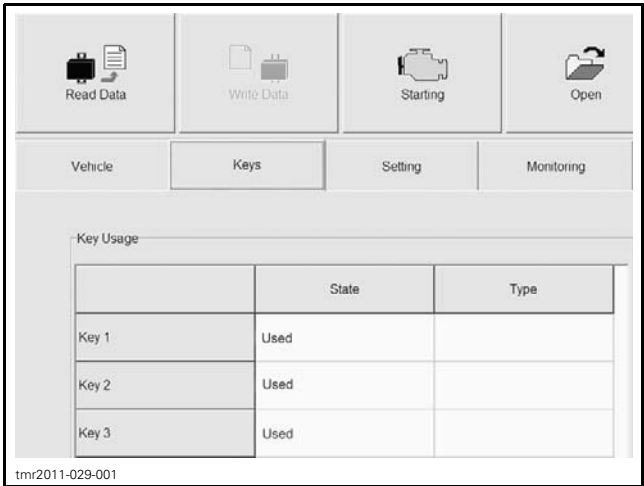
5. Click the **Read Data** button.



6. Click on **Keys** tab.

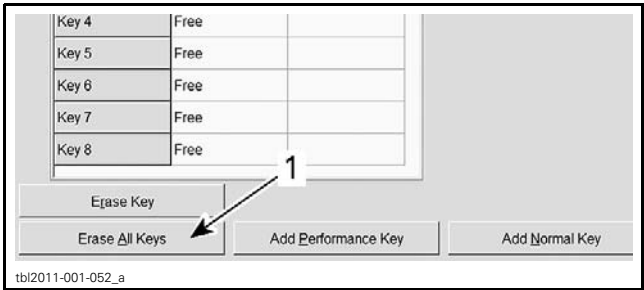
Section 05 ELECTRICAL SYSTEM

Subsection 06 (DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.))



KEYS TAB

7. Click on Erase All Keys button.

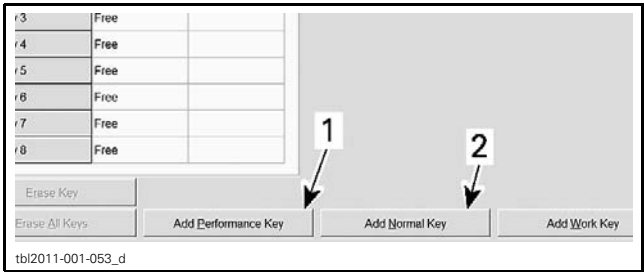


1. Click here to erase all keys

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.

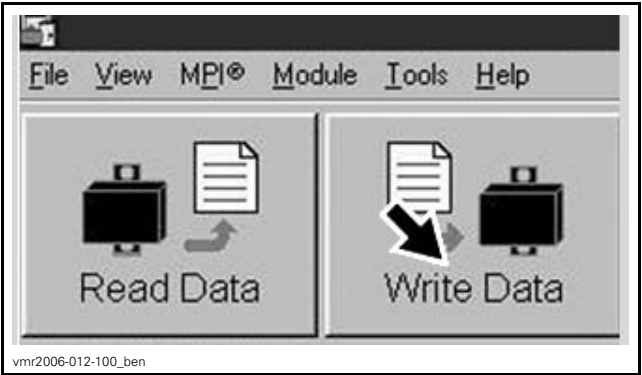


1. Add Performance Key button

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.

LIGHTS, GAUGE AND ACCESSORIES

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	1

GENERAL

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 DIELECTRIC GREASE (P/N 293 550 004) or other appropriate lubricant when reassembling them, except if otherwise specified such as for the ECM connectors.

Pay attention to ground wires.

PROCEDURES

CONSOLE SWITCHES

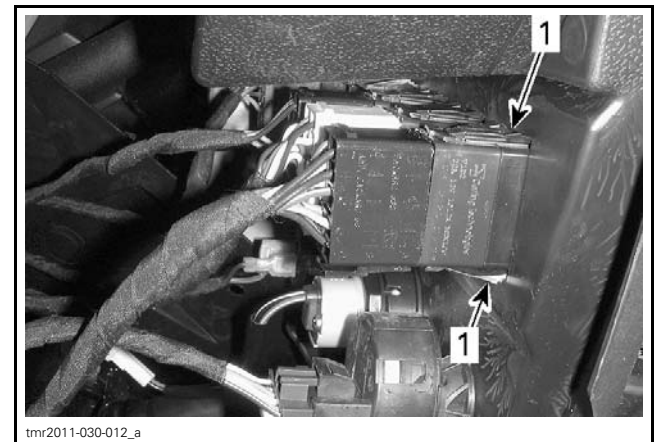
Switches Access

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.

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

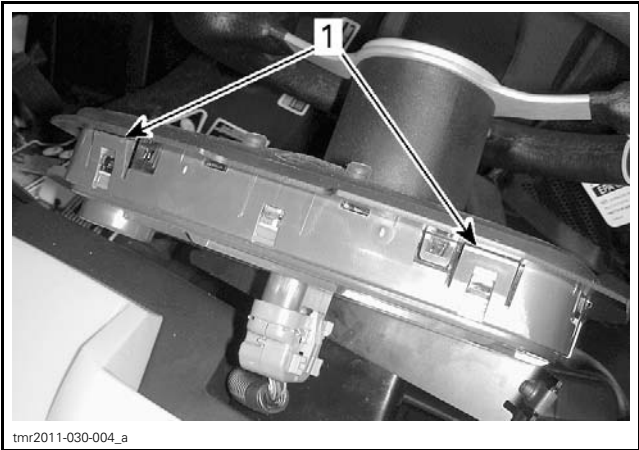
FUNCTION	PIN	COLOR
12 volt input from fuse F4	17	ORANGE/GREEN
12 volt input from fuse F8	16	BEIGE/WHITE
Ground	20	BLACK
CAN LO	18	WHITE/BLACK
CAN HI	19	WHITE/BEIGE
Fuel level gauge supply	4	BROWN/PINK
Fuel level gauge ground	21	VIOLET/PINK
2WD/4WD switch signal (-)	7	BLACK/BEIGE
HI beam signal (+)	5	BLUE
Vehicle speed sensor signal (VSS)	9	PINK

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.

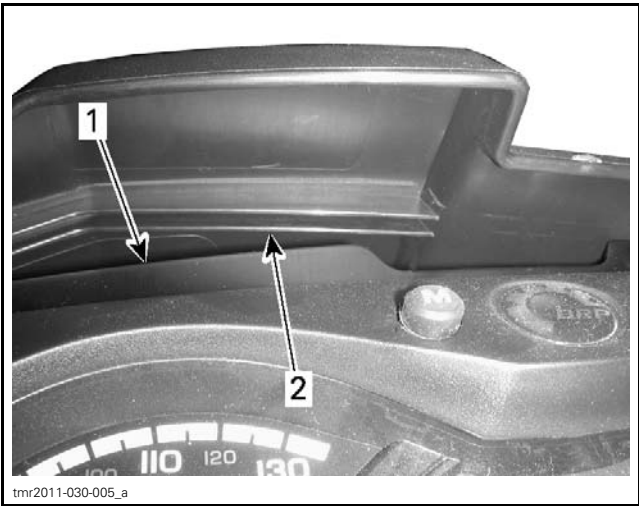


ANALOG/DIGITAL GAUGE SHOWN
1. Retaining clips

- 4. Tilt top of gauge rearward, then pull it up to remove it from its support.

Multifunction Gauge Installation

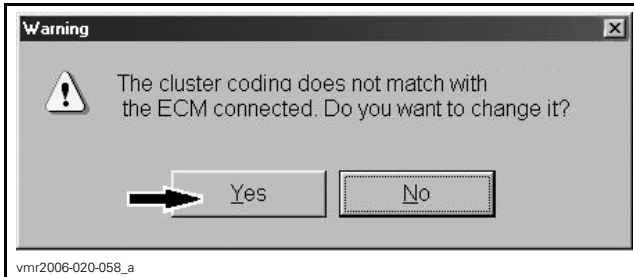
For the installation, reverse the removal procedure, however pay attention to the following.
Align gauge support top in the gauge cover slots on each side.



ANALOG/DIGITAL GAUGE SHOWN
1. Gauge support top
2. Gauge cover slot

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.**

Maintenance Soon Message

Maintenance Soon Message Manual Reset

1. Select PARK.
2. Turn ignition switch to ON. Do NOT start engine.

NOTE: The steps 3 through 9 must be completed within **5 seconds**.

3. Press override switch and HOLD.
4. Press and release brake pedal.
5. Release override switch.
6. Press and release brake pedal.
7. Press override switch and HOLD.
8. Press and release brake pedal.
9. Release override switch.
10. Turn ignition switch to OFF.

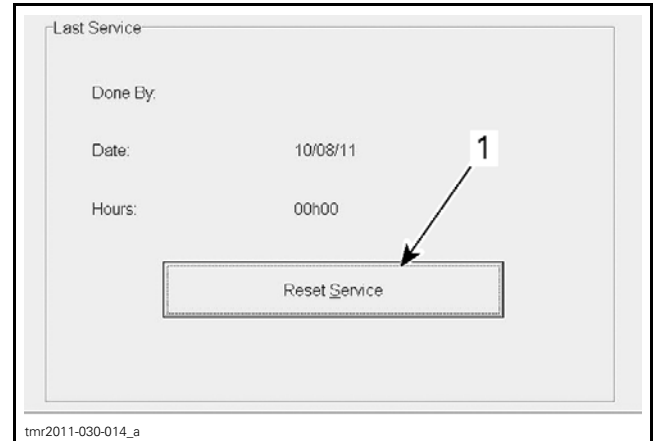
NOTE: Do not turn ignition switch to ON before the multifunction gauge turns off.

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.

Click on the **Reset Service** button.



1. Reset Service button

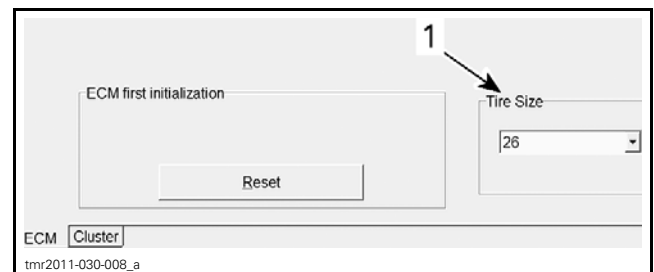
Multifunction Gauge Set-Up Using B.U.D.S.

Connect to the applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

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.

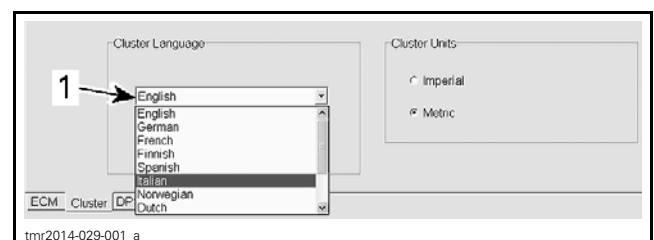


1. Tire Size box

Language Selection

Select **Setting** and **Cluster** tabs.

Scroll and select the desired display language in the **Cluster Language** box.



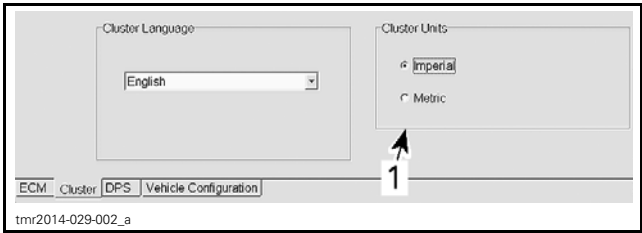
1. Cluster Language box

Units Selection

Select **Setting** and **Cluster** tabs.

Select **Imperial** or **Metric** in the **Cluster Units** box.

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)



1. Cluster Units box

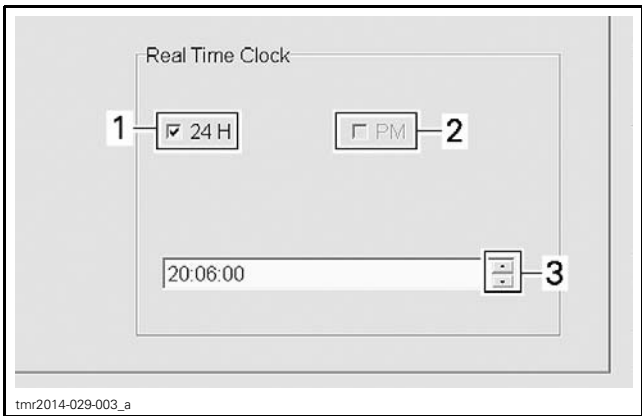
Clock Setting

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.

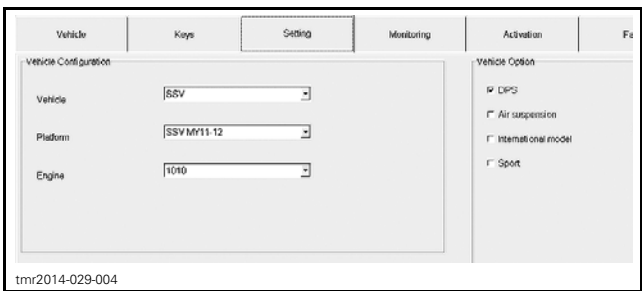


1. 24 H box
2. PM box
3. Arrows

Vehicle Configuration and Vehicle Option

NOTE: Options and proper configuration have been activated at factory. It could be necessary to modify them manually after ECM replacement.

Select **Setting** and **Vehicle Configuration** tabs.



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.

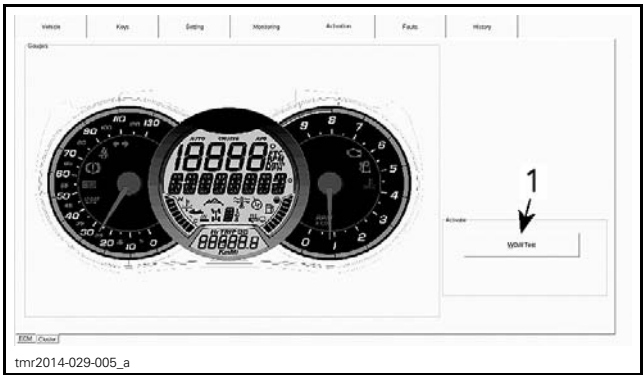
Wow Test

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.



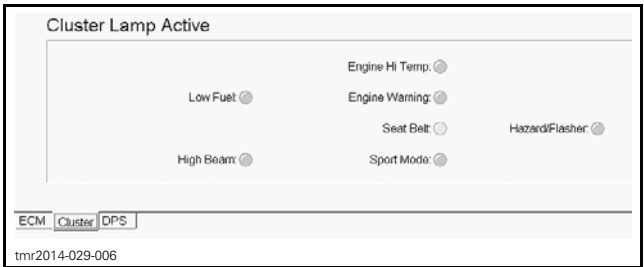
TYPICAL

1. WOW Test button

Indicator Lights Monitoring

Select **Monitoring** and **Cluster** tabs.

Use the **Cluster Lamp Active** box to monitor different indicator lights outputs.



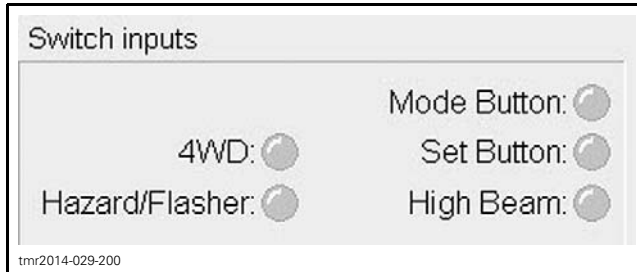
CLUSTER LAMP ACTIVE BOX

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 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.

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 accessories relay activated	Fuse 12 of fuse block 1 (from accessories 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 *HEADLIGHT 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 voltage
HI beam	BLUE (Hi beam bulb)	BLACK	

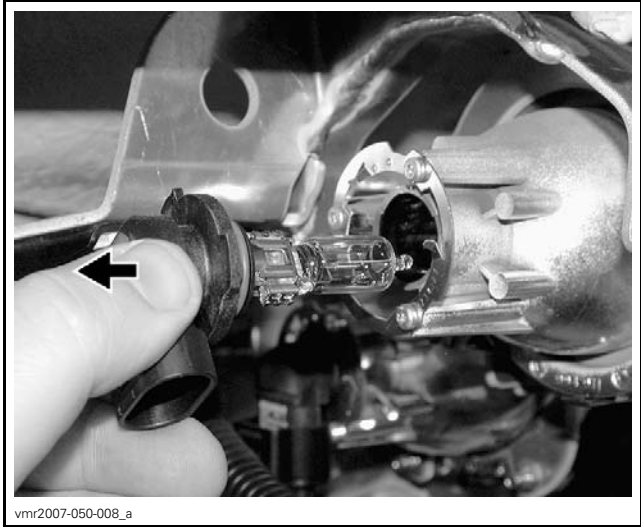
Headlight Bulb Replacement

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.

Pull bulb out.



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

Validate headlight operation.

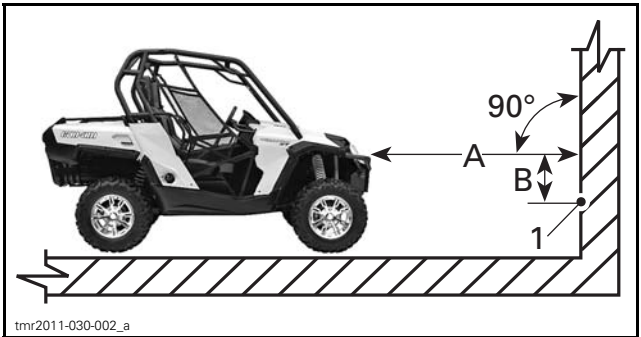
Headlamp Beam Aiming

Select high beam.

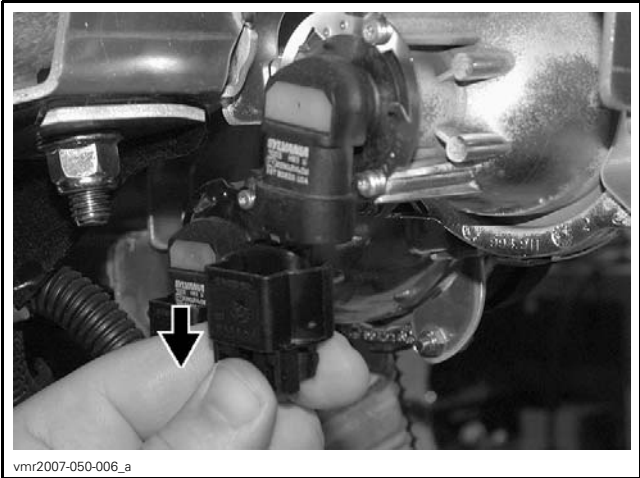
Beam aiming is correct when center of high beam is 130 mm (5 in) below the headlight horizontal center line, scribed on a test surface, 5 m (16 ft) away.

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.

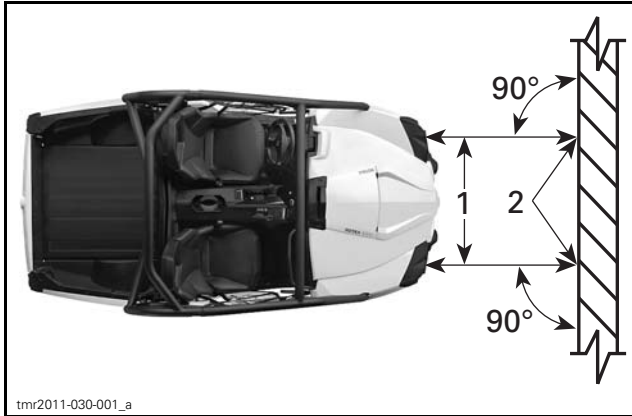


- 1. Light beam center
- A. 5 m (16 ft)
- B. 130 mm (5 in)



Rotate bulb.

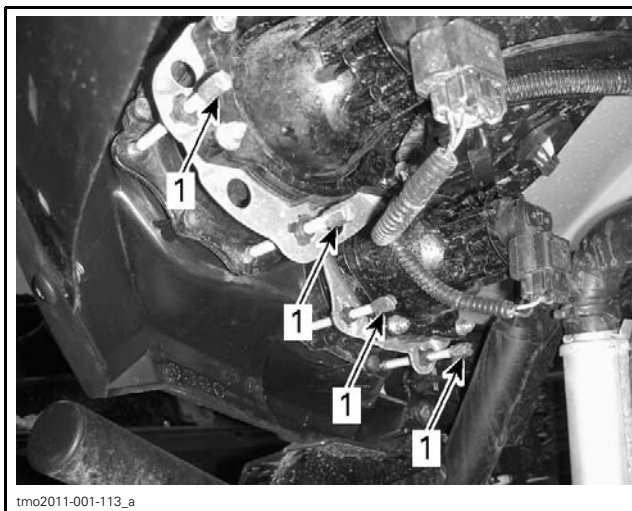




1. Headlight center lines
2. Light beam center

Beam Aiming Adjustment

Turn adjustment screws to adjust beam height and side orientation as described below. Adjust both headlight evenly.



1. Adjustment screws

TAILLIGHTS/BRAKE LIGHTS

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

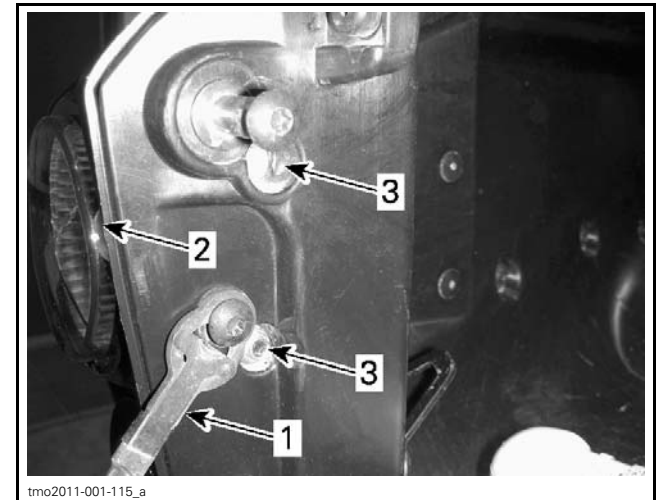
Taillight/Brake Light Circuit Protection

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.

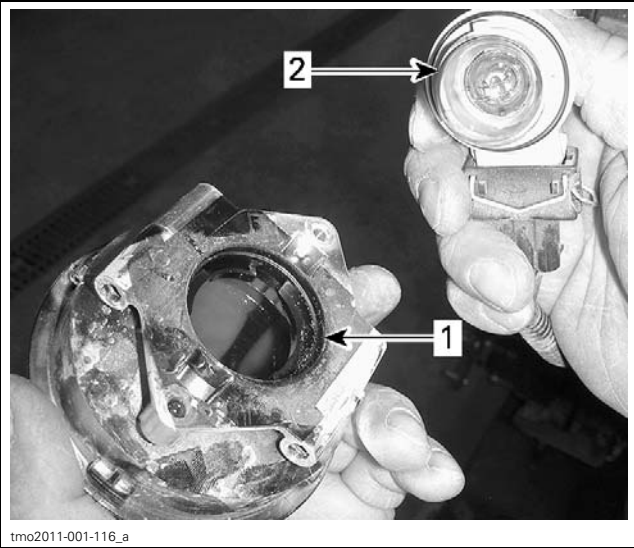
Remove both taillight retaining screws.



1. Tail gate cable
2. Taillight
3. Retaining screws

Pull taillight out of its location.

Remove bulb socket from taillight.



1. Taillight
2. Light bulb and socket

Push the bulb in and hold while turning counter-clockwise to release.

Installation is the reverse of the removal procedure.

WINCH

XT and LTD Models Only

Winch Wire Identification

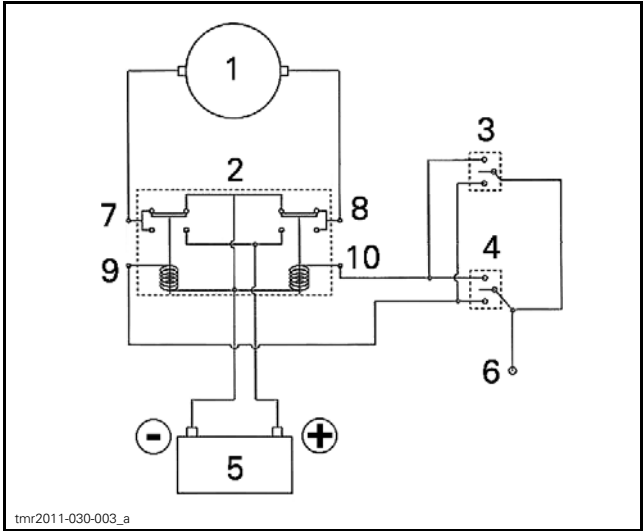
WINCH RELAY		
FUNCTION	PIN	COLOR
12 volt input from battery (winch power)	BP4	RED
Ground	BN4	BLACK
12 volt input from switch ("IN")	SW1	GREEN/BLUE
12 volt input from switch ("OUT")	SW2	LIGHT BLUE
Motor power (switches polarity depending on rotation direction)	SW3	RED (with Blue sleeve)
Motor power (switches 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**

Before testing, make sure the winch is in **FREESPOOL** mode (Freespool clutch disengaged).



- SIMPLIFIED WINCH WIRING DIAGRAM**
- 1. Winch motor
 - 2. Winch relay
 - 3. Winch remote control
 - 4. Winch switch
 - 5. Battery
 - 6. 12 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 accessories relay activated	Fuse 7 of fuse block 1 (from accessories relay R3)

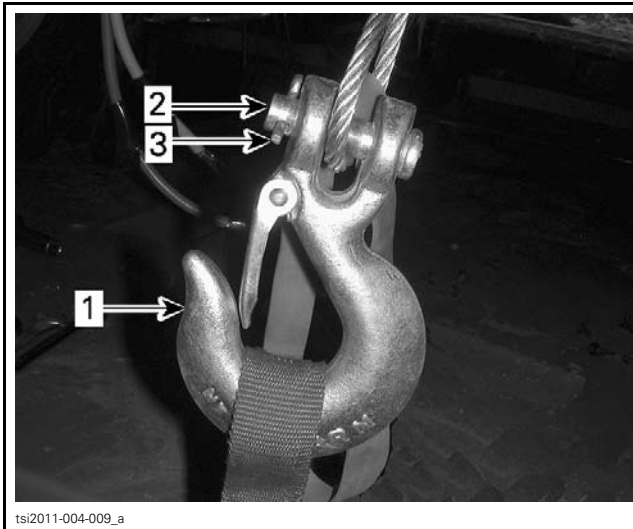
Winch Removal

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

⚠ WARNING

Always respect this order for disassembly; disconnect BLACK (-) cable first. Electrolyte or fuel vapors can be present 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
2. Hook pin
3. 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.

TIGHTENING TORQUE	
Winch retaining screws	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•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

Subsection 07 (LIGHTS, GAUGE AND ACCESSORIES)

HAZARD SWITCH		
FUNCTION	PIN	COLOR
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

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 MULTIFUNCTION 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	1	BLACK

Horn Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay (R2) activated	Fuse 4 of fuse block 1 (from main relay R2)

REAR DRIVE

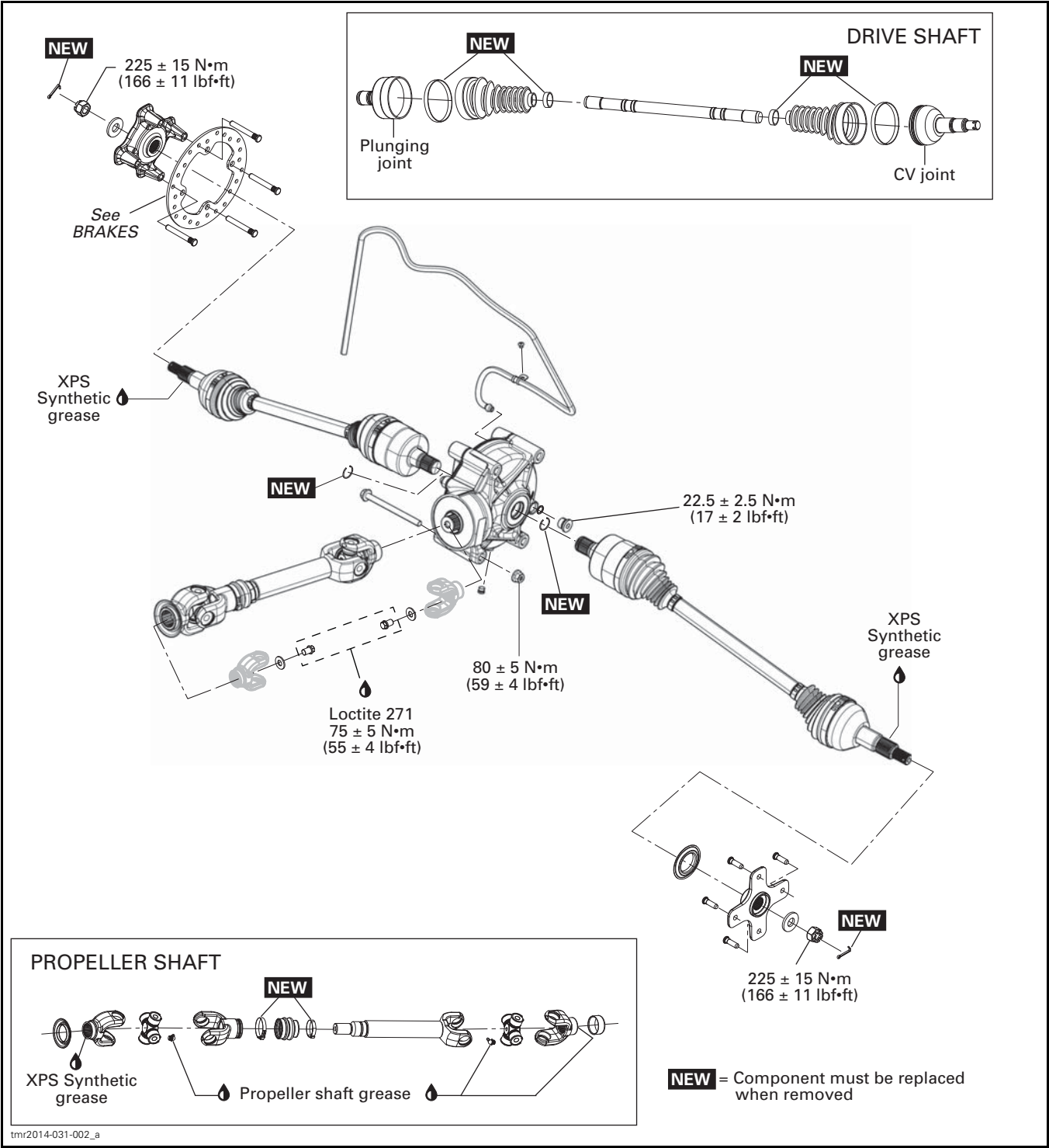
SERVICE TOOLS

Description	Part Number	Page
BACKLASH MEASUREMENT TOOL.....	529 035 665	8
CV BOOT CLAMP PLIER	529 036 120	5
CV JOINT EXTRACTOR.....	529 036 005	5
PINION NUT SOCKET	529 036 274	10

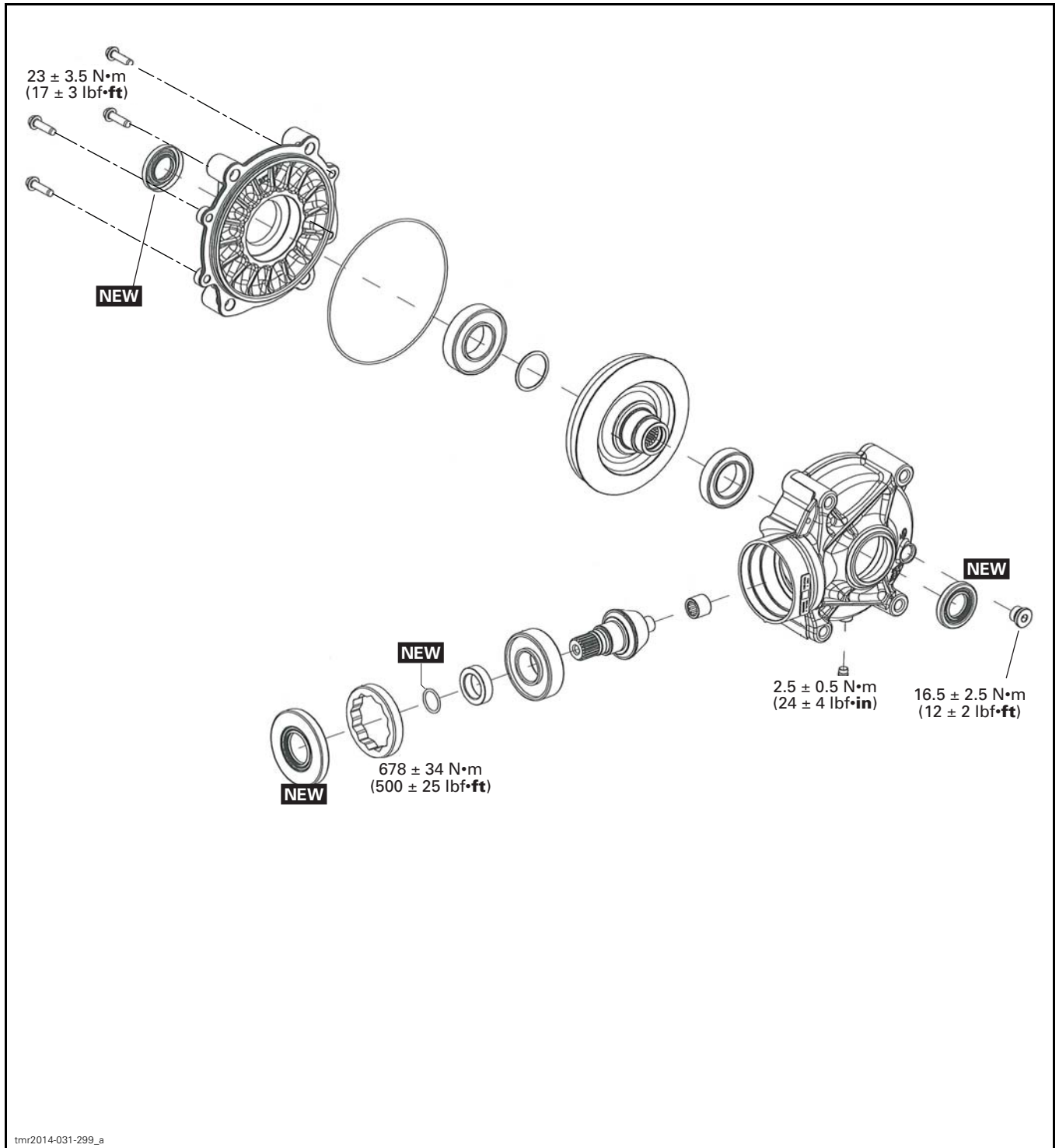
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 271 (RED).....	293 800 005	6
LOCTITE 277	293 800 073	11
PROPELLER SHAFT GREASE.....	293 550 063	6-7
XPS SYNTHETIC GREASE.....	293 550 010	4, 6

Subsection 02 (REAR DRIVE)



REAR DRIVE ASSEMBLY



PROCEDURES

WHEEL HUB

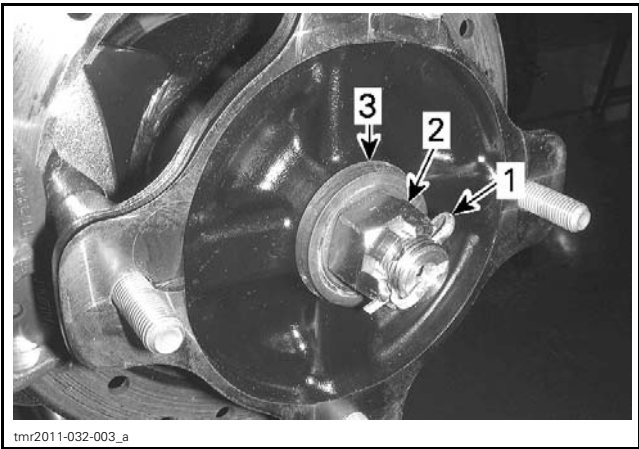
Wheel Hub Removal

Lift and support vehicle. Refer to *INTRODUCTION* section for proper procedure.

Remove the wheel.

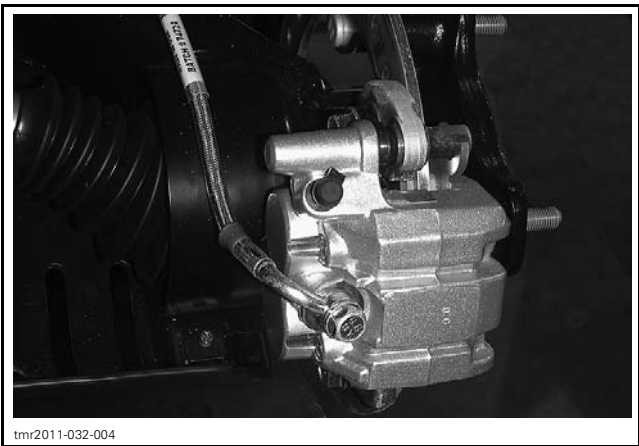
Remove the following parts:

- 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.

