

DEFENDER 2016
ENGINE HARNESS

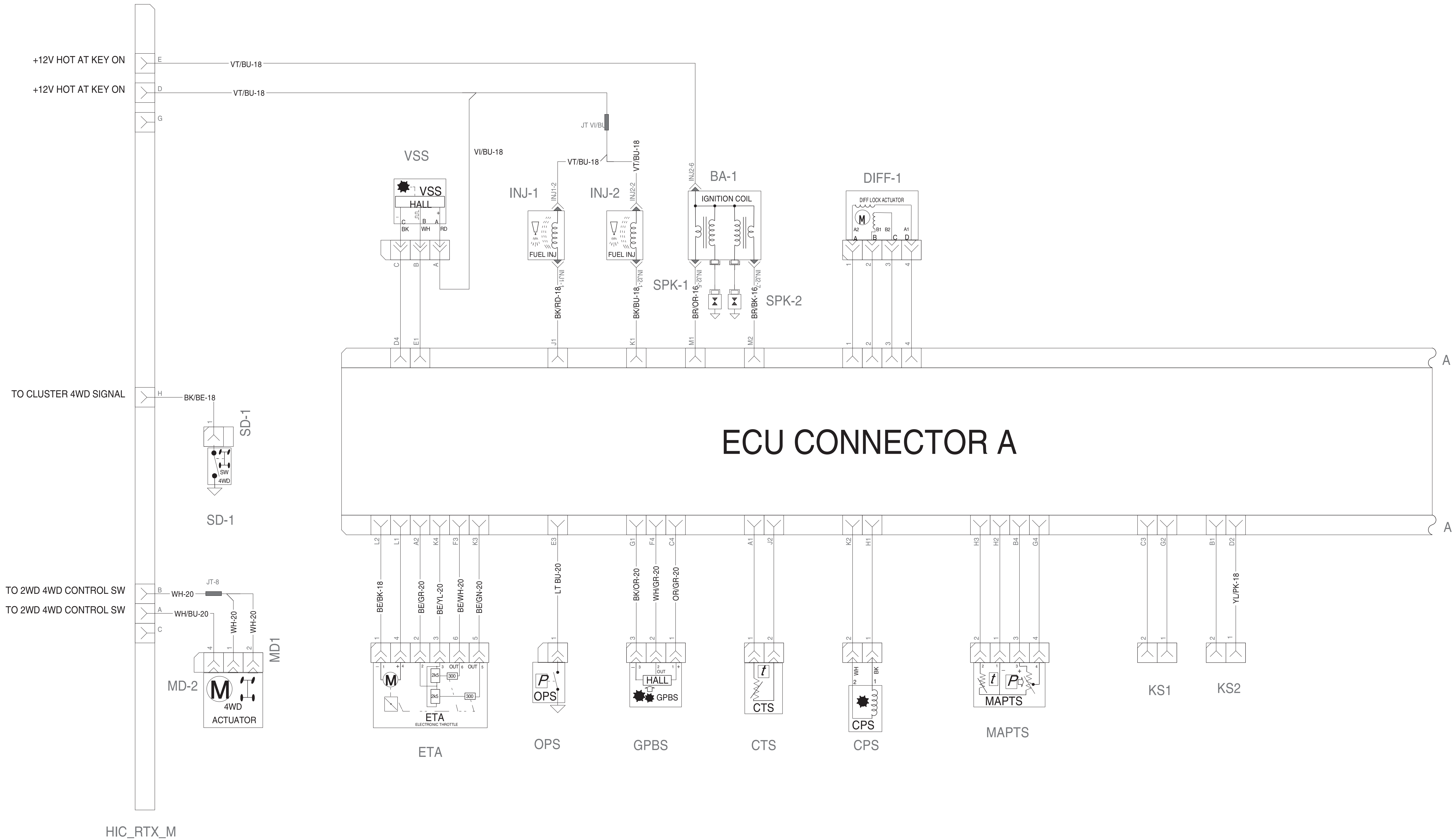
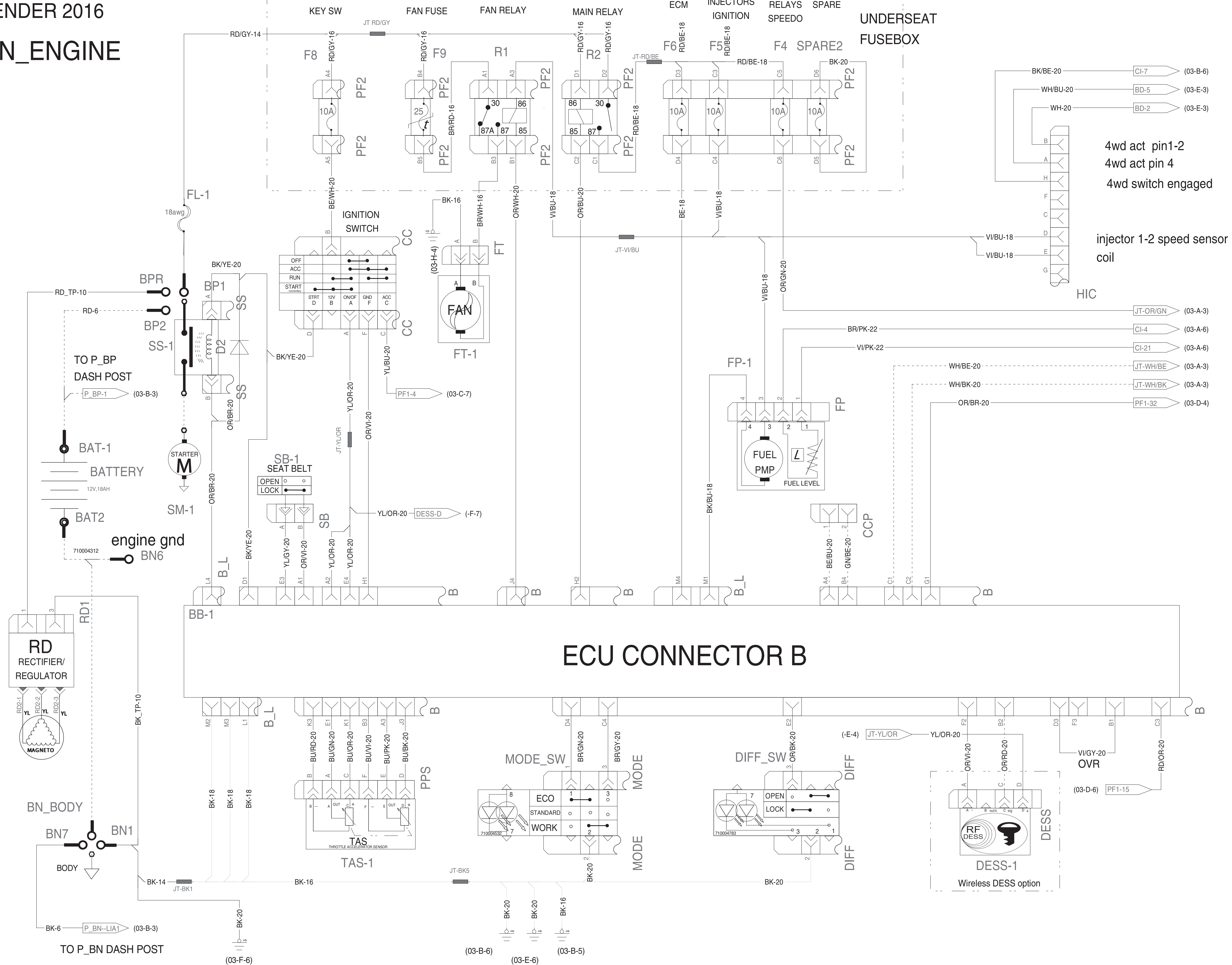


Diagram 01

DEFENDER 2016

MAIN_ENGINE



4wd switch engaged

4wd act 4

4wd act 1

TO ENGINE HARNESS

- +12v switched acc power/cluster
- to fuel level sensor
- to fuel level sensor
- CAN HI
- CAN LO
- acc RELAY output (sink)

Diagram 02

DEFENDER 2016

MAIN_ACCESSORIES

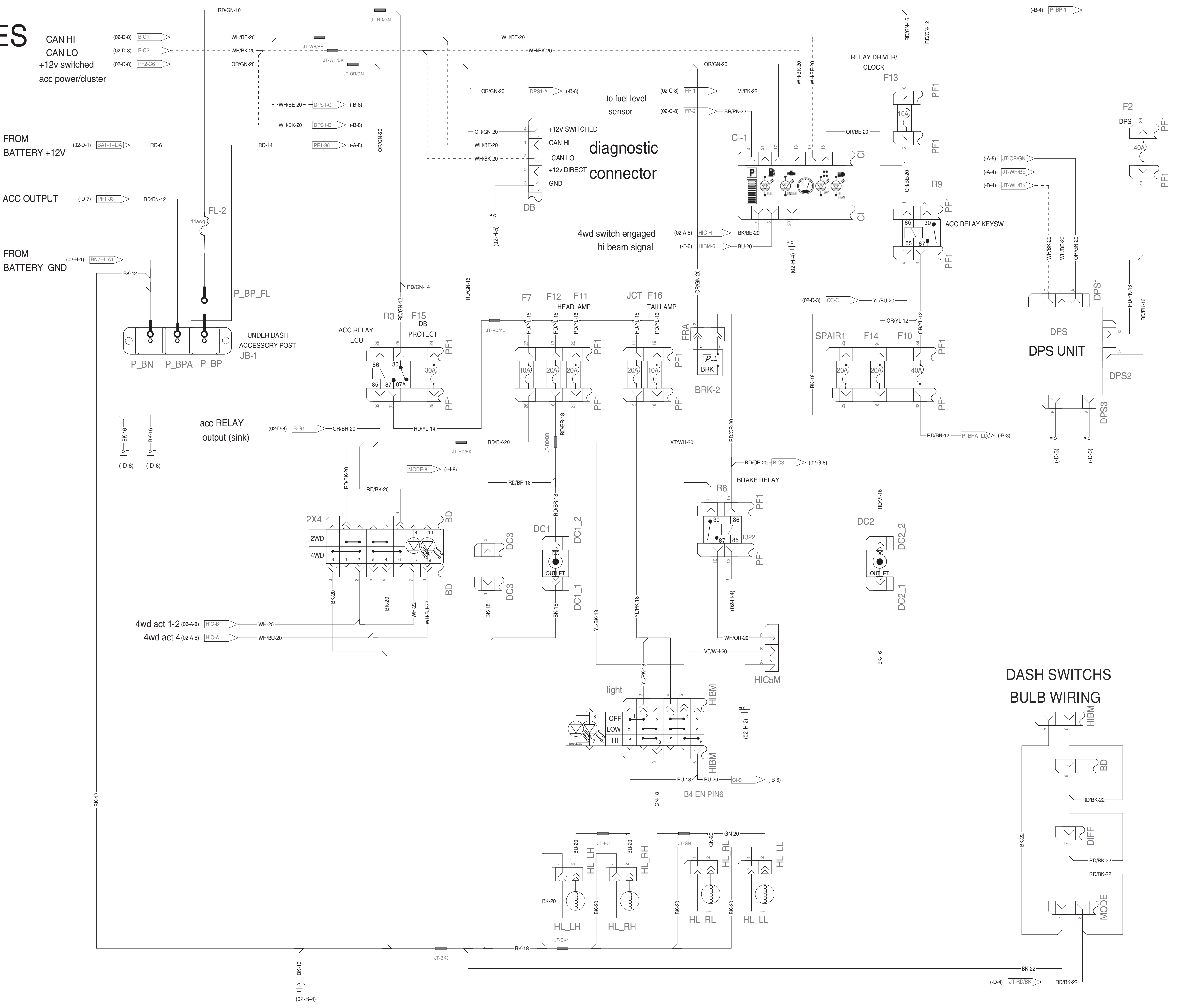


Diagram 03

SPECIFIC HARNESSSES

WINCH HARNESS

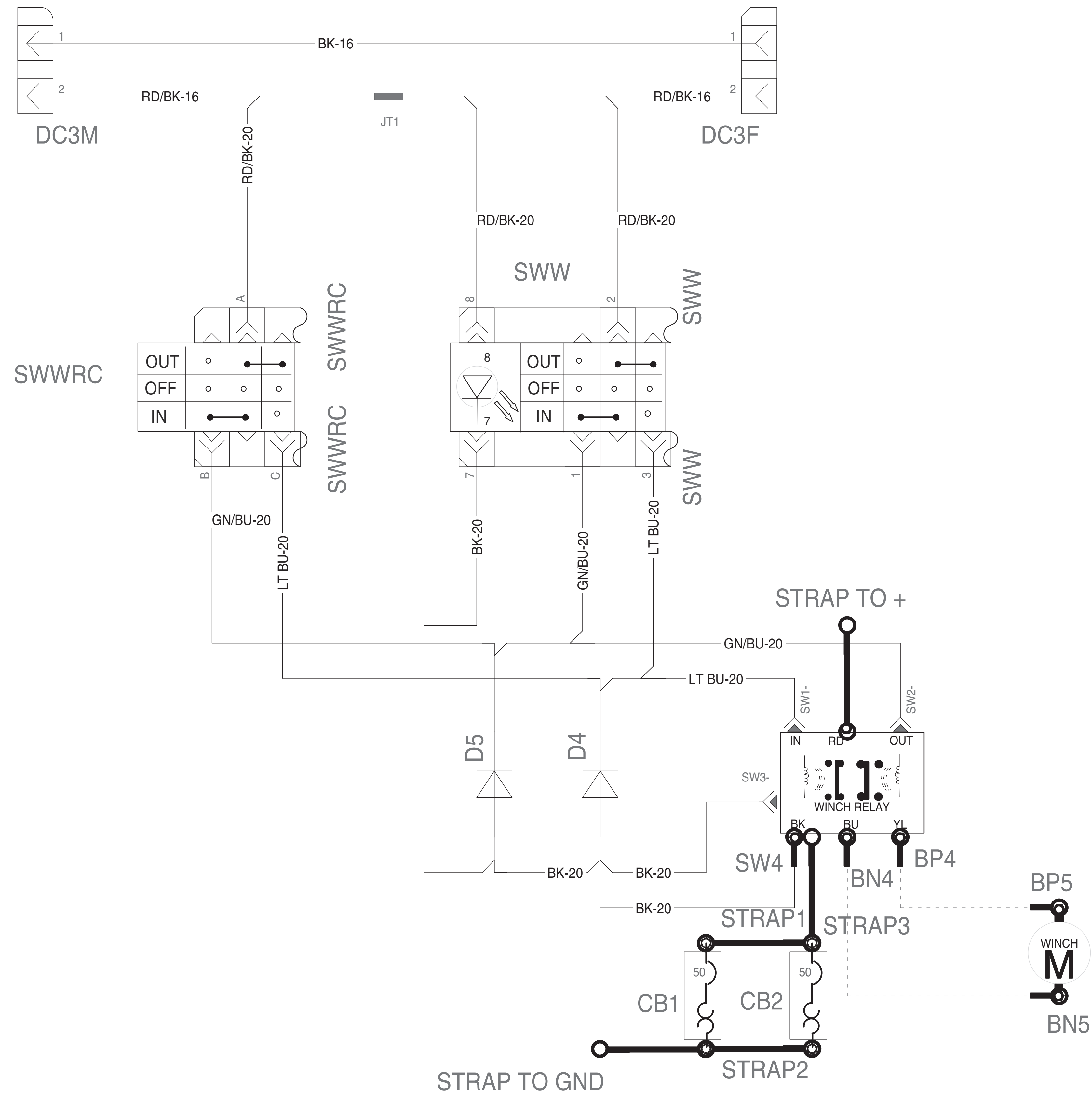


Diagram 5

CARGO BOX HARNESS

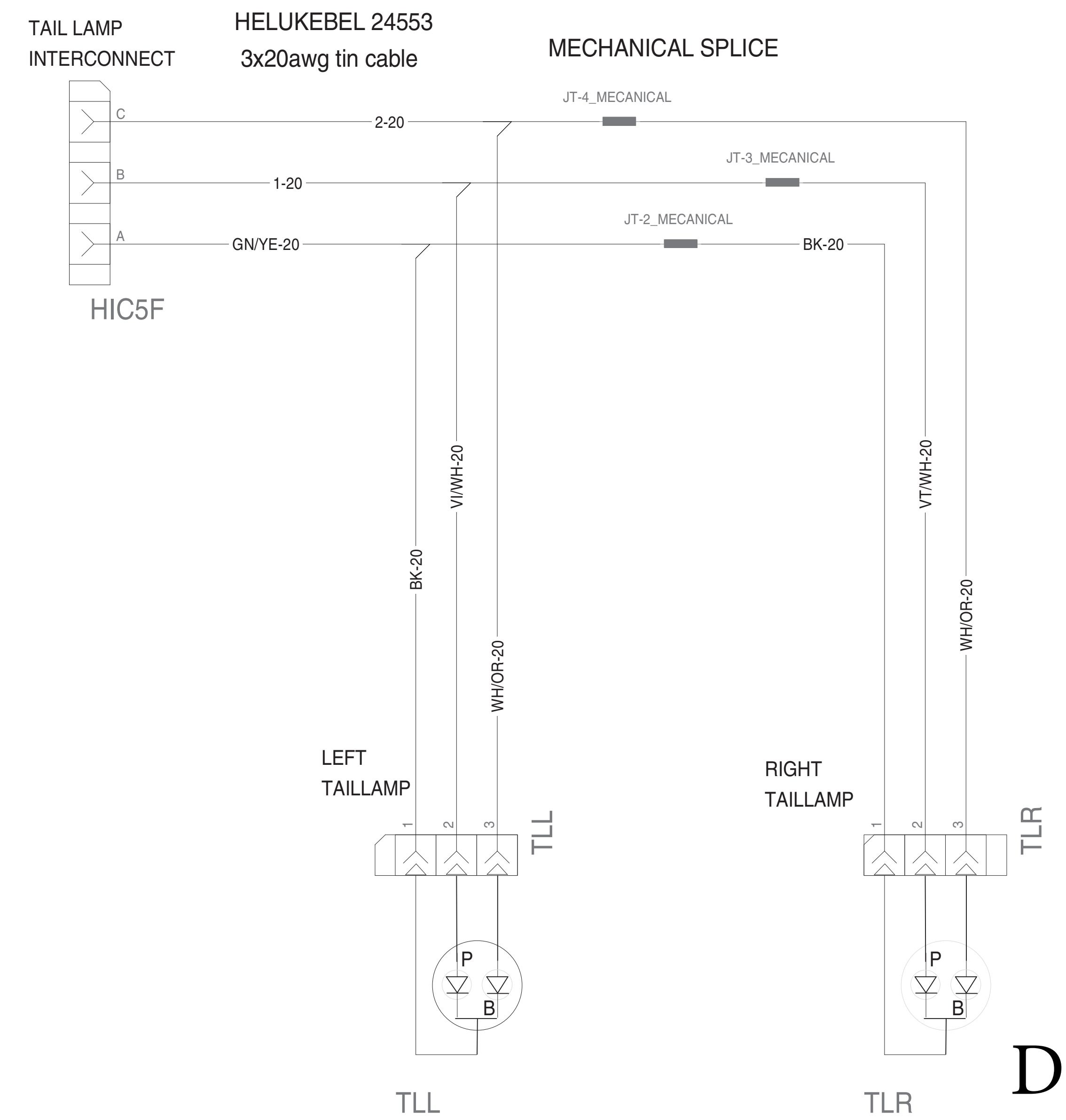


Diagram 4

WIPER HARNESS

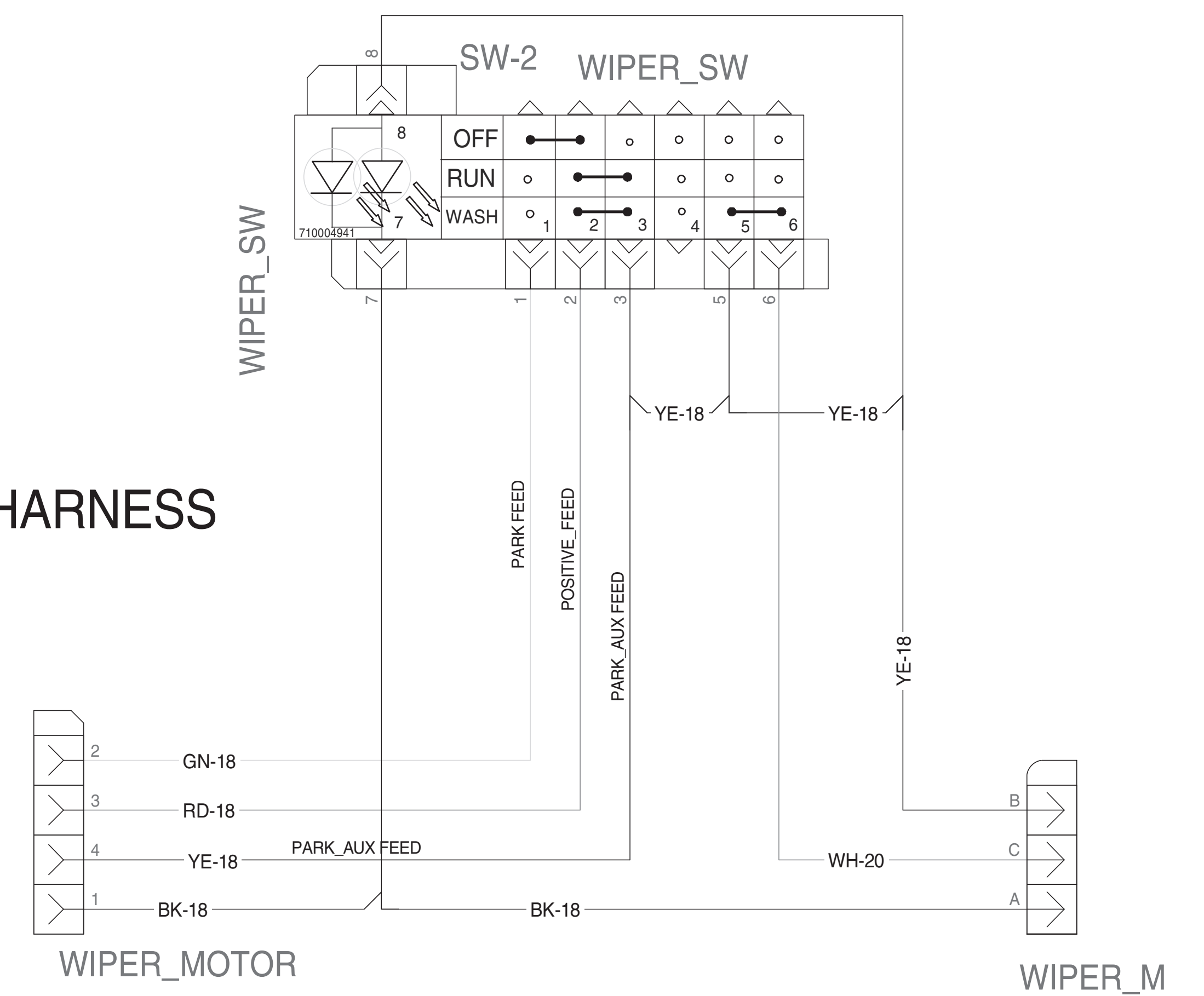


Diagram 11

DEFENDER 2016
DOORS HARNESS

DOORS and WIPER

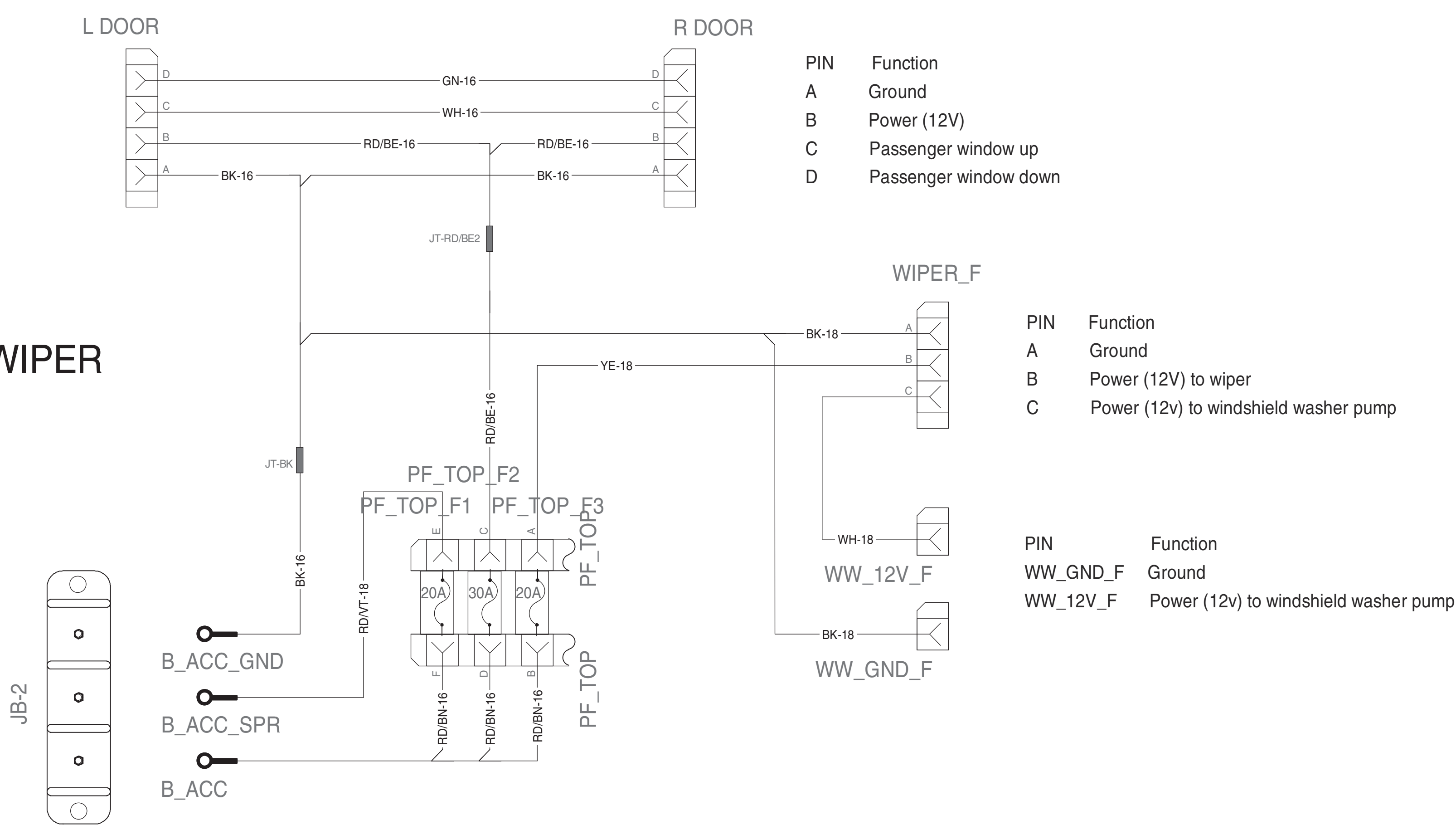
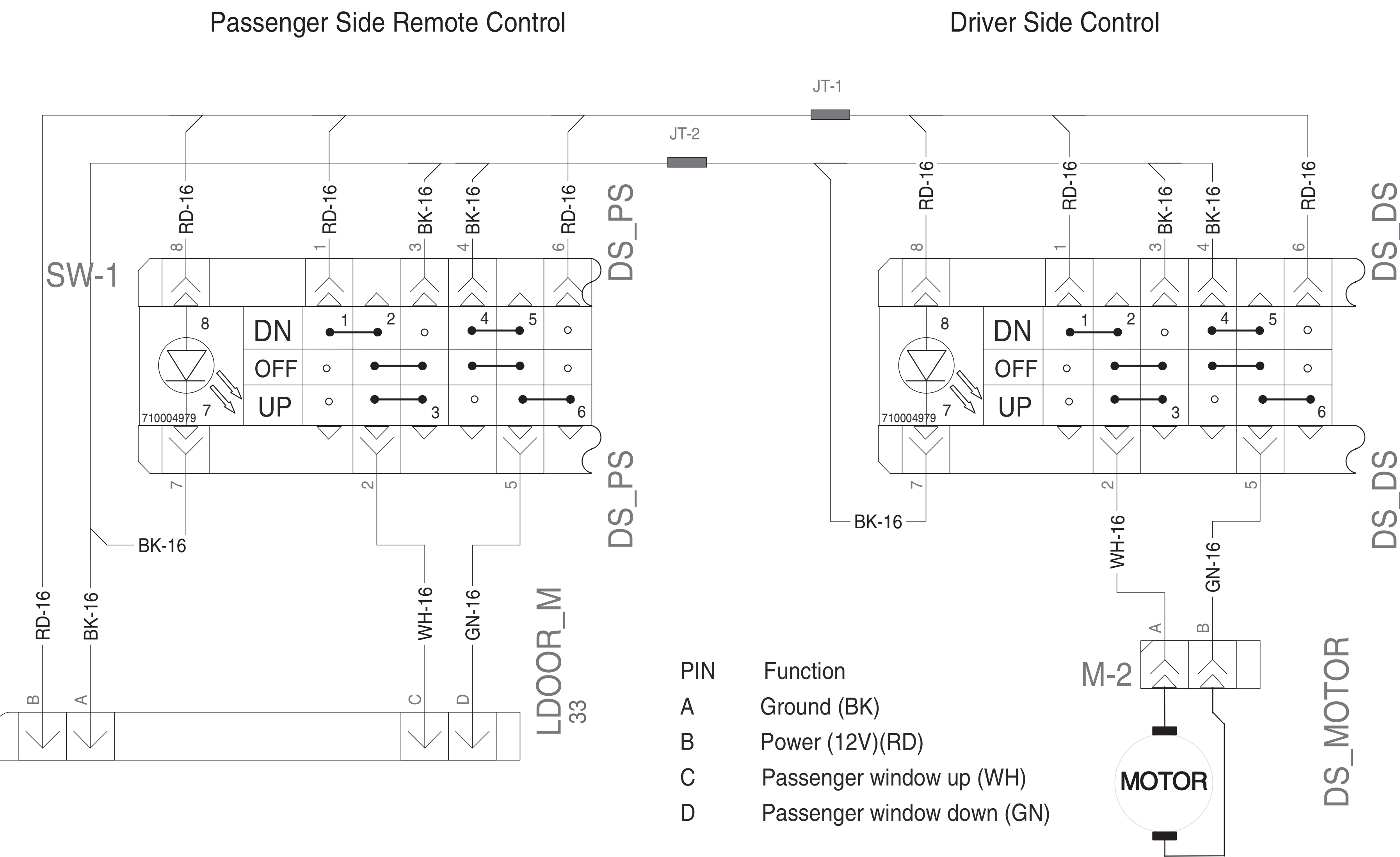


Diagram 10

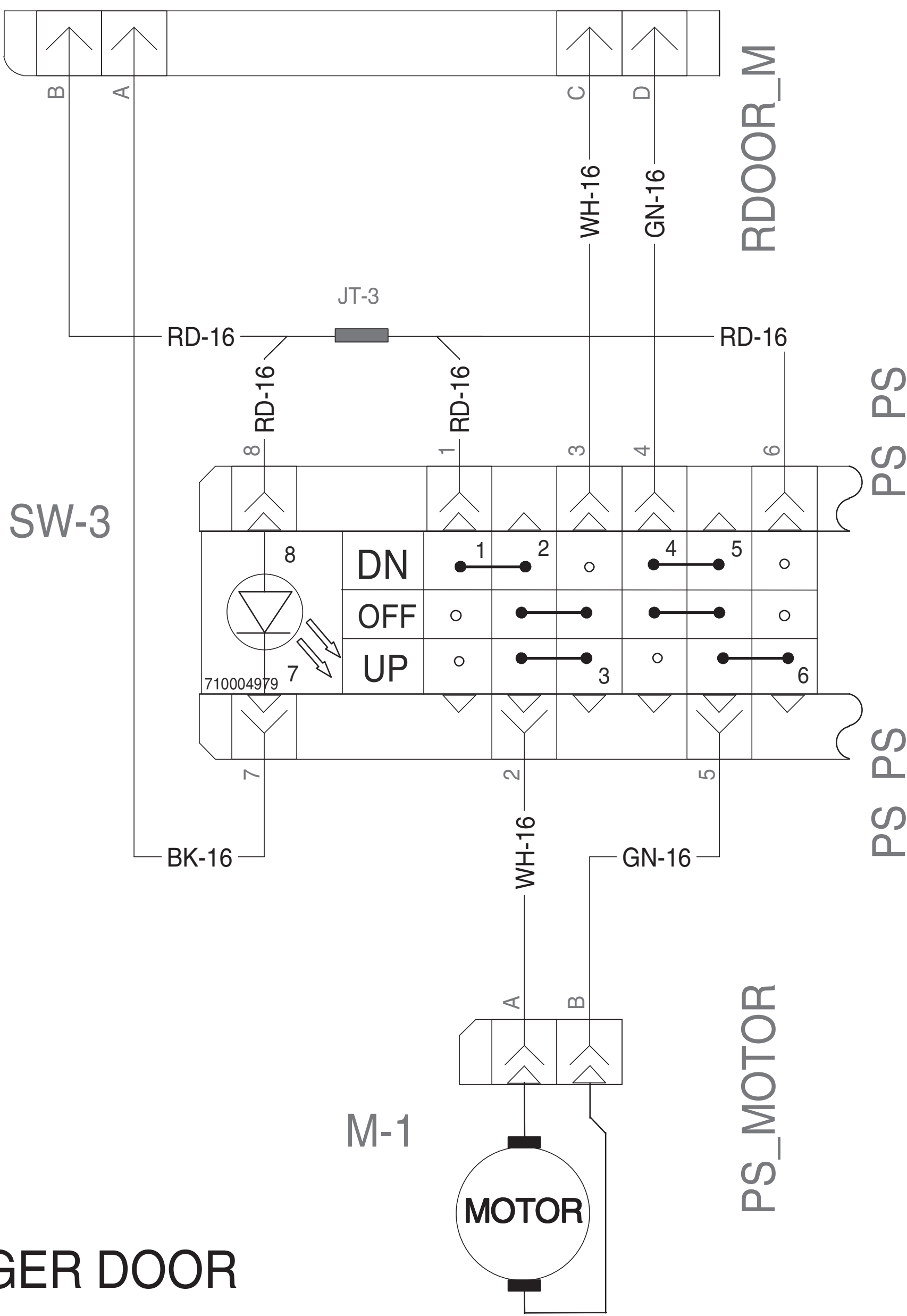
DRIVER DOOR

Diagram 21



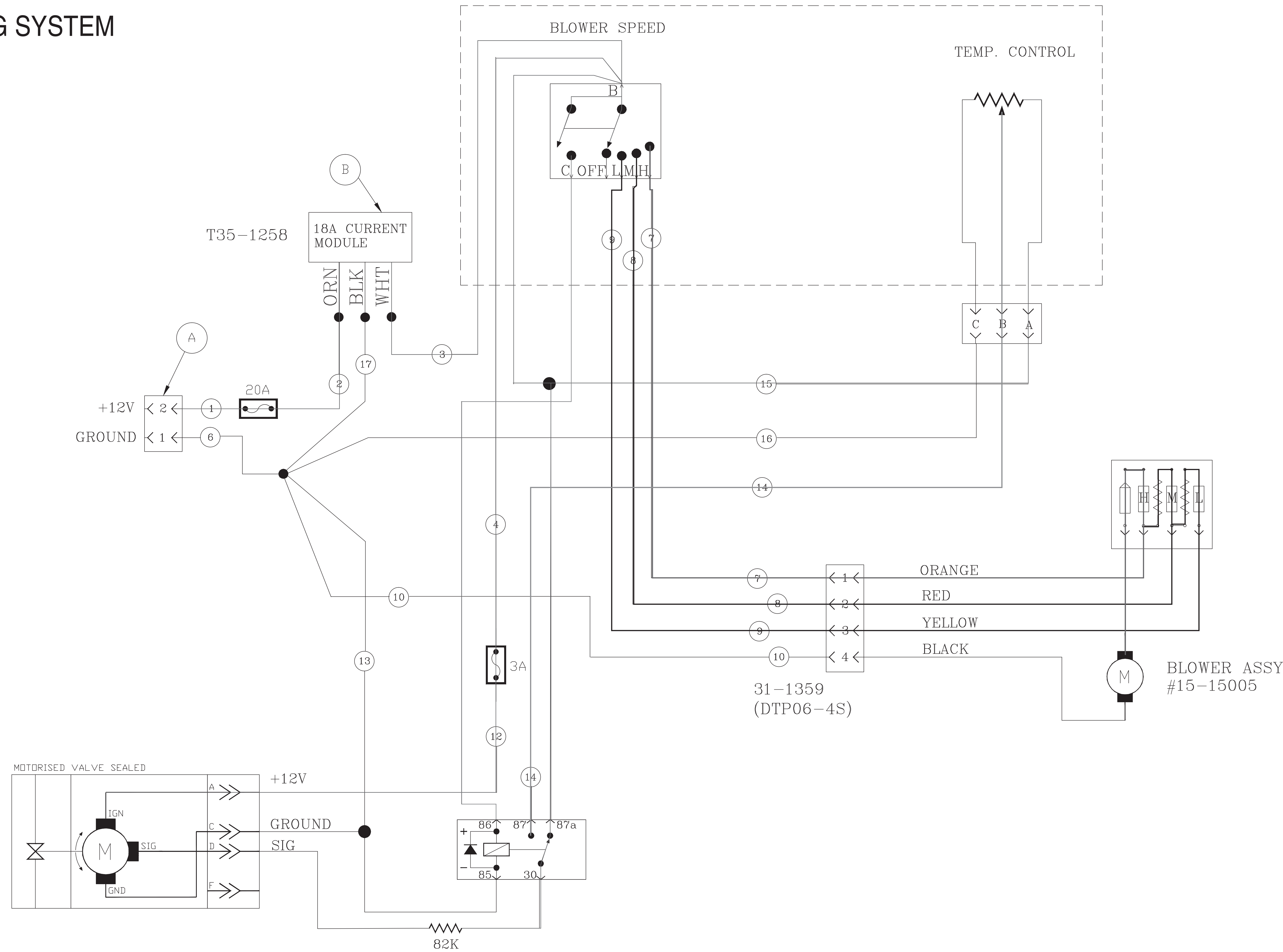
PASSENGER DOOR

Diagram 22



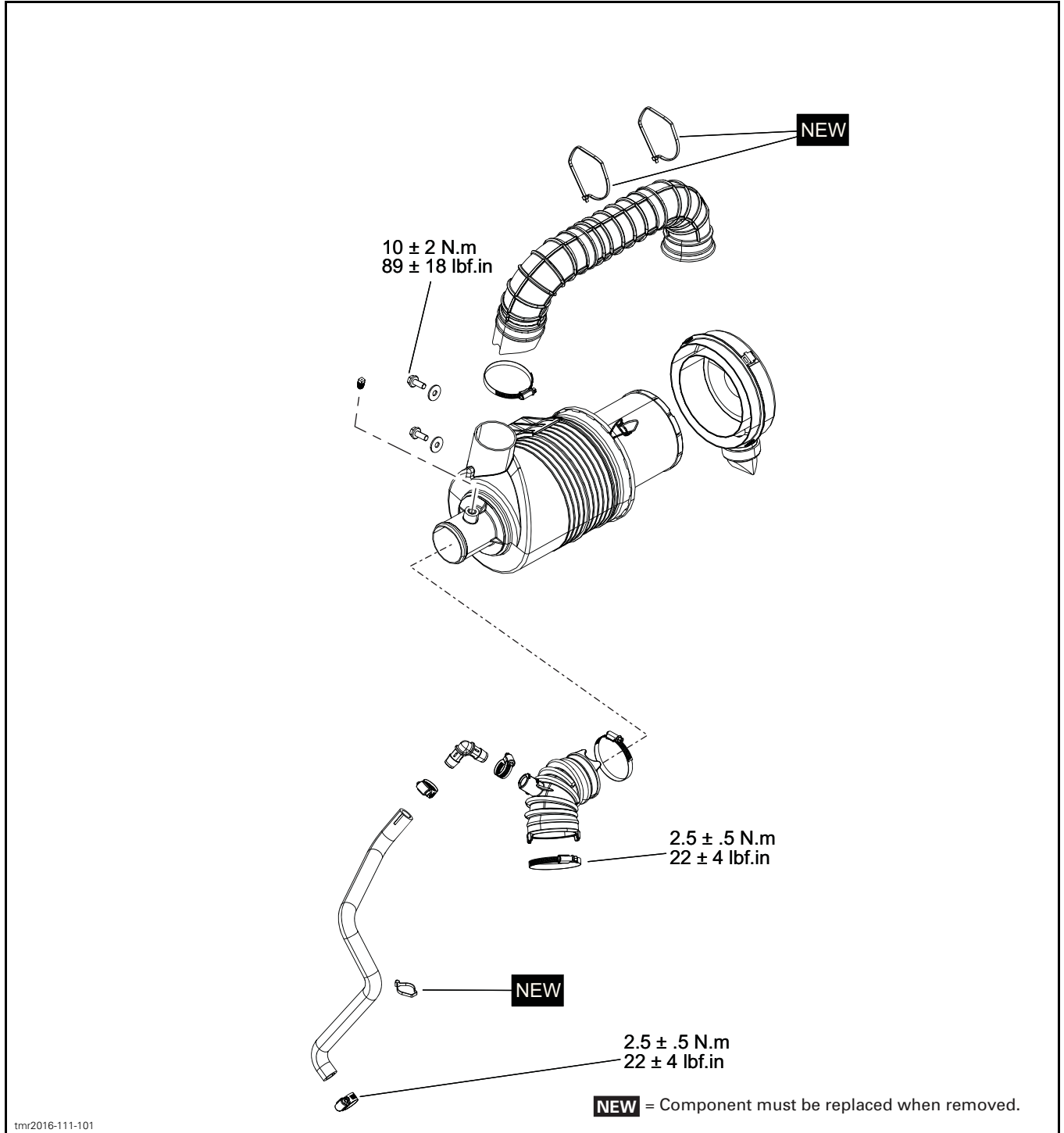
DEFENDER 2016
HEATING SYSTEM

CONTROL PANEL



AIR INTAKE SYSTEM

AIR FILTER HOUSING



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

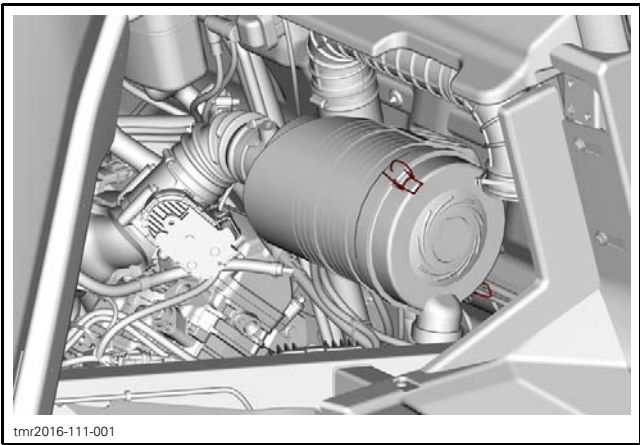
AIR FILTER

For air filter servicing, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

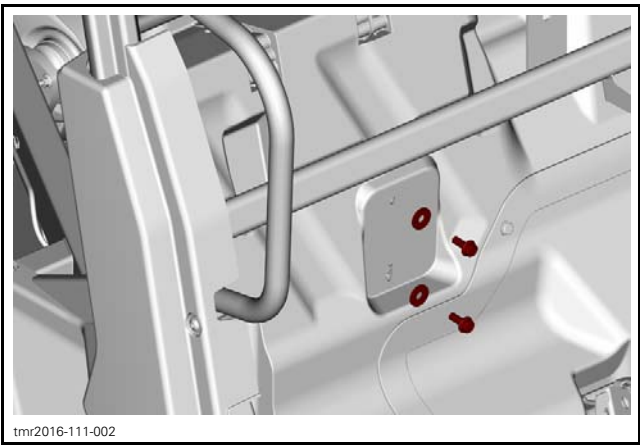
AIR FILTER HOUSING

Removing Air Filter Housing

Release clamps and remove air filter cover and filter.



Remove fasteners behind passenger seat.



Installing Air Filter Housing

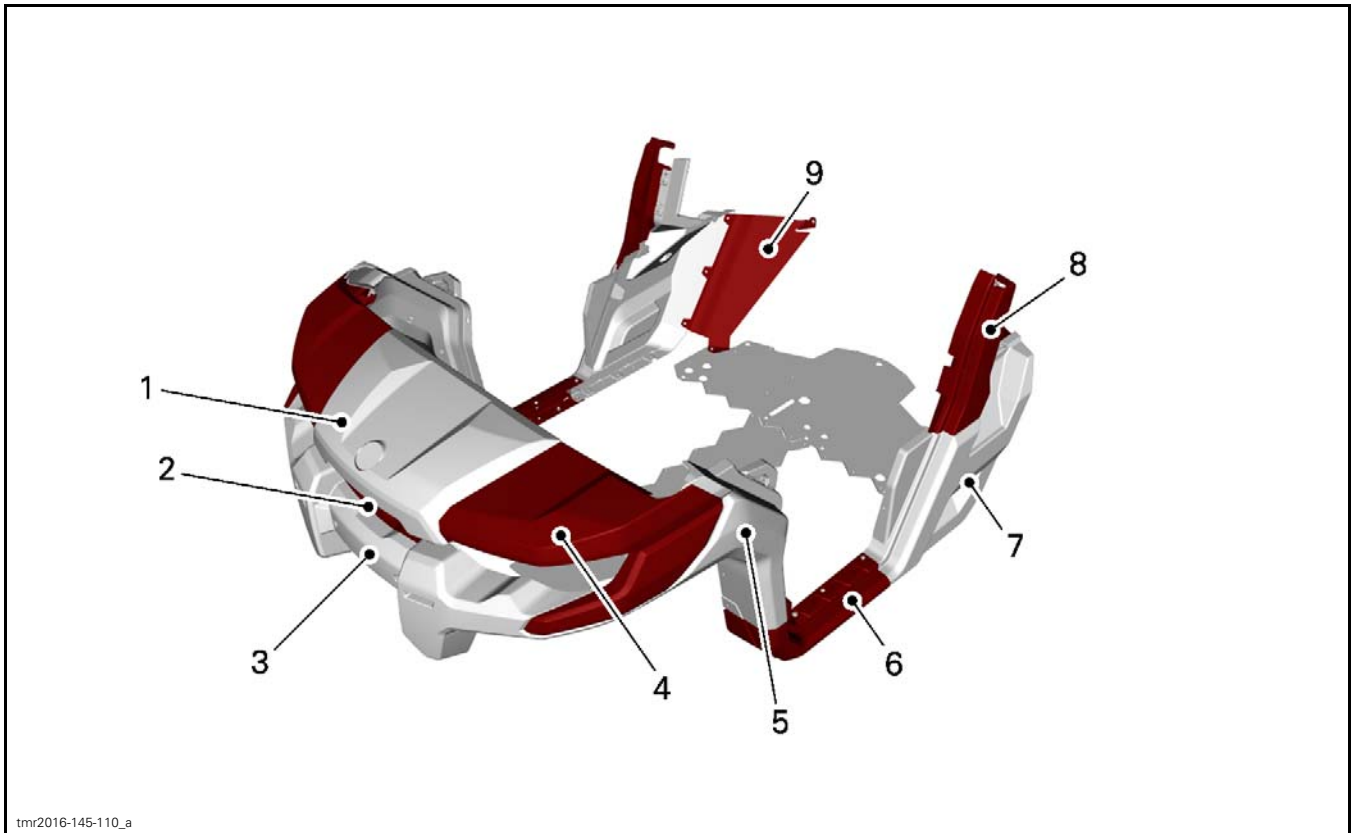
For installation, reverse the removal procedure but pay attention to the following.

Align installation marks on throttle body, air box and housing vent hose and make sure bellow is not crushed.

Do not overtorque.

TIGHTENING TORQUE	
Air filter housing screws	10 N•m ± 2 N•m (89 lbf•in ± 18 lbf•in)

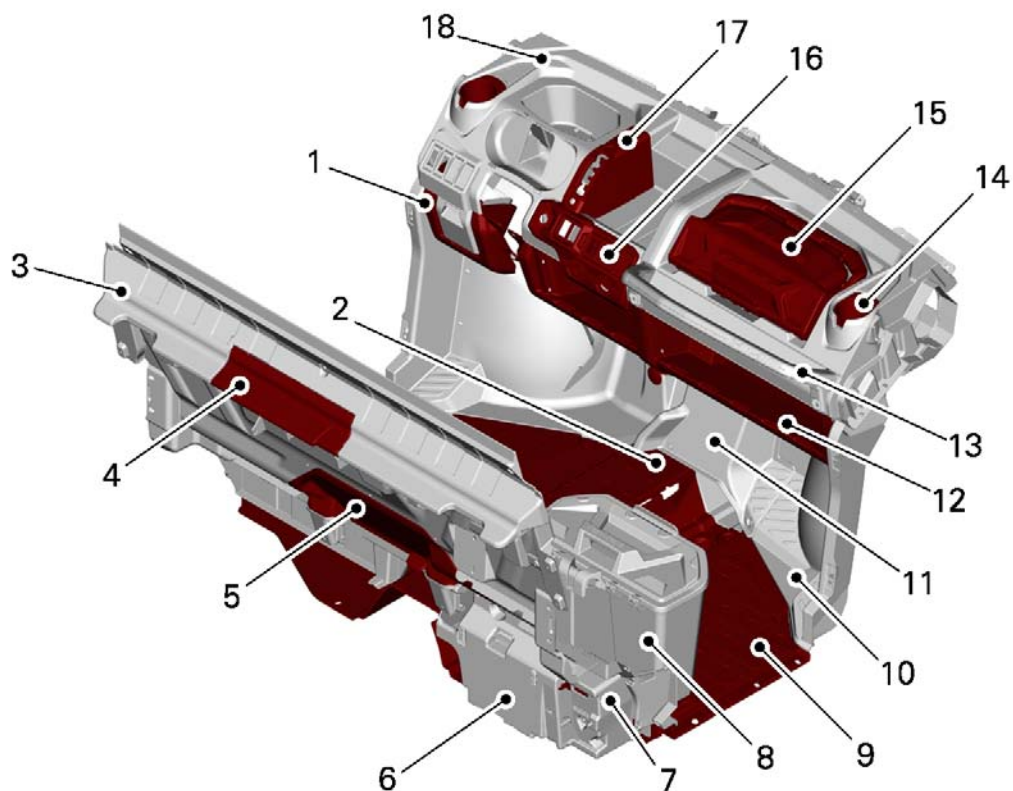
BODY



tmr2016-145-110_a

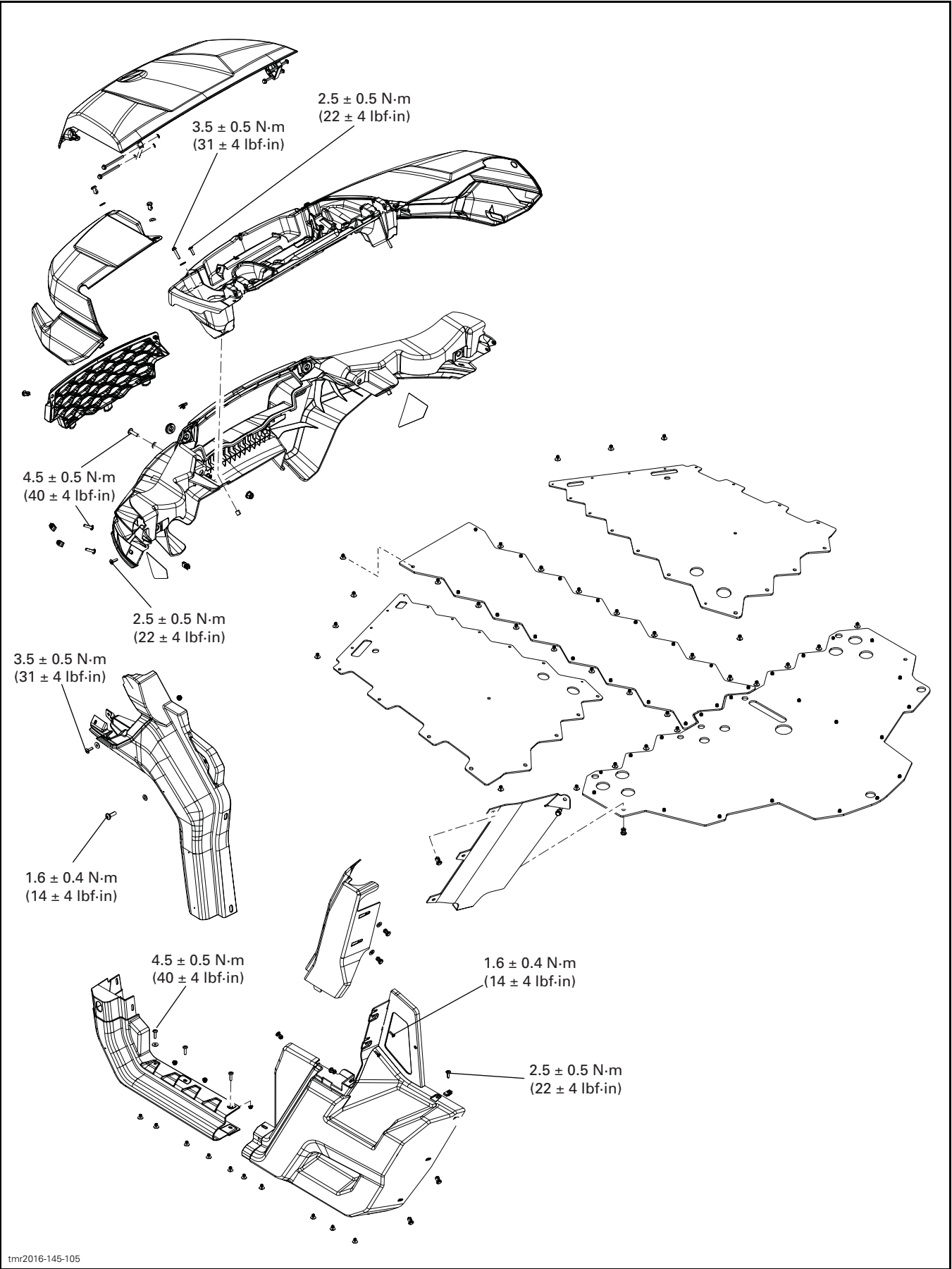
1. Front service cover
2. Front grille
3. Front fascia
4. Front fender
5. Front lateral panel
6. Central lateral panel
7. Rear lateral panel
8. Upper lateral panel
9. Rear Deflector

Subsection XX (BODY)

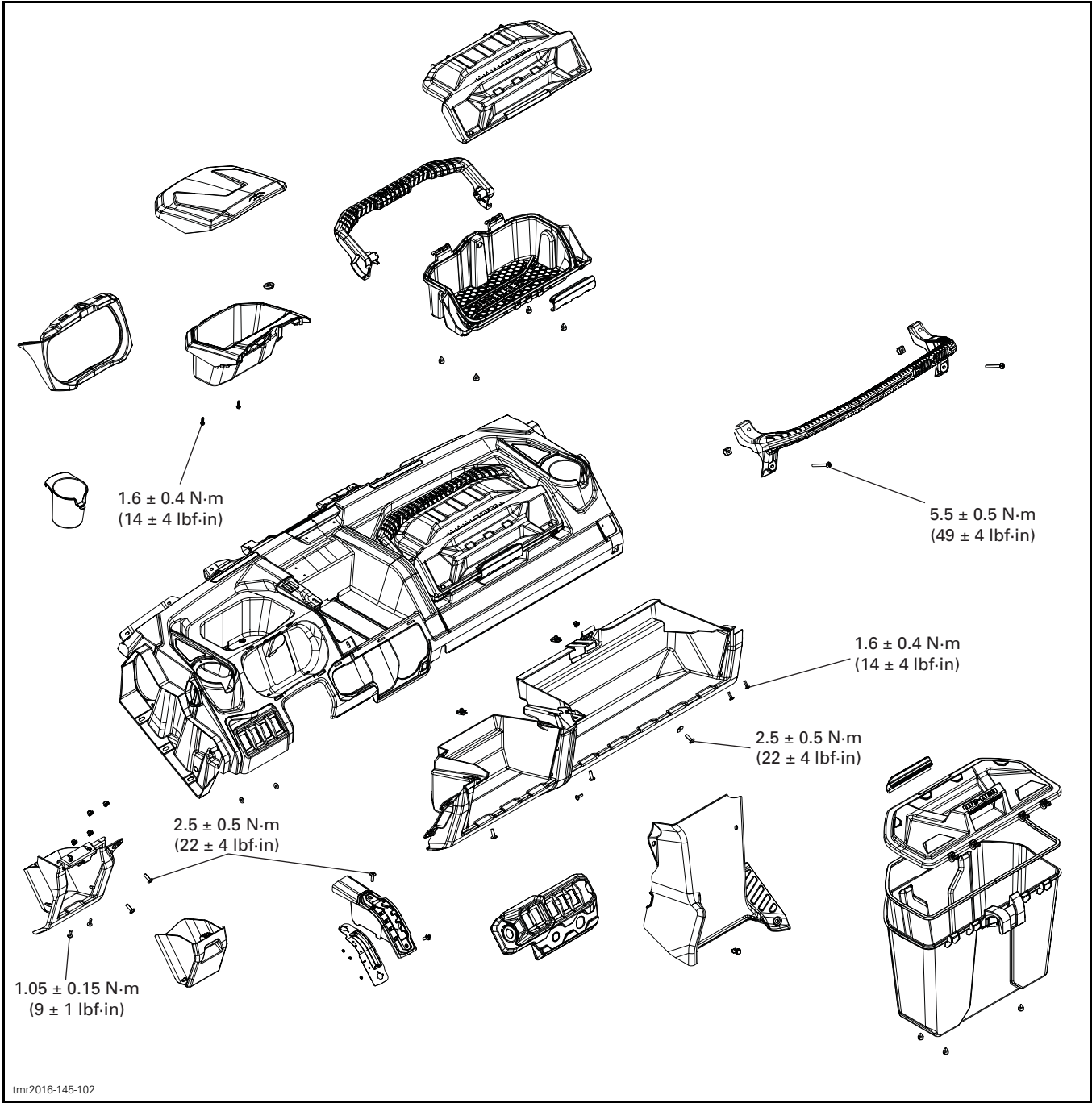


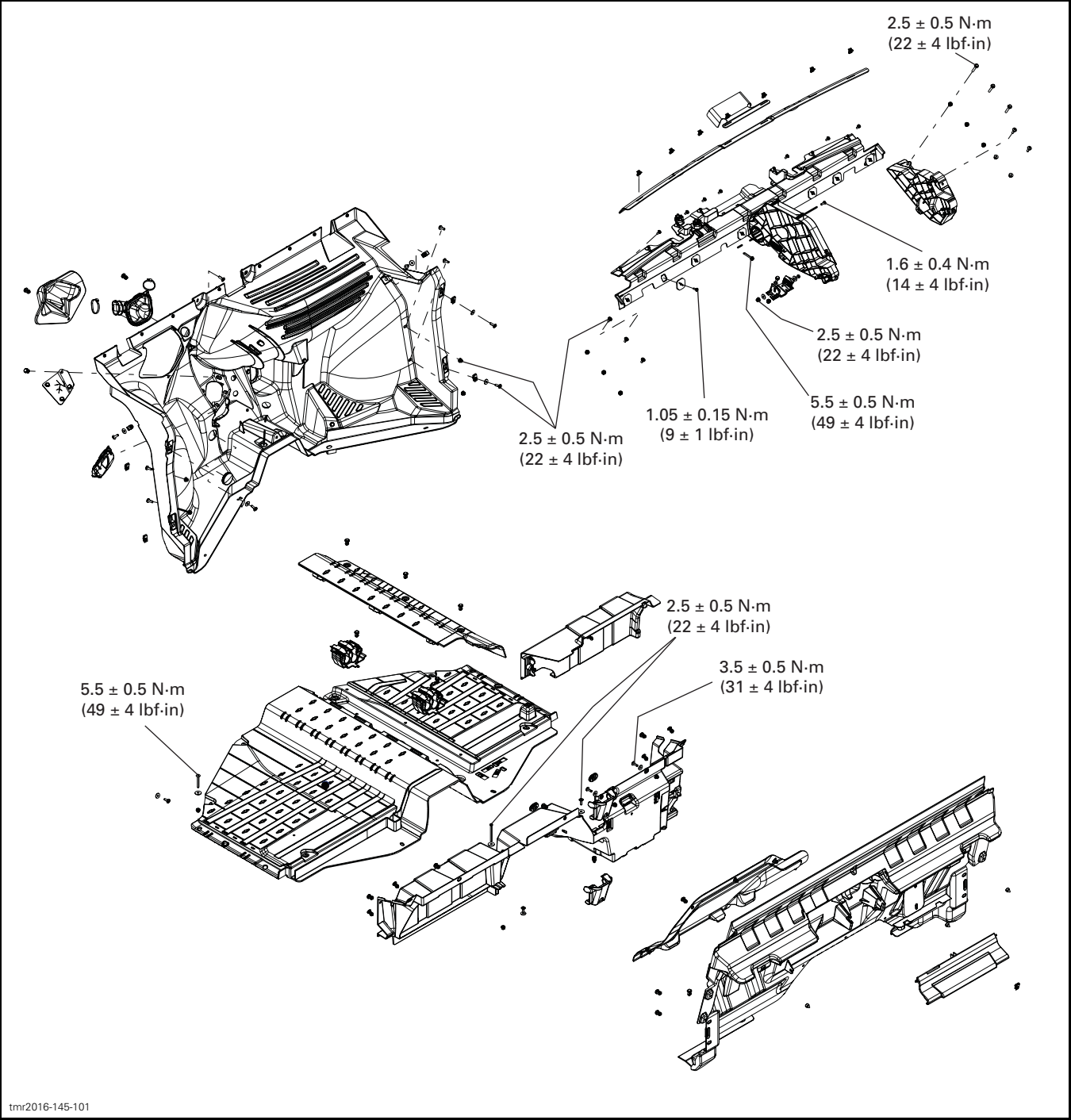
tmr2016-145-112_a

1. LH lower dash
2. Floor cover
3. Rear upper bulkhead
4. Rear service cover
5. Engine service cover
6. Rear lower bulkhead
7. Battery cover
8. Storage box
9. Floor
10. Front bulkhead
11. Front bulkhead cover
12. RH lower dash
13. Passenger handhold
14. Cup holder
15. Removable glove box
16. Switches panel
17. Shift indicator
18. Upper dash

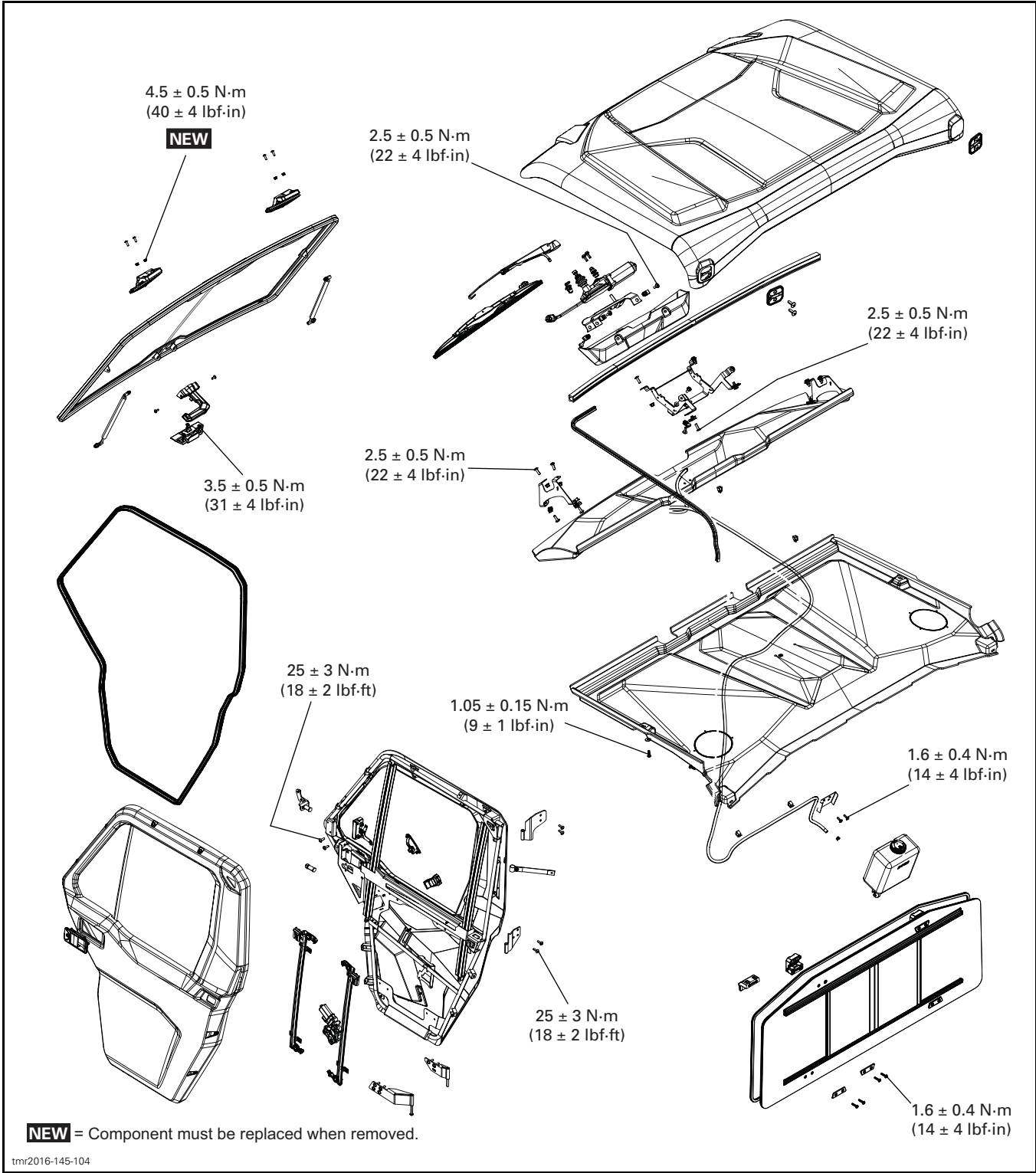


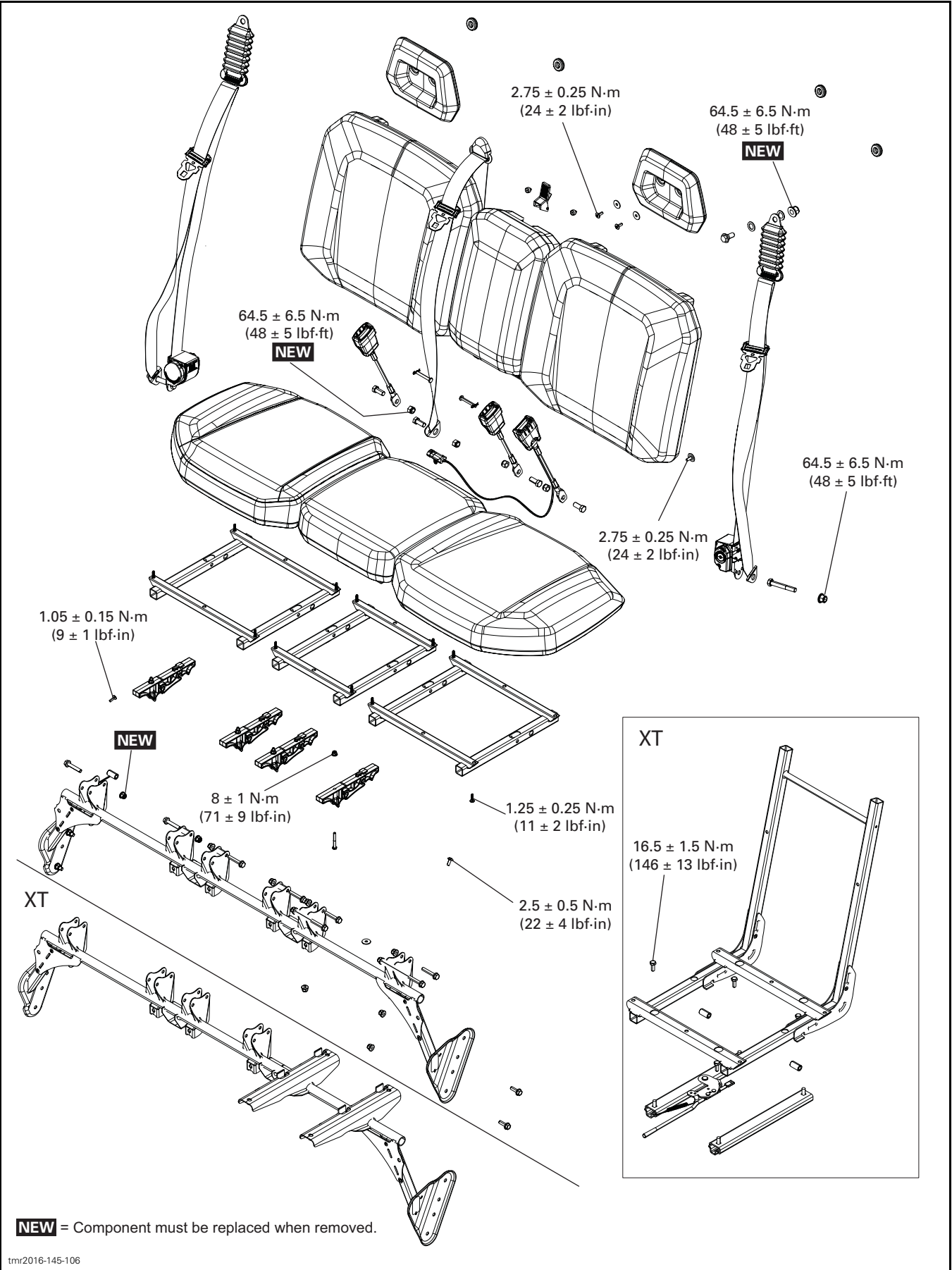
Subsection XX (BODY)





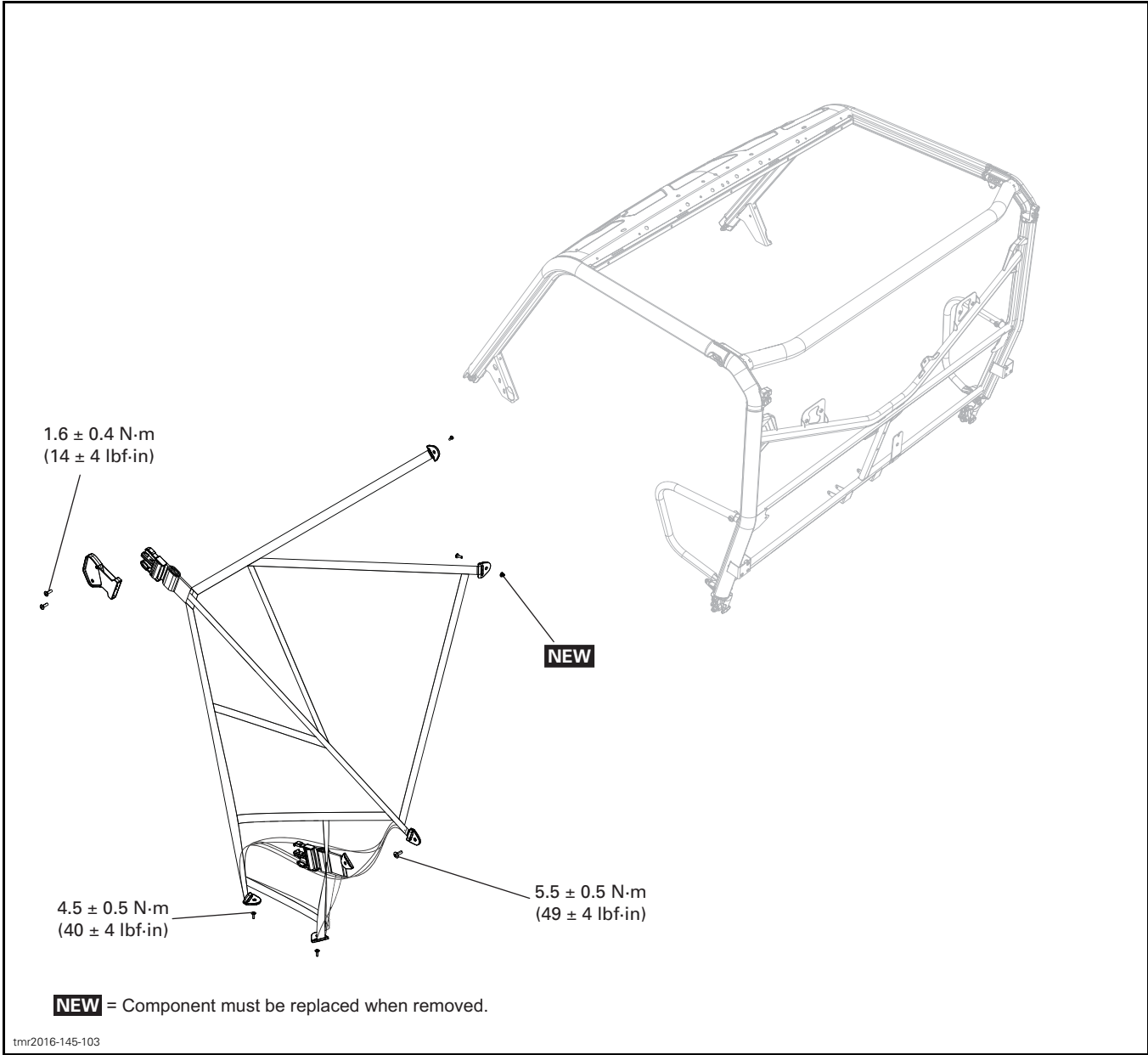
Subsection XX (BODY)





tmr2016-145-106

Subsection XX (BODY)



PROCEDURES

DECALS

Removing a Decal

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.