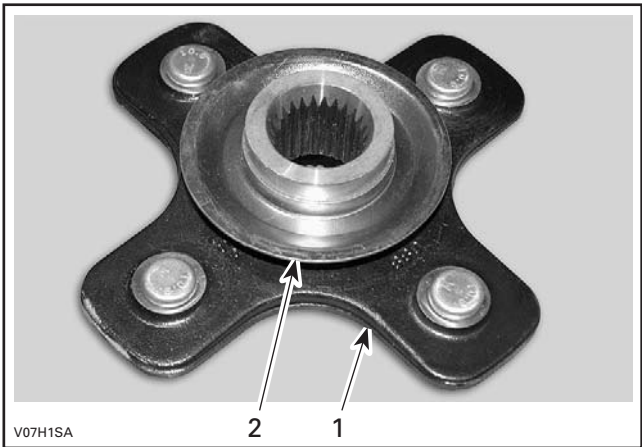
Wheel Hub Inspection

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.

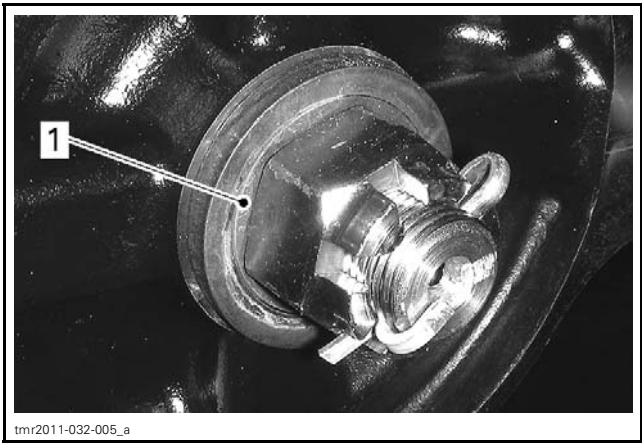
Apply XPS SYNTHETIC GREASE (P/N 293 550 010) on drive shaft splines.

Install Belleville washer with its domed side outwards.

PART	TORQUE
Wheel hub 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.

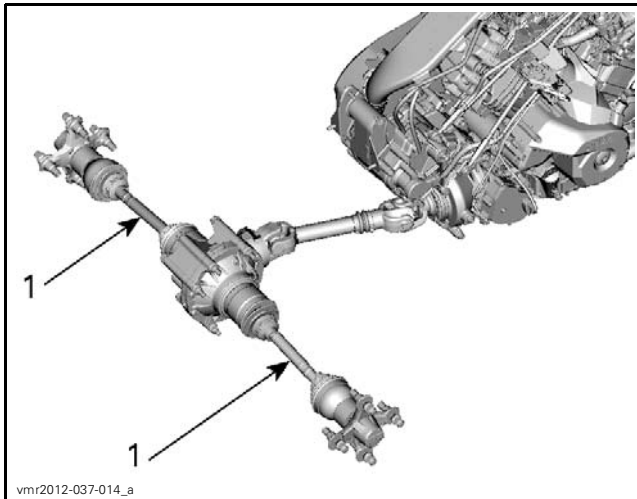
Install a **NEW** cotter pin.



- 1. Domed side here

DRIVE SHAFT

Drive Shaft Removal



TYPICAL

1. Drive shafts

Lift and support vehicle. Refer to *INTRODUCTION* section for proper procedure.

Remove the wheel hub. See procedure in this subsection.

Remove trailing arm. Refer to *REAR SUSPENSION*.

Strongly pull drive shaft out of final drive.

Drive Shaft Inspection

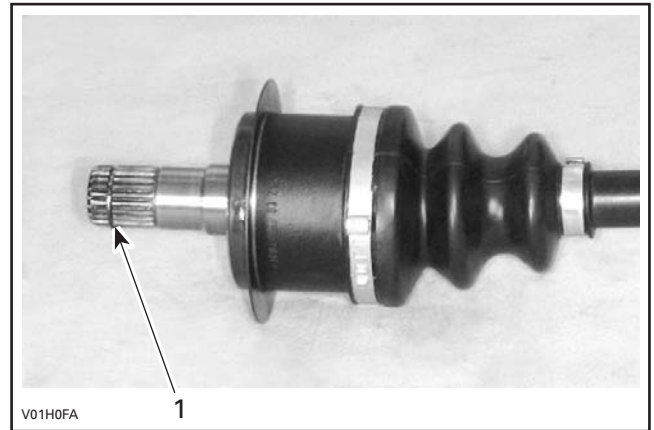
Inspect the condition of boots. If there is any damage or evidence of leaking lubricant, replace them. Refer to *DRIVE SHAFT BOOT*.

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 following tools:

TOOL	
CV BOOT CLAMP PLIER (P/N 529 036 120)	

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.

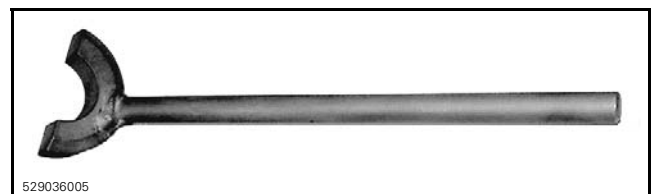
Remove boot from drive shaft.

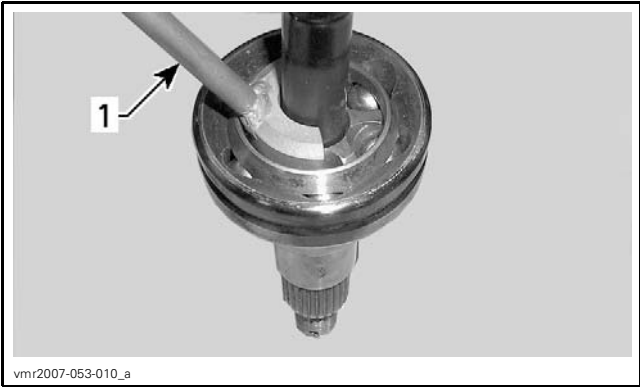
Remove and discard the circlip. A new one is included in the boot kit.

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.





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

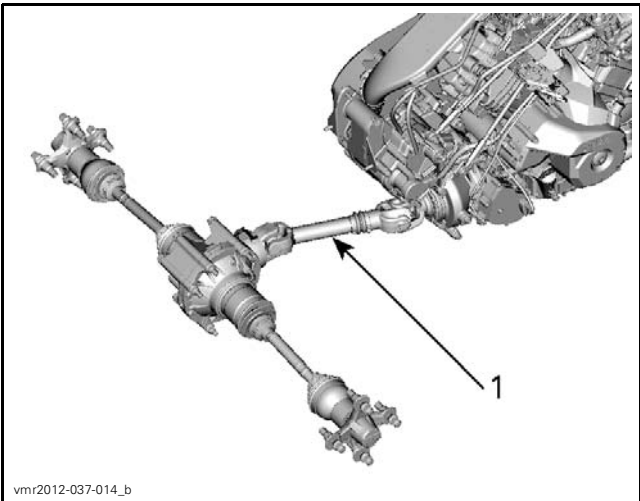
For installation, reverse the removal procedure. Pay attention to the following.

Pack bearing area with grease (included with the new boot kit).

NOTE: Do not use any other grease.

PROPELLER SHAFT

Propeller Shaft Removal



TYPICAL
1. Propeller shaft

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 *INTRODUCTION* section for proper procedure.
- 4. 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

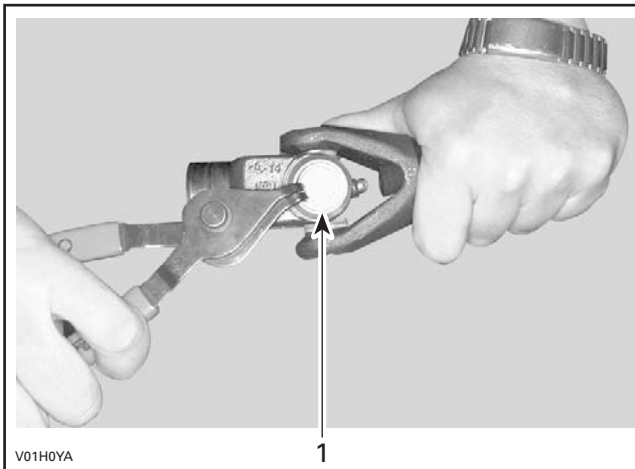
Installation is essentially the reverse of removal procedure. Pay attention to the following details. Engine side: apply XPS SYNTHETIC GREASE (P/N 293 550 010) to splines. Drive side: apply PROPELLER SHAFT GREASE (P/N 293 550 063) to splines. If new bolts are used, scotch grip is already applied to threads. When re-using bolts, apply LOC-TITE 271 (RED) (P/N 293 800 005).

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)

PROPELLER SHAFT U-JOINTS

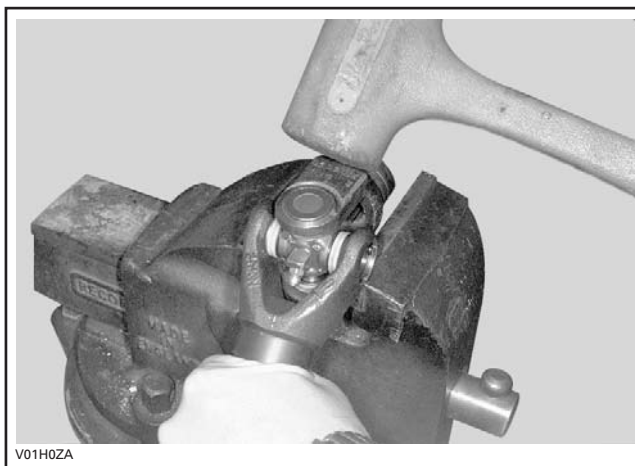
Propeller Shaft U-Joint Removal

Remove internal snap ring from bearing caps.



1. Snap ring

Support inner yoke in vise and drive other yoke down with a soft hammer.



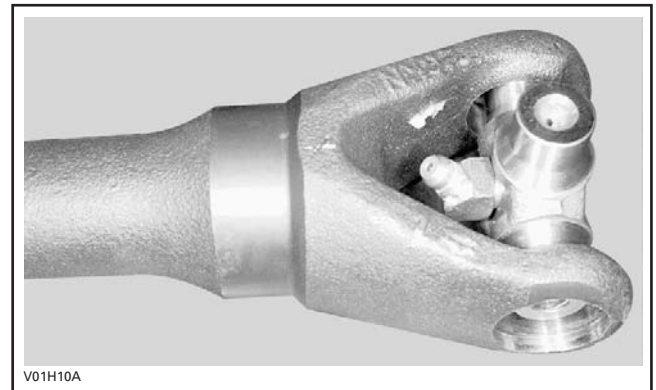
Support U-joint in vise and drive inner yoke down to remove remaining bearing caps.

Remove U-joint cross.

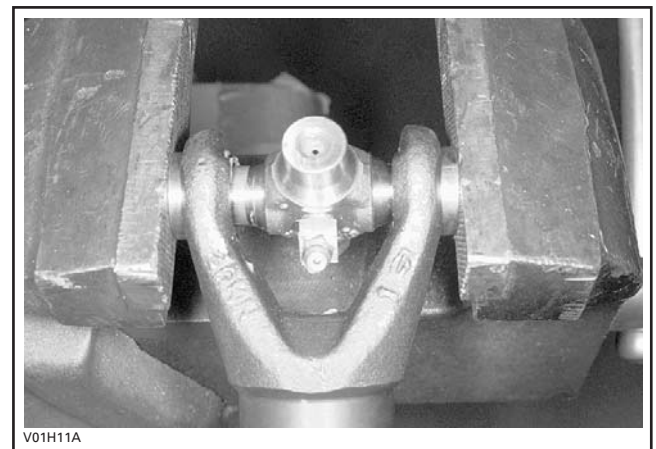
Propeller Shaft U-Joint Installation

Install new U-joint in inner yoke.

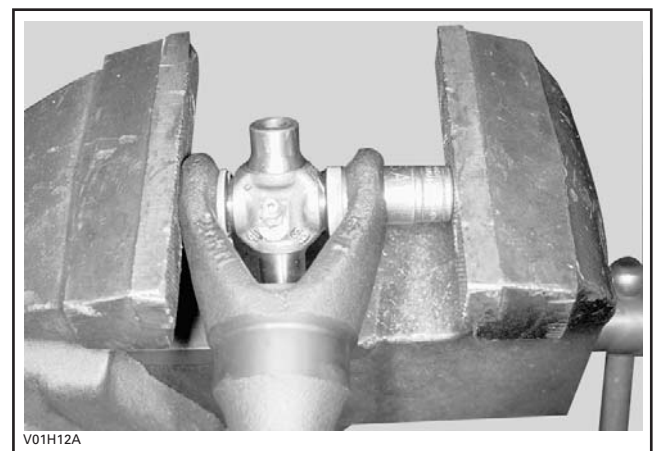
NOTE: Position propeller shaft U-joint as shown for proper grease fitting location.



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. PROPELLER SHAFT GREASE (P/N 293 550 063).

REAR FINAL DRIVE

Rear Final Drive Removal

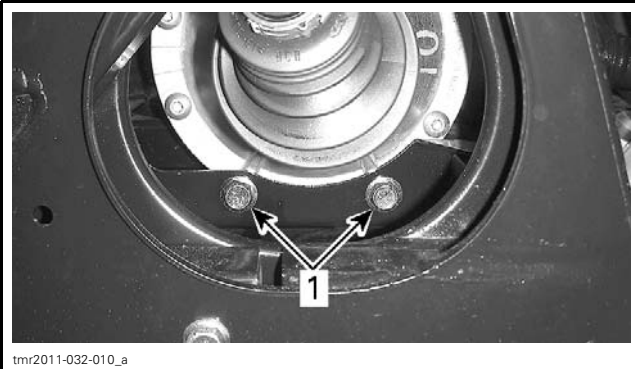
Drain oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove drive shafts. See procedure in this subsection.

Remove the rear skid plate.

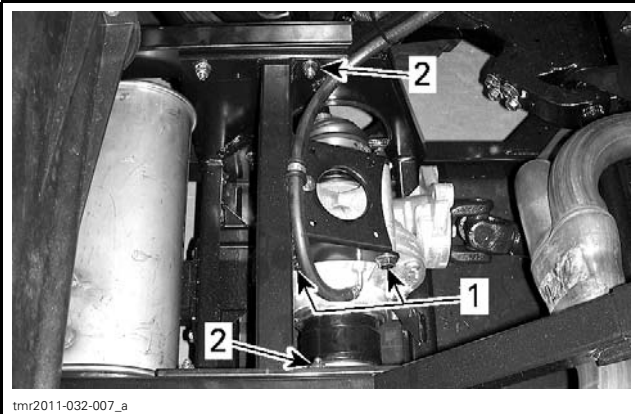
Remove the propeller shaft screw from the rear final drive yoke.

Remove final drive lower bolts.



1. Lower final drive bolts

Remove final drive upper bolts and the front bolts of the final drive support.



1. Upper final drive bolts
2. Final drive support front bolts

Unplug the vent hose from final drive.

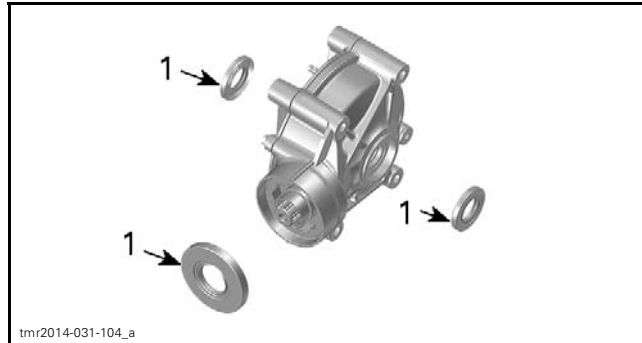
Loosen rear bolts of the final drive support and tilt the support rearward to make room.

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 if oil seals are brittle, hard or damaged. Replace if necessary.



FINAL DRIVE

1. Oil seals

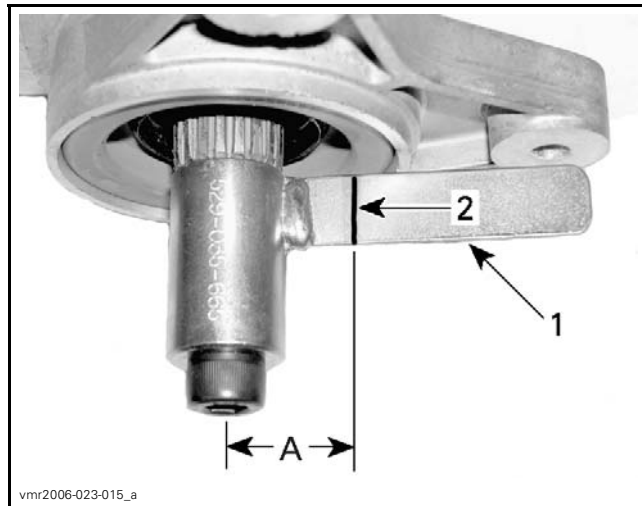
Backlash Inspection

Using a dial indicator and the BACKLASH MEASUREMENT TOOL (P/N 529 035 665), measure the backlash.

Place the backlash measurement tool at the end of pinion gear.

Tighten a M10 X 1.25 bolt so that tool does not move on pinion.

From center of bolt, measure 23 mm (.9 in) and scribe a mark on the tab.



1. Tab of backlash measurement tool

2. Mark on tab

A. 23 mm (.9 in)

Position the dial indicator tip against the tab at a 90° angle and right on the previously scribed mark.

NOTICE During backlash readings, the ring gear should be pushed out of mesh (into cover) and the pinion shall be pushed out of mesh (towards nut) to remove any endplay.

Gently, move the tab back and forth. Note the result.



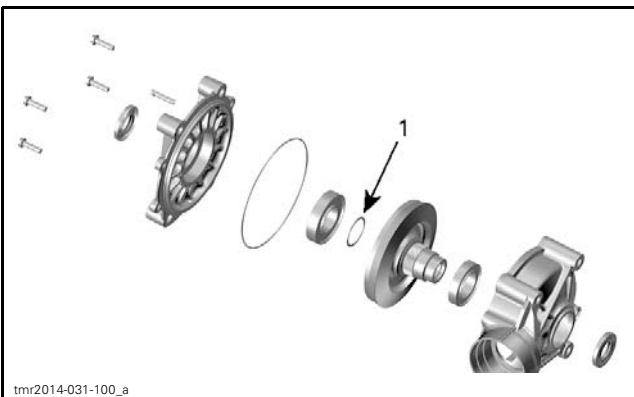
Rotate pinion gear 1/2 turn and check backlash again. Note the result.

Rotate pinion gear 1 turn and check backlash again.

BACKLASH SPECIFICATION
0.2035 mm $\pm$ 0.1015 mm (.008 in $\pm$.004 in)

If backlash is out of specification, split final drive housing and adjust shim thickness as per following guideline.

BACKLASH ADJUSTMENT GUIDELINE	
BACKLASH MEASUREMENT	WHAT TO DO
Below 0.102 mm (.004 in)	Remove shim(s) and recheck backlash
Above 0.305 mm (.012 in)	Add shim(s) and recheck backlash



1. Backlash shim

Verify that there is no "tight mesh" conditions as the ring gear rotates through 360 degrees of travel.

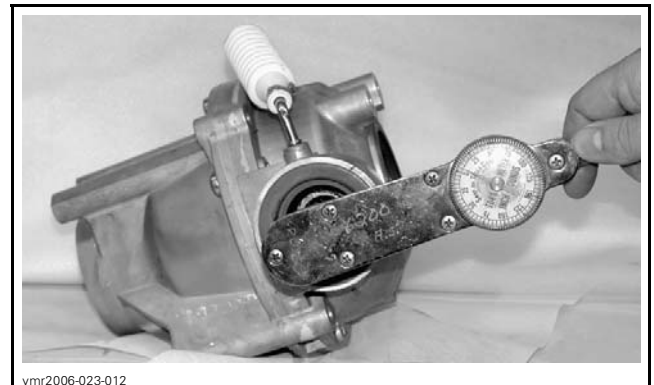
Preload Inspection

Screw the propeller shaft adaptor bolt in pinion gear.



TYPICAL — FRONT DIFFERENTIAL SHOWN

Using a needle torque wrench, measure the drag torque.



TYPICAL — FRONT DIFFERENTIAL SHOWN

PRELOAD SPECIFICATION
0 N•m - 1.5 N•m (0 lbf•in - 13 lbf•in)

There is no preload adjustment on this differential. If the preload is out of specification:

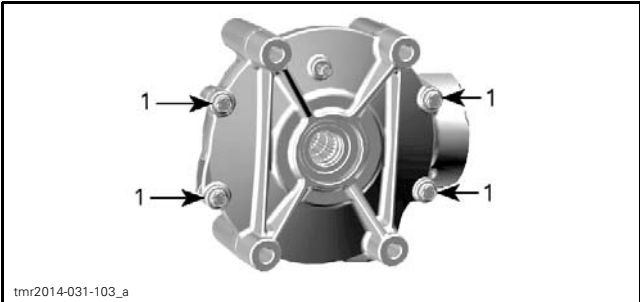
1. Check if all bearings are in their proper places and well inserted.
2. Check if all bearings can rotate easily on 360 degrees of travel.

Rear Final Drive Disassembly

Ring Gear

Unscrew the final drive housing screws.

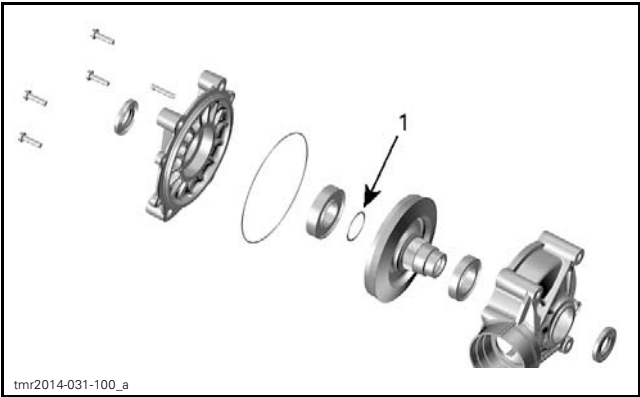
Subsection 02 (REAR DRIVE)



1. Housing screws

Split final drive housings.

NOTE: Be careful to keep track of backlash shim on ring gear.

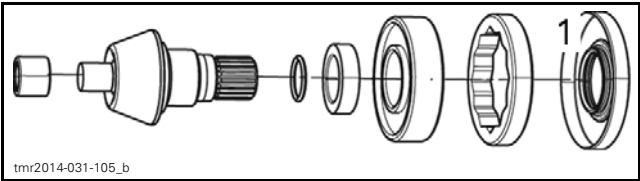


1. Backlash shim

Extract ring gear out of half housing.

Pinion Gear

Remove and discard pinion oil seal.

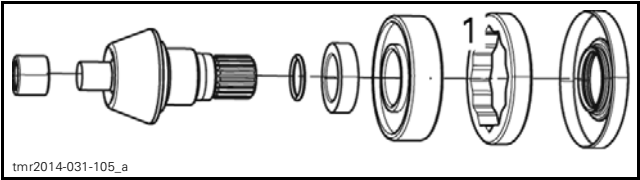


1. Pinion seal

Unscrew the pinion nut. Use the PINION NUT SOCKET (P/N 529 036 274).



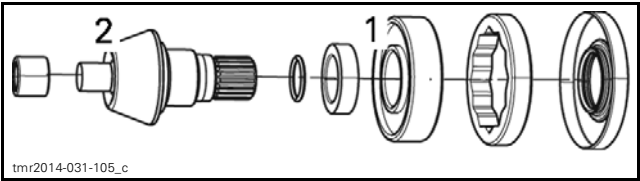
NOTE: The pinion nut is LH threaded. Unscrew by turning clockwise.



1. Pinion nut

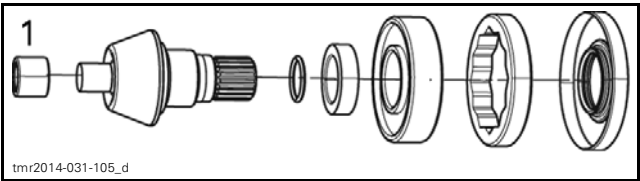
Remove the pinion bearing at the same time as the pinion gear. Discard bearing.

Use a press and bearing clamp to separate pinion and bearing.



1. Pinion bearing
2. Pinion gear

Remove and discard the needle bearing.



1. Needle bearing

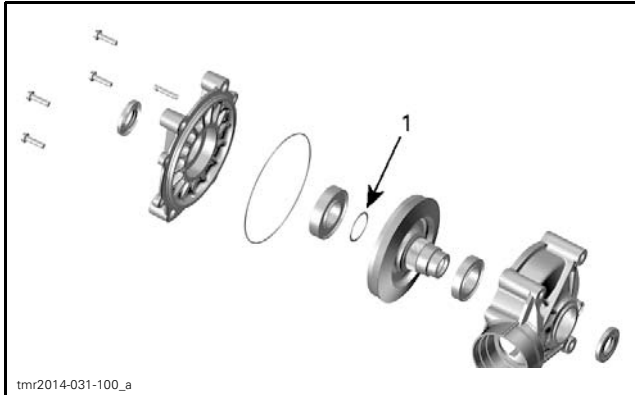
Rear Final Drive Assembly

Adjustment is required when any of the following part is changed.

- Pinion gear
- Ring gear
- Housing.

As a preliminary setup, install shims according to the following table.

RECOMMENDED SHIM THICKNESS	
BACKLASH	1.27 mm (.05 in) (as a preliminary adjustment)



1. Backlash shim

Prior to finalizing assembly, proceed in this order:

- Temporarily assemble final drive using recommended torques.
- Do not apply thread locker product.
- Do not install a new pinion nut.
- Check backlash.
- Check preload.

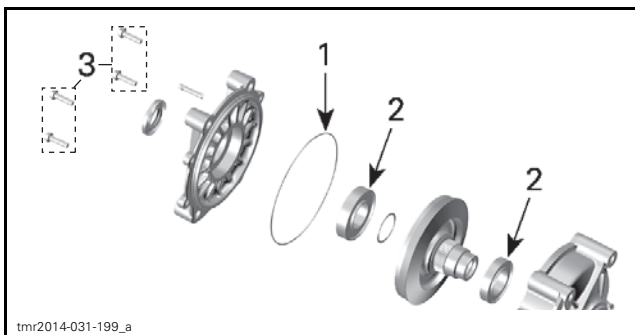
Ring Gear

To assemble, reverse the removal procedure. Pay attention to the following.

Check condition of seal **no.1**. Replace if damaged.

Install new bearings . **no.2**

Tighten final drive housing screws **no.3**.



PART	TORQUE
Final drive housing screws	23.5 N•m ± 3.5 N•m (17 lbf•ft ± 3 lbf•ft)

Pinion Gear

To install, reverse the removal procedure. Pay attention to the following.

Replace the O-ring **no.1**.

Install the ball bearing **no.2**.

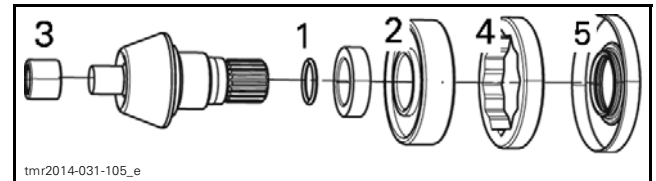
Install a new needle bearing **no.3**.

NOTE: If a new pinion nut is used, a self-locking product is already applied, do not use Loctite 277.

Apply LOCTITE 277 (P/N 293 800 073) to pinion nut **no.4**.

Install and tighten the pinion nut.

Lubricate oil seal **no.5**.



PART	TORQUE
Pinion nut (LH THREADS)	678 N•m ± 34 N•m (500 lbf•ft ± 25 lbf•ft)

Rear Final Drive Installation

The installation is the reverse of the removal procedure.

PART	TORQUE
Final drive retaining nuts	80 N•m ± 5 N•m (59 lbf•ft ± 4 lbf•ft)

Refill the final drive with recommended oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

WHEELS AND TIRES

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	346

PROCEDURES

TIRES

⚠ WARNING

Do not rotate tires. The front and rear tires have a different size. Respect direction of rotation when applicable.

Tire Pressure

⚠ WARNING

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

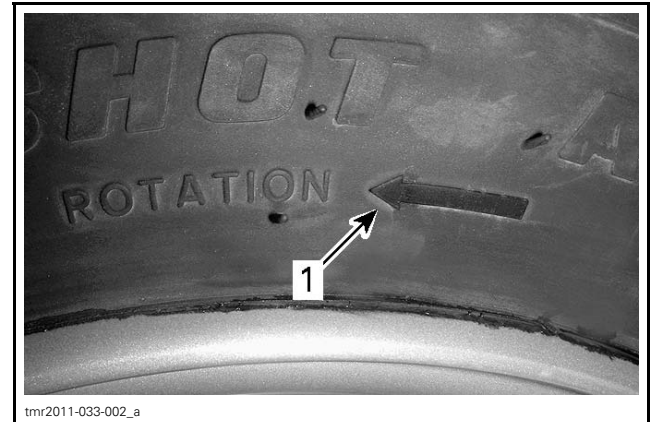
Check tire for presence of slits, bulges, wear or other damage. Replace if necessary.

Tire Replacement

Use an automotive tire changer to replace tires.

⚠ 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.



TYPICAL

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.

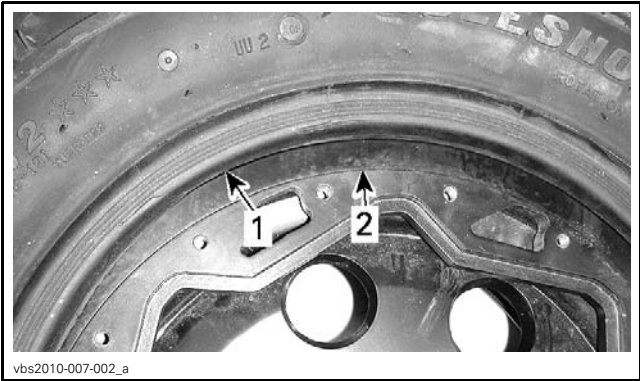
- 1.1 On the opposite side of beadlock, apply the tire mounting lube on inner bead of tire and wheel to ensure proper seating when inflating.

- 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)



- 1. Tire outer bead
- 2. Beadlock inner ring shoulder

2. Place the beadlock clamp ring on the tire. Align the valve opening with valve.



- 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.

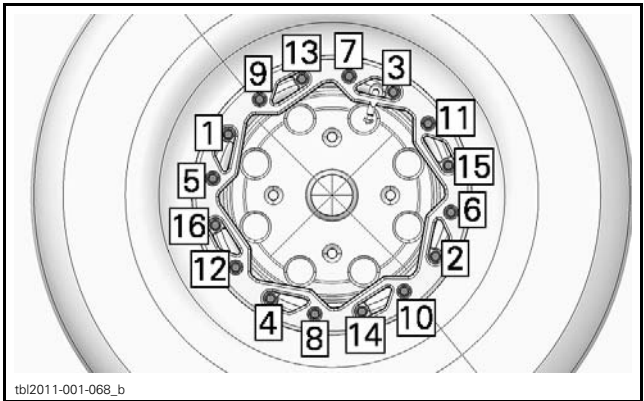
NOTICE Do not use an impact wrench for installing beadlock screws. The risk of screw breaking or screw stripping is high when using an impact wrench.



5. Tighten beadlock screws as per following specification and sequence.

NOTE: To ensure even pressure on the beadlock clamp ring, tighten screws **a few turns at a time**.

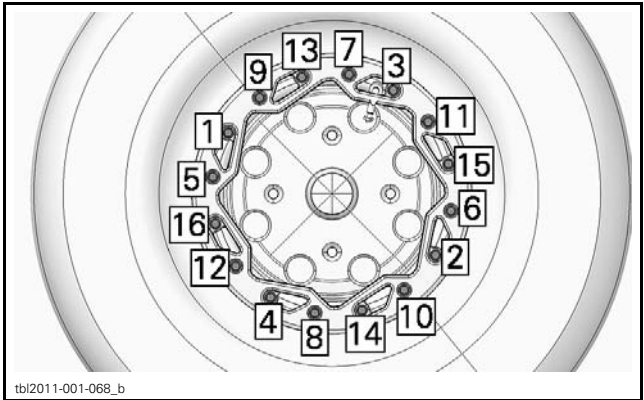
TIGHTENING TORQUE	
Beadlock screws (FIRST TORQUE)	3 N•m ± 1 N•m (27 lbf•in ± 9 lbf•in)



FIRST AND SECOND TIGHTENING SEQUENCE

- 6. At this time check if the tire is still centered on wheel. Reposition it if necessary.
- 7. Tighten beadlock screws as per the **second** torque using the same sequence.

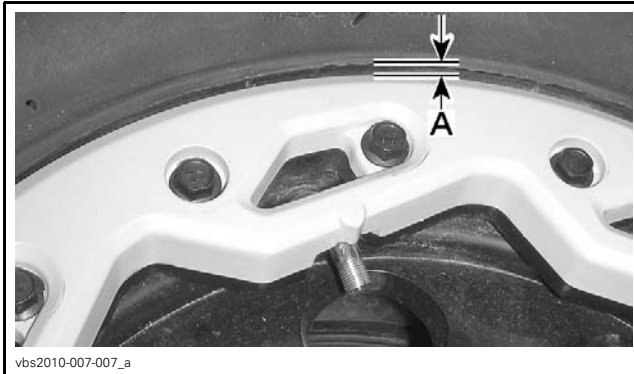
TIGHTENING TORQUE	
Beadlock screws (SECOND TORQUE)	8 N•m ± 1 N•m (71 lbf•in ± 9 lbf•in)



TIGHTENING SEQUENCE

NOTE: The beadlock clamp ring should be in contact with the beadlock inner ring. 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.



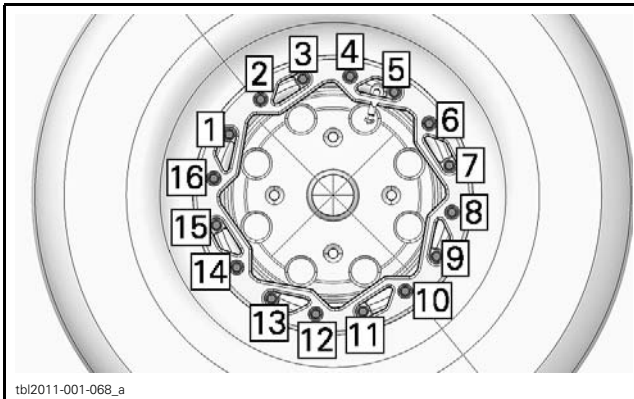
A. Gap equal all around beadlock clamp ring

If the gap is not acceptable:

- Loosen all screws.
- Check tire position on wheel and reposition it if necessary.
- Restart the tightening sequence as detailed.

9. Torque beadlock screws a **final** time as per following specification and sequence.

TIGHTENING TORQUE	
Beadlock screws (FINAL TORQUE)	8 N•m ± 1 N•m (71 lbf•in ± 9 lbf•in)



FINAL TIGHTENING SEQUENCE

10. Inflate tire to seat the inner bead on wheel. Always use safe practices, such as a tire safety cage.

⚠ WARNING

Never exceed tire 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 *INTRODUCTION* 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 anti-seize lubricant on threads.

Check if tires are unidirectional.

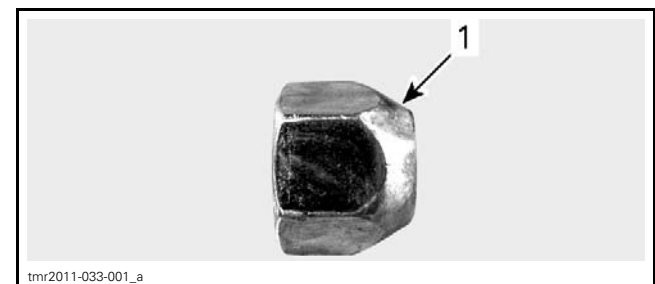


TYPICAL

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)

Section 07 CHASSIS

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 (WITHOUT DPS)

SERVICE TOOLS

Description	Part Number	Page
STEERING ALIGNMENT TOOL.....	529 036 059	3

SERVICE PRODUCTS

Description	Part Number	Page
XPS SYNTHETIC GREASE.....	293 550 010	6

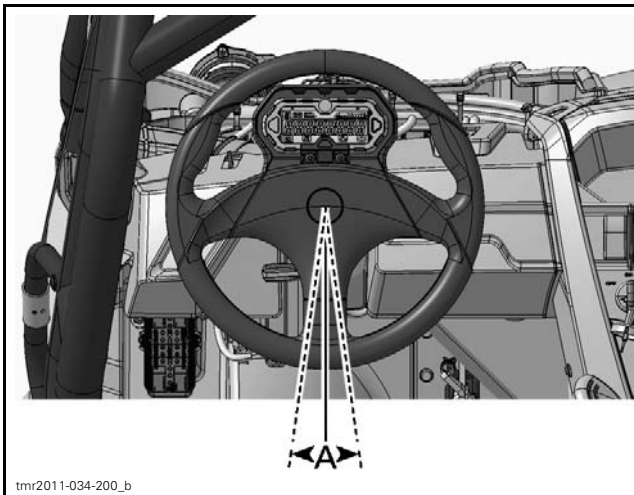
GENERAL

The procedures described below are the same for the RH and LH sides, unless otherwise instructed. If the vehicle has dynamic power steering (DPS) refer to *STEERING SYSTEM (WITH DPS)* section of this supplement.

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 $\pm 3^\circ$, go to **step 6**.
 - 4.2 If steering angle is outside of $\pm 3^\circ$, go to **step 5**.

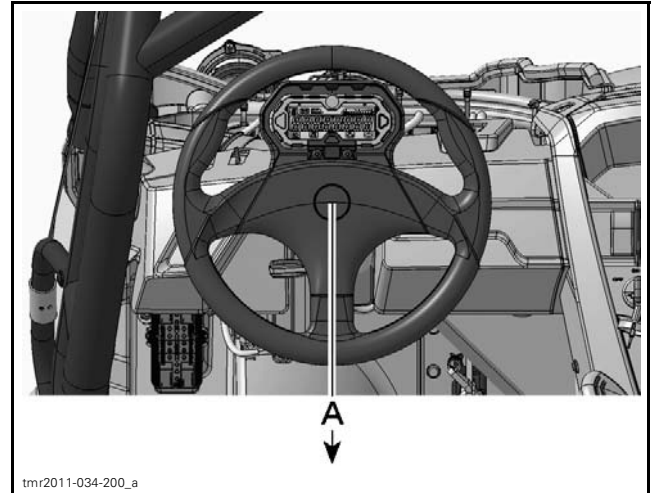


A. Steering wheel angle $\pm 3^\circ$

5. Reposition steering wheel onto steering shaft as follows:

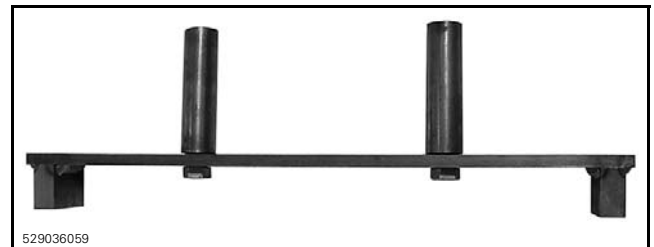
NOTICE Make sure rack and pinion does not move during steering wheel repositioning.

- 5.1 Remove steering wheel, refer to *STEERING WHEEL REMOVAL*.
- 5.2 Reinstall steering wheel to the closest centered position (nearest spline).
6. Center steering wheel.

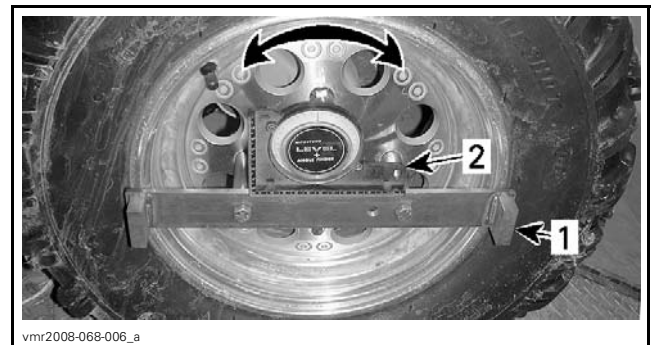


A. Steering wheel centered

7. Remove two wheel lug nuts from a rear wheel.
8. Install STEERING ALIGNMENT TOOL (P/N 529 036 059) using proper spacers.



9. Move vehicle to place the tool level with the ground.

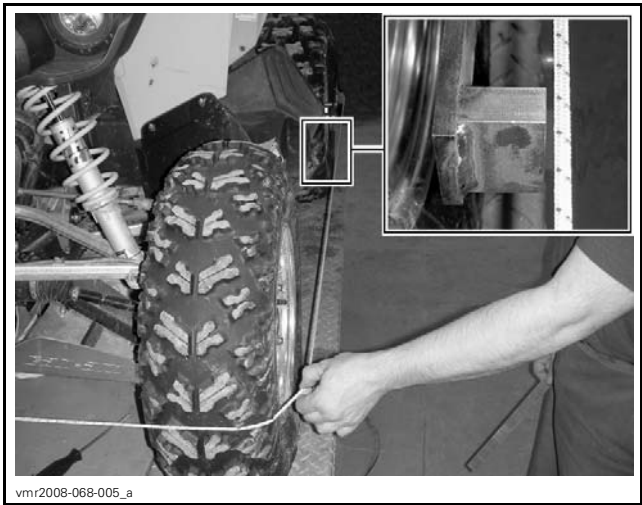


REAR WHEEL

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.
13. From the front of vehicle, near the front of rim, move rope so that it does not touch the first spacer of tool.

Subsection 01 (STEERING SYSTEM (WITHOUT DPS))



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

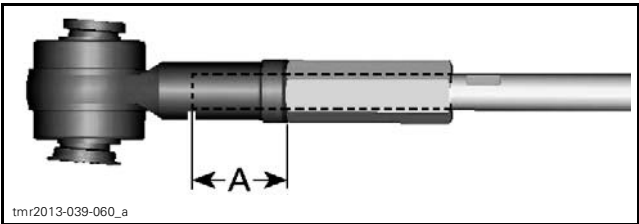
17. Calculate the difference between the rear and the front measurement.
18. The difference must be as per the following specification:

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.

 **WARNING**

The minimum tie-rod end length engagement in the tie rod must be 25 mm (1 in).



A. Minimum tie-rod end length engagement

- 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

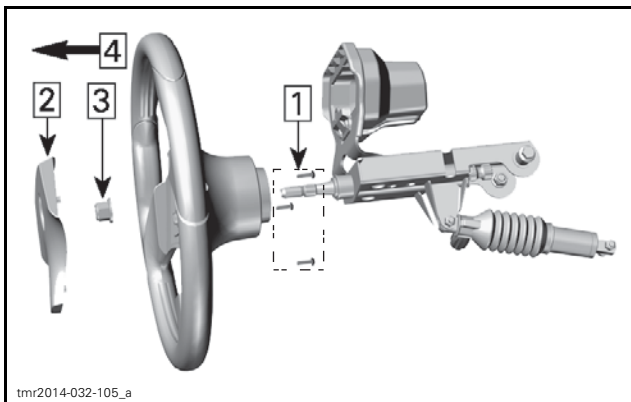
If vehicle turns more on one side than the other, check rack and pinion center to center. Refer to *STEERING ALIGNMENT* in this subsection.

PROCEDURES

STEERING WHEEL

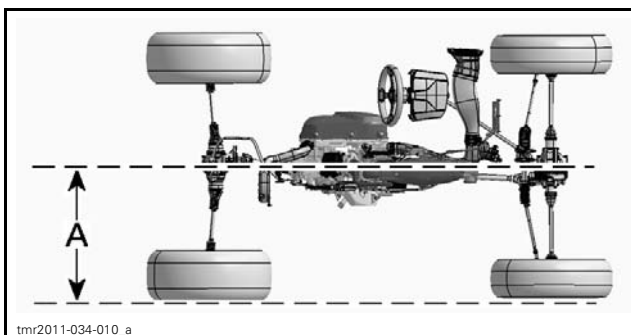
Steering Wheel Removal

Follow order in illustration below.



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

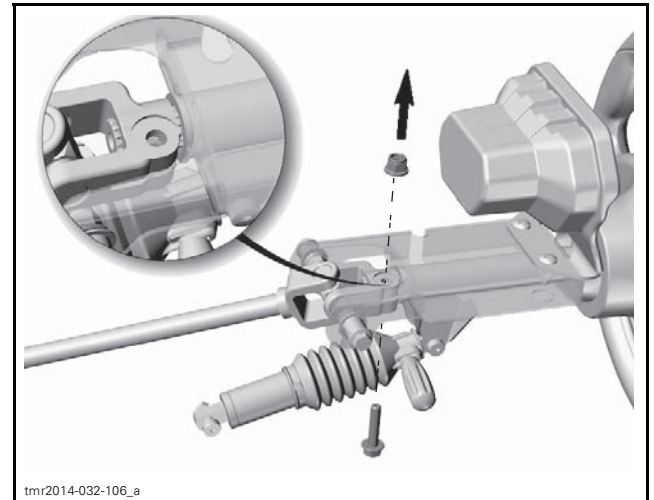
50 N•m ± 5 N•m (37 lbf•ft ± 4 lbf•ft)

Check front wheel alignment. Refer to *STEERING ALIGNMENT* in this subsection.

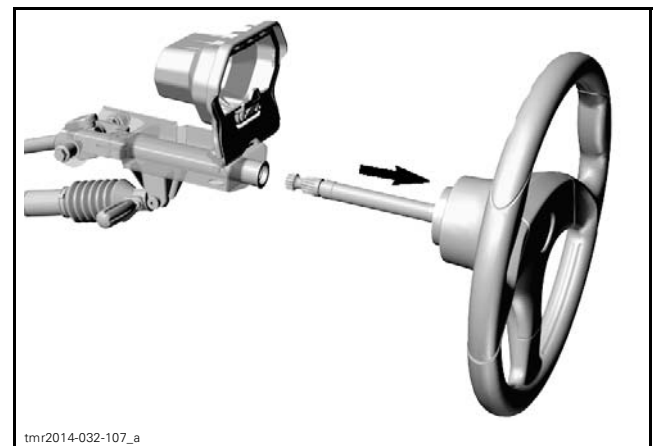
STEERING COLUMN

Steering Column Removal

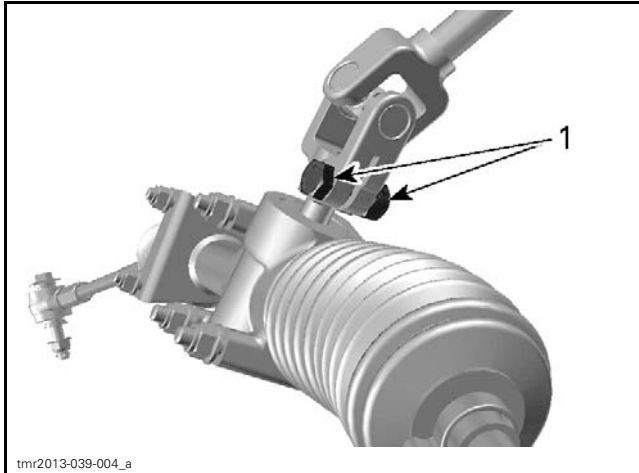
1. Center steering wheel.
2. Remove bolt and nut securing upper universal joint to steering shaft. Discard the nut.



3. Remove steering wheel and steering shaft as an assembly.

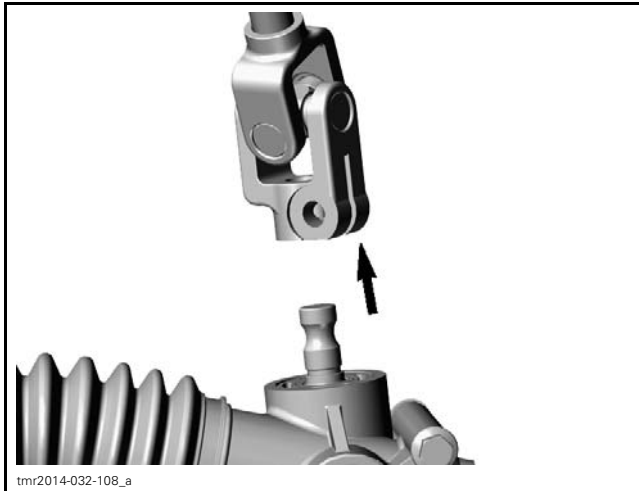


4. Remove bolt and nut securing lower universal joint to rack and pinion. Discard the nut.



1. Bolt and nut

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.

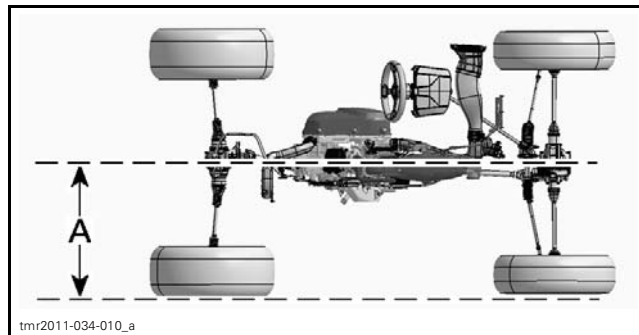
Check if steering shaft O-rings are brittle, hard or otherwise damaged.

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.



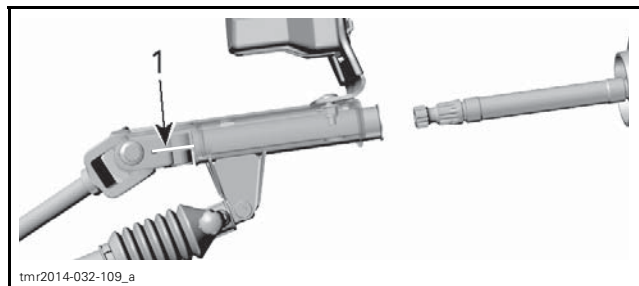
A. Front wheels parallel

Lubricate steering shaft.

STEERING SHAFT LUBRICATION

XPS SYNTHETIC GREASE (P/N 293 550 010)

NOTE: If upper yoke opening is not horizontal when the steering shaft is installed, the steering wheel will appear crooked if the height is adjusted.



1. Horizontal yoke opening

Install steering wheel and steering shaft. Make sure steering wheel is properly centered.

Fully engage the yoke onto pinion shaft.

Tighten steering column U-joints to specification. Use NEW nuts.

UPPER U-JOINT NUT TORQUE
31 N•m ± 3 N•m (23 lbf•ft ± 2 lbf•ft)
LOWER U-JOINT NUT TORQUE
70 N•m ± 5 N•m (52 lbf•ft ± 4 lbf•ft)

Check front wheels alignment. Refer to *STEERING ALIGNMENT* in this subsection.

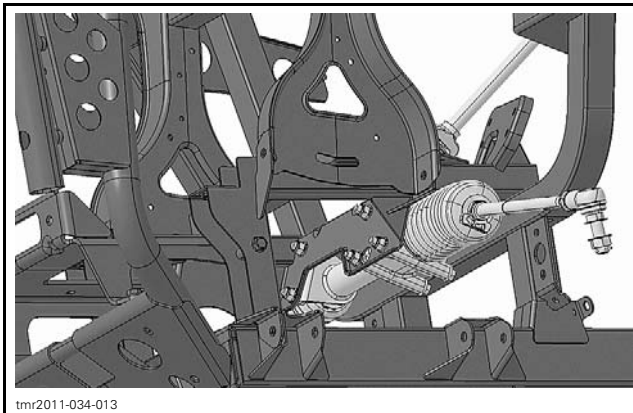
RACK AND PINION

Rack and Pinion Servicing

Rack and pinion is not serviceable except for boots and tie rod ends replacement.

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-rod ends from knuckles. Refer to *TIE ROD END REPLACEMENT* in this subsection.
5. Remove bolts and nuts securing rack and pinion to frame.



LH SIDE VIEW

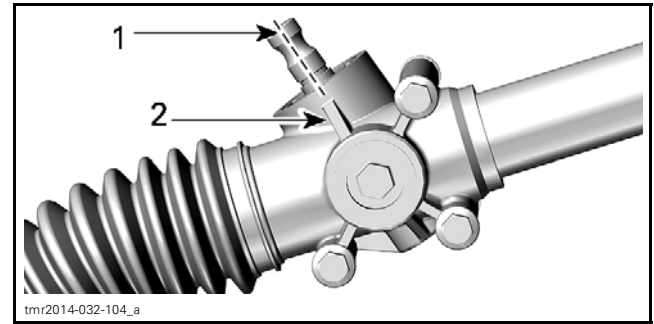
6. From the LH side, remove rack and pinion from vehicle.

Rack and Pinion Installation

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

Find rack and pinion center as follows:

- Calculate the total pinion shaft rotations from side to side.
- Position the pinion shaft at **half** the total rotations.

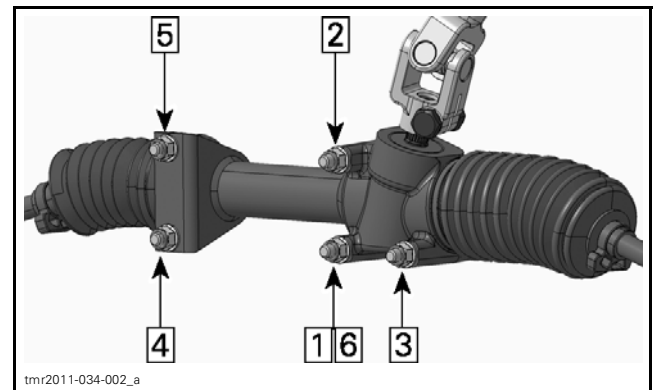


1. Mark center
2. Rack and pinion casing

Loosely install retaining bolts and nuts of rack and pinion.

Torque retaining nuts of rack and pinion according to specification using the following sequence.

RACK AND PINION RETAINING NUTS TORQUE
24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

Install steering column.

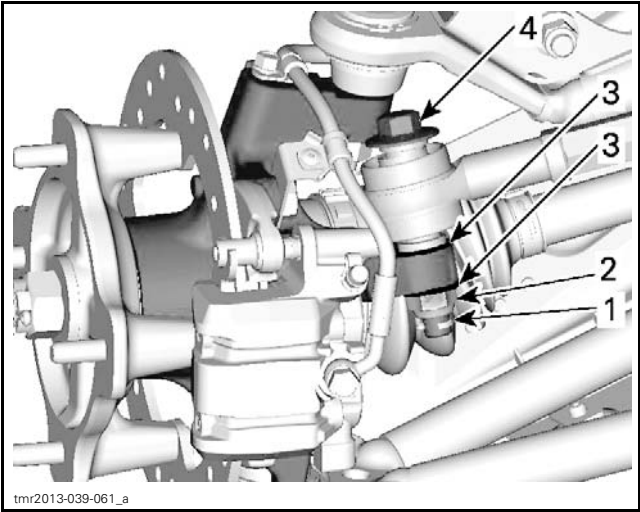
Check the steering alignment. Refer to *STEERING ALIGNMENT* in this subsection.

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
 - Tie-rod end bolt.

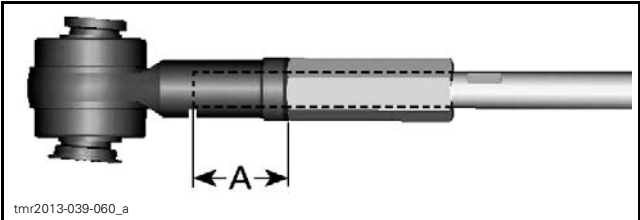
Subsection 01 (STEERING SYSTEM (WITHOUT DPS))



- 1. Cotter pin
- 2. Tie-rod end retaining nut
- 3. Hardened washers
- 4. Tie-rod end bolt

- 4. Discard cotter pin and nut.
- 5. Replace tie-rod end.
- 6. Adjust tie-rod end to the nominal engagement length.

TIE-ROD END NOMINAL ENGAGEMENT LENGTH
25 turns or 31 mm (1.22 in)



A. Nominal length

**WARNING**

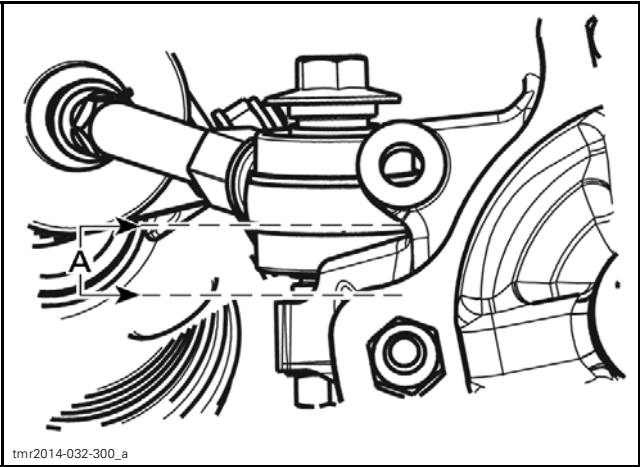
The minimum tie-rod end length engagement in the tie rod must be 25 mm (1 in).

- 7. Torque 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.

NOTE: When tightening, make sure tie-rod end casing is parallel with knuckle mounting face to avoid damaging the casing.



TIE ROD END ASSEMBLY
A. Parallel planes

- 9. Install a **NEW** tie-rod end retaining nut and torque to specification.

TIE-ROD END RETAINING NUT TORQUE
105 N•m ± 15 N•m (77 lbf•ft ± 11 lbf•ft)

- 10. Install a **NEW** cotter pin. Both ends of cotter pins must be folded.
- 11. Install front wheel.
- 12. Check the steering alignment, refer to *STEERING 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 caliper, refer to *BRAKES* subsection.



tmr2011-034-108
TYPICAL

5. Remove wheel hub, refer to *FRONT DRIVE* 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 PROCEDURES* 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.

⚠ WARNING

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 **NEW** circlip and **NEW** seal.

STEERING SYSTEM (WITH DPS)

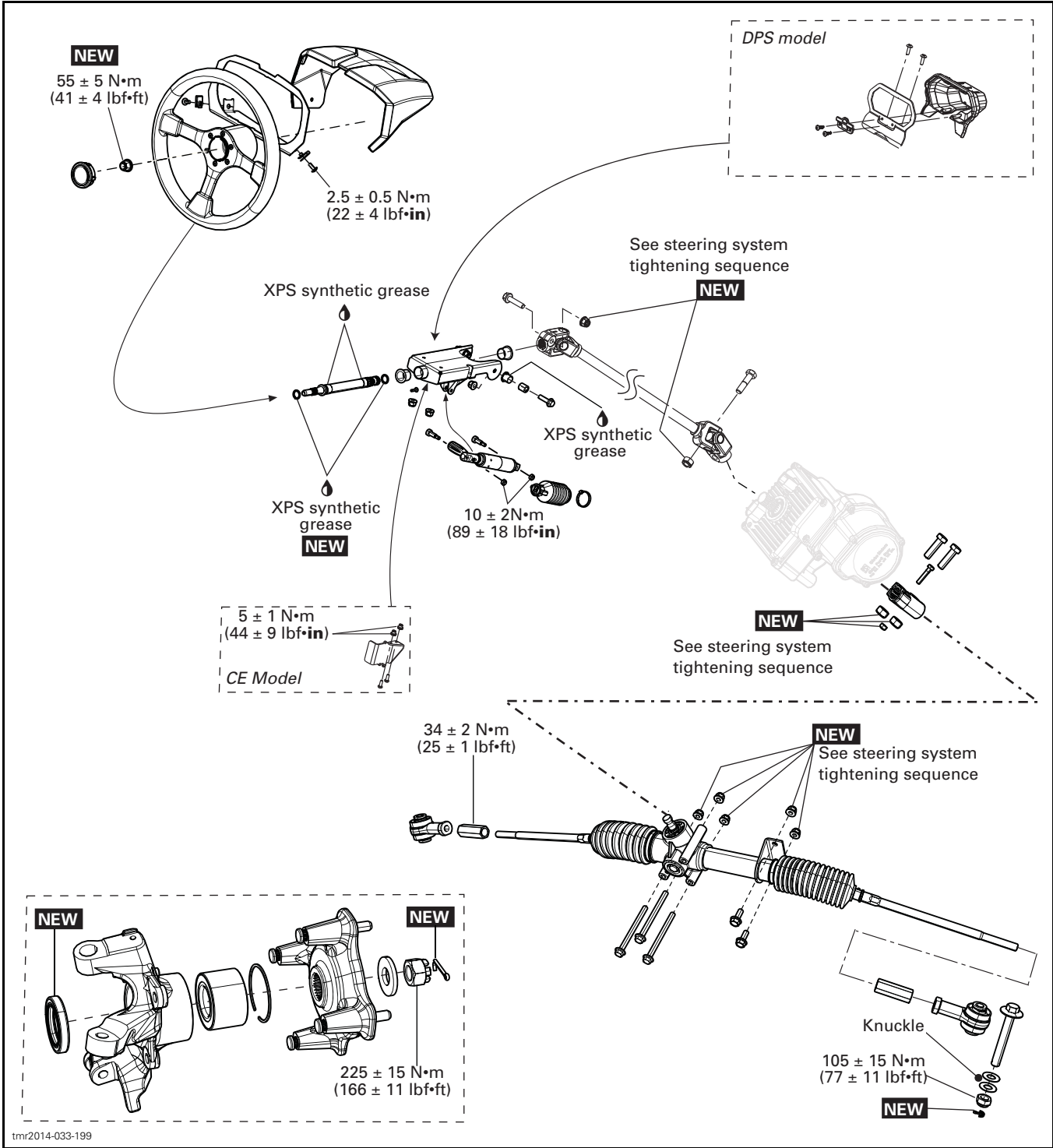
SERVICE TOOLS

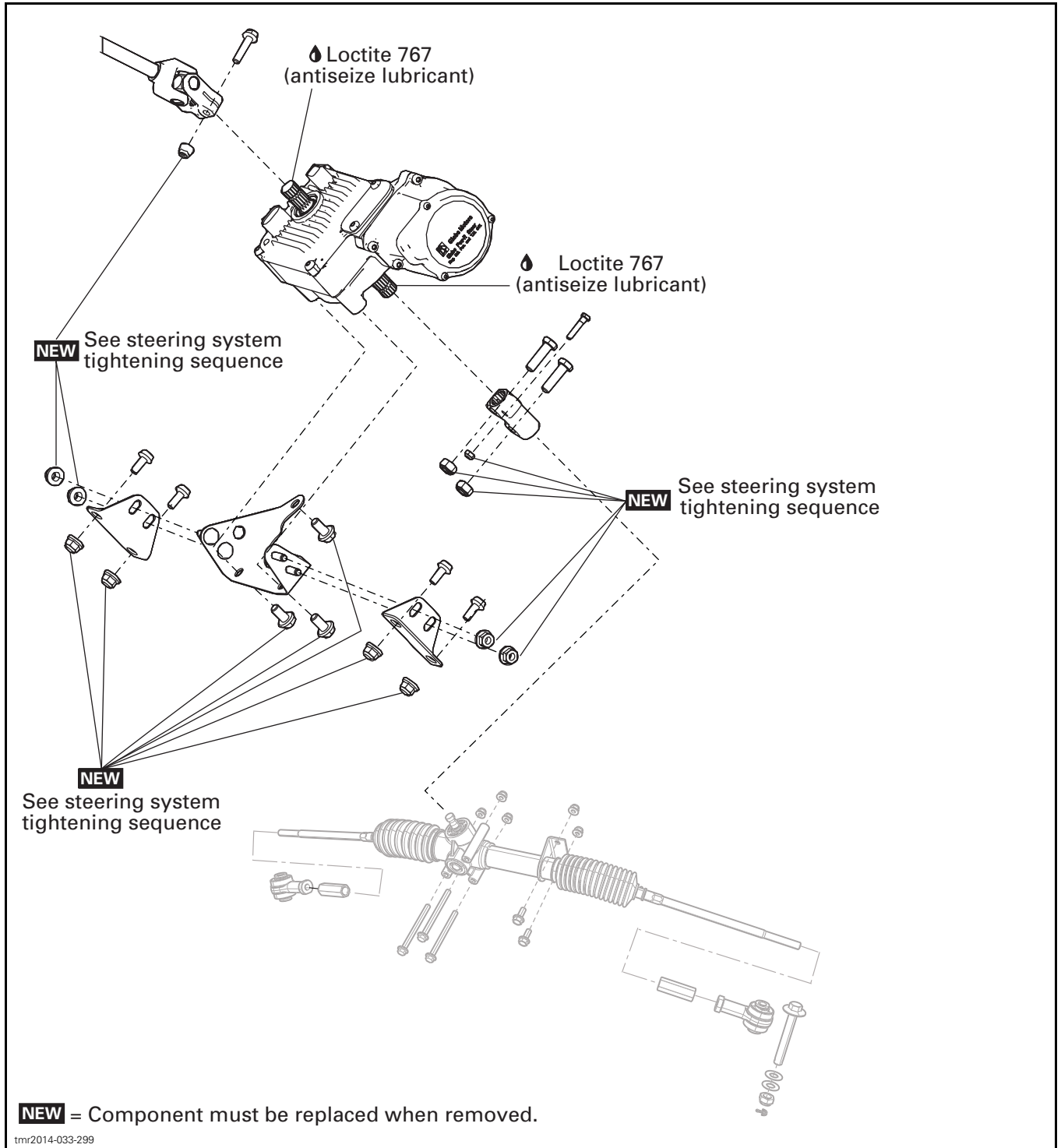
Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	15, 18
STEERING ALIGNMENT TOOL.....	529 036 059	7

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	23
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	14, 21–22
XPS SYNTHETIC GREASE.....	293 550 010	14

Subsection 03 (STEERING SYSTEM (WITH DPS))



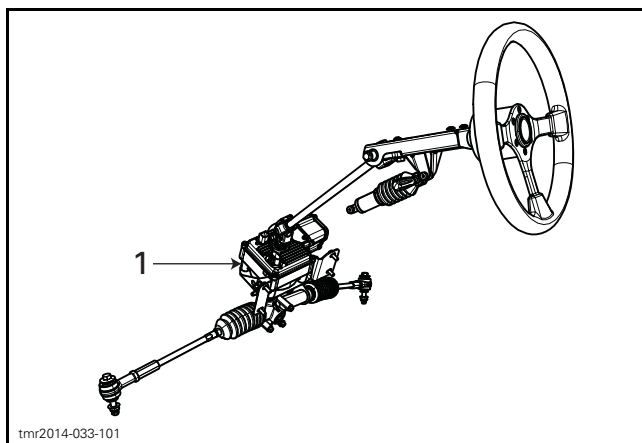


GENERAL

NOTICE Never perform arc welding in the DPS area. Otherwise, poor DPS operation might occur.

DPS SYSTEM DESCRIPTION (FEATURES)

The Dynamic Power Steering (DPS) provides a computer controlled, variable power assist, achieved by an electric motor to optimize the amount of steering input required by the rider.



1. Dynamic power steering unit (DPS)

The DPS system uses the following parameters to determine how much steering assist it provides:

- DPS mode
- Engine RPM
- Battery/electrical system voltage
- Vehicle speed
- DPS shaft torque sensor input.

The amount of steering assist provided is dependent on the steering wheel effort (steering torque), electrical power available, vehicle speed and the DPS assist mode selected.

The greater the steering wheel effort (torque), the greater the assist will be.

The slower the vehicle speed, the greater the assist will be.

If the electrical system is activated but the engine is **not** running, DPS assist will be provided for approximately 30 seconds. DPS assist will resume once the engine is started.

Steering torque may also come from the wheels due to rough terrain. This will produce steering kickback that is reduced by the DPS module, while providing feedback to the driver.

The greater the power steering assist, the greater the load on the electrical system.

When the electrical system is under high load (battery not at full charge, operating the vehicle for prolonged periods of time at slow speed and low RPM which, requires higher power steering assist), the battery power reserve will gradually decrease. This further increases the load on the charging system and the electrical system voltage will drop. As system voltage drops, so does power steering assist.

NOTE: It is important to maintain the battery at a full state of charge to ensure proper DPS operation.

DPS Assist Mode

The DPS system provides three rider selectable modes of operation.

DPS MAX provides maximum steering assist for technical low speed riding in rough or muddy terrain, or for touring.

DPS MED provides normal (medium) steering assist for general all purpose riding.

DPS MIN provides less steering assist for increased feedback and aggressive trail riding.

A fourth mode of operation is available as an accessory to adjust the steering assist level for operation with an approved BRP track kit.

DPS Derating Explanation

Derating is an internal protection system integrated in the DPS electronic module.

This system protects the electronic components when the DPS works too hard and the internal temperature reaches a critical level, or when the battery voltage becomes too low.

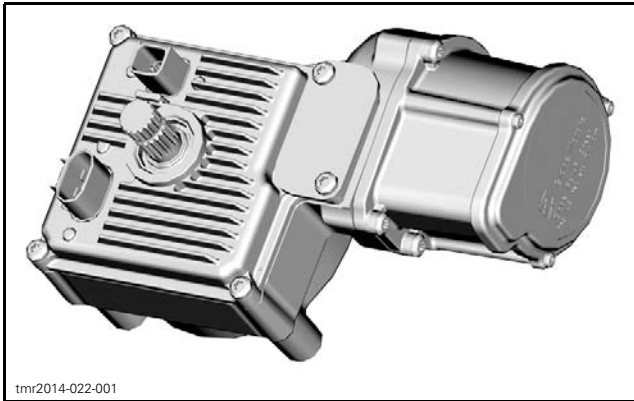
The internal protection system decreases the assistance level available to protect its electronic board. The normal assistance level will return when riding conditions are back to normal and the internal temperature decreases, and/or when the battery voltage increases above a threshold voltage.

NOTE: This reaction is a normal protective behavior of the unit and does not necessarily raise a fault in the cluster. However, under extreme conditions, a scrolling DPS OVERHEAT message may appear in the cluster. When the DPS is allowed to cool down below the threshold recovery temperature, the DPS OVERHEAT message will cease.

DPS SYSTEM DESCRIPTION (COMPONENTS)

DPS Unit

The DPS unit is a self contained unit that includes the steering gear, the DPS module, the DPS motor, and the torque sensor.



DPS UNIT

The DPS module provides DC power to the motor. The amount and duration of that DC power is determined by the inputs to the DPS module. The direction in which the motor turns is changed by reversing the polarity of the circuit current.

The DPS motor does not "spin", but rather turns in very small increments based on the amount, duration, and direction of DC power delivered by the DPS module.

NOTE: Should the DPS unit fail, vehicle steering is still available with increased steering effort.

DPS Unit Protection

To protect the DPS electronic components, the steering assist behavior will change as follows.

CONDITION	DPS BEHAVIOR
DPS internal board temperature is above 105°C (221°F)	Steering assist will gradually decrease.
DPS internal board temperature is above 120°C (248°F)	Steering assist is stopped.

When the DPS unit temperature is back within normal operating range, steering assist should resume to normal operation.

Steering Torque Sensor

The DPS shaft is composed of two shafts and a torsion rod.

The steering column is connected to the DPS input shaft. The DPS output shaft is connected to the rack and pinion via the DPS coupler. The torsion rod is inserted inside the input and output shafts.

When the steering wheel is turned, torque is applied to the input shaft which tends to twist the torsion rod slightly. The sensor detects the torque by measuring the angular torsion in the rod.

The torsion rod is designed so that it can twist inside the two DPS shafts sufficiently to provide a reading of up to 10 N•m (89 lbf•in) of torque either side, after which it will simply turn with the two shafts as if they were a single unit. When the torsion rod has attained its maximum twist point, the DPS will provide maximum steering assist.

Steering assist is applied to the DPS output shaft. This will tend to untwist the torsion rod and null out the input torque applied by the steering effort.

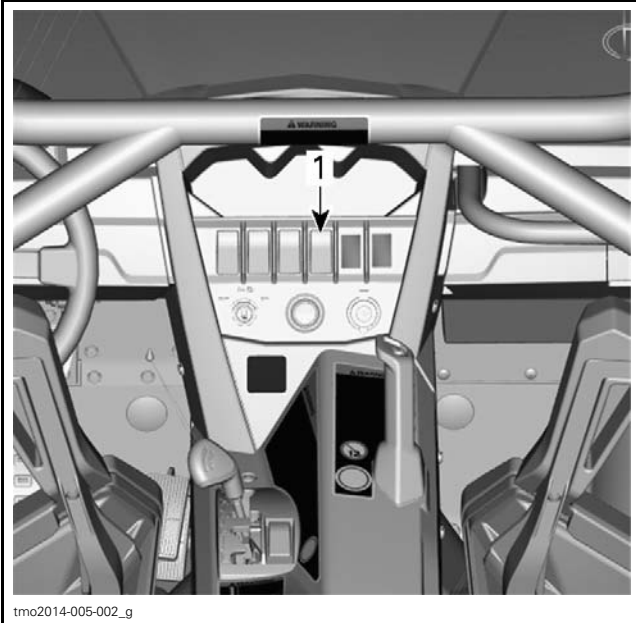
When the torque comes from the wheels due to the rough terrain, the same twisting action will occur. But in this case, the DPS will serve to dampen steering kickback to the driver by countering the torque from the output shaft, while allowing some feedback.

The torque sensor is very sensitive and can detect very small amounts of twist in the torsion rod. The harder the steering wheel is turned, the greater the torsion, the greater the power steering assist.

NOTICE The internal torque sensor is very sensitive to radial and axial loading on the DPS input and output shafts. **All steering system components** must be correctly aligned and torqued using the specified installation, alignment and tightening sequence for the entire steering system. Not following these procedures correctly will result in poor DPS unit operation.

DPS Switch

The DPS switch is used to change the DPS mode.



1. DPS switch

It provides a ground to the multifunction gauge that tells the gauge the operator wants to change DPS operating mode.

When the switch is held for 2 seconds, the gauge signals the DPS (through CAN bus) to switch to the following DPS mode.

Repeatedly pressing the DPS switch toggles the DPS through its operating modes. The DPS mode selection message will be seen scrolling in the multifunction gauge.



NOTE: The DPS mode cannot be changed if the vehicle transmission is set to REVERSE.

ADJUSTMENT

STEERING COMPONENTS ALIGNMENT

IMPORTANT: This procedure may solve most of the DPS steering issues and must be carried out before a torque offset reset procedure.