Installing a Decal

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.

BOTTOM END

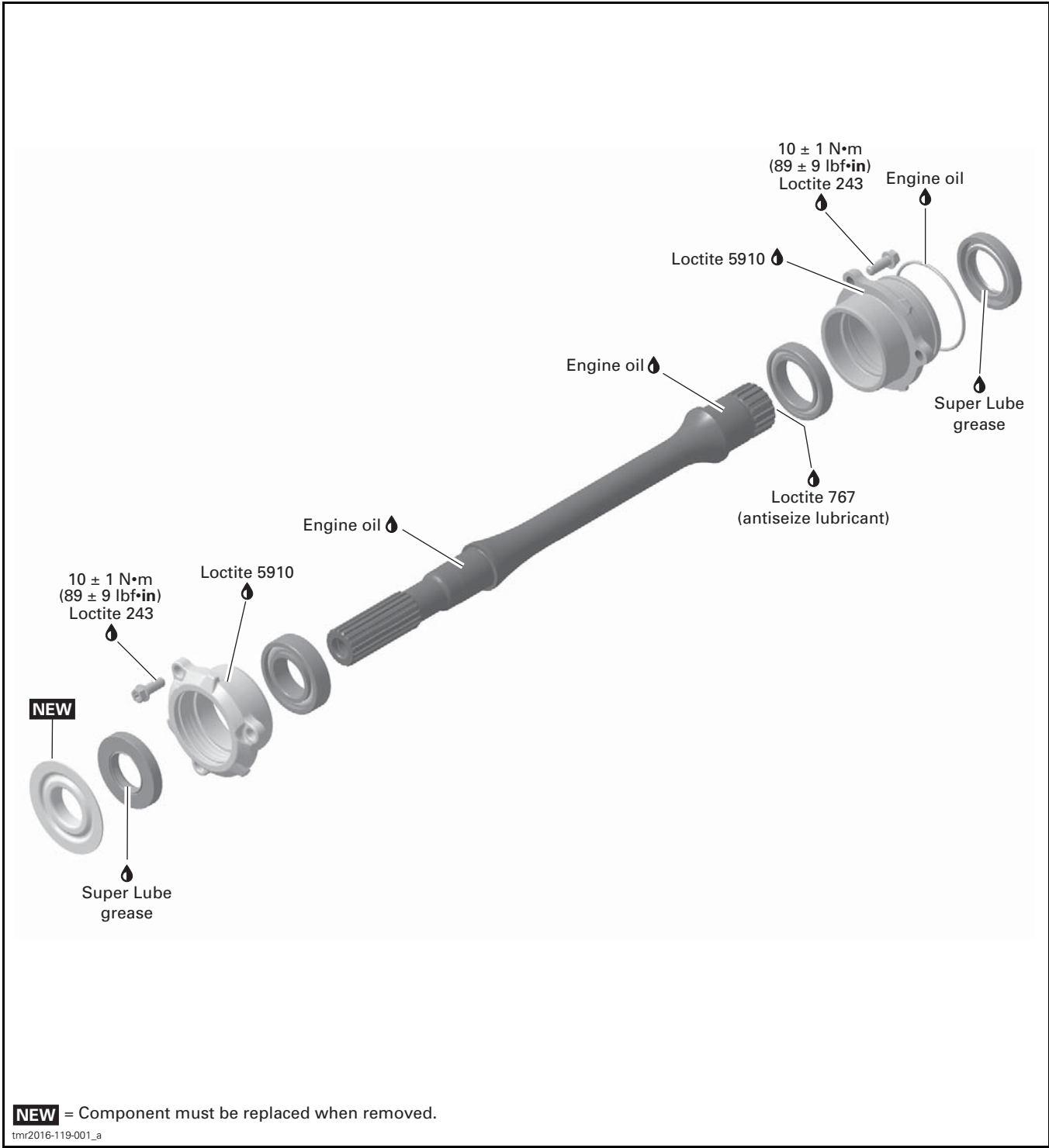
SERVICE TOOLS

Description	Part Number	Page
COVER WASHER INSTALLER.....	529 036 271	8
CRANKCASE SUPPORT MAG/PTO	529 036 031	16
CRANKSHAFT LOCKING BOLT.....	529 035 617	19
DRIVE SHAFT OIL SEAL INSTALLER	529 036 028	8–9
DRIVE SHAFT OIL SEAL PROTECTOR.....	529 036 029	7
PLAIN BEARING REMOVER/INSTALLER	529 035 917	16
PLAIN BEARING REMOVER/INSTALLER	529 036 032	11
PTO COVER OIL SEAL INSTALLER	529 036 033	9

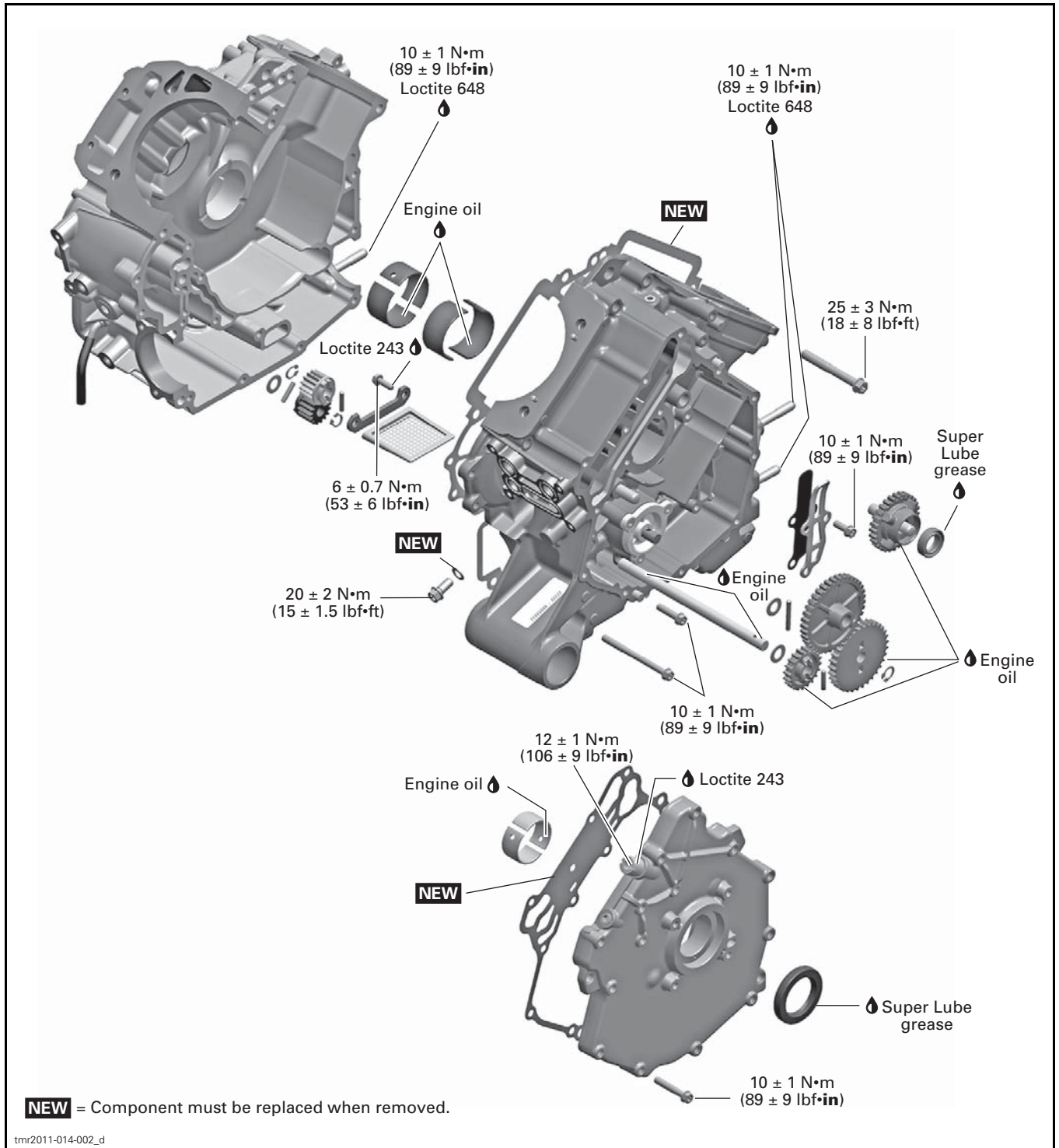
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	7
LOCTITE 5910	293 800 081	6
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	6

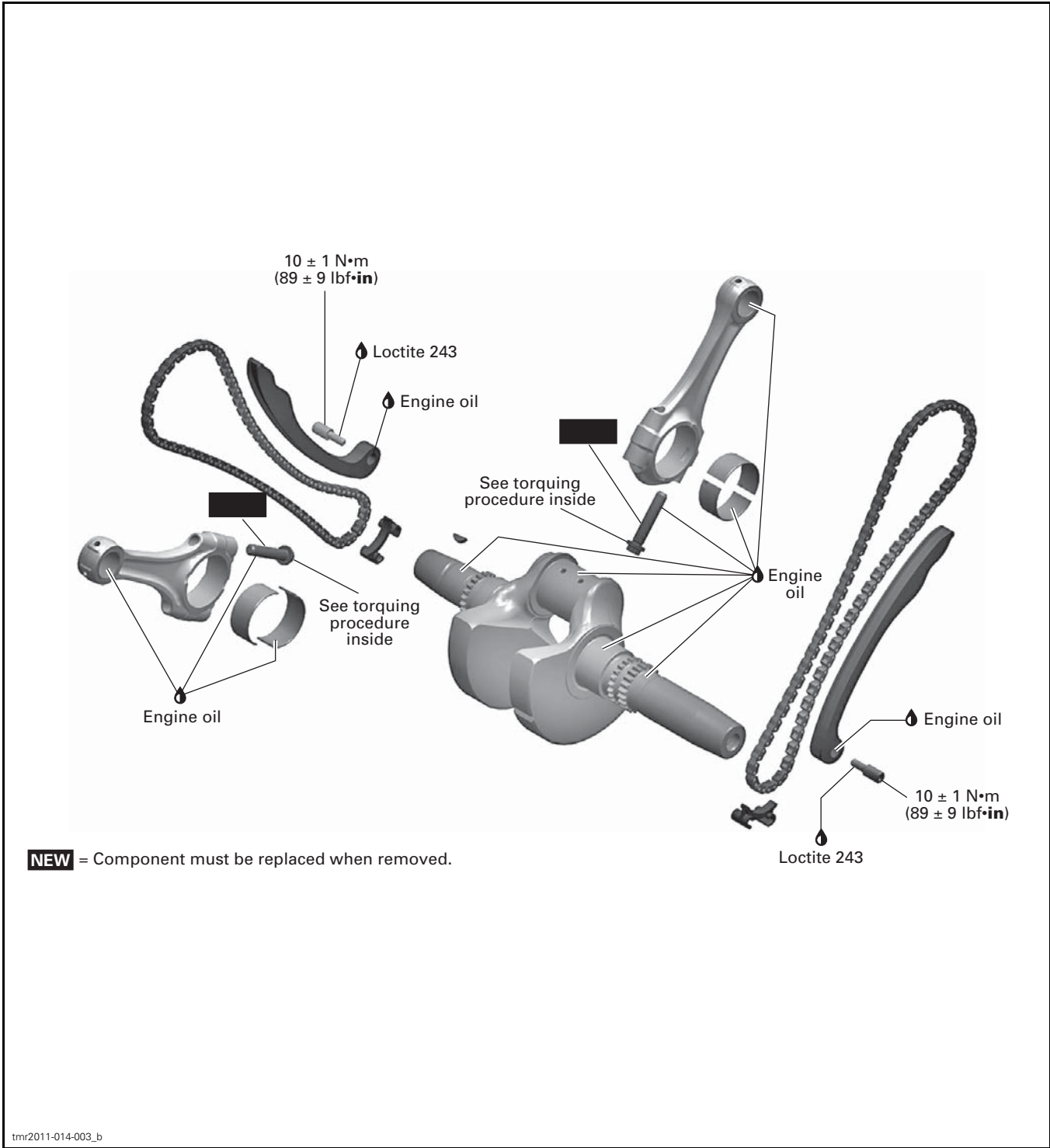
ENGINE DRIVE SHAFT



CRANKCASE AND PTO COVER



CRANKSHAFT



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.

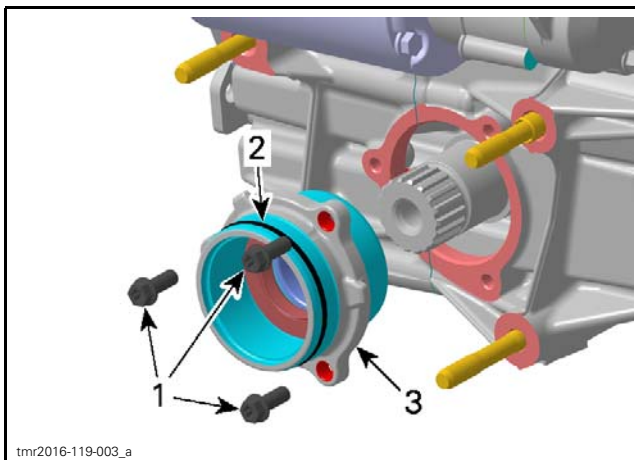
Removing the Engine Drive Shaft

Remove the engine. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Removing the Rear Bearing Cover

Detach gearbox from engine, refer to *GEARBOX AND 4X4 COUPLING UNIT* subsection.

Remove the bearing cover and its O-ring.



1. Bearing cover screws
2. O-ring
3. Bearing cover

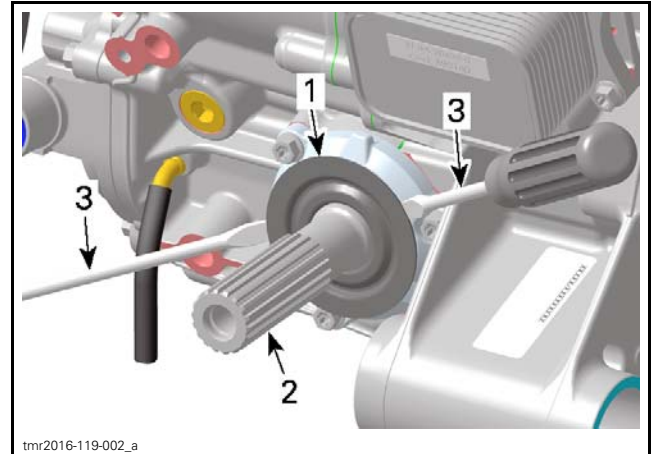
Removing the Front Bearing Cover

NOTE: The front bearing cover can be replaced with the engine installed.

Lift and support vehicle.

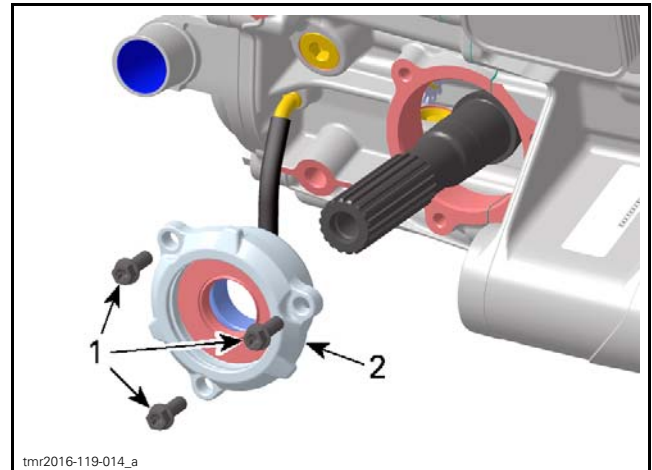
Remove the front drive shaft. Refer to *FRONT DRIVE* subsection.

Remove cover washer from drive shaft using 2 screwdrivers.



1. Cover washer
2. Drive shaft
3. Screwdrivers

Remove the bearing cover.



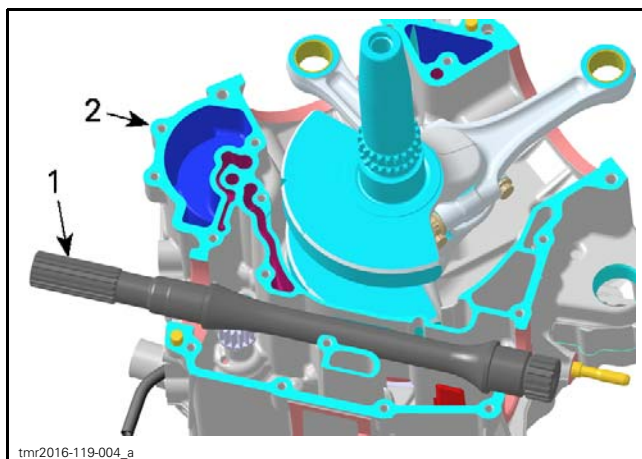
1. Bearing cover screws
2. Bearing cover

Removing the Engine Drive Shaft

Split crankcase, refer to *CRANKCASE* in this subsection.

Remove engine drive shaft from the crankcase.

Subsection XX (BOTTOM END)

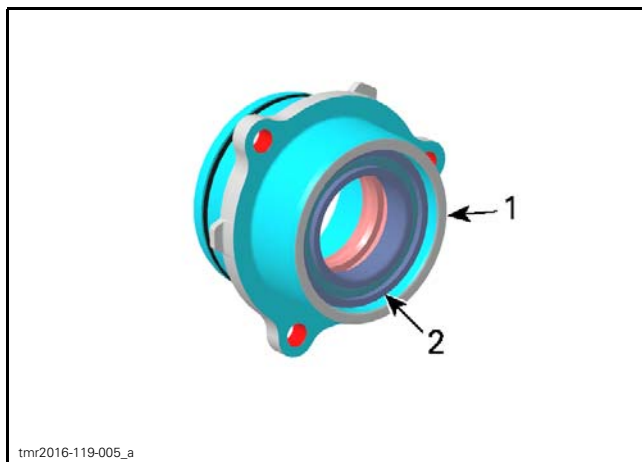


1. Engine drive shaft
2. Crankcase MAG side

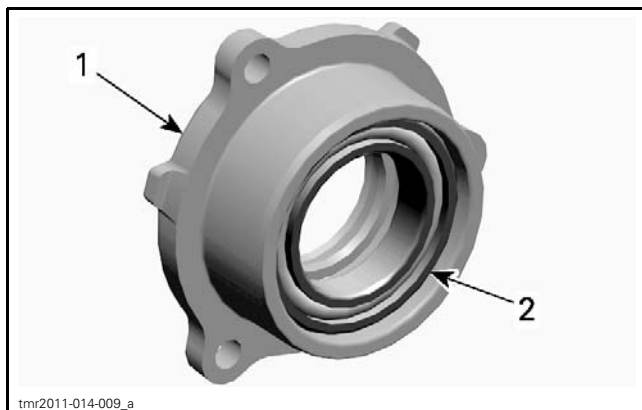
Inspecting the Engine Drive Shaft

Replace oil seals and/or O-ring (bearing cover gearbox side) if they are brittle, hard or damaged.

Check drive shaft bearings for contamination and/or metal shavings. Check if bearings turn freely and smoothly. Replace if necessary.



1. Rear bearing cover
2. Drive shaft bearing



1. Front 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.

Installing the Engine Drive Shaft

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.

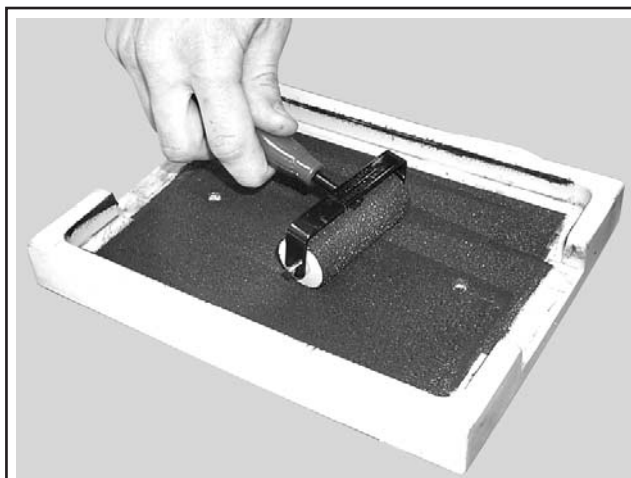
NOTICE Do not wipe with rags. Use a new clean hand towel only.

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.



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Do not apply in excess as it will spread out inside crankcase.

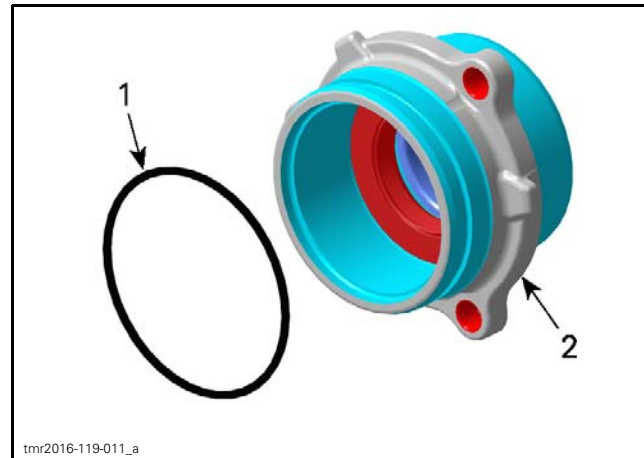
NOTE: It is recommended to apply this specific sealant as described here to get a uniform application without lumps. If you do not use the roller method, you may use your finger to uniformly distribute the sealant (using a finger will not affect the adhesion).

Installing the Rear Bearing Cover

Check O-ring on bearing cover if brittle, hard or damaged. Replace if necessary.

Lubricate O-ring.

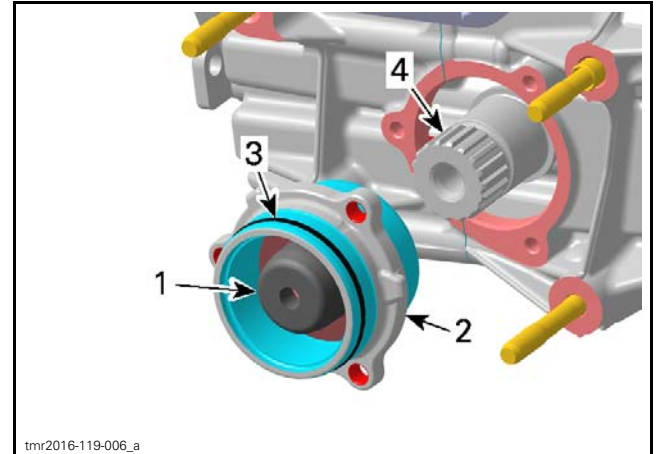
O-RING LUBRICATION	
Service product	Engine oil



1. O-ring
2. Bearing cover

For bearing cover installation on gearbox side, protect the oil seal to avoid damaging the sealing lip.

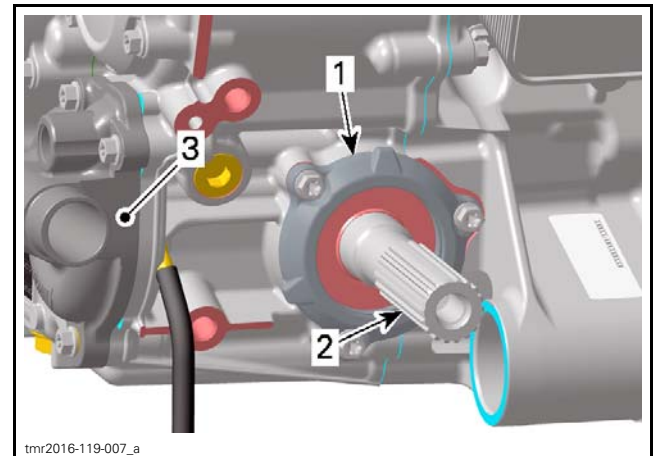
REQUIRED TOOL	
DRIVE SHAFT OIL SEAL PROTECTOR (P/N 529 036 029)	



1. Protection sleeve
2. Bearing cover
3. O-ring
4. Drive shaft

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Rear bearing cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Installing the Front Bearing Cover



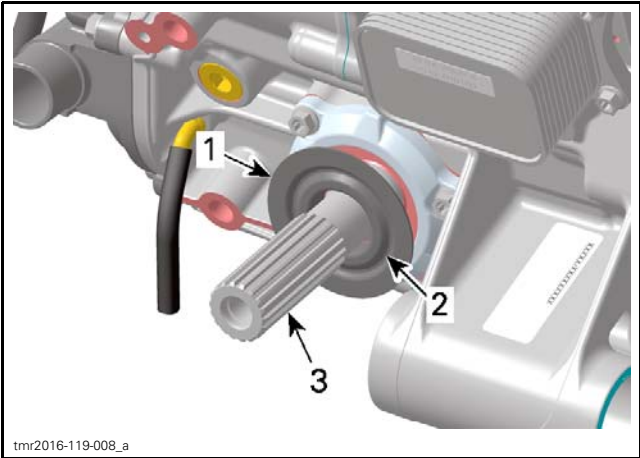
1. Bearing cover
2. Drive shaft
3. Water pump cover

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Front bearing cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Place **NEW** cover washer on drive shaft.

NOTE: Groove must face outwards the engine

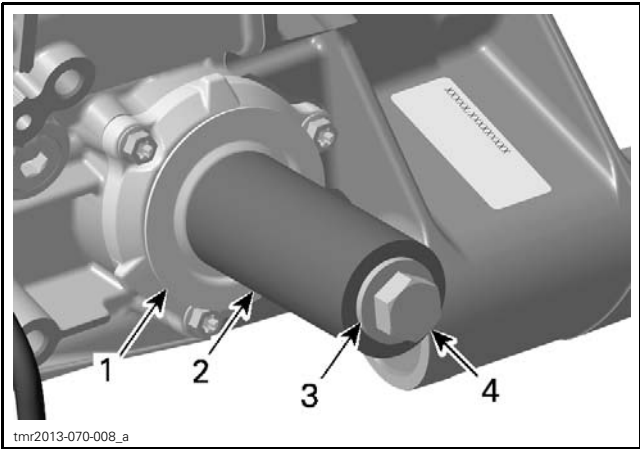
Subsection XX (BOTTOM END)



- 1. Cover washer
- 2. Groove
- 3. Drive shaft

Press cover washer on drive shaft.

REQUIRED TOOL	
COVER WASHER INSTALLER (P/N 529 036 271)	
Flat washer (P/N 250200102)	
M12 x 1.25 x 35 hexagonal screw	



- 1. Cover washer
- 2. Cover washer installer (P/N 529 036 271)
- 3. Flat washer (P/N 250200102)
- 4. M12 x 1.25 x 35 hexagonal screw

Installing the Engine Drive Shaft

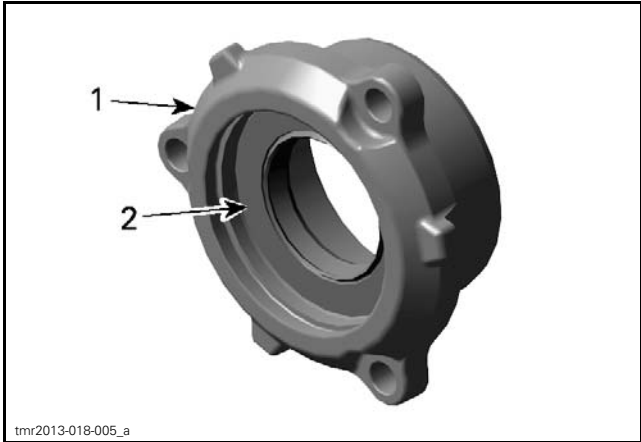
Finally check for axial play of the drive shaft.

FRONT OIL SEAL
(ENGINE DRIVE SHAFT)

Front Oil Seal Replacement
(Engine Drive Shaft)

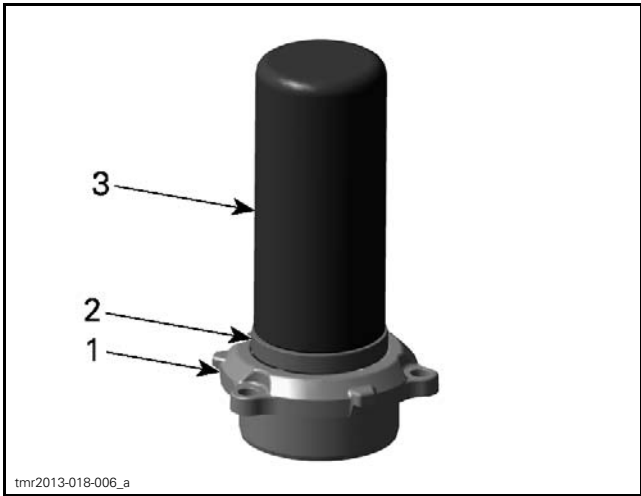
- 1. Remove front propeller shaft. Refer to *FRONT DRIVE* subsection.

- 2. Remove the front bearing cover, refer to *ENGINE DRIVE SHAFT REMOVAL/INSTALLATION* in this subsection.
- 3. Remove drive shaft seal from bearing cover.



- 1. Bearing cover
- 2. Oil seal

- 4. Install drive shaft oil seal.



- 1. Bearing cover
- 2. Oil seal
- 3. Oil seal installer

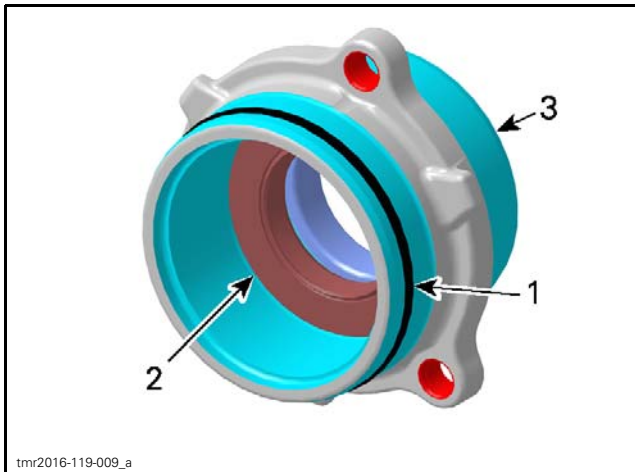
REQUIRED TOOL	
DRIVE SHAFT OIL SEAL INSTALLER (P/N 529 036 028)	

- 5. Reinstall remaining parts in the reverse order of removal.

REAR OIL SEAL (ENGINE DRIVE SHAFT)

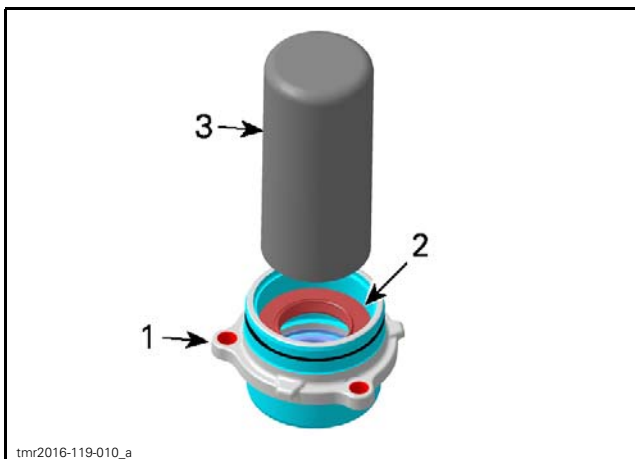
Rear Oil Seal Replacement (Engine Drive Shaft)

1. Remove rear bearing cover, refer to *ENGINE DRIVE SHAFT REMOVAL/INSTALLATION* in this subsection.
2. Remove drive shaft seal from bearing cover.



1. O-ring
2. Oil seal
3. Bearing cover

3. Install drive shaft oil seal.



1. Bearing cover
2. Oil seal
3. Oil seal installer

REQUIRED TOOL

DRIVE SHAFT OIL SEAL
INSTALLER (P/N 529 036 028)



4. 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.

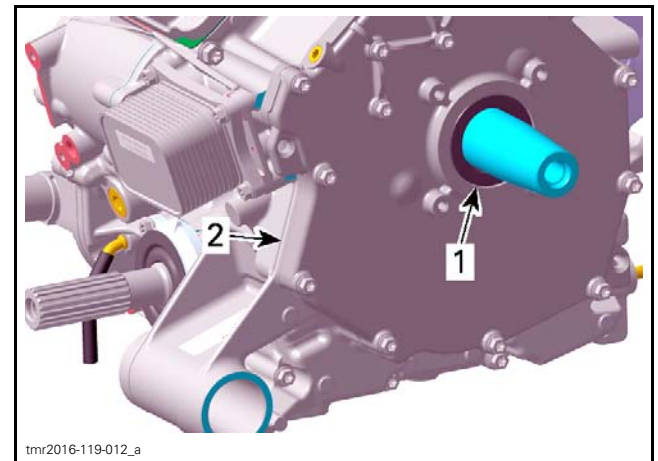
Removing the PTO Oil Seal

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. Oil seal
2. PTO cover

Inspecting the PTO Oil Seal

Check oil seal running surface of crankshaft PTO side for grooves. Replace if necessary.

Installing the PTO Oil Seal

The installation is the reverse of the removal procedure.

Pay attention to the following details.

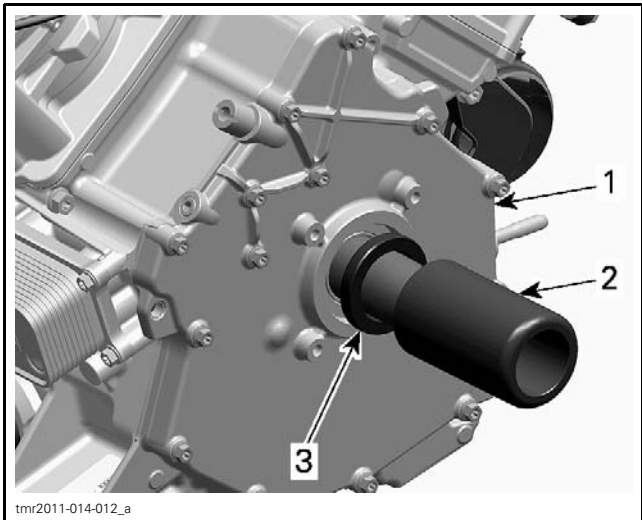
NOTICE Oil seal must be installed with sealing lip toward the engine.

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

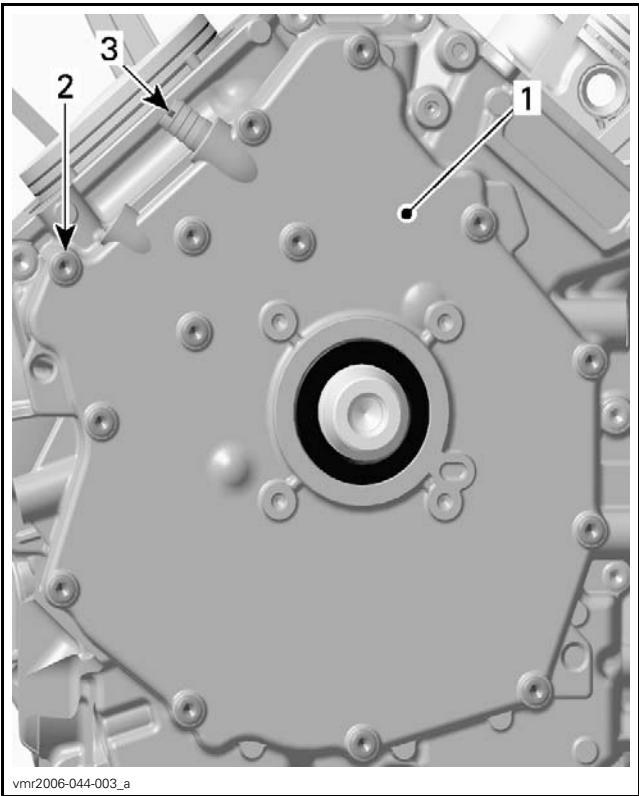
Removing the PTO Cover

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

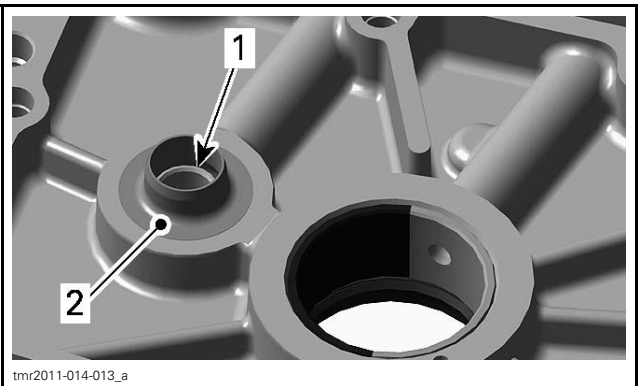
Inspecting the PTO Cover

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.

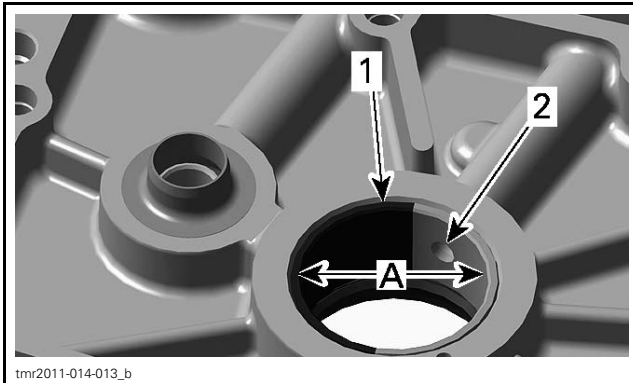
Check surface of sealing sleeve for wear or other damages. Replace PTO cover if damaged.



- 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)

Removing the Plain Bearing

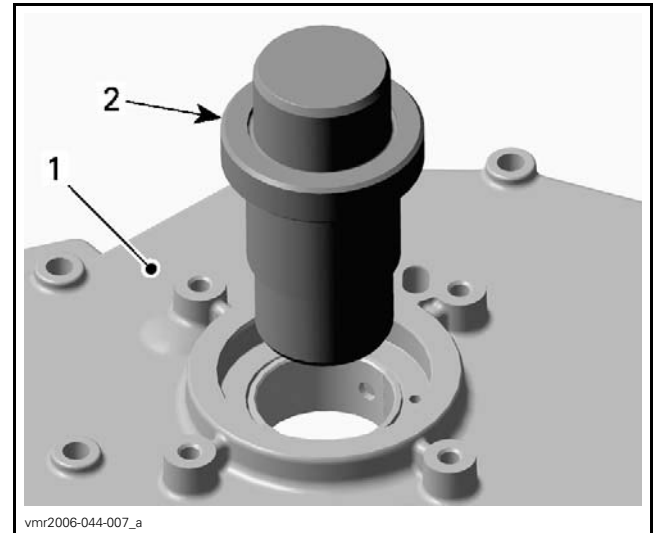
NOTICE Unless otherwise instructed, never use a hammer to install plain bearings. Use a press only.

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

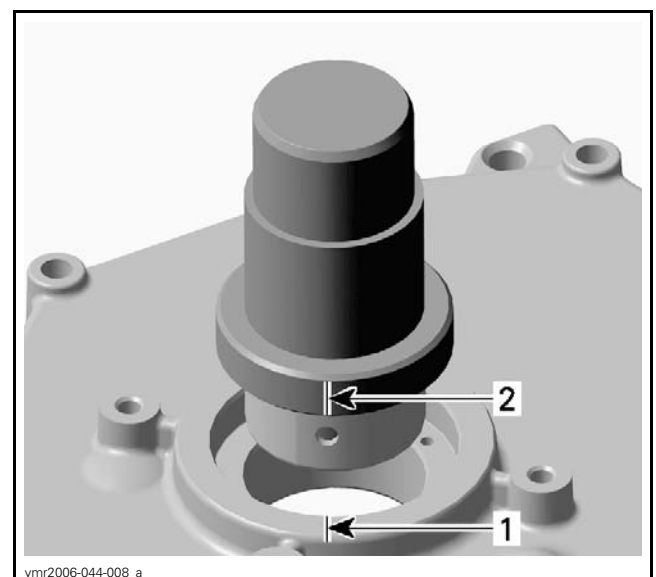
Installing the Plain Bearing

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.



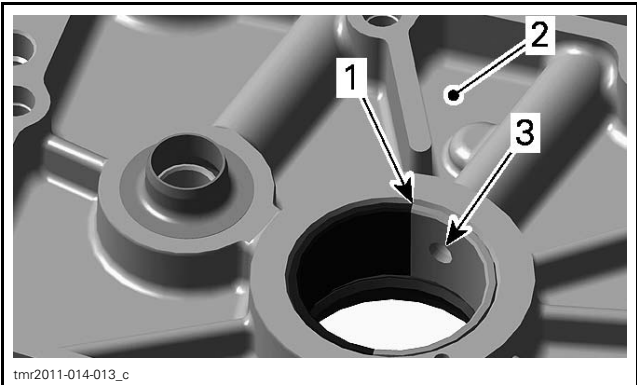
1. Mark position of oil bore on PTO cover
2. Mark position of oil bore on plain bearing remover/installer

Subsection XX (BOTTOM END)

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

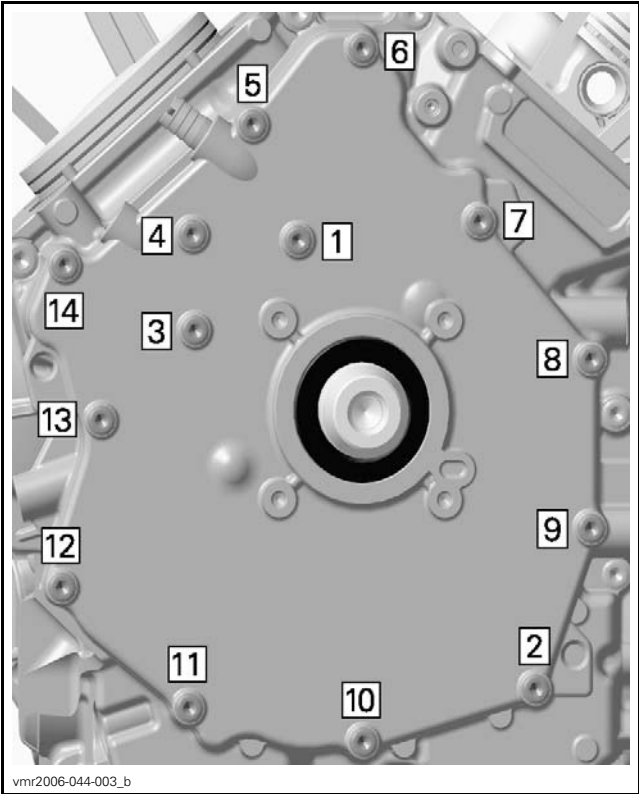
Installing the PTO Cover

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

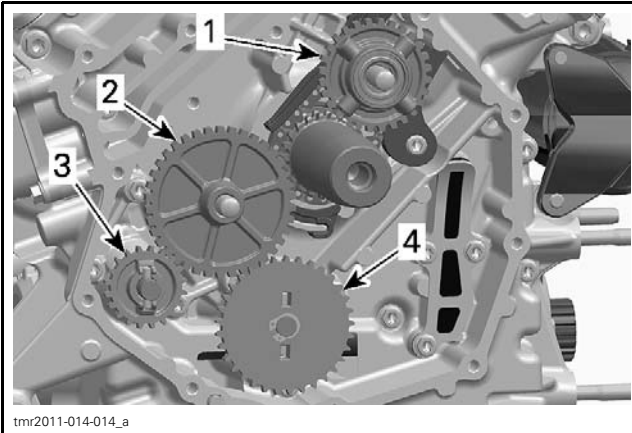
TIGHTENING TORQUE	
PTO cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

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.



1. Breather gear
2. Intermediate gear
3. Water pump drive gear
4. Oil pump drive gear

Removing the Drive Gears

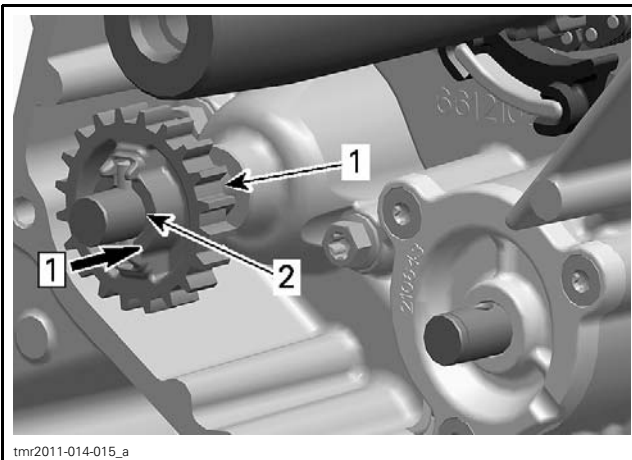
Remove PTO cover (refer to *PTO COVER*).

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.

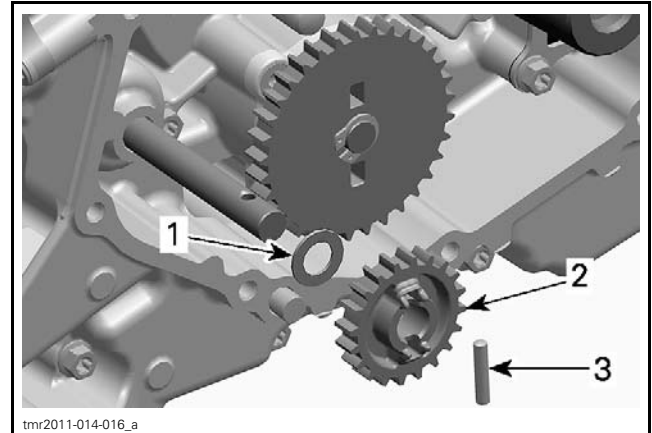
Then push water pump drive gear in.



- 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

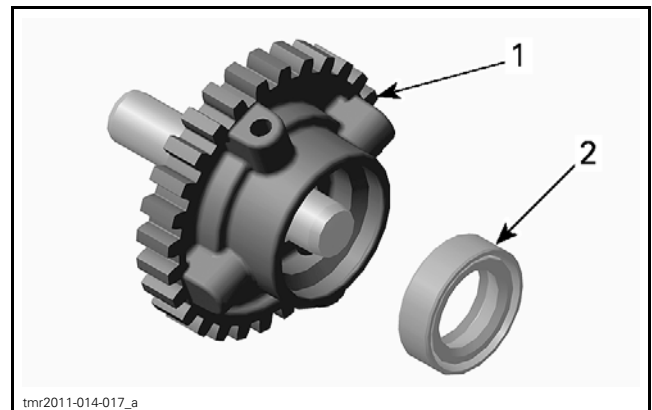
Inspecting the Drive Gears

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.

Installing the Drive Gears

The installation is essentially the reverse of the removal procedure.

Adequately oil the ball bearing of the breather gear.

CRANKCASE

Disassembling the Crankcase

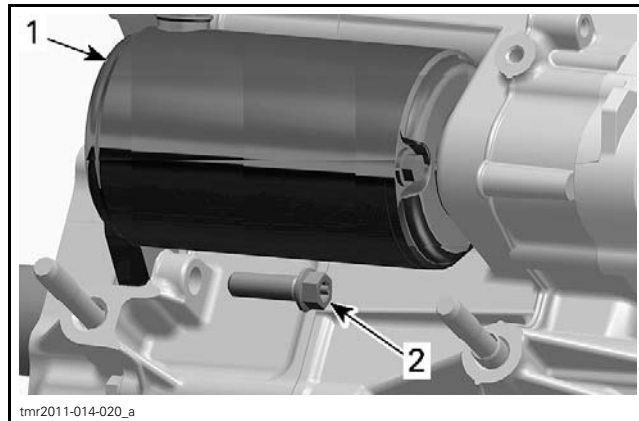
1. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection and:
 - 1.1 Drain cooling system.
 - 1.2 Drain engine oil.
 - 1.3 Drain gearbox oil.
2. Lock crankshaft. Refer to *CRANKSHAFT LOCKING PROCEDURE* in the this subsection.
3. Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection to remove 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 (HD10 engine only)
- 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).

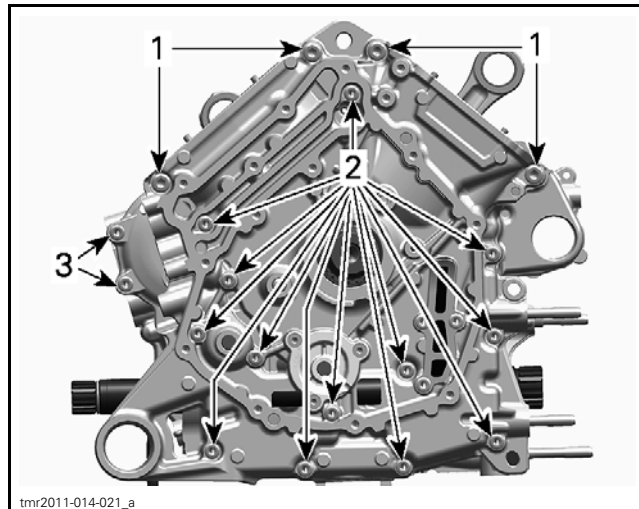
12. Remove electric starter.



1. Electric starter
2. Screw

NOTE: Before splitting the crankcase, measure crankshaft axial play. Refer to *CRANKSHAFT*.

Remove retaining screws of crankcase.



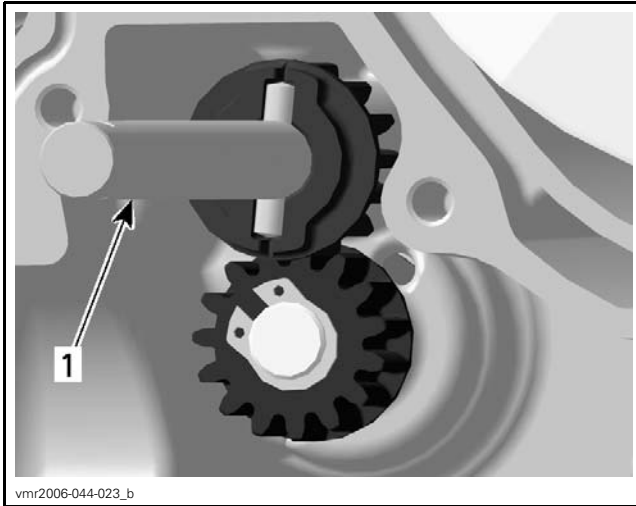
1. 4 screws M8 x 65
2. 13 screws M6 x 75
3. 2 screws M6 x 25

Carefully split crankcase halves.

NOTE: During disassembly, do not damage the sealing surfaces of the crankcase halves.

Pull crankshaft out of crankcase.

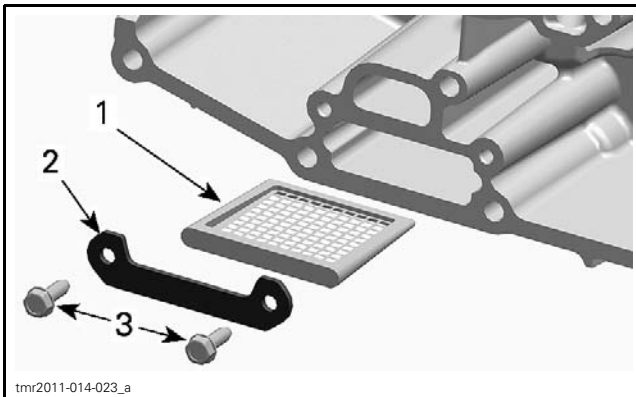
Remove the water pump intermediate shaft.



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

Cleaning the Crankcase

Clean crankcase using a part cleaner.

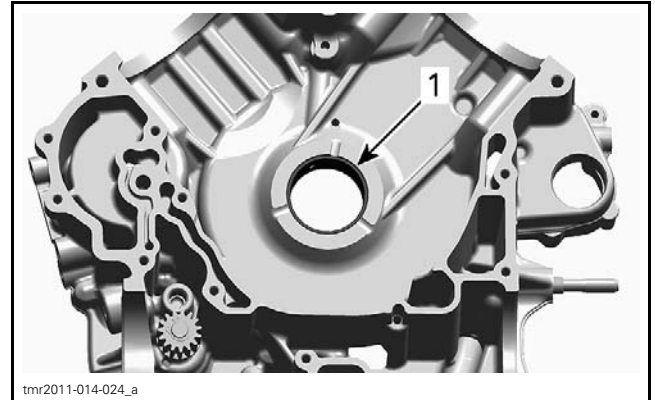
Dry crankcase using compressed air.

Blow the oil supply lines.

Inspecting the Crankcase

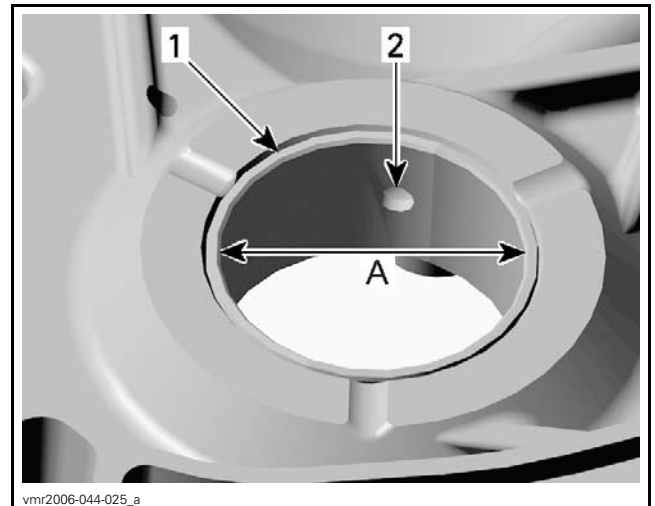
Check crankcase halves for cracks or other damage. Replace if damaged.

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)

Removing the Plain Bearing

NOTICE Always support crankcase halves properly when plain bearings are removed. Damages to crankcase halves may occur if this procedure is not performed correctly.

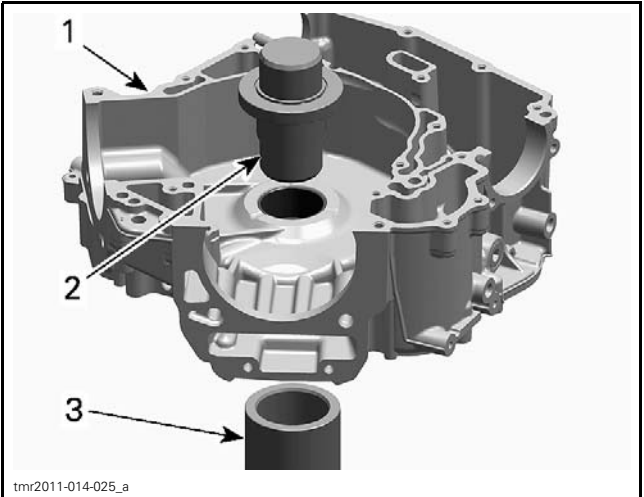
NOTE: Always use a press for removal of plain bearings.

Carefully press the plain bearings out, from the crankcase half inside towards the outside.

Subsection XX (BOTTOM END)

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)

Installing the Plain Bearing (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.

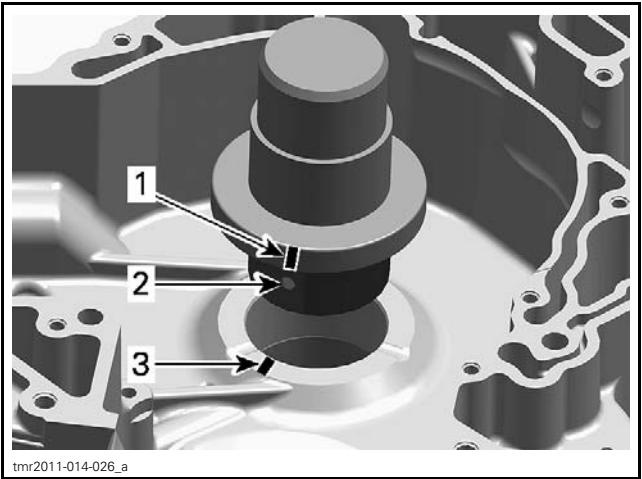
REQUIRED TOOL	
PLAIN BEARING REMOVER/INSTALLER (P/N 529 035 917)	

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.

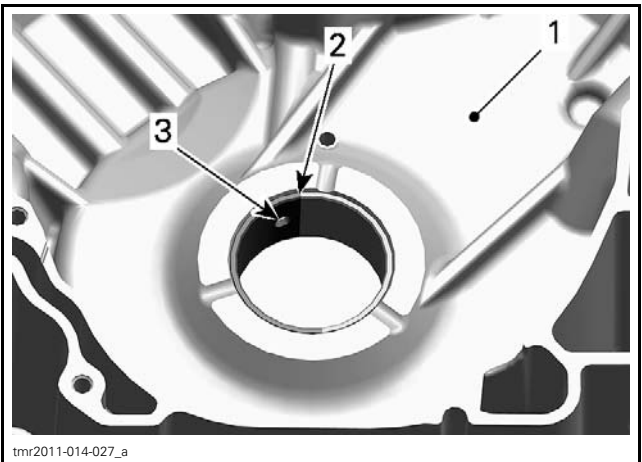


1. Oil bore position marked on plain bearing remover/installer
2. Plain bearing oil bore
3. Oil bore position marked on crankcase

NOTICE Misalignment of the plain bearing and crankcase oil bores will prevent proper oil supply to plain bearings.

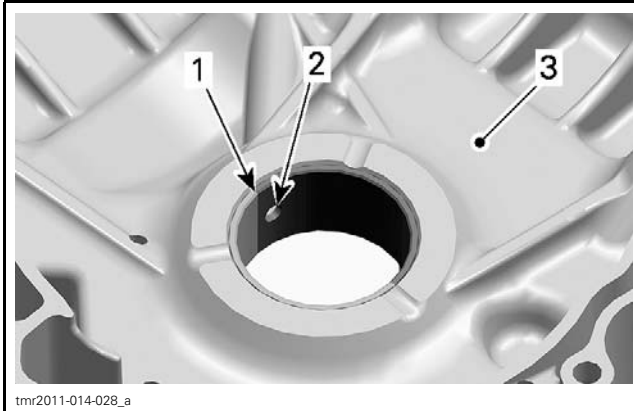
Carefully press in the plain bearings from inside the crankcase towards the outside.

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)

Assembling the Crankcase

The assembly of crankcase is essentially the reverse of removal procedure. However, pay attention to the following details.

Install a **NEW** crankcase gasket.

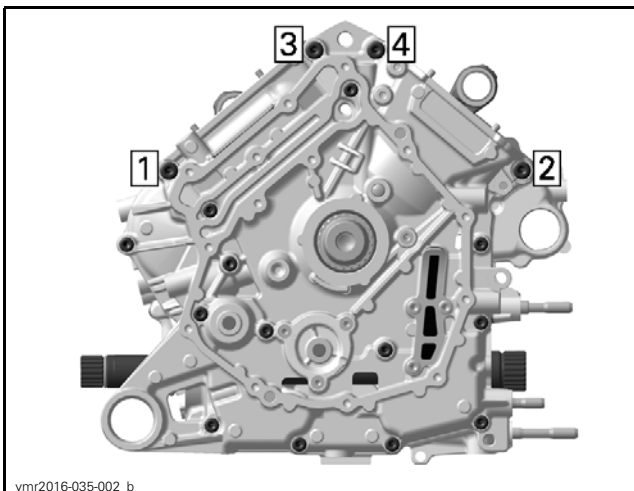
Oil the plain bearings before mounting the crankshaft.

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.

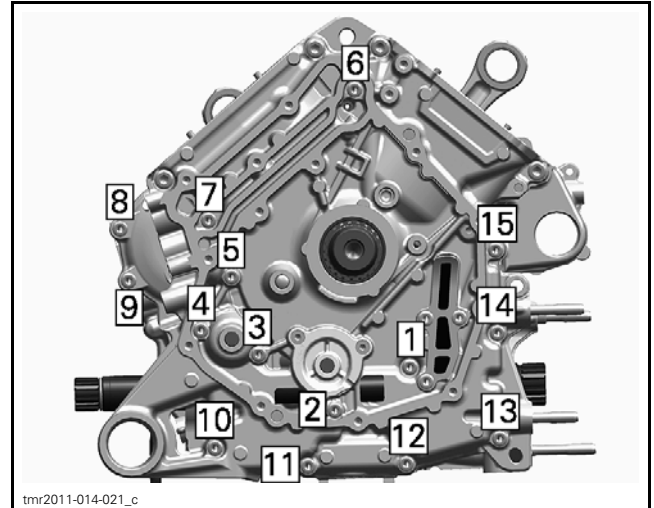
Tightening sequence for screws on crankcase is as per following illustration.



M8 SCREWS TIGHTENING SEQUENCE

TIGHTENING TORQUE

M8 crankcase screws	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)
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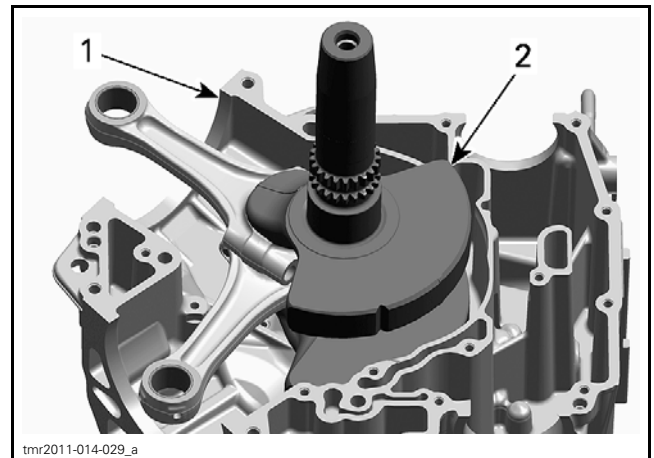


M6 SCREWS TIGHTENING SEQUENCE

TIGHTENING TORQUE

M6 crankcase screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)
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CRANKSHAFT



1. Crankcase MAG
2. Crankshaft

Crankshaft Locking Procedure

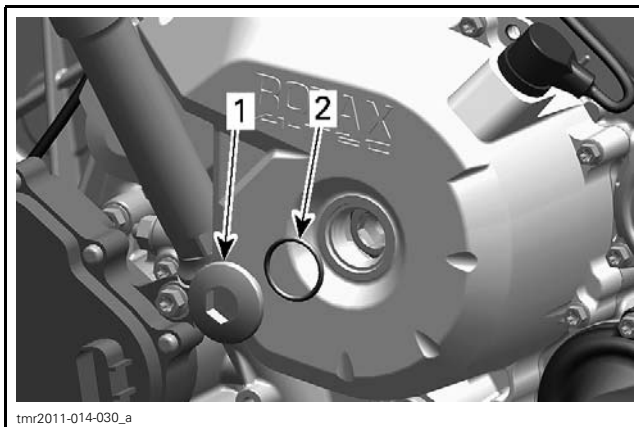
NOTE: When crankshaft is locked, the rear piston no. 2 is at TDC. Crankshaft can not be locked at piston no.1 TDC.

NOTICE To see if the rear piston no. 2 is at TDC ignition refer to **CAMSHAFT TIMING GEAR** in the **TIMING CHAIN** subsection.

Subsection XX (BOTTOM END)

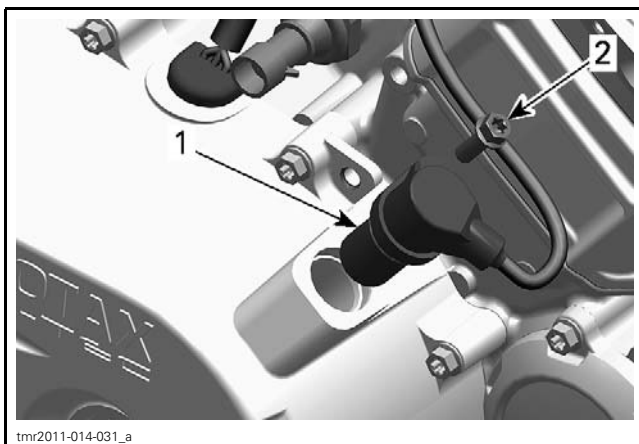
Remove:

1. Spark plug cables and spark plugs of both cylinders.
2. Plug screw and O-ring of magneto cover.



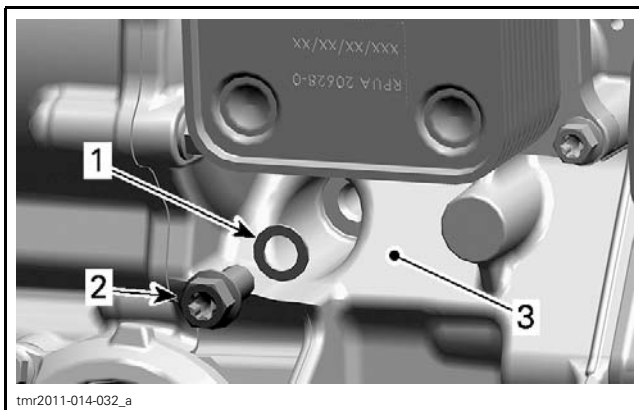
1. Plug screw
2. O-ring

3. Crankshaft position sensor.



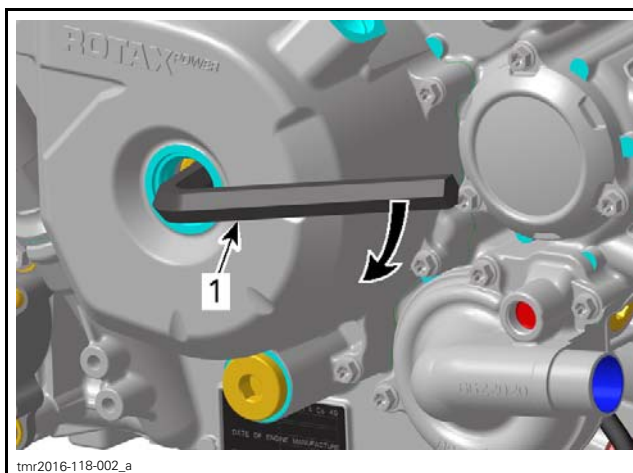
1. Crankshaft position sensor
2. Screw

4. Plug screw and discard sealing ring.



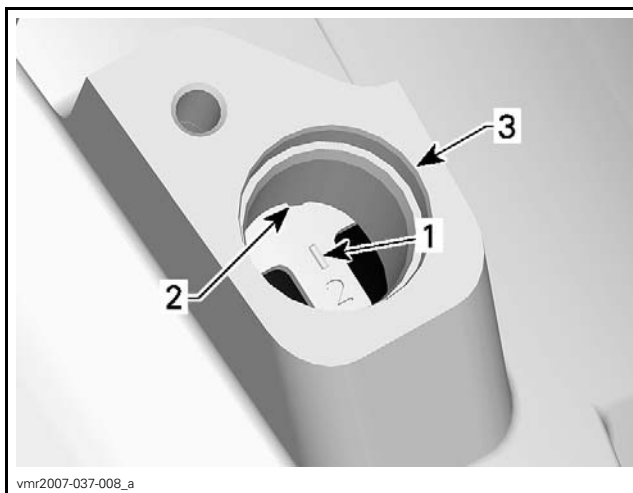
1. Sealing ring
2. Plug screw
3. Crankcase PTO side, front side

Use a 14 mm Allen key to turn crankshaft until piston no. 2 is at TDC.



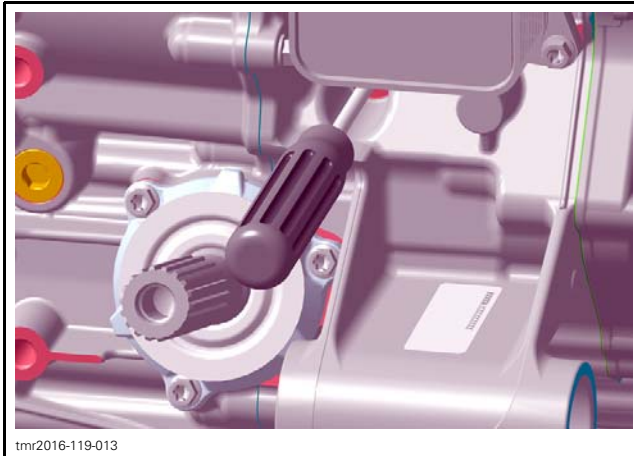
1. Allen key 14 mm

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



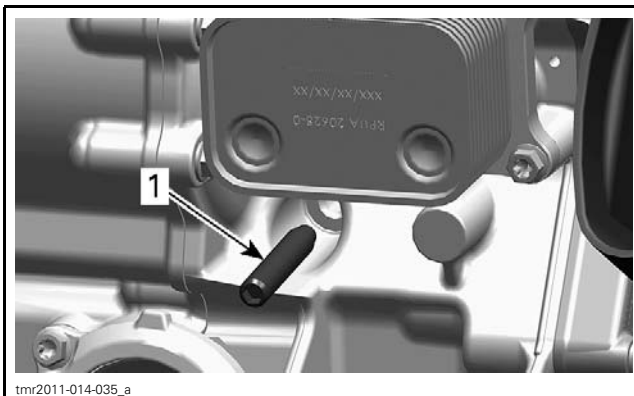
1. Mark "2" on magneto flywheel
2. Notch on magneto cover
3. Crankshaft position sensor location

Use a screwdriver to check if the groove in the crankshaft is aligned with the hole.



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.

Removing the Crankshaft

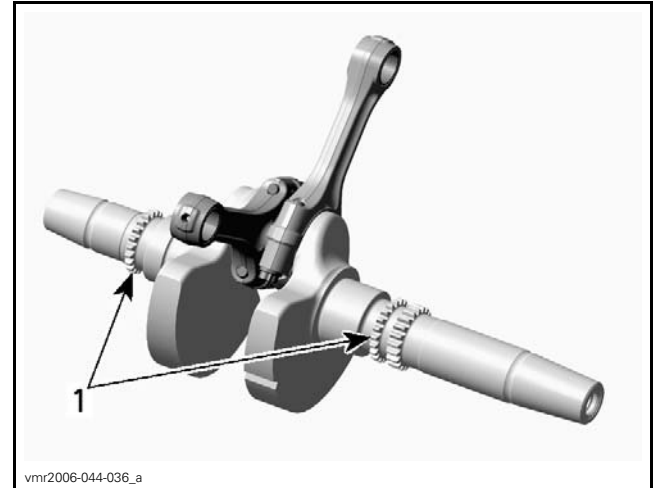
Refer to *CRANKCASE*.

Inspecting the Crankshaft

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.

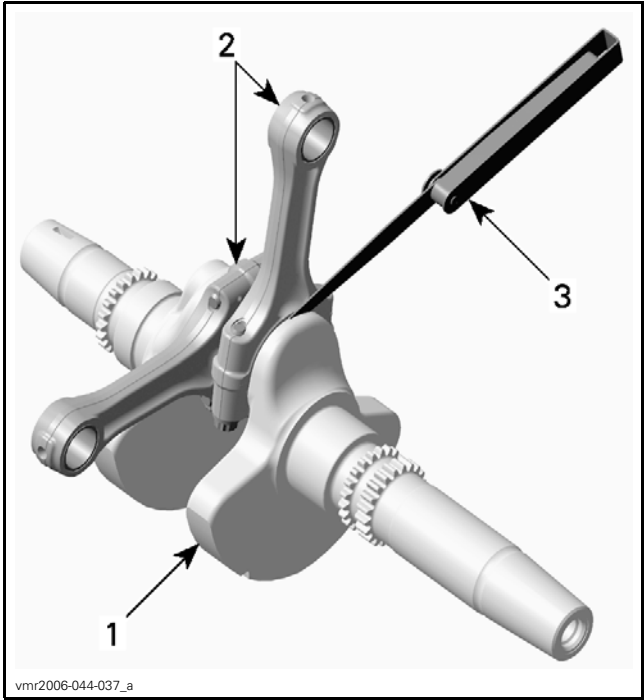
CRANKSHAFT AXIAL PLAY	
NEW	0.200 mm to 0.500 mm (.008 in to .02 in)
SERVICE LIMIT	0.600 mm (.024 in)

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.

Subsection XX (BOTTOM END)



1. Crankshaft
2. Connecting rods
3. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY		
HD8 ENGINE	NEW	0.200 mm to 0.500 mm (.008 in to .02 in)
	SERVICE LIMIT	0.600 mm (.024 in)
HD10 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

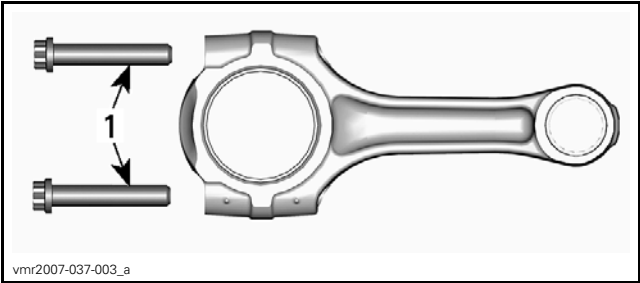
Refer to *TOP END* section.

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).

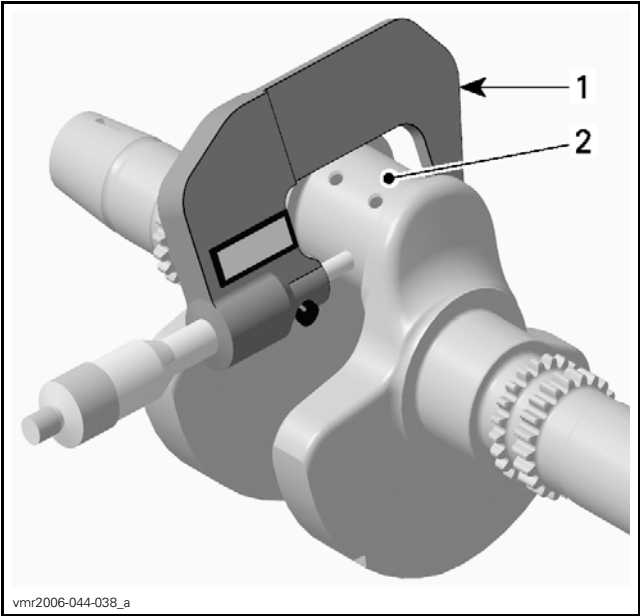
Remove connecting rods from crankshaft.

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

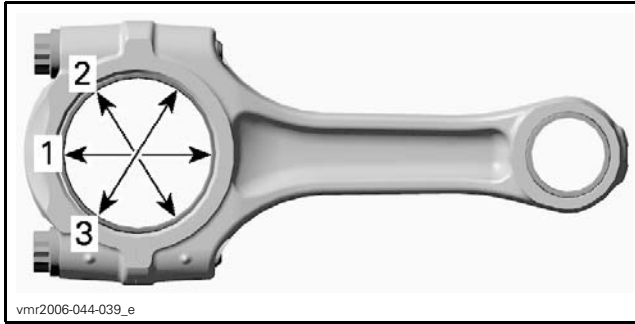
CRANK PIN DIAMETER		
HD8 ENGINE	NEW	40.001 mm to 40.025 mm (1.5748 in to 1.5758 in)
	SERVICE LIMIT	39.990 mm (1.5744 in)
HD10 ENGINE	NEW	41.986 mm to 42.010 mm (1.653 in to 1.6539 in)
	SERVICE LIMIT	41.967 mm (1.6522 in)

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.



MEASURE AT 3 DIFFERENT POSITIONS

CONNECTING ROD BIG END DIAMETER		
HD8 ENGINE	SERVICE LIMIT	40.100 mm (1.5787 in)
HD10 ENGINE		42.100 mm (1.6575 in)

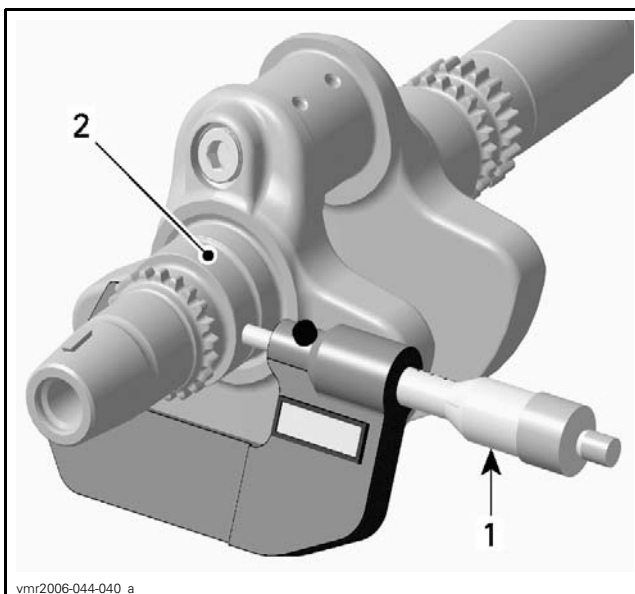
If connecting rod big end diameter is out of specification, replace plain bearings and recheck.

CONNECTING ROD BIG END RADIAL CLEARANCE		
HD8/HD10 ENGINES	SERVICE LIMIT	0.09 mm (.0035 in)

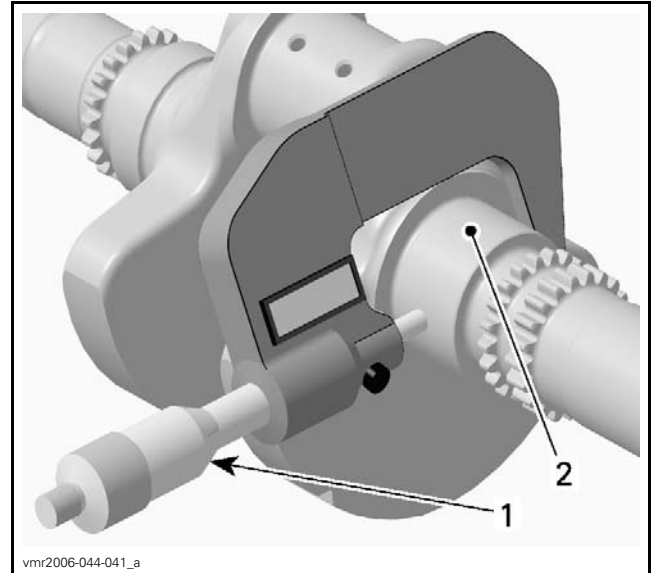
If connecting rod big end radial clearance is out of specification, replace plain bearings and recheck.

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



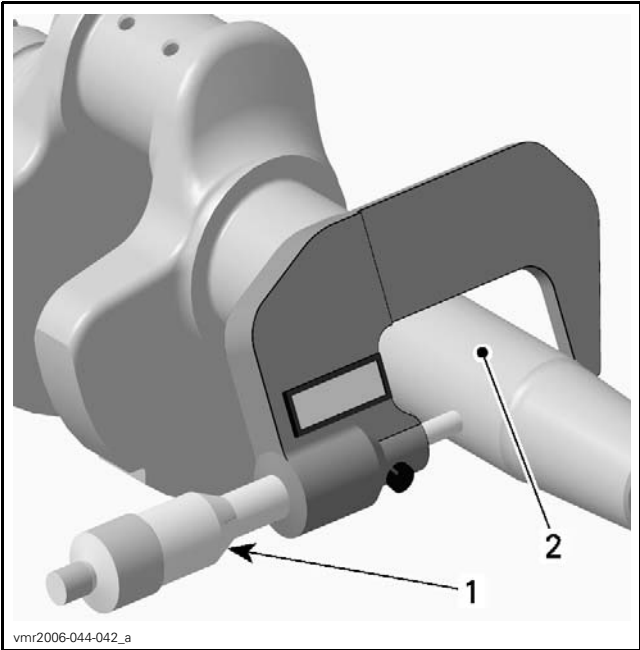
1. Micrometer
2. Crankshaft area for PTO plain bearing

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.

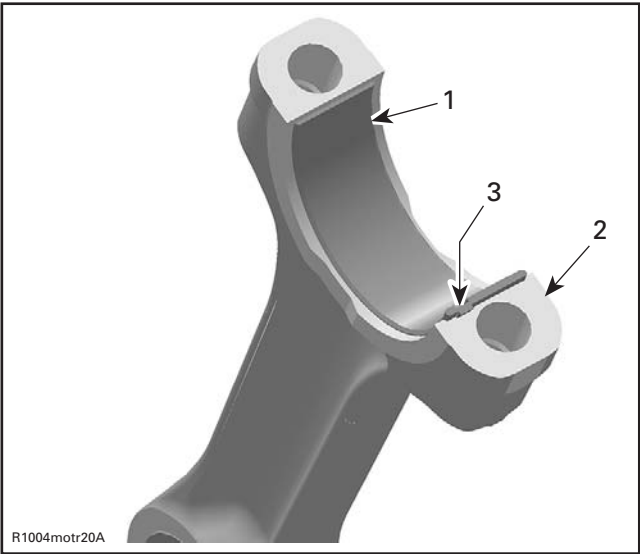
If crankshaft radial play (PTO cover bearing) out of specification, replace plain bearings and recheck.

Assembling the 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.

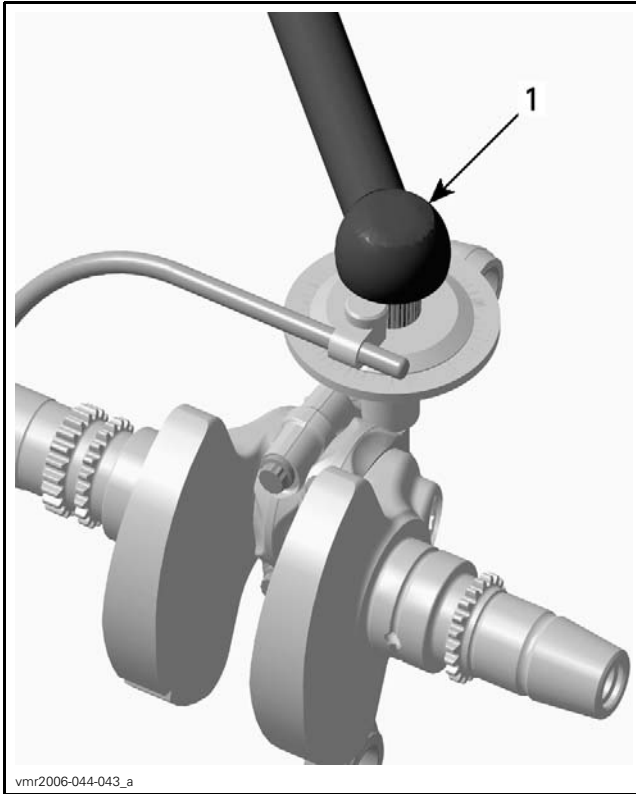
NOTICE Always use NEW connecting rod screws at final assembly. They are not reusable.

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



1. Angle torque wrench

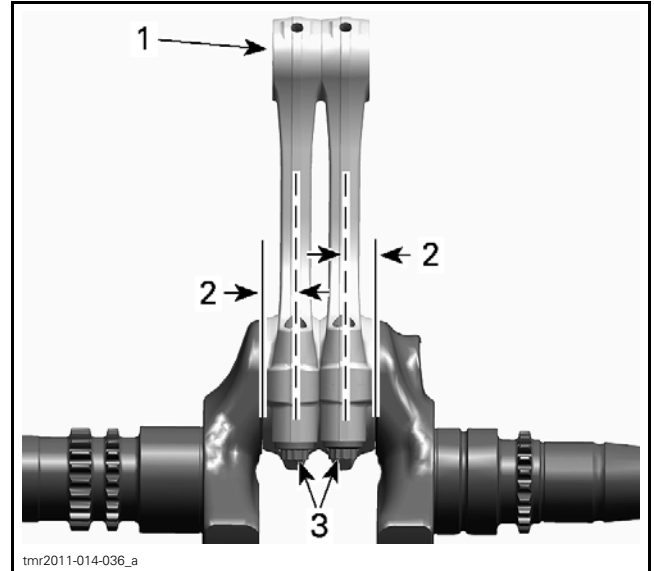
HD8 Engine:

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 $20 \text{ N}\cdot\text{m} \pm 2 \text{ N}\cdot\text{m}$ ($15 \text{ lbf}\cdot\text{ft} \pm 1 \text{ lbf}\cdot\text{ft}$)
3.	Torque by an additional $60 \pm 5^\circ$ turn using an angle torque wrench

HD10 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 $30 \text{ N}\cdot\text{m} \pm 2 \text{ N}\cdot\text{m}$ ($22 \text{ lbf}\cdot\text{ft} \pm 1 \text{ lbf}\cdot\text{ft}$)
3.	Torque by an additional $90 \pm 5^\circ$ turn using an angle torque wrench

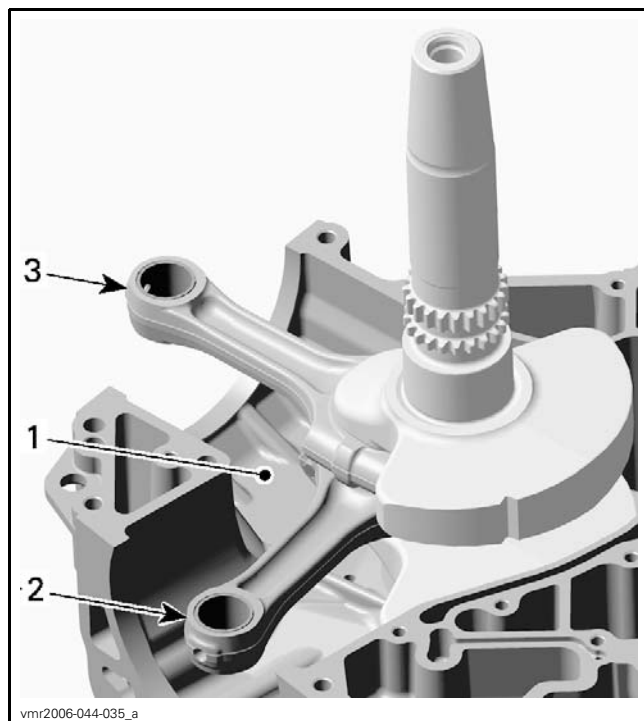
Installing the Crankshaft

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.

Subsection XX (BOTTOM END)



vmr2006-044-035_a

- 1. Crankcase half MAG side
- 2. Connecting rod cylinder 1
- 3. Connecting rod cylinder 2

BRAKES

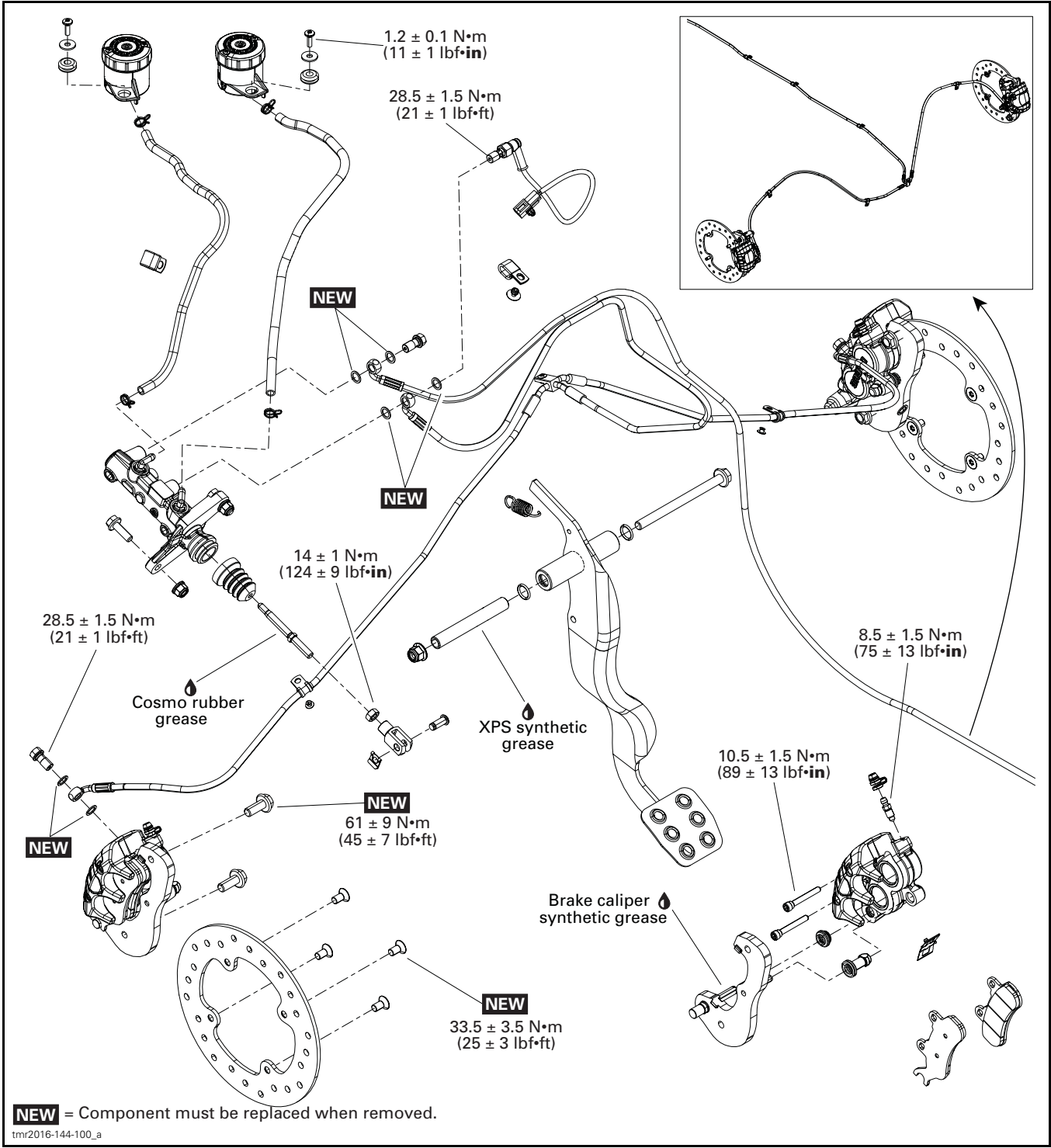
SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	4
FLUKE 115 MULTIMETER	529 035 868	4

SERVICE PRODUCTS

Description	Part Number	Page
COSMO RUBBER GREASE	715 900 399	5
LOCTITE 243 (BLUE).....	293 800 060	7
XPS BRAKES AND PARTS CLEANER (USA)	219 701 705	7-8
XPS BRAKES AND PARTS CLEANER	219 701 776	7-8

Subsection XX (BRAKES)



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.

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

Always clean the area around a brake component before servicing.

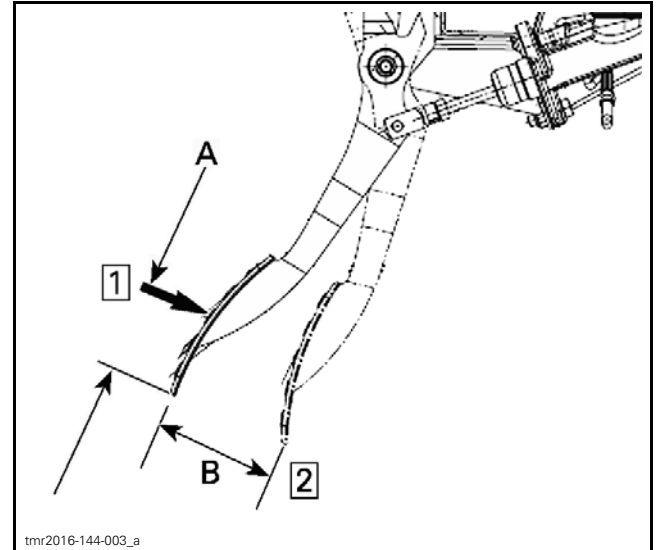
INSPECTION

BRAKE SYSTEM PRESSURE VALIDATION

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

REQUIRED TOOLS	
Compression force gauge	
Ruler	

1. Position a ruler perpendicularly to brake pedal.



Step 1: Position compression force gauge at distance A
Step 2: Push brake pedal from distance B

A. 41 mm $\pm$ 5 mm (1.6 in $\pm$.2 in)
B. 70 mm (2-3/4 in)



tmr2011-037-112

BRAKE PEDAL LOAD AT 70 MM

Minimum 250 N (56 lbf)

2. If load reading is not in accordance with the specification:

- 2.1 Clean and inspect the brake system.
- 2.2 Bleed brake system.

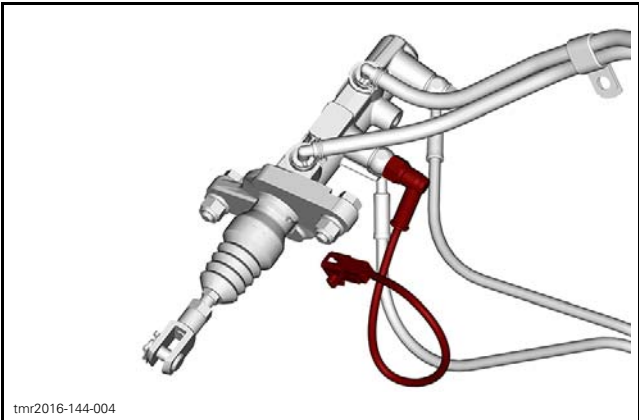
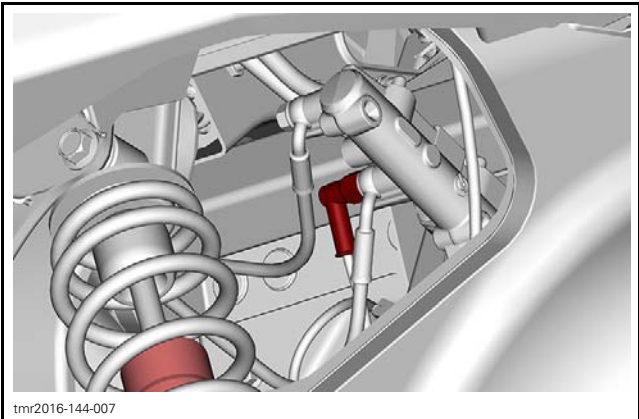
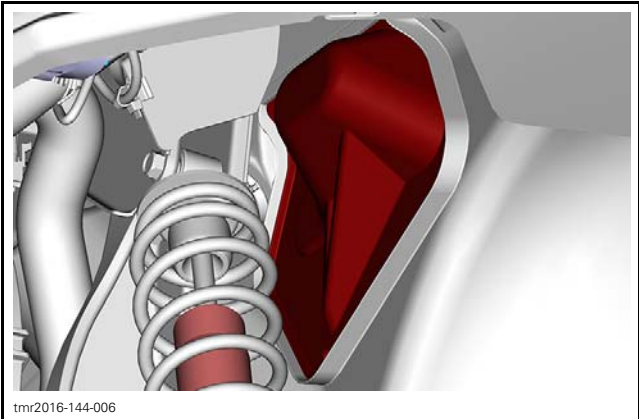
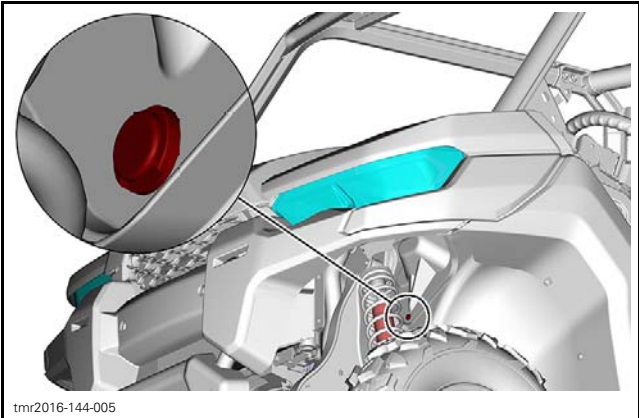
NOTE: Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

PROCEDURES

BRAKE LIGHT SWITCH

Brake Light Switch Location

Brake light switch is located underneath LH front fender on master cylinder.



Testing the Brake Light Switch Resistance

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

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)

Replace switch as required.
If the switch tests good, verify wire continuity between harness connector and ECM-B connector.

REQUIRED TOOL	
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.

Replacing the Brake Light Switch

1. Disconnect brake light switch connector.
2. Drain front 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 new brake light switch on master cylinder.

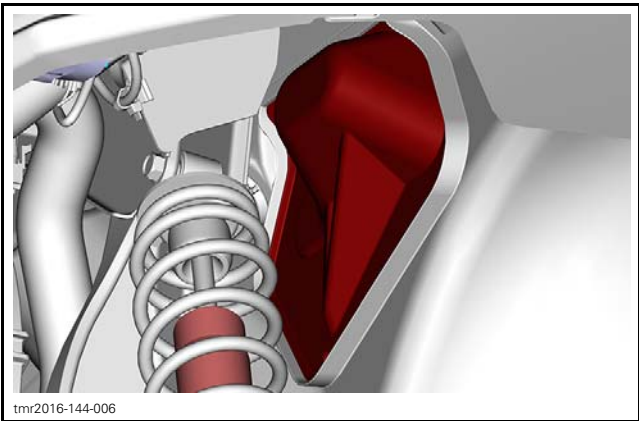
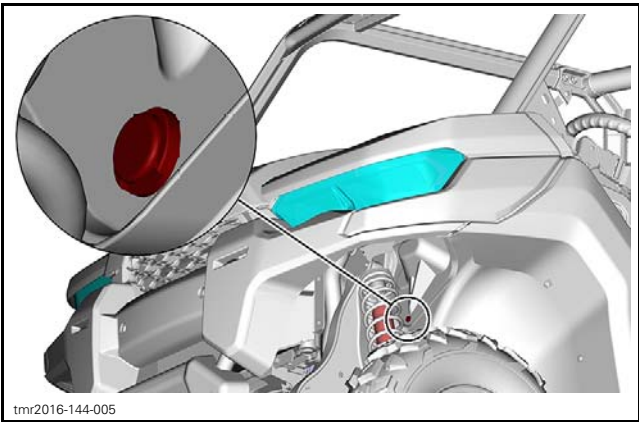
TIGHTENING TORQUE	
Brake light switch	28.5 N•m $\pm$ 1.5 N•m (21 lbf•ft $\pm$ 1 lbf•ft)

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

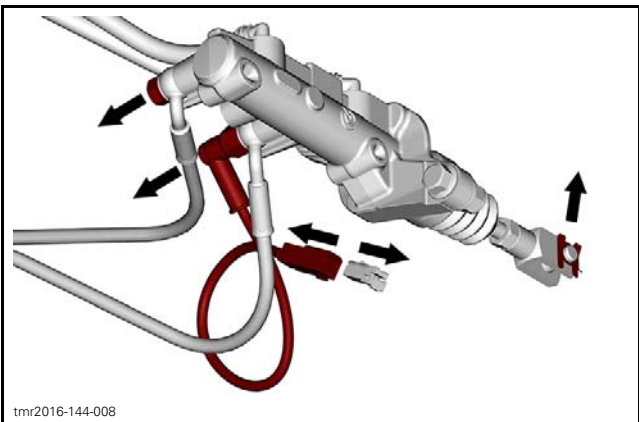
MASTER CYLINDER

Removing the Master Cylinder

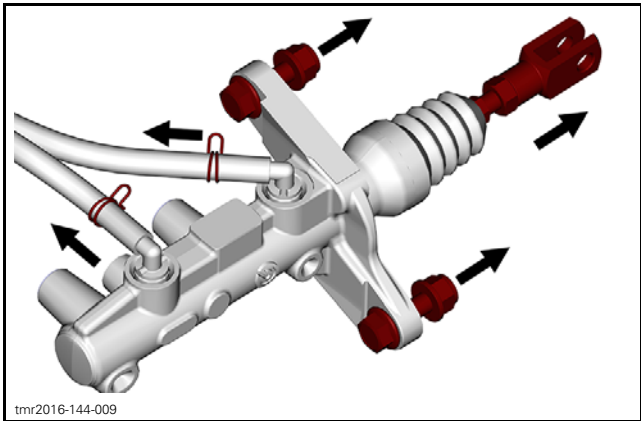
- 1. Drain brake system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
- 2. Remove master cylinder protective cover.



- 3. Remove / disconnect:
 - 1. Master cylinder push rod clip
 - 2. Brake light switch connector
 - 3. Brake light switch and rear brake hose screw.



- 4. Remove / disconnect:
 - 1. Master cylinder push rod
 - 2. Brake oil reservoir hoses
 - 3. Master cylinder screws.



- 5. Remove master cylinder from vehicle.

Inspecting the Master Cylinder

Check boot for crack.
Check rod for wear and scratch.
Check master cylinder housing and reservoir for leaks or damage.

Installing the Master Cylinder

The installation is the reverse of the removal procedure. However, pay attention to the following.
Install new sealing washers.

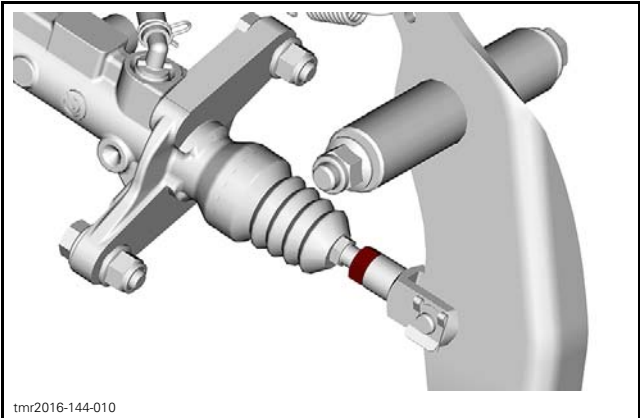
TIGHTENING TORQUE	
Rear brake hose screw	28.5 N•m ± 1.5 N•m (21 lbf•ft ± 1 lbf•ft)
Brake light switch nut	
SERVICE PRODUCT	
Push rod end lubrication	COSMO RUBBER GREASE (P/N 715 900 399)
Master cylinder boot lubrication	

Refill and bleed brake system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
Adjust master cylinder rod. Refer to *ADJUSTING THE MASTER CYLINDER ROD* in this subsection.

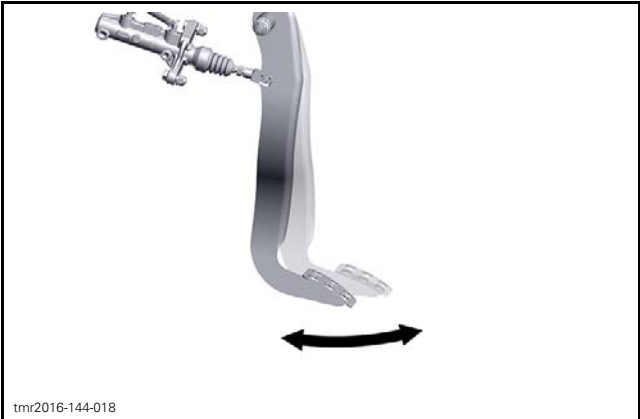
Adjusting the Master Cylinder Rod

- 1. Loosen locking nut of master cylinder rod.

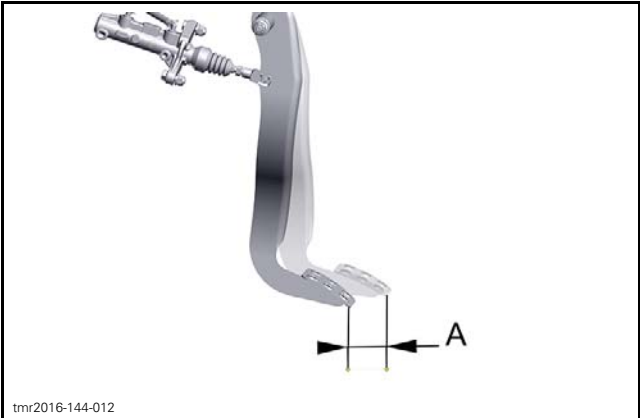
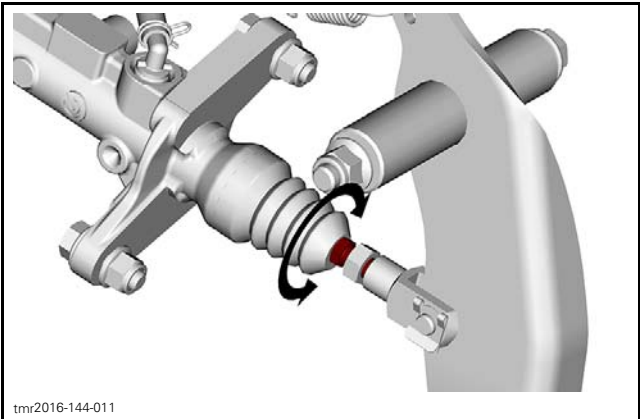
Subsection XX (BRAKES)



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.



A. Free play

BRAKE PEDAL FREE PLAY	
3.5 mm ± 1.5 mm (1/8 in ± 1/16 in)	

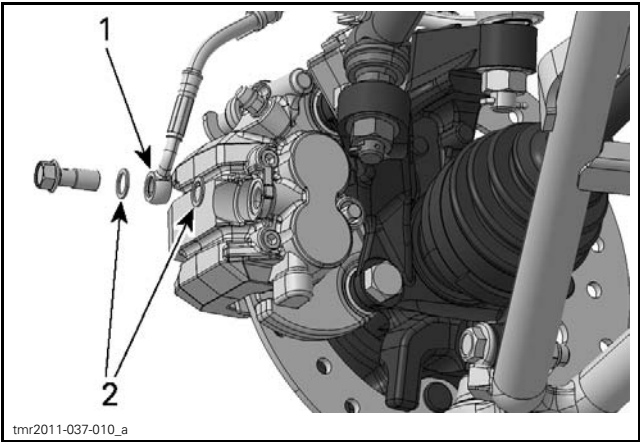
4. Tighten locking nut of master cylinder rod to specification.

TIGHTENING TORQUE	
Rod locking nut	14 N•m ± 1 N•m (124 lbf•in ± 9 lbf•in)

CALIPER

Removing the Caliper

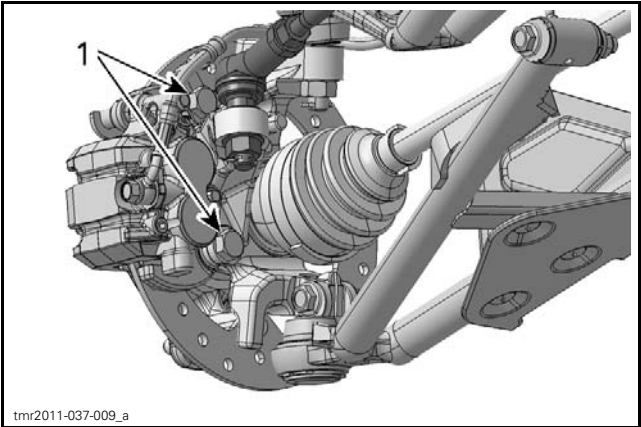
- 1. Remove wheel. Refer to *WHEELS AND TIRES* subsection.
- 2. If caliper is removed from vehicle for replacement, remove brake hose screw.



TYPICAL - FRONT CALIPER SHOWN

- 1. Brake hose
- 2. Sealing washers

3. Remove screws securing caliper support to knuckle.



TYPICAL - FRONT CALIPER SHOWN
1. Caliper screws

4. Place caliper assembly onto a support.

NOTICE Do not let caliper hangs by the hose and do not stretch or twist hose.

Install the Caliper

The installation is the reverse of the removal procedure. However, pay attention to the following.
If caliper was removed for replacement:

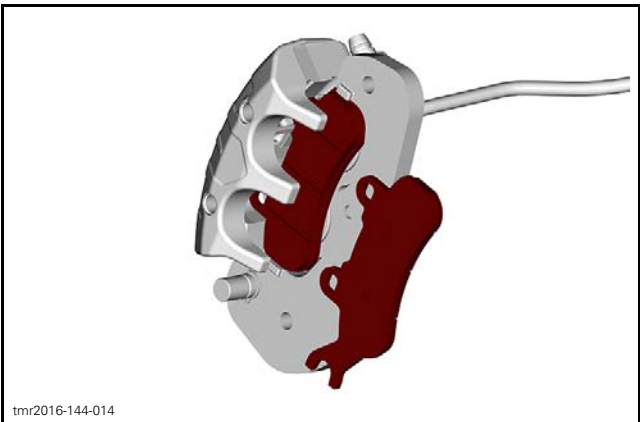
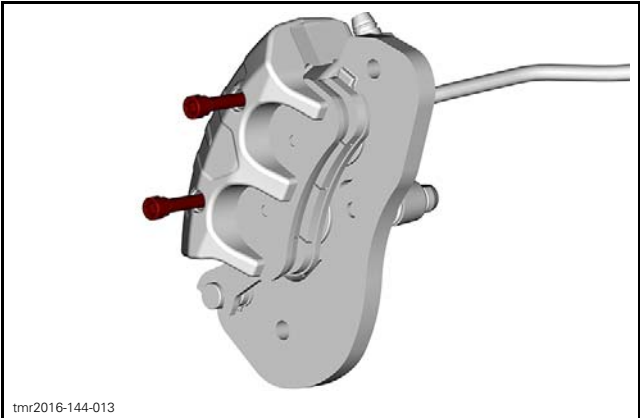
- Install new sealing washers.
- Refill and bleed brake system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

TIGHTENING TORQUE	
Brake hose screw	28.5 N•m ± 1.5 N•m (21 lbf•ft ± 1 lbf•ft)
Caliper retaining screw	61 N•m ± 9 N•m (45 lbf•ft ± 7 lbf•ft) + LOCTITE 243 (BLUE) (P/N 293 800 060)

BRAKE PADS

Replacing the Brake Pads

1. Loosen brake pad pins.
2. Remove caliper from knuckle. Refer to *REMOVING THE CALIPER* in this subsection.
3. Remove brake pad pins and pads.

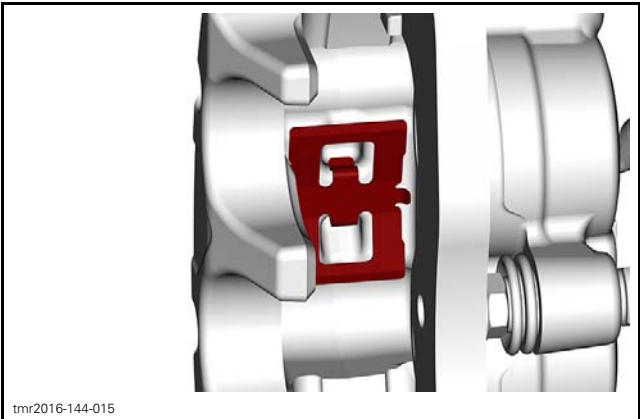


4. Use XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705) or XPS BRAKES AND PARTS CLEANER (P/N 219 701 776) to clean pistons end.

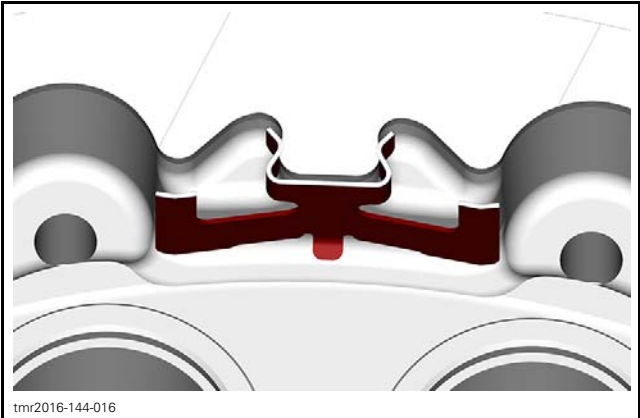
5. Push caliper pistons inward.

NOTE: To avoid damaging pistons, use an old pad to push it into the caliper using a C-clamp.

6. Ensure brake pad spring is properly positioned onto caliper.



Subsection XX (BRAKES)



- 7. Install new brake pads.
- 8. Use XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705) or XPS BRAKES AND PARTS CLEANER (P/N 219 701 776) to clean brake pad pins.
- 9. Install brake pad pins.
- 10. Install caliper on knuckle, refer to *INSTALLING THE CALIPER* in this subsection.
- 11. Tighten brake pad pins to specification.

TIGHTENING TORQUE	
Brake pad pin	10 N•m ± 1.5 N•m (89 lbf•in ± 13 lbf•in)

BRAKE DISC

Inspecting the Brake Disc

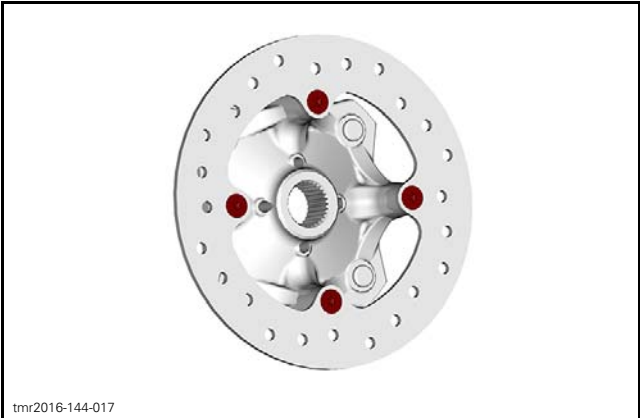
Check disc surfaces for scratches or grooves on both sides.

Measure thickness and warpage of the disc. Ensure measures are as per specifications. Refer to *TECHNICAL SPECIFICATIONS*.

NOTICE Do not machine Brake discs.

Replacing the Brake Disc

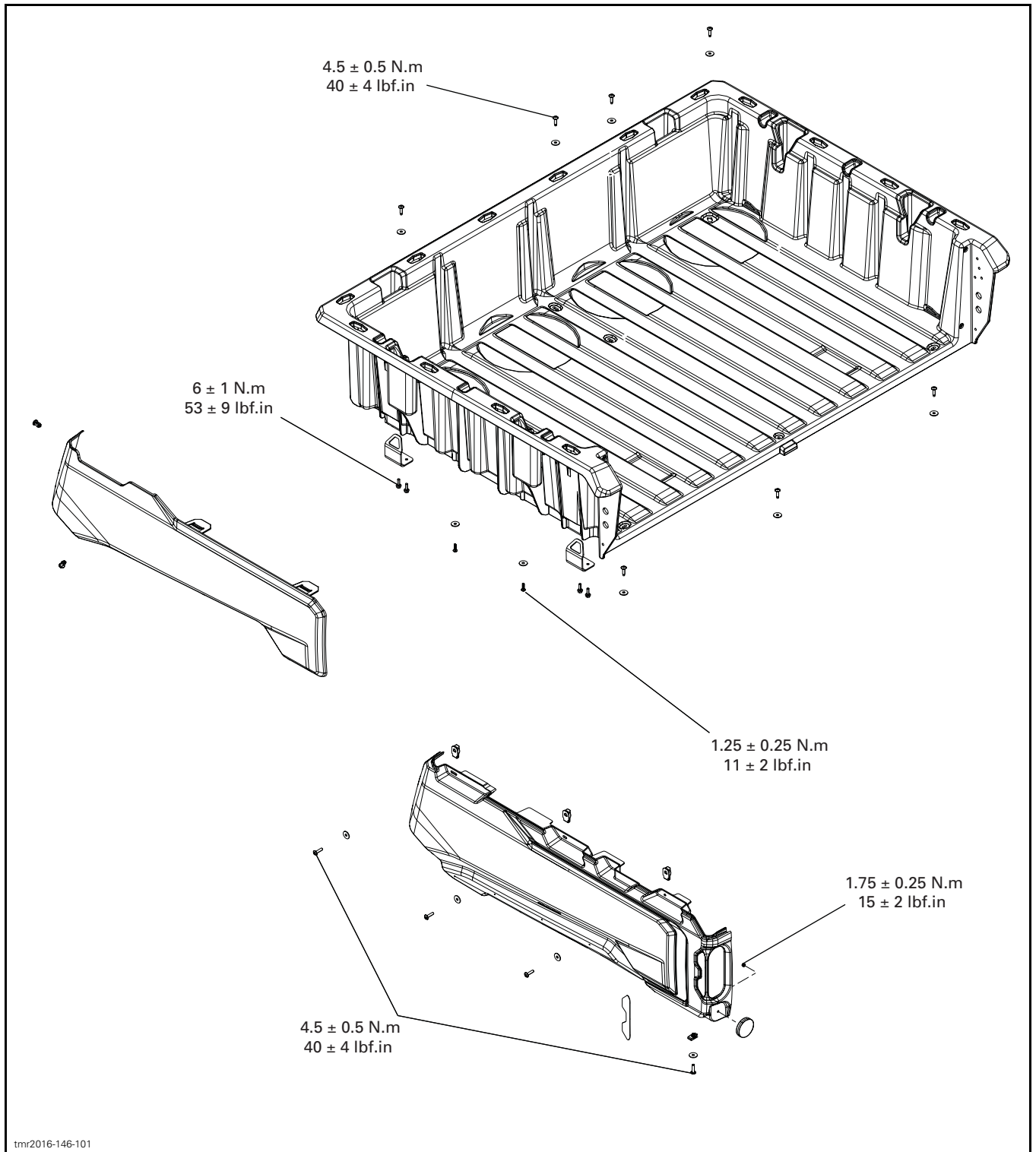
- 1. Remove caliper from knuckle. Refer to *REMOVING THE CALIPER* in this subsection.
- 2. Remove wheel hub. Refer to *FRONT DRIVE* or *REAR DRIVE* subsection.
- 3. Remove brake disc screws.



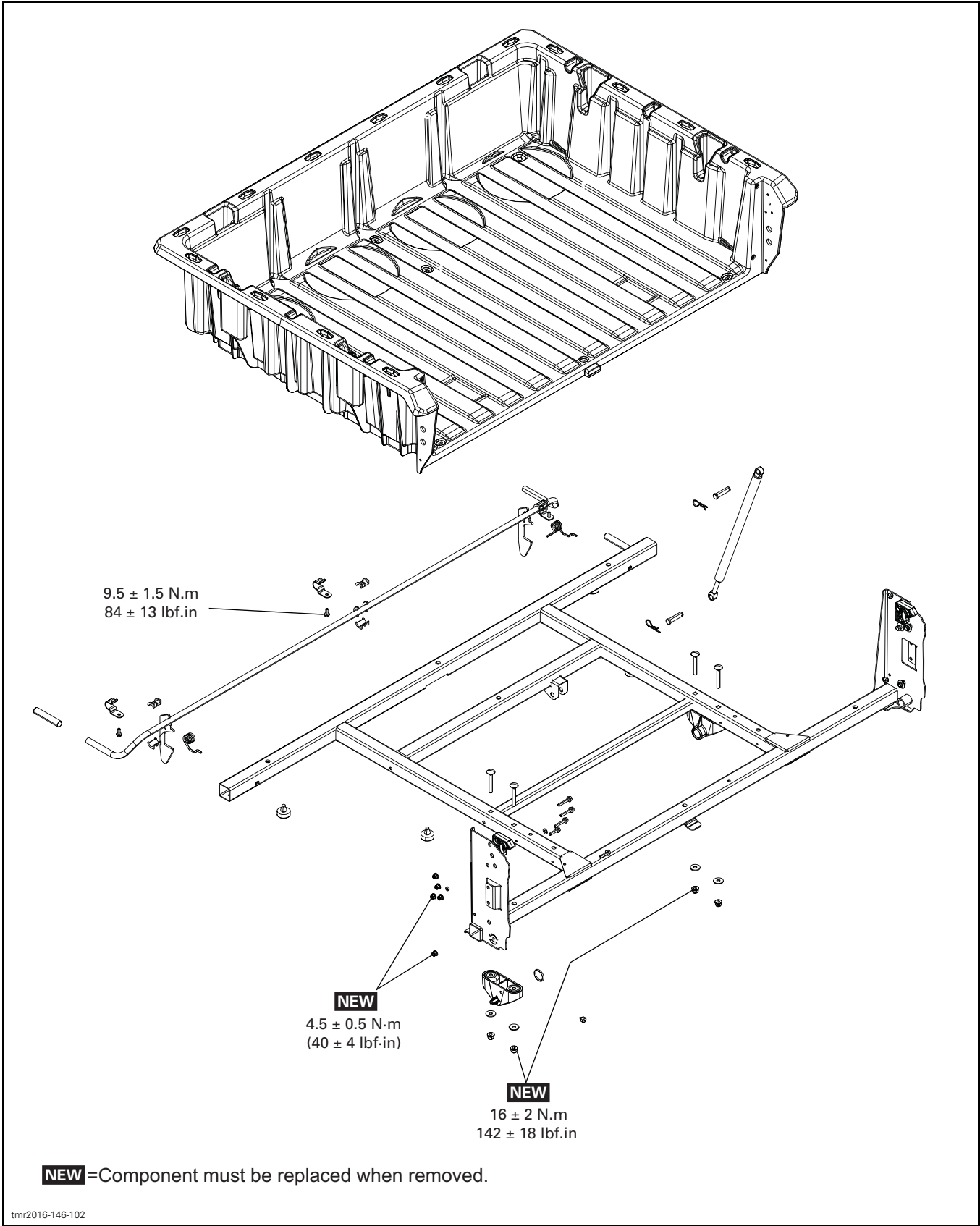
- 4. Replace brake disc.
- 5. Install new brake disc screws.
- 6. Tighten brake disc screws to specification.
- 7. Install wheel hub, then caliper.
- 8. Install new cotter pin to secure wheel hub nut.

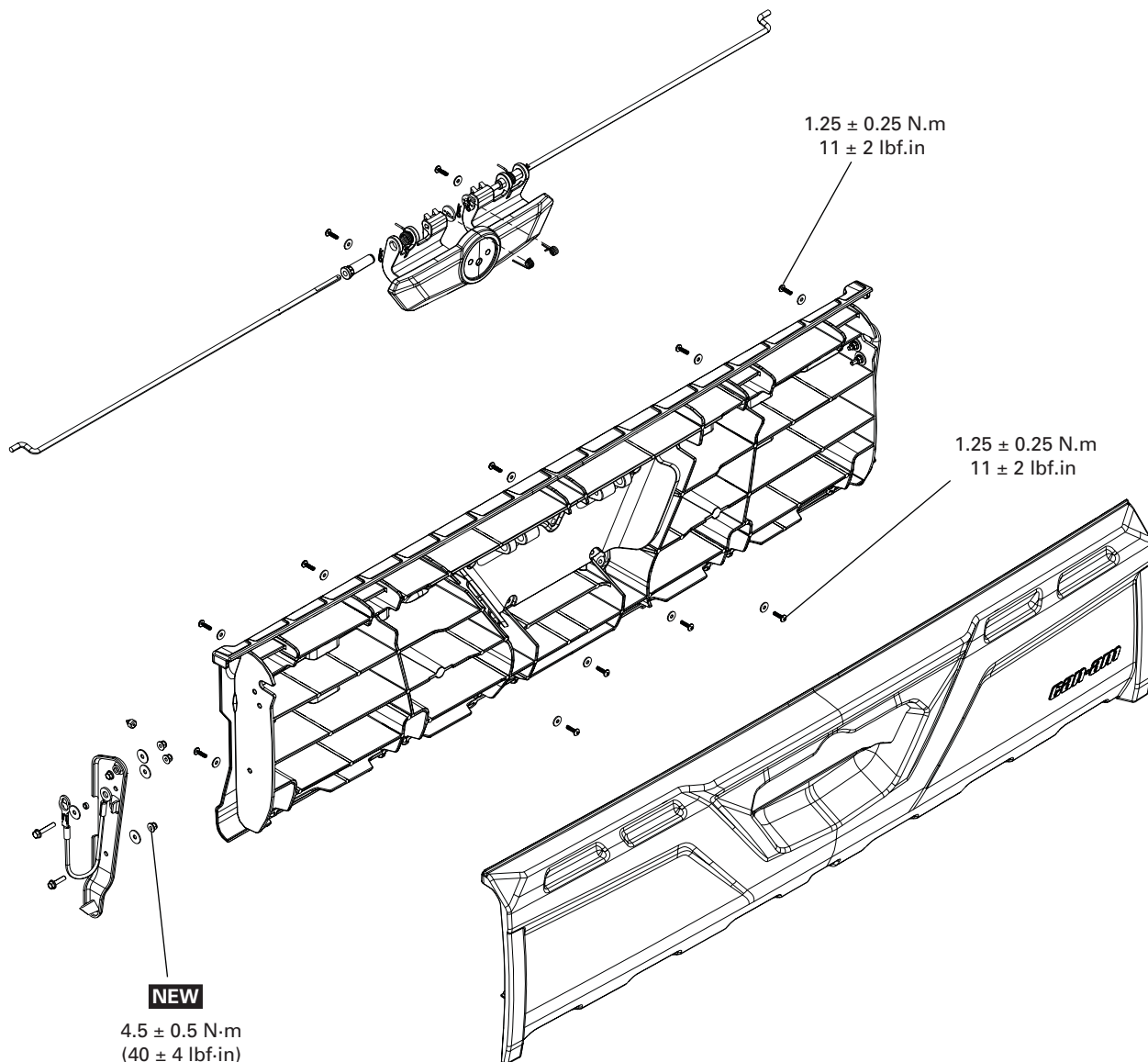
TIGHTENING TORQUE	
Brake disc screw	33.5 N•m ± 3.5 N•m (25 lbf•ft ± 3 lbf•ft)

CARGO BOX



Subsection XX (CARGO BOX)





NEW = Component must be replaced when removed.

tmr2016-146-103

CHARGING SYSTEM

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
EXTECH INDUCTIVE AMMETER	380941	3
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	2-4

GENERAL

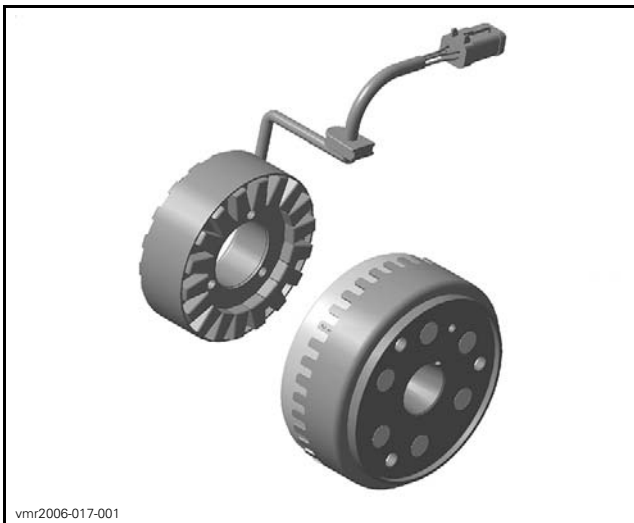
SYSTEM DESCRIPTION

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.

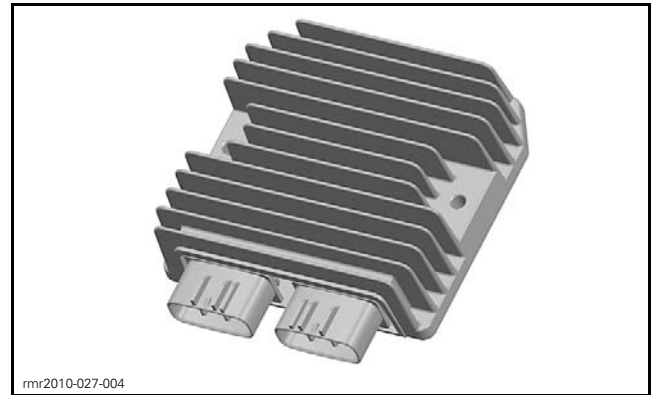


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TYPICAL

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.



rmr2010-027-004

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

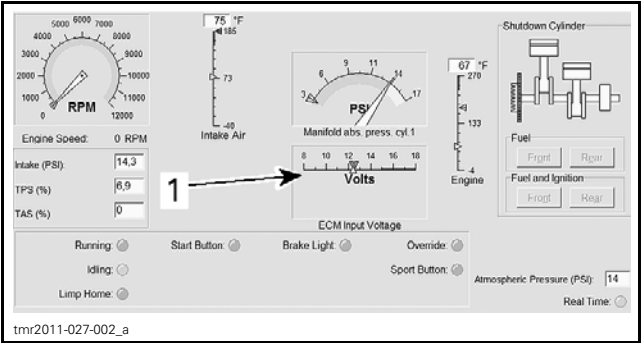
First ensure that battery is in good condition prior to performing the following tests.

Testing the Output Voltage 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 with the less consumption as possible (no lights, no accessories).
4. Increase engine RPM as specified in the following table and read voltage in the **ECM Input Voltage** box.

Subsection XX (CHARGING SYSTEM)

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 AND STARTER* 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 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, refer to *MAGNETO AND STARTER* subsection.
- 4. Defective regulator/rectifier.
- Test system voltage.
- 5. Damaged magneto rotor or Woodruff key.
- Replace magneto rotor or Woodruff key, refer to *MAGNETO AND STARTER* subsection.

PROCEDURES

Ensure battery is fully charged.
Refer to *WIRING HARNESS AND CONNECTORS* subsection for harness layout and connector locations on vehicle.

Refer to appropriate *WIRING DIAGRAM* for additional information.

⚠ WARNING

Ensure vehicle is in PARK when performing charging system tests.

BATTERY LOAD TEST

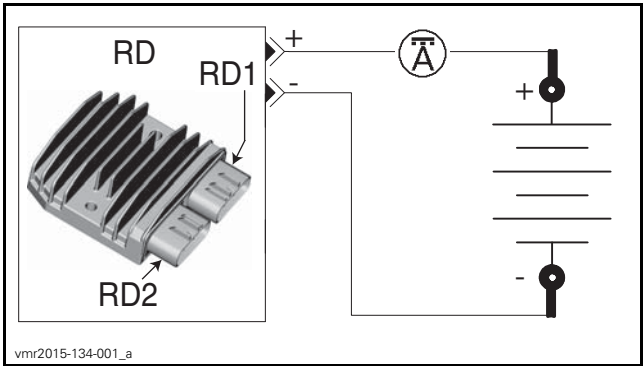
- 1. Connect a battery load tester such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260).
- 2. Ensure proper test conditions.

TEST CONDITIONS	
Initial battery voltage±	Above 12.5 Vdc
Engine	OFF
Load	3 times the amp-hour (AH) rating
Time	15 seconds
± Required for accurate testing	

SPECIFICATION	
Battery	Above 9.6 Vdc

If battery voltage drops below specification during test, replace battery and perform a *CHARGING SYSTEM LOAD TEST*.

CHARGING SYSTEM LOAD TEST

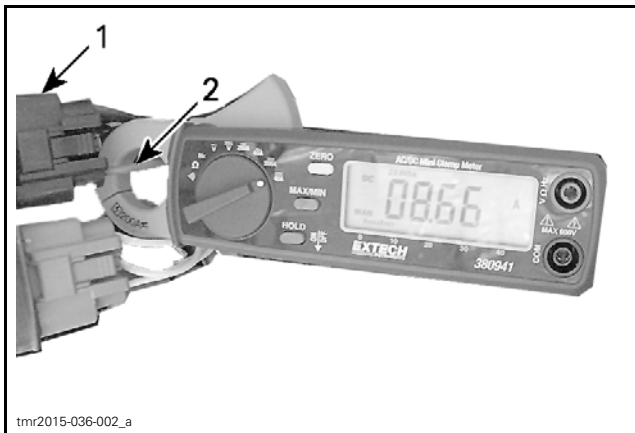


- 1. Connect a battery load tester such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260).
- 2. Start vehicle and read voltage on tester.

SPECIFICATION	
Voltage	12.5 - 15 Vdc

If voltage is **above** specification, replace regulator and continue *CHARGING SYSTEM LOAD TEST*.

3. Connect an ammeter such as EXTECH INDUCTIVE AMMETER (P/N 380941) around RD1-1 wire.



DC CURRENT TEST WITH INDUCTIVE AMMETER

1. Output connector of voltage regulator
2. Ammeter clamped over RED wire

4. Ensure proper test conditions.

TEST CONDITIONS	
Battery voltage at idle†	Above 12.6 Vdc
Engine	Increase to 4000 RPM
Load	As required to decrease battery voltage to 12 Vdc
Time	15 seconds
† Required for accurate testing	

5. Read amperage on ammeter.

MODEL	SPECIFICATION
All models	50 ± 5 Amps

NOTE: With a fully charged battery and no electrical loads, specification is less than 10A.

If amperage or voltage is not within specification, verify magneto and wires. Refer to *MAGNETO AND STARTER* subsection. Replace:

- Voltage regulator if magneto test is within specifications.
- Magneto if magneto test is not within specifications.

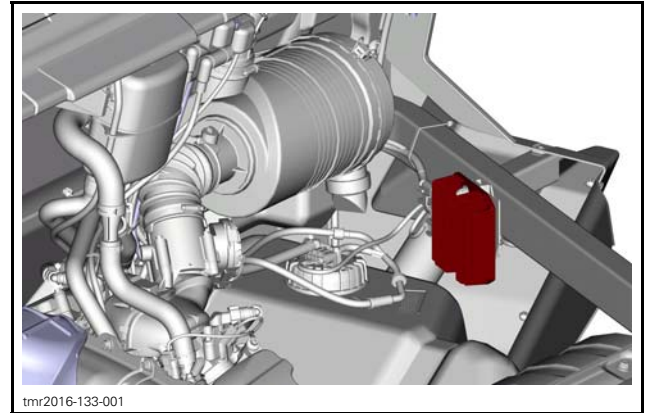
VOLTAGE REGULATOR (RD)

Testing the Voltage Regulator Continuity

Due to internal circuitry, there is no static test available.

Voltage Regulator Access

The voltage regulator is located on the RH member of the extension frame, near the air filter housing.

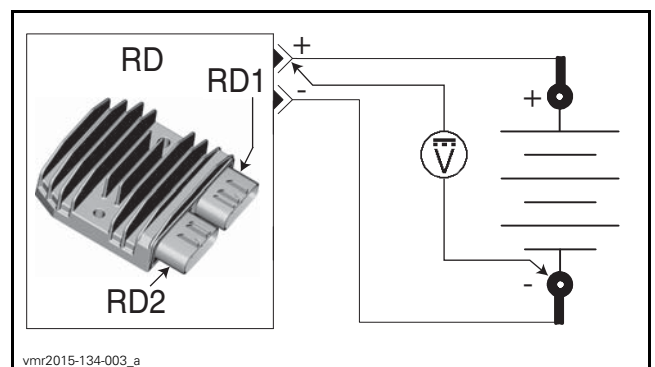


Voltage Regulator Wire Identification

FUNCTION	PIN	COLOR
12 Vdc output	RD1-1	RD
12 Vdc ground	RD1-3	BK
12 Vac input	RD2-1	YE
12 Vac input	RD2-2	YE
12 Vac input	RD2-3	YE

Testing the Voltage Regulator Power

1. Check voltage at RD1-1.



TEST CONDITIONS		
RD1-1		Hot at all times
BACKPROBE	PROBE	SPECIFICATION
RD1-1	BAT2 (-)	Battery voltage

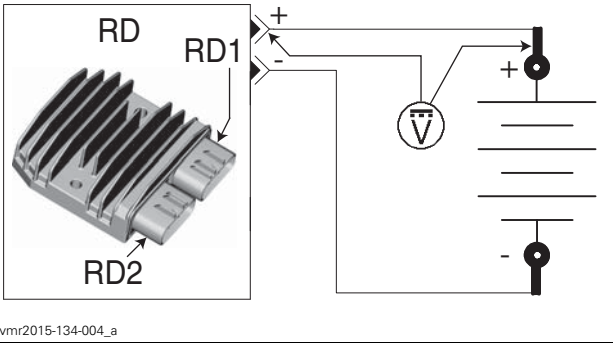
2. Connect a battery load tester such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260).
3. Start vehicle.

Subsection XX (CHARGING SYSTEM)

4. Ensure proper test conditions.

TEST CONDITIONS	
Battery voltage at idle‡	Above 12.6 Vdc
Engine	Increase to 4000 RPM
Load	As required to decrease battery voltage to 12 Vdc
Time	15 seconds
‡ Required for accurate testing	

5. Measure voltage drop.



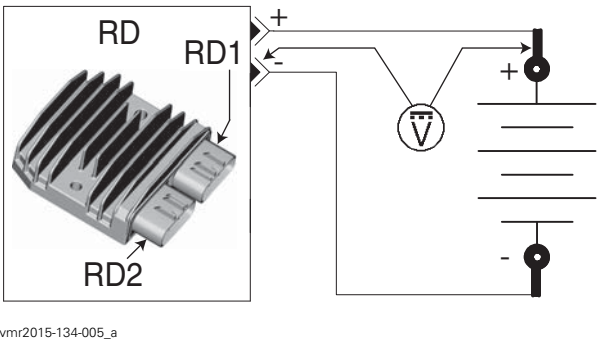
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BACKPROBE	PROBE	SPECIFICATION
RD1-1	BAT1 (+)	Under 0.2 Vdc

If voltage drop is above specification, locate and repair damaged connector/wire.

Testing the Voltage Regulator Ground

1. Check ground at RD1-3.



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TEST CONDITIONS		
RD1-3	Permanent ground	
BACKPROBE	PROBE	SPECIFICATION
RD1-3	BAT1 (+)	Battery voltage

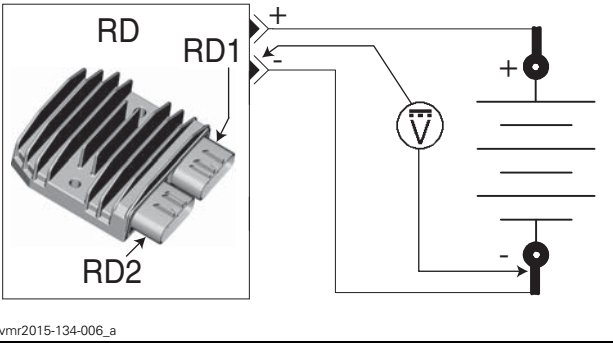
2. Connect a battery load tester such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260).

3. Start vehicle.

4. Ensure proper test conditions.

TEST CONDITIONS	
Battery voltage at idle‡	Above 12.6 Vdc
Engine	Increase to 4000 RPM
Load	As required to decrease battery voltage to 12 Vdc
Time	15 seconds
‡ Required for accurate testing	

5. Measure voltage drop.



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BACKPROBE	PROBE	SPECIFICATION
RD1-3	BAT2 (-)	Under 0.4 Vdc

If voltage drop is above specification, locate and repair damaged connector/wire.

BATTERY

Battery Information

These vehicles are equipped with a VRLA battery (Valve Regulated Lead Acid). **It is a maintenance-free type battery.**

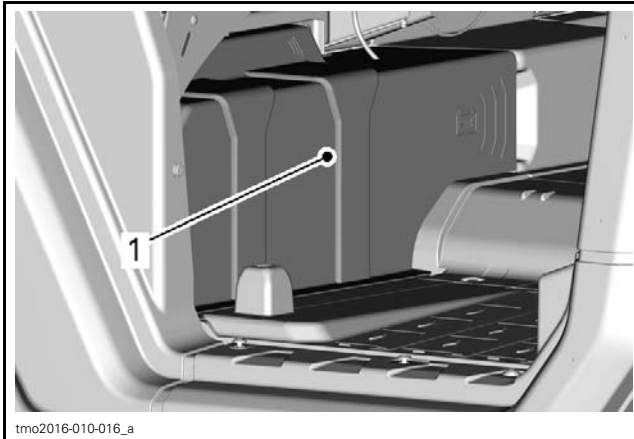
Refer to battery manufacturer's instructions for proper filling, activation and routine charging procedures.

Battery Access

The battery is located underneath the right passenger's seat.

Removing the Battery

- 1. Remove under seat storage compartment if equipped.
- 2. Remove battery cover

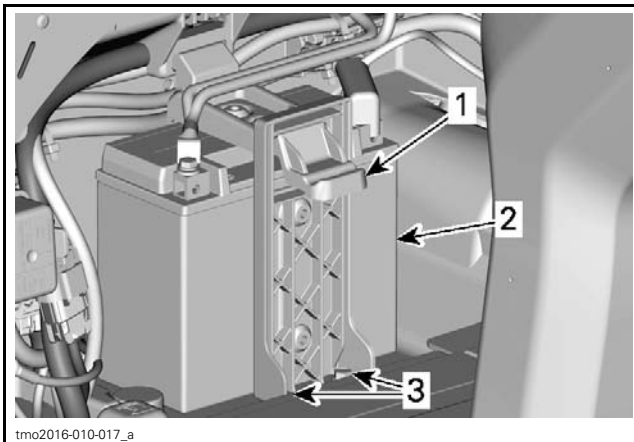


1. Battery cover

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

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

4. Remove battery holder retaining screws.



1. Battery holder
2. Battery
3. Battery holder retaining screw(s)

5. Remove battery holder.
6. Remove battery.

Cleaning the Battery

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.