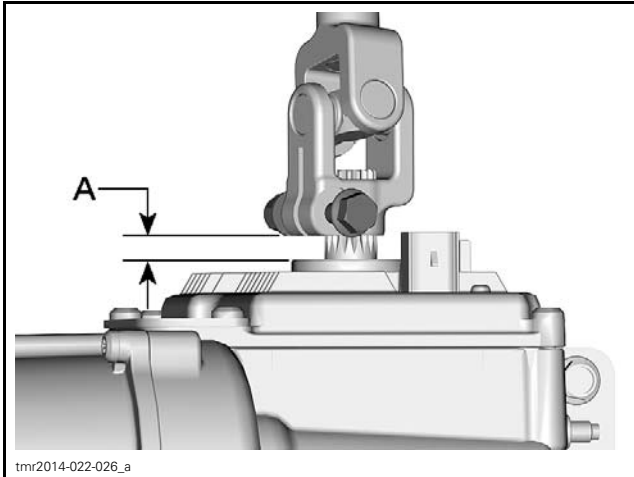
NOTE: The steering components alignment procedure will ensure that no axial or radial loads are applied to the DPS shaft which would result in poor DPS operation. All steering components must be aligned with the rack and pinion, and torqued starting from the rack and pinion, then upwards sequentially to each component from there.

1. Ensure the rack and pinion is centered. Refer to *STEERING ALIGNMENT*.
2. Ensure steering wheel is within 8° of horizontal position.
3. Loosen the fasteners retaining the following steering components sufficiently to provide free movement of the component:
 - Pinch bolts on upper and lower steering column U-joints
 - All fasteners on the DPS side brackets
 - The 3 bolts on the DPS coupler
4. Re-torque the fasteners according to the *STEERING SYSTEM TIGHTENING SEQUENCE* illustration at the beginning of *PROCEDURES*.

NOTICE The steering system tightening sequence **must be strictly followed**. Failure to do so may result in a steering component misalignment, poor DPS operation due to an induced erroneous torque on DPS shaft, or the impossibility to perform a torque sensor reset.

NOTICE When tightening all screws on the DPS side brackets, be sure to hold the brackets snugly against the frame and DPS unit to remove any gap. The side brackets must NOT apply any force on the DPS unit in any direction. This would create an induced erroneous torque to the DPS shaft.

IMPORTANT: Before tightening lower U-joint bolt on steering column, ensure the following measurements for the steering column engagement depth.


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STEERING COLUMN ENGAGEMENT DEPTH

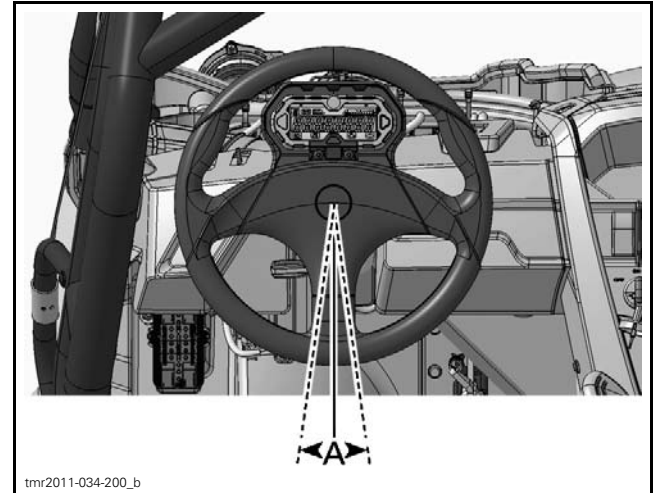
STEERING COLUMN ENGAGEMENT DEPTH (DISTANCE "A")	
Minimum distance	8.5 mm (.335 in)
Maximum distance	15 mm (.591 in)

5. Carry out a *STEERING ALIGNMENT* if needed.

STEERING ALIGNMENT

Front Toe Adjustment

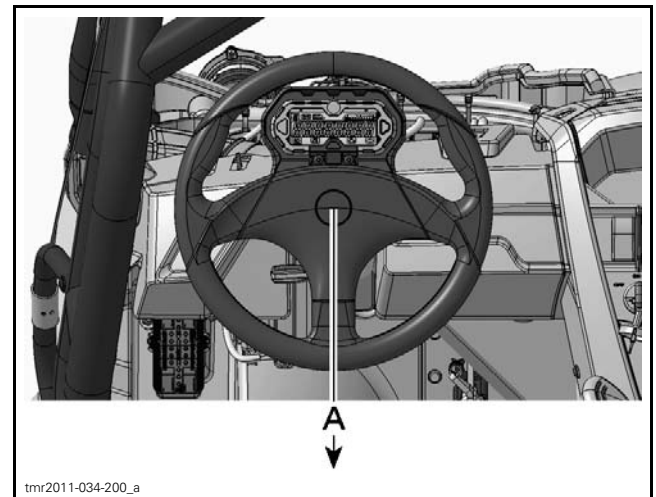
1. Place vehicle on a level surface.
2. Inflate tires to recommended pressure.
3. Find rack and pinion center to center as follows:
 - 3.1 Calculate the total steering wheel rotations from side to side.
 - 3.2 Position the steering wheel at **half** the total rotations.
4. Check steering wheel position:
 - 4.1 If steering angle is within $\pm 3^\circ$, go to **step 6**.
 - 4.2 If steering angle is outside of $\pm 3^\circ$, go to **step 5**.


tmr2011-034-200_b
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 *STEERING WHEEL REMOVAL*.
- 5.2 Reinstall steering wheel to the closest centered position (nearest spline).
6. Center steering wheel.

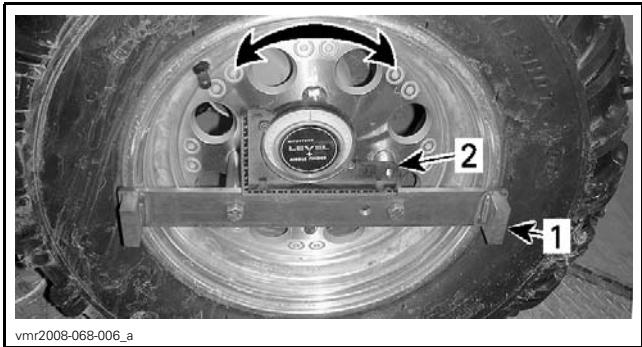

tmr2011-034-200_a
A. Steering wheel centered

7. Remove two wheel lug nuts from a rear wheel.
8. Install STEERING ALIGNMENT TOOL (P/N 529 036 059) using proper spacers.

Subsection 03 (STEERING SYSTEM (WITH DPS))

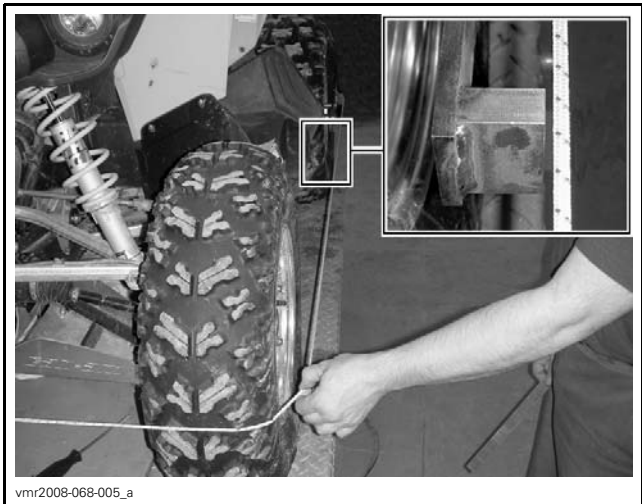


9. Move vehicle to place the tool level with the ground.



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.
- 13. 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

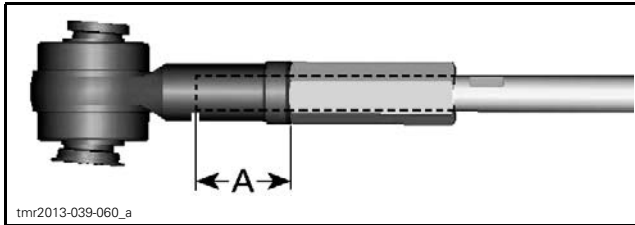
- 17. Calculate the difference between the rear and the front measurement.
- 18. The difference must be as per the following specification:

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.

⚠ WARNING

The minimum tie-rod end length engagement in the tie rod must be 25 mm (1 in).



A. Minimum tie-rod end length engagement

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.

TORQUE OFFSET RESET

NOTE: Before carrying out a torque offset reset procedure:

- A *STEERING COMPONENTS ALIGNMENT* must be carried out.
- The vehicle must be properly aligned and the steering centered.

The torque offset reset procedure must then be carried out (last) if one of the following conditions exist:

- Left and right steering imbalance (steering effort)
- Unequal self centering
- The torque offset is within ±1Nm.

1. Position the steering wheel is at the center position.
2. Connect vehicle to the latest B.U.D.S. software.
3. In B.U.D.S., select **Read Data**.
4. Check if a software update is available and warranted for the DPS. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* If so, install it prior to performing the reset.
5. Choose the **Setting** tab.
6. At the bottom LH corner of the **Setting** page, choose the **DPS** tab.

REQUIRED CONDITIONS TO ALLOW THE TORQUE OFFSET RESET

Steering wheel should be free and centered. There **MUST NOT** be any effort applied to the steering column.

Torque sensor value must be within offset threshold value of ± 1Nm.

Engine not running.

7. Press **Reset Torque Offset** button.

NOTE: Torque sensor reset may not be possible if the torque value is over the 1Nm threshold.

Reset Torque Offset

With the steering wheel centered and no effort is applied, if the indicated **Torque Sensor** value in B.U.D.S. is over the threshold value of 1Nm, a steering imbalance may be noticeable.

If all steering components are undamaged, in good working order, and a proper *STEERING COMPONENTS ALIGNMENT* was carried out, repeated torque offset reset procedures will not solve the problem if the torque offset is greater than ±1Nm. DPS unit replacement may be required.

TROUBLESHOOTING

UNEQUAL TURNING RADIUS

1. Rack and pinion not centered during steering system parts installation.
 - Refer to *STEERING ALIGNMENT* in this subsection.

NO POWER STEERING ASSIST

1. DPS malfunction.
 - If the **CHECK ENGINE** light is on and a **CHECK DPS** message is visible in the multifunction gauge, check for fault codes using B.U.D.S. and carry out service action.
2. No power to DPS unit.
 - Carry out a **DPS FUSE TEST** as detailed in this subsection. Replace as required.
 - Carry out a **DPS INPUT VOLTAGE TEST** as detailed in this subsection. Repair or replace wiring/connectors as required.
 - Carry out a **DPS IGNITION SIGNAL VOLTAGE TEST** as detailed in this subsection. Repair or replace wiring/connectors as required.

Subsection 03 (STEERING SYSTEM (WITH DPS))

3. No ground to DPS unit.

- Carry out a *DPS GROUND CIRCUIT TEST* as detailed in this subsection. Repair or replace wiring/connectors as required.

4. No engine RPM signal from ECM.

- If engine RPM can be displayed in the multifunction gauge when the engine is running, carry out a *DPS UNIT COMMUNICATION LINK (CAN) CONTINUITY TEST* as detailed in this subsection. Repair or replace wiring/connector as required.
- If engine RPM cannot be displayed in the multifunction gauge, use B.U.D.S. to check for applicable fault codes. Carry out service actions.

5. No DPS mode signal from multifunction gauge

- Ensure DPS switch circuit is functioning correctly (continuity to ground).
- Check for multifunction gauge (CLUSTER) or communication fault codes using B.U.D.S.
- Ensure continuity of CAN bus from multifunction gauge to DPS unit as detailed in this subsection. Repair or replace wiring/connector as required.
- Replace multifunction gauge.

LOW POWER STEERING ASSIST

1. DPS mode selection

- If DPS is selected to *DPS MIN* mode, switch to a higher assist mode and ensure DPS assist has increased.

2. Low battery voltage.

- Check battery terminals. Clean, repair, replace or tighten as required.
- Test battery. Recharge or replace battery as required.
- Carry out a *DPS SYSTEM LOAD TEST* as detailed in this subsection.

3. Low input voltage to DPS unit.

- Carry out a *DPS INPUT VOLTAGE TEST* as detailed in this subsection. Ensure power connector pin (DPS2-A) is clean, corrosion free, tight, and make good contact. Repair or replace wiring/connectors as required.

4. Faulty DPS ground circuit.

- Carry out a *DPS GROUND CIRCUIT TEST*. Ensure DPS ground connector pin (DPS2-B) and frame ground post are clean, corrosion free, tight, and make good contact. Repair or replace wiring/connector as required.

ASYMMETRICAL POWER STEERING ASSIST (SIDE TO SIDE)

1. Vehicle alignment.

- Ensure all steering components are undamaged and in good working order. Repair or replace as required.
- In B.U.D.S., check for a torque offset. If so, refer to *STEERING COMPONENTS ALIGNMENT* procedure as detailed in this subsection.
- Carry out the *STEERING ALIGNMENT* procedure as detailed in this subsection.

2. Steering system components misaligned.

- Carry out the *STEERING COMPONENTS ALIGNMENT* procedure as detailed in this subsection.

3. DPS malfunction.

- Carry out a *DPS CURRENT TEST* as detailed in this subsection.

4. Torque sensor not reset to zero.

- When all other possibilities have been eliminated, carry out the *TORQUE OFFSET RESET* procedure detailed in this subsection.

DPS ASSIST MODE CANNOT BE CHANGED

1. Communication problem, faulty gauge, faulty DPS, faulty wiring or connections.

- Connect vehicle to B.U.D.S and check for applicable fault codes.
- Carry out service actions.

2. No DPS switch signal to multifunction gauge.

- Disconnect multifunction gauge and check continuity of DPS switch circuit to ground.

3. No DPS mode signal from multifunction gauge to DPS unit.

- Check continuity of CAN bus from multifunction gauge to DPS unit.
- If the CAN bus circuit and mode switch circuit test good, replace gauge.

4. DPS unit not responding to mode change signal from multifunction gauge.

- Ensure DPS unit is properly connected and that connector contacts are clean and in good condition.
- Ensure DPS unit has a good ground.
- Ensure DPS unit receives proper input voltages.

TORQUE SENSOR CANNOT BE RESET

1. Mechanical problem or DPS parts.

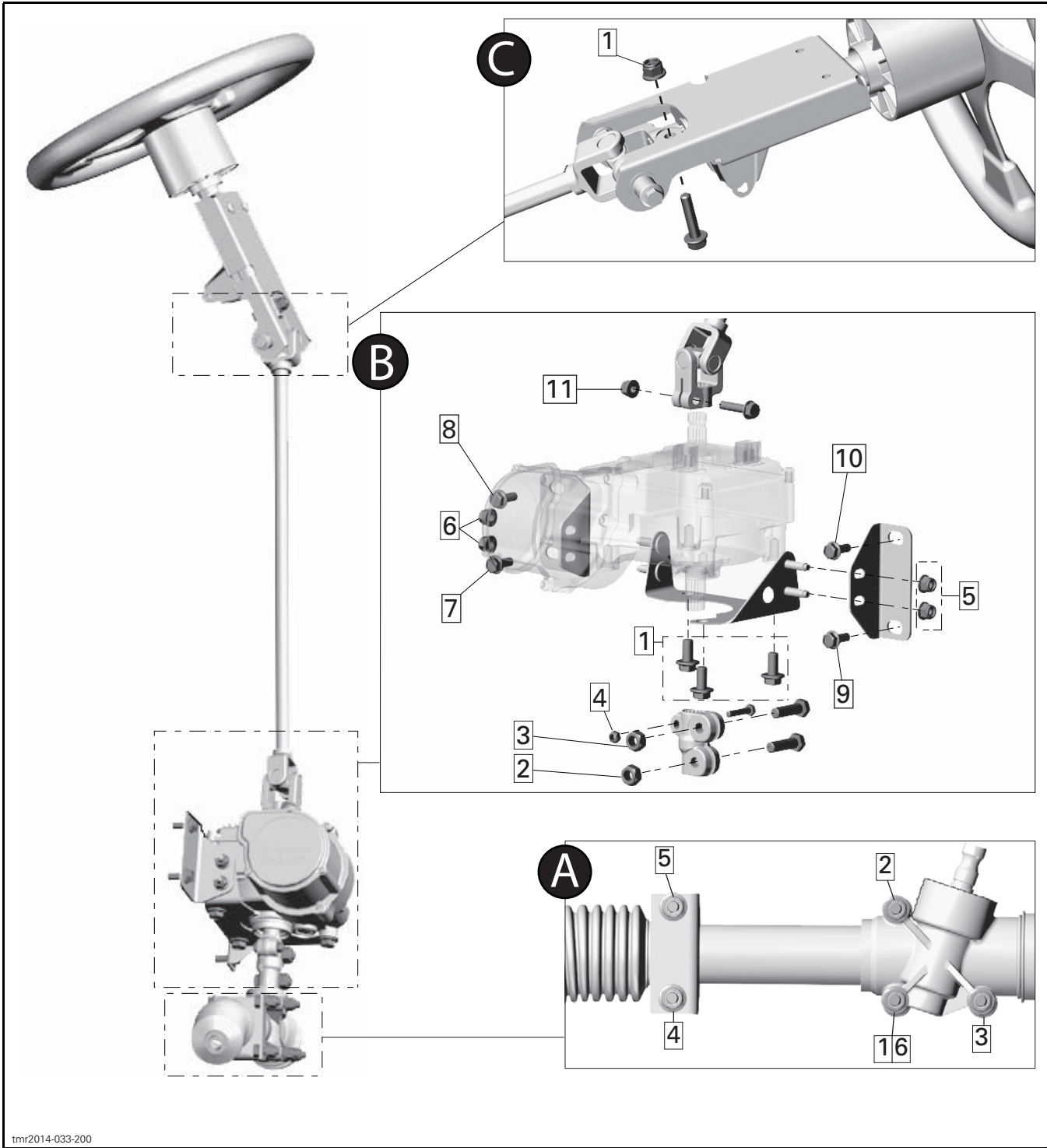
- Refer to *TORQUE OFFSET RESET* procedure detailed in this subsection.

2. Torque offset too great.

- *Refer to TORQUE OFFSET RESET procedure detailed in this subsection.*

PROCEDURES

STEERING SYSTEM TIGHTENING SEQUENCE



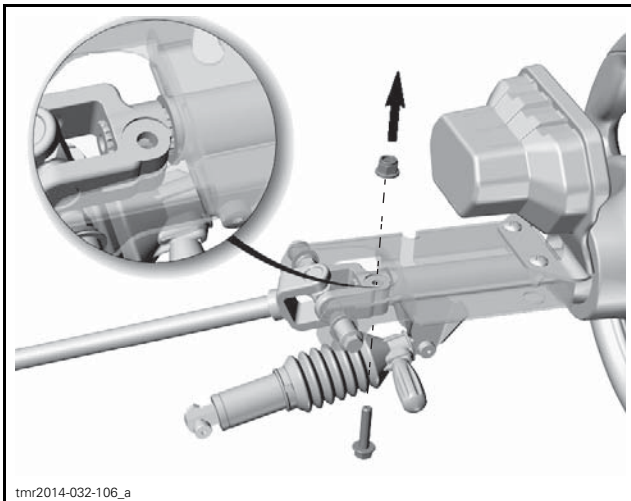
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STEERING SYSTEM TORQUE SPECIFICATIONS		
Level A	no. 1 - 6	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)
Level B	no. 1	48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)
	no. 2 -3	70 N•m ± 5 N•m (52 lbf•ft ± 4 lbf•ft)
	no. 4	10 N•m ± 2 N•m (89 lbf•in ± 18 lbf•in)
	no. 5 - 10	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)
	no. 11	31.5 N•m ± 3.5 N•m (23 lbf•ft ± 3 lbf•ft)
Level C	no. 1	31.5 N•m ± 3.5 N•m (23 lbf•ft ± 3 lbf•ft)

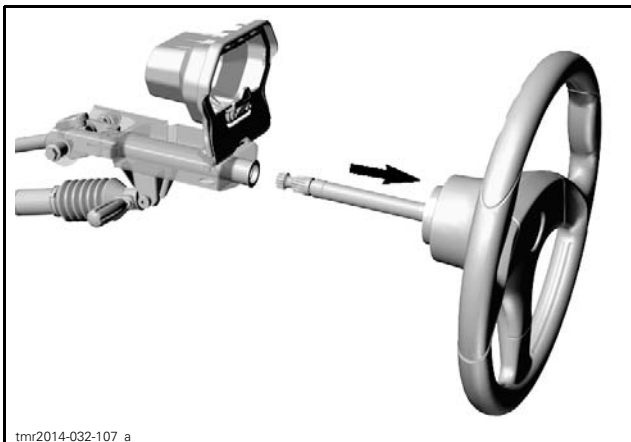
STEERING COLUMN

Steering Column Removal

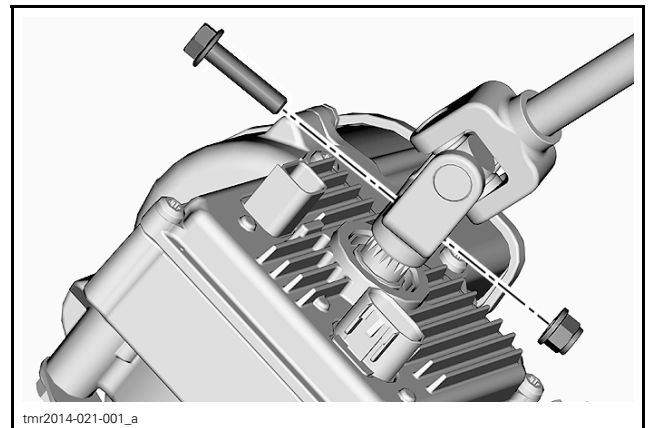
1. Center steering wheel.
2. Remove bolt and nut securing upper universal joint to steering shaft. Discard the nut.



3. Remove steering wheel and steering shaft as an assembly.



4. Remove bolt and nut securing lower universal joint to DPS. Discard the nut.



5. Pull steering column upwards to detach it from DPS.
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.

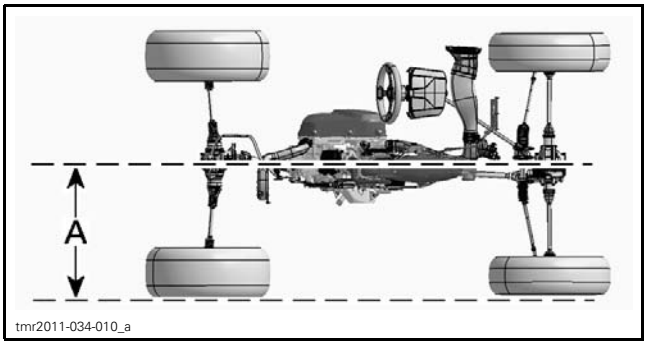
Ensure universal joints are not worn and move freely.

Subsection 03 (STEERING SYSTEM (WITH DPS))

Ensure steering shaft O-rings are not worn, brittle, hard or otherwise damaged.
Replace if necessary.

Steering Column Installation

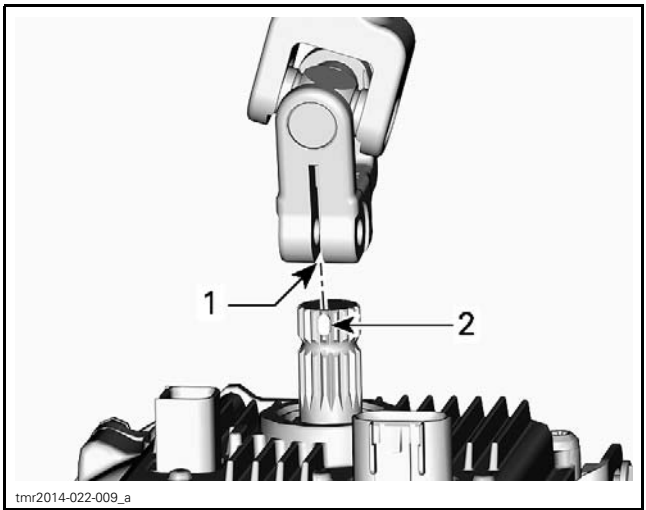
Prior to installing the steering column, place front wheels parallel with longitudinal plane of vehicle.



A. Front wheels parallel

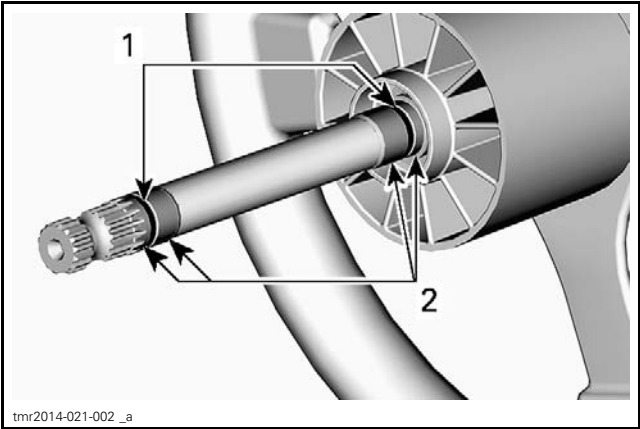
Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to DPS shaft.
Position steering column in vehicle and insert lower U-joint on DPS input shaft.

NOTE: Be sure to align the opening in the steering column U-joint with the staked tooth on the DPS shaft.



STEERING COLUMN INDEXED TO DPS SHAFT
1. Opening in steering column U-joint
2. Stake tooth on DPS input shaft

Lubricate O-rings on steering shaft, and all around steering shaft on both sides of O-rings.

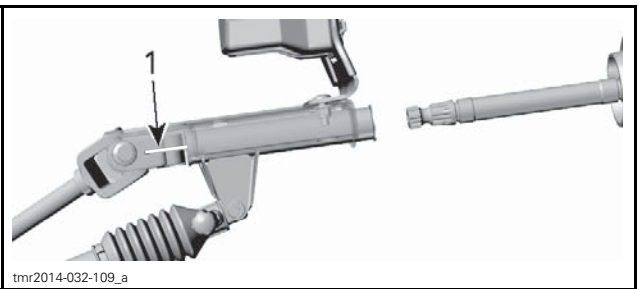


1. O-rings to lubricate
2. Shaft areas to lubricate

Lubricate steering shaft.

STEERING SHAFT LUBRICATION
XPS SYNTHETIC GREASE (P/N 293 550 010)

NOTE: If upper yoke opening is not horizontal when the steering shaft is installed, the steering wheel will appear crooked if the height is adjusted.



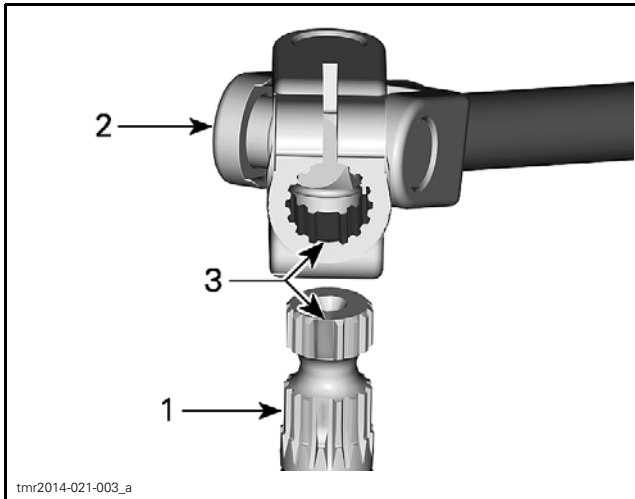
1. Horizontal yoke opening

Install steering wheel and steering shaft. Make sure steering wheel is properly centered.

NOTE: Be sure to align the opening in the steering column U-joint with the staked tooth on the DPS shaft.

Install steering wheel and steering shaft.

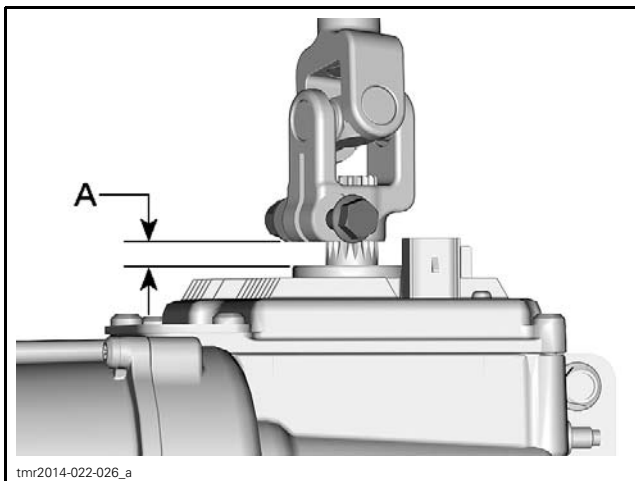
NOTE: Make sure the blind spline on the steering shaft inserts over the blind spline in the steering column upper U-joint.



1. Steering shaft
2. Upper steering column U-joint
3. Blind splines (alignment keys)

IMPORTANT: Before tightening lower U-joint bolt on steering column, ensure the following measurements for the steering column engagement depth.

Tighten steering column U-joints to specification (lower U-joint first). Use **NEW** nuts.



STEERING COLUMN ENGAGEMENT DEPTH

STEERING COLUMN ENGAGEMENT DEPTH (DISTANCE "A")	
Minimum distance	8.5 mm (.335 in)
Maximum distance	15 mm (.591 in)

Tighten steering column U-joints to specification (lower U-joint first). Use **NEW** nuts.

NOTE: If the steering shaft or steering column were replaced, loosen the 8 bolts on the DPS side brackets, then retighten all fasteners as specified in *STEERING SYSTEM TIGHTENING SEQUENCE* and *STEERING SYSTEM TORQUE SPECIFICATIONS* table. Start from level "B".

NOTICE The steering system tightening sequence **must be strictly followed**. Failure to do so may result in a steering component misalignment, poor DPS operation due to an induced erroneous torque on DPS shaft, or the impossibility to perform a torque sensor reset.

NOTICE When tightening all screws on the DPS side brackets, be sure to hold the brackets snugly against the frame and DPS unit to remove any gap. The side brackets must **NOT** apply any force on the DPS unit in any direction. This would create an induced erroneous torque to the DPS shaft.

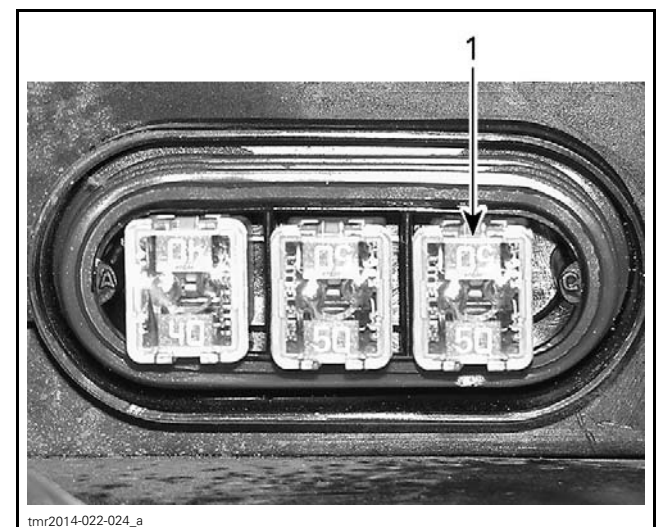
Check front wheel alignment. Refer to *STEERING ALIGNMENT* in this subsection.

DPS UNIT

NOTICE Never perform arc welding in the DPS area. Otherwise, poor DPS operation might occur.

DPS Fuse Test

A 50 A DPS fuse located in fuse box no.2 (PF2-F3), provides power for the DPS motor.



TYPICAL
1. DPS fuse

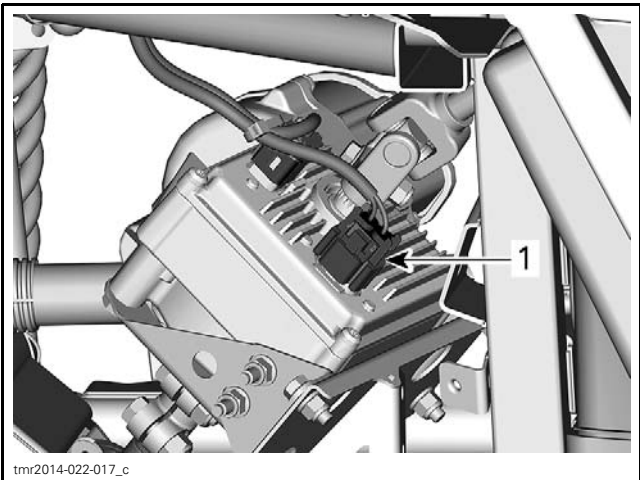
1. Remove the DPS fuse cap to expose the fuse contacts.
2. Using a FLUKE 115 MULTIMETER (P/N 529 035 868) set to VDC, test for a voltage drop across the DPS fuse while the DPS is in operation.



- 3. If a voltage is measured, turn power off and remove fuse.
- 4. Check fuse continuity, fuse contacts and fuse box contact condition. Replace fuse as required.

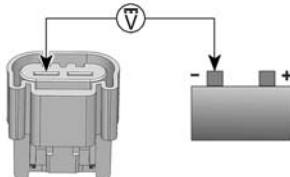
DPS Input Voltage Test

- 1. Disconnect the DPS PWR (power) connector.



1. DPS PWR connector

- 2. Test for 12 Vdc DPS motor power at DPS2-A harness connector as per following table.

MULTIMETER PROBE POSITIONS		VOLTAGE
DPS power connector pin A	Battery ground	
		Battery voltage

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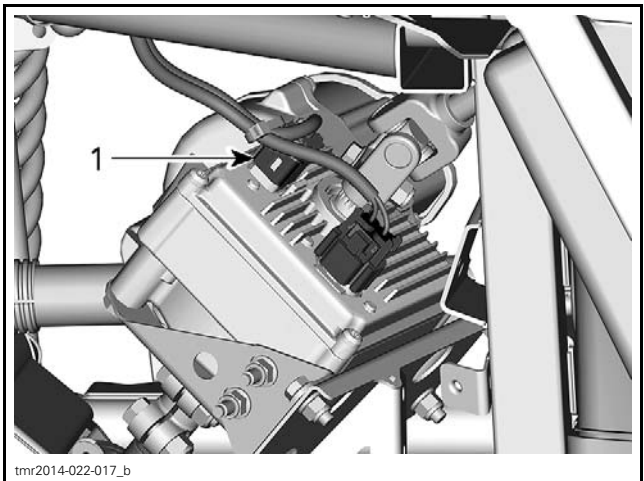
If NO voltage is measured, test the 50 A DPS fuse in fuse box **no. 2** (PF2-F3). If good, check wires and connector pins. Replace or repair defective parts and reset fault codes.

If battery voltage is measured, carry out the following *DPS IGNITION SIGNAL VOLTAGE TEST*.

NOTE: This test may also be carried out by connecting a 12 Vdc test light between the DPS PWR harness connector (pin A), and the battery (-) negative terminal. The test light must come on bright.

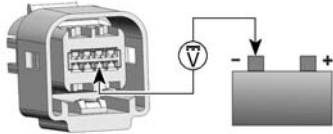
DPS Ignition Signal Voltage Test

- 1. Disconnect DPS SENSOR connector.



1. Sensor connector

- 2. Set the ignition switch to ON.
- 3. Test for 12 Vdc power to the DPS module at DPS1-3 harness connector as per following table.

MULTIMETER PROBE POSITIONS	VOLTAGE
DPS sensor connector (pin 3) and battery ground	Battery voltage
	

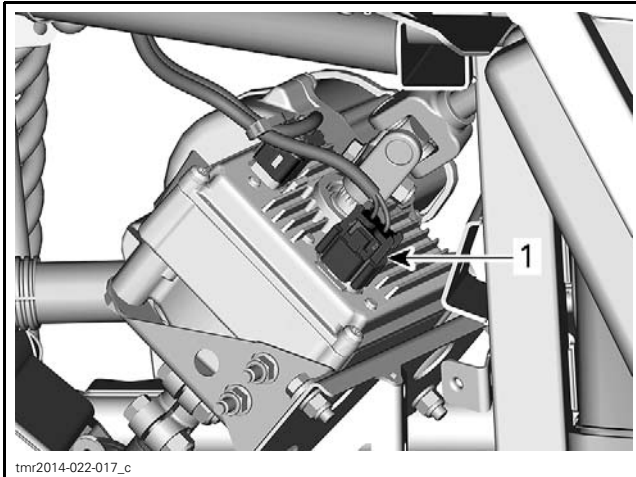
If NO voltage is measured, check wires and connector pin from DPS unit to main relay 2 in fuse box **no. 1** (PF1-2B). Replace or repair defective parts and reset fault codes.

If battery voltage is measured, carry out the following *DPS GROUND CIRCUIT TEST*.

NOTE: This test may also be carried out by connecting a 12 Vdc test light between the DPS sensor harness connector (pin 3), and the battery (-) negative terminal. The test light must come on bright.

DPS Ground Circuit Test

1. Disconnect the DPS POWER connector (DPS2).



1. DPS POWER connector

2. Test for continuity between DPS2-B to battery ground.

MULTIMETER PROBE POSITIONS		READING
DPS POWER connector pin B	Battery ground	Continuity (close to 0 Ω)

If there is NO continuity or a high resistance is measured, check wires and connector pins from DPS unit to chassis ground post. Replace or repair defective parts and reset fault codes.