Inspecting the Battery

Visually inspect battery casing for cracks or any other damages. If casing is damaged, replace battery and thoroughly clean battery support with a water and baking soda solution.

Inspect condition of battery posts, battery support, holding strap and strap attachment points and wire terminal lugs.

Battery Storage

It is not necessary to remove the battery during vehicle storage but it is recommended for long term storage.

If the battery is left in the vehicle during storage or used infrequently, disconnect the BLACK (-) negative battery cable to eliminate battery current drain from the electrical equipment.

Recharge the battery once a month with an approved battery charger as per manufacturer's recommendations.

Clean battery, battery support and connections as required, refer to *CLEANING THE BATTERY* in this section.

For other recommendations during storage, refer to battery manufacturers instructions.

WARNING

Ensure battery is stored in a safe place, out of reach for children.

Activating a New Battery

Refer to the instructions provided with the battery.

Charging a Battery

WARNING

Always wear safety glasses and charge in a well ventilated area. Never charge or boost a battery while it is installed on vehicle. Do not open the sealed cap during charging. Do not place battery near open flame.

NOTICE If battery becomes hot, stop charging and allow it to cool before continuing.

NOTE: Sealed VRLA batteries have an internal safety valve. If battery pressure increases due to overcharging, the valve opens to release excess pressure, preventing battery damage.

An automatic charger is a fast and convenient way for error-proof charging.

Always follow the battery manufacturer's charging instructions.

When using a constant current charger, charge battery according to the chart below.

Subsection XX (CHARGING SYSTEM)

Battery Voltage Below 12.8 V and Above 11.5 V

STANDARD CHARGING (RECOMMENDED)	
APPROXIMATE TIME	CHARGE
4 - 9 HOURS	2 A

QUICK CHARGING	
APPROXIMATE TIME	CHARGE
50 MINUTES	10 A

Installing the Battery

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

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

- Tighten battery holder retaining screws to specification.

TIGHTENING TORQUE	
Battery holder retaining screws	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

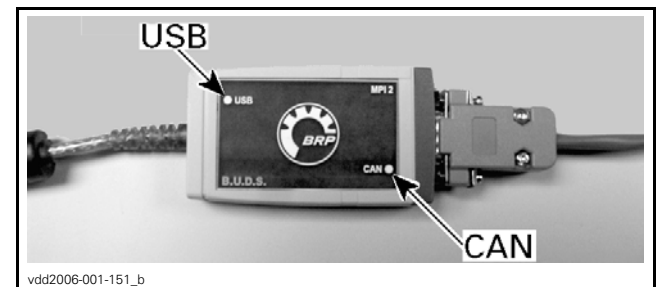
DIAGNOSTIC TIPS

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.).

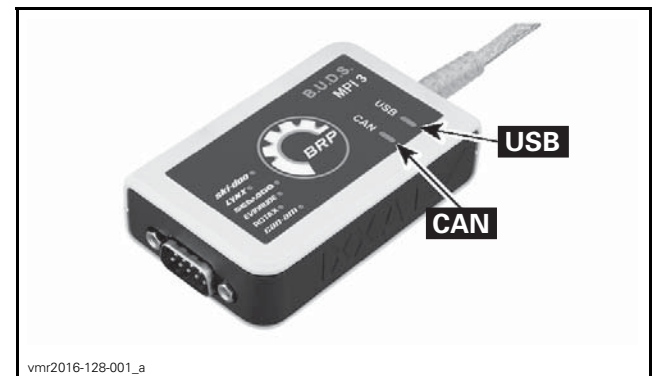
Multi-Purpose Interface Card Connection Troubleshooting

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)

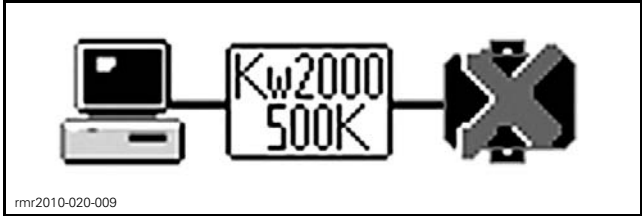


TYPICAL
1. Number of modules

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

No Vehicle is Detected

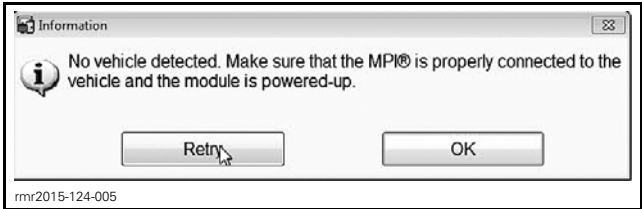
If an "X" is shown in the status bar and the protocol indication is blinking between Kw2000 500K and KW2000, it means that no "ECU" is communicating with the MPI card.



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)

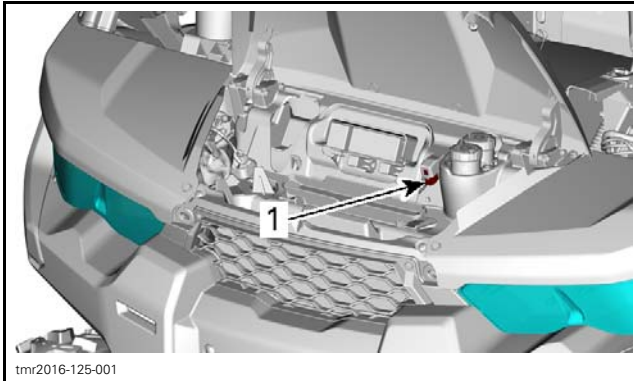
The MPI (Multi-Purpose Interface) in conjunction with the diagnostic cable is used with B.U.D.S. to communicate with the ECM (engine control module) and other modules.

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 it's 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 its 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:

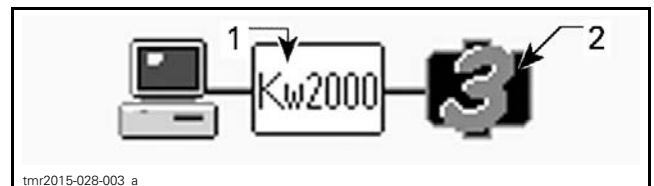
- Programming ignition key(s) to the vehicle
- Monitoring some electrical and electronic components
- Activating certain components for diagnostic purposes
- Updating electronic module software
- And, to carry out setting changes.

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.



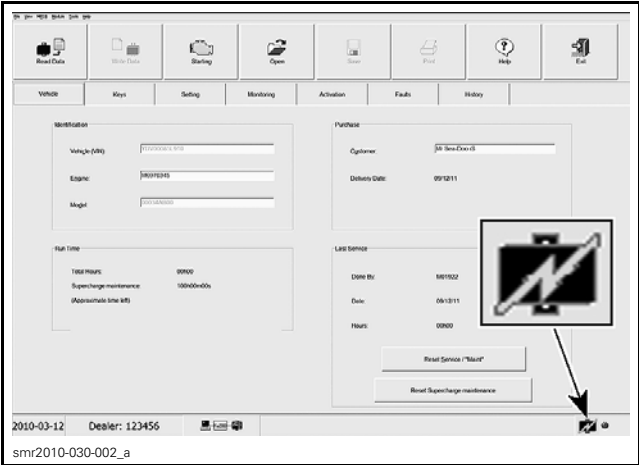
B.U.D.S. is now ready to use.

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.

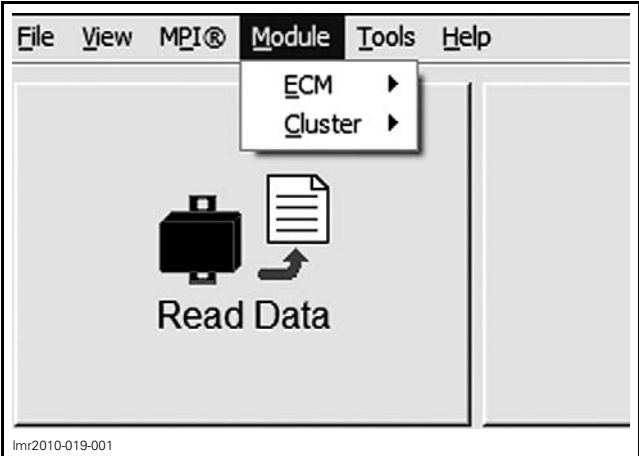


TYPICAL

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.



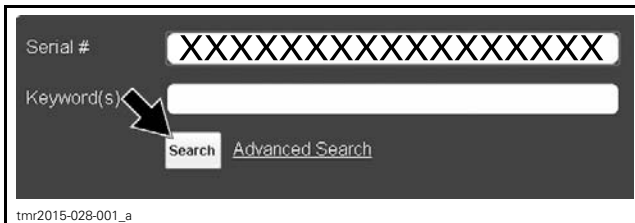
TYPICAL - MODULE SUBMENU LIST

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.



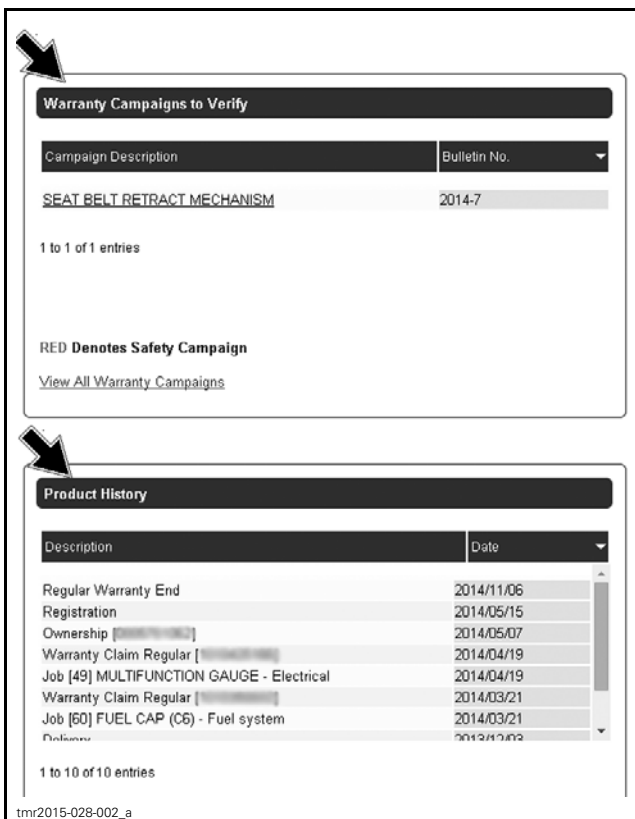
1. Greyed out: No update to perform
Black: Update file available

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

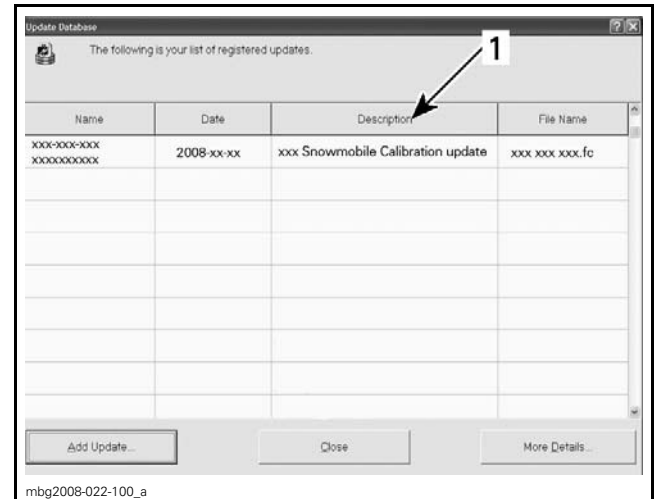


Complete all *WARRANTY CAMPAIGNS TO VERIFY*.

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*.

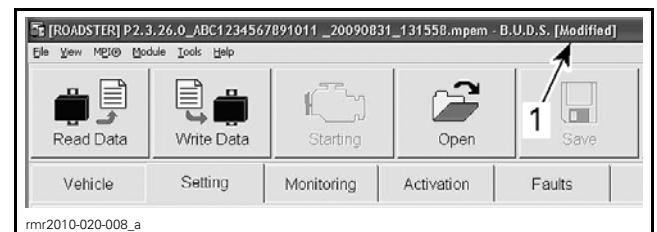


TYPICAL

1. File description

Saving Changes to an ECU

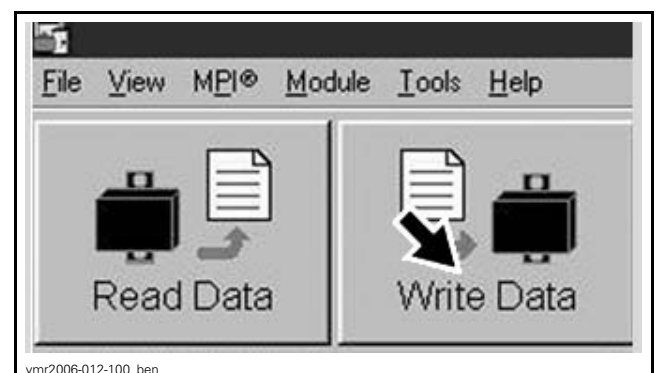
If the word **Modified** appears at the end of the vehicle file name at the top of the B.U.D.S. page, then a change has been made that requires it to be saved to the proper electronic module.



TYPICAL

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

Click the **Write Data** button.

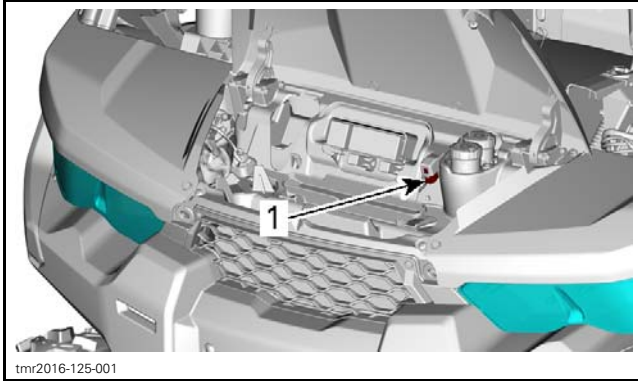


NOTE: A message box will confirm a successful operation.

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

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.



1. Diagnostic connector

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

CONTROLLER AREA NETWORK (CAN)

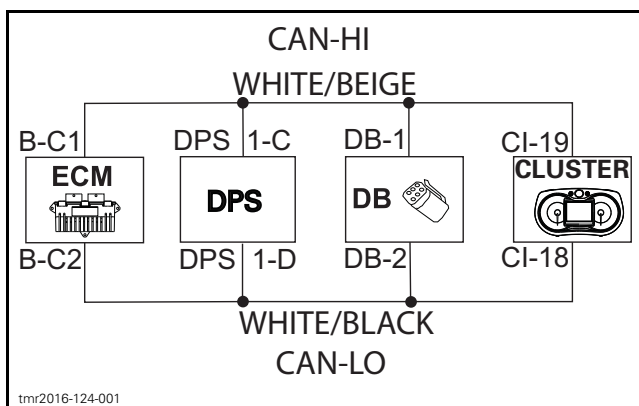
GENERAL

SYSTEM DESCRIPTION

The CAN (Controller Area Network) protocol is an ISO standard for serial data communication.

The CAN bus links the ECM and multifunction gauge together so that they communicate to interact as required. The components are connected together by 2 wires and they are in constant communication with each other at a rate of about every 20 milliseconds. CAN lines consist of a pair of twisted 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 display, 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

COOLING SYSTEM

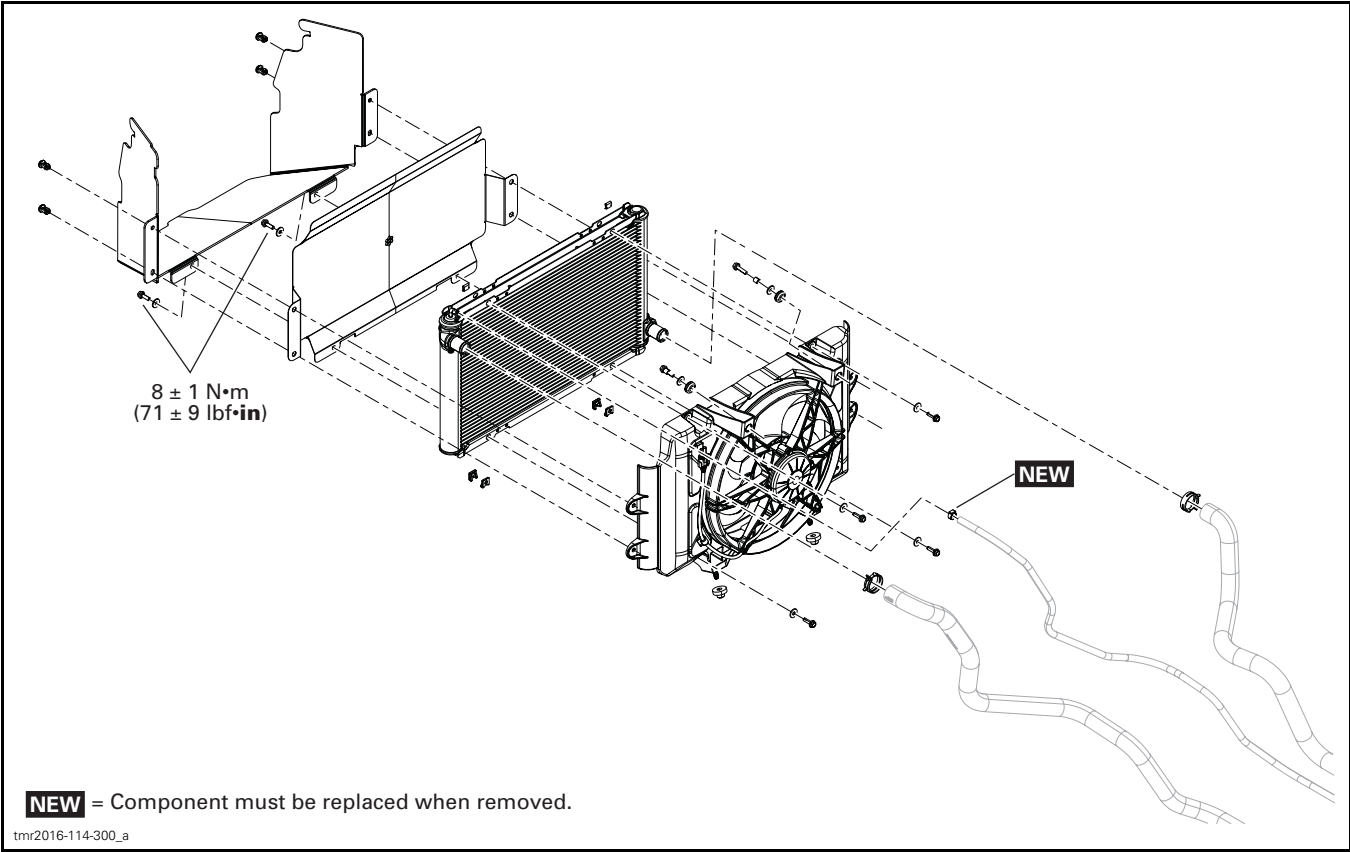
SERVICE TOOLS

Description	Part Number	Page
HANDLE	420 877 650	16
LARGE HOSE PINCHER.....	529 032 500	6
OIL SEAL PUSHER.....	529 035 757	16
ROTARY SEAL PUSHER PLATE	529 036 130	14
SEAL PUSHER	529 035 766	14, 17

SERVICE PRODUCTS

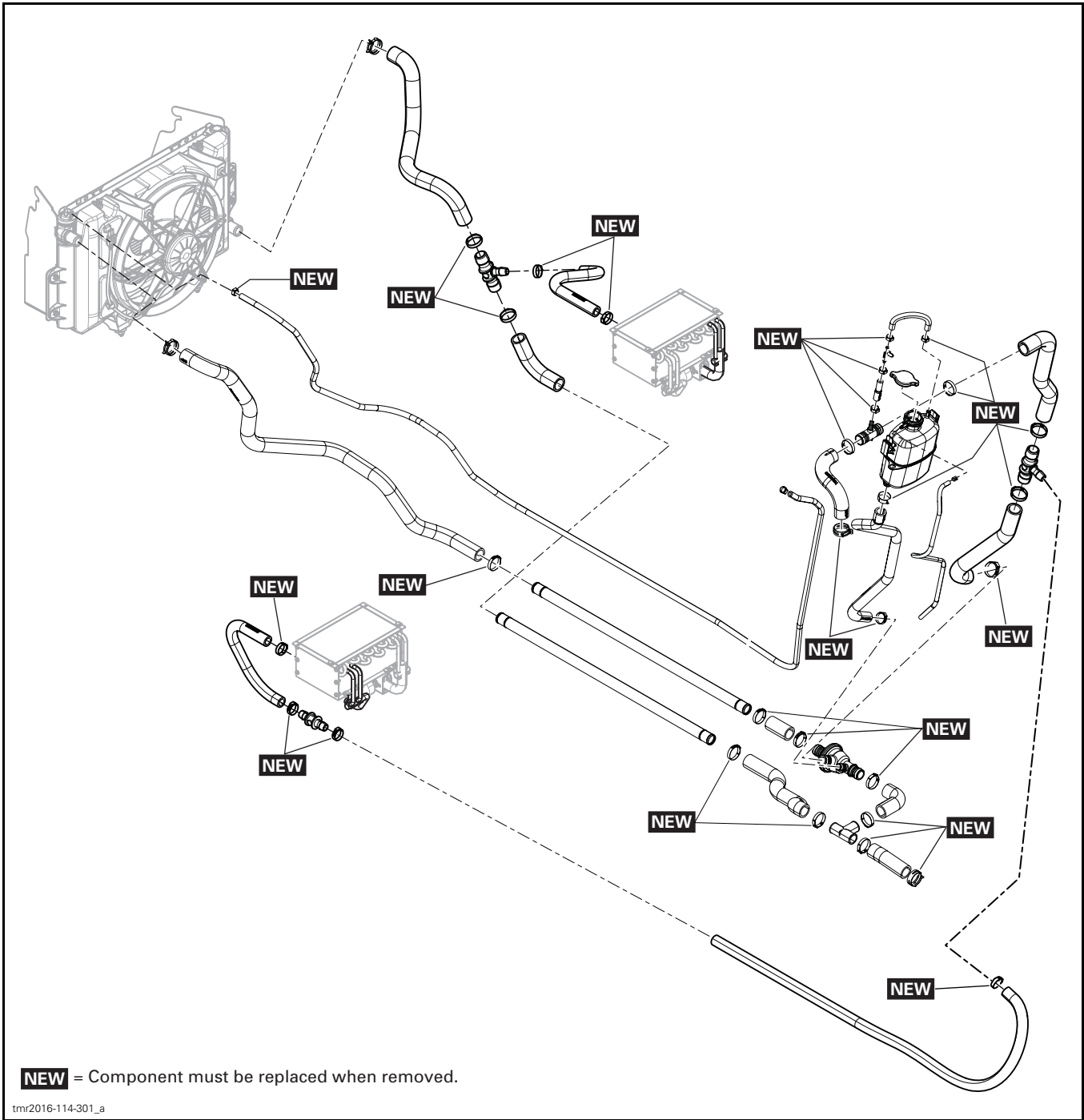
Description	Part Number	Page
DOW CORNING 111	413 707 000	17

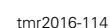
RADIATOR



COOLING HOSES

Models with Heating System





GENERAL

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

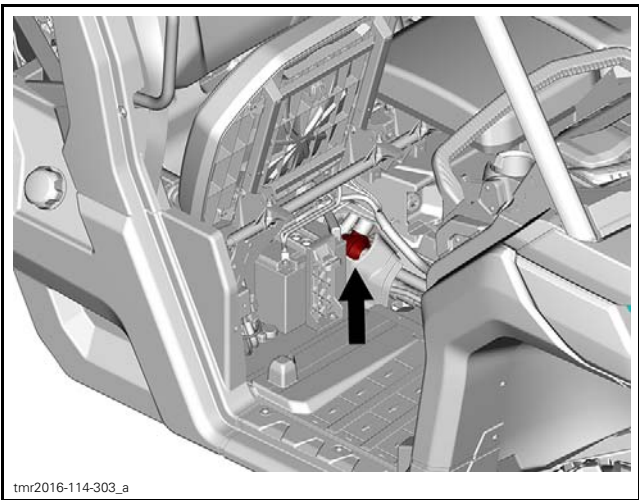
PROCEDURES

THERMOSTAT

The thermostat is a single action type.

Thermostat Location

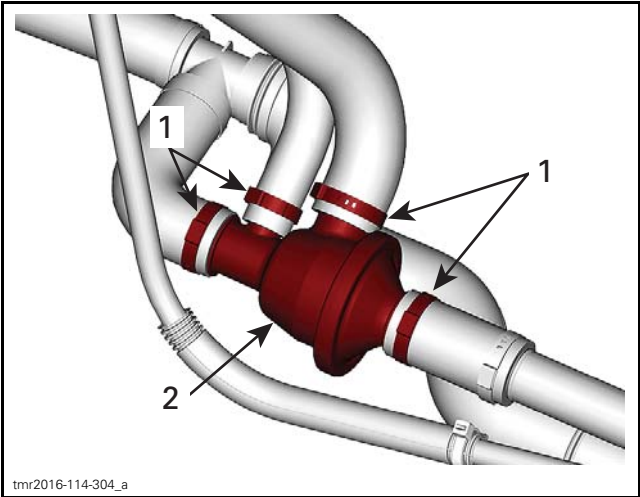
The thermostat is mounted in-line in the cooling system circuit.



THERMOSTAT LOCATION - BESIDE BATTERY, UNDER FLOOR COVER

Removing the Thermostat

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



1. Clamps
2. Thermostat

Testing the Thermostat

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

THERMOSTAT OPENING TEMPERATURE	
Starts to open	65°C (149°F)
Fully open	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.

Installing the Thermostat

The installation is the reverse of the removal procedures.

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

Inspecting the Radiator

Check radiating fins for clogging or damage.

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

Removing the Radiator

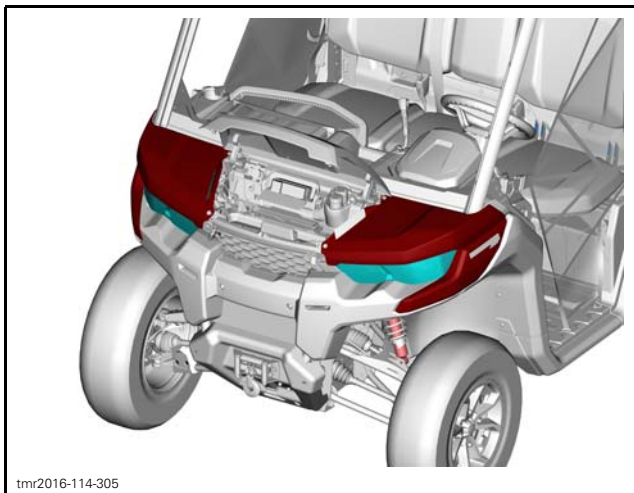
1. Install a hose pincher on both radiator hoses.

Subsection XX (COOLING SYSTEM)

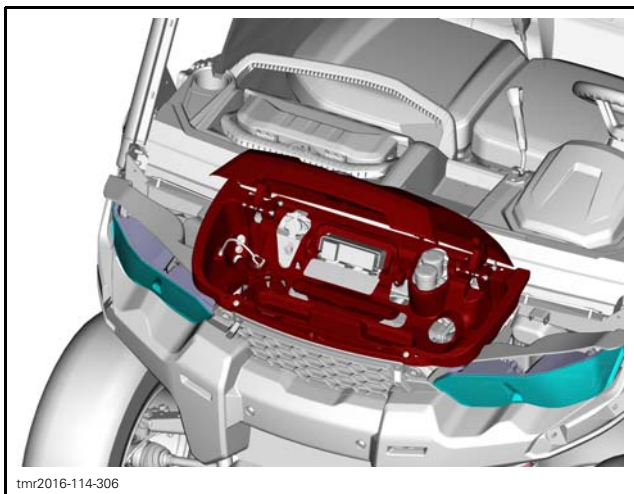
REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 529 032 500)	

2. Remove the following parts to reach radiator:

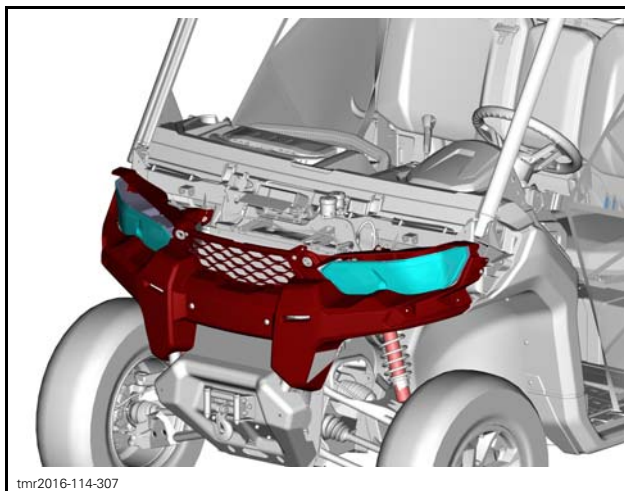
- Front fenders
- Service center tray with service cover
- Front fascia and head lights
- Radiator deflector.



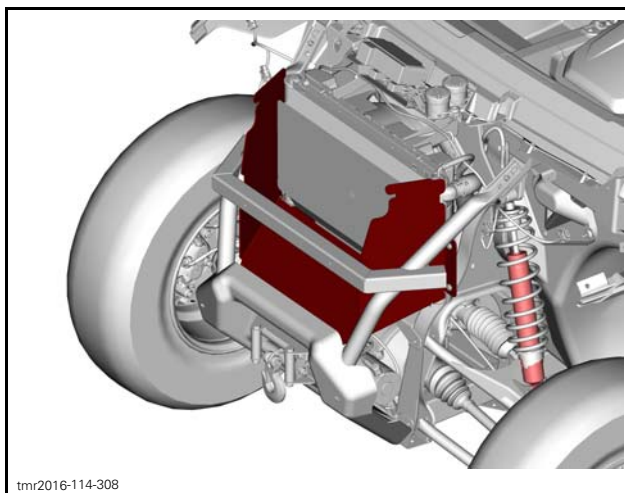
FRONT FENDERS



SERVICE CENTER TRAY WITH SERVICE COVER



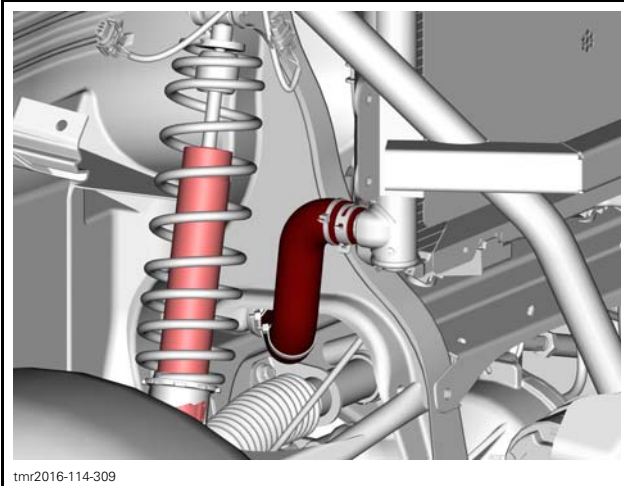
FRONT FASCIA AND HEAD LIGHTS



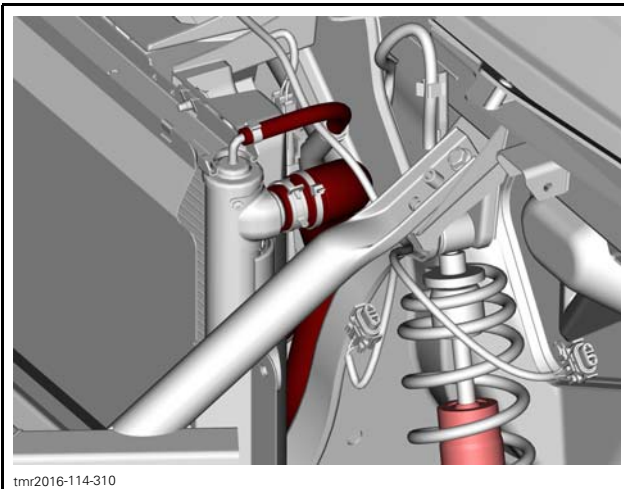
RADIATOR DEFLECTOR

3. Remove the following parts from the radiator:

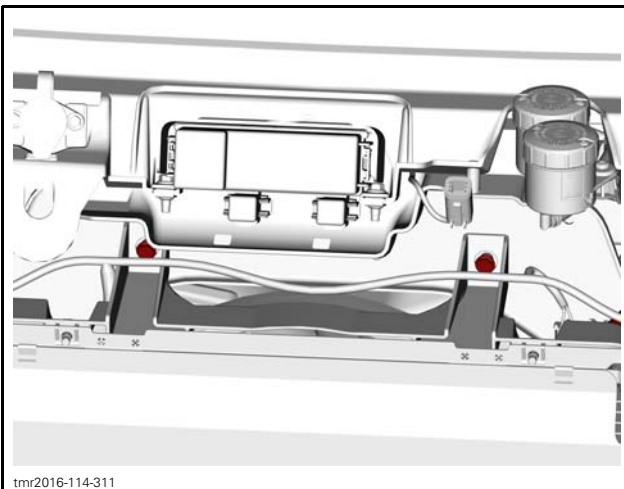
- Radiator outlet hose (RH lower)
- Radiator inlet hose (LH upper)
- Coolant reservoir vent hose (LH upper)
- Radiator mounting screws (2 at top of radiator).



RADIATOR OUTLET HOSE



RADIATOR INLET HOSE AND RESERVOIR VENT HOSE



RADIATOR MOUNTING SCREWS

4. Disconnect cooling fan electrical connector.
5. Carefully remove radiator.

Installing the Radiator

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

Fill radiator with the recommended coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Check for coolant leaks from radiator and hoses.

COOLANT TEMPERATURE SENSOR (CTS)

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

RADIATOR COOLING FAN RELAY (R1)

Installing the Relay

Relay may be inverted by 180° at installation and it will work correctly.



1. R1: Radiator cooling fan relay

Testing the Relay Operation

The easiest way to check the relay is to remove it and temporarily substitute with a new one. If the radiator cooling fan operates, the relay is defective.

RADIATOR COOLING FAN

Radiator Cooling Fan Operation

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

Subsection XX (COOLING SYSTEM)

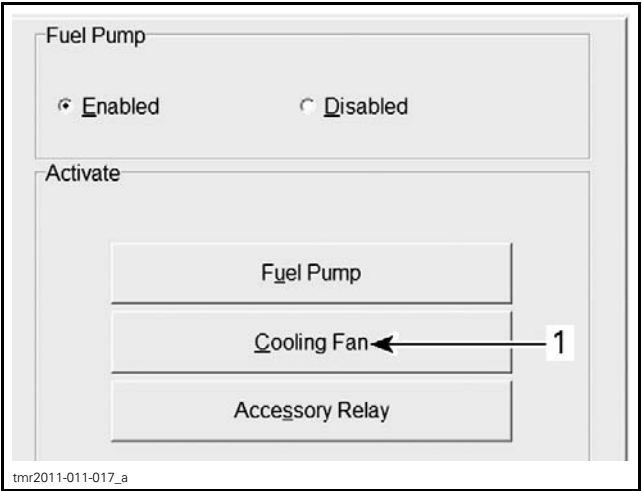
ENGINE TEMPERATURE	COOLING FAN	CHECK ENGINE LIGHT	MESSAGE IN MULTIFUNCTION GAUGE	LIMP HOME MODE
96°C (205°F)	Turns ON	—	—	—
92°C (198°F)	Turn OFF	—	—	—
114°C (237°F)	ON	OFF	- Limp Home - Hi Temp	Gradual power reduction according to engine temperature.

Radiator Cooling Fan Fuse Location

The fuse (25A) is located in the fuse box underneath the passenger seat, near the battery.



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.

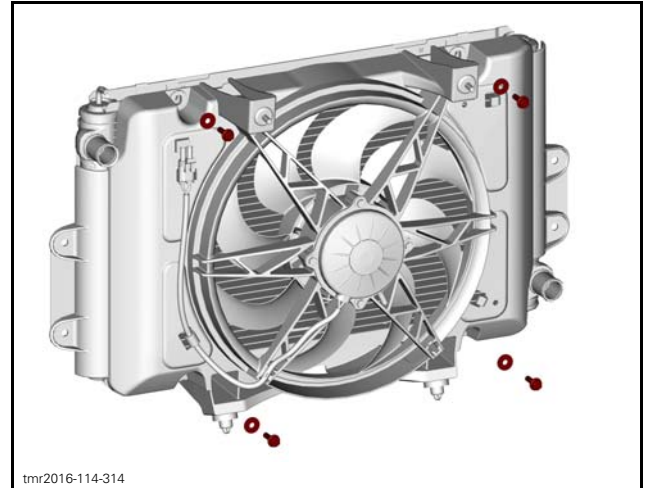
Testing the Radiator Cooling Fan

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.

COOLING FAN TROUBLESHOOTING CHART		
Is fan working?	YES →	Everything is OK
NO ↓		
Check fan fuse (25A). 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?

Removing the Radiator Cooling Fan

1. Remove the radiator.
2. Remove 4 fan retaining screws.
3. Remove the radiator fan.



FAN RETAINING SCREWS

Installing the Radiator Cooling Fan

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.

Removing the Water Pump Housing

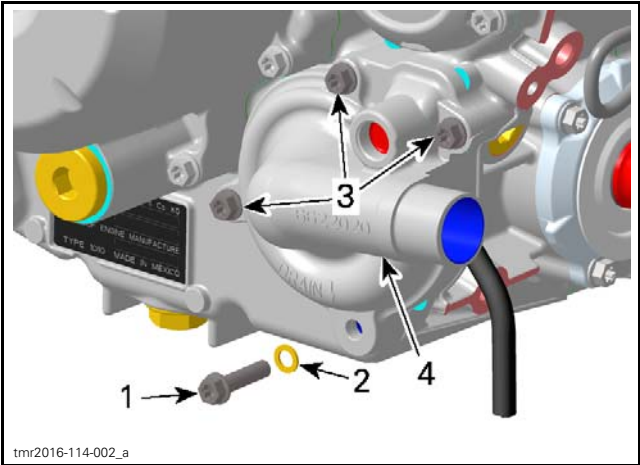
⚠ WARNING

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.

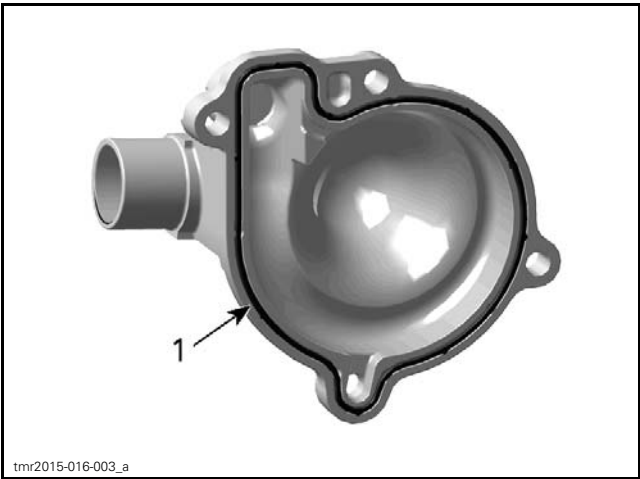


- 1. Coolant drain plug
- 2. Sealing ring
- 3. Screws
- 4. Water pump housing

Pull water pump housing to remove it.

Inspecting the Water Pump Housing

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



- 1. Gasket

Installing the Water Pump Housing

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.

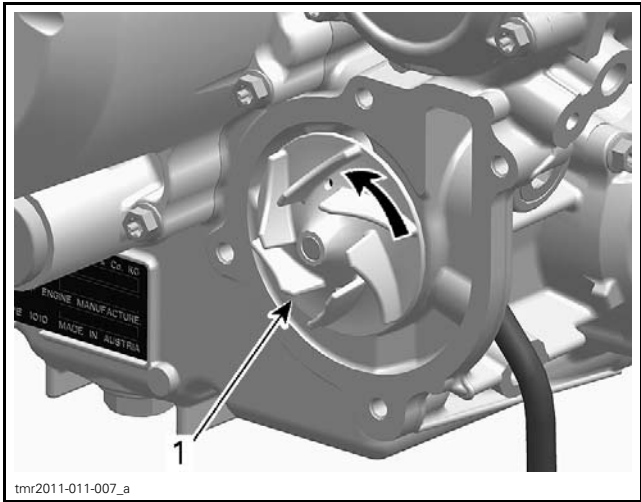
Tighten screws of water pump housing in a criss cross sequence to specification.

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

WATER PUMP IMPELLER

Removing the Water Pump Impeller

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.

Inspecting the Water Pump Impeller

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

Installing the Water Pump Impeller

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.

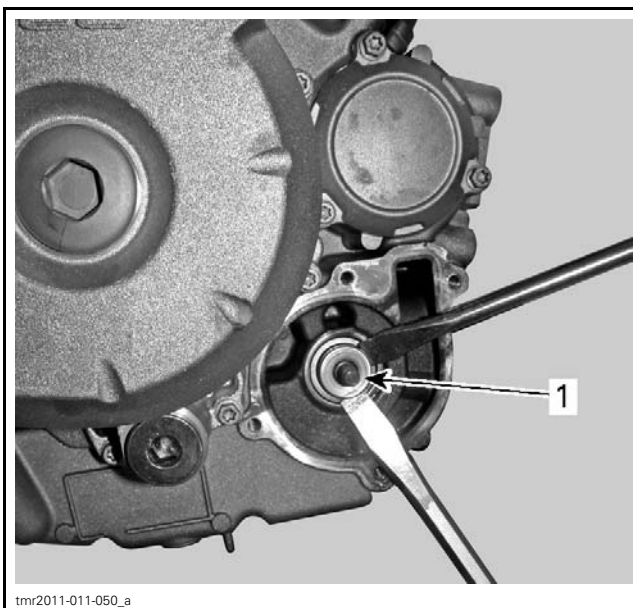
Water Pump Seals Replacement (Assembled Engine)

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

Removing the Seals

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.

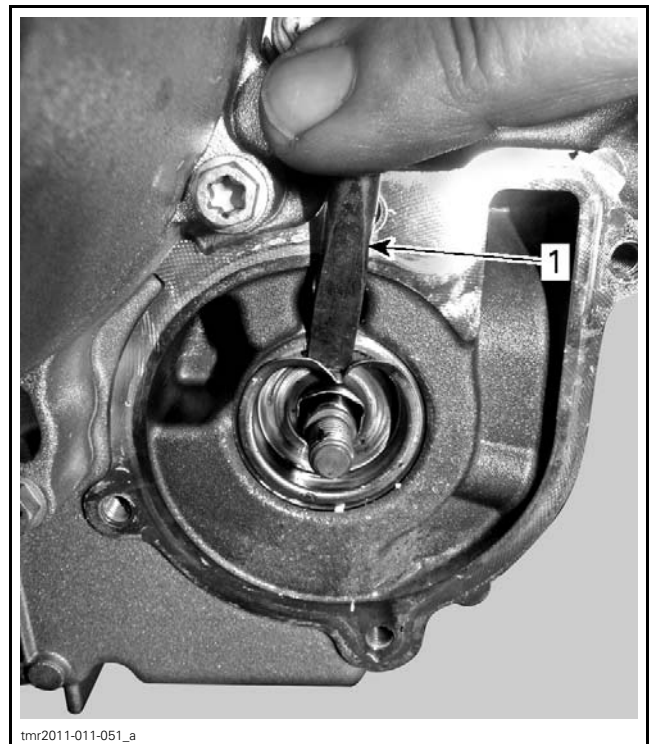


1. Inner part of rotary seal



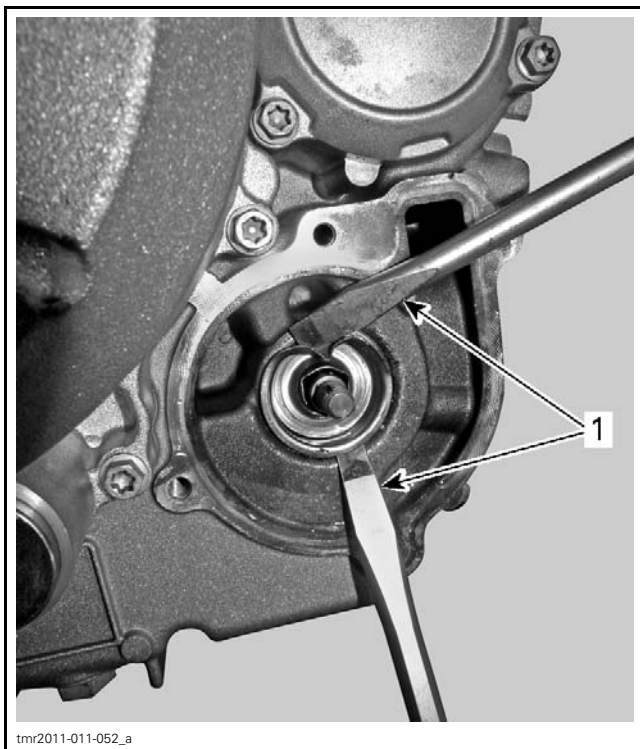
TYPICAL - INNER PART OF ROTARY SEAL REMOVED

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



1. Small chisel

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

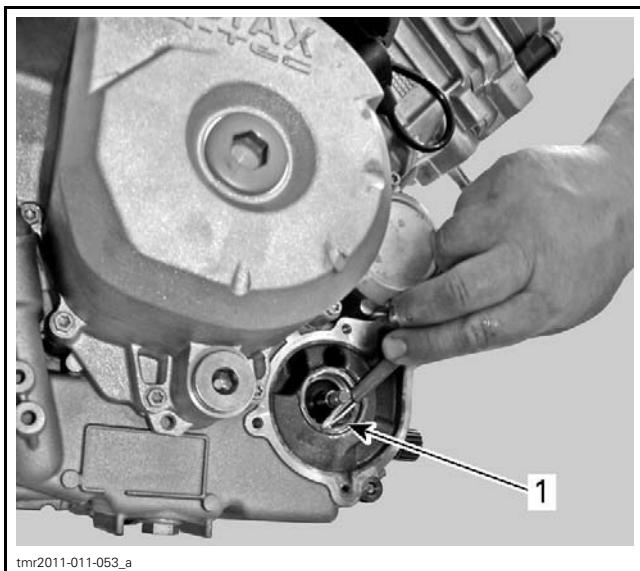


1. Screwdrivers

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

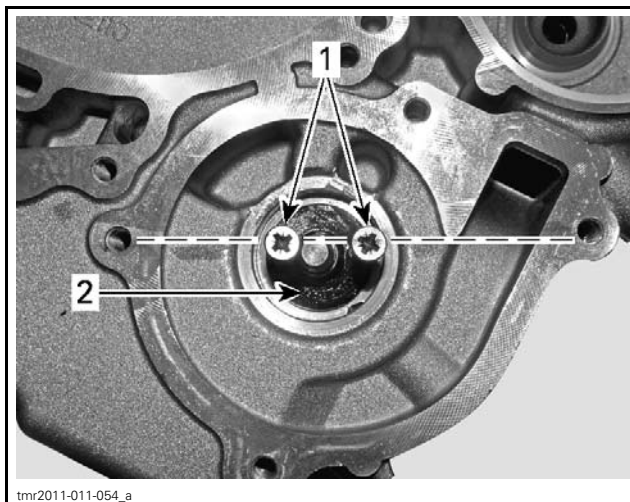
5. Thoroughly remove carefully sealing residue and burr of rotary seal using a scraper.

NOTICE Be careful not to damage water pump shaft.



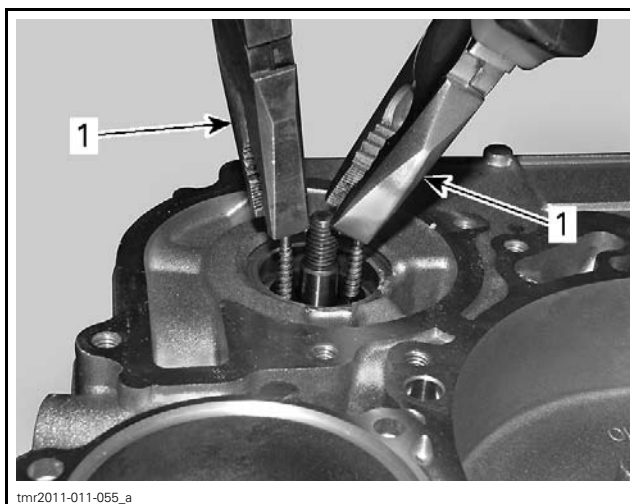
1. Scraper

6. Install 2 wooden screws in the seal.



1. Wooden screws
2. Oil seal

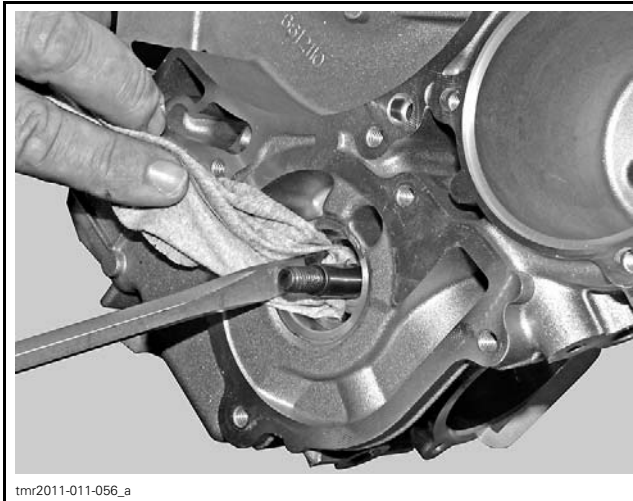
7. Remove oil seal from crankcase by pulling screws with pliers.



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.

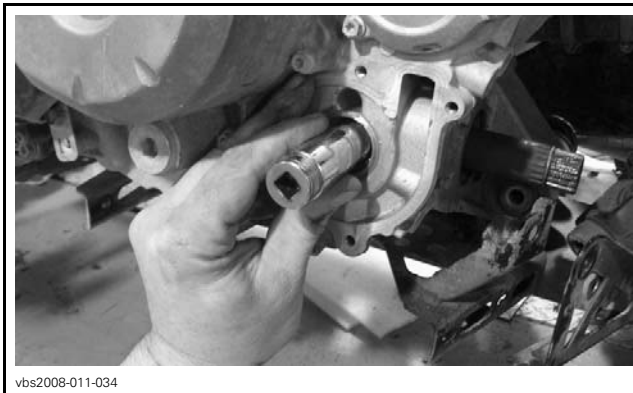


Installing the Seals

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.

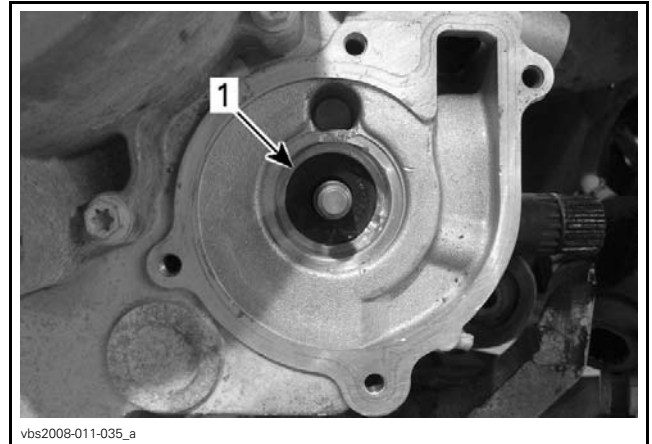
REQUIRED TOOL

17 mm (11/16 in) deep socket



OIL SEAL INSTALLATION

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



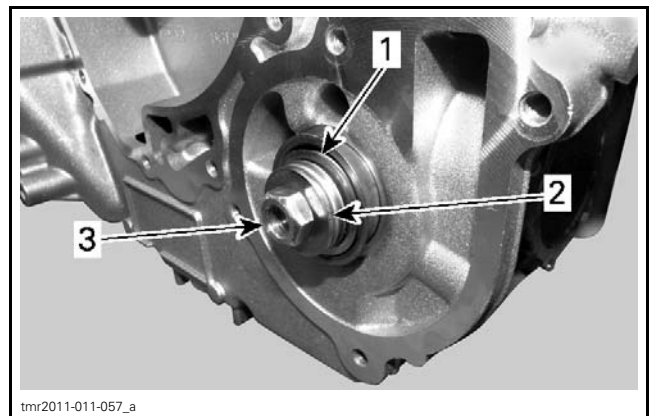
TYPICAL

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)

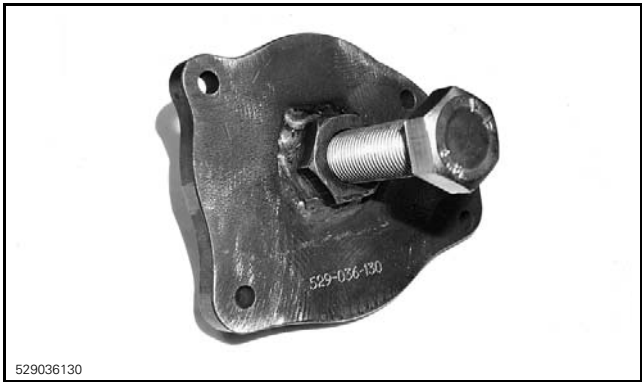
11. Remove M8 nut.

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

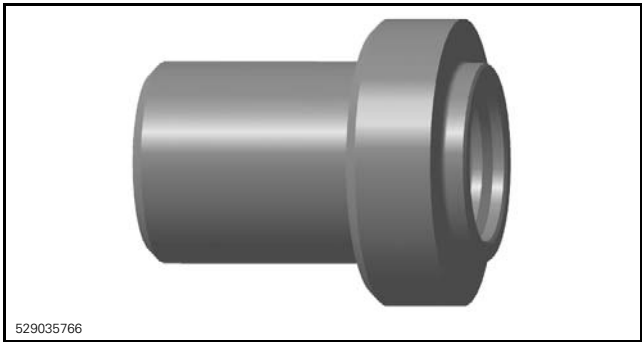
12. Install rotary seal installation tools on crankcase as follows.

Subsection XX (COOLING SYSTEM)

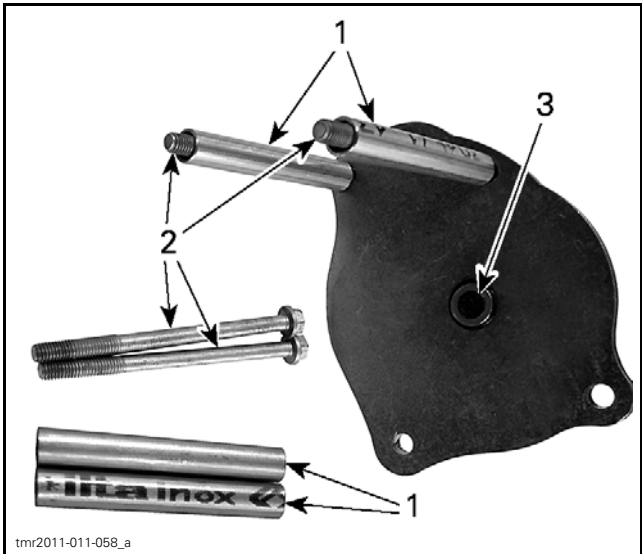
REQUIRED TOOLS
ROTARY SEAL PUSHER PLATE (P/N 529 036 130)
4x M6 x 85 screws (P/N 420 440 347)
4x tubes 70 mm (2.75 in)
SEAL PUSHER (P/N 529 035 766)



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



SEAL PUSHER (P/N 529 035 766)



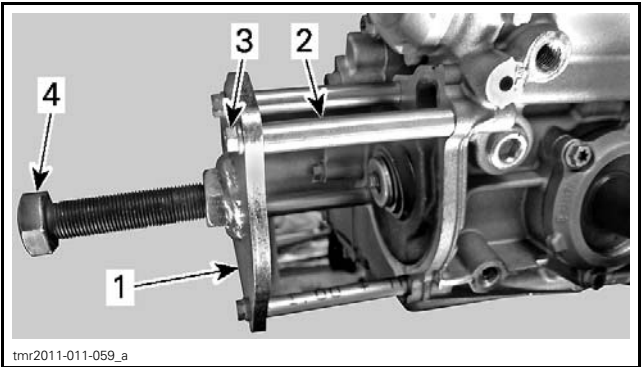
ROTARY SEAL PUSHER PLATE ASSEMBLY

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.

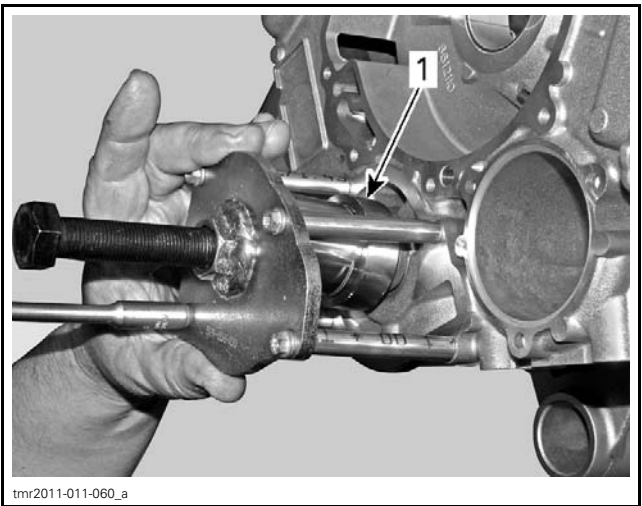
NOTICE Do not use pneumatic or electric tools for tightening screws.



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)

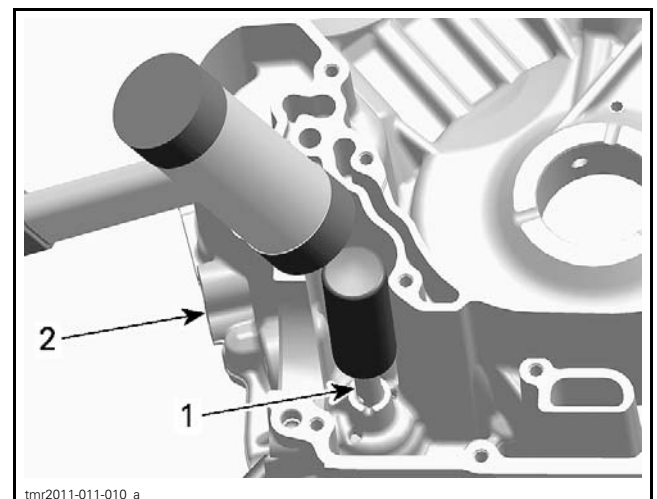
Removing the Water Pump Shaft and Seals

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.

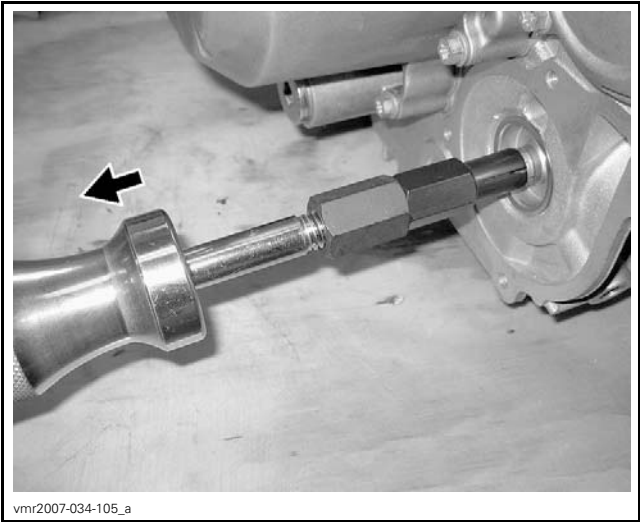
REQUIRED TOOL
Soft hammer



1. Water pump shaft
2. Crankcase MAG side

3. Using a blind hole puller, remove outer part of rotary seal.

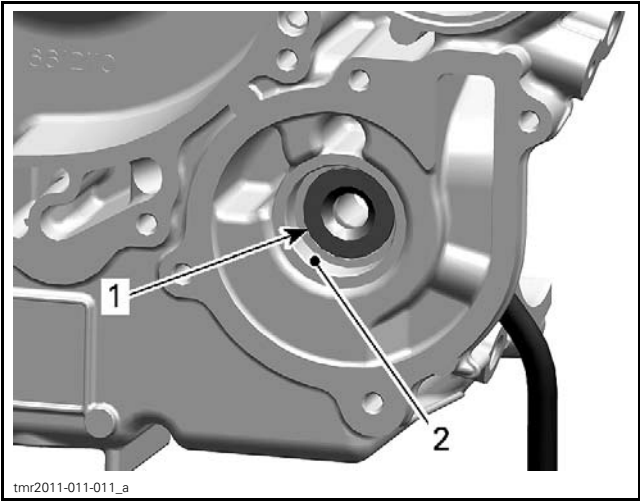
4. Install expander snugly against outer part of rotary seal and pull seal out.



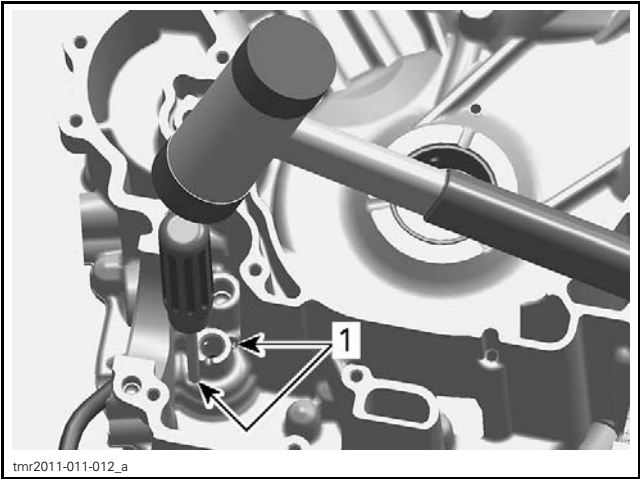
TYPICAL

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

Installing the Water Pump Shaft and Seals

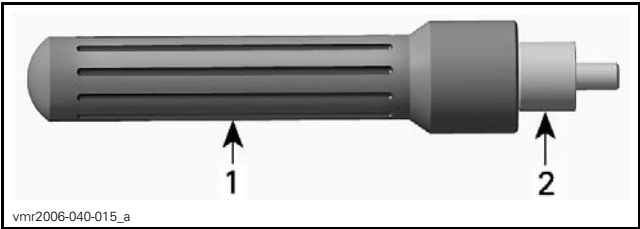
The installation is the reverse of the removal procedure. However, pay attention to the following. Use tightening torque values specified in the exploded view.

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.

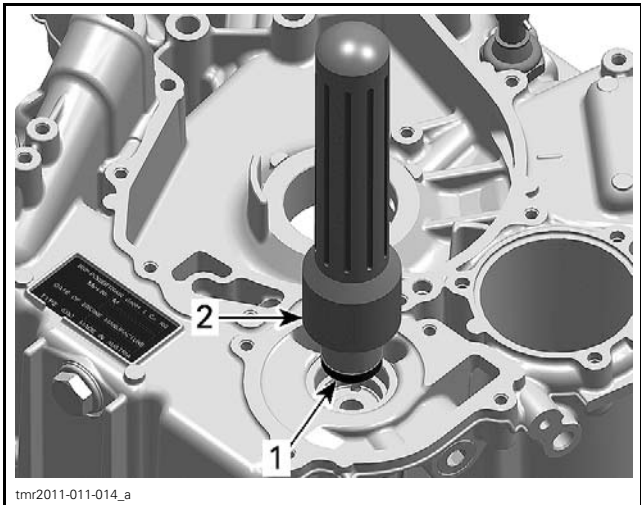
REQUIRED TOOL
OIL SEAL PUSHER (P/N 529 035 757)
HANDLE (P/N 420 877 650)



1. Handle
2. Pusher

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

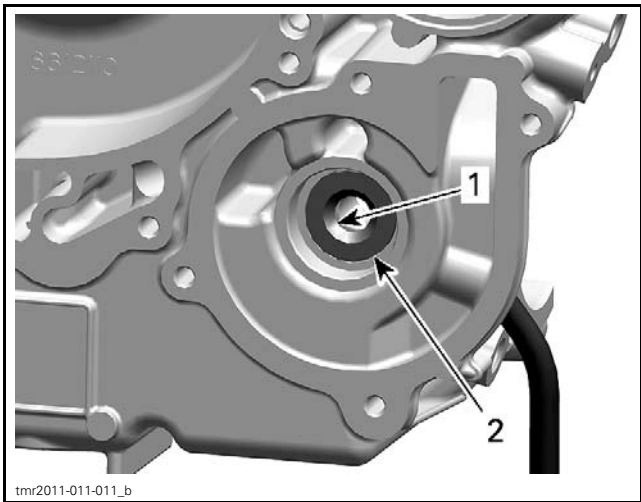
Push NEW oil seal in place.



- 1. Oil seal
- 2. Installer handle with oil seal pusher

Lubricate sealing lip of the oil seal.

SERVICE PRODUCT	
Sealing lip of the oil seal	DOW CORNING 111 (P/N 413 707 000)

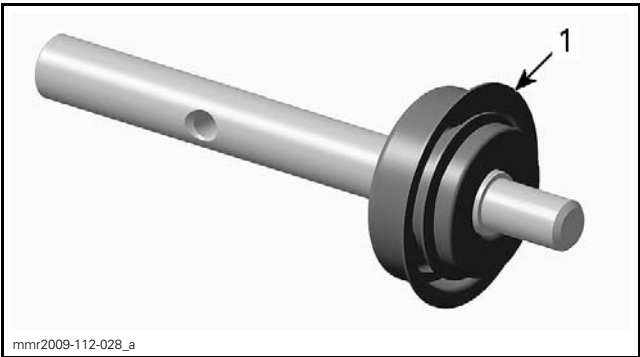


- 1. Sealing lip
- 2. Oil seal properly installed

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

Slide NEW water pump shaft assembly into crankcase.

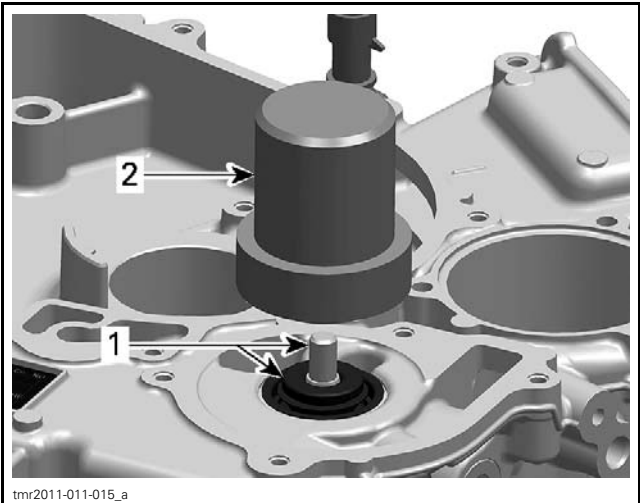
REQUIRED TOOL	
SEAL PUSHER (P/N 529 035 766)	



- 1. Surface where rotary seal is pushed by tool

Assembling the Water Pump Shaft

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

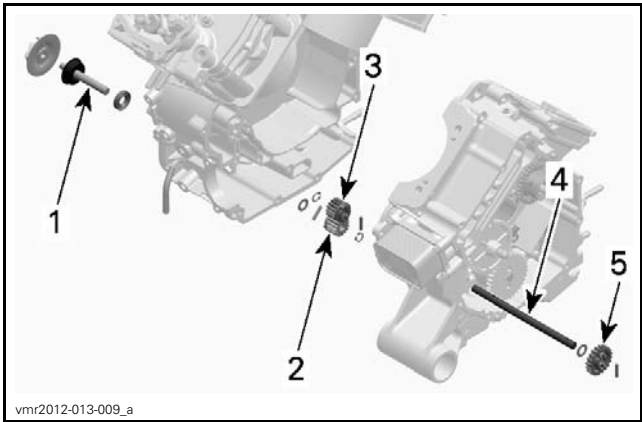


- 1. Water pump shaft with rotary seal
- 2. Water pump seal installer

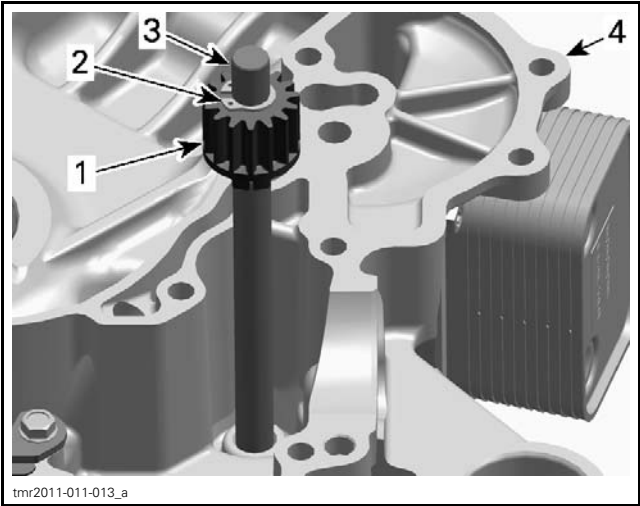
NOTICE After installation, water pump shaft with rotary seal must rotate freely.

WATER PUMP GEARS

Water Pump Gears Identification



- TYPICAL**
- 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)



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

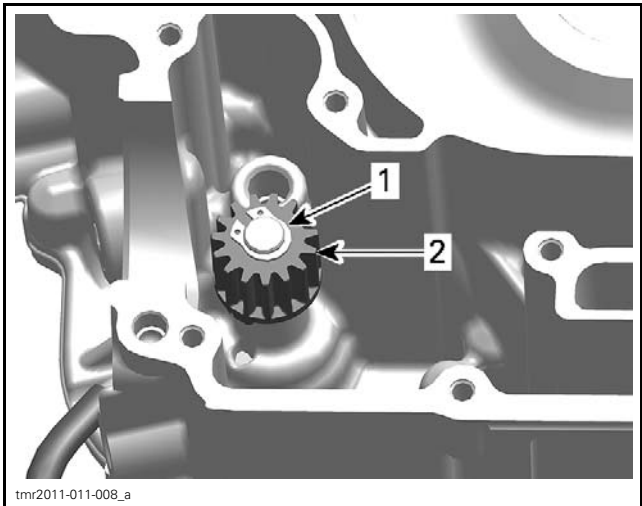
Water Pump Drive Gear

See *BOTTOM END* subsection.

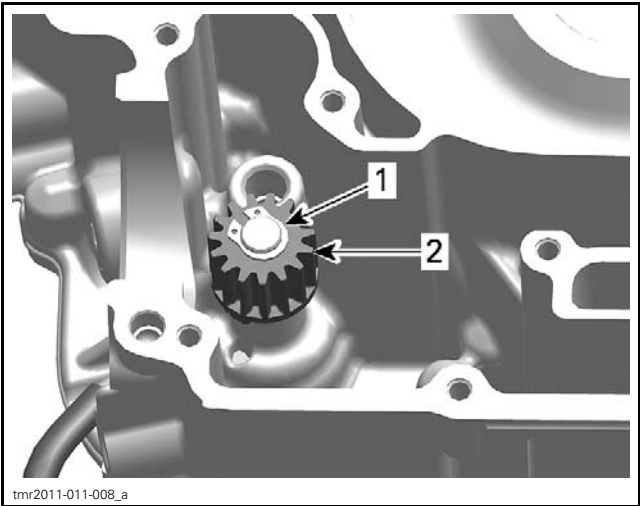
Removing the Water Pump Gears

Water Pump Gear

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



- CRANKCASE MAG SIDE**
- 1. Circlip
 - 2. Water pump gear

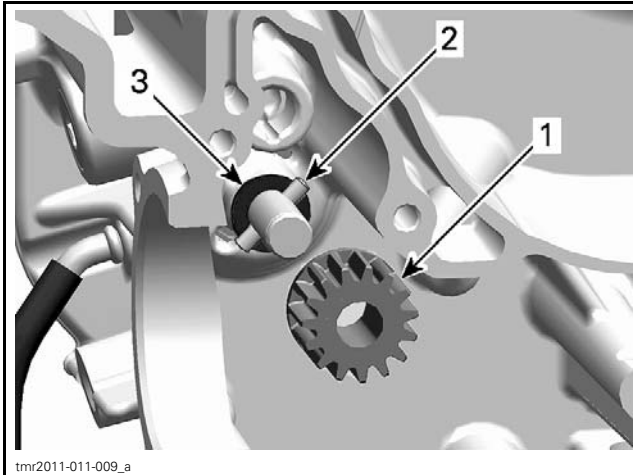


- CRANKCASE MAG SIDE**
- 1. Circlip
 - 2. Water pump gear

Water Pump Intermediate Drive Gear

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

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

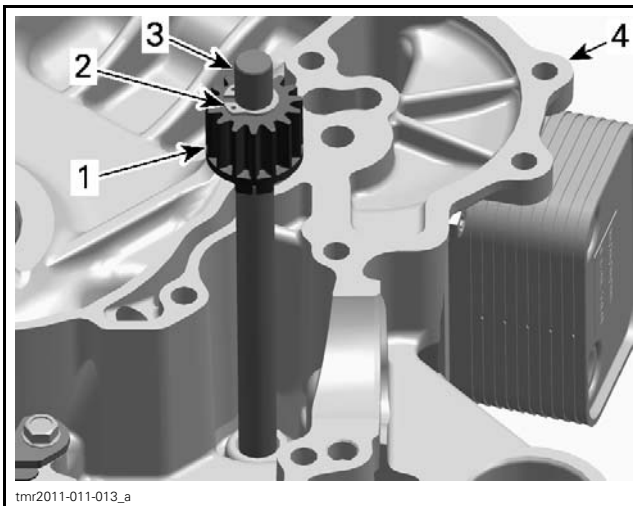


CRANKCASE MAG SIDE

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.



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.

Installing the Water Pump Gears

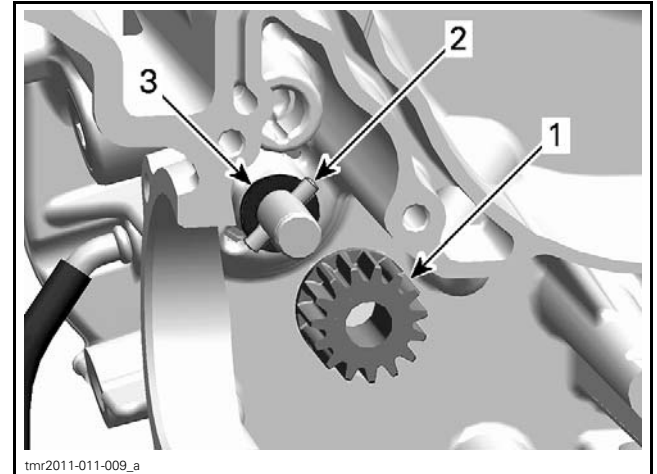
Water Pump Gear

Install the following parts on water pump shaft.

- Thrust washer

- Needle pin
- Water pump gear.

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

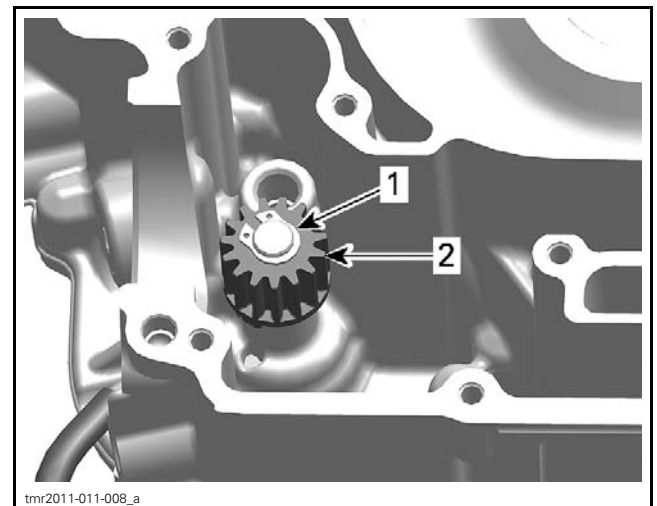


1. Water pump gear
2. Needle pin
3. Thrust washer

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.

Subsection XX (COOLING SYSTEM)

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

Water Pump Drive Gear

See *BOTTOM END* subsection.

CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

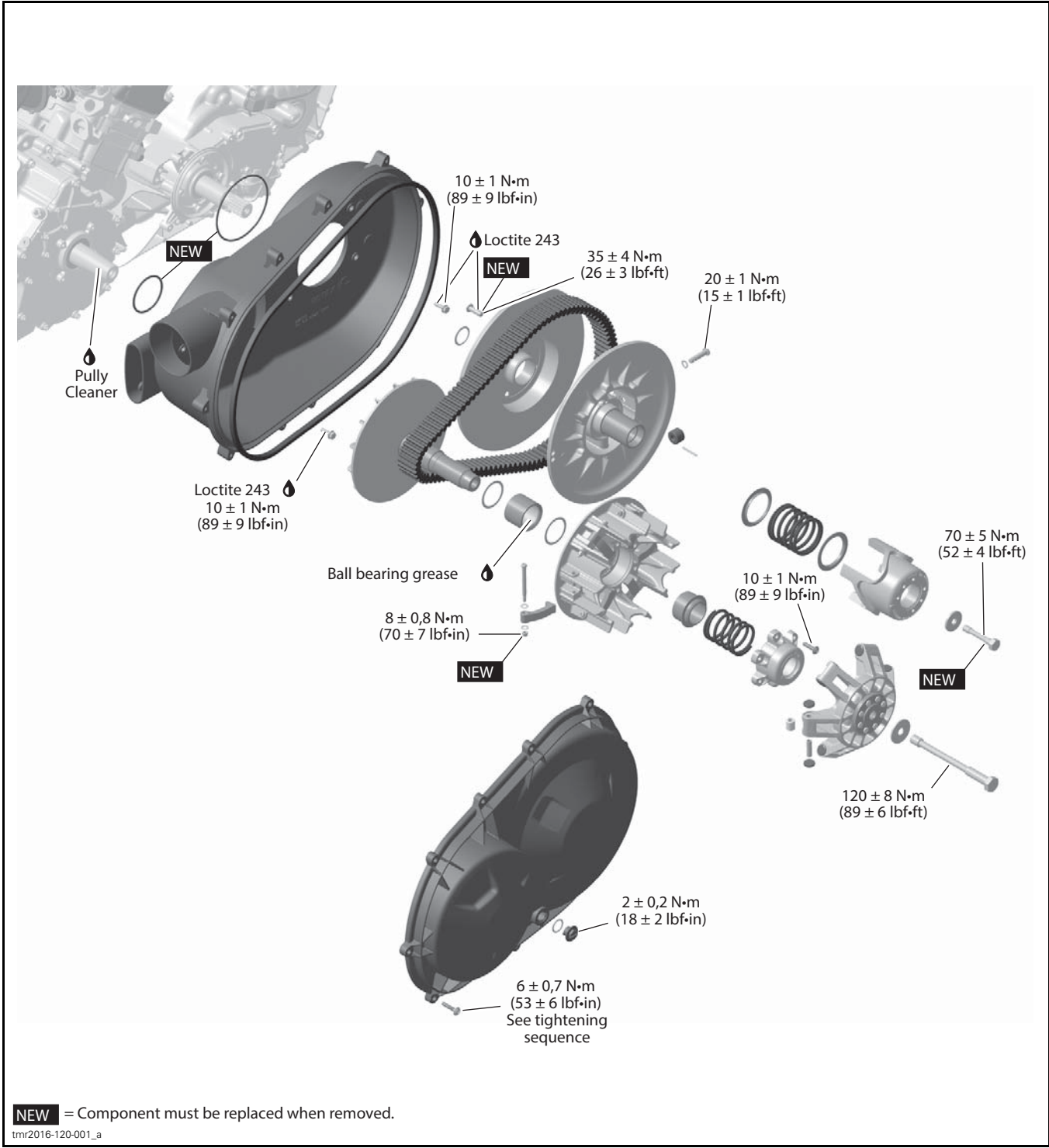
SERVICE TOOLS

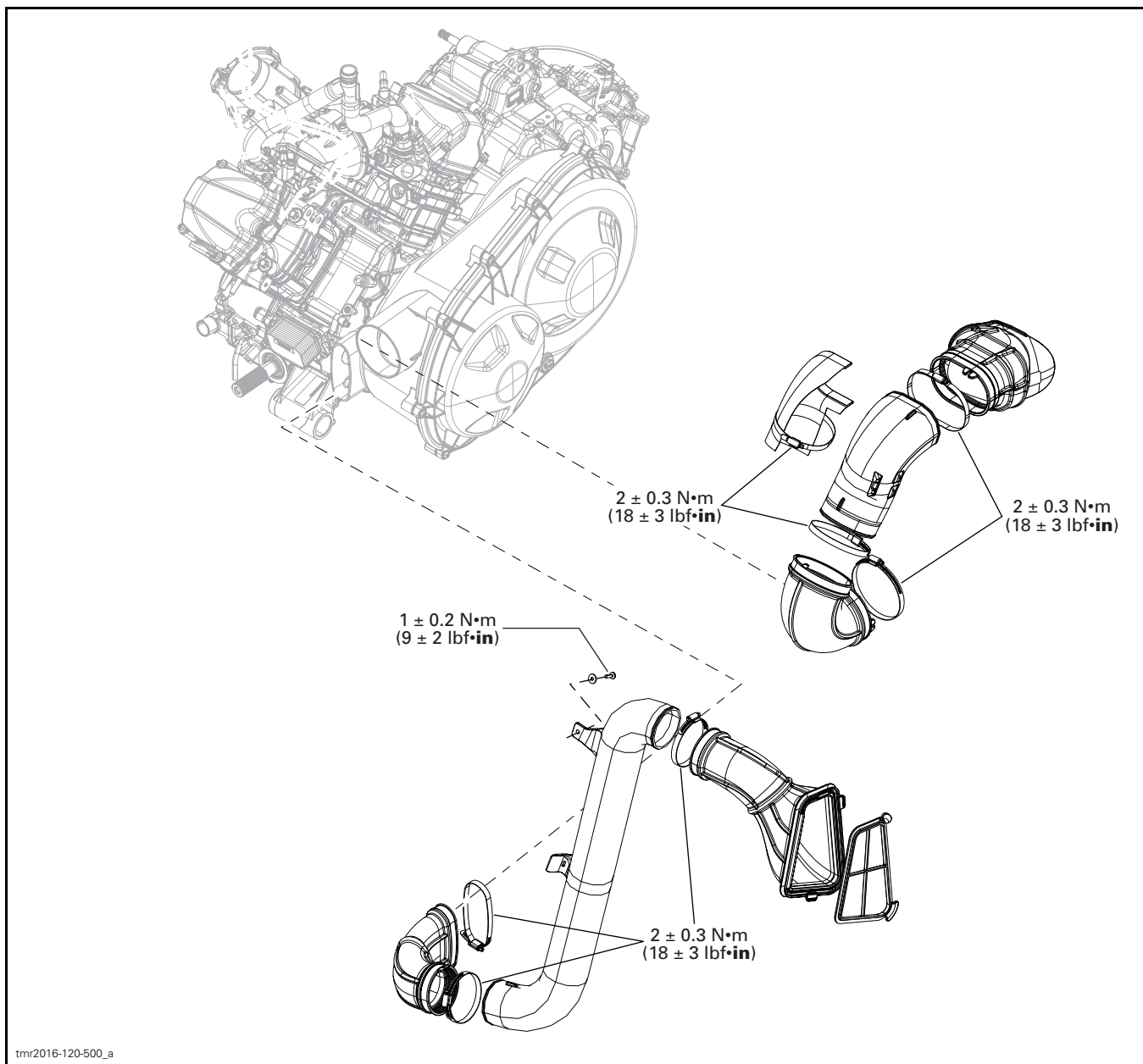
Description	Part Number	Page
CLUTCH HOLDER.....	529 036 380	6, 15, 20
CLUTCH PULLER	529 035 746	7
DRIVEN PULLEY ADAPTER	708 200 686	5, 15
DRIVEN PULLEY EXTRACTOR	529 036 352	5, 15
DRIVEN PULLEY SPACER.....	529 036 351	16
PULLEY SPRING COMPRESSOR TOOL.....	529 036 012	8, 16

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	19, 21
PULLEY FLANGE CLEANER	413 711 809	9–10, 19
XPS BRAKES AND PARTS CLEANER (USA)	219 701 705	20
XPS BRAKES AND PARTS CLEANER	219 701 776	20

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 hub.

 **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

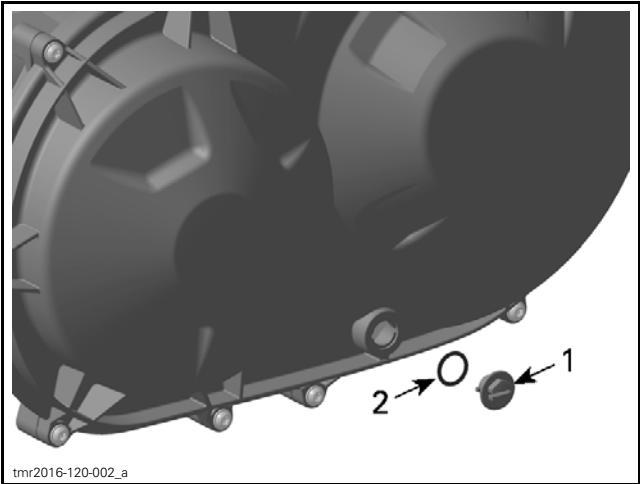
CVT Cover Access

Tilt the cargo box.
Remove the rear deflector on the driver side.
The wheel can also be removed to make more room.

Draining the CVT Cover

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

1. Turn bayonet cap 90° counterclockwise to open it.
2. Remove bayonet cap and O-ring.



1. Bayonet cap
2. O-ring

3. Let water drain from CVT cover.
4. Reinstall bayonet cap and O-ring.

TIGHTENING TORQUE	
Bayonet cap	2 N•m ± 0.2 N•m (18 lbf•in ± 2 lbf•in)

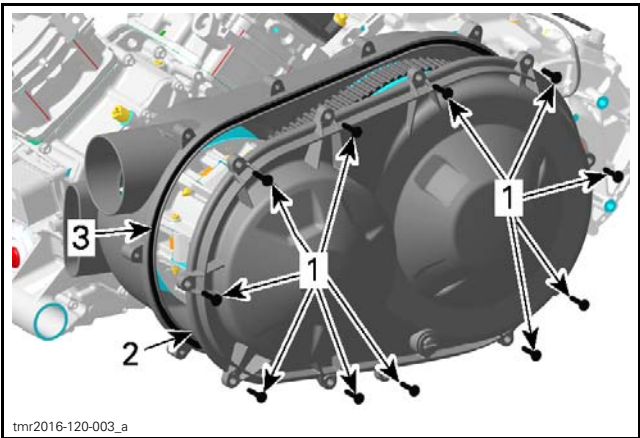
NOTICE If any debris entered the CVT cover, CVT must be cleaned and inspected.

Removing the CVT Cover

- Remove:
- Retaining screws
 - CVT cover
 - Gasket.

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

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

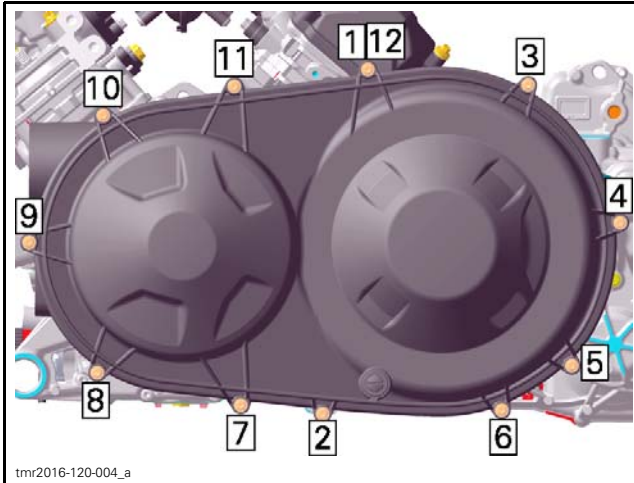


1. Retaining screws
2. CVT cover
3. Gasket

Installing the CVT Cover

Install the center top screw of first.

Tighten the CVT cover retaining screws as per following sequence.



TIGHTENING TORQUE	
CVT cover retaining screws	6 N•m ± 0.7 N•m (53 lbf•in ± 6 lbf•in)

DRIVE BELT

Removing the Drive Belt

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

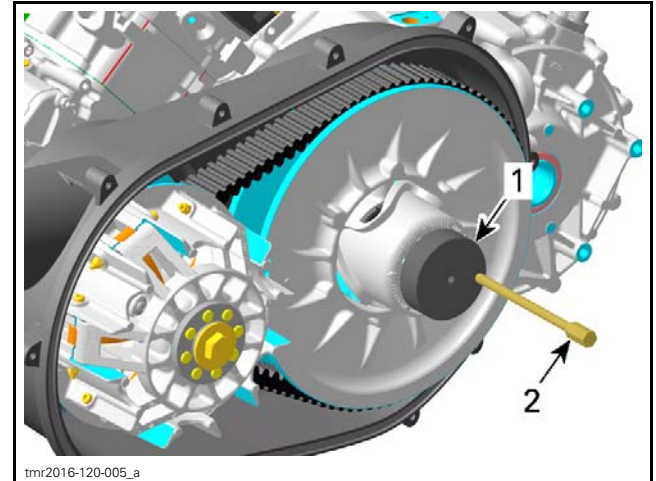
Remove *CVT COVER*.

REQUIRED TOOL	
DRIVEN PULLEY EXTRACTOR (P/N 529 036 352)	
<u>DRIVEN PULLEY ADAPTER</u> <u>(P/N 708 200 686)</u>	

Screw in the driven pulley adapter into the driven pulley shaft.

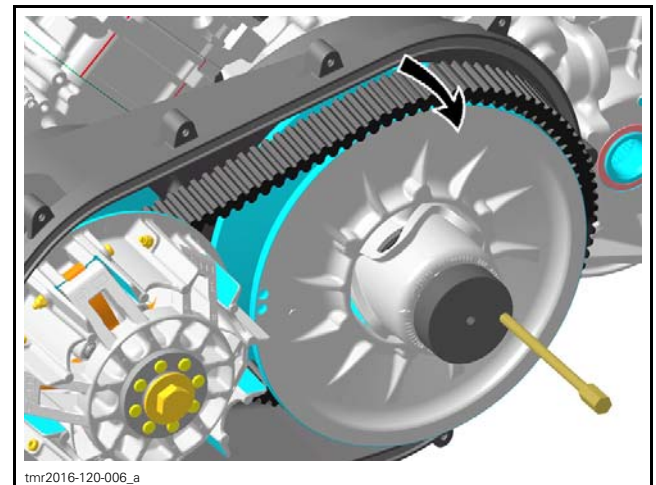
Screw in the driven pulley extractor into the threaded offset hole of the adapter.

Tighten the extractor to open the pulley.



1. Driven pulley adapter
2. Driven pulley extractor

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



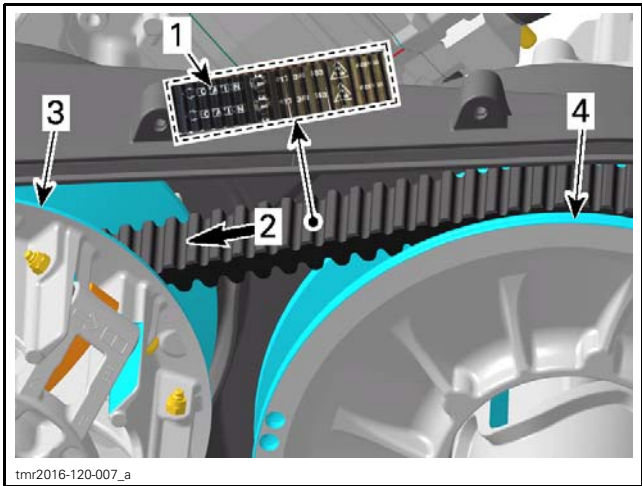
Inspecting the Drive Belt

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

Installing the Drive Belt

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.

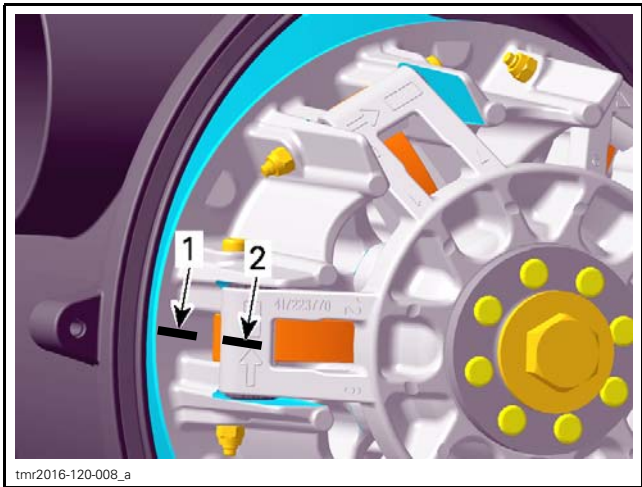


- 1. Arrow printed on belt
- 2. Rotation direction
- 3. Drive pulley (front)
- 4. Driven pulley (rear)

DRIVE PULLEY

Removing the Drive Pulley

- 1. Remove *DRIVE BELT*, see procedure in this subsection.
- 2. Prior to removing the drive pulley, mark sliding sheave and governor cup to ensure correct indexation at reinstallation.

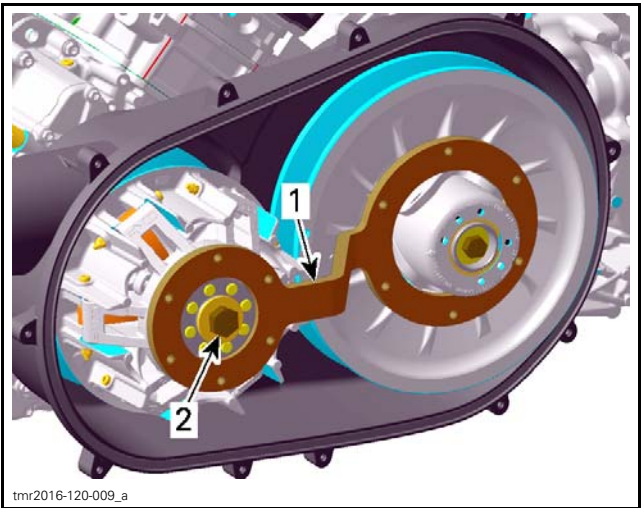


- 1. Mark on drive pulley sliding sheave
- 2. Mark on governor cup

- 3. Lock the drive pulley.

REQUIRED TOOL	
CLUTCH HOLDER (P/N 529 036 380)	

- 4. Loosen the drive pulley screw.



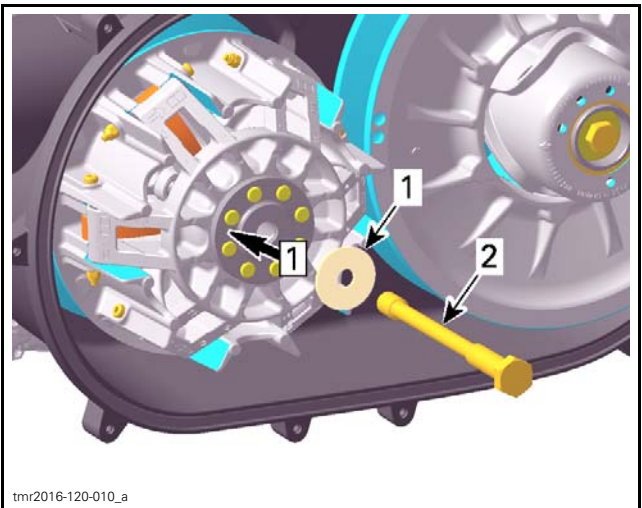
- 1. Clutch holder
- 2. Drive pulley screw

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

NOTE: Do not unscrew the drive pulley screw completely.

- 5. Remove service tool.
- 6. Apply axial pressure with your hand on the governor cup until clutch puller for removal is installed.
- 7. Remove drive pulley screw and spring washer.

CAUTION Sliding sheave of drive pulley is spring loaded.



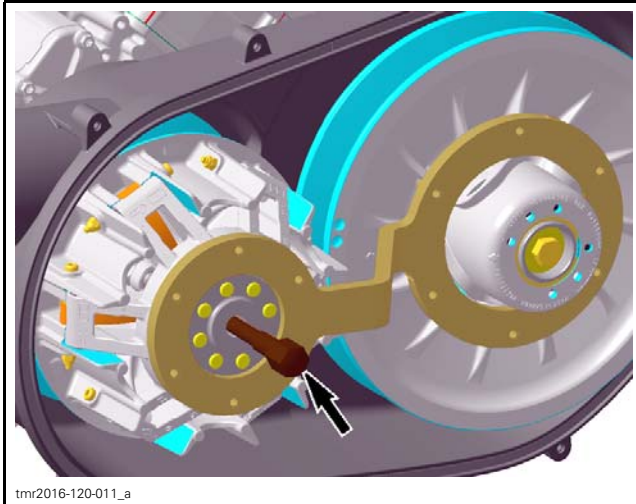
Step 1: Push

- 1. Spring washer
- 2. Drive pulley screw

- 8. Screw clutch puller in fixed sheave to remove drive pulley.

NOTICE Use only recommended tool.

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



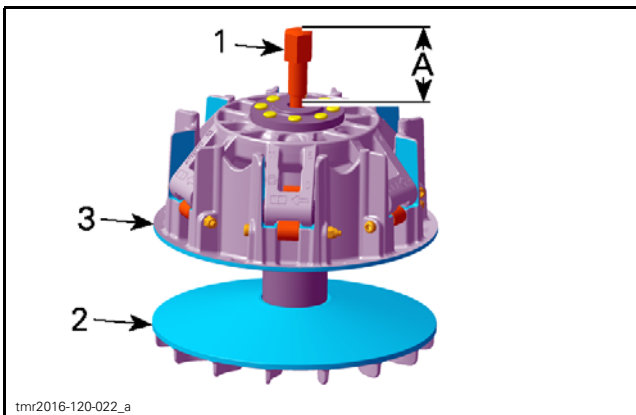
Disassembling the Drive Pulley

Drive Pulley

Screw clutch puller into fixed sheave shaft about 63 mm (2-1/2 in).

Raise drive pulley by the sliding sheave while knocking on the puller head to disengage fixed sheave.

NOTICE Never tap on governor cup.

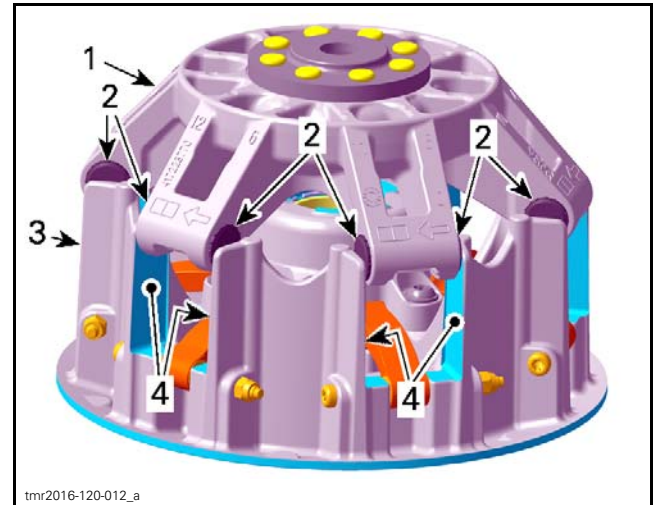


A. Maximum protrusion of 63 mm (2-1/2 in)

1. Clutch puller
2. Fixed sheave
3. Sliding sheave

Governor Cup

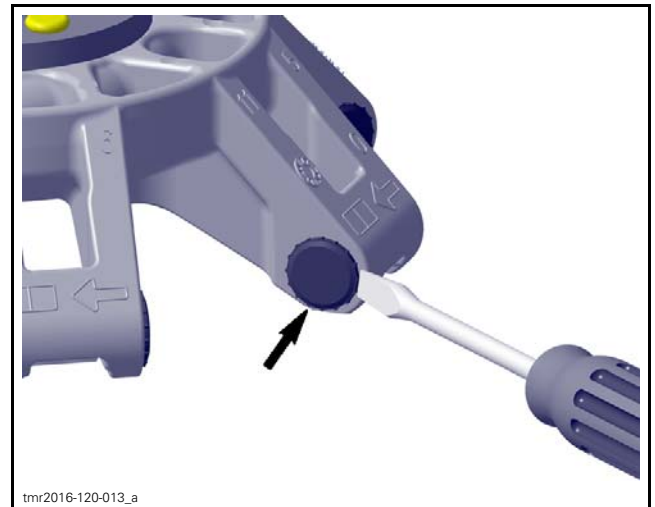
Carefully lift governor cup until slider shoes come at their highest position into guides.



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 *INSPECTING THE DRIVE PULLEY* before proceeding.

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



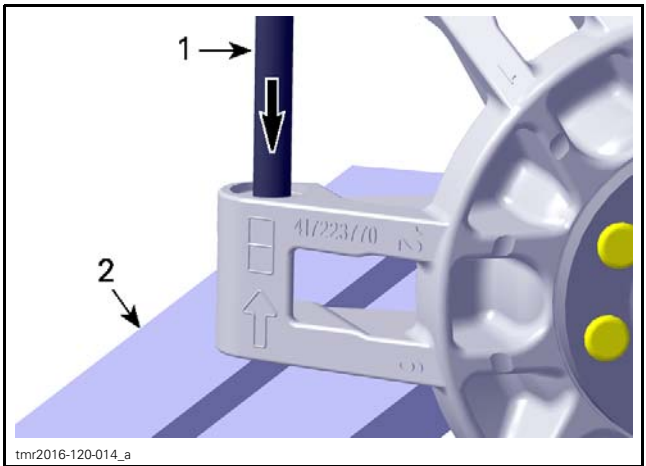
Put governor cup on a vice to push out bearing sleeve of roller in the foreseen direction (against arrow). Use an appropriate punch (diameter of punch must be smaller than the bearing sleeve diameter).

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

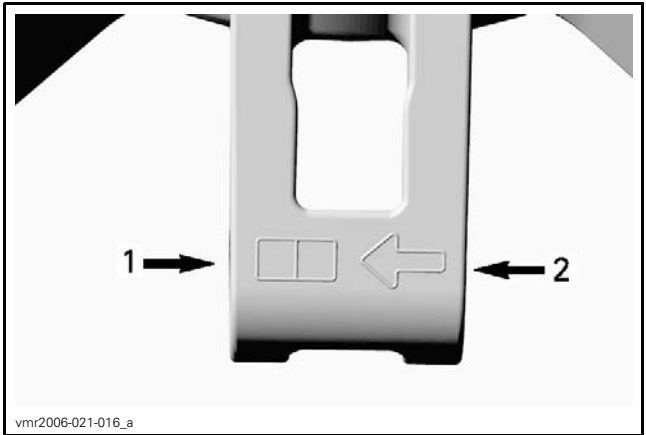
NOTE: Use protection plates to avoid marks and/or damages to the governor cup.

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

NOTICE Always replace all rollers at the same time. Partly worn rollers may cause damage to the CVT system.

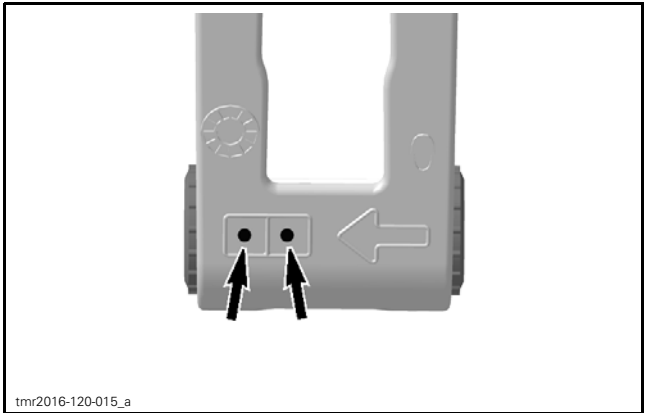


- 1. Punch
- 2. Vice



- 1. Removal direction
- 2. Assembly direction

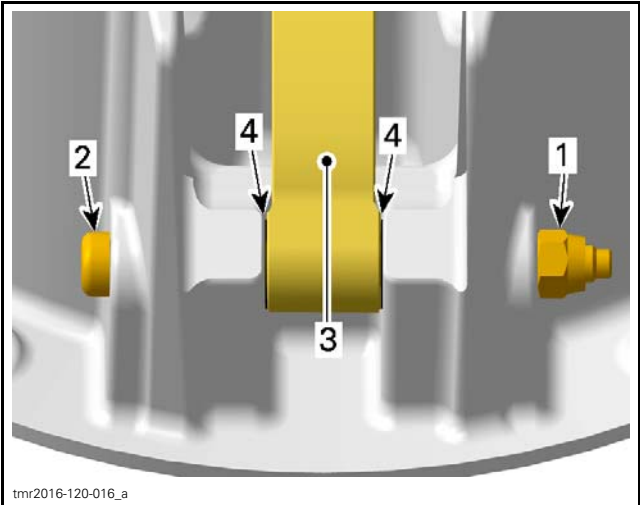
NOTE: Whenever removing a governor cup with already two marked boxes replace it by a **NEW** one.



Sliding Sheave

This drive pulley is equipped with 6 levers.

- Remove:
- Lock nut
 - Centrifugal lever pivot bolt
 - Centrifugal lever
 - Thrust washers.
- and both



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

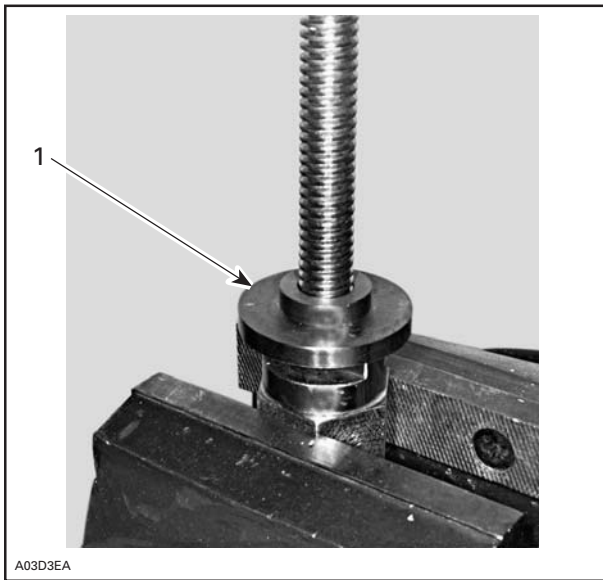
Remove spring cover.

**WARNING**

Spring cover is under high clutch spring preload. Never attempt to remove spring cover without the recommended tools.

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

Install support guide of spring compressor in a vice.

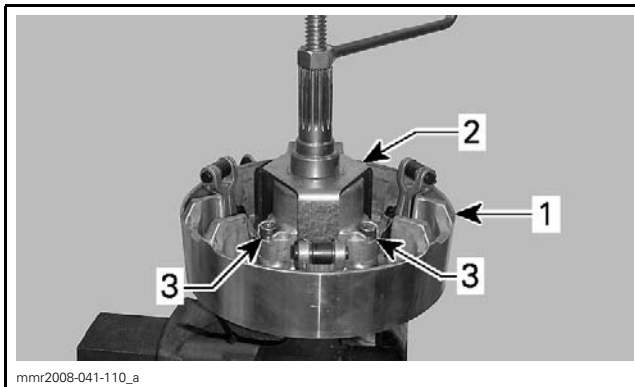


NOTE: The support guide will prevent bushing damage.

Place sliding sheave on support guide.

Place support cup over spring cover and tighten nut.

Remove spring cover screws.

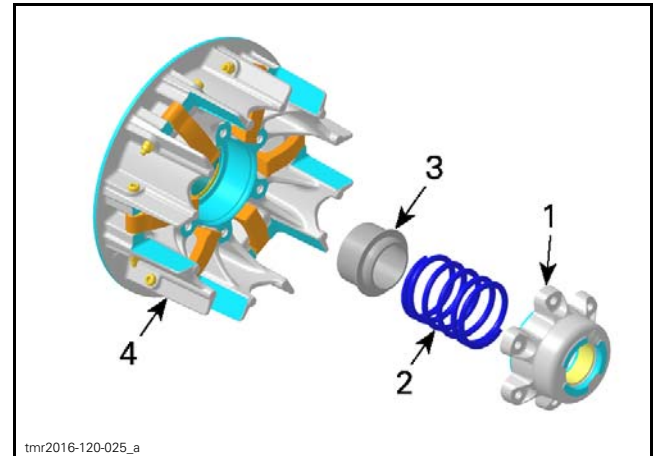


TYPICAL

Remove service tool.

Remove:

- Spring cover
- Spring
- Spring seat.

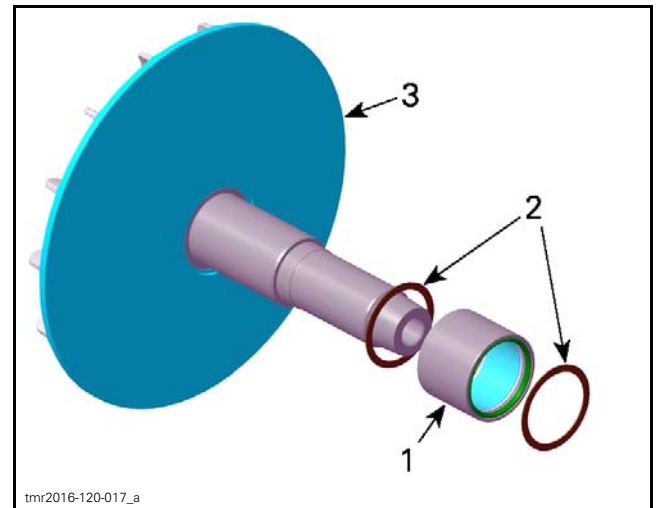


1. Spring cover
2. Spring
3. Spring seat
4. Sliding sheave

Fixed Sheave

Remove:

- Hub
- Thrust washers.



1. Hub
2. Thrust washers
3. Fixed sheave

Cleaning the Drive Pulley

Clean pulley faces and shaft with fine steel wool and dry cloth.

Using a paper towel with cleaning solvent, clean:

- Crankshaft tapered end
- Crankshaft threads
- Taper on the fixed sheave
- Threads of drive pulley screw.

DRIVE PULLEY CLEANING	
Service product	PULLEY FLANGE CLEANER (P/N 413 711 809)

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

NOTICE Avoid contact between cleaner and crankshaft seal because damage may occur.

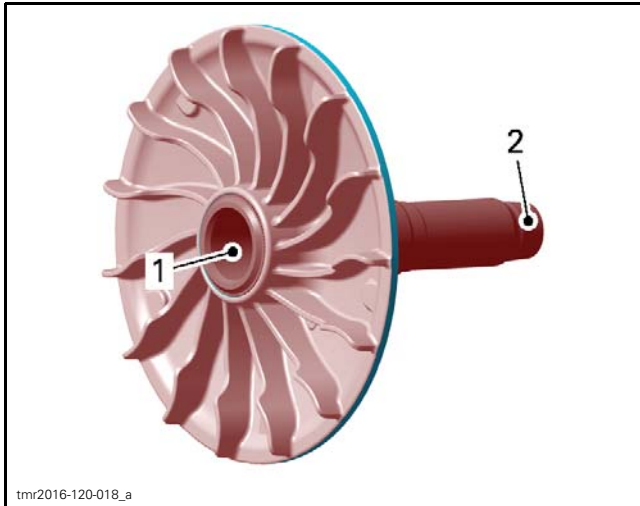
Remove all hardened oil deposits that have baked on crankshaft and pulley tapered surfaces with coarse or medium steel wool and/or sand paper no. 600.

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.

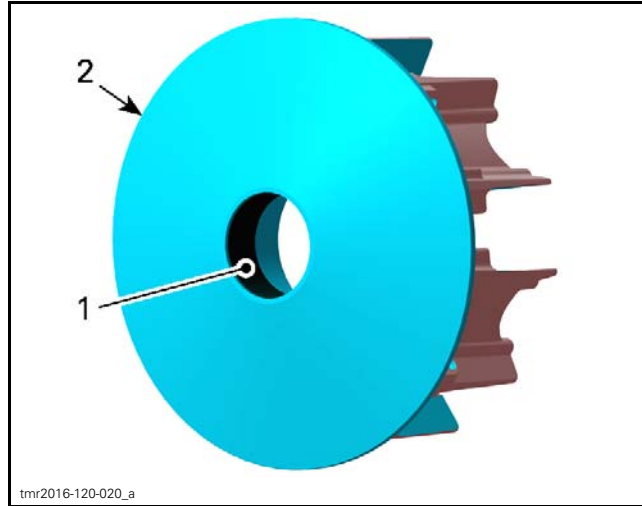
NOTICE Mounting surfaces must be free of any oil, cleaner or towel residue.



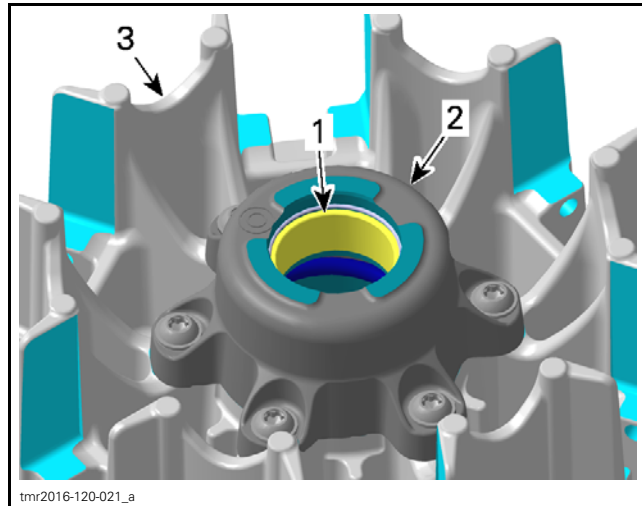
1. Taper of fixed sheave, crankshaft side
2. Tapered end of fixed sheave shaft

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

NOTICE Do not use acetone to clean bushing.



1. Bushing
2. Sliding sheave



1. Bushing
2. Spring cover
3. Sliding sheave

Inspecting the Drive Pulley

Bushings

For bushing inspection, refer to *SLIDING SHEAVE AND SPRING COVER* in this subsection.

Governor Cup

Check governor cup for cracks or other visible damage. Replace if necessary.

Roller and Slider Shoe

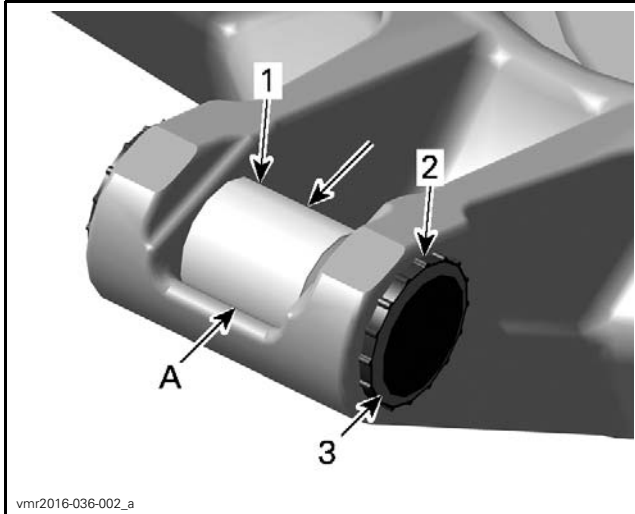
Check each roller for roundness of external diameter.

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. If chamfer is not present anymore, replace **ALL** slider shoes.

NOTE: If necessary, use a screwdriver to remove slider shoes.

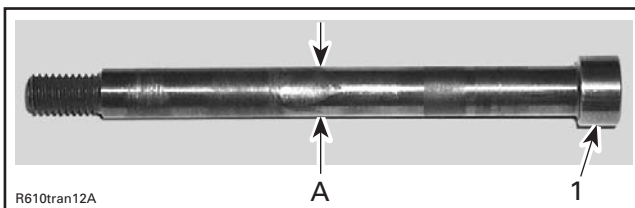


- 1. Roller
- 2. Slider shoe
- 3. Chamfer
- A. Roller outer diameter

ROLLER OUTER DIAMETER	
NEW	13.80 mm to 14.00 mm (.543 in to .551 in)
SERVICE LIMIT	13.20 mm (.519 in)
ROLLER INNER DIAMETER	
NEW	8.025 mm to 8.175 mm (.3159 in to .3219 in)
SERVICE LIMIT	9.000 mm (.3543 in)

Centrifugal Lever Pivot Bolt

Measure diameter of centrifugal lever pivot bolt, replace if it is out of specification.

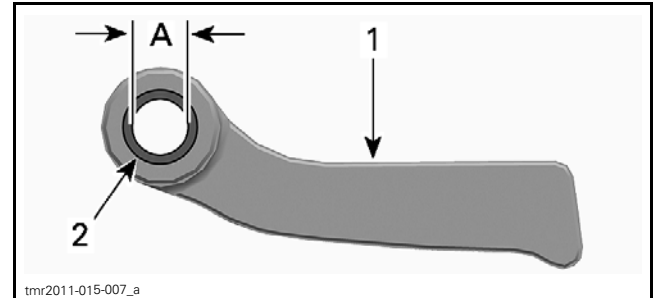


- 1. Centrifugal lever pivot bolt
- A. Measure diameter here

CENTRIFUGAL LEVER PIVOT BOLT DIAMETER	
NEW	6.063 mm to 6.091 mm (.2387 in to .2398 in)
SERVICE LIMIT	6.000 mm (.2362 in)

Centrifugal Lever

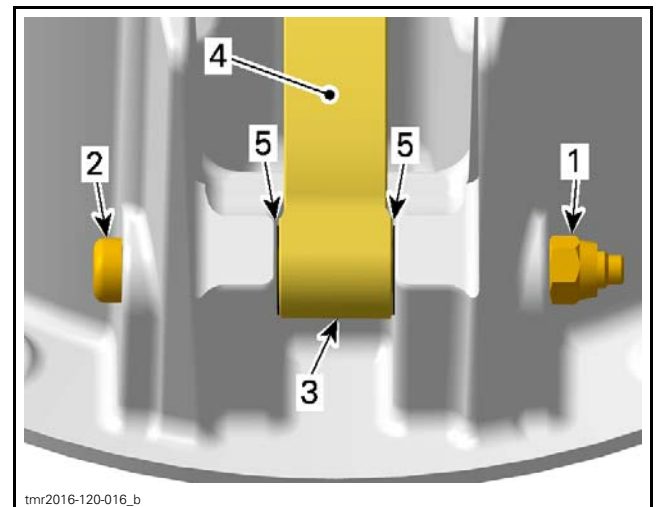
Check bushing diameter in the centrifugal lever for wear. Replace centrifugal lever if necessary.



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

CENTRIFUGAL LEVER BORE DIAMETER	
NEW	6.000 mm to 6.120 mm (.236 in to .241 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. Contact surface to the roller
- 5. Thrust washers

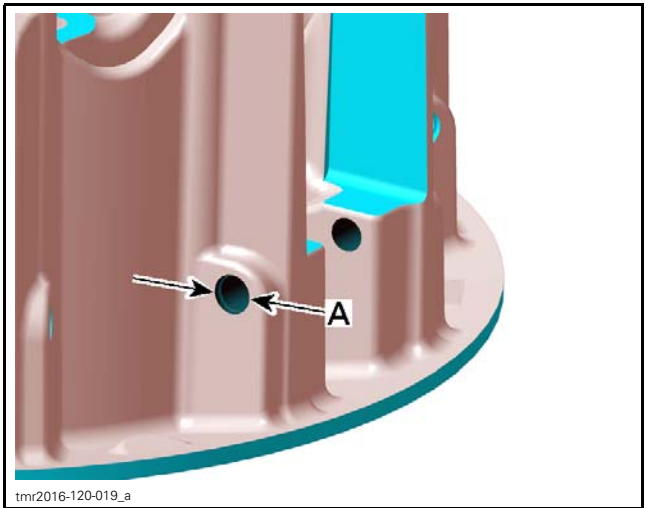
WARNING

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

Sliding Sheave and Spring Cover

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.

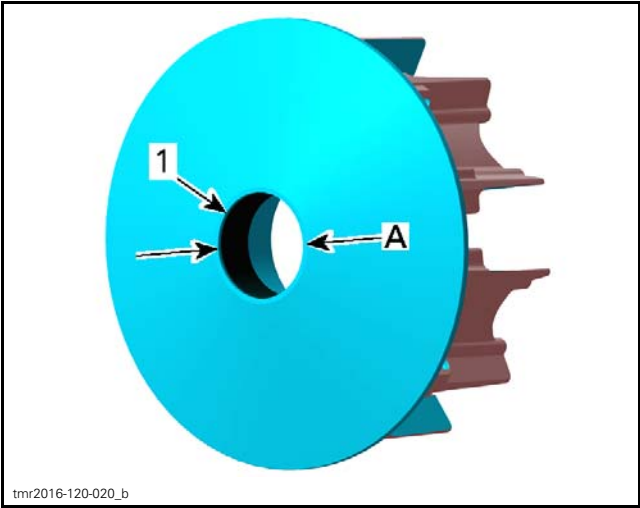


A. Centrifugal lever pivot bolt bore diameter

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)

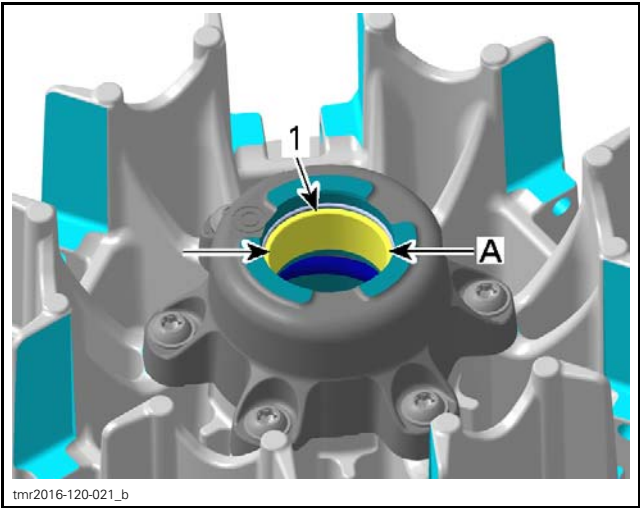
Measure bushing diameters of sliding sheave.

REQUIRED TOOL	
Dial bore gauge	
MEASURING POINT	
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	46.950 mm to 47.130 mm (1.848 in to 1.856 in)
SERVICE LIMIT	47.160 mm (1.857 in)



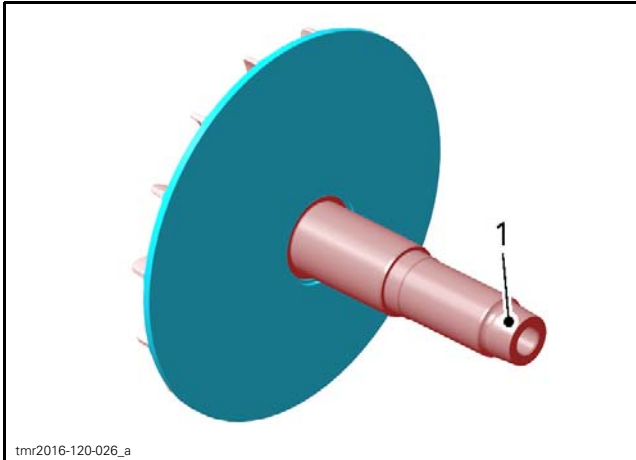
1. Bushing on governor cup side
A. Bore diameter of bushing

SLIDING SHEAVE SMALL BUSHING	
NEW	32.010 mm to 32.135 mm (1.26 in to 1.265 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

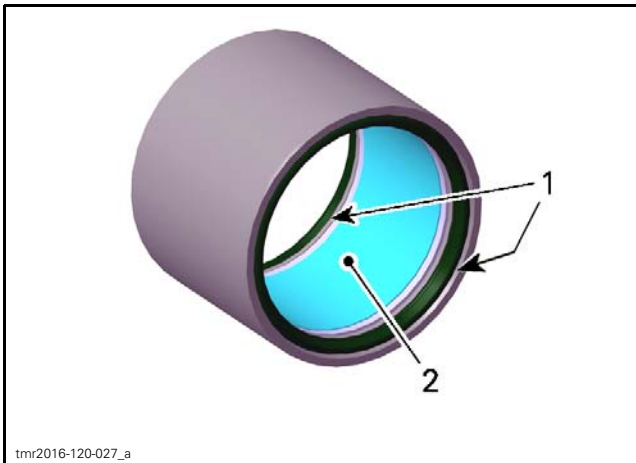
Check for any marks on fixed sheave plate. Replace if necessary.

Hub

Check:

- Oil seals in brittle, hard or damaged
- Needle bearing for excessive play and smooth operation.

Replace hub if necessary.



1. Oil seals
2. Needle bearing

Assembling the Drive Pulley

For assembly, reverse the disassembly procedure. Pay attention to following details.

Hub

Clean parts.

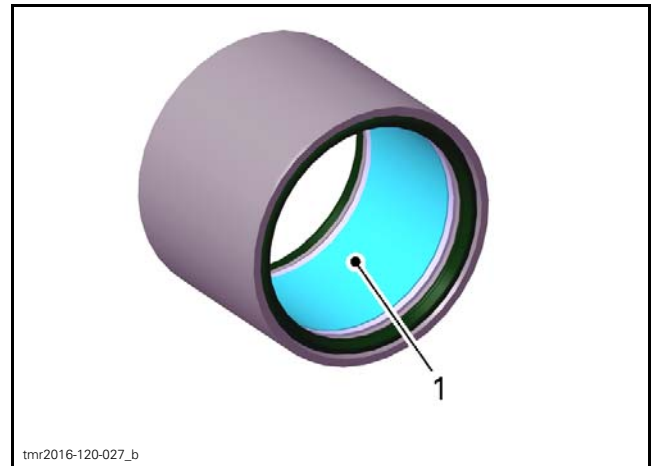
Lubricate needle bearing.

NOTICE Grease the needle bearing slightly. Do not apply in excess as it will spread out and lead to CVT malfunction.

NEEDLE BEARING LUBRICATION

Service product

Ball bearing grease



1. Lubricate needle bearing

Sliding Sheave

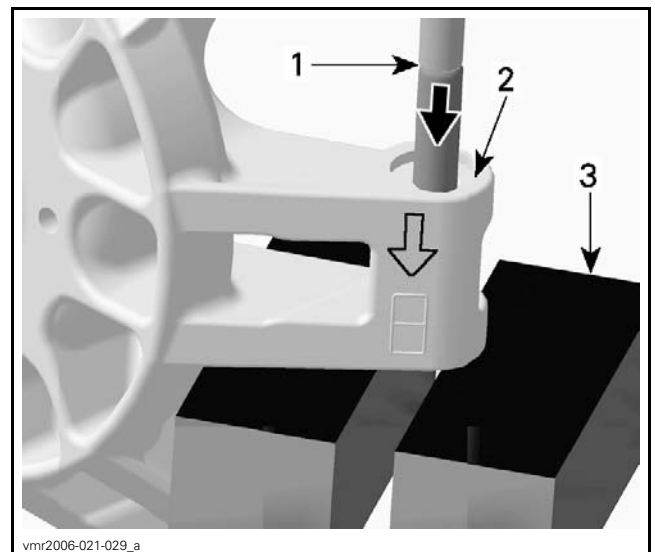
Install centrifugal levers with their thrust washers.

NOTICE Centrifugal levers must move easily after installation.

Governor Cup

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

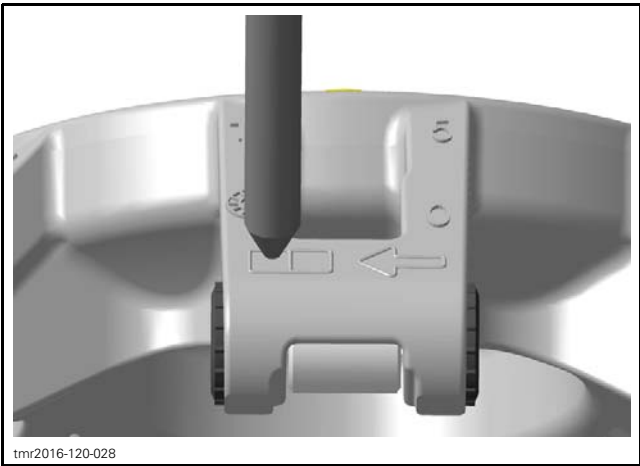
NOTICE Final position has to be aligned with the contact surface of the slider shoes (no protrusion).



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.

Installing the Drive Pulley

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

**WARNING**

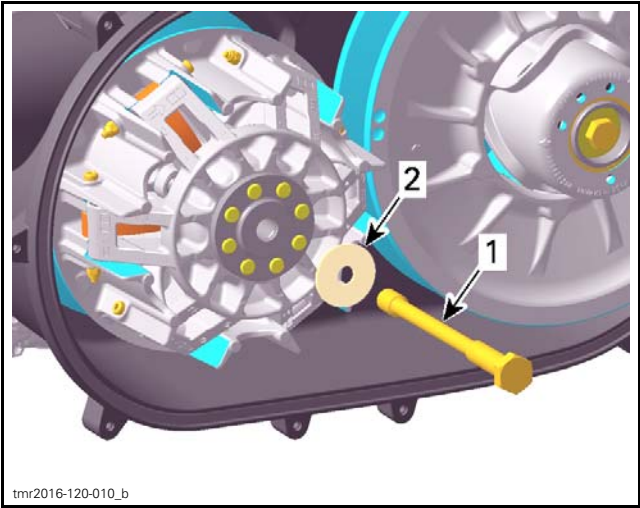
Do not apply antiseize or any lubricant on crankshaft and drive pulley tapers.

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.

Install conical spring washer with its concave side towards drive pulley then install drive pulley screw.



- 1. Drive pulley screw
- 2. Conical spring washer

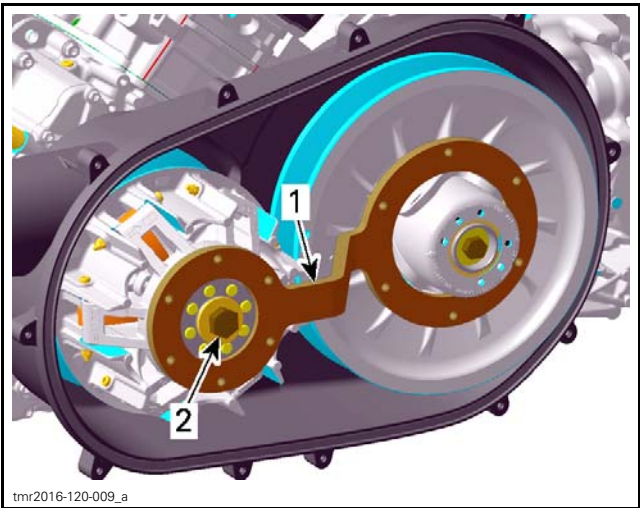
**WARNING**

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.

TIGHTENING TORQUE	
Drive pulley screw	120 N•m ± 8 N•m (89 lbf•ft ± 6 lbf•ft)



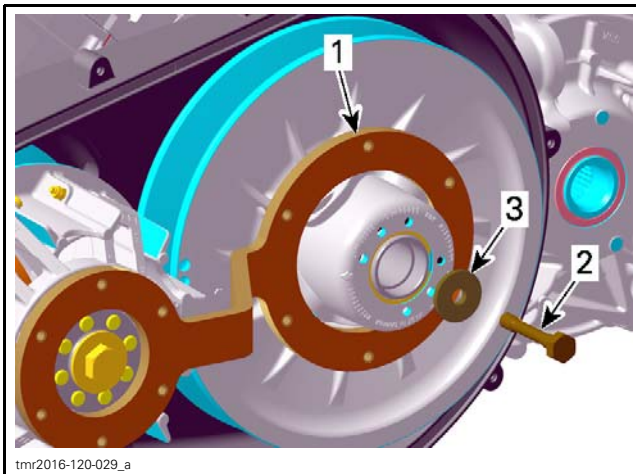
- 1. Clutch holder (P/N 529 036 380)
- 2. Drive pulley screw

DRIVEN PULLEY

Removing the Driven Pulley

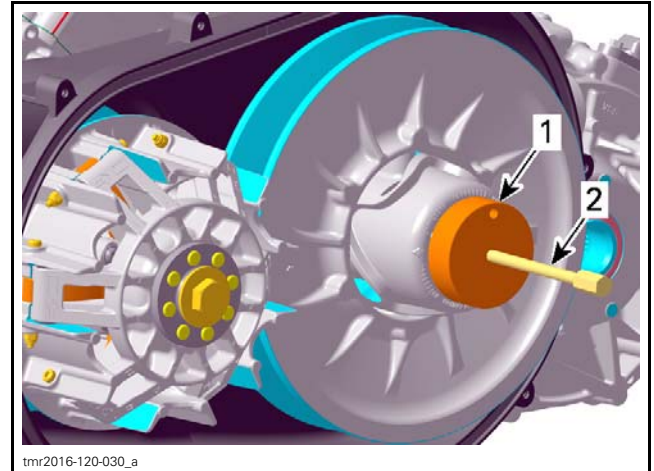
REQUIRED TOOLS	
CLUTCH HOLDER (P/N 529 036 380)	
DRIVEN PULLEY ADAPTER (P/N 708 200 686)	
DRIVEN PULLEY EXTRACTOR (P/N 529 036 352)	

1. Remove:
 - CVT cover
 - Drive belt.
2. Install the clutch holder.
3. Remove:
 - Driven pulley screw (discard it)
 - Collar washer.



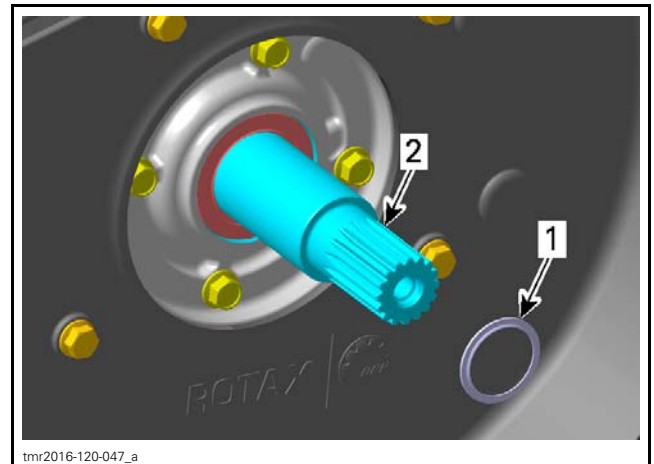
1. Clutch holder
2. Driven pulley screw (discard)
3. Collar washer

4. Remove the clutch holder.
5. Pull the driven pulley out of the vehicle.
 - 5.1 If removed, reinstall the [DRIVEN PULLEY ADAPTER \(P/N 708 200 686\)](#).
 - 5.2 Screw in the DRIVEN PULLEY EXTRACTOR (P/N 529 036 352) in the **center hole** of the driven pulley adapter.
 - 5.3 Tighten the extractor until driven pulley is free.
 - 5.4 Remove tools from the driven pulley.



1. Driven pulley adapter
2. Driven pulley extractor

6. Remove thrust washer from countershaft.



1. Thrust washer
2. Countershaft

Disassembling the Driven Pulley

Removing the Cam and Spring

To remove the cam and the spring, always use the following tools.

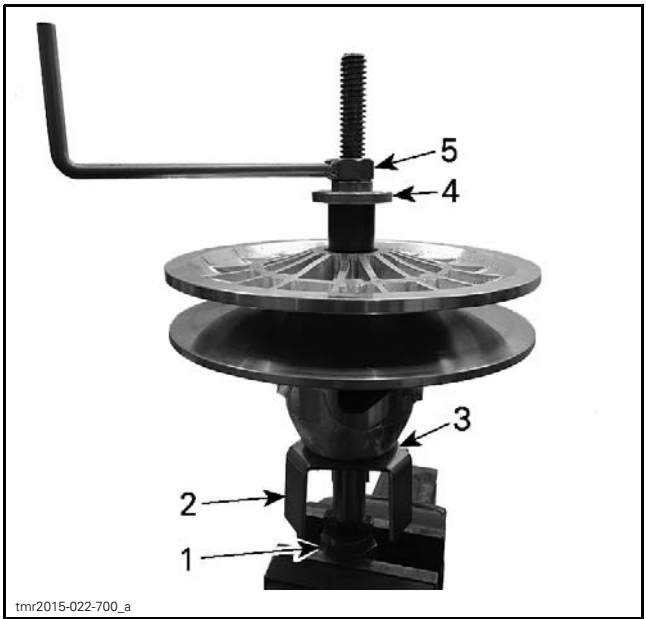
⚠ WARNING

Cam is under high clutch spring preload. Never attempt to remove the cam without the recommended tools.

Subsection XX (CONTINUOUSLY VARIABLE TRANSMISSION (CVT))

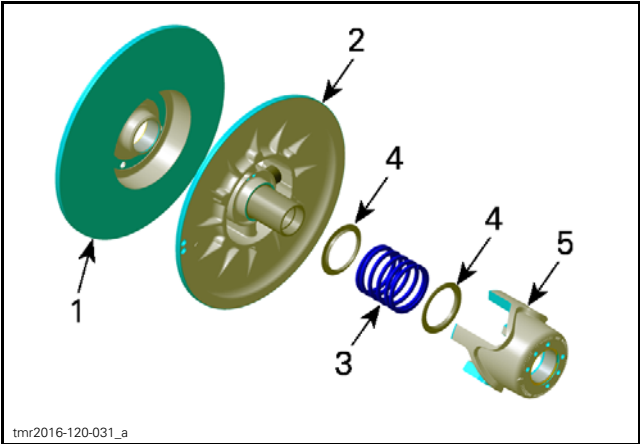
REQUIRED TOOLS	
PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012)	
DRIVEN PULLEY SPACER (P/N 529 036 351)	

- 1. Install the driven pulley on the spring compressor tool.
 - 1.1 Secure the spring compressor tool rod in a vice.
 - 1.2 Install the support cup, the driven pulley spacer, the driven pulley (with the cam towards the vice), the support guide and the handle.
 - 1.3 Screw in the handle to remove all play.



TYPICAL
1. Pulley spring compressor tool
2. Support cup
3. Driven pulley spacer
4. Support guide
5. Handle

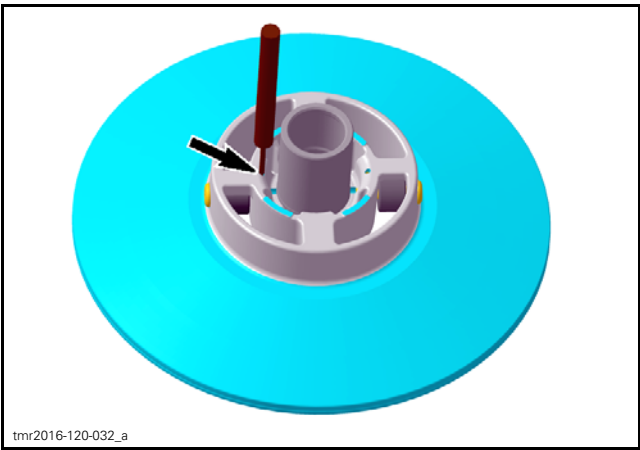
- 2. Remove and discard the four (4) Torx cam retaining screws.
- 3. Remove the driven pulley assembly from the spring compressor tool.
- 4. Separate parts.



1. Fixed sheave
2. Sliding sheave
3. Spring
4. Spring support
5. Cam

Removing the Driven Pulley Roller

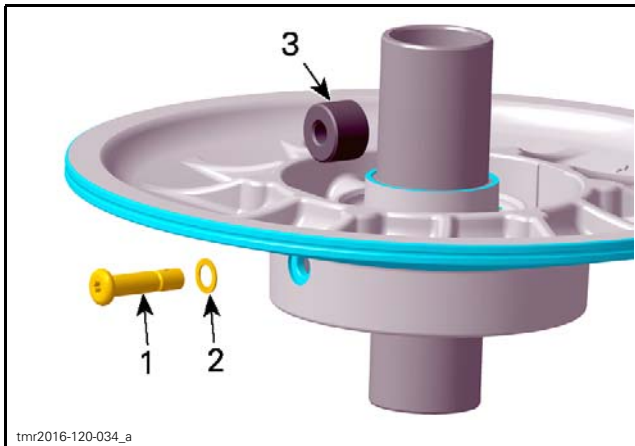
- 1. Remove spring pin used to lock pivot screw.
 - 1.1 Use a pin punch to start removing spring pin.



- 1.2 Once spring pin is accessible to pliers, pull pin out using pliers.



2. Remove pivot screw and roller.
 - 2.1 Identify pivot screws location before removal.
 - 2.2 Remove pivot screw and ribbed lock washer.
- NOTICE** Make sure not to damage or lose pivot screws. If screws need to be replaced, replace fixed sheave assembly.
- 2.3 Remove roller.



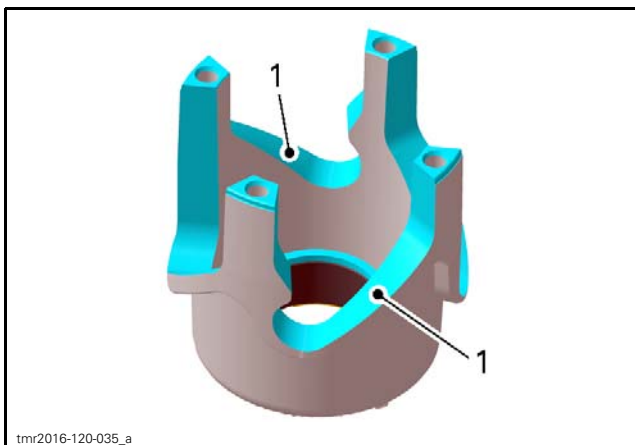
1. Pivot screw
2. Ribbed lock washer
3. Roller

3. Proceed with removal of other roller.

Inspecting the Driven Pulley

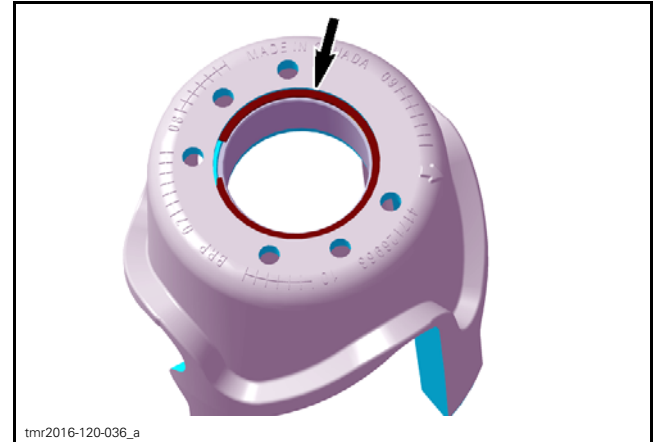
Cam

1. Verify all contact surfaces of cam for visible damages.



1. Contact surfaces

2. Ensure circlip properly locks the inner bushing. Replace part if necessary.



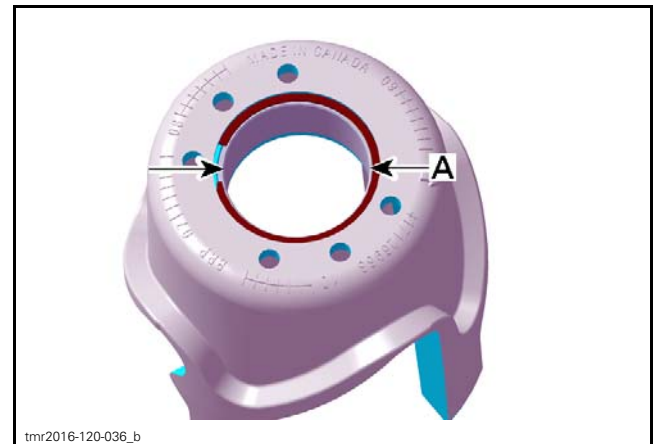
3. Measure the inner diameter of cam bushing.