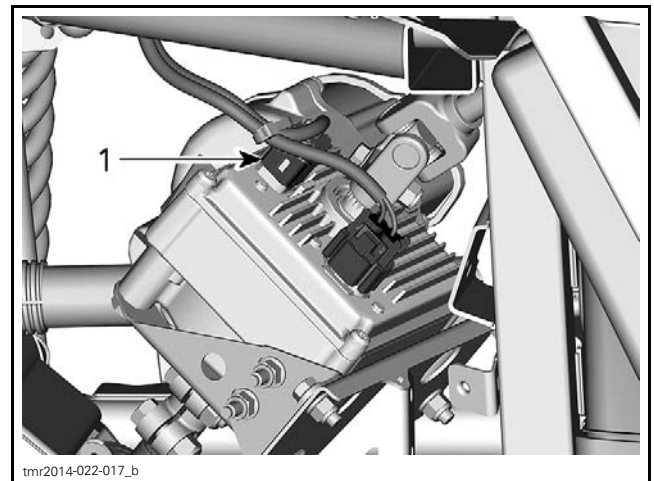
If there is good continuity, carry out the following **DPS UNIT COMMUNICATION LINK (CAN) CONTINUITY TEST**.

NOTE: This test may also be carried out by connecting a 12 Vdc test light between the POWER connector pin B and the battery (+) positive terminal. The test light must come on bright.

DPS Unit Communication Link (CAN) Continuity Test

NOTE: DPS unit must receive a "MODE" signal from the multifunction gauge and an RPM signal to provide power steering assist. If the DPS mode changes when the DPS mode switch is activated for 2 seconds, then the system is functioning correctly. If the DPS does not respond, check for applicable faults using B.U.D.S. before carrying out this test.

Disconnect the DPS SENSOR connector and the multifunction gauge connector.



1. SENSOR connector

Test continuity of CAN Bus Wires as per following table.

MULTIMETER PROBE POSITIONS		RESISTANCE @ 20°C (68°F)
DPS SENSOR CONNECTOR	MULTIFUNCTION GAUGE CONNECTOR	
Pin 4	Pin 18	Less than 1 Ω
Pin 8	Pin 19	

If resistance measured is out of specification, check wires and connector pins. Carry out repairs as required and reset fault codes using B.U.D.S. software.

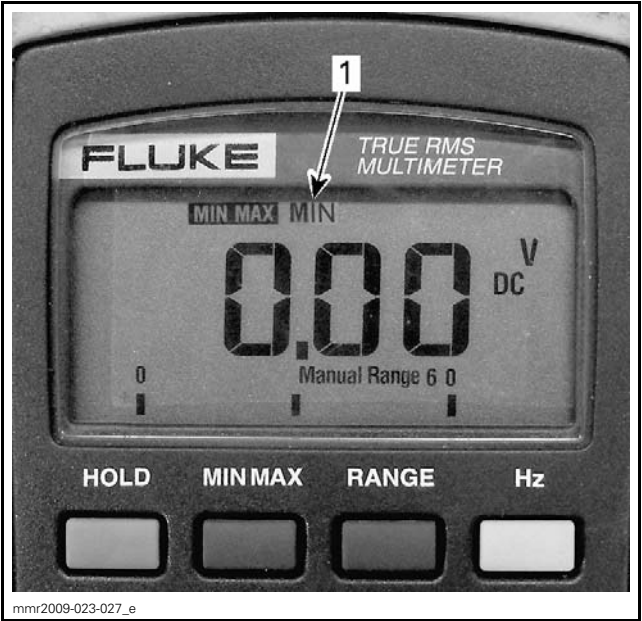
If resistance measured is good, replace the DPS unit and reset fault codes using B.U.D.S. software.

DPS System Load Test

If the charging system cannot sustain normal voltage when the DPS is operating, DPS ASSIST may be reduced or nonexistent. Carry out the following steps.

- 1. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Vdc.
- 2. Connect the RED multimeter lead to the positive battery terminal.
- 3. Connect the BLACK multimeter lead to the battery ground.
- 4. Measure the battery voltage.

- NOTE:** If battery voltage is low, recharge battery.
- 5. Ensure the vehicle transmission is set to PARK.
 - 6. Start the engine.
 - 7. Note the voltage on the multimeter with the engine running (charging system voltage).
 - 8. Press the **RANGE** button repeatedly to select **Manual Range 6 0**.



1. MIN function selected

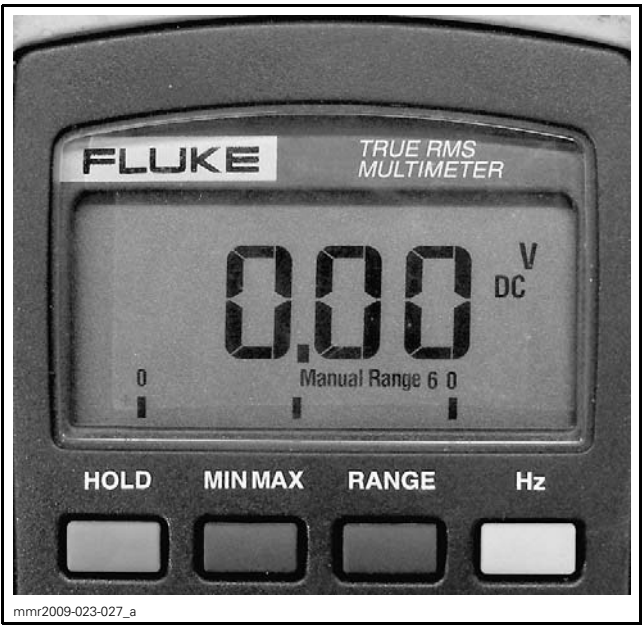
- 10. Turn the steering wheel **momentarily** against the steering hard stops to each side.

NOTE: Do not hold steering against steering hard stops for an extended period of time.

- 11. Read the MIN charging system voltage recorded while the steering wheel was turned against each stop.

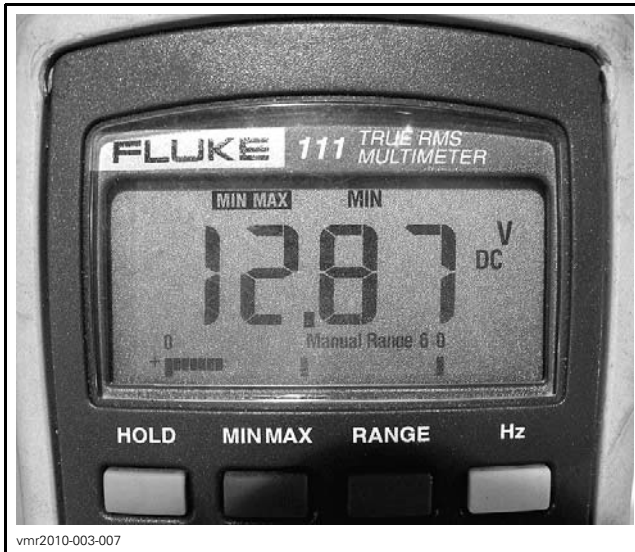
DPS SYSTEM LOAD TEST			
PROBE POSITIONS		STEERING POSITION	VOLTAGE READING
Battery (-) terminal	Battery (+) terminal	LH stop	At least 12 Vdc
		RH stop	

NOTE: Turning the steering wheel momentarily against the steering hard stops generates maximum DPS load (maximum current draw on electrical system). Electrical system must sustain at least 12 Vdc for proper DPS operation.



VDC SELECTED TO MANUAL RANGE 6 0

- 9. Press the **MIN MAX** button on the multimeter to engage the MIN function.



If the electrical system cannot sustain at least 12 Vdc, check the following:

- Battery
- Battery connections
- DPS unit power and ground connections
- Charging system
- Frame and engine ground studs.

If the previously listed items, carry out the following *DPS UNIT CURRENT TEST*.

DPS Unit Current Test

1. Connect vehicle to the latest B.U.D.S. software.
2. Click on the **Read Data** button.
3. Choose the **Monitoring** tab.
4. At the bottom of the **Monitoring** page, choose the **DPS** tab.
5. With the vehicle engine running in PARK and without any steering effort, the indications on the B.U.D.S. **DPS Monitoring** page should be as per following table.

TORQUE SENSOR	DPS CURRENT
0 Nm	0 Amp

6. Turn the steering wheel side to side, momentarily against each steering hard stop and observe the **DPS Torque Sensor** value. The torque value should increase with steering effort applied to the steering wheel.

The **DPS Current** value should increase proportionately to the torque applied, and decrease with the torque as steering assist is provided.

NOTE: The increase and decrease in torque and current readings is very brief as steering assist is quickly provided. Current draw should remain within green scale but may momentarily peak to or exceed 60 amps, then drop off close to 0 amps as torque applied is nulled out by steering assist. If steering is held against hard stops the torque and current readings will remain high.

If current draw tends to remain high, carry out the following:

- *STEERING COMPONENTS ALIGNMENT*
- *TORQUE OFFSET RESET* procedure detailed in this section (only if steering components alignment did not solve the problem)
- DPS unit replacement.

NOTE: The *STEERING COMPONENTS ALIGNMENT CHECK* must always be carried out before even considering a torque offset reset.

7. Turn steering to LH stop and hold at least 8 Nm. Note DPS current value.
8. Turn steering to RH stop and hold at least 8 Nm. Note DPS current value.
9. Repeat previous two steps while holding at (+ or -) 5 Nm. Note DPS current value.

LH and RH DPS current readings should be the same for the same applied torque.

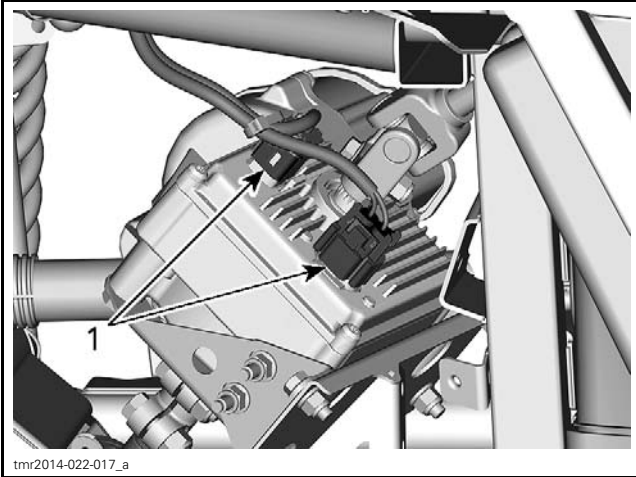
If the *STEERING COMPONENTS ALIGNMENT* and *TORQUE OFFSET RESET* procedures have been carried out, and the current or steering imbalance is too great, the DPS unit will require replacement to resolve the problem.

DPS Unit Removal

NOTICE Before proceeding with the DPS removal, remove the 50 Amp DPS fuse (F3) in the fuse box no.2. Handle the DPS unit with extreme care as it is very sensitive to physical shock. Store unit in a secure area. If the DPS unit is dropped, it must be replaced even if only minimal damage is apparent.

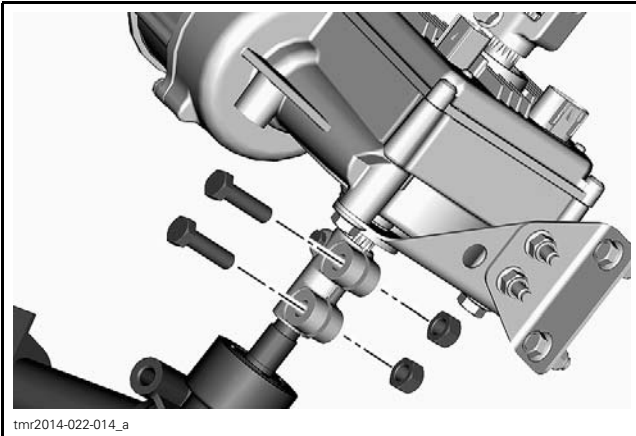
1. Remove both front wheels.
2. Disconnect the electrical connectors from the DPS unit.

Subsection 03 (STEERING SYSTEM (WITH DPS))

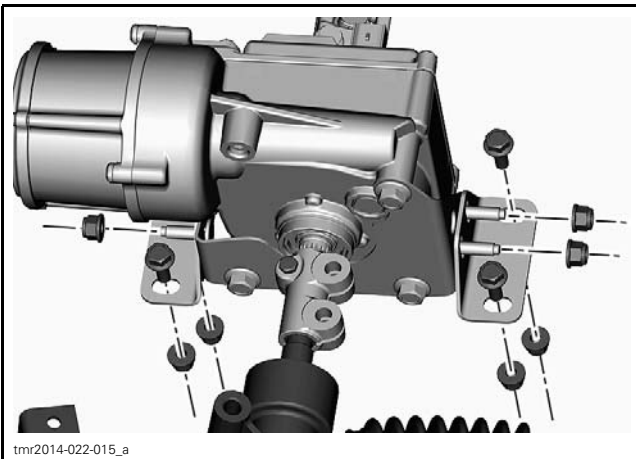


1. DPS connectors

3. Remove steering column. Refer to *STEERING COLUMN REMOVAL* in this subsection.
4. Remove the DPS coupler pinch bolts and nuts. Discard the nuts.



5. Remove all DPS unit retaining screws.



6. Pull up on DPS unit to disengage from the rack and pinion shaft and remove it from the vehicle.

NOTE: If replacing DPS unit, remove the DPS support and DPS coupler from the unit.

DPS Unit Inspection

Inspect DPS shaft splines. If damaged, replace DPS unit.

Inspect DPS coupler splines. If damaged, replace coupler.

Inspect and clean terminal contacts.

DPS Unit Installation

NOTICE The following installation sequence **MUST** be strictly followed (see procedure details in upcoming paragraphs). Failure to do so may result in DPS misalignment and poor DPS operation due to an induced erroneous torque on DPS shaft or the impossibility to perform a torque sensor reset.

If Replacing DPS Unit

Remove DPS support from unit and install it on new DPS unit. Torque mounting bolts.

Insert DPS coupler on DPS output shaft. Ensure DPS coupler opening is aligned with staked tooth on DPS output shaft.

Loosely install DPS coupler locking bolt (M6) and nut.

Loosely install one DPS coupler pinch bolt (M10) and nut (nearest DPS).

Continue with IF INSTALLING SAME DPS UNIT.

If Installing Same DPS Unit

Engage DPS coupler on rack and pinion shaft. Ensure rack and pinion input shaft is and remains centered when installing DPS on pinion.

Loosely install DPS coupler pinch bolts (2 x M10)

Loosely install side brackets on DPS support and DPS unit on frame (DO NOT torque nuts).

Engage steering column on DPS input shaft. Ensure opening in steering column U-joint is aligned with staked tooth on DPS input shaft.

Engage steering column and steering shaft. Ensure alignment key in steering column U-joint is aligned with blind tooth on steering shaft.

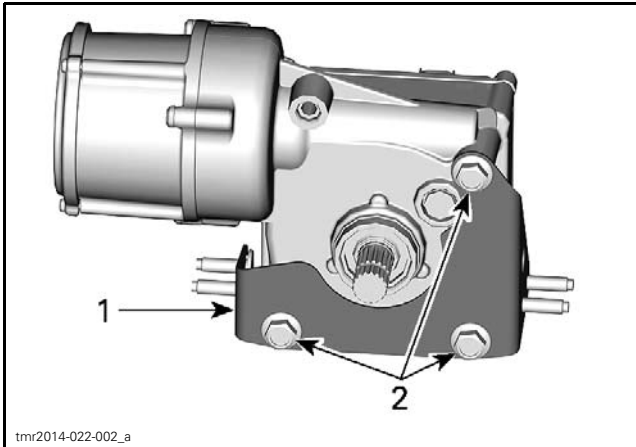
Loosely install pinch bolts on both ends of steering column.

Refer to *STEERING SYSTEM TIGHTENING SEQUENCE* illustration and *STEERING SYSTEM TORQUE SPECIFICATIONS* in this subsection.

If replacing DPS unit, refer to *DPS REPLACEMENT* for DPS software installation

DPS Unit Installation Procedure

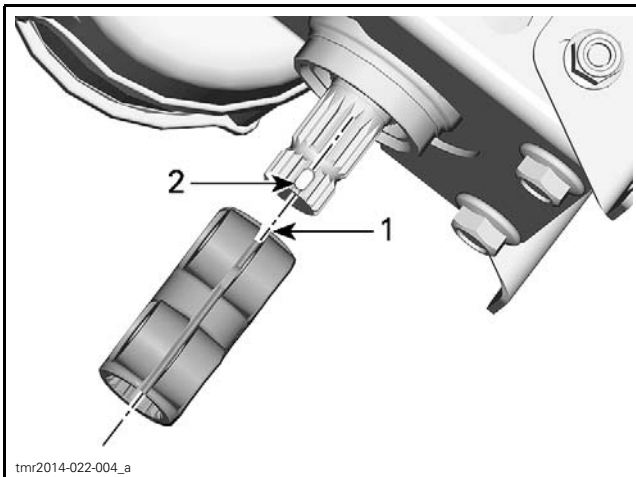
1. Align front wheels parallel to rear wheels.
2. Pre-assemble DPS unit for mounting as per following illustrations.
 - 2.1 Install DPS support and torque mounting bolts (3).



DPS SUPPORT INSTALLATION

1. DPS support
2. Bolts torqued

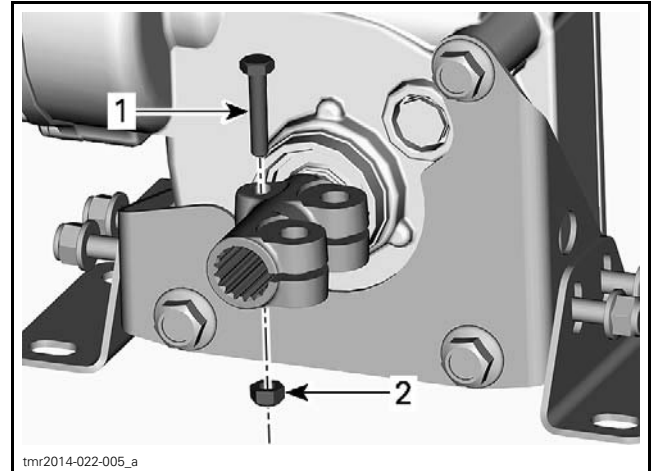
- 2.2 Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to DPS output shaft.
- 2.3 Align and insert DPS coupler on output shaft.



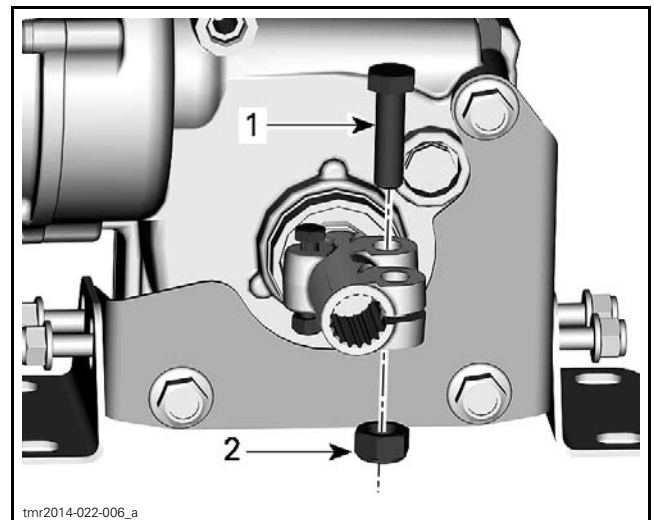
DPS COUPLER ALIGNMENT

1. Opening in DPS coupler
2. Staked spline on DPS output shaft (alignment key)

- 2.4 Loosely install DPS coupler M6 locking bolt and nut, and the M10 pinch bolt nearest DPS.

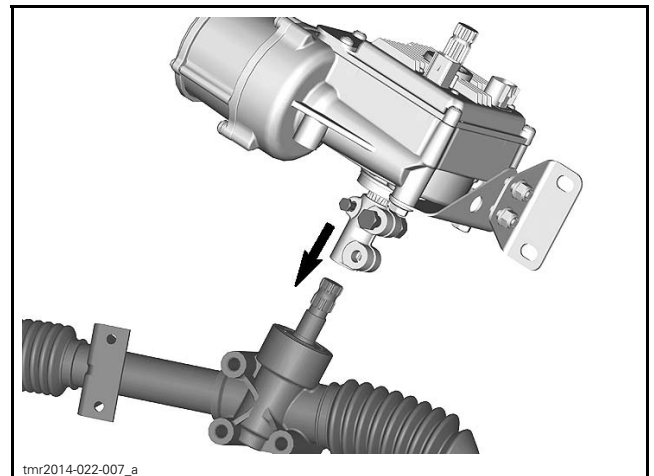


1. Coupler locking bolt (M6)
2. Locking nut (install loose)



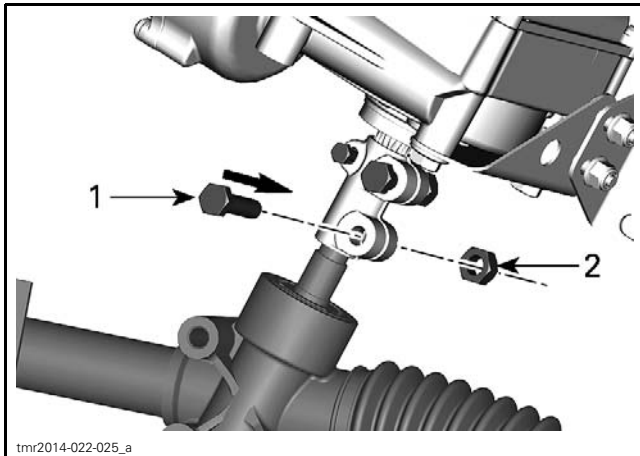
1. M10 bolt loose
2. Locking nut (install loose)

3. Engage DPS coupler on rack and pinion shaft. Ensure pinion shaft remains centered.



4. Loosely install second M10 DPS coupler pinch bolt (rack and pinion end).

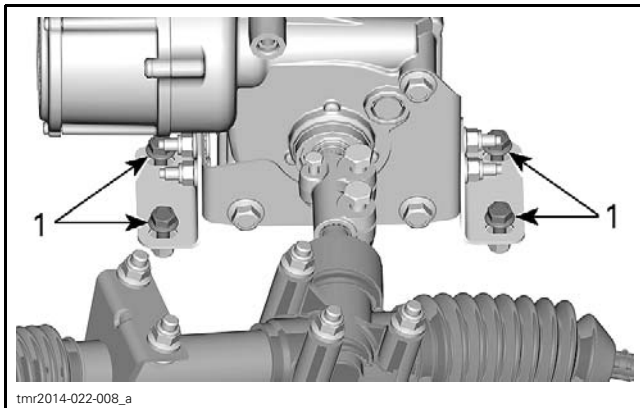
Subsection 03 (STEERING SYSTEM (WITH DPS))



1. M10 pinch bolt nearest pinion
2. Locking nut (install loose)

5. Loosely install side brackets on DPS support and DPS unit on frame (DO NOT torque nuts).

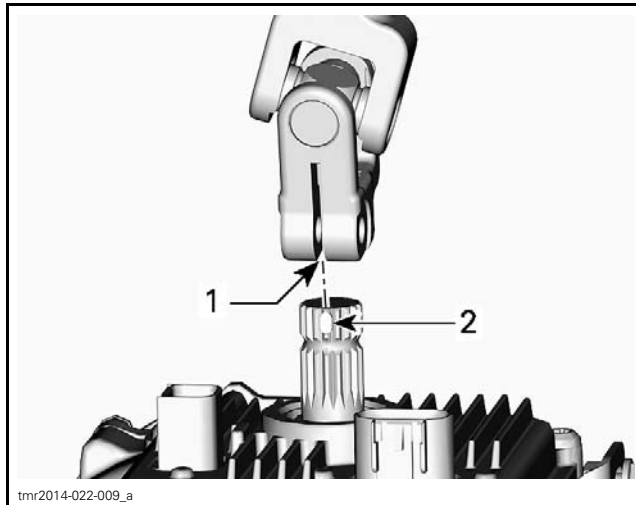
NOTICE When installing bolts make sure to keep both brackets **LOOSE**.



1. Loosely install bolts x4

6. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to DPS input shaft.

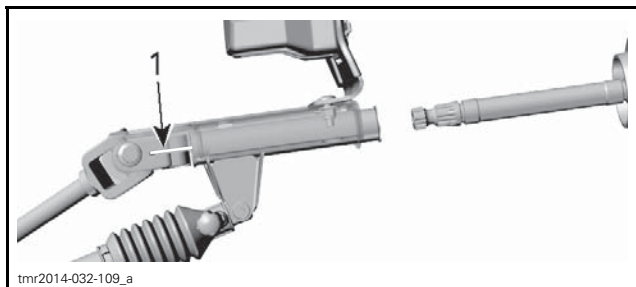
7. **Loosely** install steering column on DPS and steering shaft.



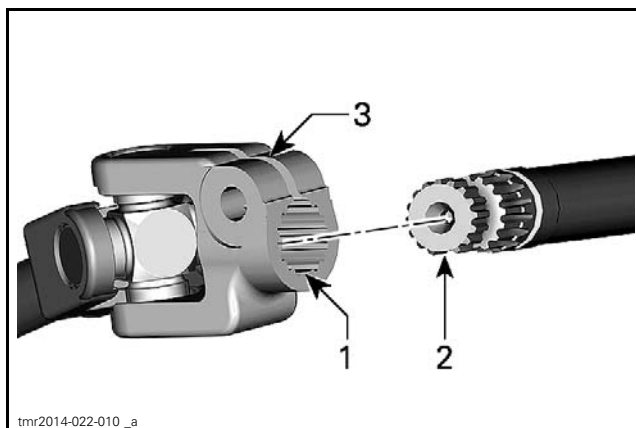
STEERING COLUMN INDEXED TO DPS SHAFT

1. Opening in steering column U-joint
2. Stake tooth on DPS input shaft

NOTE: If upper yoke opening is not horizontal when the steering shaft is installed, the steering wheel will appear crooked if the height is adjusted.



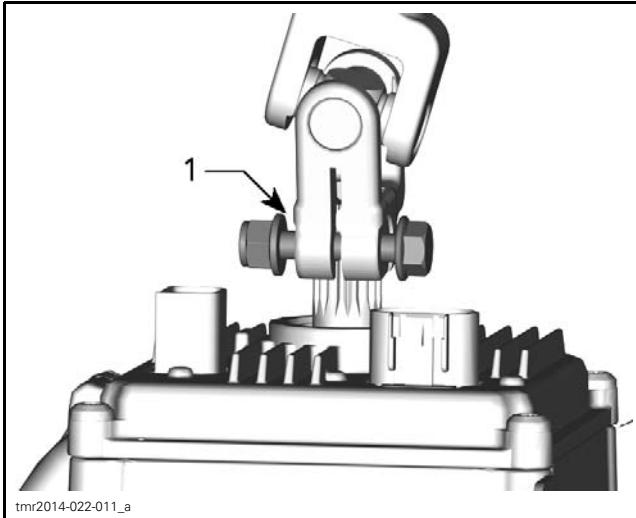
1. Horizontal yoke opening



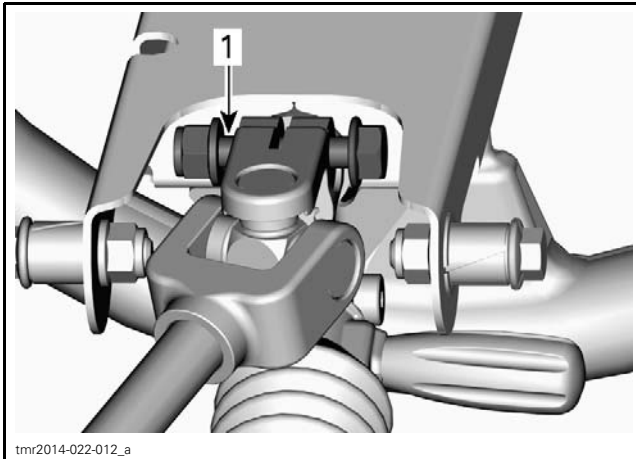
STEERING COLUMN INDEXED TO STEERING SHAFT

1. Alignment key in upper steering column U-joint
2. Blind tooth on steering shaft
3. Opening in upper steering column U-joint

8. **Loosely** install pinch bolts on both ends of steering column.



LOWER U-JOINT ON STEERING COLUMN
1. Pinch bolt mounted loose



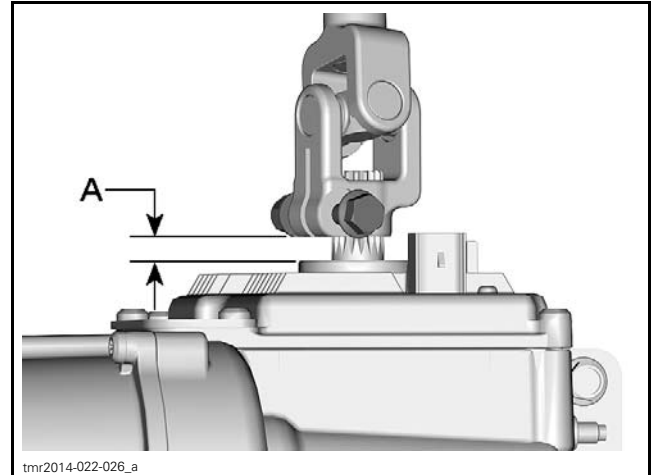
UPPER U-JOINT ON STEERING COLUMN
1. Pinch bolt mounted loose

9. Torque all steering system fasteners to specification. Refer to *STEERING SYSTEM TIGHTENING SEQUENCE* illustration and *STEERING SYSTEM TORQUE SPECIFICATIONS* in this subsection.

NOTICE The steering system tightening sequence must be strictly followed. Failure to do so may result in a steering component misalignment, poor DPS operation due to an induced erroneous torque on DPS shaft, or the impossibility to perform a torque sensor reset.

NOTICE When tightening all screws on the DPS side brackets, be sure to hold the brackets snugly against the frame and DPS unit to remove any gap. The side brackets must NOT apply any force on the DPS unit in any direction. This would create an induced erroneous torque to the DPS shaft.

IMPORTANT: Before tightening lower U-joint bolt on steering column, ensure the following measurements for the steering column engagement depth.



STEERING COLUMN ENGAGEMENT DEPTH

STEERING COLUMN ENGAGEMENT DEPTH (DISTANCE "A")	
Minimum distance	8.5 mm (.335 in)
Maximum distance	15 mm (.591 in)

10. Apply DIELECTRIC GREASE (P/N 293 550 004) on harness connector terminals.
11. Connect DPS connectors to DPS unit.
12. If installing a replacement DPS unit, refer to *DPS REPLACEMENT* in this subsection.
13. Check *STEERING ALIGNMENT*. Refer to *STEERING SYSTEM* subsection.
14. Carry out the *DPS SYSTEM FINAL VERIFICATION*.

DPS System Final Verification

With the front wheels off the ground:

1. Start engine to enable DPS unit.
2. Slowly turn steering wheel from one side to the other 3 times.

Make sure:

- Assistance and travel are equal when turning right or left
- Steering system operates smoothly through all its range.

3. Lower vehicle on the ground.
4. Repeat step 2.

Subsection 03 (STEERING SYSTEM (WITH DPS))

RESULT	ACTION
Uneven/incorrect steering behavior	Troubleshoot steering problem

5. Carry out a test ride of the vehicle to ensure proper operation of the DPS unit.

DPS Unit Replacement

New DPS units **do not** come with the required software programmed into the unit. A DPS unit fault will be generated when the vehicle is powered up. The check engine light will come on and a CHECK DPS message will appear in the multi-function gauge.

The new DPS unit will require 2 mandatory updates. The first update is required for the DPS to recognize what type of vehicle it is installed in, the second to upload the software required for proper operation on that vehicle.

When DPS unit installation is complete, carry out the following steps.

- 1. Connect the vehicle to the latest B.U.D.S. software.
- 2. Select the **Read Data** button.
- 3. A message window will appear in B.U.D.S. asking you if you would like to update the DPS module; select **YES** and follow the instructions. When a second window appears asking you the same question, select **YES** again.
- 4. Once the correct DPS software file is installed, go to the **Faults** page and clear the fault codes.
- 5. Carry out the *TORQUE OFFSET RESET* procedure (if required) as described in this subsection.
- 6. Test drive the vehicle to ensure proper DPS operation.

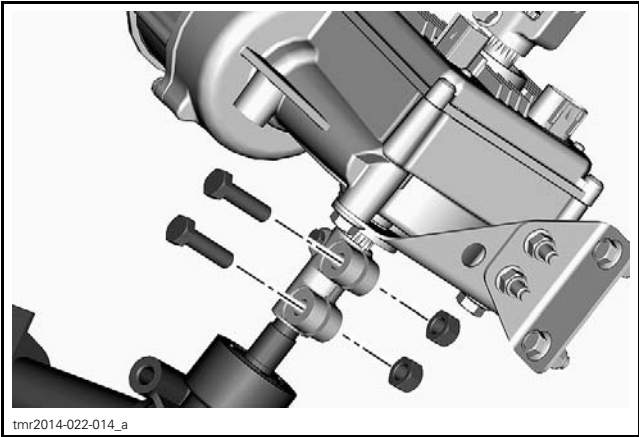
RACK AND PINION

Rack and Pinion Servicing

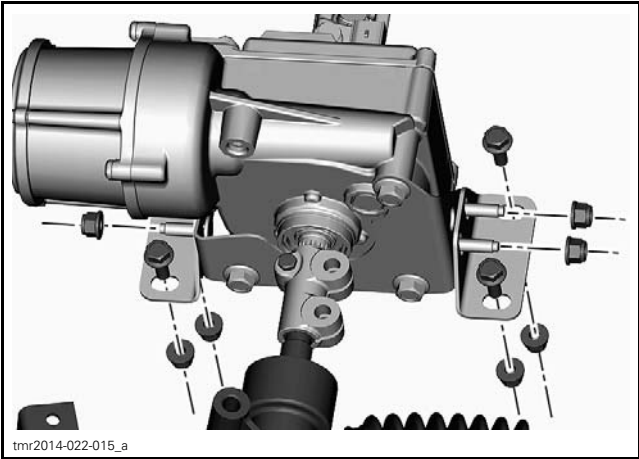
The rack and pinion cannot be serviced except for replacement of the boots and tie rod ends.

Rack and Pinion Removal

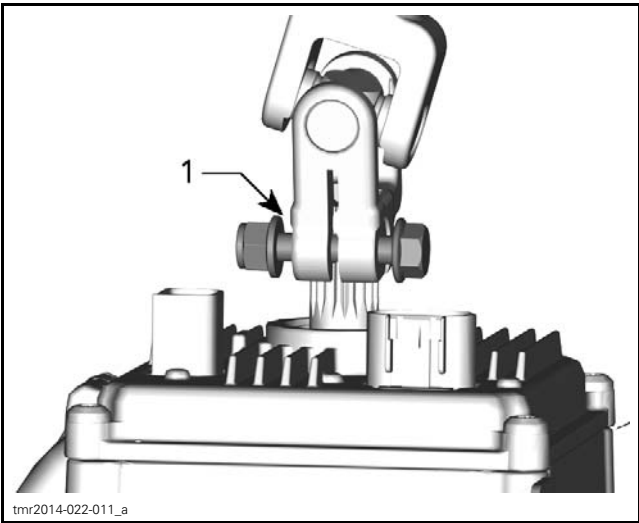
- 1. Safely lift and support the front of vehicle. Refer to *INTRODUCTION* subsection.
- 2. Remove both front wheels.
- 3. Detach tie-rod ends from knuckles. Refer to *TIE ROD END REPLACEMENT* in this subsection.
- 4. Remove the DPS coupler pinch bolts and nuts. Discard the nuts.



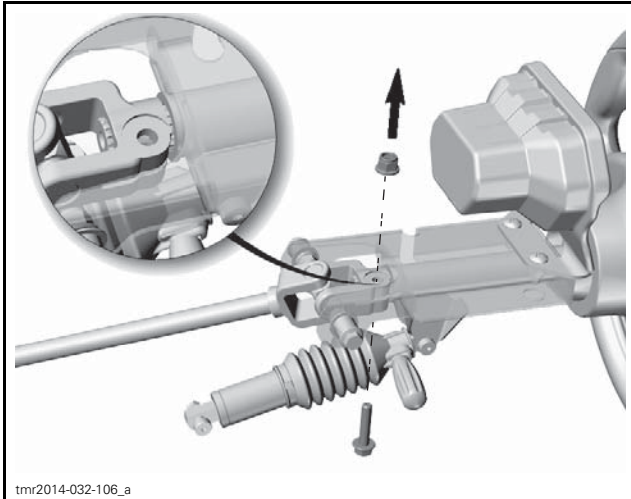
5. Loosen all DPS unit retaining bolts.