REQUIRED TOOL

Dial bore gauge

MEASURING POINT

At least 5 mm (1/4 in) from bushing edge



A. Inner diameter of cam bushing

CAM BUSHING INNER DIAMETER

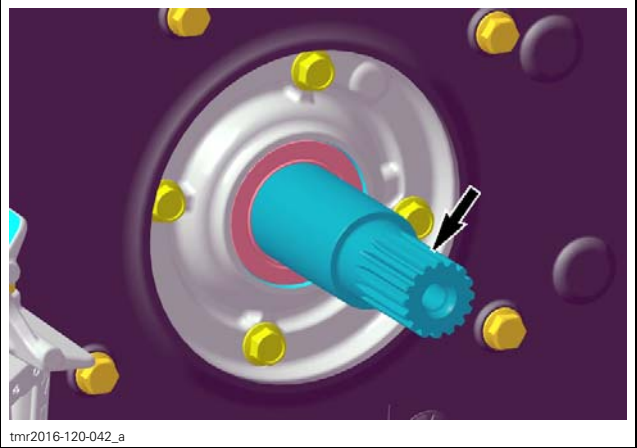
NEW	41.278 mm to 41.363 mm (1.625 in to 1.628 in)
SERVICE LIMIT	41.420 mm (1.631 in)

Replace the cam if the inner diameter of bushing is out of specification.

Sliding Sheave

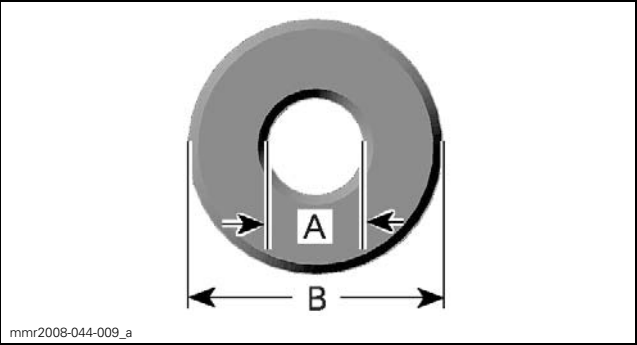
1. Inspect pulley sheave for marks or scratches.
2. Ensure circlip properly locks the inner bushing. Replace part if necessary.
3. Measure the inner diameter of sliding sheave bushing.

REQUIRED TOOL
Dial bore gauge
MEASURING POINT
At least 5 mm (1/4 in) from bushing edge



Driven Pulley Roller

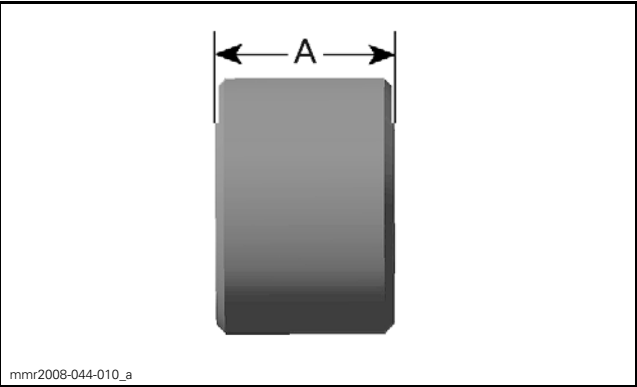
1. Check the rollers for flat spots, cracks or other visible damages. Replace if necessary (as a set).
2. Measure inner and outer diameter of rollers.



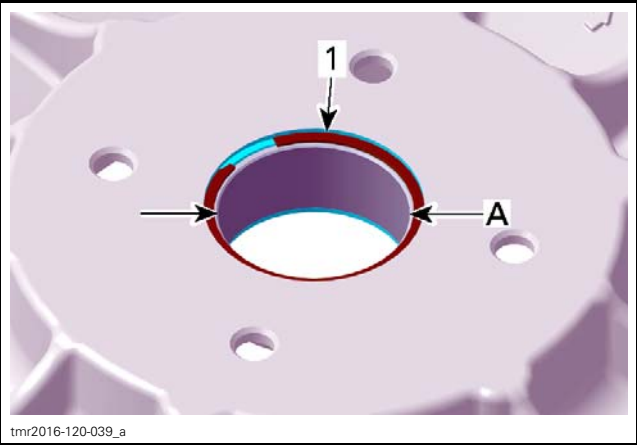
- A. Inner diameter
B. Outer diameter

DRIVEN PULLEY ROLLER	SERVICE LIMIT
Inner diameter	8.5 mm (.335 in)
Outer diameter	21.5 mm (.846 in)

3. Measure the roller thickness.



- A. Thickness of roller

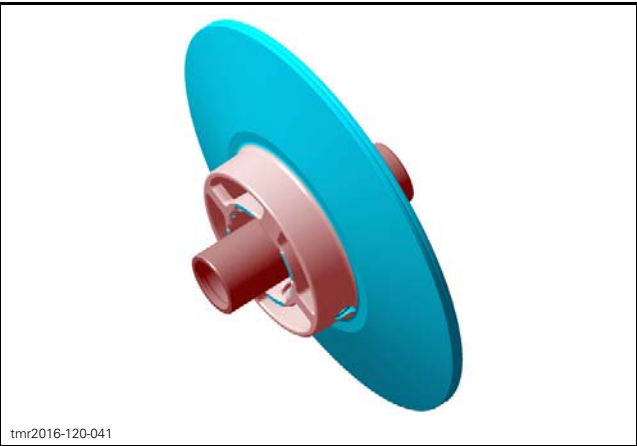


1. Circlip
A. Inner diameter of sliding sheave bushing

DRIVEN PULLEY INNER HALF BUSHING	
NEW	41.278 mm to 41.363 mm (1.625 in to 1.628 in)
SERVICE LIMIT	41.420 mm (1.631 in)

Replace the sliding sheave if the inner diameter of bushing is out of specification.

Fixed Sheave



Replace fixed sheave and countershaft if one of the following problem is detected:

- Marks or scratches on pulley sheave
- Bent, twisted or otherwise damaged countershaft
- Defective splines and threads at the end of countershaft.

DRIVEN PULLEY ROLLER	SERVICE LIMIT
Thickness	14.75 mm (.581 in)

If a roller is out of specifications, replace both rollers at the same time.

Cleaning the Driven Pulley

Use the PULLEY FLANGE CLEANER (P/N 413 711 809) and a clean rag to clean pulley sheaves.

Cam and Spring

During break-in period, teflon from bushing moves to cam or countershaft surface. A teflon over teflon running condition occurs, leading to low friction. So it is normal to see gray teflon deposit on cam or countershaft. Do not remove this deposit.

When a dust deposit has to be removed from the cam or the countershaft, use dry cloth to avoid removing transferred teflon.

Assembling the Driven Pulley

Installing the Driven Pulley Roller

NOTE: Exceptionally, do NOT clean threaded hole to avoid changing the screw position when torqued.

1. Using a hand wire brush, clean pivot screw threads.

IMPORTANT: Do not use a thread die to clean pivot screw of threadlocker as this may alter the screw threads.

Pivot screw and ribbed lock washer must be reused if in good condition. If damaged, replace fixed sheave assembly.

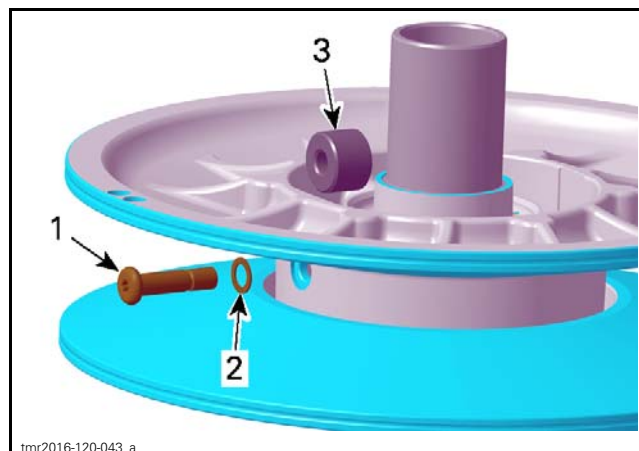
2. Apply the threadlocker to the pivot screw threads.

SERVICE PRODUCT	
Pivot screw threads	LOCTITE 243 (BLUE) (P/N 293 800 060)

3. Insert roller in fixed sheave, thread in pivot screw with ribbed lock washer.

IMPORTANT: For proper fit, each pivot screw must be reinstalled where originally mounted in the fixed sheave.

The ribbed locked washer must be installed with the concave side towards the fixed sheave.



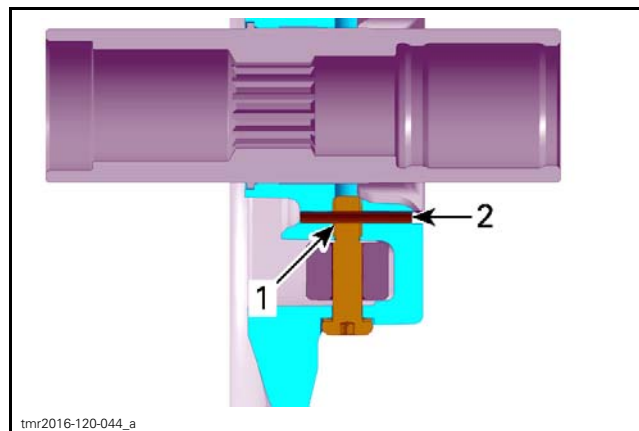
1. Pivot screw
2. Ribbed lock washer (concave side towards fixed sheave)
3. Roller

4. Torque pivot screw as specified.

TIGHTENING TORQUE	
Pivot screws	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)

The holes in the fixed sheave and pivot screw must be perfectly aligned when torque is applied.

NOTICE If both holes are not properly aligned, the spring pin will not be inserted properly, causing damages to the pivot screw hole and the fixed sheave.



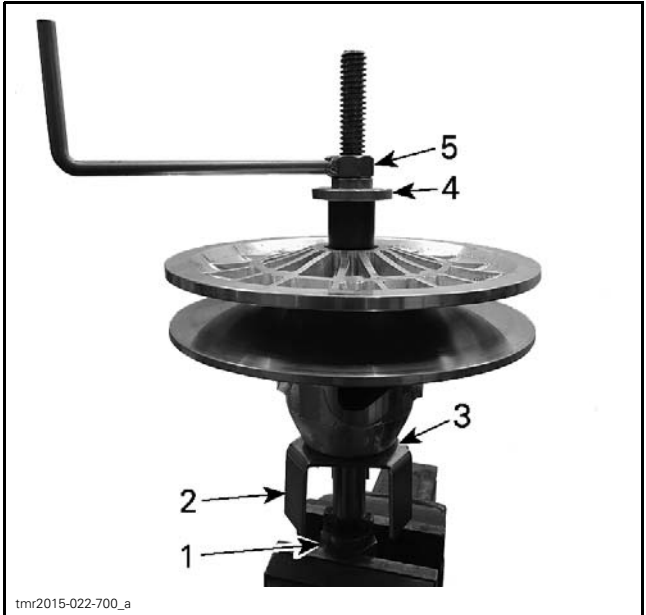
1. Hole in pivot screw
2. Spring pin

5. Install spring pin and tighten as specified.

Assembling the Sheaves and Cam

1. Install the cam on the spring compressor tool, over the support cup and the clutch shim.
2. Install the spring into the cam then the fixed sheave and the sliding sheave.
3. Complete with the support guide and the handle.

- 4. Before tightening the handle, align the arrows on cam and the sliding sheave with the one on the fixed sheave.
- 5. Tighten the handle until the cam is completely pressed against the sliding sheave.



- 1. Pulley spring compressor tool
- 2. Support cup
- 3. Driven pulley spacer
- 4. Support guide
- 5. Handle

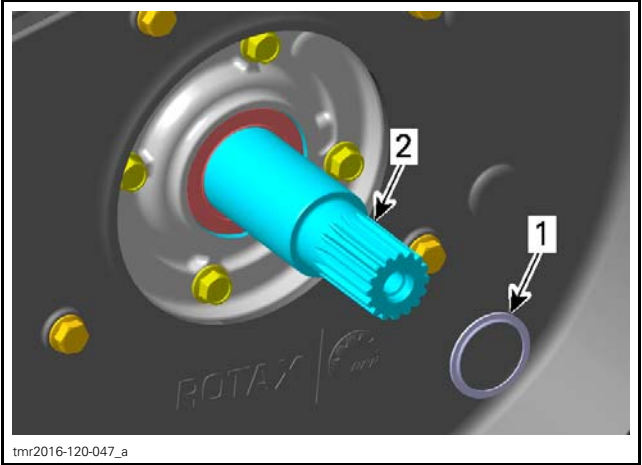
- 6. From the back of the sliding sheave, install four (4) **NEW** cam screws.

TIGHTENING TORQUE	
Cam screw	35 N•m ± 4 N•m (26 lbf•ft ± 3 lbf•ft)

- 7. Remove the driven pulley from the tool.

Installing the Driven Pulley

For installation, reverse the removal procedure. Pay attention to the following details. Install thrust washer on countershaft.



- 1. Thrust washer
- 2. Countershaft

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

Clean threads of gearbox countershaft and **NEW** driven pulley screw.

SERVICE PRODUCT	
Gearbox countershaft threads and driven pulley screw	XPS BRAKES AND PARTS CLEANER (P/N 219 701 776) or XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705)

NOTICE Threads must be free of oil and grease. Lubricants in threads will create too high preload to tightened driven pulley screw.

Install the driven pulley onto the countershaft. Make sure to align splines.

Install driven pulley screw with collar washer.

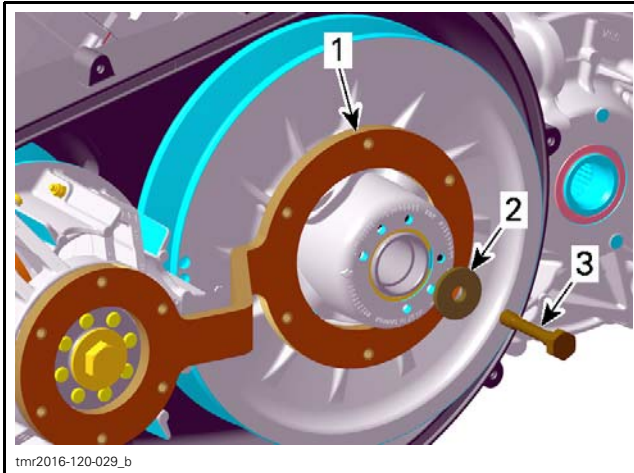
NOTICE Make sure to position the large diameter of the thrust washer against the conical side of the spring washer.

Install the clutch holder.

REQUIRED TOOL	
CLUTCH HOLDER (P/N 529 036 380)	

Tighten driven pulley screw as specified.

TIGHTENING TORQUE	
Driven pulley screw	70 N•m ± 5 N•m (52 lbf•ft ± 4 lbf•ft)



1. Clutch holder
2. Collar washer
3. Driven pulley screw (NEW)

Remove the clutch holder.

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

NOTICE After the repair procedure is finished, allow vehicle to sit for 6 hours for threadlocker curing.

CVT AIR GUIDE

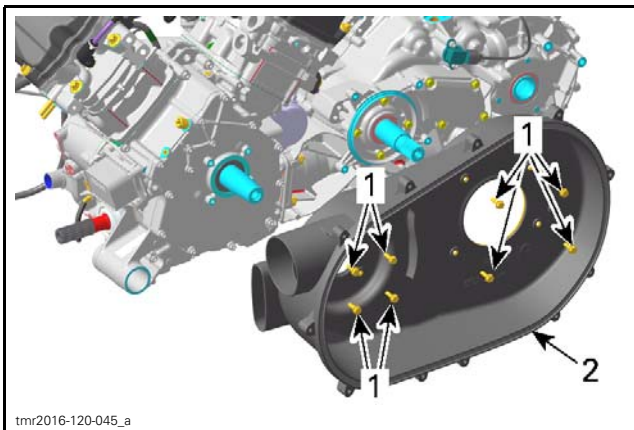
Removing the CVT Air Guide

Remove:

- *DRIVE PULLEY*
- *DRIVEN PULLEY*.

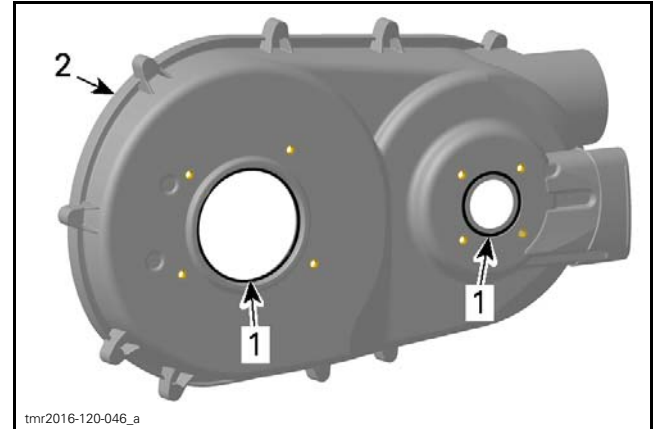
Unscrew the clamps retaining the CVT air hoses.

Remove CVT air guide.



1. Retaining screws
2. CVT air guide

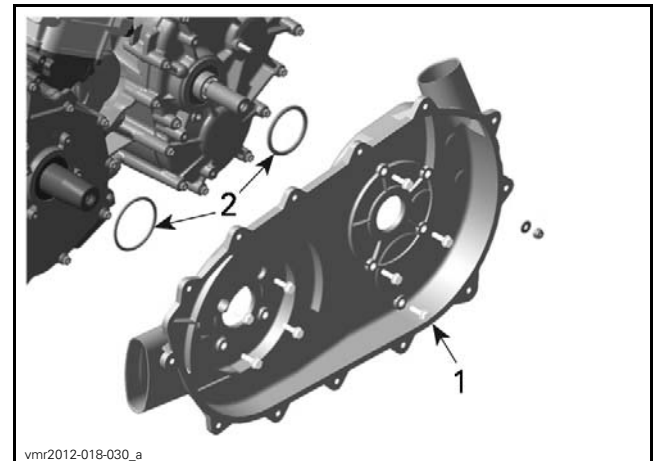
Remove and discard O-rings.



1. CVT air guide
2. O-rings

Inspecting the CVT Air Guide

Clean CVT air guide from contamination



1. CVT air guide
2. O-rings

Installing the CVT Air Guide

For installation reverse the removal procedure.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
CVT air guide retaining screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

DIAGNOSTIC 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.

A fault code is an indication that a glitch or malfunction is detected by the monitoring system of the vehicle.

If a minor fault occurs, the engine and vehicle will continue to operate without noticeable loss of performance.

If a more important fault occurs, engine RPM may be limited. The engine/vehicle will continue to operate with reduced performance.

If a major component of the EMS fails, engine RPM will be limited as well as vehicle speed.

These strategies are used to protect engine/electrical system from damage and to maintain safe operation of the vehicle. In extreme cases, the engine may also be completely shut down.

Pilot Lamps for Problematic Conditions

When a problem is detected, a pilot lamp will turn on or blink in the multifunction gauge. If the fault that caused the pilot lamp to come on is momentary, the pilot lamp may turn off automatically, or may need to be reset by powering down the vehicle and then restarting it.

A message may also be displayed to provide additional information related to the fault that turned on the pilot lamp. Refer to the following chart.

NOTE: In some cases, the CHECK ENGINE message can be displayed along with other messages.

PILOT LAMP	MULTI-FUNCTION GAUGE MESSAGE	CAUSE
	DESS KEY NOT RECOGNIZED	Module unable to read the key
	BAD KEY	Key not programmed for the vehicle
	LO BATT VOLT	Low system voltage
	HIGH BATT VOLT	High system voltage
	LOW OIL PRESSURE STOP ENGINE	Low engine oil pressure
	LIMP HOME MODE	An important engine management component is not working properly. Vehicle performance is purposely limited
	CHECK ENGINE	An engine management component is not functioning properly
	MAINTENANCE REQUIRED	Periodic maintenance required
	ECM NOT RECOGNIZED	Communication error between gauge and ECM
	CHECK DPS	DPS malfunction
	-	Gauge receives an invalid gear position data
	BRAKE	Displayed when brake is applied for more than 15 seconds (while riding)
 	HI TEMP	High engine temperature

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 designa- tor 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, TCM 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

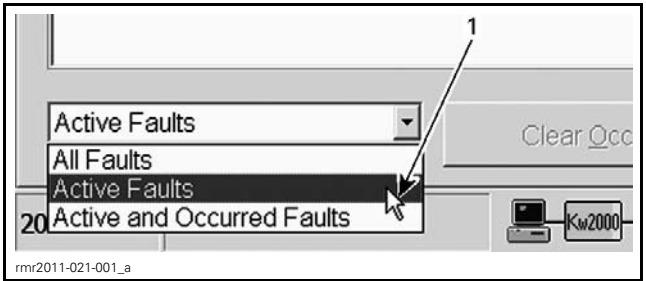
Fault Code States

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 ac- tion 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 sys- tem 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 op- erating 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, re- placing 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

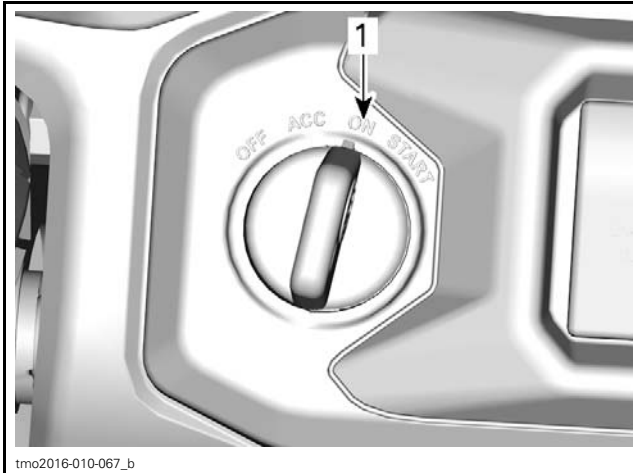
An inactive fault code represents a fault code that is neither active, nor occurred. It is simply part of a list of all possible faults that can be monitored by the ECM and multifunction gauge, which may become active or occurred if the monitoring sys- tem detects an applicable fault. These codes can be viewed in B.U.D.S.

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.

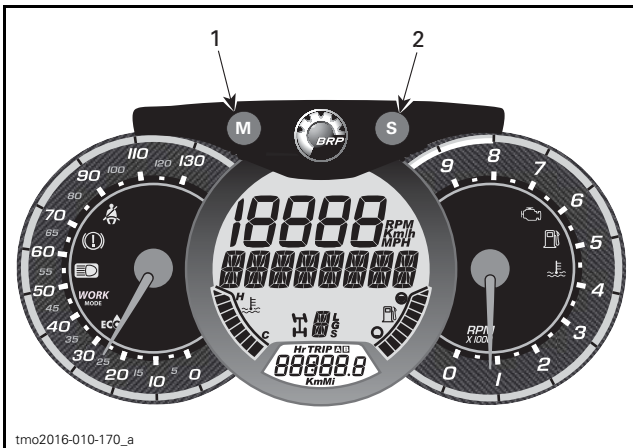
Analog/Digital Gauge

Proceed as follows to view the active fault codes:
1. Turn ignition key to ON position.



1. Key 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.



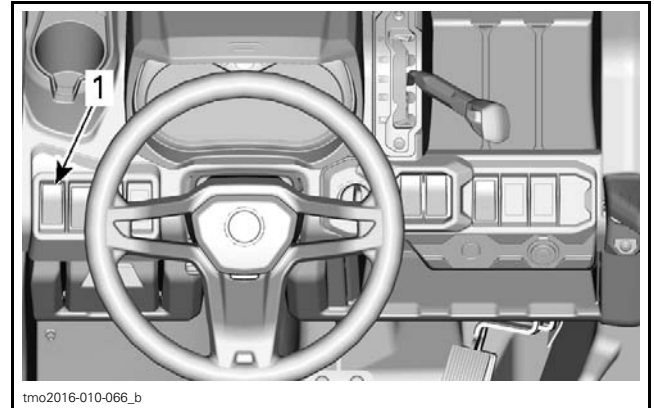
1. M (mode) button
2. S (set) button (pressed repeatedly to toggle secondary display)



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. OFF/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.

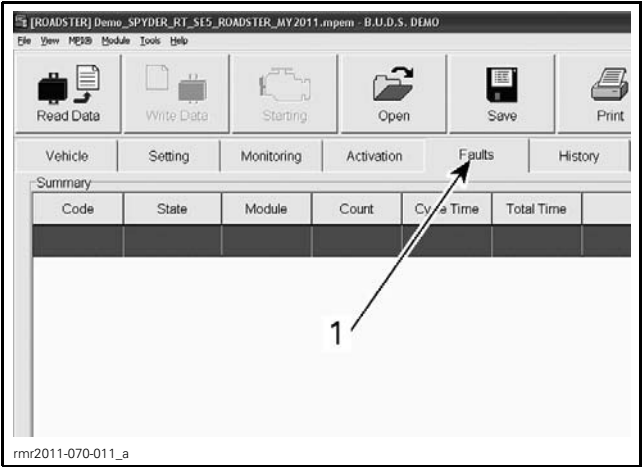
To exit the fault code display function, press both the M and S buttons simultaneously.

How to Read Fault Codes Using B.U.D.S.

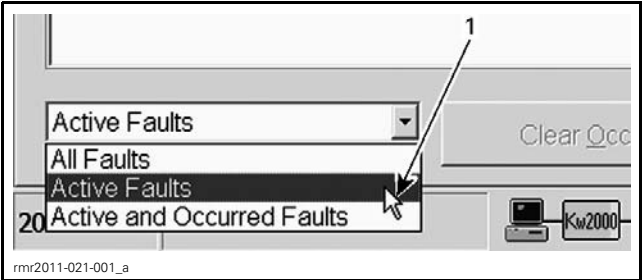
NOTE: All fault code (regardless of their state) can be read with B.U.D.S.

1. Connect vehicle to the latest applicable B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Click on the **Read Data** button.
3. Click on the **Faults** tab.

Subsection XX (DIAGNOSTIC AND FAULT CODES)

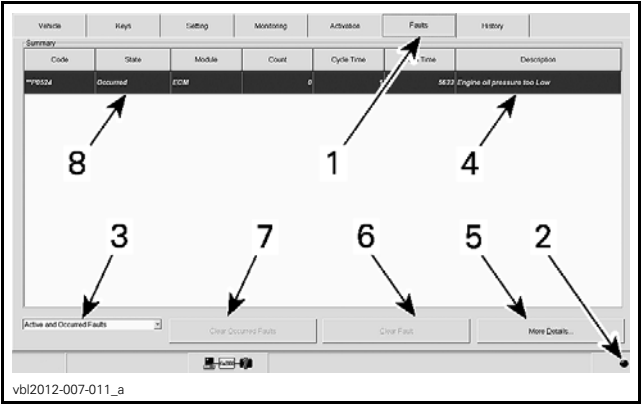


- 1. Fault tab
- 4. Click on the drop-down list on the LH lower corner.
- 5. Choose the fault state to display.



- 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
Fault 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 nomenclature	Display specific information and statistics related to the fault (see fault nomenclature table)
More Details button	To display possible causes and service actions related to the selected fault
Clear Fault button	To clear occurred faults one at a time
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 NOMENCLATURE	
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

FAULT NOMENCLATURE	
COLUMN	INFORMATION
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
Cycle time	Not to be used. Value: From 0 to 255 minutes
Total time	Not to be used. Value: From 0 to 64 255 minutes
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.

Summary		
Code	Module	Description
P0563	ECM	System voltage high
P0600	ECM	Communication problem detected by ECM
P0600	ECM	Communication fault with VCM, no response

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.

Summary						
Code	State	Module	Count	Cycle Time	Total Time	Description
P0600	Active	ECM	N/A	N/A	N/A	Communication problem detected by ECM

1. Click here

Fault						
Code	State	Module	Count	Cycle Time	Total Time	Description
P1619	Active	ECM	1	N/A	0	TPS adaptation failure

MORE DETAILS PAGE

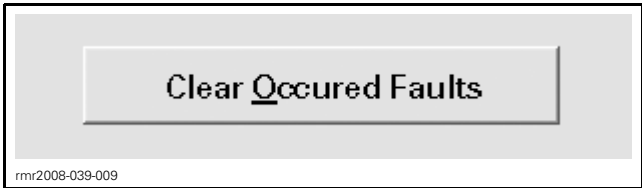
1. Possible causes related to the selected fault
2. Service actions
3. Operating conditions when fault occurred

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.

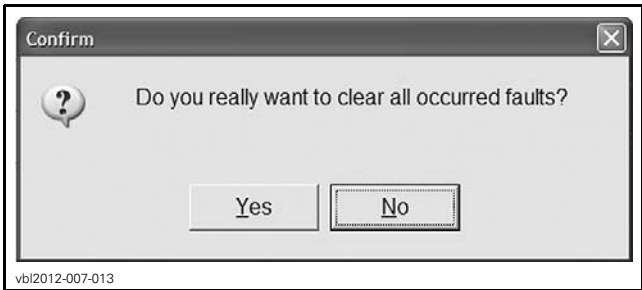
1. Connect vehicle to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Click on the **Read Data** button.
3. Click on the **Faults** tab.

The fault(s) (occurred state only) can be cleared by pressing the **Clear Occurred Faults** or **Clear Fault** buttons in B.U.D.S.

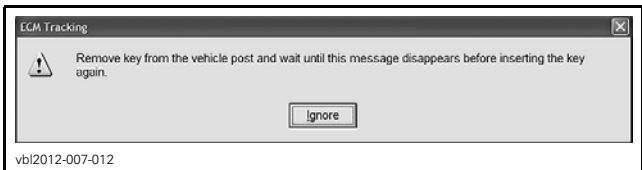


FAULTS PAGE TAB, CLEAR OCCURRED FAULTS

4. Click YES on the following message box.



The following message will appear.



5. Turn ignition OFF and wait until the message disappears.

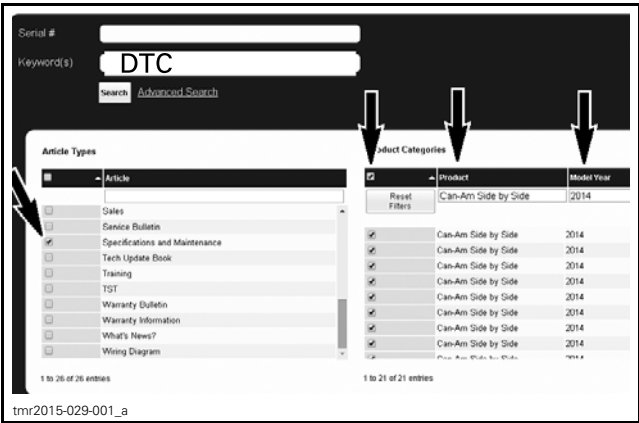
This will reset the appropriate counter(s) and will also record that the problem has been fixed in the related ECU memory.

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 Find Fault Code Descriptions

For the latest fault code table, use the **Knowledge Center**.

1. Use *ADVANCED SEARCH* and filter by:
 - 1.1 Specifications and Maintenance
 - 1.2 Product
 - 1.3 Model Year
2. Search for "DTC".



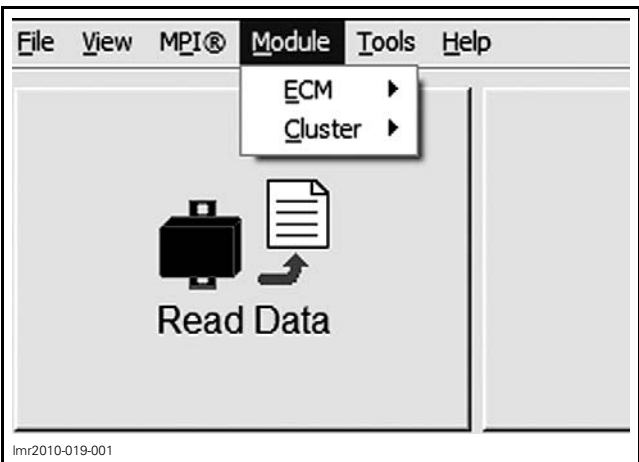
FAULT CODE DIAGNOSTIC

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. Turn ignition switch to ON position (ACC will not work). Do not start the engine.
3. Click on the **Read Data** button.
4. Click **Module** in the menu bar.
5. Look at the list of modules.
6. If a module is not visible, then it is not communicating through the CAN bus (controller area network).



TYPICAL - MODULE SUBMENU LIST

7. 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>
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.

History

Minimum / Maximum Run Time RPM Profile

	RPM	Intake (PSI)	Intake (°F)	Engine (°F)	Battery (V)
Maximum	8640	13	78	155	15.60
Minimum	0	4	71	72	11.30

Clear Min/Max

mmr2011-070-003_a

- History tab
- Additional history pages

HISTORY PAGE DESCRIPTION	
ITEM	INFORMATION
Minimum/Maximum	Display the minimum and maximum values encountered. 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 XX (DIAGNOSTIC 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. 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.
Communication faults displayed as "Occurred" after module flashing	Normal behavior when flashing a module. Clear all occurred faults and check again.
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 bus OFF	When several modules and sensors report that a module is missing. The missing module may report CAN bus off. 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.

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.

FAULT CODE TABLE

ACRONYMS USED IN THE FAULT CODE TABLE	
USED IN FAULT CODE TABLE	MEANING
ECM	Engine Control Module
DPS	Dynamic Power Steering
CAN	Controller Area Network
TPS	Throttle Position Sensor
GBPS	Gearbox Position Sensor
SCM	Suspension Control Module

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.

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.

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.

DYNAMIC POWER STEERING (DPS)

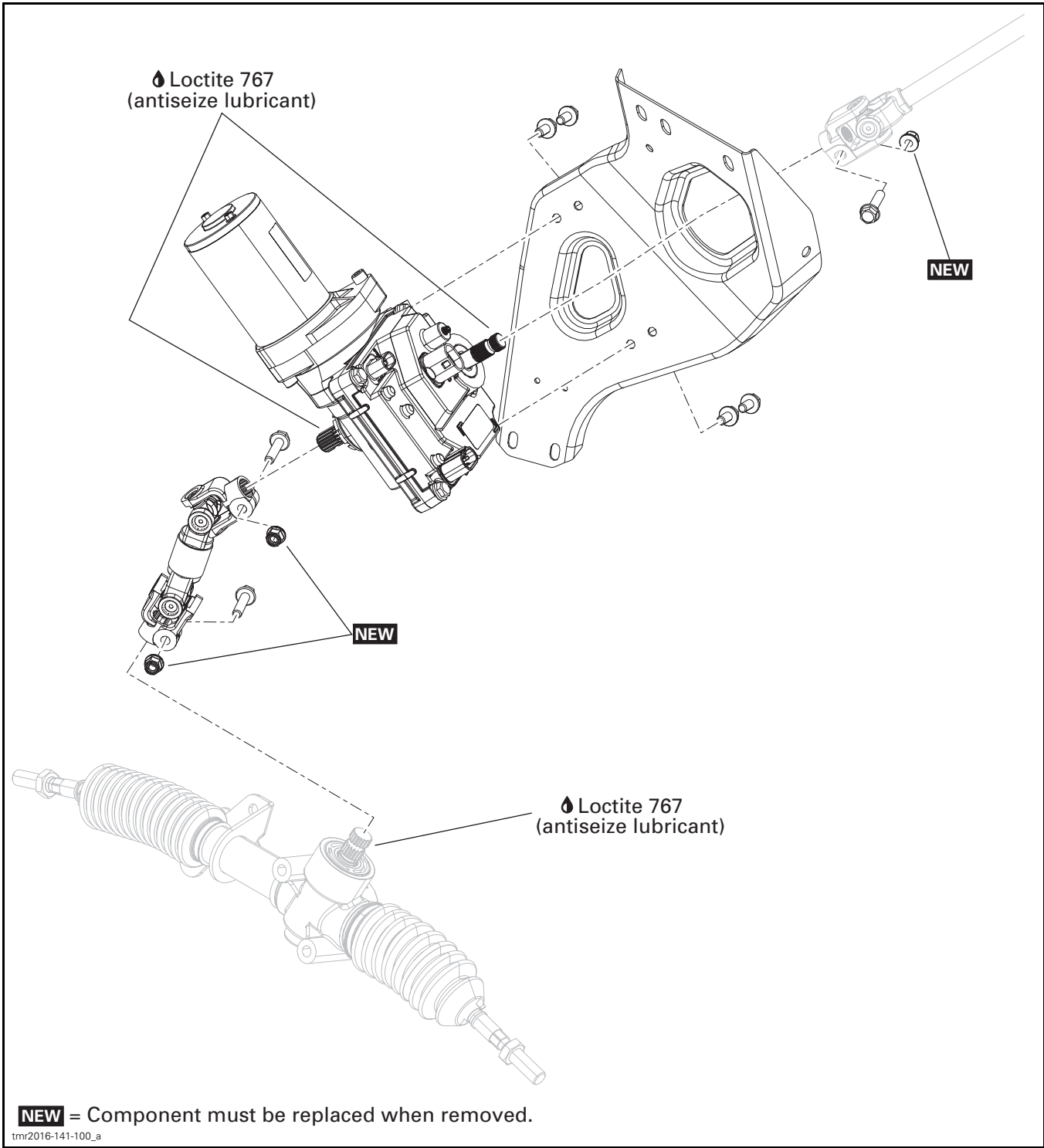
SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	6

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	11
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	11

Subsection XX (DYNAMIC POWER STEERING (DPS))

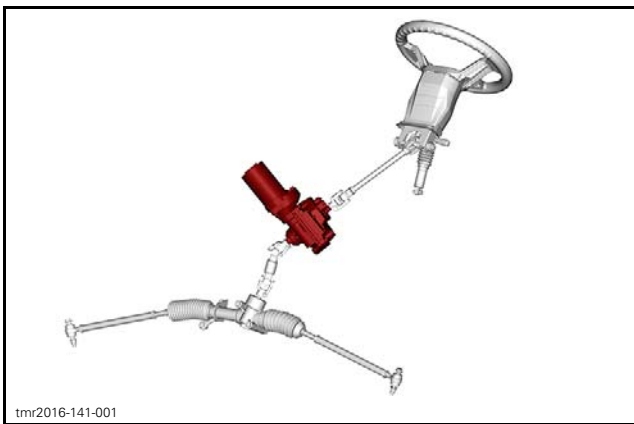


GENERAL

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.



The DPS system uses the following parameters to determine how much steering assist it provides:

- Engine RPM
- Battery/electrical system voltage
- Vehicle speed
- DPS shaft torque sensor input
- DPS temperature.

The amount of steering assist provided is dependent on the steering wheel effort (steering torque), electrical power available, and vehicle speed.

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 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. When system voltage has dropped to a low threshold voltage, 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 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 intensively and the internal temperature reaches a critical level, or when the battery voltage becomes too low.

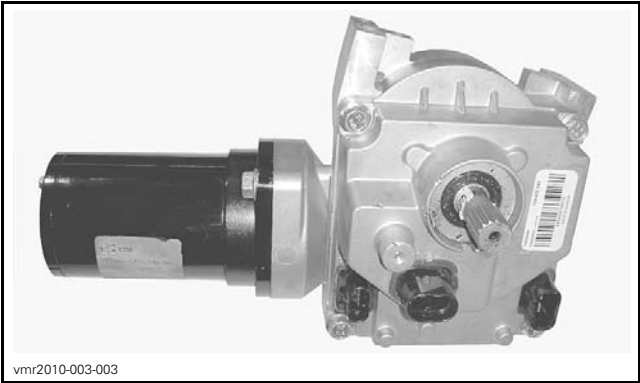
The internal protection system decreases the assistance level available to protect its electronic board. The normal assistance level will return when riding conditions are back to normal and the internal temperature decreases, and/or when the battery voltage increases above a threshold voltage.

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 its normal operating range, steering assist should return to normal operation.

Steering Torque Sensor

The steering column is connected to the shaft on the DPS unit. A small area of the DPS shaft is magnetized. Inside the DPS unit, a torque sensor surrounds the magnetized area of the DPS shaft.

When the handlebar is turned, torque is applied to the shaft which tends to twist the shaft slightly, deforming the magnetic field in the shaft. The sensor detects the torque by measuring the deviation of the magnetic field.

The torque sensor is very sensitive and can detect very small changes in the magnetic field. The harder the handlebar is turned, the greater the magnetic deviation, the greater the power steering assist.

NOTICE The internal torque sensor is very sensitive to external magnetic source. **All components touching the DPS unit** must be kept in a non-magnetic area and avoid any contact with components. If a magnetic source or part is in contact with the DPS shaft, or touching components, it will affect the torque reading values and inadvertently affect the behavior of the DPS unit.

ADJUSTMENT

RESETTING THE TORQUE OFFSET

Before resetting the torque offset, align wheels as detailed in the *STEERING SYSTEM* subsection.

Reset the torque offset if one of the following conditions exist:

- Left and right steering imbalance (steering effort)
 - Unequal self centering
 - The torque offset reading at rest is greater than 1Nm.
1. Position the steering wheel 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 RESET THE TORQUE OFFSET
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 $\pm$ 1Nm.
Engine not running.

7. Press **Reset Torque Offset** button.

NOTE: Torque sensor reset is not possible when the torque value is greater than $\pm 10\text{Nm}$.



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 aligned, resetting the torque offset repeatedly will not solve the problem if the torque offset is greater than 10Nm . DPS unit replacement may be required.

TROUBLESHOOTING

UNEQUAL TURNING RADIUS

1. Rack and pinion not centered during steering system parts installation.
 - Align wheels. Refer to *STEERING SYSTEM* 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.
 - Test the DPS fuse as detailed in this subsection. Replace as required.
 - Test the DPS input voltage as detailed in this subsection. Repair or replace wiring/connectors as required.
 - Test the DPS ignition signal voltage as detailed in this subsection. Repair or replace wiring/connectors as required.
3. No ground to DPS unit.
 - Test the DPS ground circuit 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, test the DPS unit communication link (CAN) continuity 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.

LOW POWER STEERING ASSIST

1. Low battery voltage.
 - Check battery terminals. Clean, repair, replace or tighten as required.
 - Test battery. Recharge or replace battery as required.
 - Test the DPS system load as detailed in this subsection.
2. Low input voltage to DPS unit.
 - Test the DPS input voltage as detailed in this subsection. Ensure power connector pins (DPS2-A and B) is clean, corrosion free, tight, and make good contact. Repair or replace wiring/connectors as required.
3. Faulty DPS ground circuit.
 - Test the DPS ground circuit as detailed in this subsection. Ensure DPS ground connector pins (DPS3-A and 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., carry out a **Steering Assembly Validation**. In case of failure, solution(s) will be suggested.
 - Align the wheels as detailed in the *STEERING SYSTEM* subsection.
2. DPS malfunction.
 - Test the DPS current as detailed in this subsection.
3. Torque sensor not reset to zero.
 - When all other possibilities have been eliminated, reset the torque offset as detailed in this subsection.

TORQUE SENSOR CANNOT BE RESET

1. Mechanical problem or DPS parts.
 - Refer to *RESETTING THE TORQUE OFFSET* in this subsection.
2. Torque offset too great.
 - Refer to *RESETTING THE TORQUE OFFSET* in this subsection.

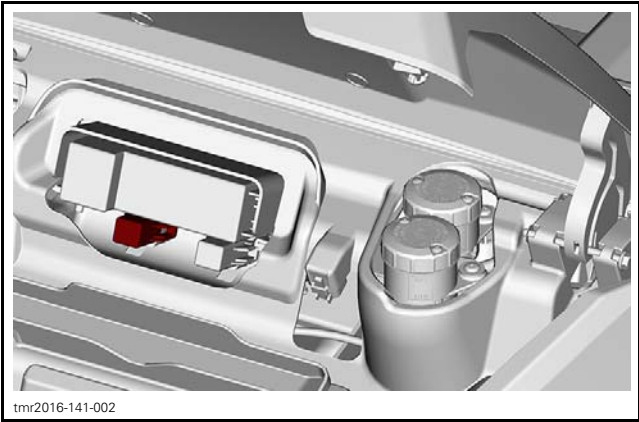
PROCEDURES

DPS UNIT

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

Testing the DPS Fuse

A 40 A fuse located in fuse box **no. 1** (PF1-F2) under the hood, provides power to the DPS motor.

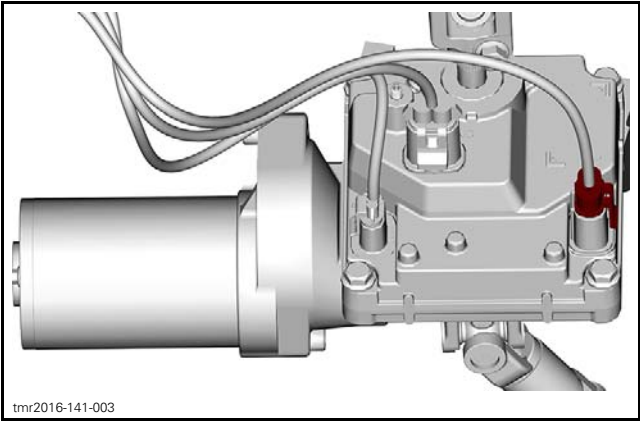


1. Remove the DPS fuse cap to expose the fuse contacts.
2. Set the multimeter to VDC and test for a voltage drop across the DPS fuse while the DPS is in operation.
3. If a voltage is measured, turn power off and remove fuse.
4. Check fuse continuity, fuse contacts and fuse box contact condition. Replace fuse as required.

Testing the DPS Input Voltage

Refer to *REMOVING THE DPS UNIT* for connectors access.

1. Disconnect the DPS power (PWR) connector.



2. Test for 12 Vdc DPS motor power at DPS2 harness connector as per following table.

MULTIMETER PROBE POSITIONS		VOLTAGE
DPS power connector pin A	Battery ground	Battery voltage
DPS power connector pin B		

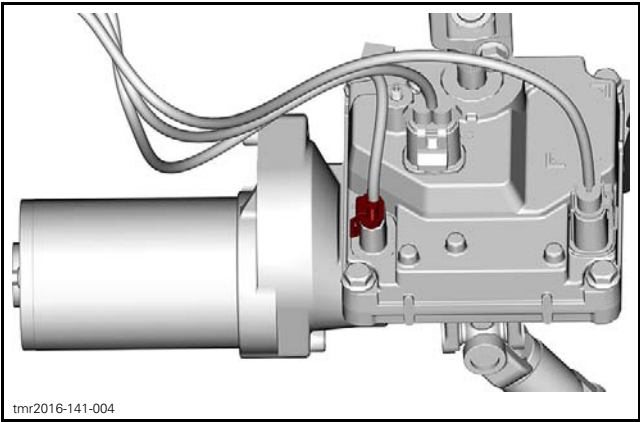
If no voltage is measured, test the 40 A DPS fuse in fuse box **no. 1** (PF1-F2). If good, check wires and connector pins. Replace or repair defective parts and reset fault codes.

If battery voltage is measured, test the DPS ignition signal voltage.

Testing the DPS Ignition Signal Voltage

Refer to *REMOVING THE DPS UNIT* for connectors access.

1. Disconnect DPS control (CTRL) connector.



2. Set the ignition switch to ON.
3. Test for 12 Vdc power to the DPS module at DPS1 harness connector as per following table.

MULTIMETER PROBE POSITIONS		VOLTAGE
DPS control connector pin A	Battery ground	Battery voltage

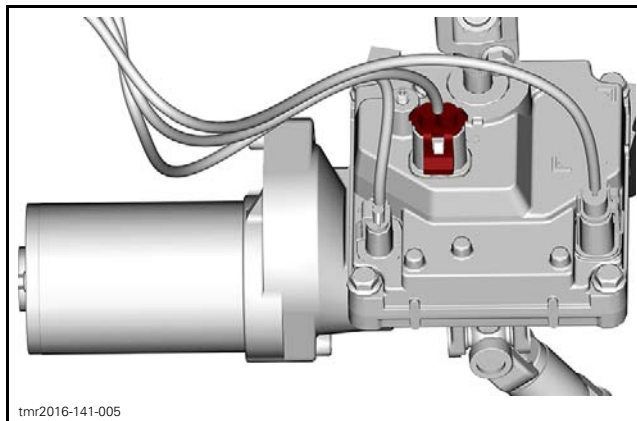
If no voltage is measured, check wires and connector pin from DPS unit to main relay 2 in fuse box **no. 2** (PF2-C1). Replace or repair defective parts and reset fault codes.

If battery voltage is measured, test the DPS ground circuit.

Testing the DPS Ground Circuit

Refer to *REMOVING THE DPS UNIT* for connectors access.

1. Disconnect the DPS ground (GND) connector.



2. Test for continuity between DPS3 to battery ground.

MULTIMETER PROBE POSITIONS		READING
DPS ground connector pin A	Battery ground	Continuity (close to 0 Ω)
DPS ground connector pin B		

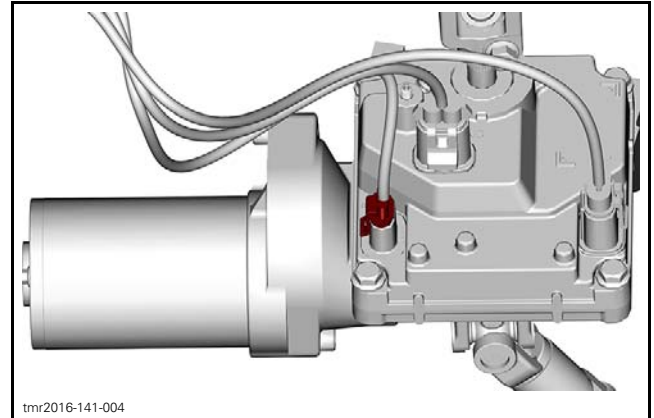
If there is no continuity or a high resistance is measured, check wires and connector pins from DPS unit to chassis ground post. Replace or repair defective parts and reset fault codes.

If there is good continuity, carry out the following *TESTING THE DPS UNIT COMMUNICATION LINK (CAN) CONTINUITY*.

Testing the DPS Unit Communication Link (CAN) Continuity

Refer to *REMOVING THE DPS UNIT* for connectors access.

Disconnect the DPS SENSOR connector and the multifunction gauge connector.



Test continuity of CAN Bus Wires as per following table.

MULTIMETER PROBE POSITIONS		RESISTANCE @ 20°C (68°F)
DPS CONTROL CONNECTOR	MULTIFUNCTION GAUGE CONNECTOR	
Pin D	Pin 18	Less than 1 Ω
Pin C	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.

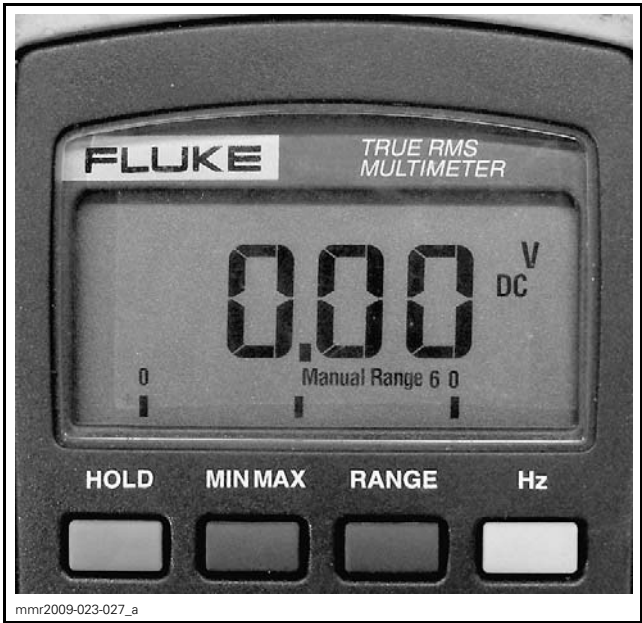
Testing the DPS System Load

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. Select Vdc on the multimeter.
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.

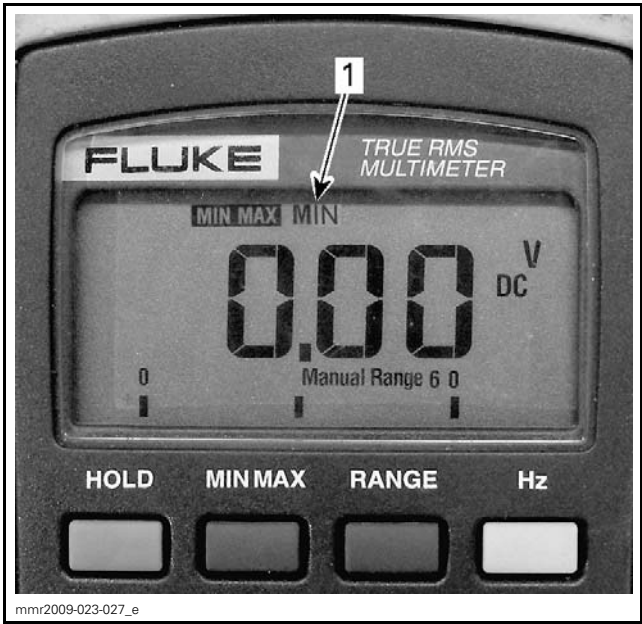
NOTE: If battery voltage is low, recharge battery.

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**.



VDC SELECTED TO MANUAL RANGE 6 0

9. Press the **MIN MAX** button on the multimeter to engage the MIN function.



1. MIN function selected

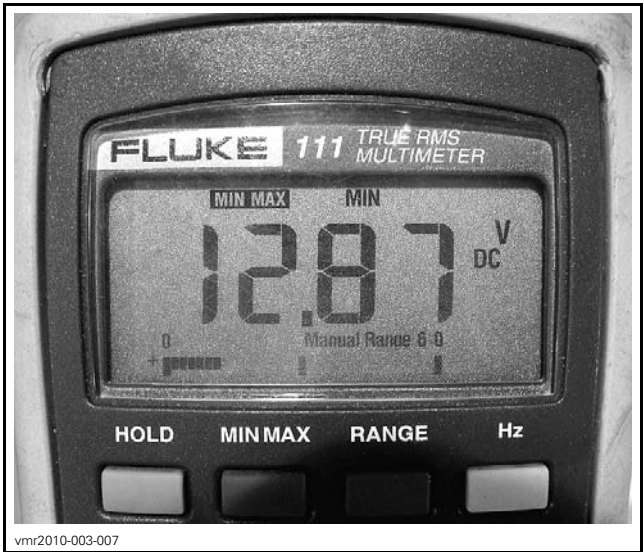
10. Turn the steering wheel **momentarily** against the steering hard stops to each side.

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.



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 are good, carry out **TESTING THE DPS UNIT CURRENT**.

Testing the DPS Unit Current

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:

- Check the *STEERING ASSEMBLY VALIDATION*. Results will guide to solutions.
- Reset the torque offset as detailed in this subsection

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.

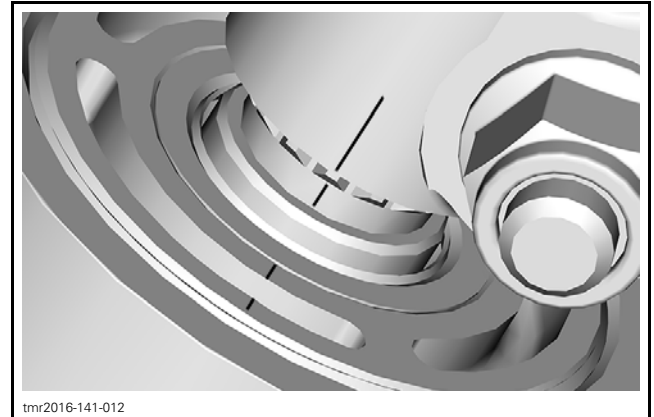
If *RESETTING THE TORQUE OFFSET* procedure has been carried out, and the current or steering imbalance is too great, or the torque reading at rest is greater than $\pm 10\text{Nm}$, replace the DPS unit.

Removing the DPS Unit

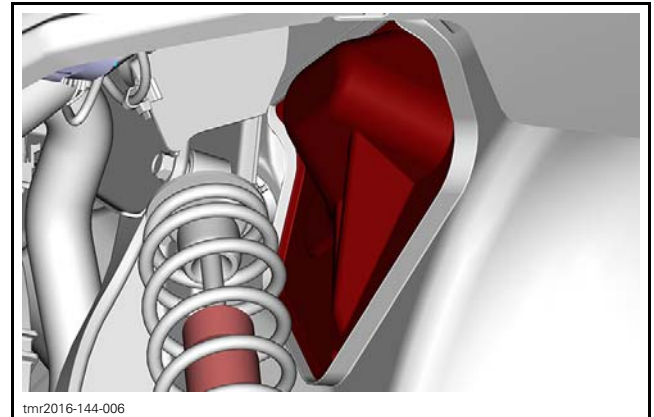
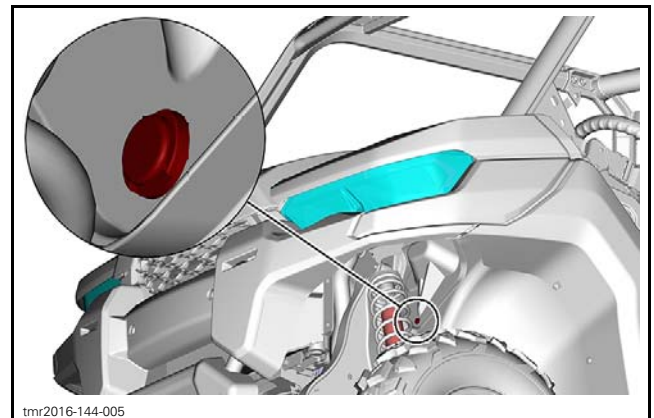
NOTICE Before proceeding with the DPS removal, remove the 40 Amp DPS fuse (F2) in the fuse box no. 1. Handle the DPS unit with extreme care as it is very sensitive to physical chock. Store unit in a secured area. If the DPS unit is dropped, it must be replaced even if only minimal damage is apparent.

1. Position the front wheels parallel to the rear wheels.
2. Remove both front wheels.

3. Mark the alignment of the lower steering shaft with the input shaft and the rack and pinion housing.

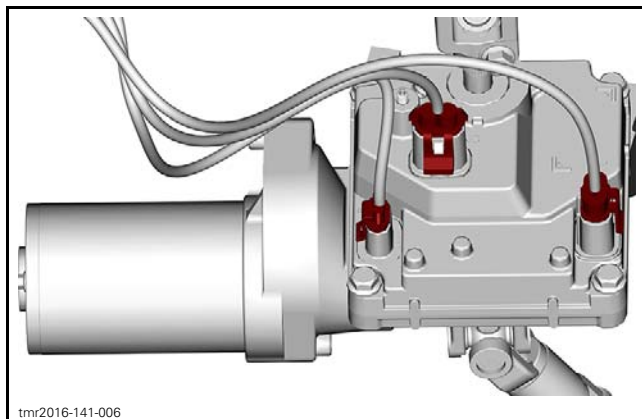


4. Remove access panel under LH front inner fender.



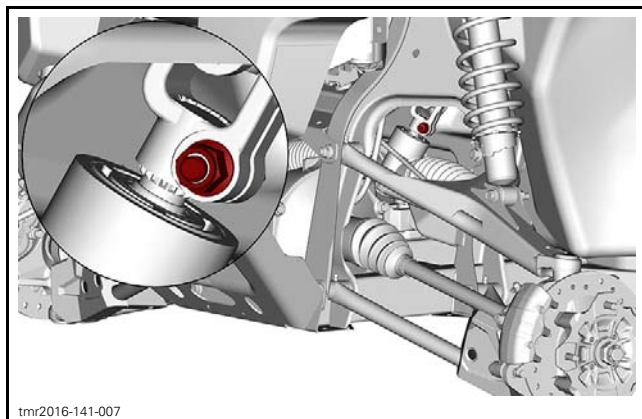
5. Disconnect the electrical connectors from the DPS unit.

Subsection XX (DYNAMIC POWER STEERING (DPS))

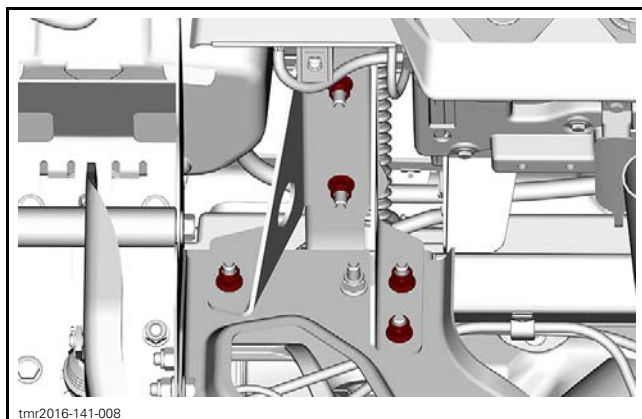


6. Remove steering column. Refer to *REMOVING THE STEERING COLUMN* subsection.

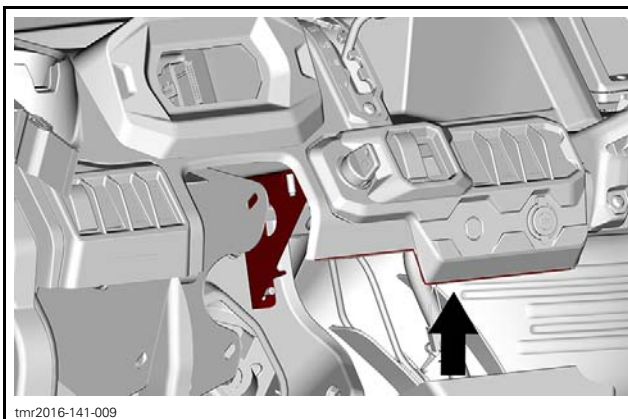
7. Remove the lower steering shaft pinch bolt and nut.



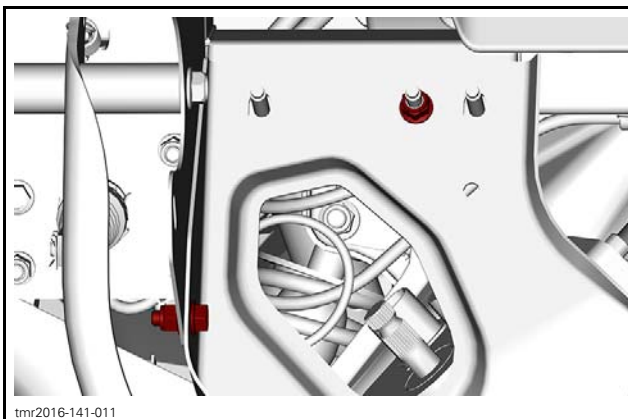
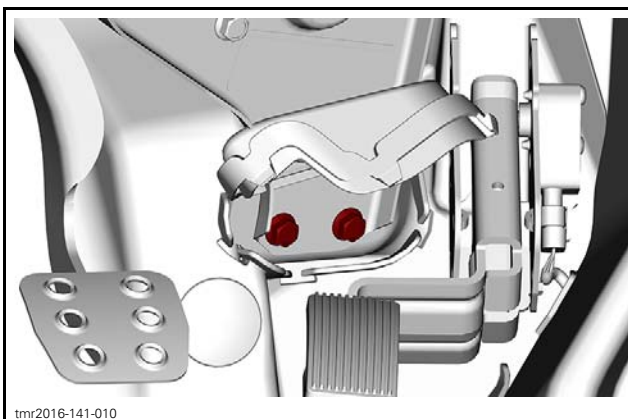
8. Remove the shifter module support retaining nuts and screw.



9. Slightly lift the dash board to remove the shifter support



10. Remove all DPS unit support retaining screws.



11. Pull up on DPS unit and support to disengage from the rack and pinion shaft and remove it from the vehicle.

NOTE: If replacing DPS unit, remove the DPS support and the lower steering shaft from the unit.

Inspecting the DPS Unit

Inspect DPS shaft splines. If damaged, replace DPS unit.

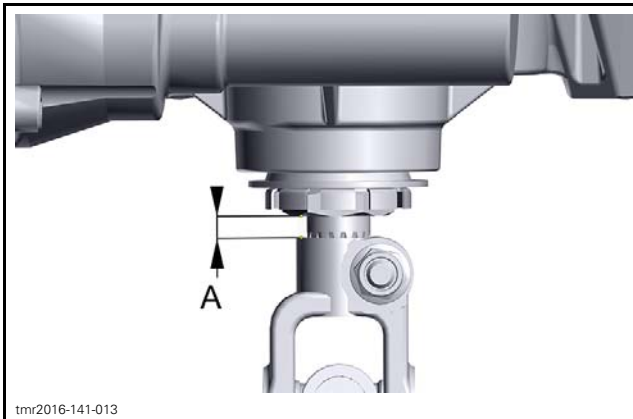
Inspect lower steering shaft splines. If damaged, replace shaft.

Inspect and clean terminal contacts.

Installing the DPS Unit

If Replacing DPS Unit

1. Install the support on the new DPS unit.
2. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to DPS input and output shaft splines.
3. Insert lower steering shaft on DPS output shaft as per the following illustration.



A. $7\text{ mm} \pm 1\text{ mm}$ (.276 in $\pm$.039 in)

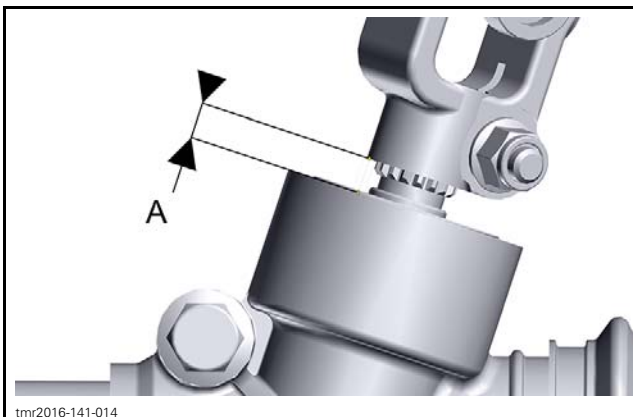
4. Install locking bolt and nut.

Continue with *IF INSTALLING SAME DPS UNIT*.

If Installing Same DPS Unit

1. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) antiseize lubricant to rack and pinion shaft splines.
2. While lowering the DPS unit with its support and the lower steering shaft in place, a second technician engage the lower yoke on the rack and pinion shaft as per following illustration.

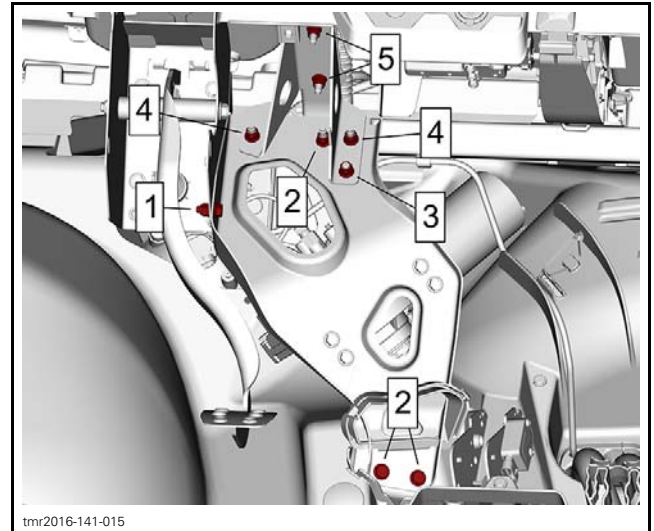
Ensure rack and pinion input shaft, housing, and lower steering shaft marks are aligned.



A. $9.5\text{ mm} \pm 1\text{ mm}$ (.374 in $\pm$.039 in)

3. Ensure DPS support is in place.
4. Install and tighten locking bolt and nut.
5. Install shifter support.
6. Install fasteners, then tighten as per the following sequence.

NOTE: Ensure the shifter support makes good contact with the shifter module and the DPS support while tightening the nuts 3, 4, and 5.



7. Install the steering column. Refer to *STEERING SYSTEM* subsection.
8. Apply DIELECTRIC GREASE (P/N 293 550 004) on harness connector terminals.
9. Connect DPS connectors to DPS unit.
10. If installing a replacement DPS unit, refer to *REPLACING THE DPS* in this subsection.
11. Align wheels. Refer to *STEERING SYSTEM* subsection.
12. Verify DPS system.

Verifying the DPS System

With the front wheels off the ground:

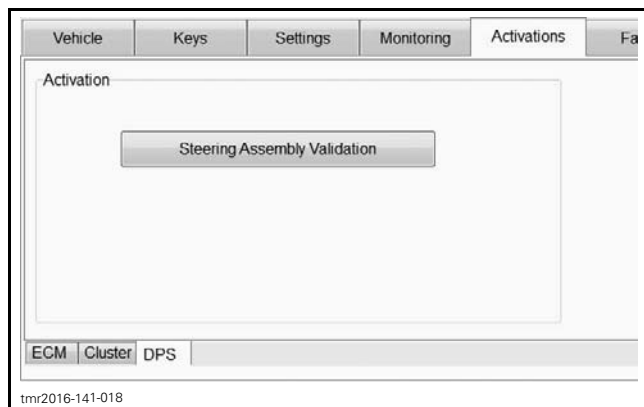
1. Start engine to enable DPS unit.
2. Slowly turn steering wheel from one side to the other 3 times.

Make sure:

- Assistance and travel are equal when turning right or left
- Steering system operates smoothly through all its range.

3. Carry out a *STEERING ASSEMBLY VALIDATION* in B.U.D.S..

Subsection XX (DYNAMIC POWER STEERING (DPS))



4. Lower vehicle on the ground.
5. Repeat step 2.
6. Test ride the vehicle to ensure proper operation of the DPS unit.

Replacing the DPS Unit

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. Reset the torque offset if required as described in this subsection.
6. Test drive the vehicle to ensure proper DPS operation.

ELECTRONIC FUEL INJECTION (EFI)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	4-5, 15-17, 19-20
FLUKE 115 MULTIMETER	529 035 868	4-5, 9, 15-17, 19
OETIKER PLIER.....	295 000 070	11

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	19
XPS SYNTHETIC GREASE.....	293 550 010	16

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

Refer to the *ENGINE MANAGEMENT SYSTEM* subsection for a general layout of the various EFI system components.

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 (Engine 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.

Air for combustion, drawn in by the engine, flows through the air intake system, then through the throttle body where it is regulated by the electronic throttle actuator (ETA).

The ETA allows the ECM to control the throttle plate, and therefore engine torque.

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 sockets. The fuel rails, which are used to secure the injectors to the sockets, 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

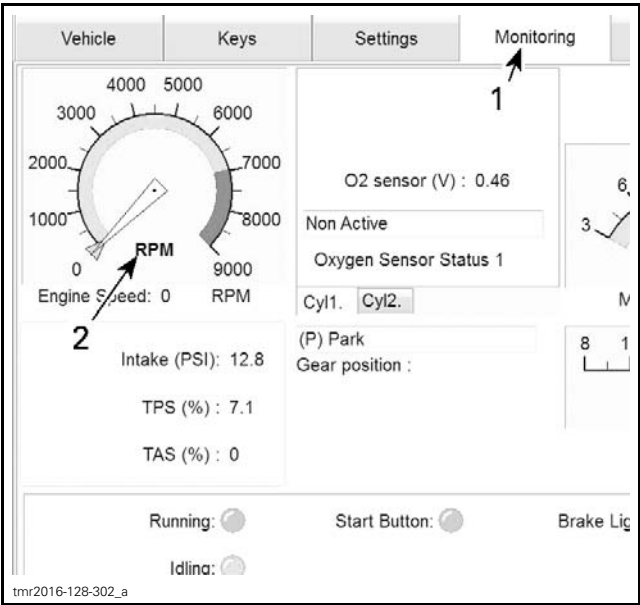
Idle speed is not adjustable. The ECM controls the idle speed of the engine primarily through control of the throttle plate position.

The vehicle multifunction gauge can provide an accurate digital readout of the engine's idle speed.

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.

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.

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

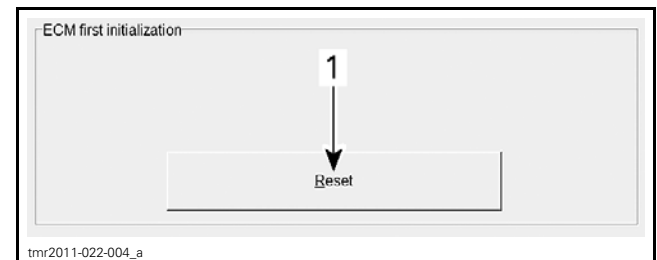
- Throttle body (for TPS)
- GBPS (Gearbox Position Sensor).

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.

Subsection XX (ELECTRONIC FUEL INJECTION (EFI))

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.

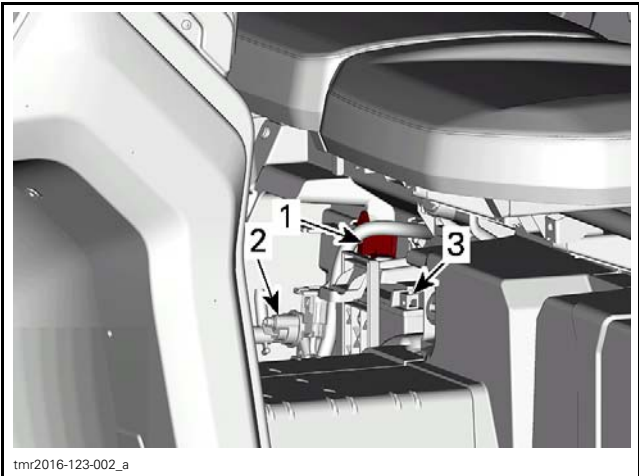
5. Check for fault codes.

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 right passenger's seat, to the right of the fuse box and behind the starter solenoid.

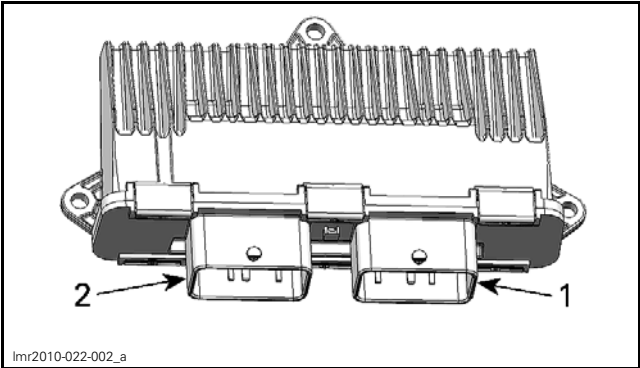


ECM LOCATION
1. ECM
2. Starter solenoid
3. Battery

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

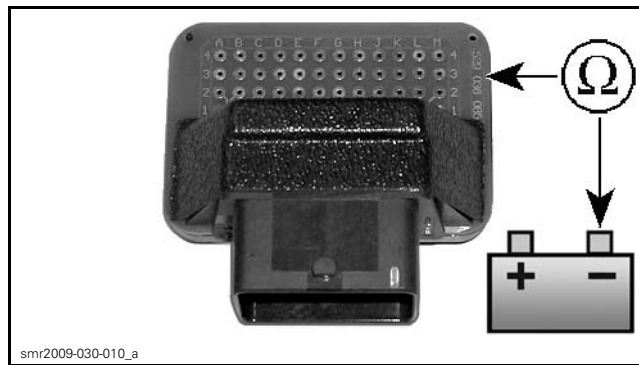
If voltage is not measured, check the following:

- Main relay
- Wiring and connections, refer to the *WIRING DIAGRAM*.

Testing the Continuity 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 grounds. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.

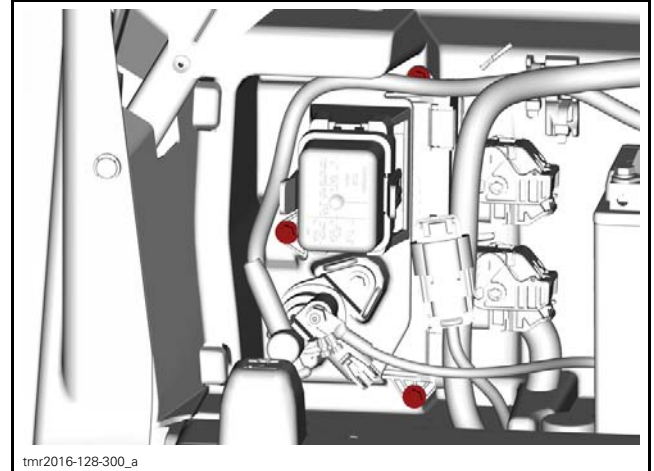
Removing the ECM

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.



Installing the ECM

Reverse removal procedure however, pay attention to the following.

TIGHTENING TORQUE	
ECM retaining screws	2.5 N•m ± 0.5 N•m (22 lbf•in ± 4 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.

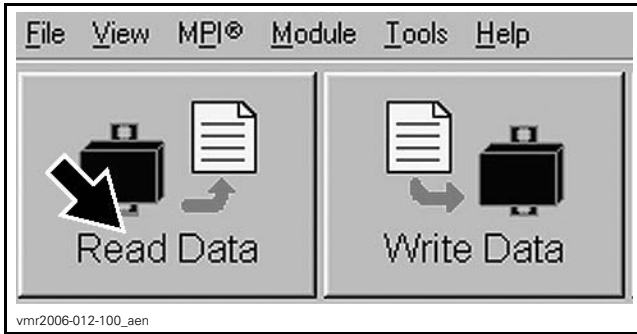
NOTE: Proceed with an *ECM FIRST INITIALIZATION* as it may resolve the problem.

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

ECM Data Transfer

1. Connect the original ECM to vehicle.
2. In B.U.D.S., click the Read Data button to load the information from the original ECM.

Subsection XX (ELECTRONIC FUEL INJECTION (EFI))



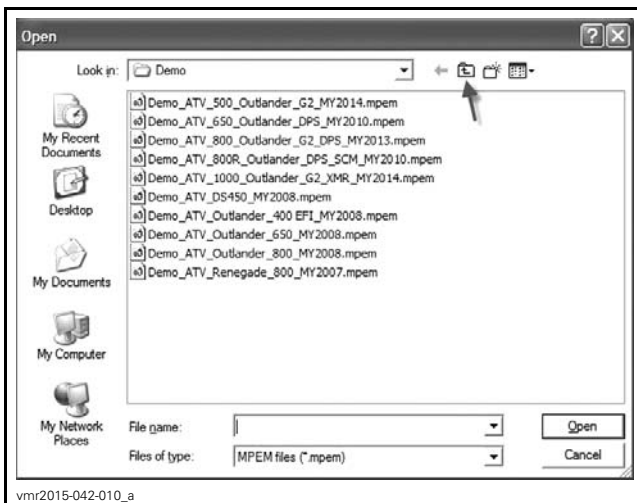
NOTE: Keep B.U.D.S. running while replacing ECMs. The data will remain stored in the PC computer as long as B.U.D.S. is running.

3. Get the Data from the saved .mpem file.

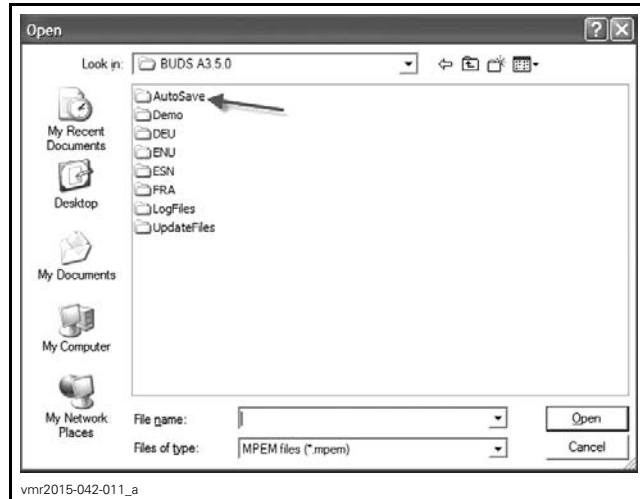
3.1 Click on the Open button.



3.2 Click once on the Folder Up button in the open box.

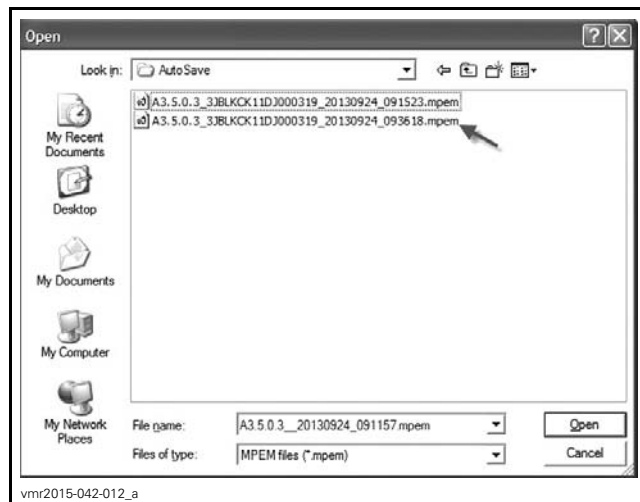


3.3 Double click on the AutoSave folder.



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

3.4 Choose the latest file saved for this specific vehicle.



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

NOTE: The file name structure is as follows:

BUDS version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem

Example:

A3.5.0.3_3JBLKCK11DJ000319_20130924_093618.mpem

B.U.D.S. version = A3.5.0.3

VIN = 3JBLKCK11DJ000319

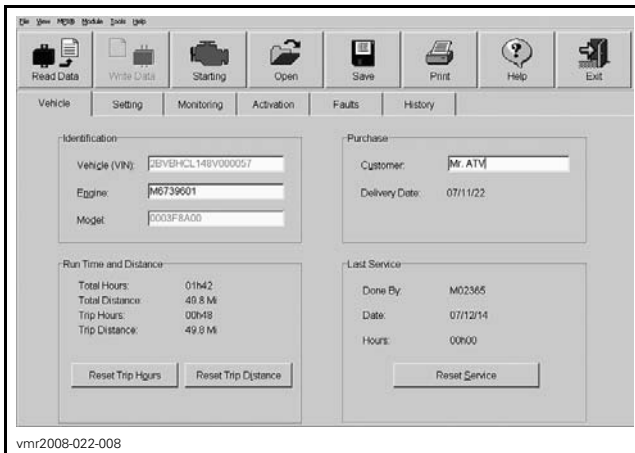
Date file was read = 2013-09-24

Hour file was read = 09h 36m 18s

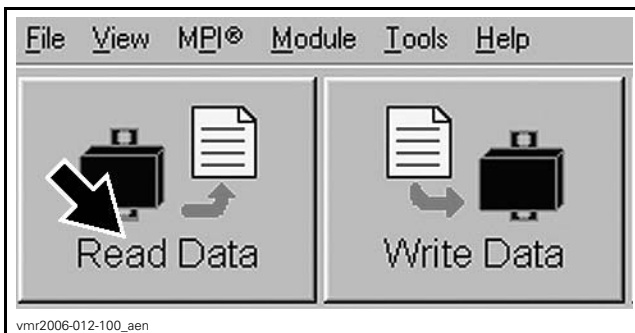
4. Go to the Vehicle tab and record the following information.

- Vehicle (V.I.N.) number
- Engine number (without the leading "M")

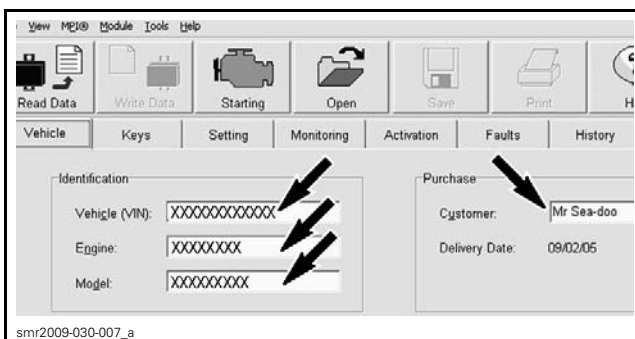
- Model number
- Customer.



- Remove the original ECM.
- Install the new ECM.
- In B.U.D.S., click the **Read Data** button to read the new ECM.

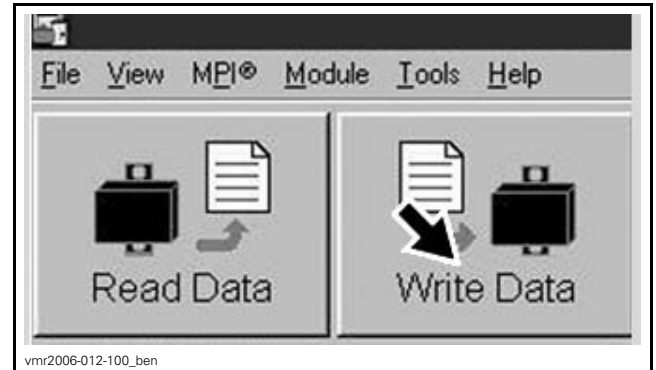


- Select the **Vehicle** tab and enter the information you recorded previously.
 - Vehicle serial number
 - Engine number (do not enter the “M” at the beginning of the engine number)
 - Enter model number.
 - Customer name.



VEHICLE TAB

- Click on the **Write Data** button.



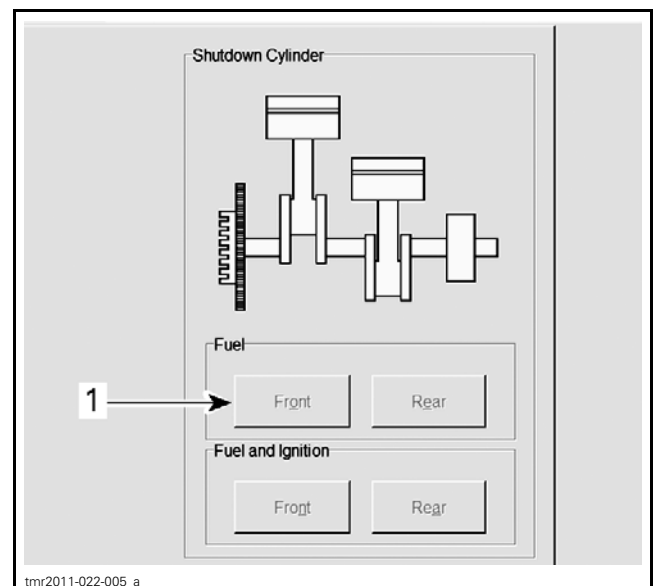
- Perform the *ECM FIRST INITIALIZATION* under the Settings/ECM tab.

FUEL INJECTOR

Testing the Fuel Injector Operation Using B.U.D.S. (Dynamic)

NOTE: As a first troubleshooting step, always check for applicable fault codes using B.U.D.S.

- Connect vehicle to the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- Start engine.
- In B.U.D.S., select the following:
 - **Read Data** button
 - **Monitoring** tab
 - **ECM** tab.
- 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.



- Click on cylinder number to be tested

Subsection XX (ELECTRONIC FUEL INJECTION (EFI))

If the engine RPM drops momentarily when clicking on a cylinder, the injector on this cylinder is functioning normally.

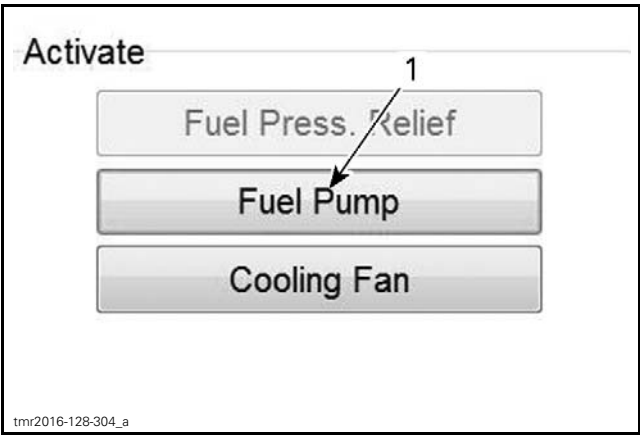
If the engine RPM does not drop momentarily when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to *TESTING THE FUEL INJECTOR BALANCE USING B.U.D.S.*
- Spark plug and ignition coil. Refer to *IGNITION SYSTEM* subsection.
- Engine condition.

Testing the Fuel Injector Balance Using B.U.D.S.

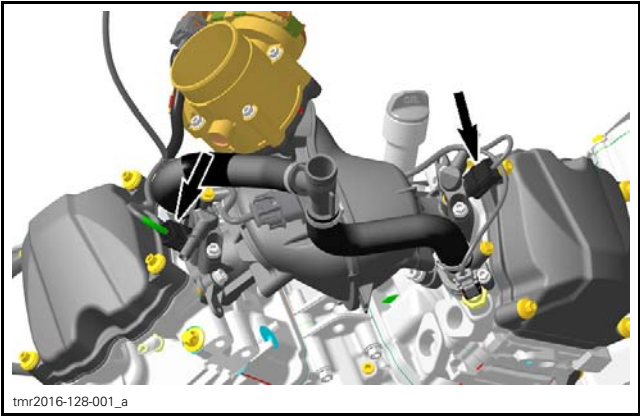
NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine and prevent a potential backfire due to fuel accumulation in engine.

1. Install a fuel pressure gauge as described in *TESTING THE FUEL PUMP PRESSURE 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**.



8. Record the fuel pressure drop for injector **no. 1**.
9. In B.U.D.S., click on the Fuel Pump button to activate fuel pump.
10. Repeat the procedure for fuel injector **no. 2** and record the pressure drop for each injector.
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 that injector then repeat the test.

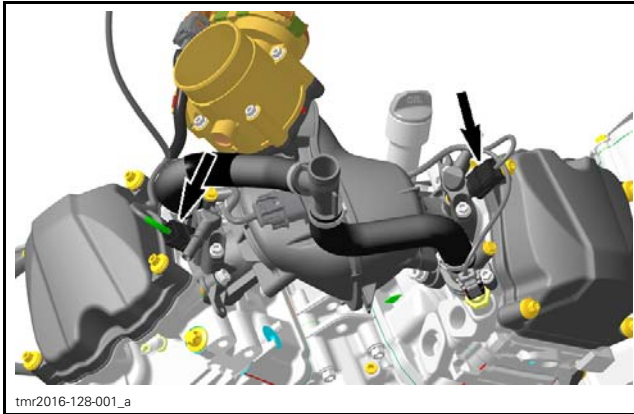
12. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
13. Remove fuel pressure gauge and reinstall removed parts.

Testing for Fuel Injector Leaks

Carry out the *TESTING THE FUEL PUMP PRESSURE* as detailed in the *FUEL TANK AND FUEL PUMP* subsection.

Testing the Fuel Injector Activation 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.



You should hear the injector functioning.

This will validate the injector mechanical and electrical operation.

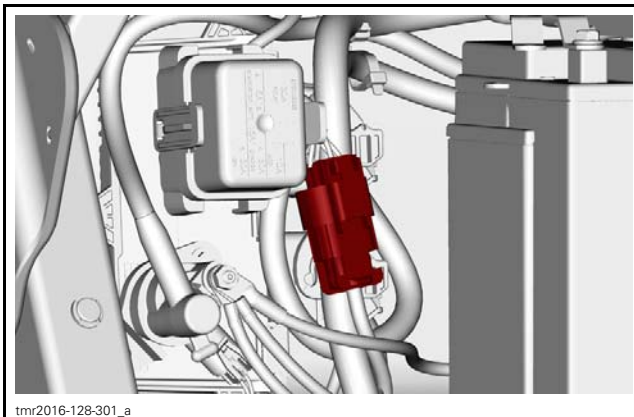
If the injector does not function, carry out the *TESTING THE FUEL INJECTOR RESISTANCE*.

Testing the Fuel Injector Resistance

Disconnect connector "A" from the ECM.

Disconnect the engine connector (HIC).

NOTE: The HIC connector is located to the right of the ECM.



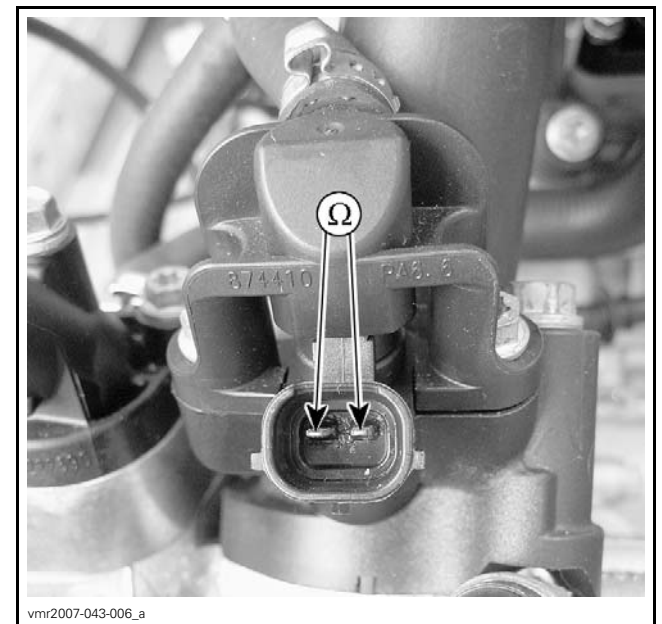
Check resistance value between terminals as follows.

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

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 *TESTING THE FUEL INJECTOR INPUT VOLTAGE*.

Testing the Fuel Injector Input Voltage

Disconnect the fuel injector connector.

NOTE: If the connector is hard to unlock, gently use a screwdriver to release connector.

Subsection XX (ELECTRONIC FUEL INJECTION (EFI))

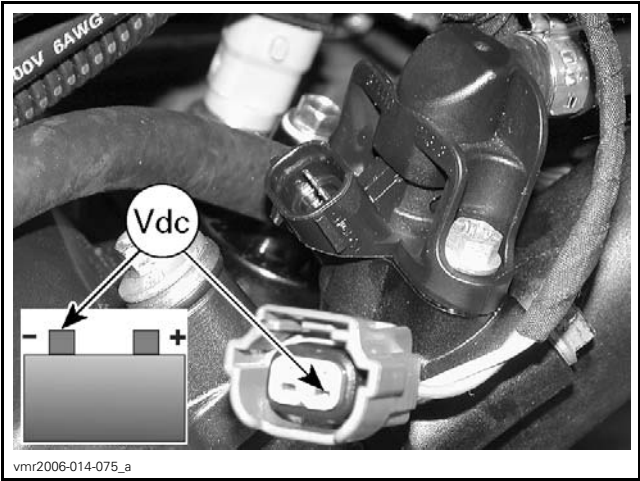


TYPICAL

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

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.

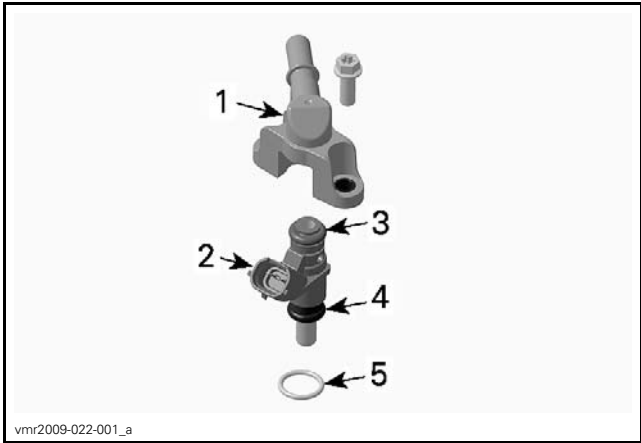
If continuity is faulty, check fuse and if OK, repair/replace wiring going to injector.

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*.

Removing the Fuel Injector

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.

Installing the Fuel Injector

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

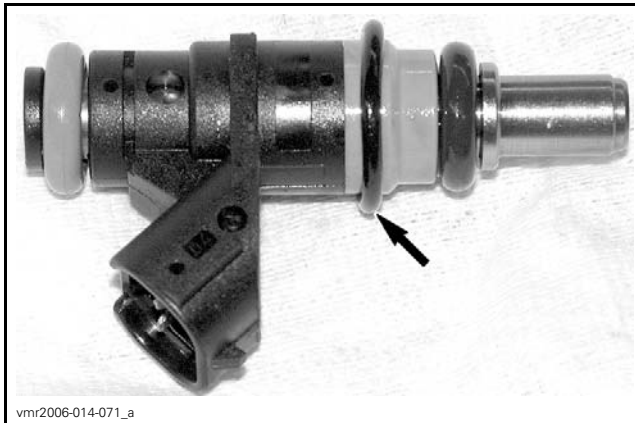
NOTICE If installing the removed injector(s), always install NEW O-rings.

Lubricate O-rings to ease insertion in rail.

FUEL INJECTOR O-RINGS	
Service product	Engine oil

Install fuel injector with your hand. Do not use any tool.

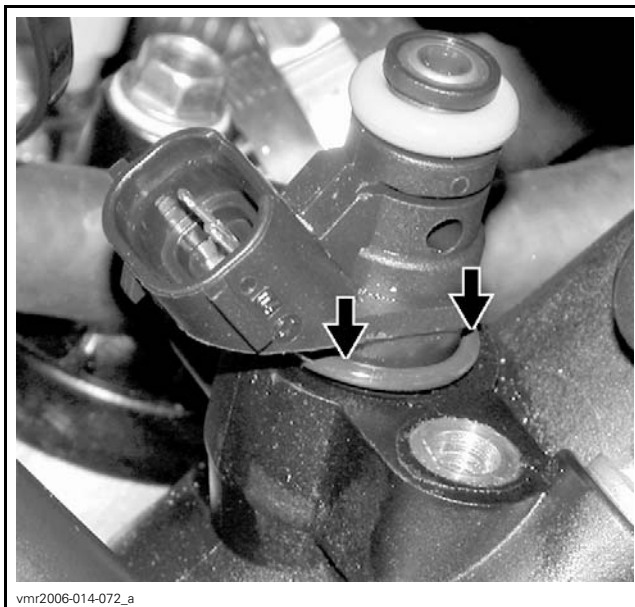
Position the manifold O-ring on injector as in following illustration.



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.



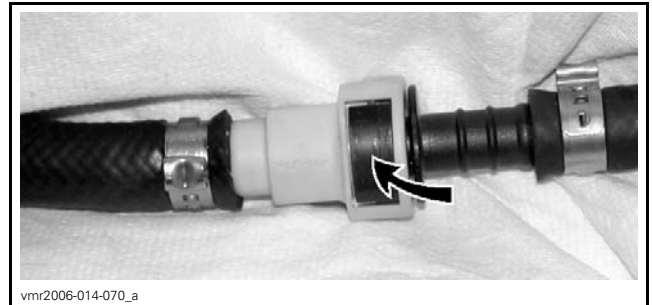
Firmly push injector until it bottoms out.
Reinstall fuel rail.

FUEL RAIL

Fuel Rail Replacement

Removing the Fuel Rail

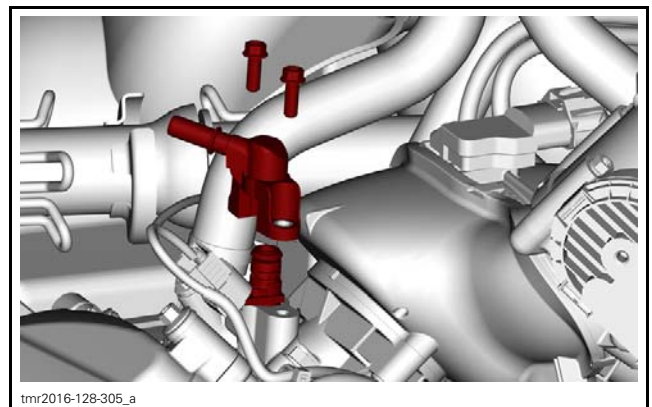
1. Wrap a rag around the inlet hose and release the quick fitting.



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TYPICAL

2. Unscrew rail retaining screws.
3. Gently pull rail off by hand.



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To disconnect fuel rail from hose, cut clamp on fuel hose. Refer to *FUEL TANK AND FUEL PUMP* for clamp removal/installation procedures.

REQUIRED TOOL	
OETIKER PLIER (P/N 295 000 070)	

NOTE: If fuel rail is removed for access to fuel injector, it is not necessary to cut hose clamp. Only to replace fuel rail.

Installing the Fuel Rail

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).

Lubricate fuel injector O-rings to ease insertion in rail.

Subsection XX (ELECTRONIC FUEL INJECTION (EFI))

FUEL INJECTOR O-RINGS	
Service product	Engine oil

Install fuel rail and evenly tighten screws a little at a time each side.

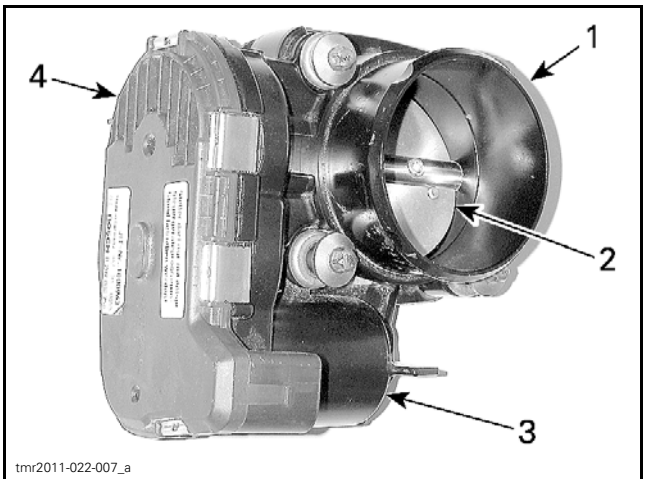
TIGHTENING TORQUE	
Fuel rail retaining screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

 **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

Tilt cargo box.

Lubricating the Throttle Body

No lubrication is required.

Cleaning the Throttle Body

1. Remove air inlet bellow 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.

THROTTLE BODY CLEANING	
Service product	GUNK INTAKE MEDIC or an equivalent throttle body cleaner

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.

4. 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.

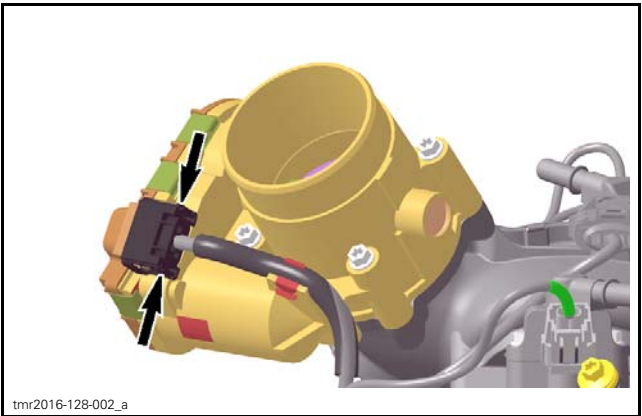
CAUTION Ensure key is removed so that nobody can activate the electrical system, otherwise the ECM would turn on and the throttle actuator (ETA) would cycle. This could cause serious finger injury as the throttle plate moves quickly.

5. Gently open throttle plate and hold fully open to reach all surfaces.
6. To remove residual dirt, spray cleaner on throttle plate and on bore.
7. Reinstall removed parts.

Removing the Throttle Body

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

Simultaneously press the end of both connector locking tabs to unlock.



3. Remove screws retaining throttle body to plenum.



4. Pull throttle body off plenum.

Installing the Throttle Body

Installation of the throttle body is the reverse of the removal procedure. However, pay attention to the following.

TIGHTENING TORQUE	
Throttle body retaining screws	10 N•m ± 1 N•m (89 lbf•in ± 9 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.

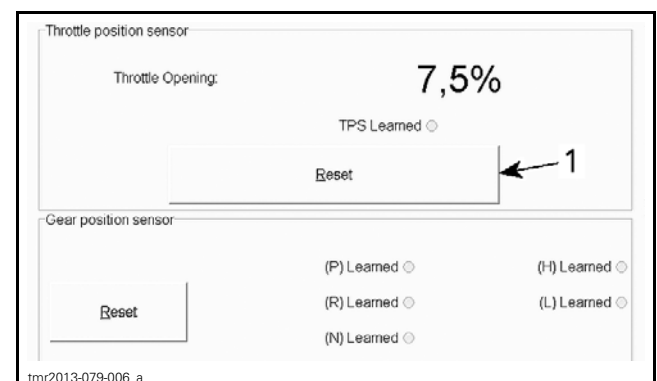
NOTICE An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.

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 XX (ELECTRONIC FUEL INJECTION (EFI))

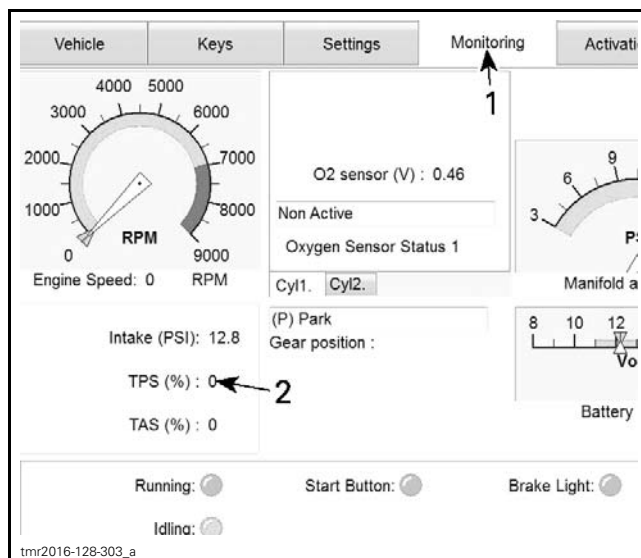
A message will be displayed if the operation is successful.

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.

Testing the TPS Wear

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 *TESTING THE TPS RESISTANCE* in this subsection.

Testing the TPS Resistance

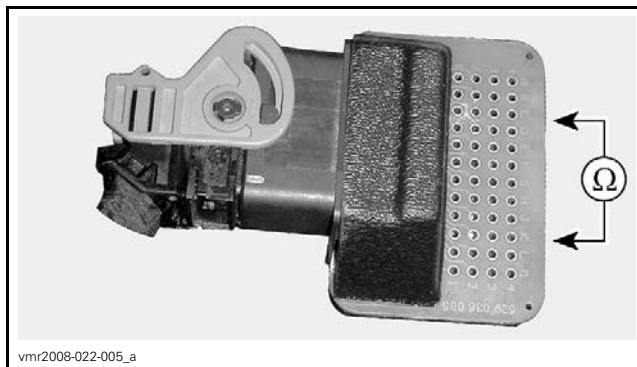
1. Ensure the throttle body connector is properly connected.
2. Disconnect ECM connector A from the ECM and install it on the ECM adapter tool.
3. Set multimeter to Ω .

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

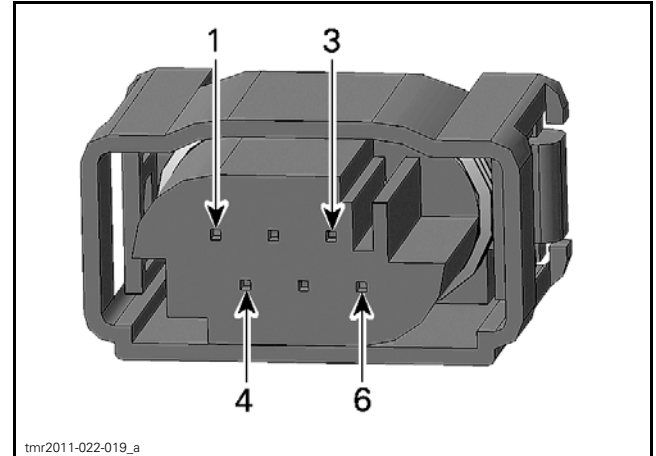
4. Probe circuit as per following table while using your hand to manually move throttle plate.

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.

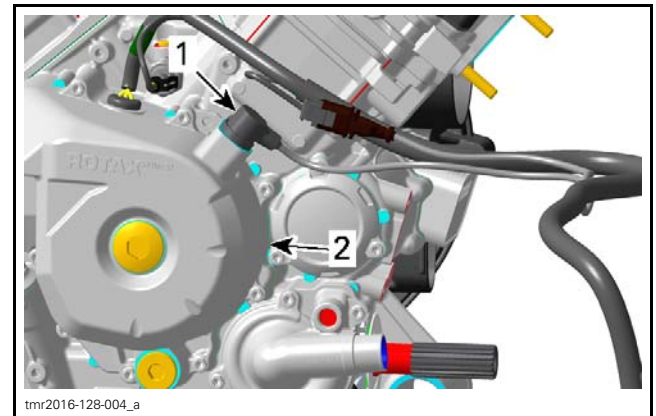


THROTTLE BODY CONNECTOR PIN-OUT

TPS Replacement

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

CRANKSHAFT POSITION SENSOR (CPS)

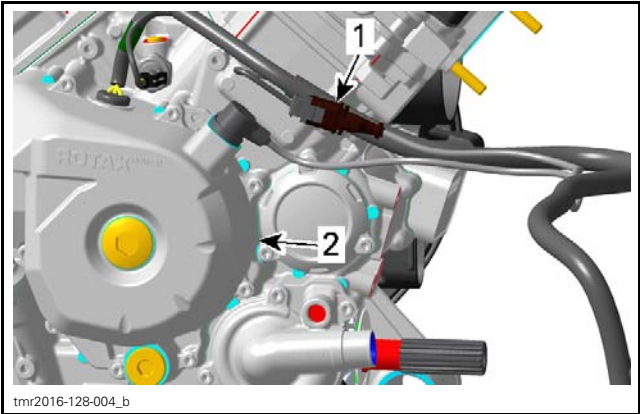


1. CPS
2. Magneto cover

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 AND STARTER* subsection).

Testing the CPS Resistance

Disconnect CPS wiring harness connector.



1. CPS connector location
2. Magneto 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.

Install ECM-A connector on ECM adapter.

Using a multimeter, recheck resistance as per table.

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

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

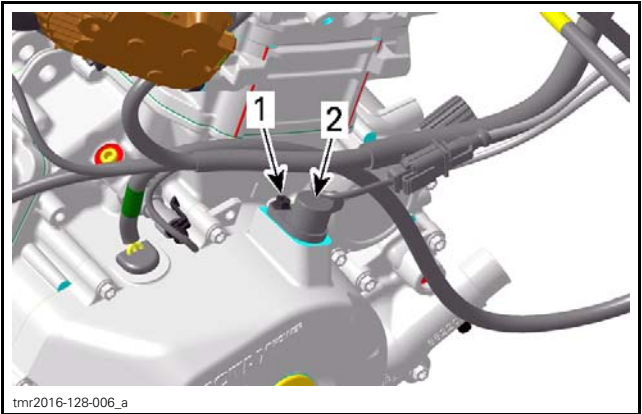
If resistance value is correct, refer to *ECM REPLACEMENT*.

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 out CPS.



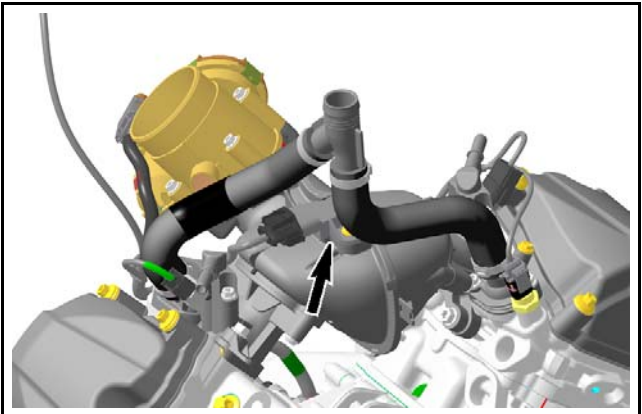
1. Retaining screw
2. CPS

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

CPS O-RING LUBRICATION	
Service product	XPS SYNTHETIC GREASE (P/N 293 550 010)

TIGHTENING TORQUE	
CPS retaining screw	10 N•m $\pm$ 1 N•m (89 lbf•in $\pm$ 9 lbf•in)

MANIFOLD AIR PRESSURE AND TEMPERATURE SENSOR (MAPTS)



NOTE: This sensor is a multifunction device.

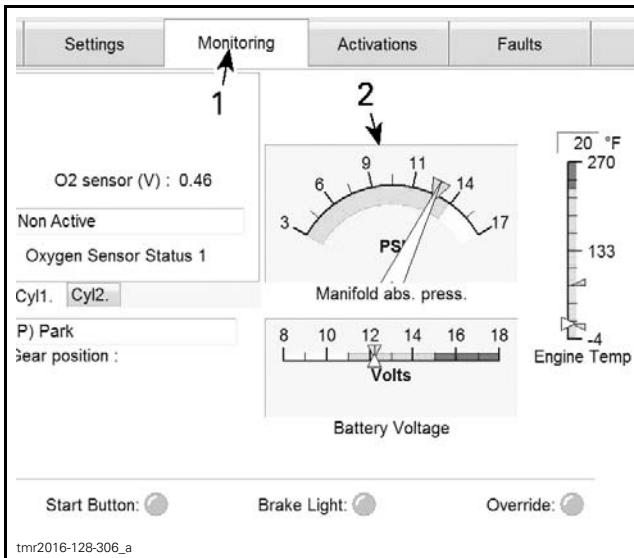
MAPTS Pressure Function

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.

Testing the MAPTS (Pressure 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.



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).

TESTING THE MAPTS PRESSURE FUNCTION

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		

Testing the MAPTS Input Voltage

Check the voltage output from ECM to the pressure sensor.

1. Turn ignition key ON.
2. Remove electrical connector from MAPTS.
3. Measure input voltage as per following table.

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

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 *TESTING THE MAPTS CIRCUIT CONTINUITY (PRESSURE FUNCTION)*.

Testing the MAPTS Circuit Continuity (Pressure Function)

1. Disconnect the ECM "A" connector.
2. Install ECM-A connector on ECM adapter tool.
3. Check continuity of the following circuits.

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

TESTING THE MAPTS CIRCUIT CONTINUITY (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.

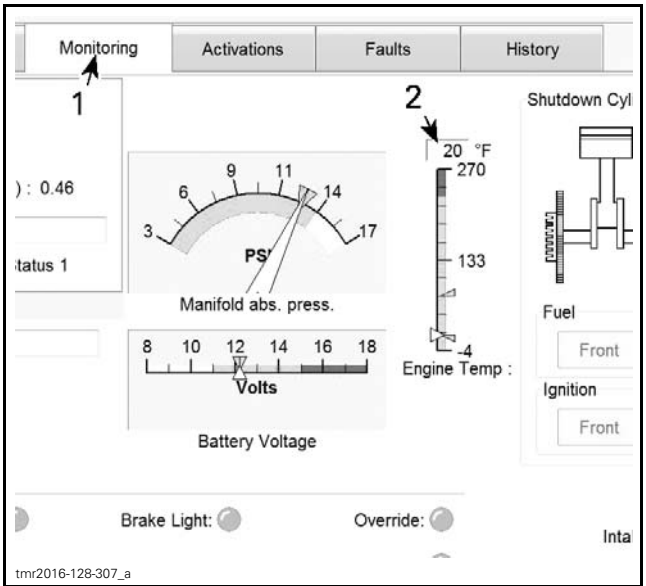
Testing the MAPTS (Temperature Function)

- 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.

If there is no reading, carry out *TESTING THE MAPTS RESISTANCE (TEMPERATURE FUNCTION)*.

Testing the MAPTS Resistance (Temperature Function)

Disconnect the connector from the MAPTS.
Check the resistance of the sensor itself as shown.



- 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.

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

REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 529 036 166)	

Using a multimeter, recheck resistance value as per following table.

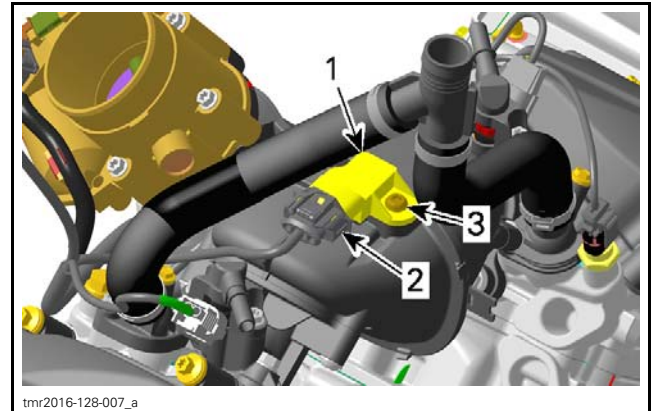
ECM CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A-H2	A-H3	2280 - 2740

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		

Testing the MAPTS Circuit Continuity (Temperature Function)

TESTING THE MAPTS CIRCUIT CONTINUITY (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

Disconnect MAPTS connector and remove the MAPTS from the plenum.

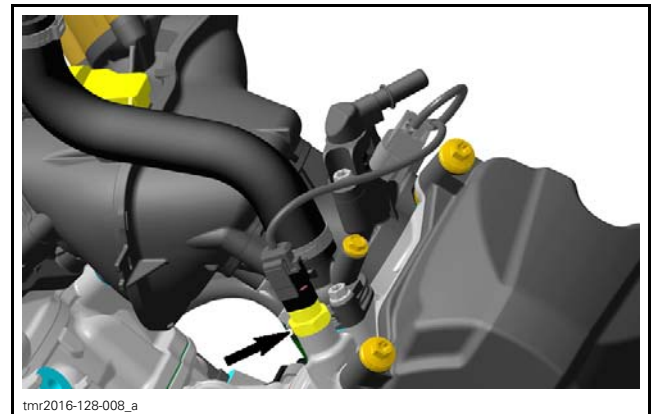
Install new MAPTS as per following table.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
MAPTS retaining screw	6 N•m $\pm$ 0.7 N•m (53 lbf•in $\pm$ 6 lbf•in)

COOLANT TEMPERATURE SENSOR (CTS)

CTS Access

The CTS is located on the LH of the engine, aft cylinder.



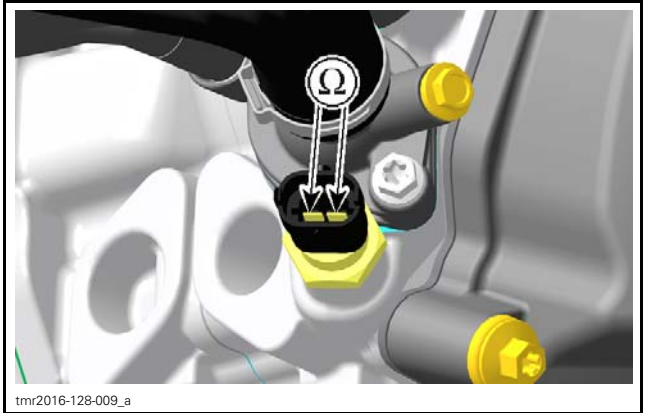
Testing the CTS Resistance

1. Disconnect the plug connector from the CTS and check the resistance of the sensor itself.

Subsection XX (ELECTRONIC FUEL INJECTION (EFI))

REQUIRED TOOLS	
ECM ADAPTER TOOL (P/N 529 036 166)	

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



If resistance is out of specification, replace the CTS.

If resistance test is good, **reconnect** the CTS and disconnect the ECM connector "A" from the ECM.

2. Install ECM-A connector on ECM adapter tool.

REQUIRED TOOLS	
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.

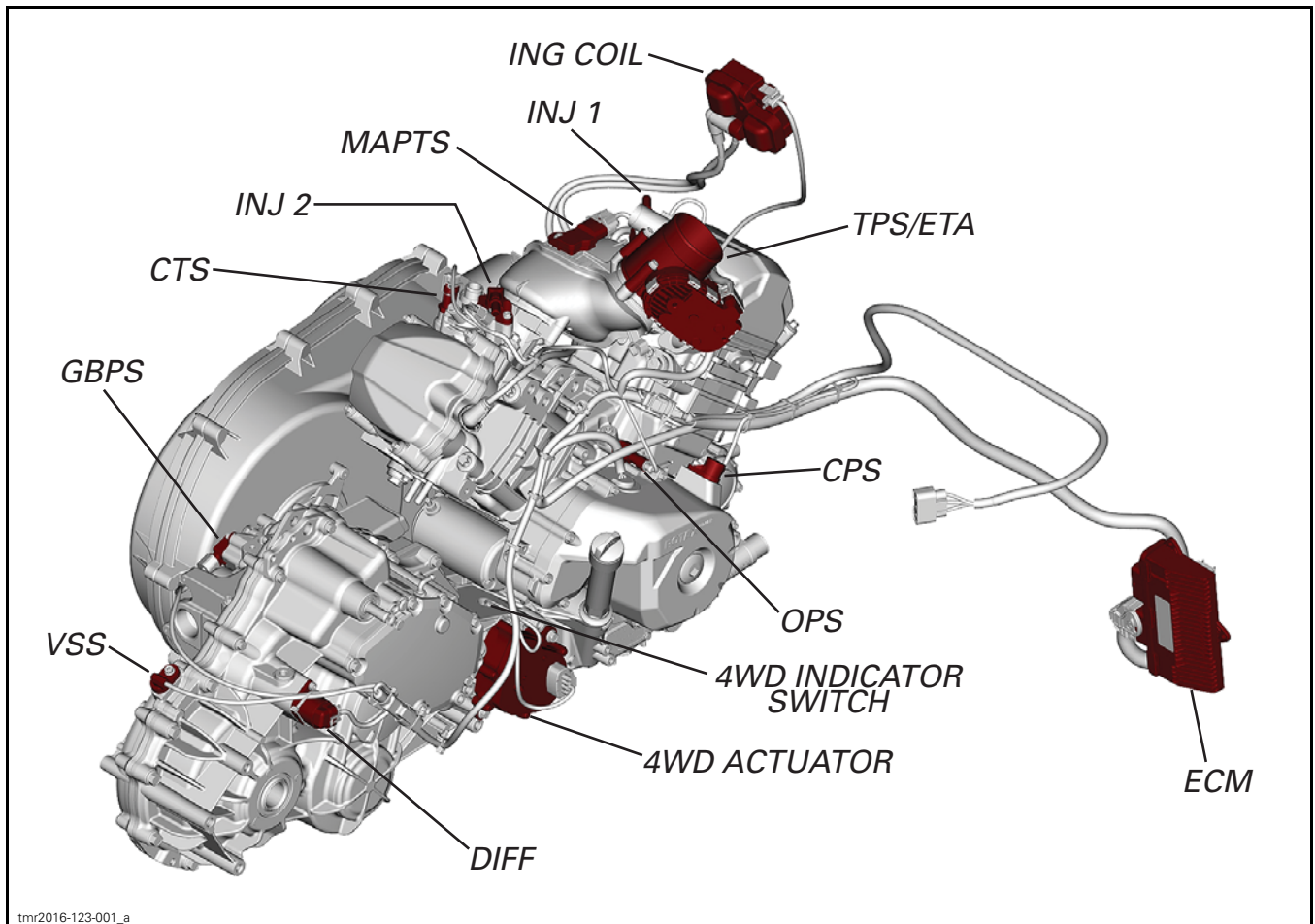
2. Install the new CTS and torque as specified.

TIGHTENING TORQUE	
CTS	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.

ENGINE MANAGEMENT SYSTEM (EMS)



tmr2016-123-001_a

4WD Actuator
4WD Indicator Switch
CPS = Crankshaft Position Sensor
CTS = Cooling Temperature Sensor
DIFF = Differential Locking Actuator
ECM = Engine Control Module
ETA = Electric Throttle Actuator
GBPS = GearBox Position Sensor

IGN COIL = Ignition coil
INJ 1= Injector 1
INJ 2 = Injector 2
MAPTS = Manifold Air Pressure/Temperature Tensor
OPS = Oil Pressure Switch
TPS = Throttle Position Sensor
VSS = Vehicle Speed Sensor

GENERAL

SYSTEM DESCRIPTION

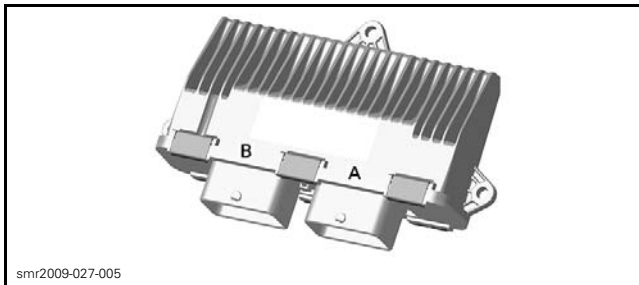
The ECM ensures a high power output with clean combustion.

There are 7 main systems that are controlled by the ECM:

1. Electronic Fuel Injection (EFI)
2. Intelligent throttle control
3. Cooling system (cooling fan)
4. Ignition system
5. Starting system
6. Fuel system

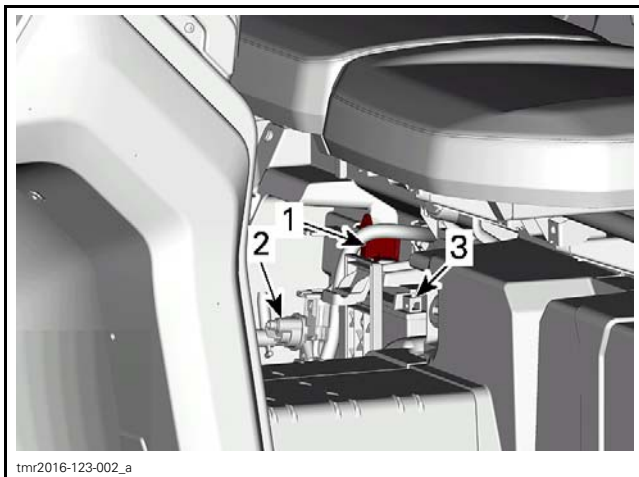
NOTE: For further information related to these systems, refer to the applicable subsection.

The ECM is the central point of the engine management system.



TYPICAL - ECM

The ECM is located under the right passenger's seat, to the right of the fuse box and behind the starter solenoid.



ECM LOCATION

1. ECM
2. Starter solenoid
3. Battery

The ECM reads input signals from various switches, controls, and sensors, that it compares to predetermined 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 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

When a major component of the EMS is not operating properly, limp home mode will be set.

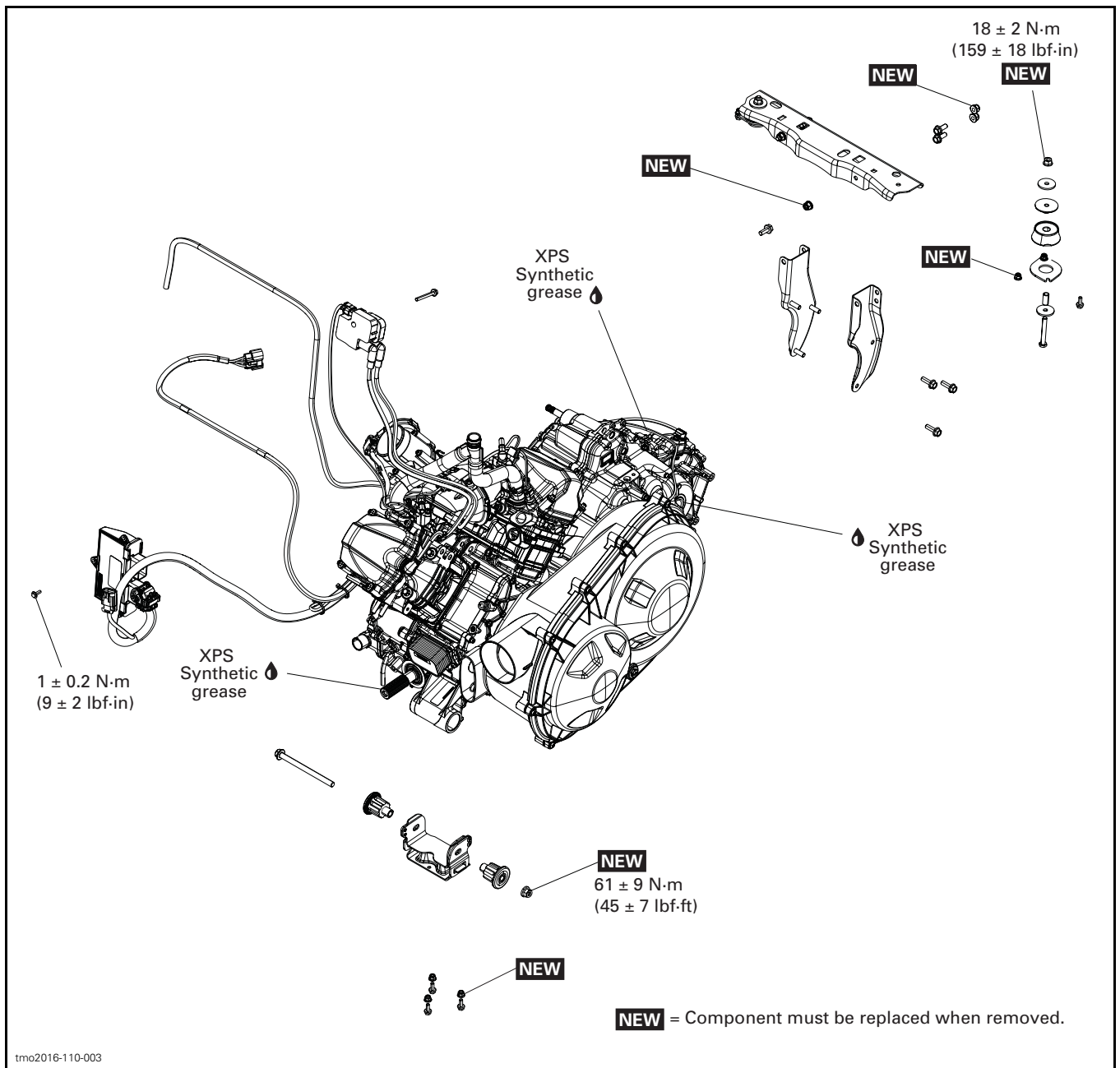
Engine RPM will be limited and/or engine behavior and control may be modified depending on the cause of the failure.

LIMP HOME will be displayed in the multifunction gauge and the CHECK ENGINE light symbol will be on in the gauge.

A failure of any of the following major components will force the vehicle into LIMP HOME MODE:

- TPS / ETC / TAS
- GBPS
- Injectors
- Low oil pressure
- High engine coolant temp
- MAPTS signal fault.

ENGINE REMOVAL AND INSTALLATION



PROCEDURES

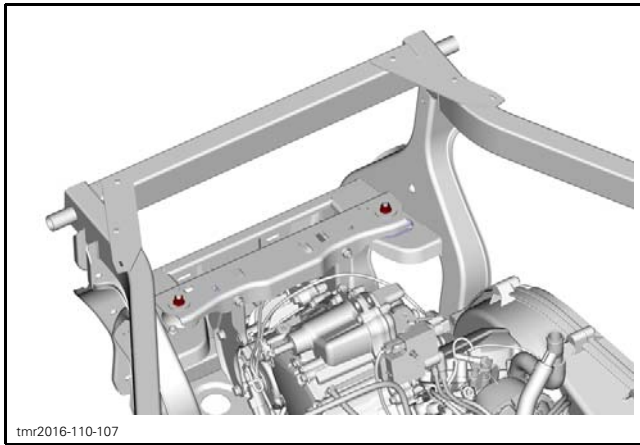
ENGINE REMOVAL

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

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

4. Remove battery.
5. Remove rear drive shafts. Refer to *REAR DRIVE* subsection.
6. Remove cargo box cylinder.
7. Remove exhaust. Refer to *EXHAUST SYSTEM* subsection.



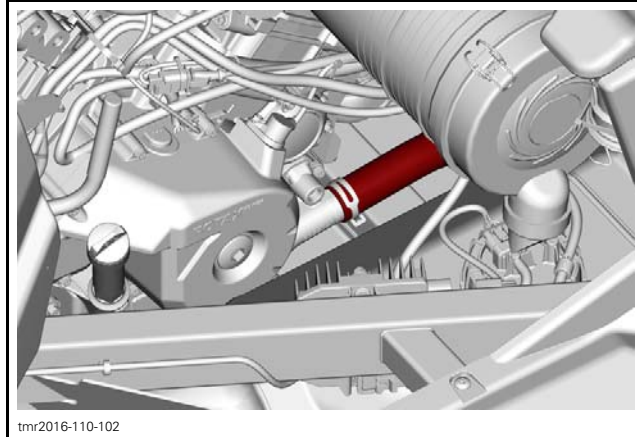
NOTE: Remove screws securing exhaust support bracket to frame. Leave muffler support bracket attached to rear engine support brackets.

8. Remove rear engine support bolts.
9. Drain engine oil. Refer to *LUBRICATION SYSTEM* subsection.

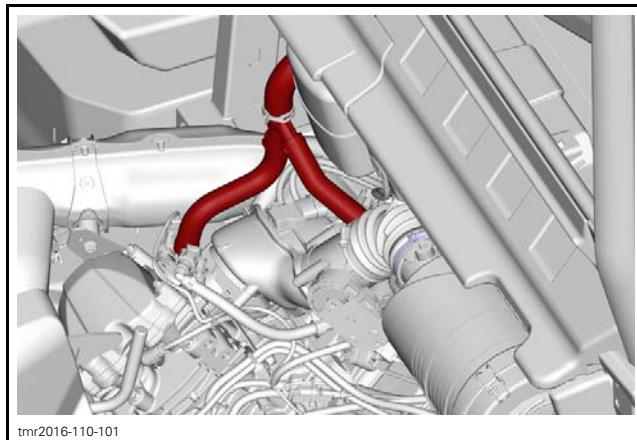
NOTE: Drain engine oil only if engine overhaul is necessary.

10. Drain the engine coolant.

10.1 Pinch coolant hose near water pump.



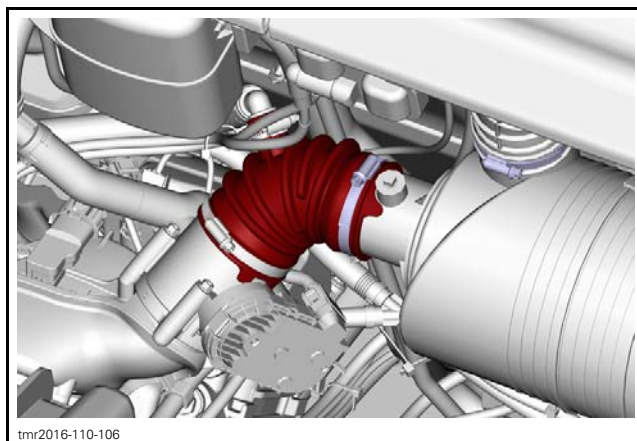
10.2 Pinch coolant hose near coolant bottle above Y fitting.



10.3 Open coolant drain plug.

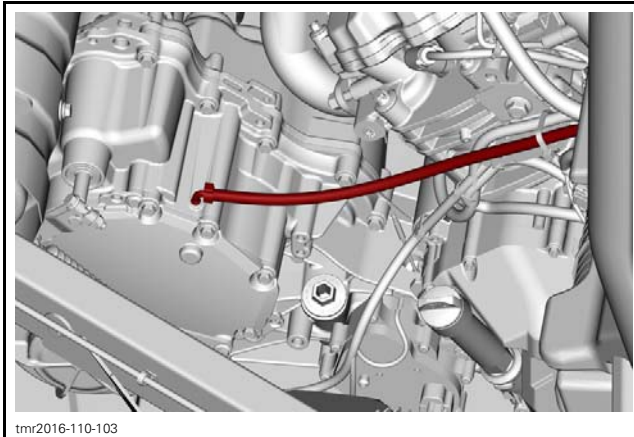
NOTE: Completely drain engine coolant only if engine overhaul is necessary. Refer to *COOLING SYSTEM* subsection.

11. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
12. Disconnect engine coolant hose above the Y fitting connecting to both cylinder heads.
13. Remove the air intake bellow.

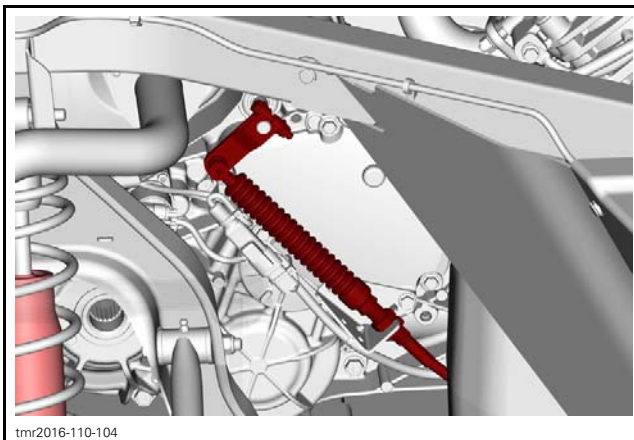


NOTE: DO NOT Remove the front and rear head pipes from engine.

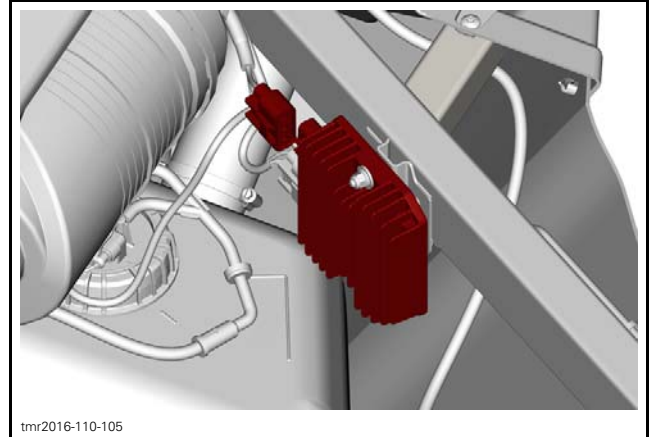
14. Disconnect the coolant hose at water pump.
15. Disconnect the gearbox vent hose.



16. Remove the CVT outlet duct.
17. Remove the CVT inlet duct.
18. Unplug and remove the CTS (coolant temperature sensor).
19. Detach the shifter cable from its bracket and remove it.



20. Remove the front engine support nut.
21. Disconnect the crankcase vent hose.
22. Disconnect voltage regulator.



23. Unplug all remaining connectors and remove required cables from engine. Cut all necessary locking ties.
 - Starter cable (retaining nut on starter body)
 - GBPS (Gear Box Position Sensor)
 - Vehicle speed sensor
 - Actuator connector
 - Neutral switch
 - 2WD/4WD and differential lock actuator
 - OPS (Oil Pressure Sensor)
 - CPS (Crankshaft Position Sensor)
 - Engine ground cable
 - Magneto.

Lifting Engine

1. Install a hook and strap through the rear engine lifting holes and route a second lifting strap under the front cylinder.
2. Remove retaining screws on front and rear propeller shafts.
3. Slightly lift engine to ease removal of front engine support bolt.
4. Remove the front engine support bolt.
5. Raise the front of engine to separate front propeller shaft from engine.

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

6. 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.

Subsection XX (ENGINE REMOVAL AND INSTALLATION)

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

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

Install air intake bellow. Ensure alignment marks are properly positioned and torque to specification. Refer to *AIR INTAKE SYSTEM*.

Install exhaust. Refer to *EXHAUST SYSTEM*.

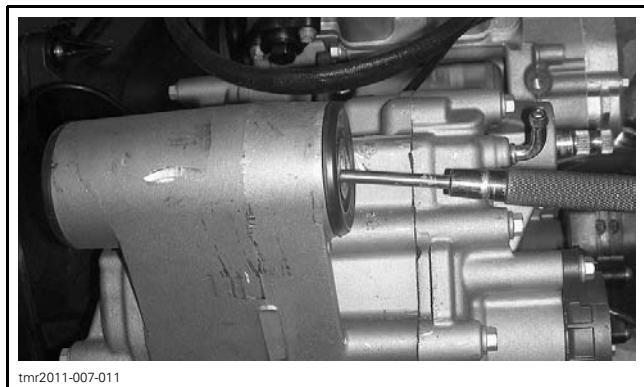
Final Assembly Procedure

1. Fill engine with the recommended oil and quantity. Refer to *LUBRICATION SYSTEM* subsection.
2. Fill and bleed cooling system. Refer to *COOLING SYSTEM* subsection.
3. Check for any leaks.
4. Test drive vehicle to confirm proper operation.