6. Loosen steering column pinch bolts (both upper and lower U-joints).

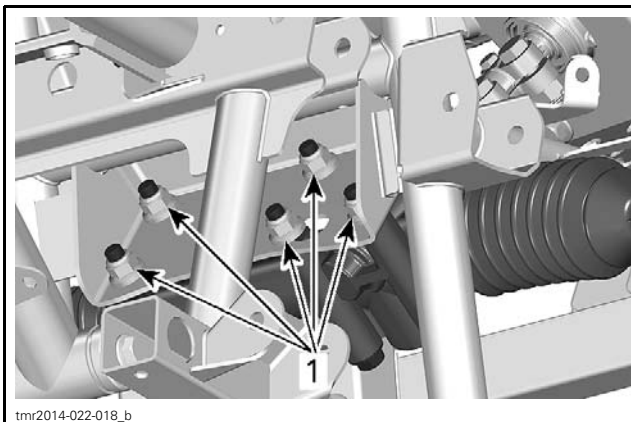


LOWER U-JOINT ON STEERING COLUMN
1. Pinch bolt



UPPER U-JOINT ON STEERING COLUMN

7. Remove the following 5 bolts and nuts securing rack and pinion to frame.



LH SIDE VIEW

1. Five nuts and bolts to remove

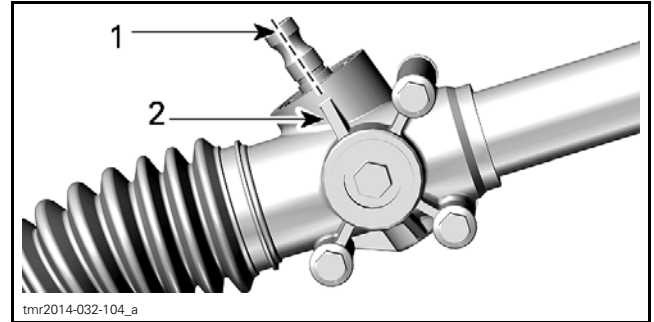
8. Pull down rack and pinion to detach it from the DPS unit.
9. From the LH side, remove rack and pinion from vehicle.

Rack and Pinion Installation

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

Find rack and pinion center as follows:

- Calculate the total pinion shaft rotations from side to side.
- Position the pinion shaft at **half** the total rotations.
- Using a paint marker, make an alignment mark on pinion and on the rack housing.



1. Mark center
2. Rack and pinion casing

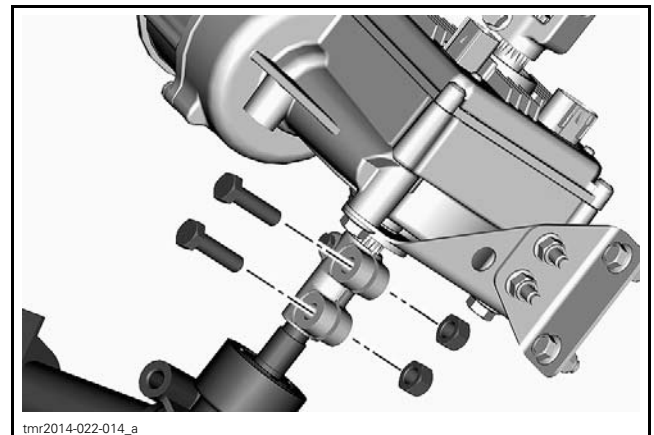
Ensure steering wheel is centered (horizontal).

Loosely install retaining bolts and nuts of rack and pinion.

Position rack and pinion in frame and engage pinion in DPS.. Make sure steering wheel remains centered.

Tighten rack and pinion retaining bolts and nuts.

Loosely install DPS coupler pinch bolts.



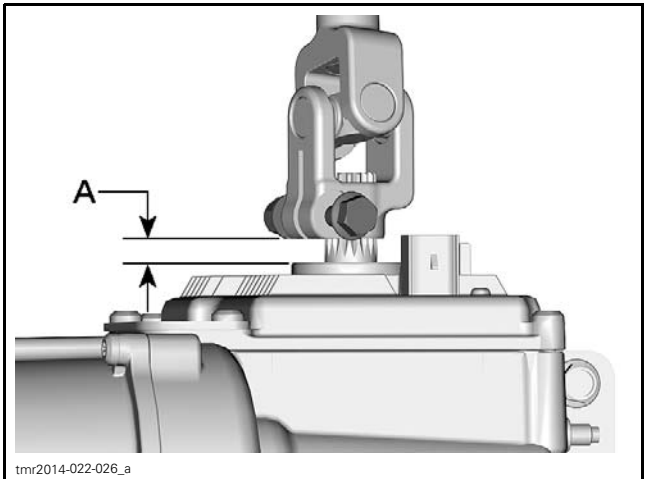
NOTICE The steering system tightening sequence must be strictly followed. Failure to do so may result in a steering component misalignment, poor DPS operation due to an induced erroneous torque on DPS shaft or the impossibility to perform a torque sensor reset.

Torque all steering system retaining nuts to specifications using the specified sequence. Refer to *STEERING SYSTEM TIGHTENING SEQUENCE* and *STEERING SYSTEM TORQUE SPECIFICATIONS* in this subsection.

NOTICE When tightening all screws on the DPS side brackets, be sure to hold the brackets snugly against the frame and DPS unit to remove any gap. The side brackets must NOT apply any force on the DPS unit in any direction. This would create an induced erroneous torque to the DPS shaft

Subsection 03 (STEERING SYSTEM (WITH DPS))

NOTE: IMPORTANT: Before tightening lower U-joint bolt on steering column, ensure the following measurements for the steering column engagement depth.



STEERING COLUMN ENGAGEMENT DEPTH

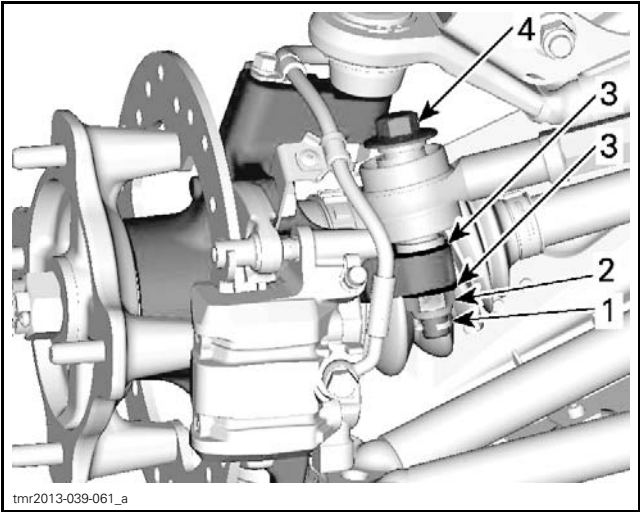
STEERING COLUMN ENGAGEMENT DEPTH (DISTANCE "A")	
Minimum distance	8.5 mm (.335 in)
Maximum distance	15 mm (.591 in)

Check steering alignment. Refer to *STEERING ALIGNMENT* in this subsection.

TIE-ROD ENDS

Tie-Rod End Replacement

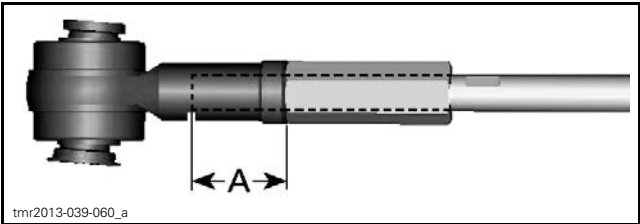
1. Safely lift and support the front of vehicle. Refer to *INTRODUCTION* subsection.
2. Remove front wheel.
3. Detach tie-rod end by removing:
 - Cotter pin
 - Tie-rod end retaining nut
 - Hardened washers
 - Tie-rod end bolt.



1. Cotter pin
2. Tie-rod end retaining nut
3. Hardened washers
4. Tie-rod end bolt

4. Discard cotter pin and nut.
5. Replace tie-rod end.
6. Adjust tie-rod end to the nominal engagement length.

TIE-ROD END NOMINAL ENGAGEMENT LENGTH
25 turns or 31 mm (1.22 in)



A. Nominal length

**WARNING**

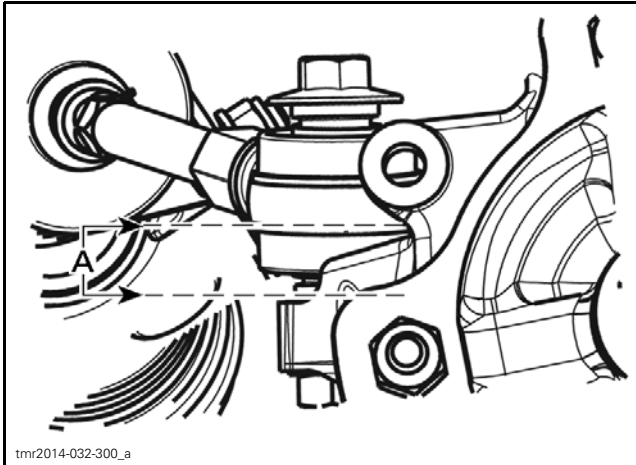
The minimum tie-rod end length engagement in the tie rod must be 25 mm (1 in).

7. Torque 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.

NOTE: When tightening, make sure tie-rod end casing is parallel with knuckle mounting face to avoid damaging the casing.



TIE ROD END ASSEMBLY

A. Parallel planes

9. Install a **NEW** tie-rod end **retaining** nut and torque to specification.

TIE-ROD END RETAINING NUT TORQUE
105 N•m ± 15 N•m (77 lbf•ft ± 11 lbf•ft)

10. Install a **NEW** cotter pin. Both ends of cotter pins must be folded.
11. Install front wheel.
12. Check the steering alignment, refer to *STEERING 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 caliper, refer to *BRAKES* subsection.



TYPICAL

5. Remove wheel hub, refer to *FRONT DRIVE* 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 PROCEDURES* 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.

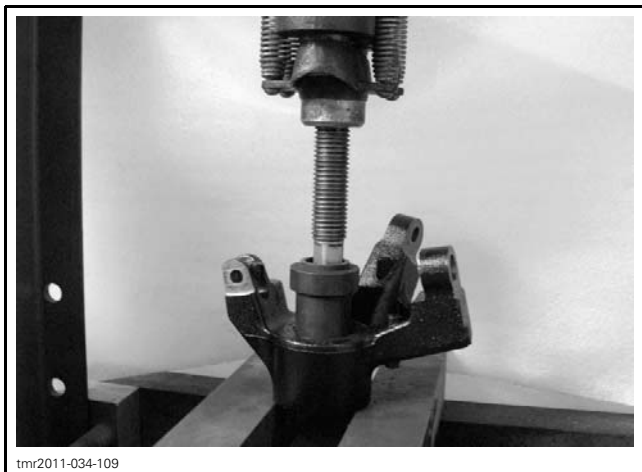


1. Seal
2. Circlip

4. Install knuckle on a press.

Subsection 03 (STEERING SYSTEM (WITH DPS))

5. Use an appropriate bearing remover.
6. Remove bearing from knuckle.



NOTE: It may be necessary to heat the knuckle to remove bearing.

WARNING

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.

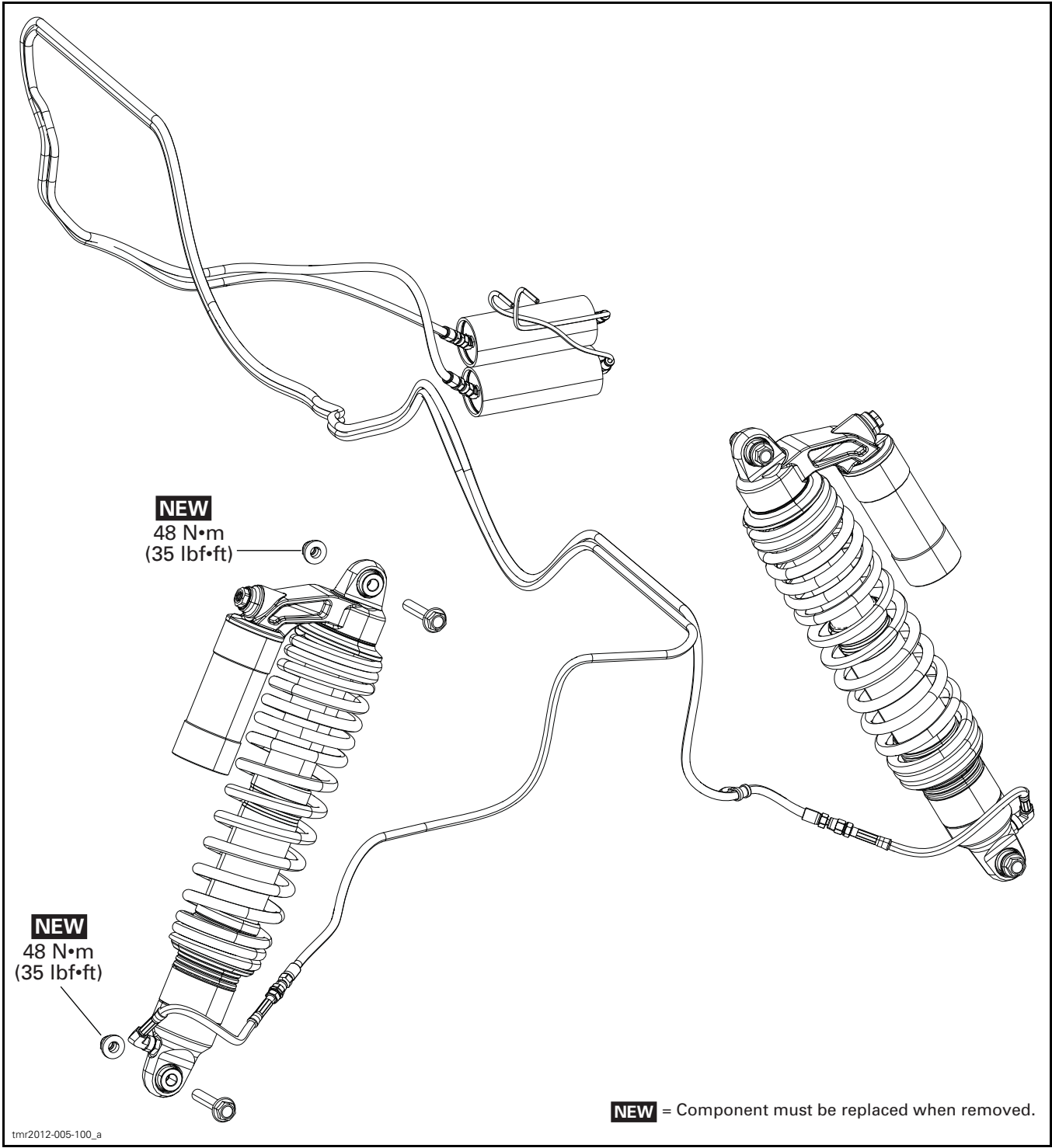
When knuckle is cooled down, install **NEW** circlip and **NEW** seal.

AIR CONTROLLED SUSPENSION (ACS)

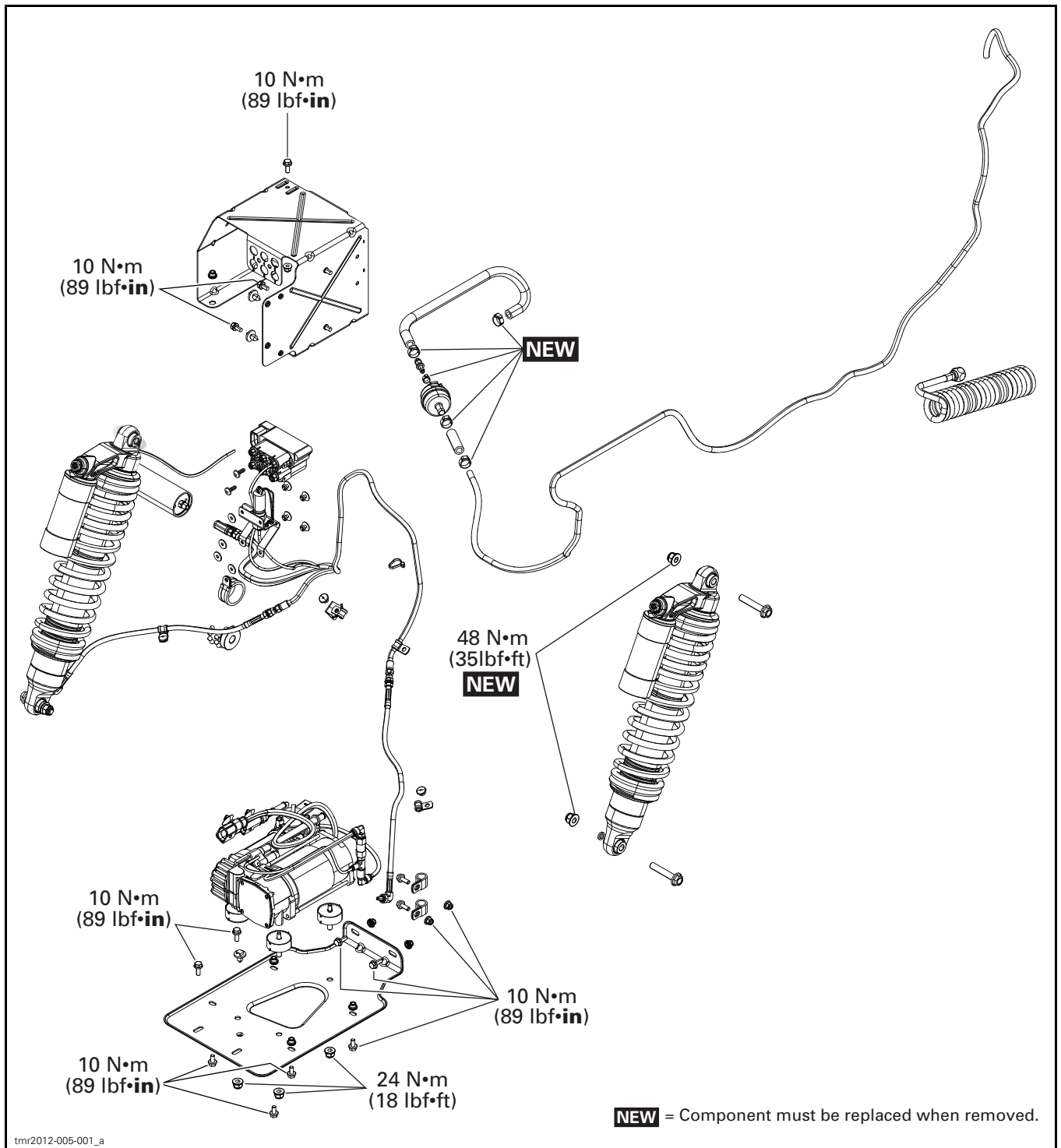
SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	400–404, 406–408

ACS FRONT SUSPENSION



ACS REAR SUSPENSION



Section 07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

GENERAL

Be careful while manipulating nylon hoses, they must not be kinked.

Vehicle must be running to adjust ACS suspension or perform certain tests.

⚠ CAUTION Always wear safety goggles when working with pressurized air system.

⚠ CAUTION The ACS suspension system may be under high pressure (over 900 kPa (130 PSI)). Release air pressure prior to working on the system. Refer to *AIR PRESSURE RELEASE FOR SERVICING*.

SYSTEM DESCRIPTION (OPERATION)

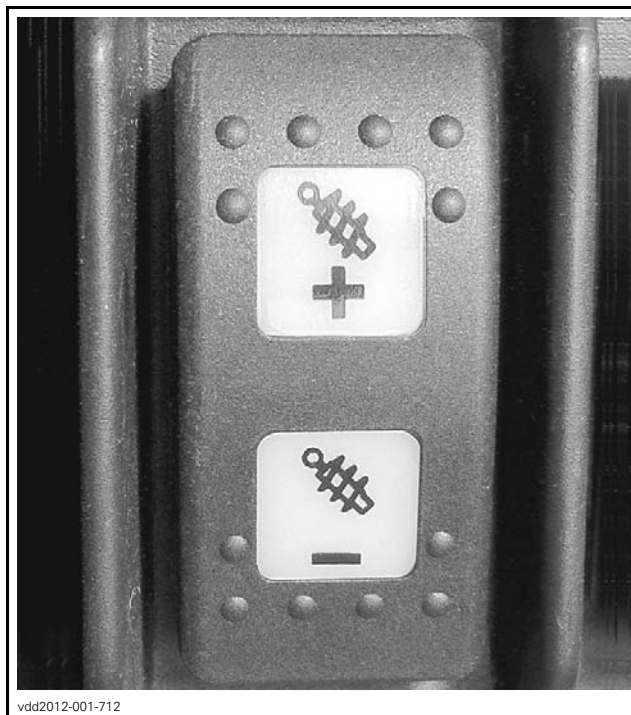
The Commander LTD comes equipped with front and rear air-controlled suspension and HPG shocks with remote reservoir (piggyback).

By changing the ACS setting, air pressure in the front and rear shocks absorbers will change to provide a multitude of different suspension adjustments.

The ACS adjusts the front and rear shocks to 6 rider selectable levels depending on trail conditions or riders preference.

The front shocks pressure is lower than the rear shocks. The pressure are determined by the setting position.

This system allows the operator to adjust the front and rear suspension by pressing the suspension button.



⚠ WARNING

Always adjust the ACS suspension setting according to load, riding condition, and speed.

NOTE: The ACS suspension will NOT self-adjust unless the engine is running, even when key switch is set to on.

The ACS has 2 modes for suspension adjustment:

- ACS auto mode
- ACS manual mode.

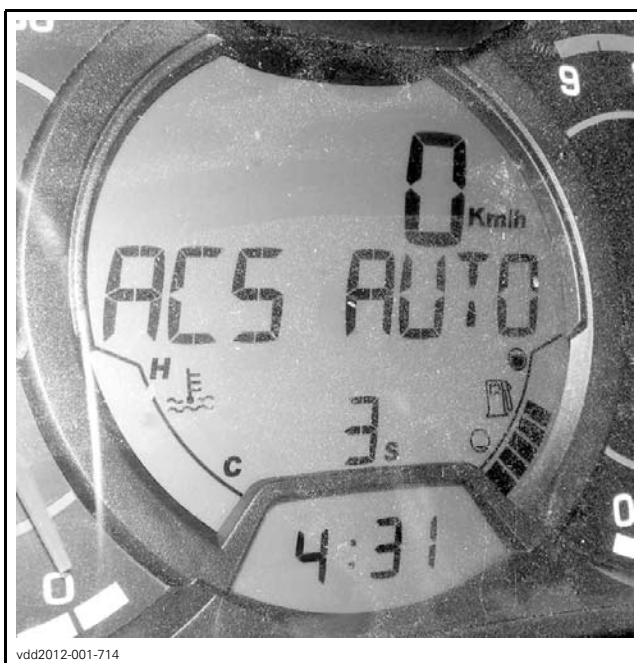
NOTE: The DPS is prioritized and as a result, when the DPS is heavily used, the ACS commands will be queued and executed when the DPS amp usage drops below a certain level.

ACS AUTO Mode

The automatic mode allows for simultaneous adjustments on the front and rear suspensions.

In auto mode, the suspension will automatically be adjusted to the preselected riding comfort position.

ACS SUSPENSION SETTINGS		
SETTING	RIDING COMFORT	RECOMMENDED LOAD
ACS 1	Softest	Operator only
ACS 2	Soft	
ACS 3	Semi-soft	Transporting a passenger OR a cargo
ACS 4	Semi-firm	
ACS 5	Firm with high ground clearance	Transporting a passenger AND a cargo
ACS 6	Firmest and highest ground clearance	



ACS AUTO MODE

Use ACS 1 to ACS 4 for trail riding.

Use the ACS 5 or ACS 6 settings to maximize ground clearance and increase performance while riding in the following environments:

- Muddy
- Watery
- Obstacles.

Use the ACS 6 setting is to maximize ground clearance and increase performance while carrying heavy loads:

⚠ WARNING

Always adjust the ACS suspension setting according to load, riding condition, and speed.

To Enter ACS Automatic Mode:

Press the MODE button until either ACS AUTO or ACS MAN is displayed.

Press SET button to have current ACS mode blink on screen.

Press SET button to select ACS AUTO mode.

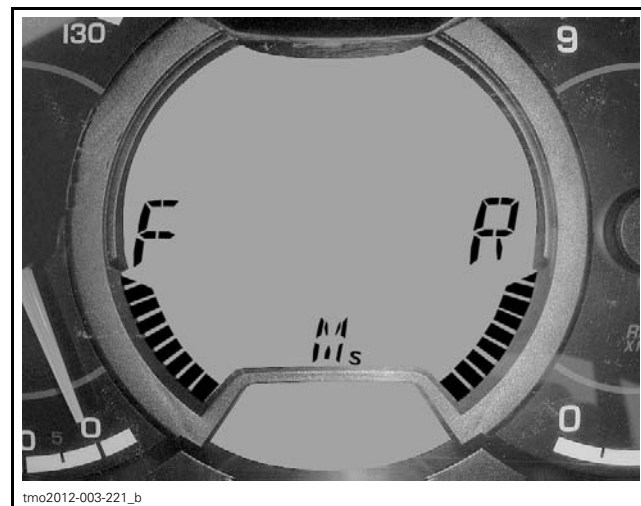
NOTE: Selected ACS Setting from ACS1 to ACS6 displayed through gearbox position indicator.



Press and hold SET button to confirm selection.

ACS MANUAL Mode

In manual mode the front and rear shock pressures can be adjusted independently. The fuel and temperature indicators will respectively become front and rear ACS pressure setting indicators.



ACS MANUAL MODE

To Enter ACS Manual Mode:

Press the MODE button until either ACS AUTO or ACS MAN is displayed.

Section 07 CHASSIS
Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

Press SET button to have current ACS mode blink on screen.

Press SET button to select ACS MAN mode.

NOTE: ACS set points and actual settings displayed through fuel, temp and gearbox position indicators.



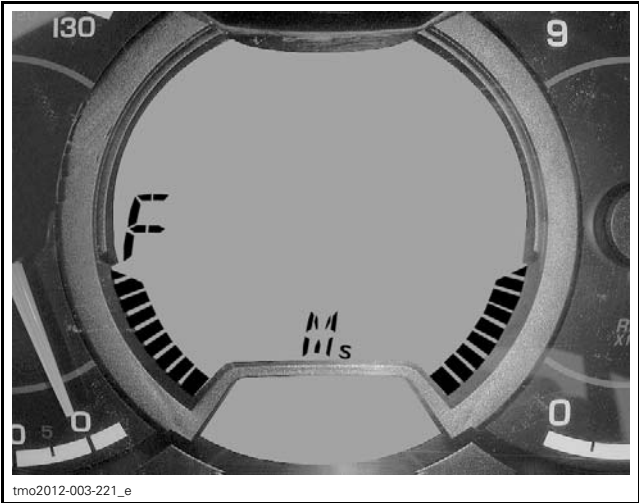
Press and hold SET button to confirm selection.

To Adjust Front Suspension:

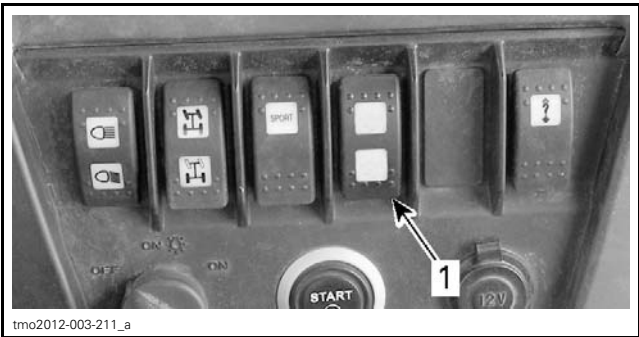
Press on the OVERRIDE button until front (F) is blinking to select front (F) suspension setting.



1. Override switch



Press and hold ACS button to lower or raise the front suspension until desired setting is achieved.



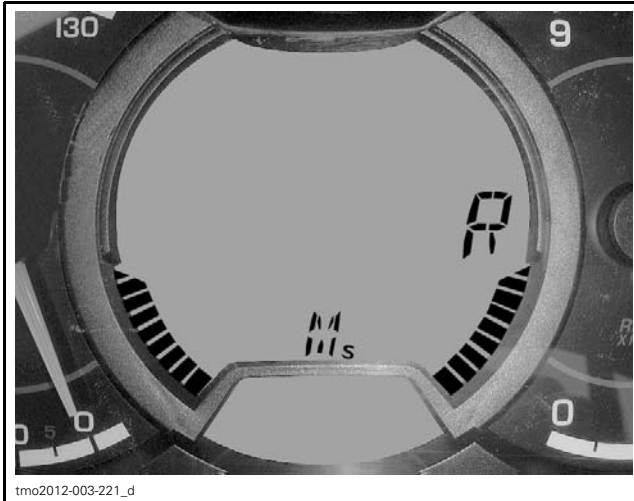
1. ACS button

To Adjust Rear Suspension:

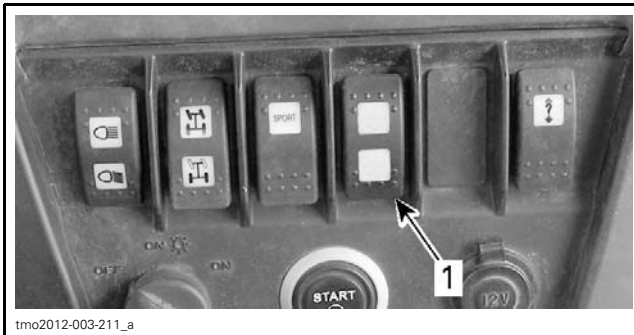
Press on the OVERRIDE button until rear (R) is blinking to select rear (R) suspension setting.



1. Override switch

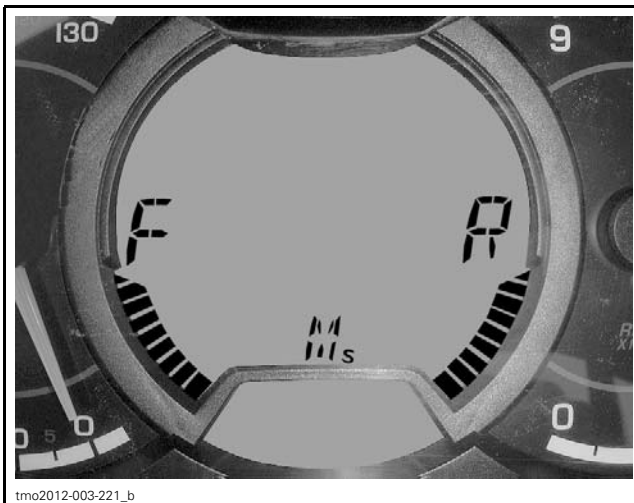


Use the ACS button to lower or raise the rear suspension.



1. ACS button

NOTE: Fuel and temperature indicators will respectively become front and rear ACS setting indicators.



Quick Mode Selection

The last setting utilized in each mode is stored in the system. This allows for quick selections between the stored automatic mode setting and the stored manual mode setting.

To Enter Quick Mode Selection:

Press the MODE button until either ACS AUTO or ACS MAN is displayed.

Press SET button to have current ACS mode blink on screen.

Press SET button to select desired mode.



Press and hold SET button to confirm selection. ACS system will adjust to the last settings.

SYSTEM DESCRIPTION (FEATURES)

Tire Inflation Using the ACS Compressor

The ACS compressor also comes with an auxiliary hose that can be used to inflate tires out on the trail.

The air outlet fitting is located behind the driver's seat.

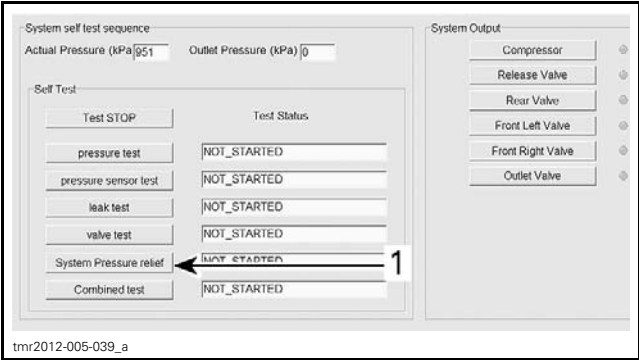


Air Pressure Release for Servicing

It is recommended to release air pressure in the system before servicing any components.

1. Connect vehicle to the latest appropriate version of B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
2. Select **Activation** page.
3. Select **ACS** folder.
4. Press the **System Pressure relief** button to proceed.

CAUTION Vehicle height will change during test. Keep away from wheelwell and suspension.



1. System Pressure relief button

NOTE: After activating the **System Pressure relief** button the system is not completely empty. The compressor setting does not allow to drop pressure under 207 kPa (30 PSI).

SYSTEM DESCRIPTION (COMPONENTS)

Fuse and Relay

ACS Fuse

The ACS system is protected by the fuse F3 (50 A) located in the fuse block no. 2. This fuse powers the ACS compressor through the ACS relay (R5).

NOTE: The ACS and DPS systems share the same fuse.

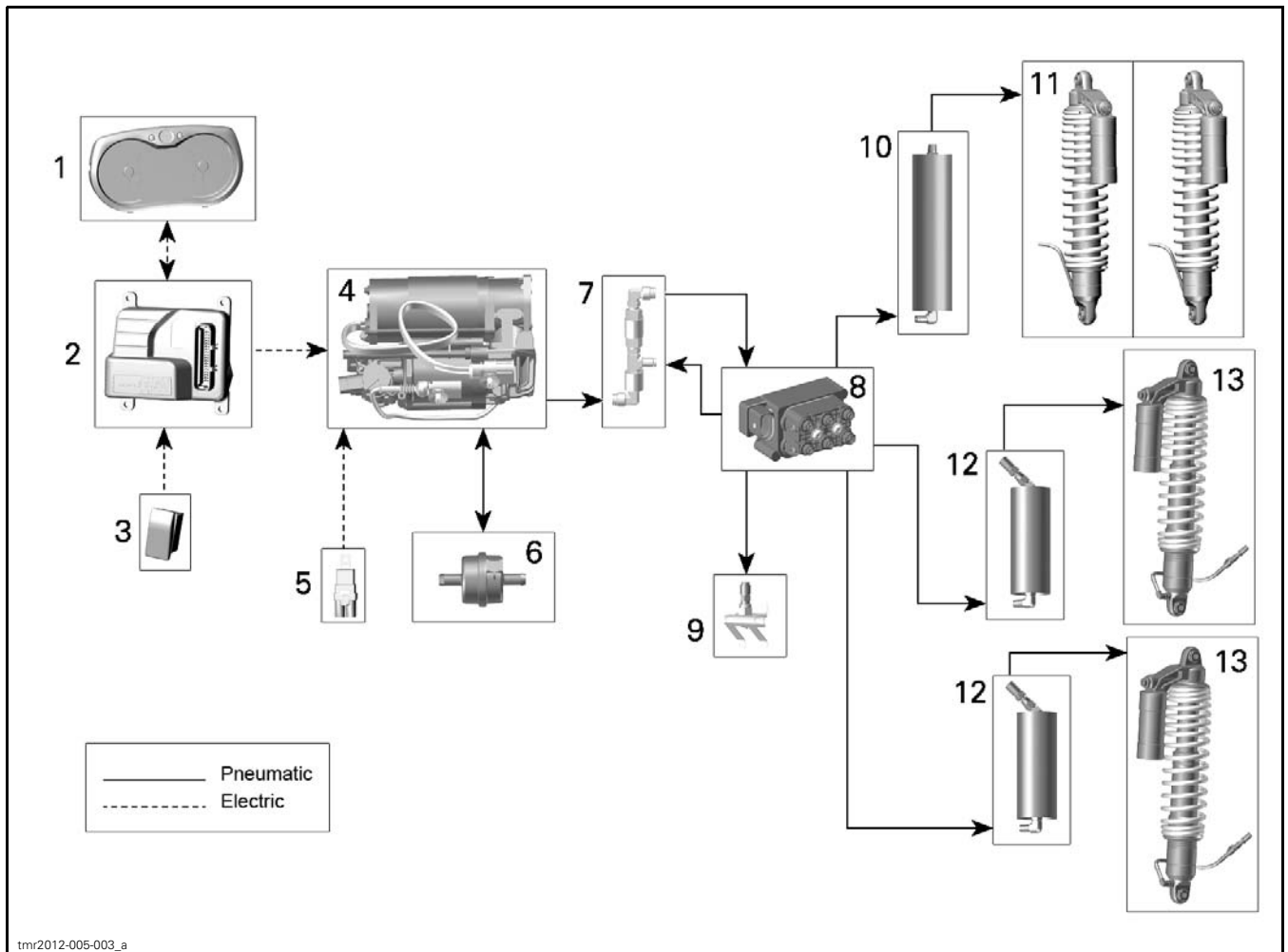
F12 powers the valve and the ACS relay.

F4 powers the electronic components.

ACS Compressor Relay (R5)

ACS compressor relay (R5) is located near ACS compressor, under driver's seat.

ACS Main Components



tmr2012-005-003_a

Pneumatic
 Electric

1. Multifunction gauge
2. Suspension control module (SCM)
3. ACS button
4. ACS compressor (including temperature sensor)
5. ACS relay (R5)
6. Air filter
7. Pressure distributor
8. ACS solenoid valve (including pressure sensor)
9. Outlet fitting
10. Rear air reservoir
11. Rear shock absorbers
12. Front air reservoirs
13. Front shock absorbers

Section 07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

TROUBLESHOOTING

DIAGNOSTIC TIPS

Error Message Displayed in Multifunction Gauge

Two error messages can appear in the multifunction gauge and they are not necessarily related to a failure of the ACS system.

AIR FAULT

If this message appears, it indicates a disparity between the requested and the actual suspension settings. The system should react to correct this situation and the message will disappear.

If the message remains active for a long period, it may indicate one of the fuses (F3, F4 or F12) is burned or a major leak in the system. In this case, the suspension control module (SCM) will automatically shut down the compressor to prevent it from overheating. The shut down procedure of the compressor will stay active until the next restart of the vehicle (key OFF, key ON).

If there is a major leak in the system, check the system for leakage, refer to *ACS SYSTEM LEAK TEST*.

If there is no leak, the problem can be electrical or mechanical. In this case, an electrical failure of the compressor or the solenoid valve will result in the impossibility to change the actual suspension setting; a mechanical failure of the solenoid valve will create the same situation.

After multiple attempts to change suspension setting, the suspension control module (SCM) will activate error message **AIR FAULT**. Refer to *TROUBLESHOOTING GUIDELINES* for further troubleshooting procedure.

COMPRESSOR TEMPERATURE OVERHEAT

This message appears when the compressor temperature is over the calibrated value.

This situation can occur if the compressor or the solenoid valves are used during a long period of time (continually or with brief halts).

Let the compressor cool down before using it again.

TROUBLESHOOTING GUIDELINES

In AUTO Mode

GAUGE DISPLAY SETTING (S1 TO S6) CHANGED BUT SUSPENSION DOES NOT WORKED

1. Burn fuse F3 (50 A).
 - *Replace.*
2. Faulty compressor.
 - *Carry out a compressor operation test. Refer to ACS COMPRESSOR OPERATION TEST.*
3. Faulty solenoid valve.
 - *Carry out a solenoid valve operation test. Refer to ACS SOLENOID VALVE OPERATION TEST.*
4. Faulty suspension control module (SCM).
 - *Check the SCM. Refer to SUSPENSION CONTROL MODULE (SCM).*

GAUGE DISPLAY SETTING (S1 TO S6) DOES NOT CHANGED BUT SUSPENSION WORKED

1. Burned fuse.
 - *Replace.*
2. Faulty suspension control module (SCM).
 - *Check the SCM. Refer to SUSPENSION CONTROL MODULE (SCM).*
3. Faulty multifunction gauge.
 - *Check the multifunction gauge.*

GAUGE DISPLAY DOES NOT CHANGE AND SUSPENSION DOES NOT WORKED

1. Make sure engine is running.
 - *Start engine.*
2. Burn fuse F3 (50 A).
 - *Replace.*
3. Faulty suspension control module (SCM).
 - *Check the SCM. Refer to SUSPENSION CONTROL MODULE (SCM).*
4. Faulty ACS button or wiring.
 - *Check ACS button continuity.*
 - *Check ACS button control circuit.*

In Manual Mode

GAUGE DISPLAY SETTING (F OR R) DOES NOT CHANGED

1. Faulty Override button.
 - *Check the Override button.*

2. Faulty multifunction gauge.
 - Check the multifunction gauge.

AUTO and MANUAL Mode

SUSPENSION PRESSURE CAN BE INCREASED ONLY

1. Faulty solenoid valve.
 - Carry out a release valve operation test. Refer to ACS RELEASE VALVE OPERATION TEST.
2. Faulty ACS release valve.
 - Carry out a solenoid valve operation test. Refer to ACS SOLENOID VALVE OPERATION TEST.
3. Faulty ACS button or wiring.
 - Check ACS button continuity. Refer to ACS BUTTON.
 - Check ACS button control circuit. Refer to ACS BUTTON.
4. Faulty suspension control module (SCM).
 - Check the SCM. Refer to SUSPENSION CONTROL MODULE (SCM).

SUSPENSION PRESSURE CAN BE DECREASED ONLY

1. Faulty relay (R5).
 - Check the ACS relay. Refer to ACS RELAY.
2. Faulty compressor.
 - Carry out a compressor operation test. Refer to ACS COMPRESSOR OPERATION TEST.
3. Faulty solenoid valve.
 - Carry out a solenoid valve operation test. Refer to ACS SOLENOID VALVE OPERATION TEST.
4. Faulty ACS button or wiring.
 - Check ACS button continuity. Refer to ACS BUTTON.
 - Check ACS button control circuit. Refer to ACS BUTTON.
5. Faulty suspension control module (SCM).
 - Check the SCM. Refer to SUSPENSION CONTROL MODULE (SCM).

SUSPENSION PRESSURE CANNOT BE CHANGED

1. Make sure engine is running.
 - Start engine.
2. Burn fuse F3 (50 A).
 - Replace.

3. Battery voltage too low.
 - Check battery voltage with engine running. It must be over 13 V.
4. Faulty charging system.
 - Check the charging system. Refer to CHARGING SYSTEM subsection.
5. Faulty relay (R5).
 - Check the ACS relay. Refer to ACS RELAY.
6. Faulty compressor.
 - Carry out a compressor operation test. Refer to ACS COMPRESSOR OPERATION TEST.
7. Faulty solenoid valve.
 - Carry out a solenoid valve operation test. Refer to ACS SOLENOID VALVE OPERATION TEST.
8. Faulty ACS button or wiring.
 - Check ACS button continuity. Refer to ACS BUTTON.
 - Check ACS button control circuit. Refer to ACS BUTTON.
9. Faulty suspension control module (SCM).
 - Check the SCM. Refer to SUSPENSION CONTROL MODULE (SCM).

AIR OUTLET FITTING DOES NOT WORKS

1. Make sure engine is running.
 - Start engine.
2. Faulty solenoid valve.
 - Carry out a solenoid valve operation test. Refer to ACS SOLENOID VALVE OPERATION TEST.

TROUBLESHOOTING WITH B.U.D.S.

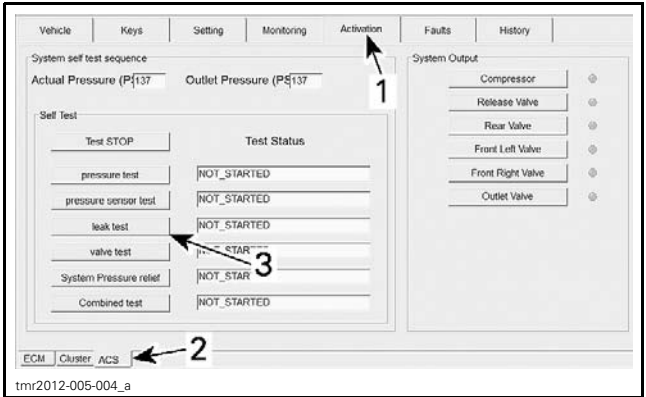
Check battery voltage before performing any B.U.D.S. test. Battery must be fully charged or use a power pack to ensure adequate power for all required tests.

ACS System Leak Test

1. Connect vehicle to the latest appropriate version of B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
2. Select **Activation** page.
3. Select **ACS** folder.
4. In **Self Test** region, press the **leak test** button to proceed.

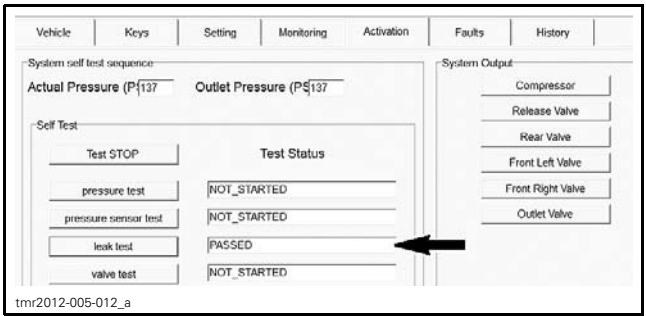
Section 07 CHASSIS
Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

CAUTION Vehicle height will change during test. Keep away from wheelwell and suspension.



- 1. Activation page
- 2. ACS folder
- 3. Leak test button

The result will be indicated in the TEST STATUS box beside the leak test button.

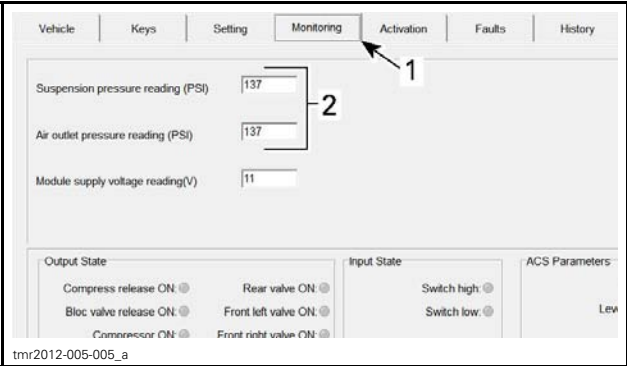


If a leak is detected, pressurize the system again and inspect hoses and fittings with soapy water to locate the faulty component.

ACS Air Pressure Monitoring

To monitor air pressure in the system during troubleshooting operation, proceed as follows:

- 1. Connect vehicle to the latest appropriate version of B.U.D.S. Refer to COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE subsection.
- 2. Select Monitoring page.
- 3. Select ACS folder.



- 1. Monitoring page
- 2. Suspension pressure

PROCEDURES

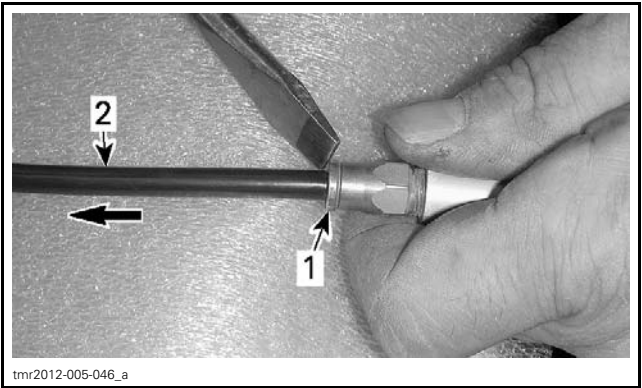
PNEUMATIC HOSE

NOTICE Do not attempt to disconnect pneumatic hoses from ACS manifold or ACS exhaust compressor valve.

Pneumatic Hose Removal

Release air pressure from the ACS system. Refer to AIR PRESSURE RELEASE FOR SERVICING in this subsection.

Pneumatic hoses may be disconnected by pushing inwards on the air fitting ring (towards the air fitting) while pulling outwards on the hose.



- 1. Fitting ring
- 2. Pneumatic hose

NOTE: Pull the hose slightly and wait during the release of the remaining air. When all air is released, remove pneumatic hose from its fitting.

Pneumatic hose Installation

Before installing the hose, verify the end of the pneumatic hose.

If deep nicks are found, cut a small portion of the hose end.

HOSE END LENGTH TO BE CUT

3.18 mm to 6.35 mm (1/8 in to 1/4 in)

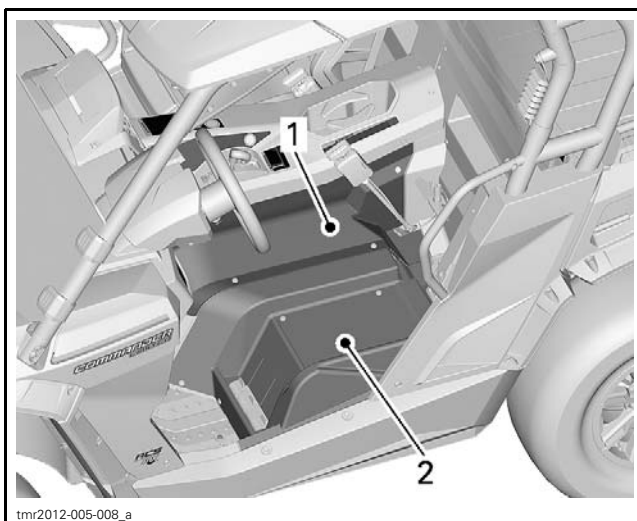
Push the hose inwards then pull the air fitting ring outwards to reestablish a good seal and lock the hose in place.

ACS RELEASE VALVE

ACS Release Valve Access

To access to ACS release valve, remove the following:

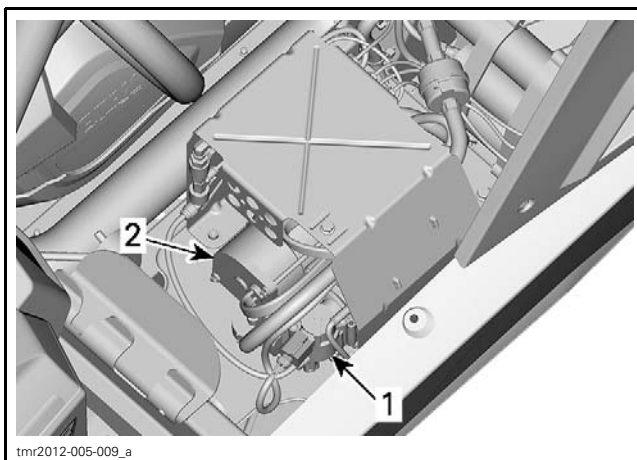
- Driver's seat
- LH lateral console panel
- Floor panel.



SIDE NET REMOVED FOR CLARITY

1. LH lateral console panel
2. Floor panel

The ACS release valve is a component of the ACS compressor. The release valve is located at the left of compressor.

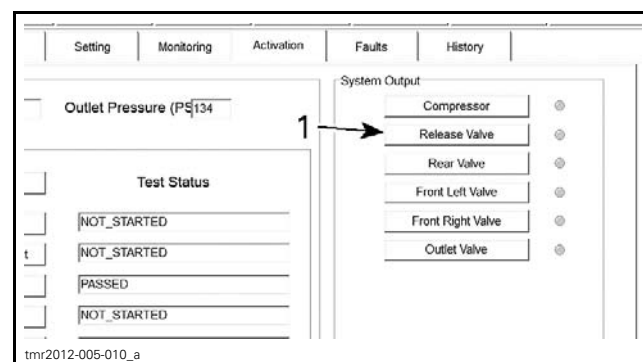


1. ACS release valve
2. ACS compressor

ACS Release Valve Operation Test

1. Connect vehicle to the latest appropriate version of B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
2. Select **Activation** page.
3. Select **ACS** folder.
4. Press the **Release Valve** button to proceed.

CAUTION Vehicle height will change during test. Keep away from wheelwell and suspension.

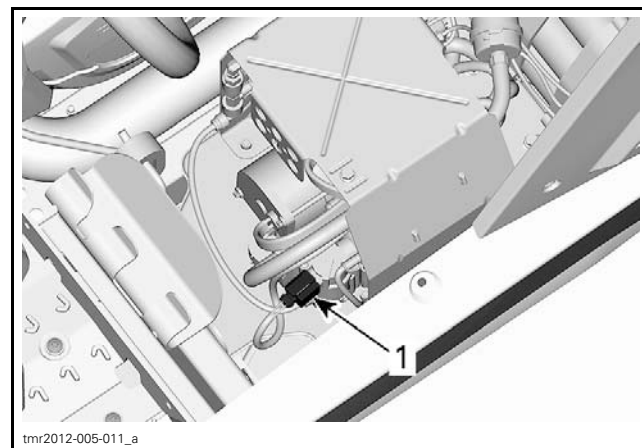


1. Release valve button

5. Listen for air exits from underneath dash and around valve to confirm proper operation.

ACS Release Valve Input Voltage Test

1. Unplug the ACS release valve connector.



1. ACS release valve connector

2. Start engine.
3. Measure voltage as per the following table.

Section07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		VOLTAGE
Pin 1 (release valve connector)	Battery negative (-) post	Battery voltage

ACS Release Valve Ground Test

1. With ACS release valve connector unplugged and engine running, measure voltage as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		VOLTAGE
Pin 2 (release valve connector)	Battery negative (+) post	Battery voltage

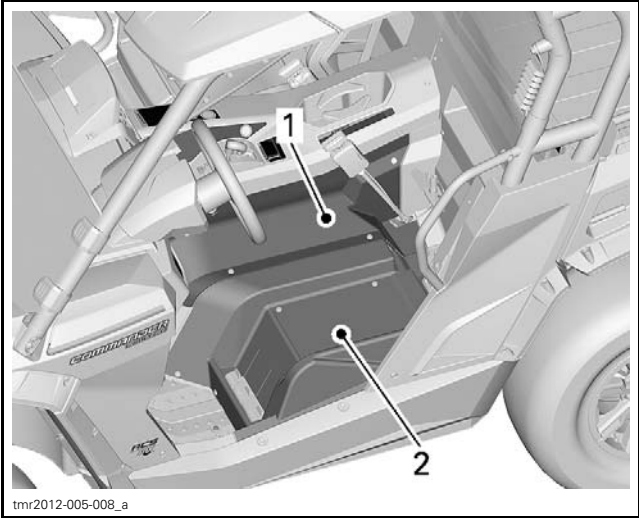
ACS Release Valve Replacement

The ACS release valve is not available separately. Replace the ACS compressor. Refer to *ACS COMPRESSOR* for complete procedure.

ACS SOLENOID VALVE

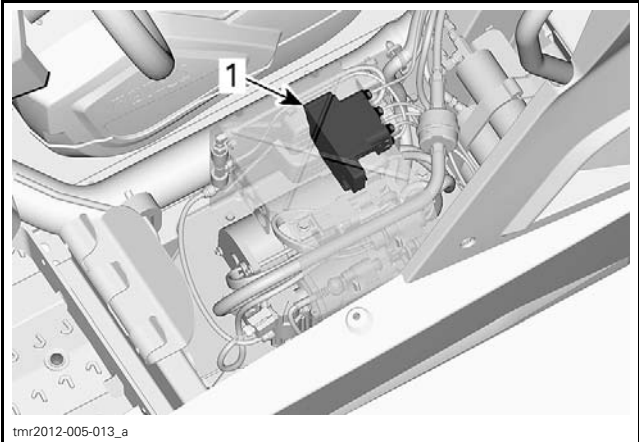
ACS Solenoid Valve Access

- To access to ACS solenoid valve, remove the following:
- Driver's seat
 - LH lateral console panel
 - Floor panel.



SIDE NET REMOVED FOR CLARITY
1. LH lateral console panel
2. Floor panel

The ACS solenoid valve is mounted on the rear side of the ACS compressor protector.

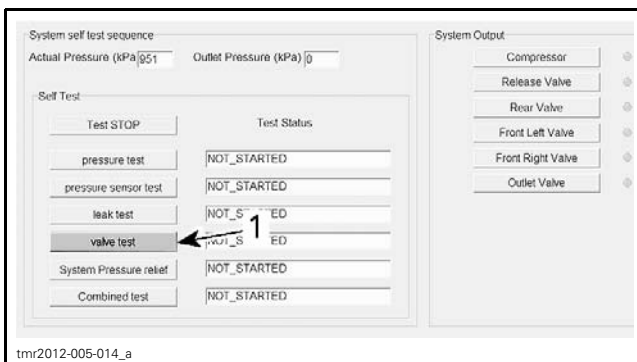


1. ACS solenoid valve

ACS Solenoid Valve Operation Test

1. Connect vehicle to the latest appropriate version of B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
2. Select **Activation** page.
3. Select **ACS** folder.
4. Press the **valve test** button to proceed.

CAUTION Vehicle height will change during test. Keep away from wheelwell and suspension.



1. Valve test button

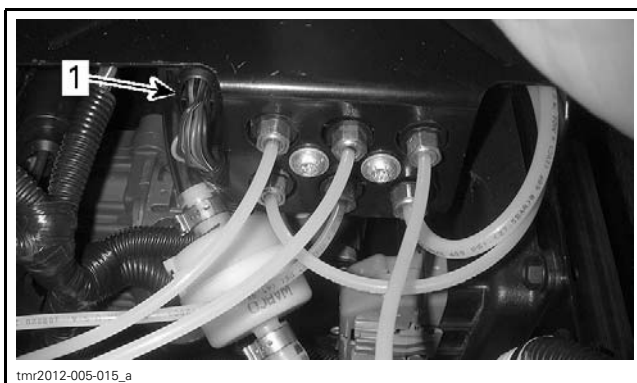
The result will be indicated in the TEST STATUS box beside the **valve test** button.

If test fails, carry out the *ACS SOLENOID VALVE INPUT VOLTAGE TEST*.

If the ACS solenoid valve passed the test, check the ACS button.

ACS Solenoid Valve Input Voltage Test

1. Unplug the ACS solenoid valve connector.



1. ACS solenoid valve connector

2. Start engine.
3. Measure voltage as per the following table.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

TEST PROBES		VOLTAGE
Pin 5 (solenoid valve connector)	Battery negative (-) post	Battery voltage
Pin 6 (solenoid valve connector)		

If the test fails, carry out an *ACS SOLENOID VALVE POWER WIRE CONTINUITY TEST*.

If result is within specification, continue the test with the *ACS SOLENOID VALVE GROUND TEST*.

ACS Solenoid Valve Ground Test

With ACS solenoid valve connector unplugged and engine running, measure voltage as per the following table.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

TEST PROBES		VOLTAGE
Pin 7 (solenoid valve connector)	Battery negative (+) post	Battery voltage

If the test fails, carry out an *ACS SOLENOID VALVE GROUND WIRE CONTINUITY TEST*.

If result is within specification, check the ACS button.

ACS Solenoid Valve Power Wire Continuity Test

1. Unplug the relay R5.
2. Check the continuity between ACS solenoid valve connector and relay R5 holder as per the following table.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

TEST PROBES		RESISTANCE
Pin 5 (solenoid valve connector)	Position 85	Close to 0 Ω
Pin 6 (solenoid valve connector)		

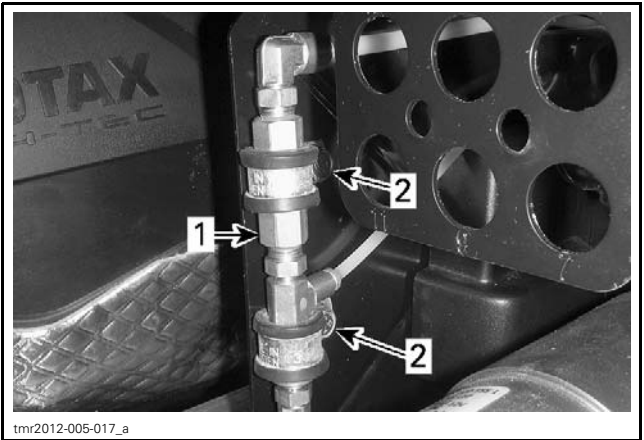
ACS Solenoid Valve Ground Wire Continuity Test

1. Unplug the suspension control module (SCM) connector.
2. Check the continuity between ACS solenoid valve connector and SCM connector as per the following table.

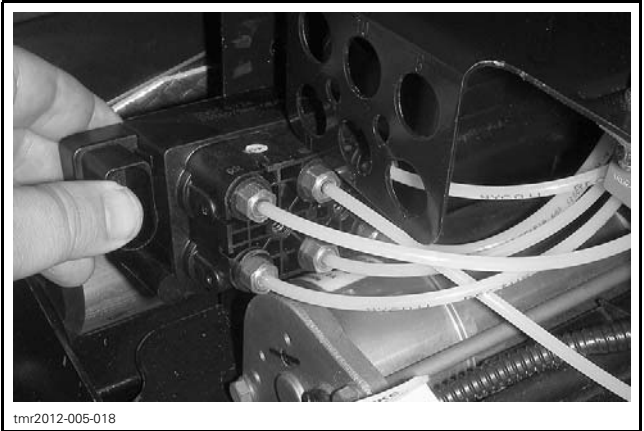
REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		RESISTANCE
Pin 7 (solenoid valve connector)	Pin 14 (SCM)	Close to 0 Ω

ACS Solenoid Valve Removal

1. Remove bolts retaining the air pressure distributor.



1. Air pressure distributor
2. Retaining bolts
2. Disconnect pneumatic hoses from:
- Air outlet fitting
 - Air reservoirs
 - Pressure distributor (except the lower one).
3. Unplug ACS solenoid valve connector.
4. Remove screws securing the ACS solenoid valve to compressor protector.
5. Remove the ACS solenoid valve from the vehicle.



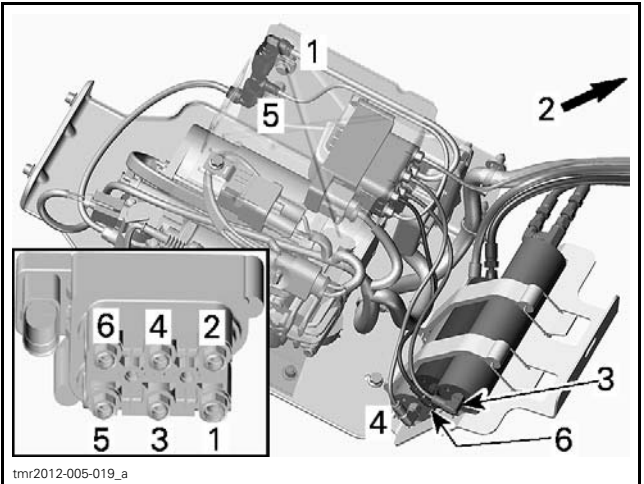
ACS Solenoid Valve Installation

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

Position the ACS solenoid valve on the compressor and route all pneumatic hoses through corresponding support holes.

Secure the ACS solenoid valve to its support.

Connect pneumatic hoses as per the following illustration.



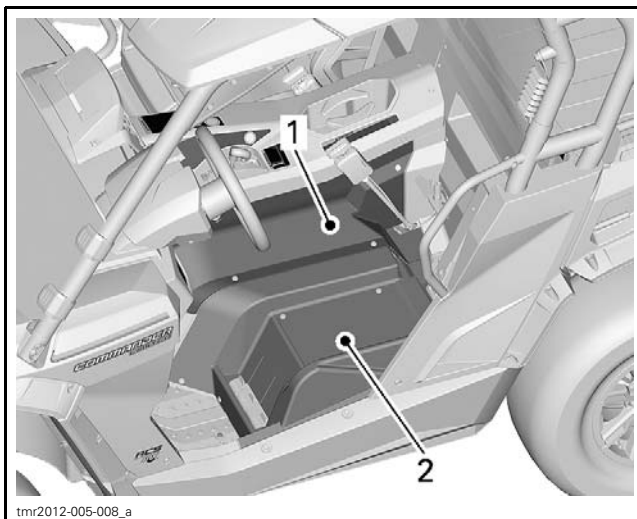
1. Air pressure distributor
2. Air outlet fitting
3. Rear air reservoir
4. Front RH air reservoir
5. Air pressure distributor
6. Front LH air reservoir

SUSPENSION CONTROL
MODULE (SCM)

SCM Access

To access the SCM, remove the following:

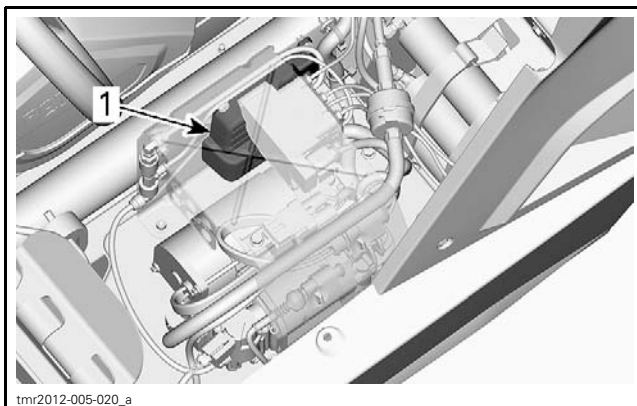
- Driver's seat
- LH lateral console panel
- Floor panel.



SIDE NET REMOVED FOR CLARITY

1. LH lateral console panel
2. Floor panel

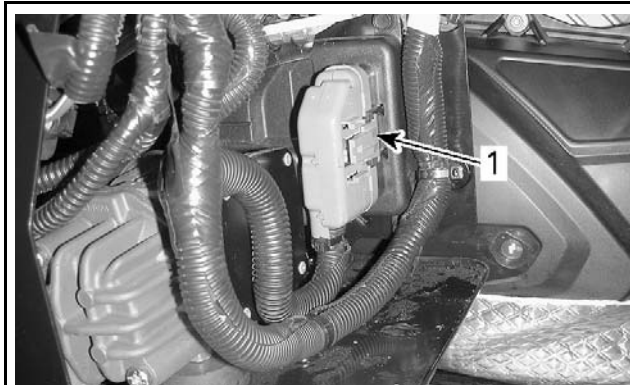
The suspension control module (SCM) is mounted on the wall of the ACS compressor protector.



1. SCM

SCM Signal Circuit Continuity Test

1. Unplug multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES* sub-section.
2. Unplug SCM connector.



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1. SCM connector

3. Measure resistance as per the following tables.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

SCM CONNECTOR	GAUGE CONNECTOR	RESISTANCE
Pin 1	Pin 19	Close to 0 Ω
Pin 2	Pin 18	

If the test fails, repair or replace wires and connectors.

If result is within specification, continue the test with the *SCM INPUT VOLTAGE TEST*.

SCM Input Voltage Test

1. Turn ignition switch to ON position.
2. Measure voltage as per the following table.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

TEST PROBES	VOLTAGE	
Pin 17 (SCM connector)	Battery negative (-) post	Battery voltage
Pin 18 (SCM connector)		
Pin 35 (SCM connector)		
Pin 36 (SCM connector)		

Section07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

If the test fails, repair or replace wires and connectors.

If result is within specification, continue the test with the *SCM GROUND TEST*.

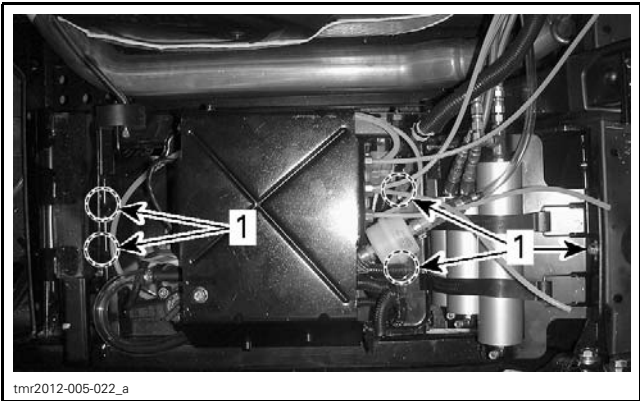
SCM Ground Test

- 1. Turn ignition switch to ON position.
- 2. Measure voltage as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		VOLTAGE
Pin 31 (SCM connector)	Battery positive (+) post	Battery voltage
Pin 32 (SCM connector)		
Pin 33 (SCM connector)		

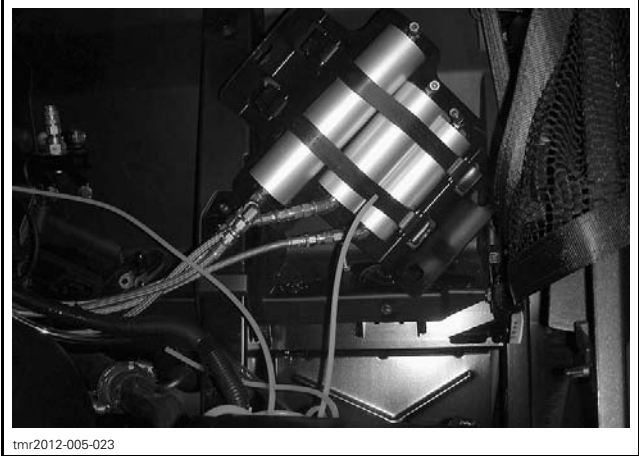
SCM Removal

- 1. Remove screws retaining the air reservoir support and the compressor support.



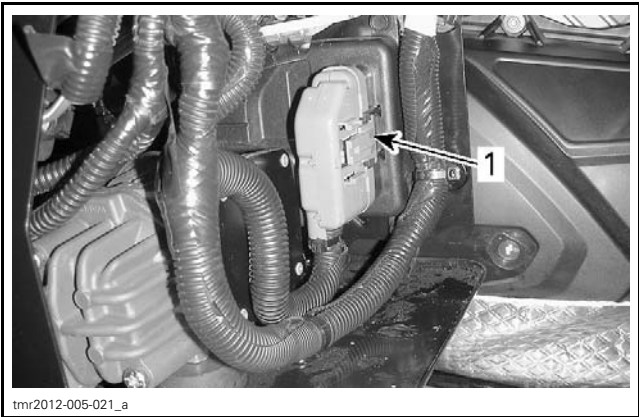
1. Screws to be removed

- 2. Disconnect pneumatic hoses from air reservoirs and air outlet fitting.
- 3. Place the air reservoir support aside to make room.



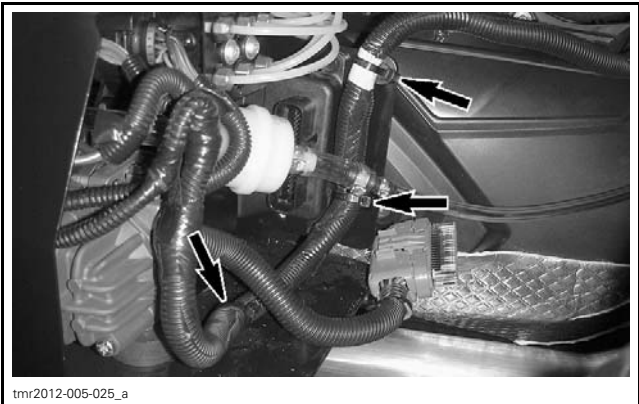
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- 4. Unplug the SCM connector.



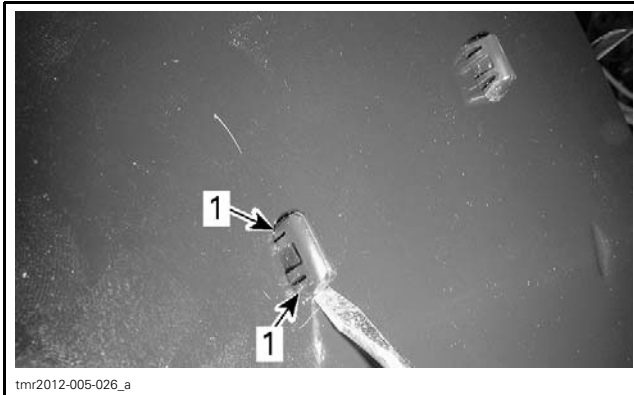
1. SCM connector

- 5. Cut locking ties securing the wiring harness.



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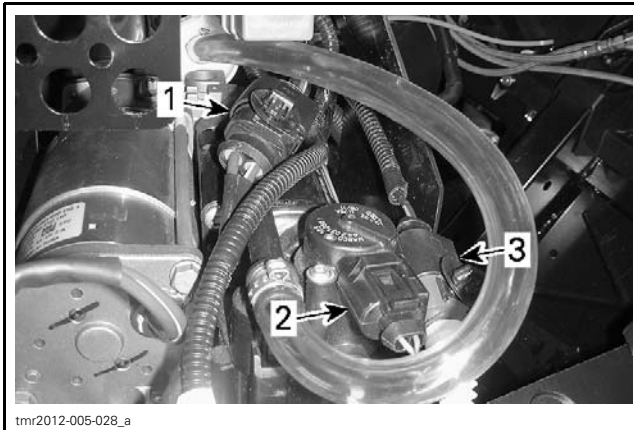
- 6. Using a small screwdriver, detach both connector housings from the compressor protector wall.



1. Press these tabs inside

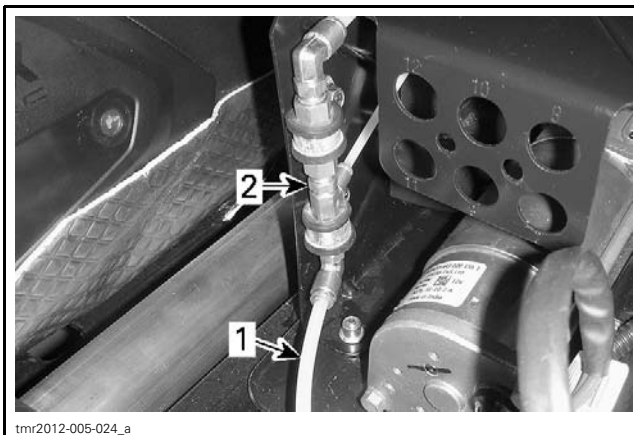
7. Unplug the following connectors:

- Compressor connector
- Release valve connector
- Pressure sensor connector.



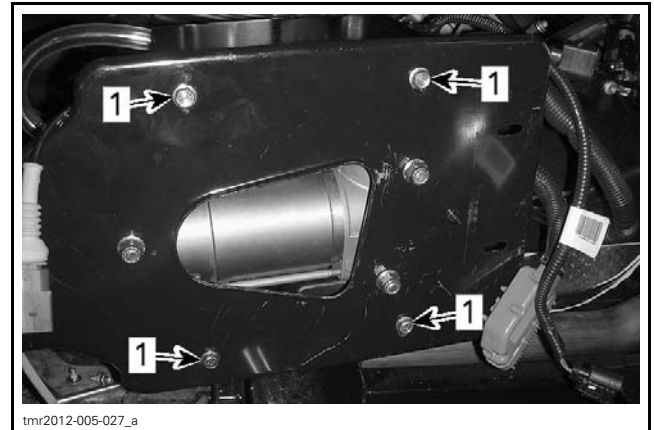
1. Compressor connector
2. Release valve connector
3. Pressure sensor connector.

8. Disconnect the lower pneumatic hose from the pressure distributor.



1. Disconnect this hose
2. Pressure distributor

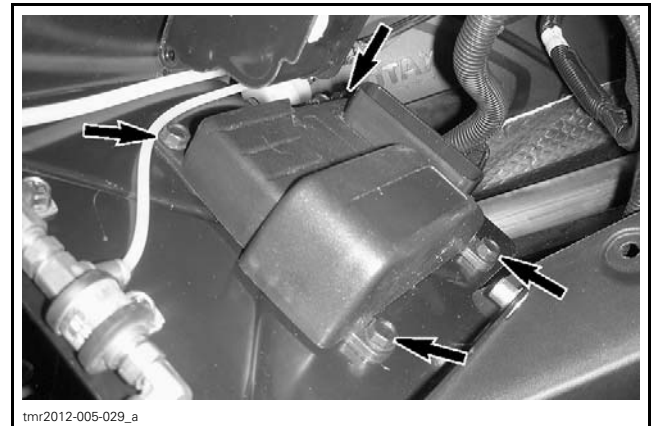
9. Turn the compressor support on the side to remove screws retaining the compressor protector.



1. Compressor protector retaining screws

10. Separate compressor protector from the compressor support.

11. Remove screws securing the SCM on the wall of the compressor protector.



SCM Installation

The installation procedure is the reverse of removal procedure.

ACS RELAY (R5)

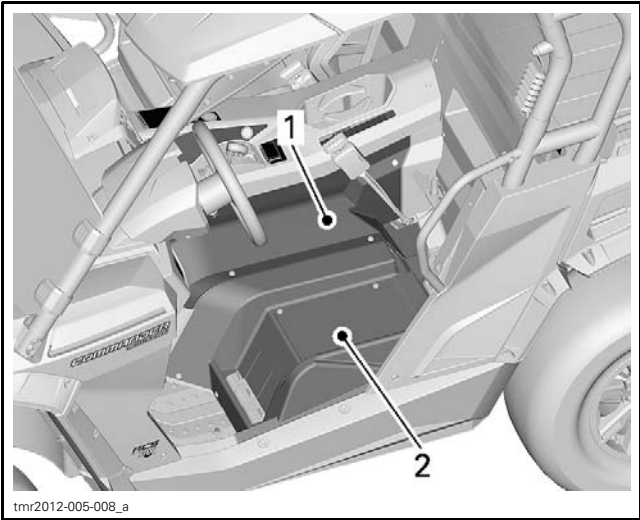
ACS Relay (R5) Access

To access to ACS relay, remove the following:

- Driver's seat
- LH lateral console panel
- Floor panel.

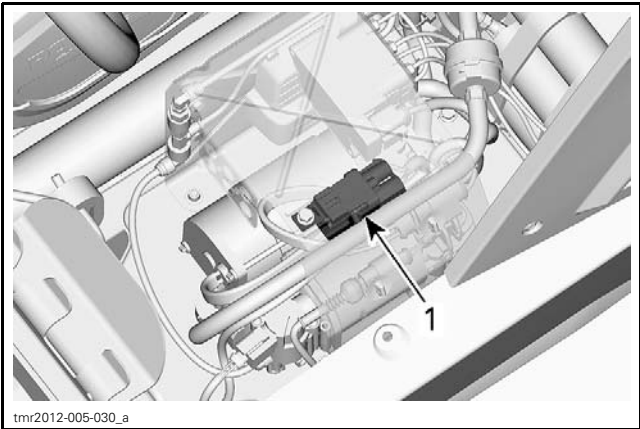
Section07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))



SIDE NET REMOVED FOR CLARITY
1. LH lateral console panel
2. Floor panel

The ACS relay is mounted under the top of the ACS compressor protector.



1. ACS relay (R5)

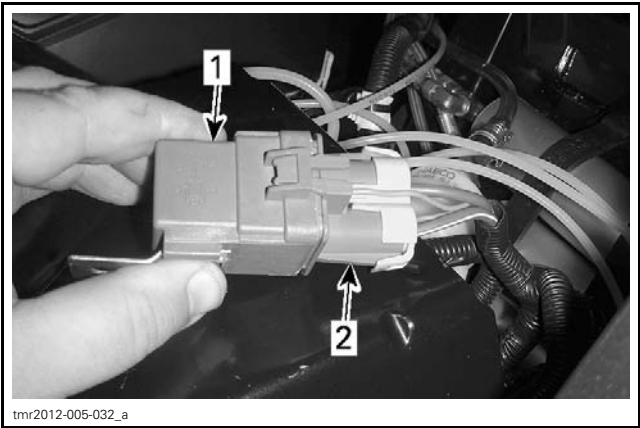
ACS Relay Continuity Test

1. Remove relay (R5).
- 1.1 Remove bolt and nut retaining the relay holder on the top of the compressor protector.



1. Relay retaining bolt

- 1.2 From the rear, pull relay out from underneath of compressor protector.
- 1.3 Remove the relay from its holder.



1. Relay
2. Relay holder

2. Measure resistance as per the following table.

REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

TEST PROBES		RESISTANCE
Terminal 30 (relay holder)	Terminal 87 (relay holder)	Open (OL)

3. Apply 12 volts on terminals 86 and 85 and measure resistance again as per the following table.

TEST PROBES		RESISTANCE
Terminal 30 (relay holder)	Terminal 87 (relay holder)	Close to 0 Ω

If results are not as per the above tables, replace relay.

ACS Relay Input Voltage Test

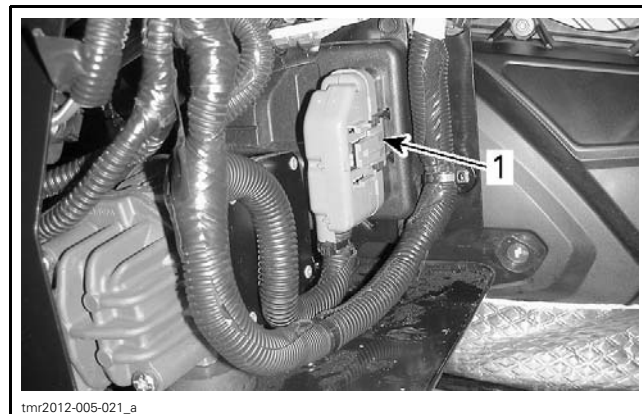
1. Measure voltage as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		VOLTAGE
Pin 87 (relay holder)	Battery negative (-) post	Battery voltage

If voltage is not as specified, check wiring, connector and terminal condition.

ACS Relay Ground Wire Continuity Test

1. Unplug suspension control module (SCM) connector.



1. SCM connector

2. Measure resistance as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		RESISTANCE
Pin 86 (relay holder)	Pin 28 (SCM connector)	Close to 0 Ω

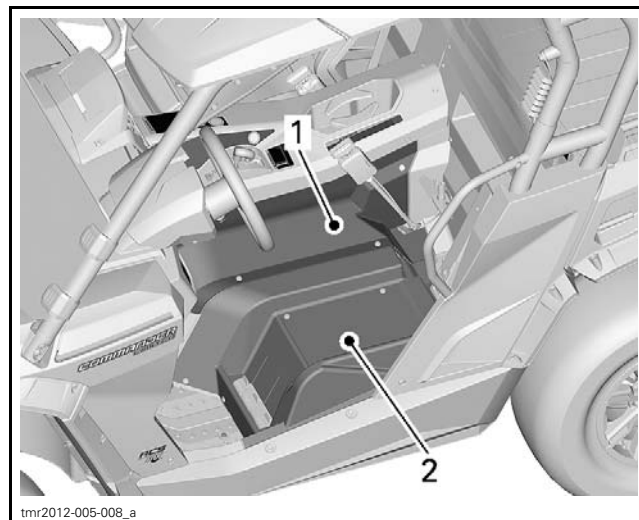
ACS COMPRESSOR

ACS Compressor Access

To access to ACS compressor, remove the following:

- Driver's seat

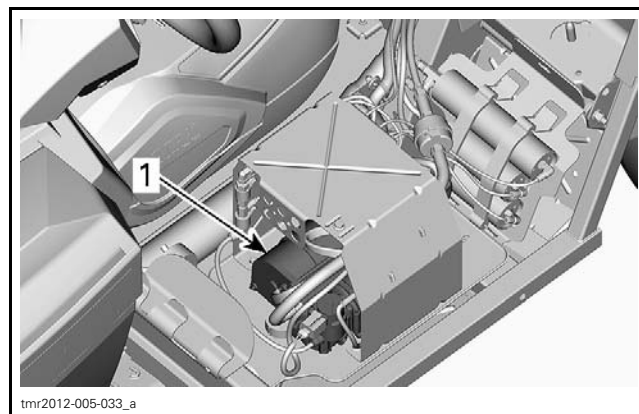
- LH lateral console panel
- Floor panel.



SIDE NET REMOVED FOR CLARITY

1. LH lateral console panel
2. Floor panel

The ACS compressor is mounted on the ACS compressor support.



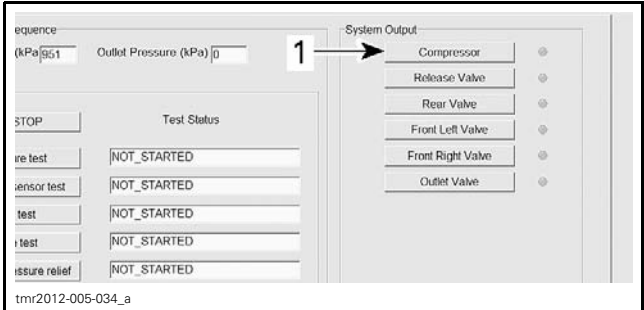
1. ACS compressor

ACS Compressor Operation Test

1. Connect vehicle to the latest appropriate version of B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE* subsection.
2. Select **Activation** page.
3. Select **ACS** folder.
4. Press **Compressor** button to proceed.

Section 07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))

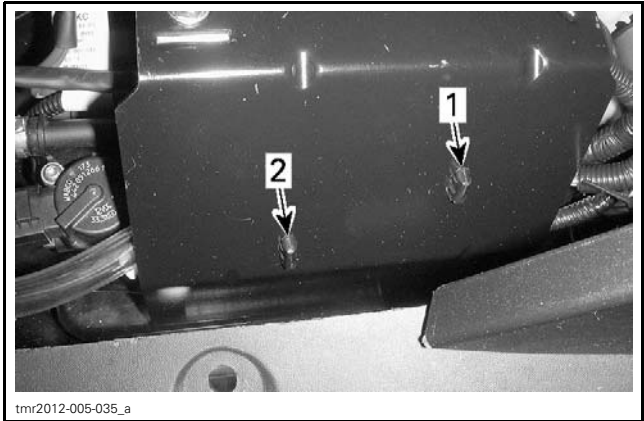


1. Compressor operation test button

5. Verify if compressor works properly.

ACS Compressor Input Voltage Test

1. Using a small screwdriver, detach the ACS compressor connector housings from the compressor protector wall.



1. ACS compressor connector
2. ACS compressor pressure sensor

2. Unplug ACS compressor connector.
3. Place ignition switch to ON position.
4. Measure voltage as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		VOLTAGE
Pin 1 (ACS compressor connector)	Battery negative (–) post	Battery voltage

ACS Compressor Ground Test

1. Place ignition switch to ON position.
2. Measure voltage as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		VOLTAGE
Pin 2 (ACS compressor connector)	Battery positive (+) post	Battery voltage

ACS Compressor Power Wire Continuity Test (from Relay)

1. Remove relay (R5).
2. Measure resistance as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		RESISTANCE
Pin 30 (relay holder)	Pin 1 (ACS compressor connector)	Close to 1 Ω

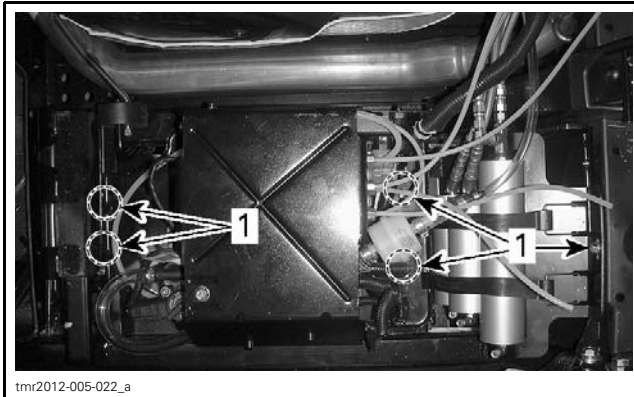
ACS Compressor Ground Wire Continuity Test

1. Reconnect the relay (R5).
2. Check the continuity as per the following table.

REQUIRED TOOL		
FLUKE 115 MULTIMETER (P/N 529 035 868)		
TEST PROBES		RESISTANCE
Pin 2 (ACS compressor connector)	Battery negative (–) post	Close to 1 Ω

ACS Compressor Removal

1. Remove screws retaining the air reservoir support and the compressor support.

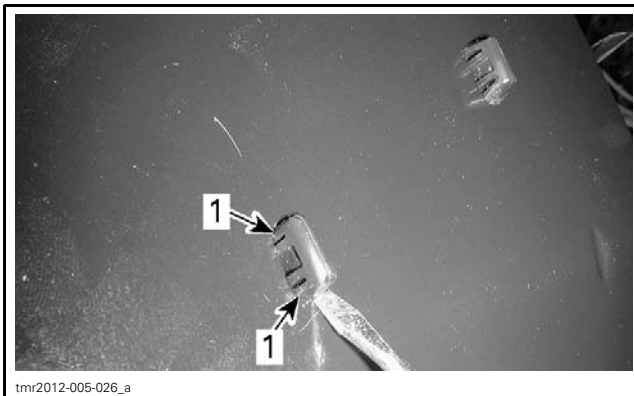


1. *Screws to be removed*

2. Disconnect pneumatic hoses from air reservoirs and air outlet fitting.
3. Place the air reservoir support aside to make room.

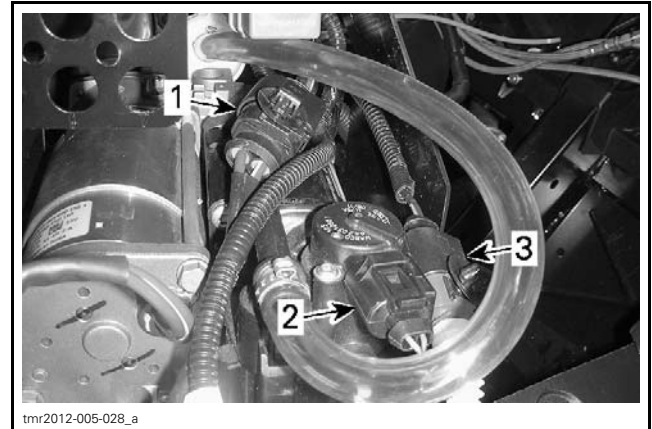


4. Using a small screwdriver, detach both connector housings from the compressor protector wall.



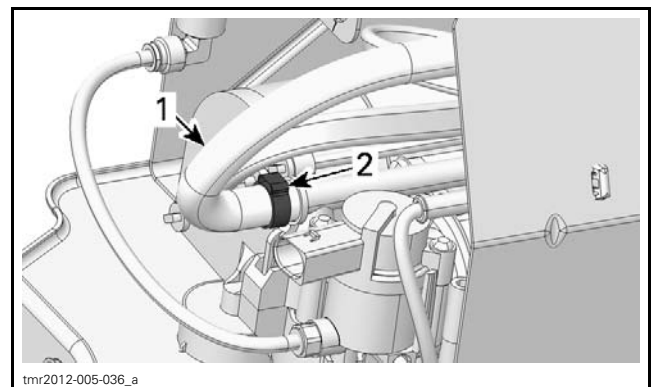
1. *Press these tabs inside*

5. Unplug the following connectors:
 - Compressor connector
 - Release valve connector
 - Pressure sensor connector.



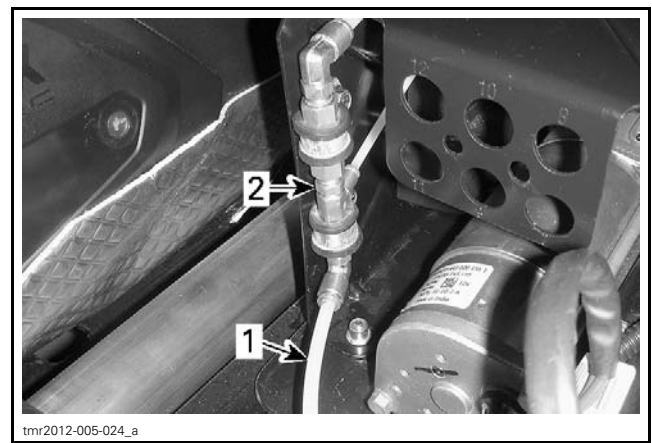
1. *Compressor connector*
 2. *Release valve connector*
 3. *Pressure sensor connector.*

6. Detach the filter hose from the compressor intake/outlet fitting.



1. *Air filter hose*
 2. *Clamp to be removed*

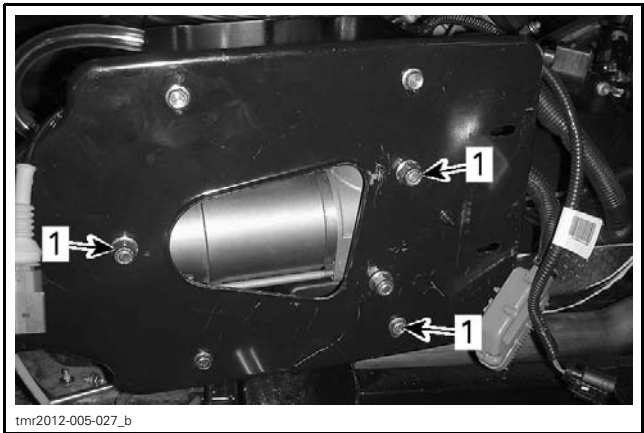
7. Disconnect the lower pneumatic hose from the pressure distributor.



1. *Disconnect this hose*
 2. *Pressure distributor*

8. Turn the compressor support on the side to remove screws retaining the compressor.

Section 07 CHASSIS
Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))



1. Compressor retaining screws

9. Remove the ACS compressor.

ACS Compressor Installation

The installation is the reverse of removal procedure.

ACS AIR FILTER

Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

SHOCK ABSORBERS

Shock Absorbers Identification

When installing shock absorbers, make sure not to mix front and rear shock absorbers.

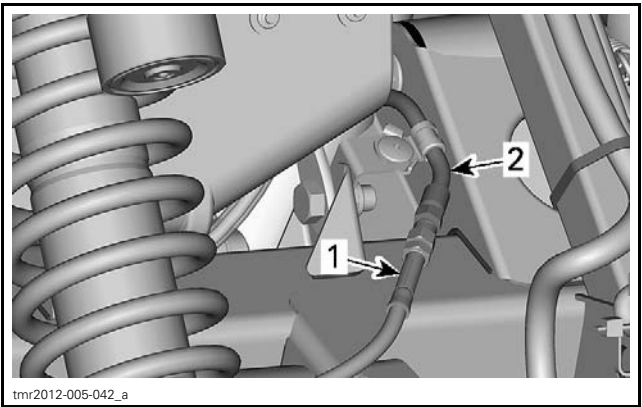
Front and rear shock absorbers can be easily identified by comparing the length of air hoses.

FRONT SHOCK ABSORBER	
Shock absorber with a short air hose on reservoir side	
REAR SHOCK ABSORBER	
Shock absorber with a long air hose on the opposite side of reservoir	

Rear Shock Absorber Removal

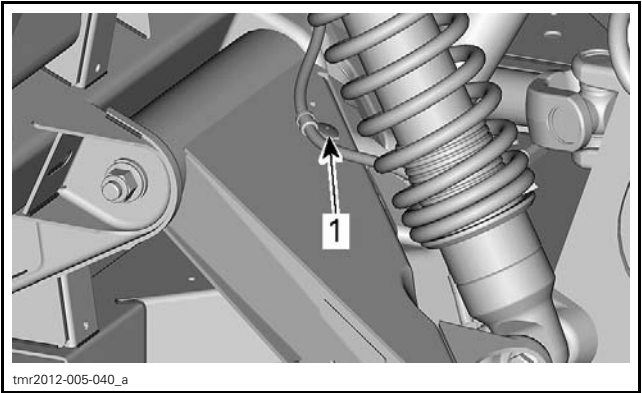
1. Block front wheels.
2. Loosen wheel lug nuts.
3. Open cargo box.
4. Place the jack under the hitch and lift the rear of vehicle.
5. Install jack stands to support the vehicle.
6. Remove wheel.

7. Disconnect shock absorber hose from vehicle air supply hose.



1. Shock absorber hose
2. Vehicle air supply hose

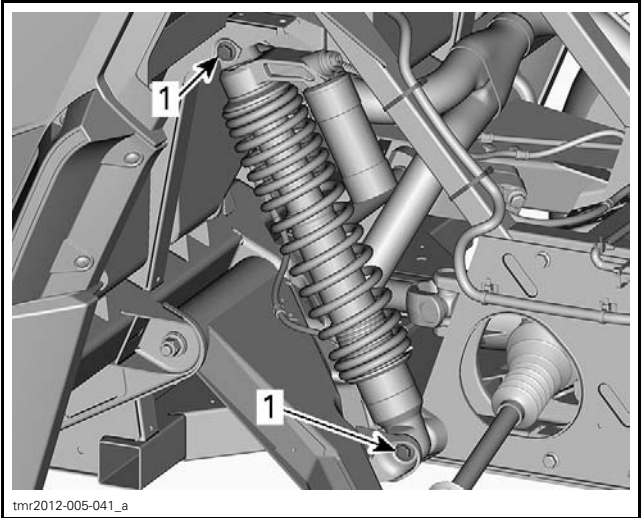
8. Drill the rivet securing the shock absorber hose to trailing arm.



REAR LH SIDE OF VEHICLE SHOWN

1. Rivet to be drilled

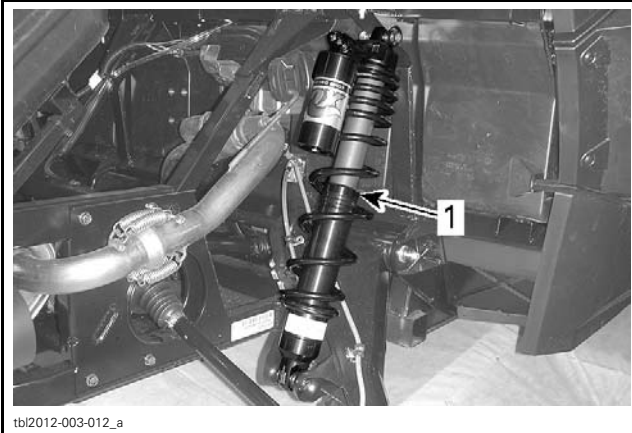
9. Remove upper and lower bolts retaining the shock absorber. Discard nuts.



1. Shock absorber retaining bolts

Rear Shock Absorber Installation

Install shock absorbers with the reservoir rearwards.



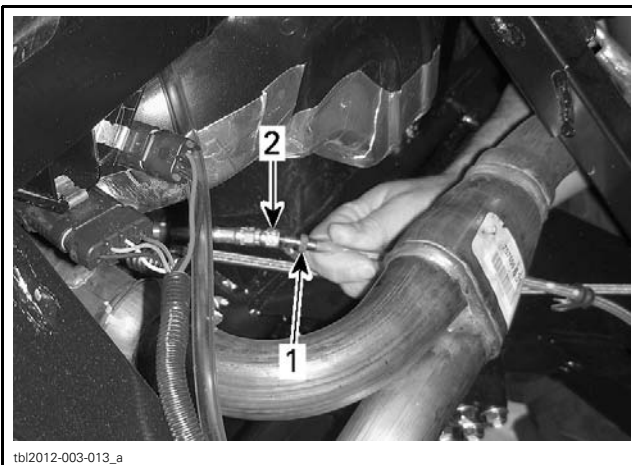
TYPICAL

1. RH rear shock absorber

Secure with new nuts.

TIGHTENING TORQUE	
Shock absorber nuts	48 N•m (35 lbf•ft)

Connect shock absorber hoses to vehicle air supply hoses.

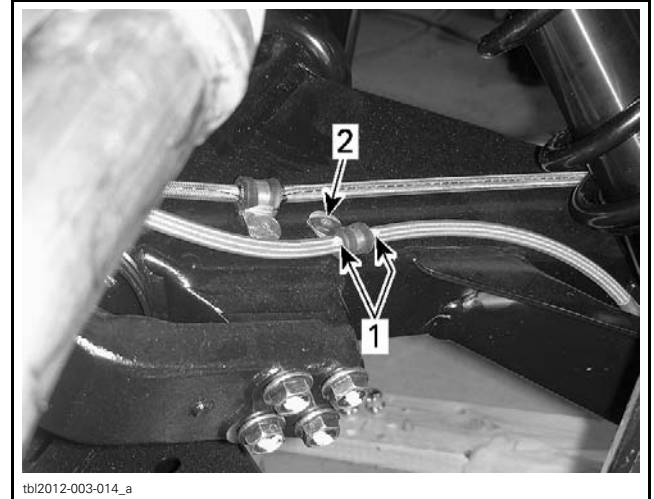


TYPICAL

1. RH shock absorber hose
2. Vehicle air supply hose

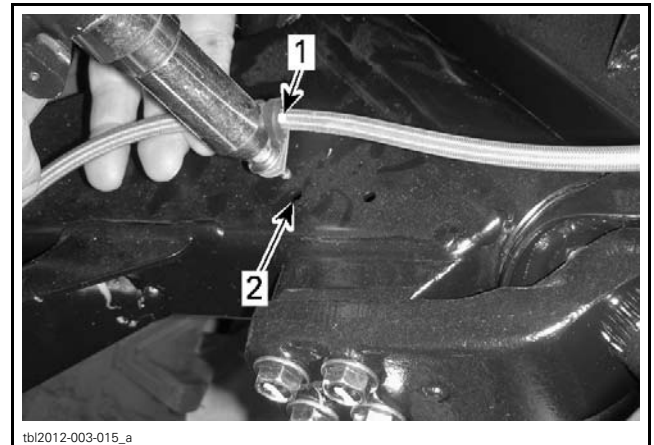
TIGHTENING TORQUE	
Air supply hose	6 N•m ± 0.5 N•m (53 lbf•in ± 4 lbf•in)

Secure shock absorber hoses to trailing arms. Ensure to position hose clamp between YELLOW dots.



RH SIDE OF VEHICLE

1. YELLOW dots
2. Rivet



LH SIDE OF VEHICLE

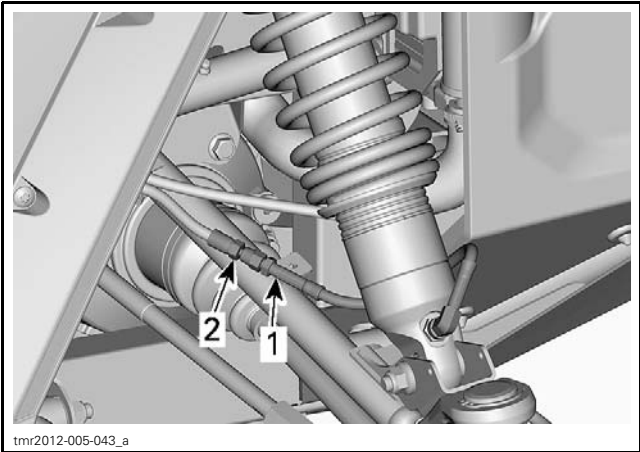
1. YELLOW dot
2. Install the rivet in this hole

Front Shock Absorber Removal

1. Block rear wheels.
2. Loosen wheel lug nuts.
3. Lift the front of vehicle and support it securely.
 - 3.1 Insert the jack under the vehicle by the side, behind front wheels.
 - 3.2 Place the jack under the central beam.
 - 3.3 Lift the front of vehicle.
4. Remove front wheels.
5. Cut locking ties securing shock absorber hose to suspension arm.
6. Disconnect shock absorber hose from vehicle air supply hose.

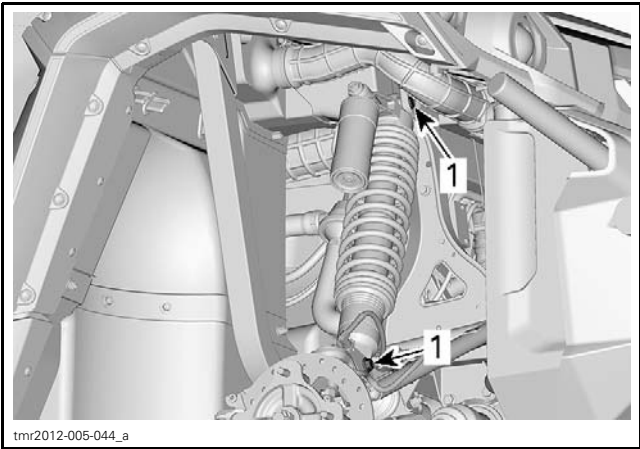
Section07 CHASSIS

Subsection 06 (AIR CONTROLLED SUSPENSION (ACS))



TYPICAL
1. RH shock absorber hose
2. Vehicle air supply hose

7. Remove upper and lower bolts retaining the shock absorber. Discard nuts.



1. Shock absorber retaining bolts

8. Remove shock absorber from vehicle.

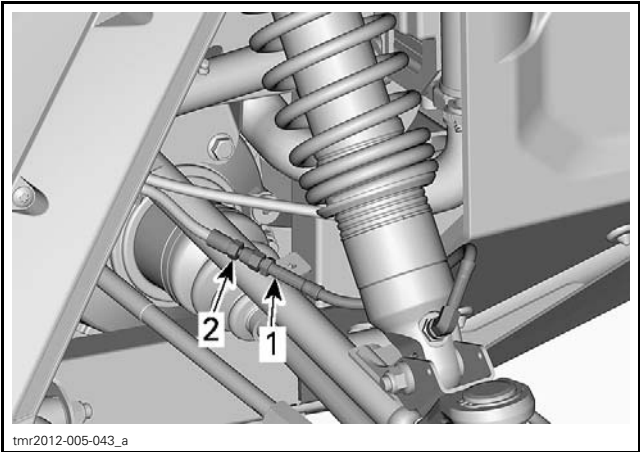
Front Shock Absorber Installation

Install shock absorbers with the reservoir outwards.

Secure it using previously removed bolts and new nuts. Tighten nuts to specification.

TIGHTENING TORQUE	
Shock absorber nuts	48 N•m (35 lbf•ft)

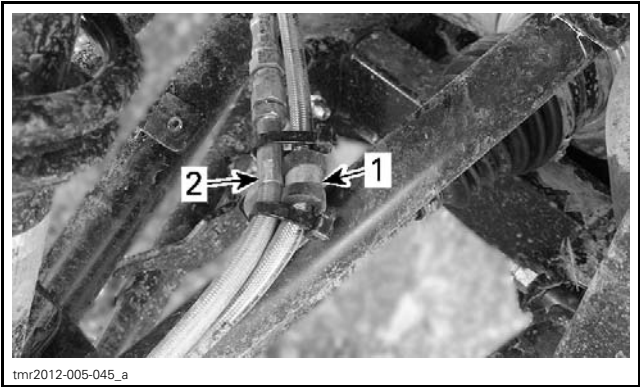
Route the hose in front of the shock absorber.



TYPICAL
1. RH shock absorber hose
2. Vehicle air supply hose

TIGHTENING TORQUE	
Air supply hose	6 N•m ± 0.5 N•m (53 lbf•in ± 4 lbf•in)

Secure the shock absorber hose to brake hose. Install a locking tie each side of the brake hose retaining clamp.



1. Brake hose retaining clamp
2. Shock absorber hose

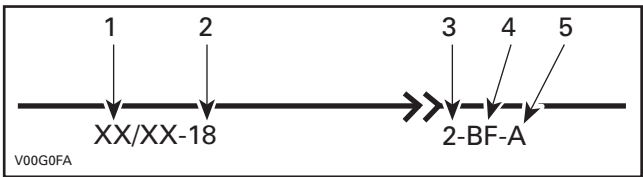
WIRING DIAGRAM INFORMATION

GENERAL

WIRING DIAGRAM LOCATION

The wiring diagrams are stored in the back cover pocket.

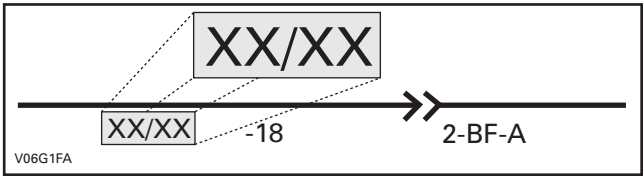
WIRING DIAGRAM CODES



1. Wire colors
2. Wire gauge
3. Connector housing area
4. Connector identification
5. Wire location in connector

Wire Colors

It identifies the color of a wire. When a 2-color scheme is used, the first color is the main color while the second color is the tracer color.

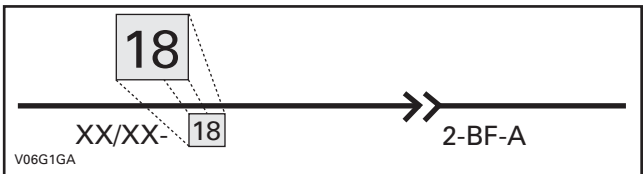


THE SHADED PART INDICATES THE WIRE COLOR

Example: YL/BK is a YELLOW wire with a BLACK stripe.

Wire Gauge

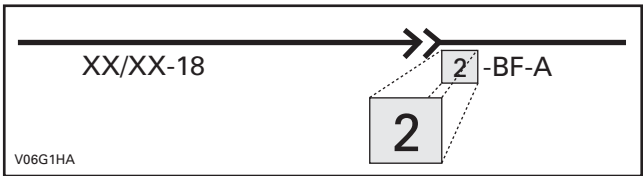
The number after wire color indicates the gauge of a wire.



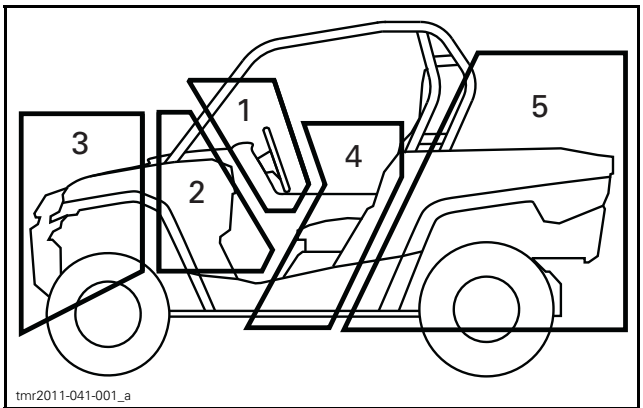
THE SHADED PART INDICATES THE WIRE GAUGE

Example: The number that follows the wire color indicates the wire size used, in this case 18 gauge wire.

Connector Housing Area



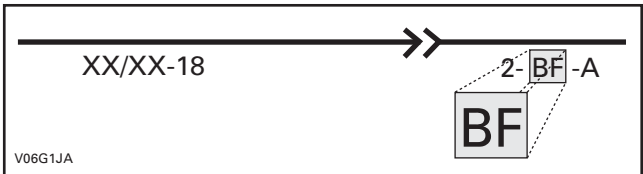
The first number in the connector/pin contact number represents the area in the vehicle where the connector is located.



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

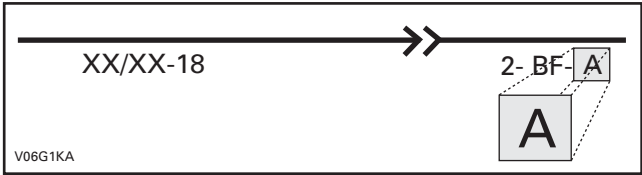
The letters in the middle of the connector/pin contact number indicates the connector's function. If there are many connectors in the same area, this helps to identify which wire is in which connector.



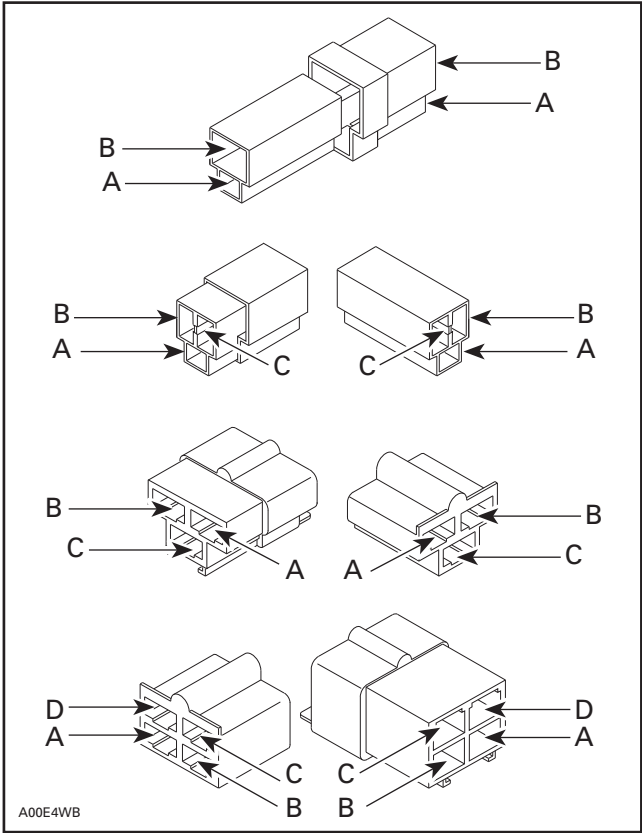
THE SHADED PART INDICATES A CONNECTOR

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