ENGINE MOUNTS

Front Engine Mount Removal

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



TYPICAL

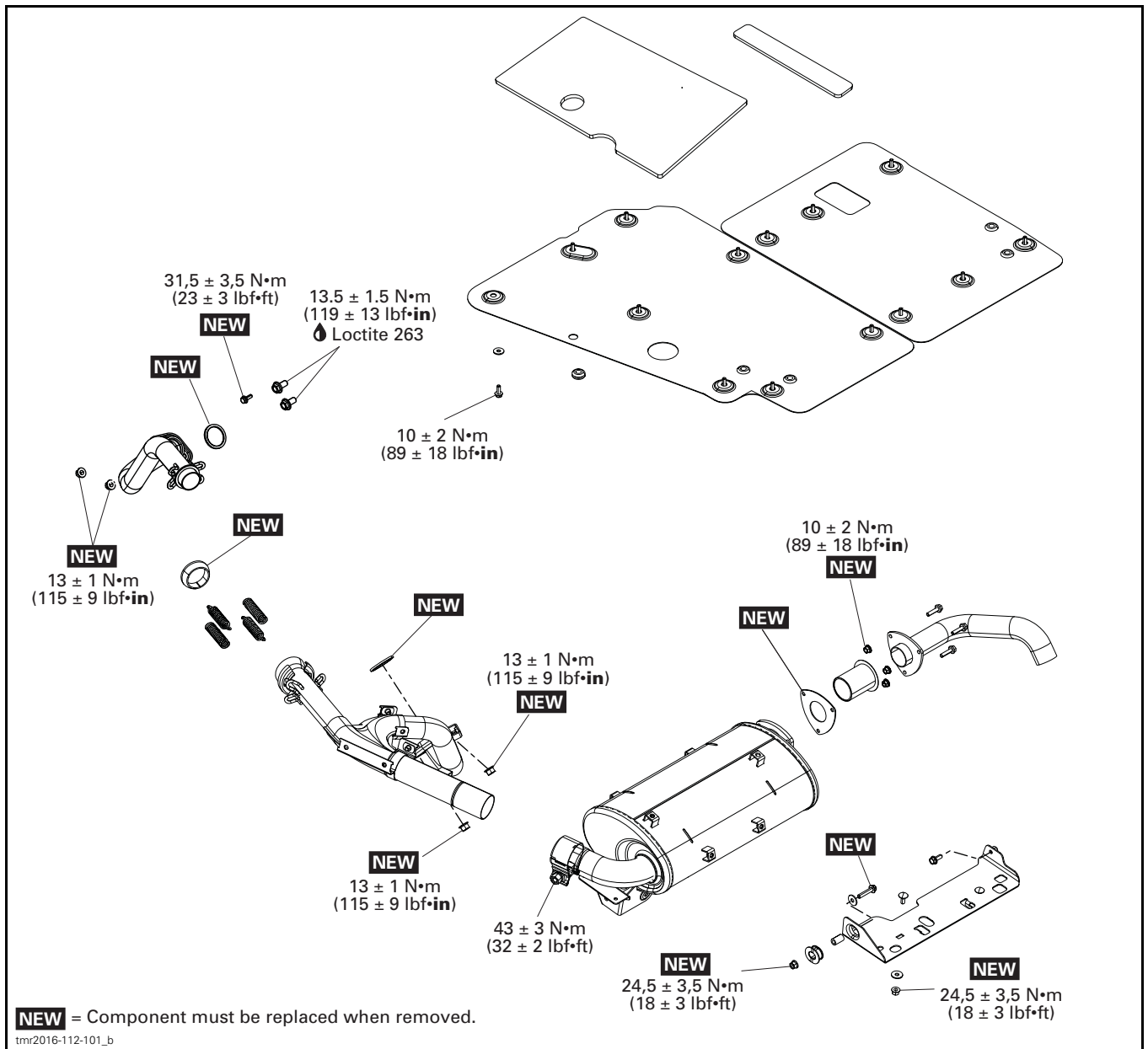
Engine Mount Installation

The installation is the reverse of the removal procedure.

EXHAUST SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 263	293 800 137	3





GENERAL

WARNING

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

PROCEDURES

SPARK ARRESTER

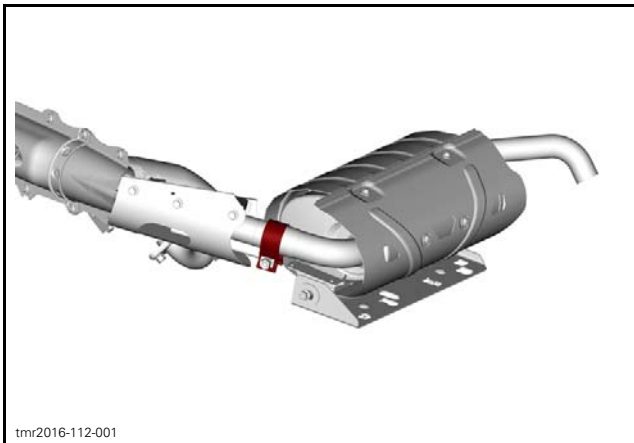
For spark arrester servicing, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

MUFFLER

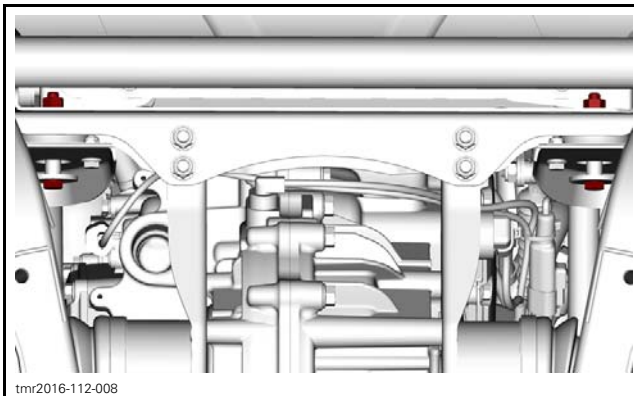
Removing Muffler

NOTICE All M6 exhaust bolts, except heat shields plates bolts under cargo box, were installed using Loctite 263. Heat nut before removal.

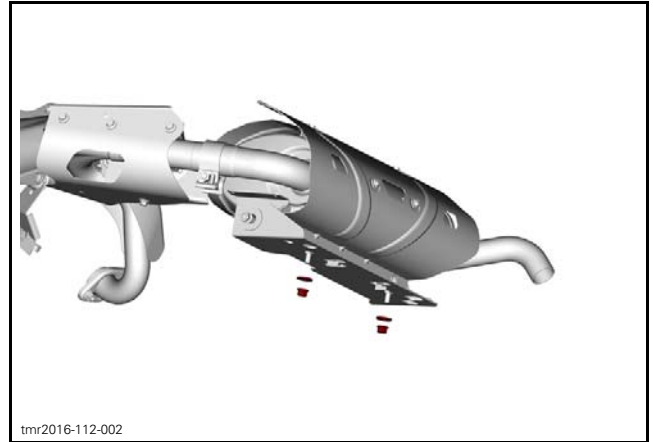
1. Loosen exhaust pipe clamp.



2. Remove engine support retaining bolts. Refer to *ENGINE REMOVAL AND INSTALLATION*.



3. Remove muffler support bracket retaining nuts and washers.



4. Remove muffler from support bracket if necessary.

5. Remove muffler heat shields if necessary.

NOTE: If heap pipes are removed as well, follow tightening sequence when re-assembling.

Inspecting Muffler

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

Check heat shields for cracks or other damages. Replace if necessary.

Check if the rubber supports are brittle, hard or otherwise damaged. Replace if needed.

Installing Muffler

NOTICE All M6 exhaust bolts, except heat shields plates bolts under cargo box, must be installed using LOCTITE 263 (P/N 293 800 137).

Head Pipes Not Removed

For the installation, reverse the removal procedure.

NOTE: Push muffler LH side towards front into rubber grommet.

Head Pipes Removed

NOTE: Do not torque any components until indicated per tightening sequence.

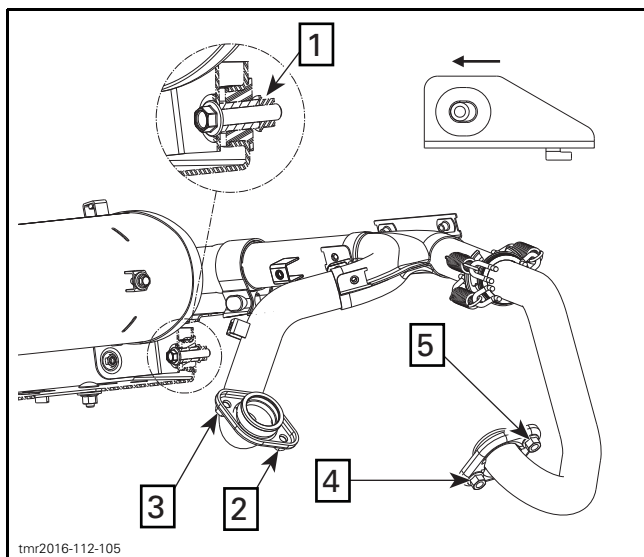
1. Reinstall head pipes and springs with new gas-kets, muffler and muffler bracket.

NOTE: All heat shields can be reinstalled except the front cylinder head pipe shield near engine and heat shield half covering LH side of front head pipe.

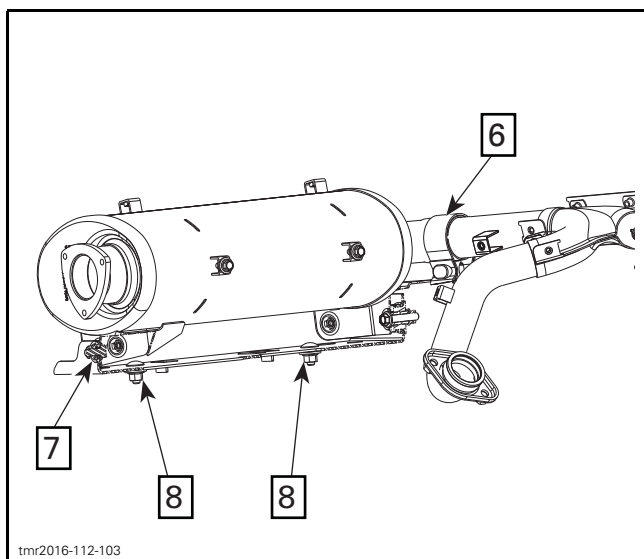
2. Tighten retaining nut then push the muffler LH side towards the front of vehicle.

Subsection XX (EXHAUST SYSTEM)

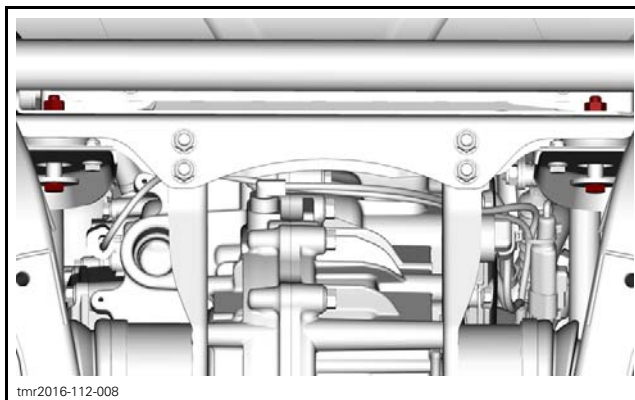
3. Tighten rear cylinder head pipe then front cylinder head pipe retaining nuts as per following sequence.



4. While keeping muffler LH side pushed towards the front of vehicle, tighten the exhaust pipe clamp.
5. Tighten the RH muffler retaining nut, then the muffler bracket to the frame.



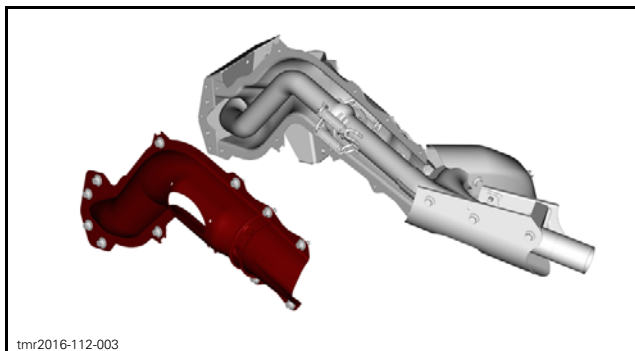
6. Tighten engine support retaining bolts. Refer to *ENGINE REMOVAL AND INSTALLATION*.



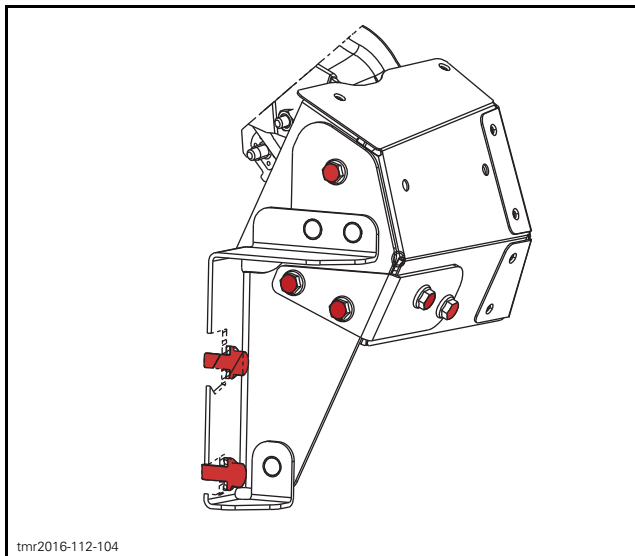
HEAD PIPE (FRONT CYLINDER)

Removing Front Head Pipe

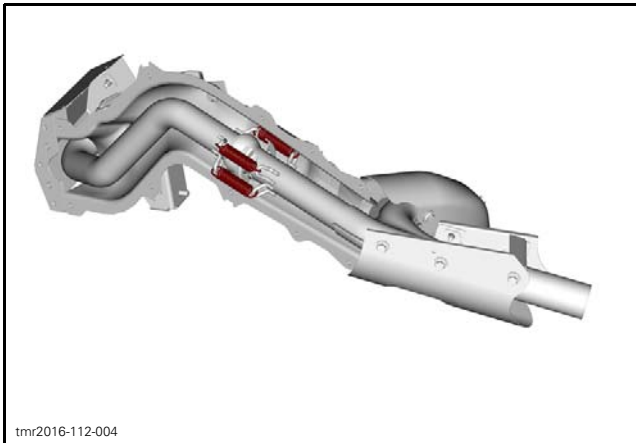
1. Remove engine service cover. Refer to *BODY*.
2. Remove muffler. Refer to *REMOVING MUFFLER*.
3. Remove heat shield half covering LH side of front head pipe.



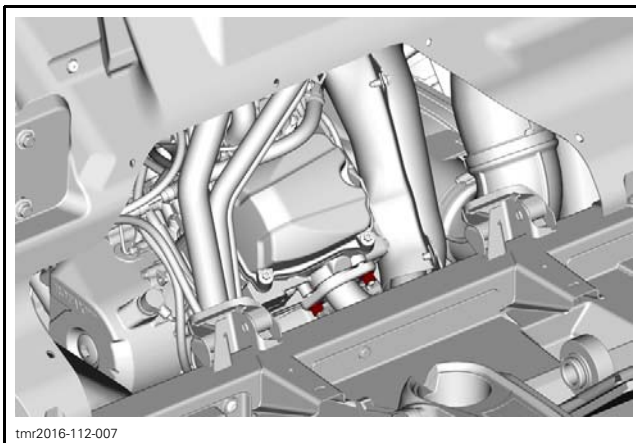
4. Remove retaining screws and conical washers from heat shield assembly near the engine.



5. Remove springs securing rear head pipe to front head pipe. Discard gasket.



6. Remove retaining nuts from front cylinder head pipe flange. Discard nuts.



7. Remove front cylinder head pipe.

Inspecting Front Head Pipe

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

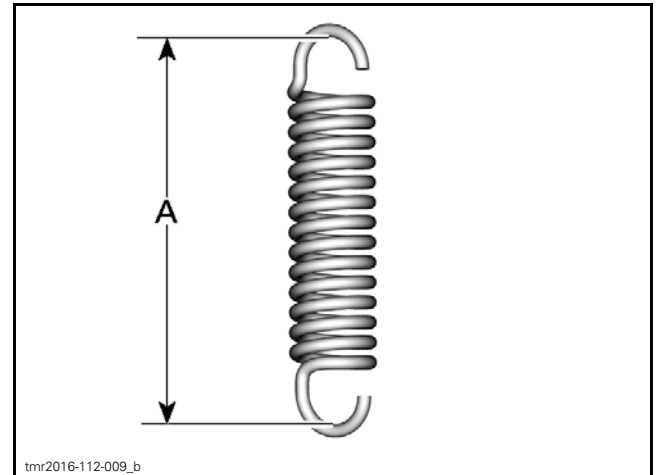
Installing Front Head Pipe

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

Install NEW exhaust gaskets and nuts.

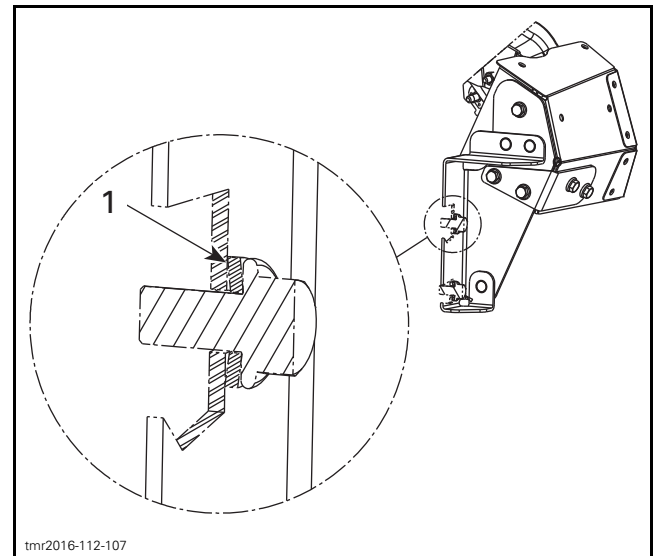
Measure front head pipe springs. If spring length exceeds specification, replace spring.

SPECIFICATION	
Spring maximum length	67.5 mm (2.66 in)



A. Maximum length

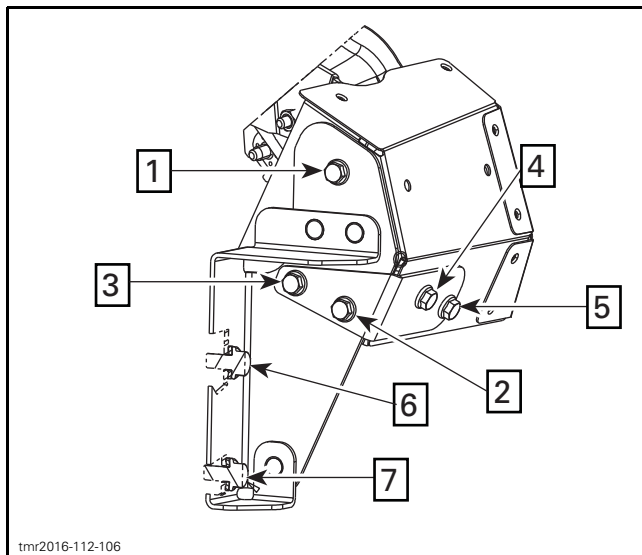
2. Install muffler. Refer to *INSTALLING MUFFLER*.
3. Install heat shield assembly near the engine.
4. Ensure proper orientation of the conical washers. Follow tightening sequence for the retaining screws.



1. Washer proper orientation

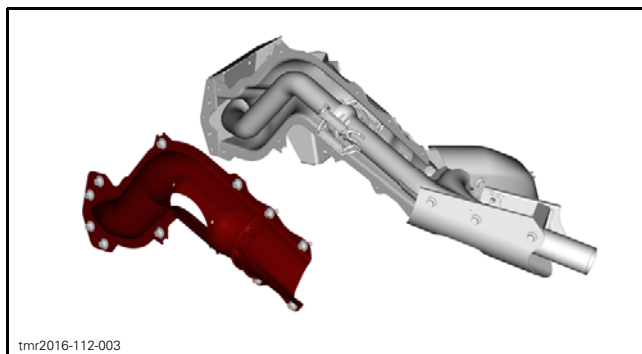
NOTE: Before tightening steps 6 and 7 bolts in following tightening sequence, install bolts which will secure heat shield half covering LH side of front head pipe.

Subsection XX (EXHAUST SYSTEM)



TIGHTENING SEQUENCE

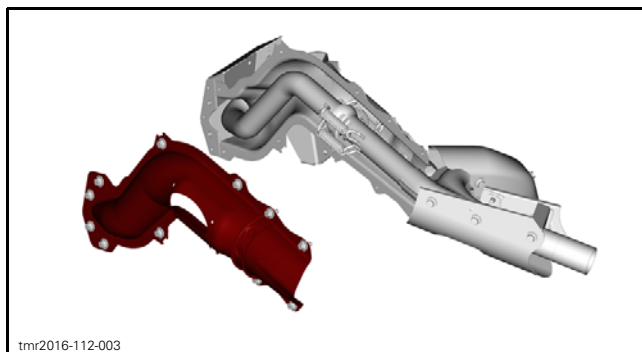
5. Reinstall heat shield half covering LH side of front head pipe.



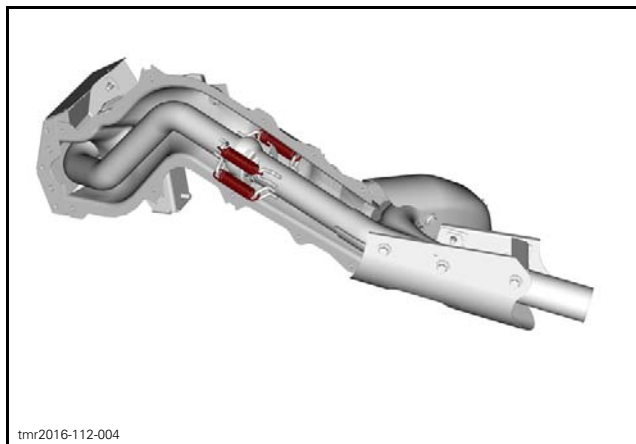
HEAD PIPE (REAR CYLINDER)

Removing Rear Head Pipe

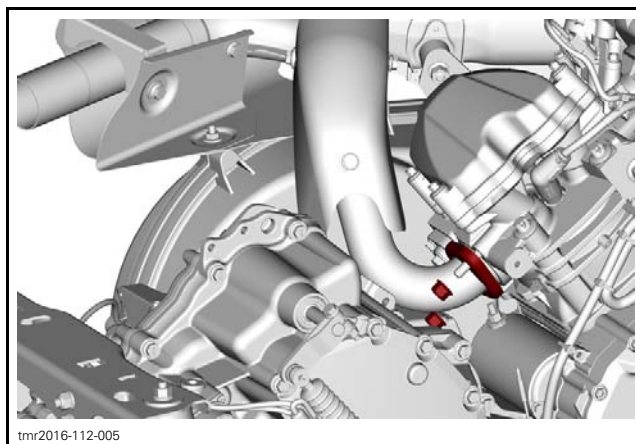
1. Remove muffler. Refer to *REMOVING MUFFLER*.
2. Remove heat shield half covering LH side of front head pipe.



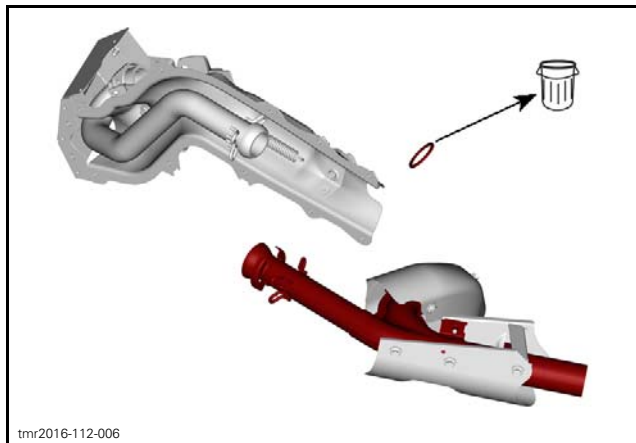
3. Remove springs securing rear head pipe to front head pipe.



4. Remove both retaining nuts from rear cylinder head pipe flange. Discard nuts.



5. Remove rear head pipe with "Y" exhaust pipe, and heat shields. Discard gasket and nuts.



Inspecting Rear Head Pipe

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

Installing Rear Head Pipe

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

Do not torque yet. Strictly adhere to tightening sequence.

Install NEW exhaust gaskets.

Install muffler. Refer to *INSTALLING MUFFLER*.

FRAME

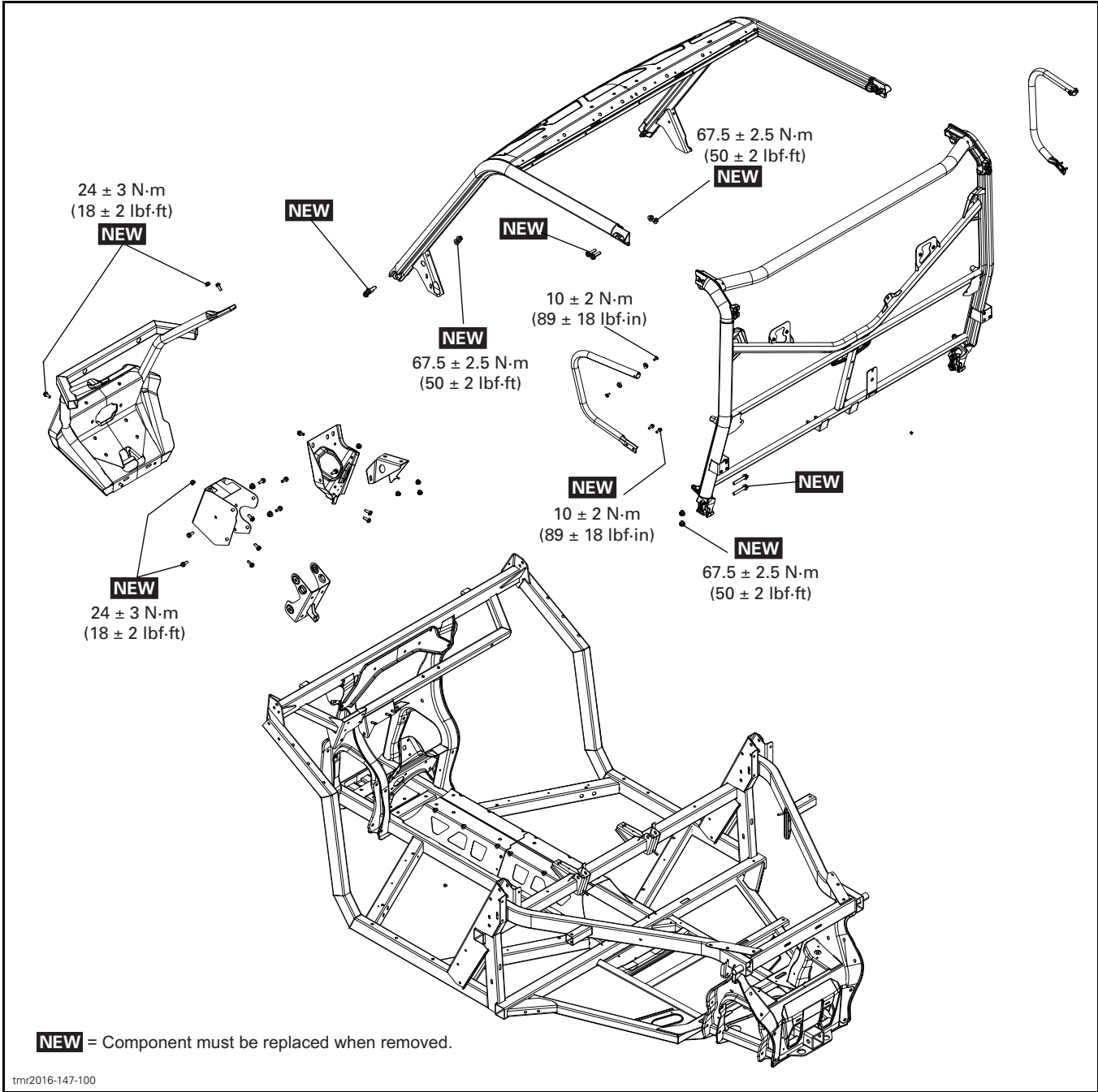
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
BLIND THREADED INSERT INSTALLER.....	model 9600	3

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	3

Subsection XX (FRAME)



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 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 under exceptional conditions, have their threads cleaned then have LOCTITE 243 (BLUE) (P/N 293 800 060) applied. Ensure to use only 10.9 grade fasteners.

1. Assemble cage rear section onto vehicle. Do not tighten fasteners.
2. Assemble cage front section onto vehicle. Do not tighten fasteners.
3. Assemble both cage sections together. Do not tighten fasteners.
4. Make sure completed assembly is properly centered without any stressed components. Apply proper torque to all fasteners.

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.

FRONT DRIVE

SERVICE TOOLS

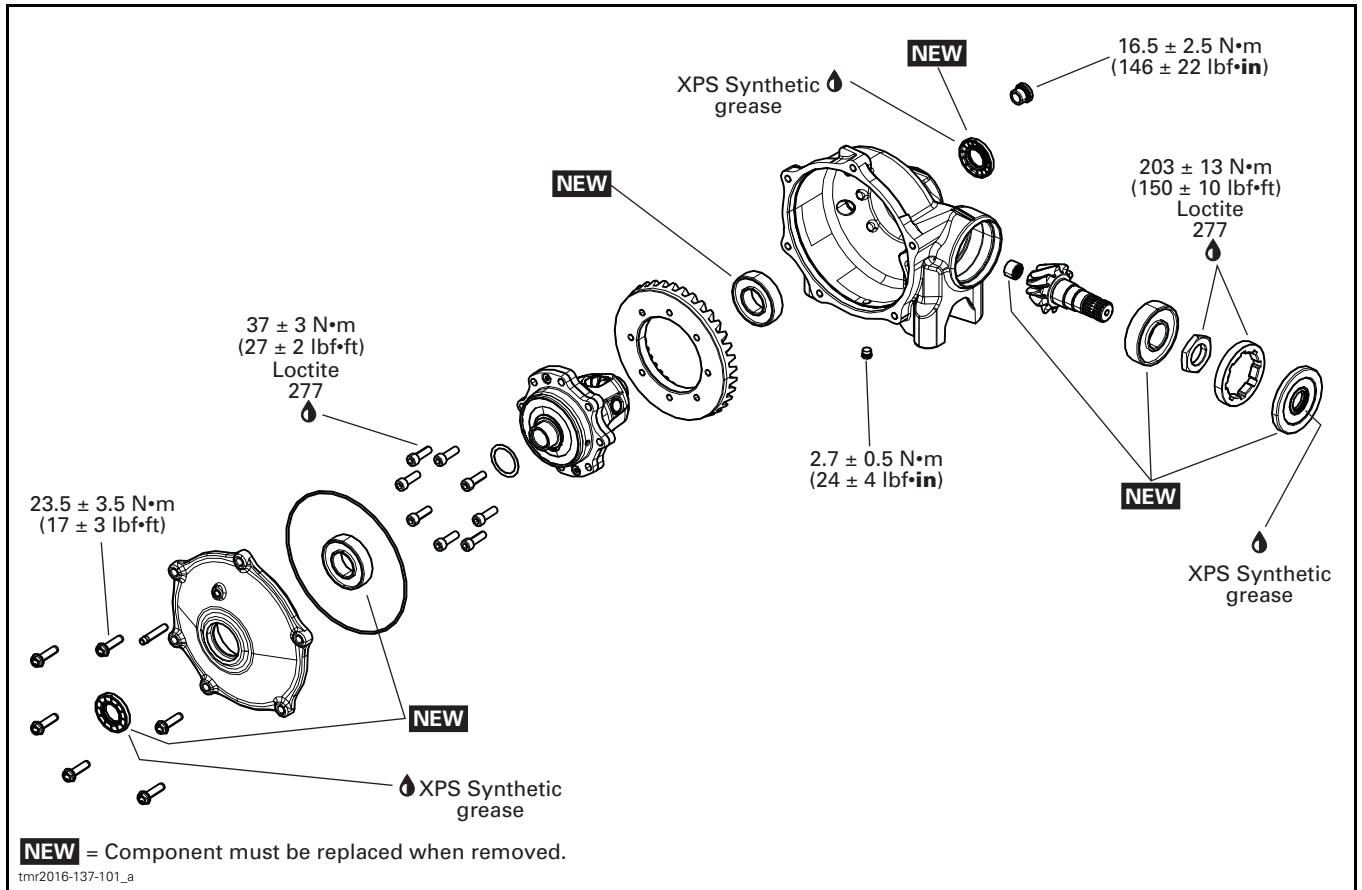
Description	Part Number	Page
CV BOOT CLAMP PLIER	529 036 120	5
CV JOINT EXTRACTOR.....	529 036 005	5

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 277	293 800 073	12
XPS SYNTHETIC GREASE.....	293 550 010	5–6, 12



FRONT DIFFERENTIAL



GENERAL

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

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.

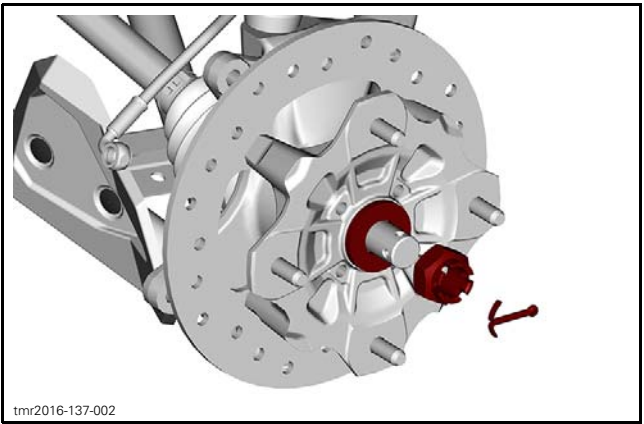
NOTE: If the pump was disassembled, its viscous fluid would be lost and it could not be replaced.

PROCEDURES

WHEEL HUB

Removing the Wheel Hub

- 1. Lift and support vehicle. Refer to *INTRODUCTION* section for proper procedure.
- 2. Select the 4WD position and place the transmission lever on "P".
- 3. Remove caliper from knuckle. Refer to *BRAKES* subsection.
- 4. Remove the following parts:
 - Wheel
 - Cotter pin
 - Castellated nut
 - Belleville washer.



- 5. Remove wheel hub.

Inspecting the Wheel Hub

Check wheel studs for damaged threads and over-all conditions

Check wheel hub for cracks or other damages.

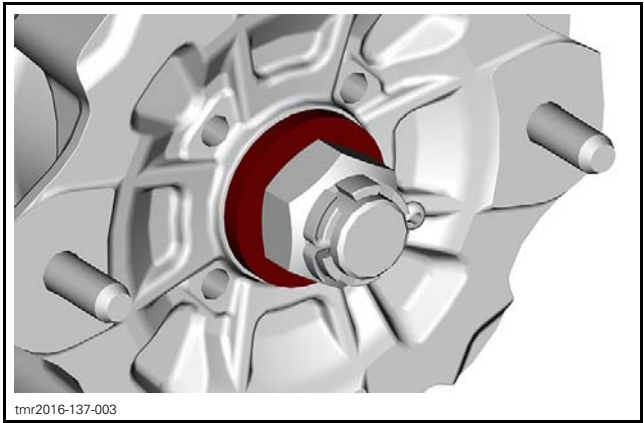
Check inner splines for wear or other damages.

Replace wheel hub and / or studs if any damage is detected.

Installing the Wheel Hub

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

Install Belleville washer with its domed side outwards.



TIGHTENING TORQUE	
Castellated nut	250 N•m ± 15 N•m (184 lbf•ft ± 11 lbf•ft)

NOTE: Tighten further castellated nut if required to align grooves with drive shaft hole.

Install a new cotter pin.

FRONT DRIVE SHAFT

Removing the Front Drive Shaft

- 1. Remove the wheel hub. Refer to procedure in this subsection.
- 2. Remove the knuckle. Refer to *STEERING SYSTEM* subsection.
- 3. Strongly pull drive shaft out of differential.
- 4. Discard the stop ring at the end of the shaft.

Inspecting the Front Drive Shaft

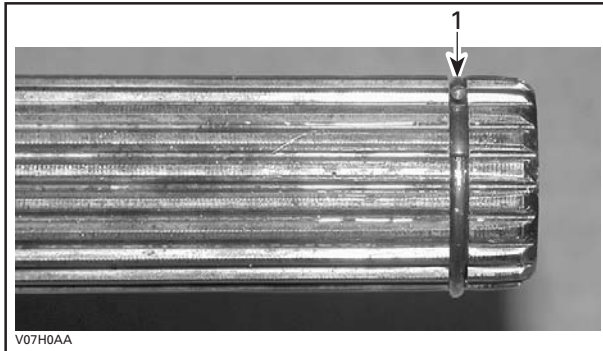
Inspect the condition of boots. If there is any damage or evidence of leaking lubricant, replace them. Refer to *DRIVE SHAFT BOOT*.

Check splines for excessive wear. Replace if necessary.

NOTE: If the splines on plunging joint are worn, a check of differential inner splines should be done.

Installing the Front Drive Shaft

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.

DRIVE SHAFT BOOT

Removing the Drive Shaft Boot

1. Remove the drive shaft from the vehicle.
2. Remove drive shaft boot clamps.

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

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

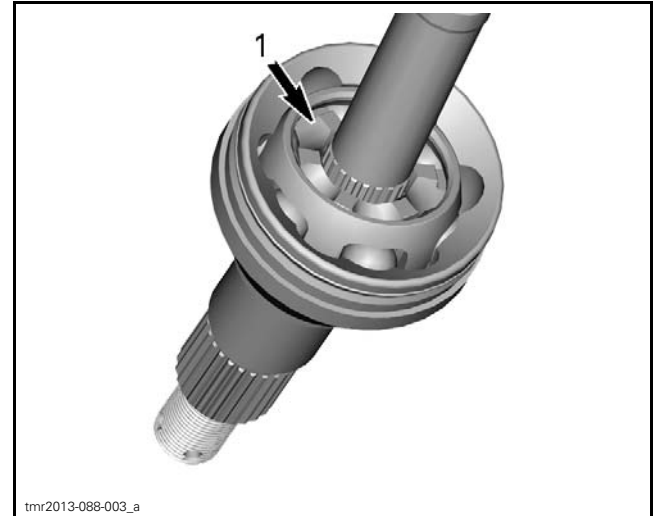
Without the Special Tool

1. Clamp joint housing in a vise.
2. Align shaft with joint.
3. Pull hard on shaft to remove from joint.
4. Remove boot from drive shaft.
5. Remove and discard the circlip.

With the Special Tool

REQUIRED TOOL	
CV JOINT EXTRACTOR (P/N 529 036 005)	

1. Place drive shaft in vice with the joint downward.
2. Install the cv joint extractor on the bearing.



TYPICAL - CV JOINT SHOWN

1. Position joint extractor tool here

3. With a hammer, hit on the tool to separate joint from shaft.
4. When joint and shaft are separated, remove boot from drive shaft.
5. Remove and discard the circlip.

Installing the Drive Shaft Boot

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

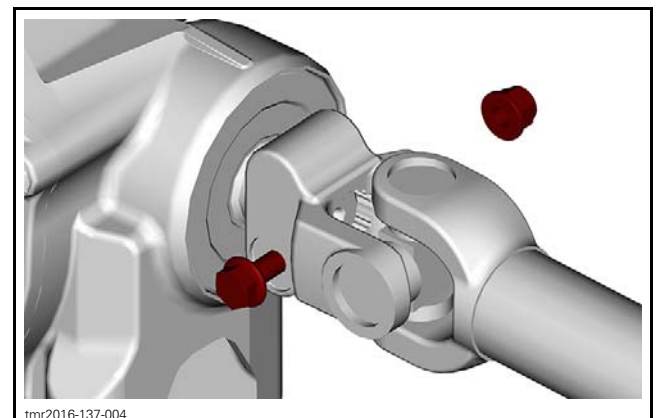
Pack bearing area with grease included with the new boot kit.

NOTE: Do not use or add other grease.

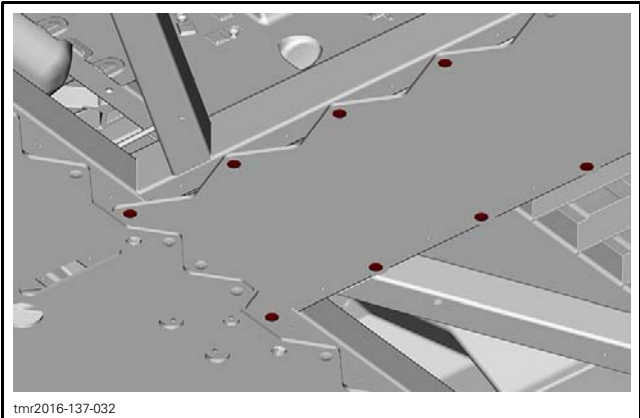
FRONT PROPELLER SHAFT

Removing the Front Propeller Shaft

1. Remove propeller shaft screw and nut on differential end.



2. Remove the 4 first row of rivets on the central skid plate starting from the rear.



- 3. Dislodge the propeller shaft from the differential side first by pushing it towards the engine. When it is disengaged from the differential, move it towards front, beside the differential to disengage from the engine.
- 4. Remove front propeller shaft through skid plate opening.



Inspecting the Front Propeller Shaft

Inspect if propeller shaft is not bent or twisted.
Check propeller shaft splines for wear or damage.
Check both U-joint crosses. They should rotate smoothly without any play.
Replace if required.

Installing the Front Propeller Shaft

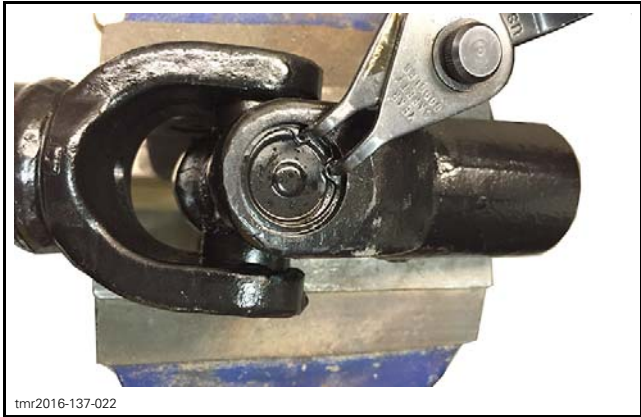
The installation is the reverse of the removal procedure. However, pay attention to the following.
Apply XPS SYNTHETIC GREASE (P/N 293 550 010) to splines on engine side.

TIGHTENING TORQUE	
Propeller shaft nut	31.5 N•m ± 3.5 N•m (23 lbf•ft ± 3 lbf•ft)

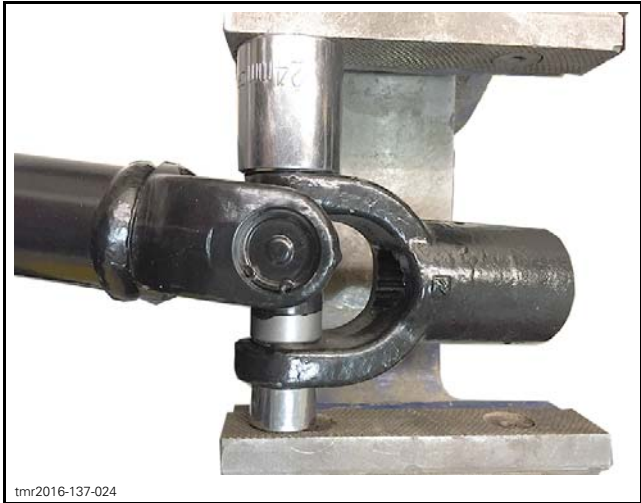
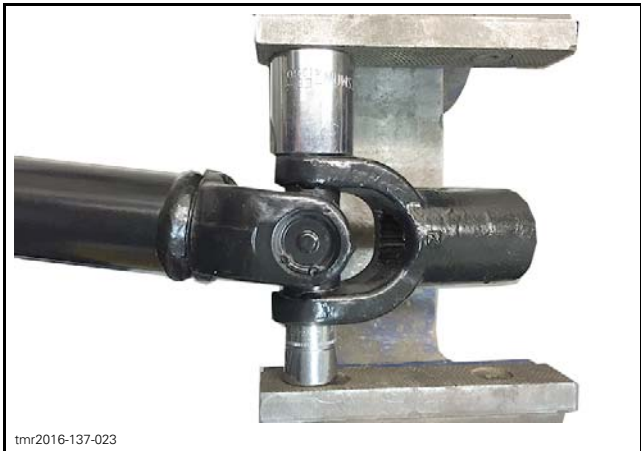
PROPELLER SHAFT U-JOINTS

Removing the Propeller Shaft U-Joint

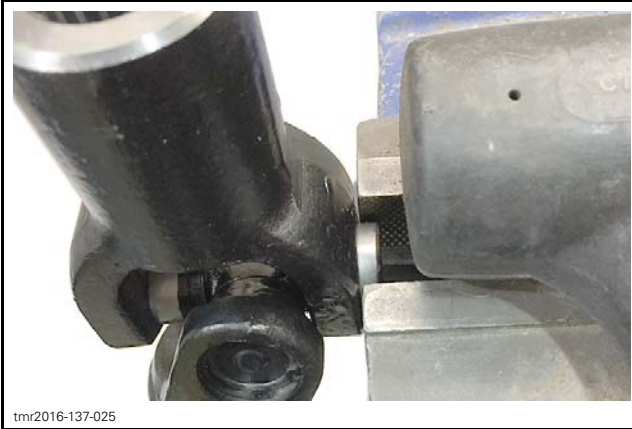
- 1. Remove internal snap ring from bearing caps.



- 2. In a vice, use a suitable box to lock the yoke on one side, and a smaller one to push on the U-joint cross on the other side..



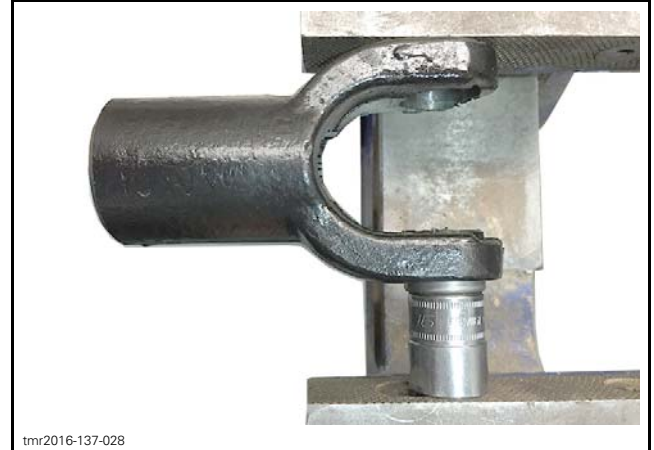
- 3. Squeeze the bearing cap in vice and hit the yoke with a soft hammer to remove it.



4. Press the cross on the other side of the yoke to disengage it.



5. Remove bearing cap.

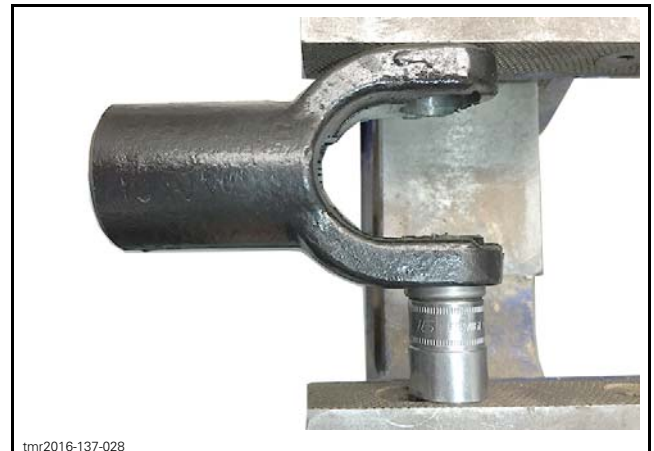


6. Repeat steps to remove the remaining bearing caps.
7. Remove U-joint cross.



Installing the Propeller Shaft U-Joint

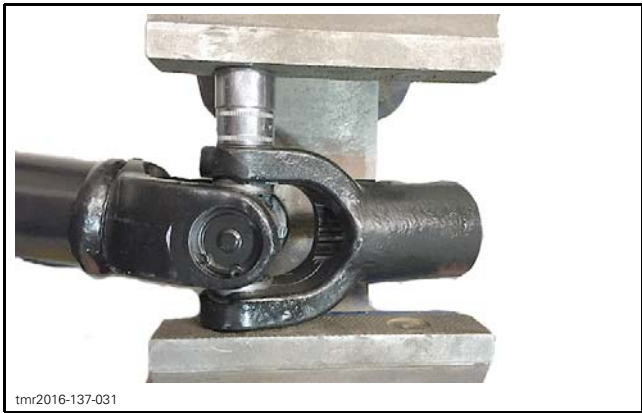
1. Use a vise to insert the first bearing cap flush with the inner wall of the yoke.



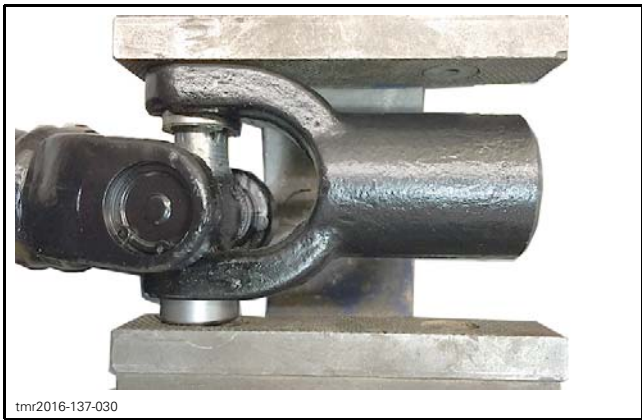
2. Install new U-joint cross in yoke and slide it in the bearing cap.

NOTICE Ensure bearing needles are perfectly positioned in caps to avoid damage to cross.

3. Fully seat bearing cap on one side.



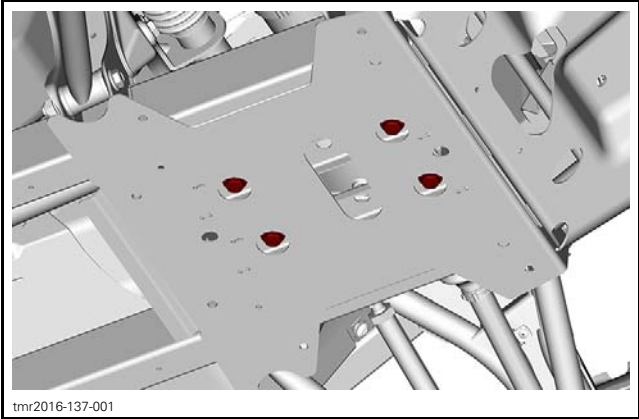
- 4. Install snap ring.
- 5. Install the second bearing cap, then snap ring.



Ensure U-joint is operating smoothly.

FRONT DIFFERENTIAL
Removing the Front Differential

- 1. Drain the differential. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
- 2. Remove both drive shafts. Refer to *REMOVING THE FRONT DRIVE SHAFT* procedure in this subsection.
- 3. Remove front bumper. Refer to *FRAME* subsection.
- 4. Remove the 4 retaining screws from the bottom skid plate.



- 5. Remove the differential with the propeller shaft from the front of vehicle.
- 6. Remove the propeller shaft if required.

Inspecting the Front Differential (Assembled)

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

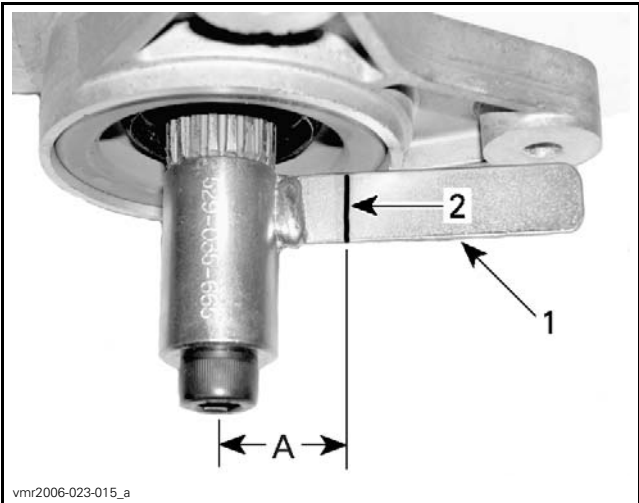
Backlash Inspection

When measuring backlash, the differential cover should be upside down to pull the ring gear out of mesh.

- 1. Measure the backlash with a dial indicator.

REQUIRED TOOL
Backlash measurement tool (P/N 529036387)

- 2. Place the backlash measurement tool at the end of pinion gear.
- 3. From center of pinion shaft, measure 23 mm (29/32 in) and scribe a mark on the tab.



- 1. Tab of backlash measurement tool
- 2. Mark on tab
- A. 23 mm (29/32 in)

4. Position the dial indicator tip against the tab at a 90° angle and right on the previously scribed mark.
5. Gently, move the tab back and forth. Note the result.

NOTE: While measuring the backlash, make sure the ring gear is not moving.

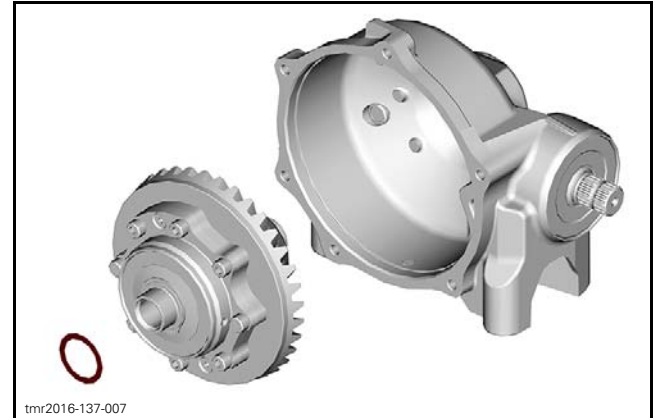


6. Rotate pinion gear 1/2 turn and check backlash again. Note the result.
7. Rotate pinion gear 1 turn and check backlash again.

BACKLASH SPECIFICATION
0.1 mm (.004 in) to 0.25 mm (.01 in)

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

BACKLASH ADJUSTMENT GUIDELINE	
BACKLASH MEASUREMENT	WHAT TO DO
Below 0.1 mm (.004 in)	Remove shim(s) and recheck backlash
Above 0.25 mm (.01 in)	Add shim(s) and recheck backlash



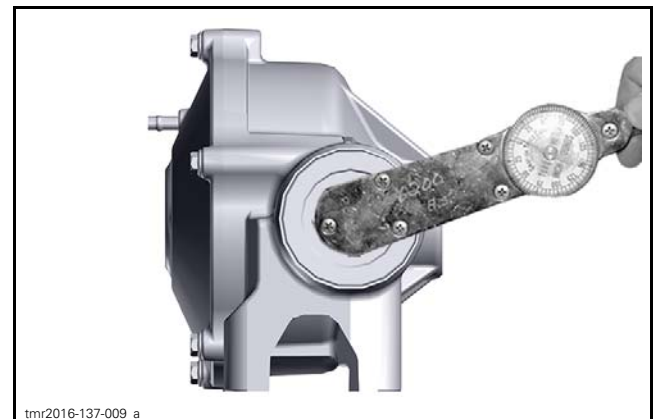
BACKLASH SHIM

Preload Inspection

Install the spline adapter tool on the pinion shaft.

REQUIRED TOOL
Spline driver (P/N 529036386)

Using a needle torque wrench, measure the drag torque.



PRELOAD SPECIFICATION
Maximum 0.50 N•m (4 lbf•in)

If preload is out of specification, split front differential housing and check all bearings conditions.

Front Differential Disassembly

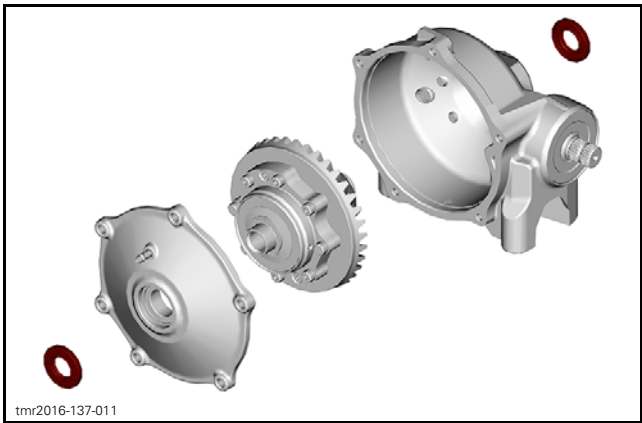
Differential Housing

1. Remove front differential housing screws.

Subsection XX (FRONT DRIVE)

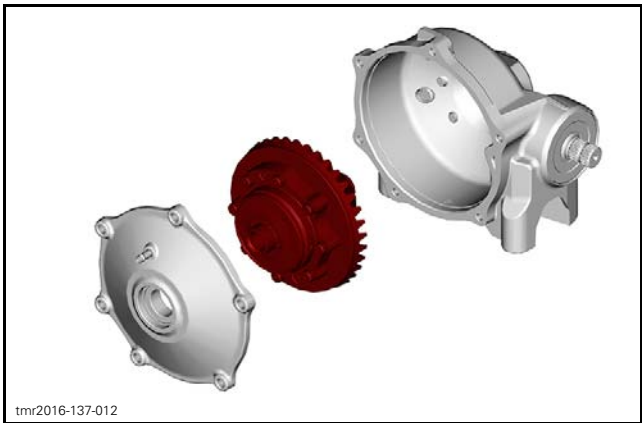


- 2. Separate half housings.
- 3. Remove oil seals.

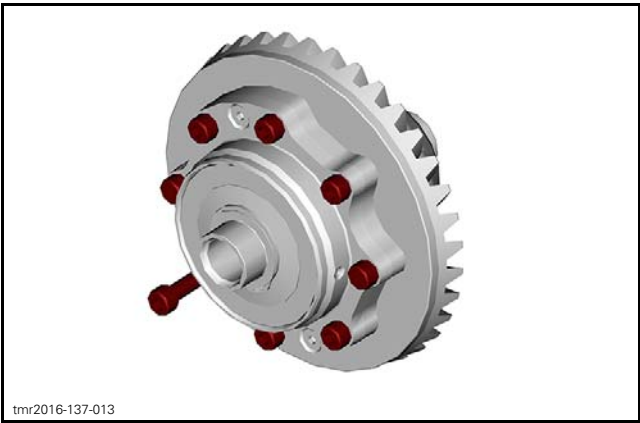


Visco-Lok Carrier/Ring Gear

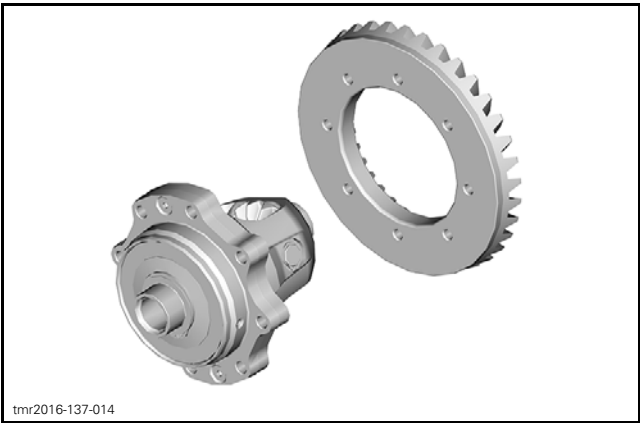
- 1. Remove Visco-Lok carrier/ring gear out of half housing.



- 2. Remove screws securing ring gear to Visco-Lok unit.



- 3. Separate ring gear from Visco-Lok unit.



Pinion Gear

REQUIRED TOOL
Multifunctional differential tool (P/N 529036385)
Spline driver (P/N 529036386)

- 1. Remove and discard oil seal.



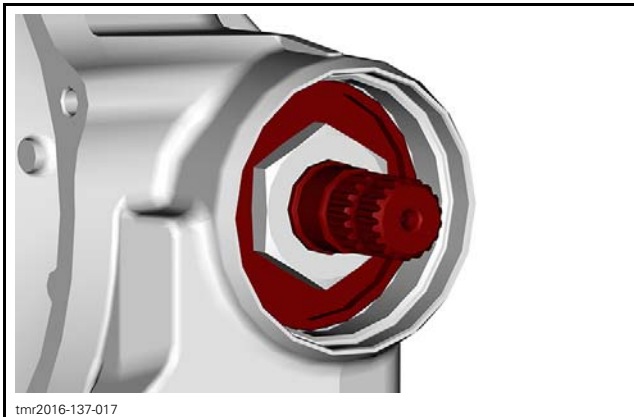
- 2. Unscrew the pinion nut.
 - 2.1 Lock the multifunctional tool with the pinion driver.
 - 2.2 Slide the tools until it engage the nut.

2.3 Unscrew the nut.



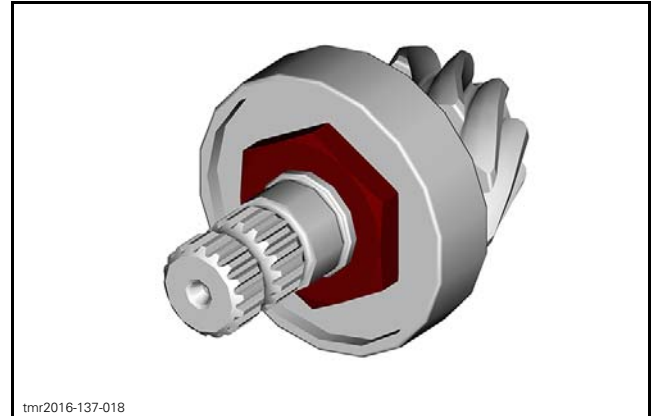
3. Remove bearing and pinion gear together.

NOTE: If pinion is hard to pull out, attach the propeller shaft to it and pull while hitting the yoke with a soft hammer.

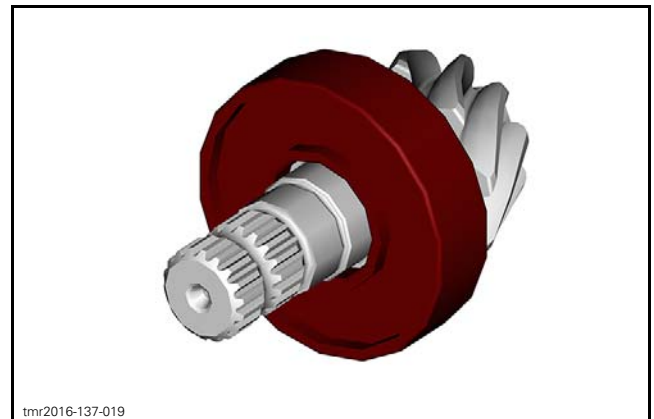


4. Remove nut from pinion.

- 4.1 Install the multifunctional tool in a vice.
- 4.2 Slide the spline driver on the pinion shaft.
- 4.3 Slide the pinion and the spline driver in the multifunctional tool until the nut is engaged.
- 4.4 Turn the spline driver clockwise to unscrew the pinion.



5. Remove bearing from pinion gear.



6. Remove and discard the needle bearing.

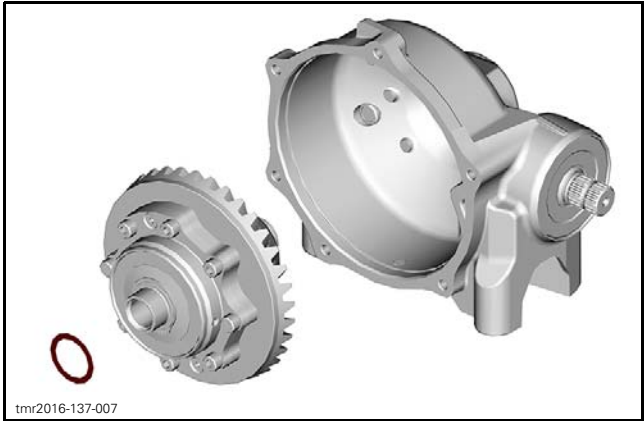
Front Differential Assembly

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

- Pinion gear
- Ring gear
- Viscolok unit
- Housing.

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

RECOMMENDED SHIM THICKNESS	
BACKLASH	0.5 mm (.02 in) (as a preliminary adjustment)



BACKLASH SHIM

Prior to finalizing assembly, proceed in this order:

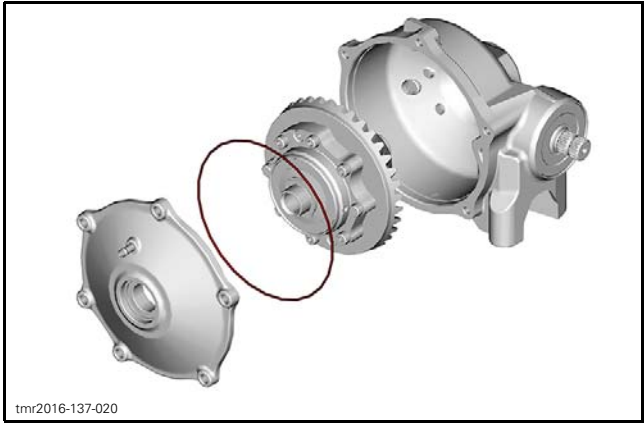
- Temporarily assemble final drive using recommended torques.
- Do not apply thread locker product.
- Do not install a new pinion nut.
- Check backlash.
- Check preload.

Visco-Lok Carrier/Ring Gear

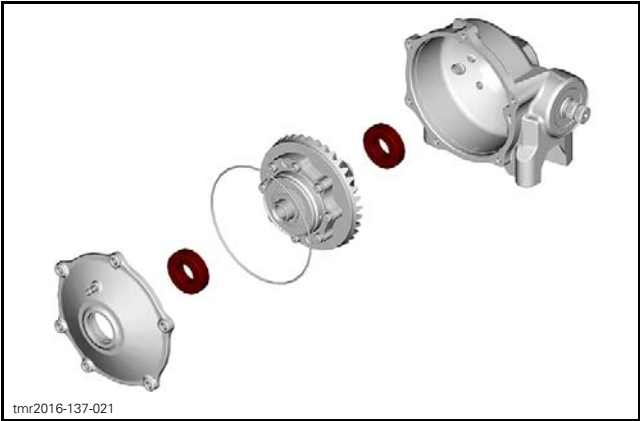
The installation is the reverse of the removal procedure. However, pay attention to the following. Tighten Visco-Lok / ring gear screws to specification.

TIGHTENING TORQUE	
Visco-Lok / ring gear screws	$37\text{ N}\cdot\text{m} \pm 3\text{ N}\cdot\text{m}$ ($27\text{ lbf}\cdot\text{ft} \pm 2\text{ lbf}\cdot\text{ft}$) + LOCTITE 277 (P/N 293 800 073)

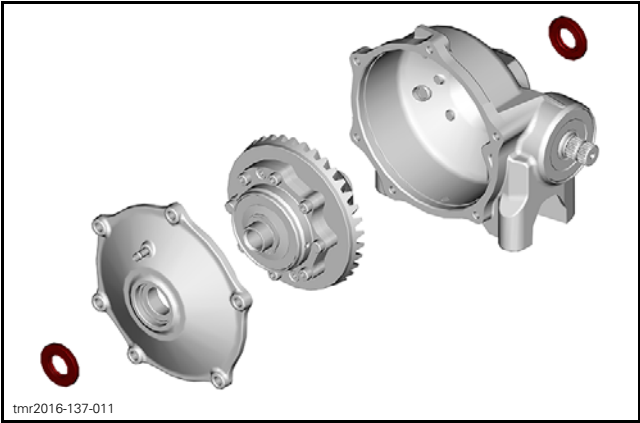
Check condition of seal. Replace if damaged.



Check bearings. Replace with new bearings if necessary.



Apply XPS SYNTHETIC GREASE (P/N 293 550 010) on new oil seals and install.



Tighten differential housing screws to specification.

TIGHTENING TORQUE	
Differential housing screws	$23.5\text{ N}\cdot\text{m} \pm 3.5\text{ N}\cdot\text{m}$ ($17\text{ lbf}\cdot\text{ft} \pm 3\text{ lbf}\cdot\text{ft}$)

Pinion Gear

Install a new ball bearing.

Install a new O-ring.

Install a new needle bearing.

Apply LOCTITE 277 (P/N 293 800 073) to pinion nut.

Install and tighten the pinion nut to specification.

TIGHTENING TORQUE	
Pinion nut (housing and shaft)	$203\text{ N}\cdot\text{m} \pm 13\text{ N}\cdot\text{m}$ ($150\text{ lbf}\cdot\text{ft} \pm 10\text{ lbf}\cdot\text{ft}$) + LOCTITE 277 (P/N 293 800 073)

Apply XPS SYNTHETIC GREASE (P/N 293 550 010) on new oil seal and install.

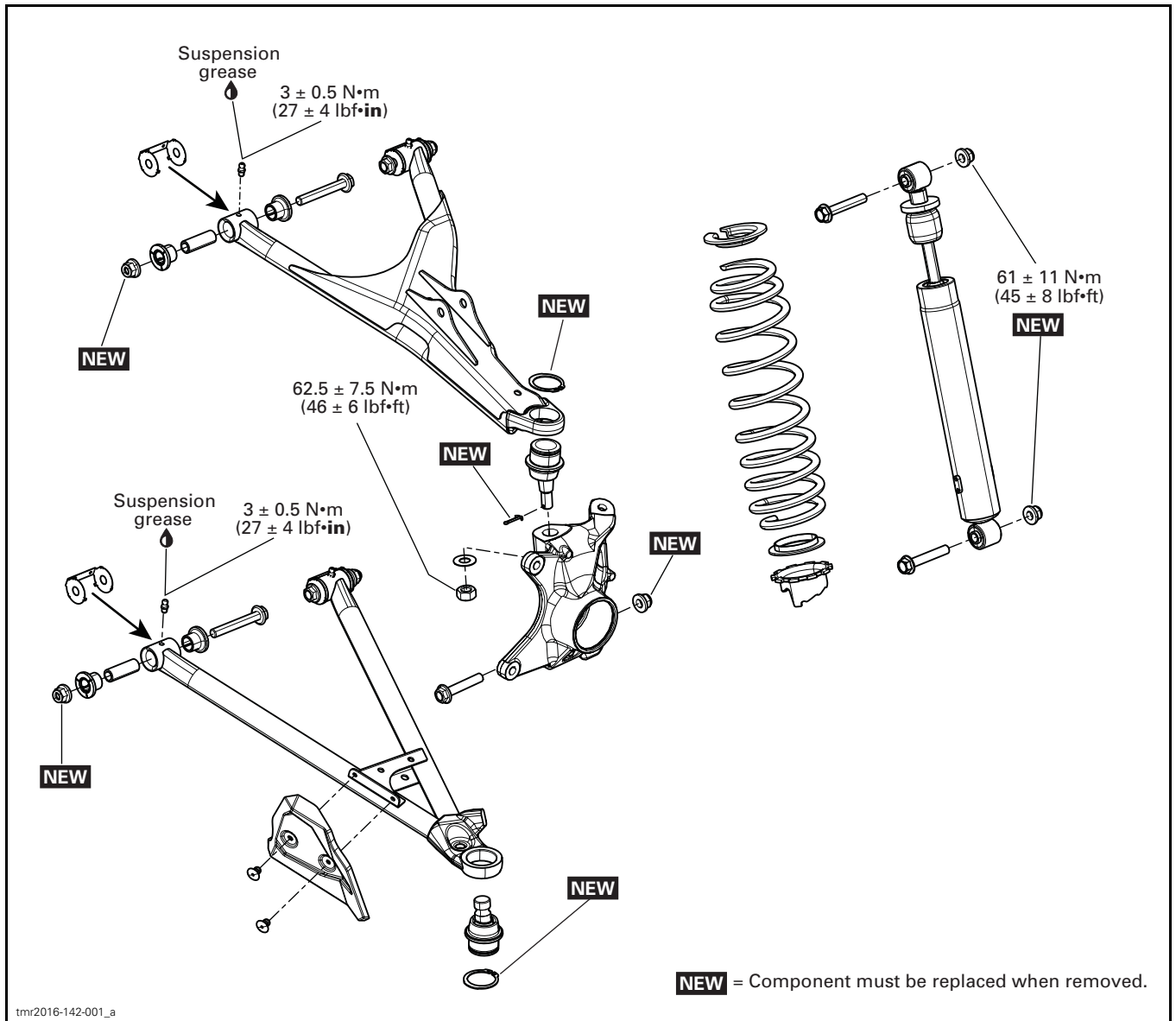
Installing the Front Differential

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

TIGHTENING TORQUE	
Differential retaining screw	65 N•m ± 5 N•m (48 lbf•ft ± 4 lbf•ft)

Refill the front differential with recommended oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

FRONT SUSPENSION



Subsection XX (FRONT SUSPENSION)

GENERAL

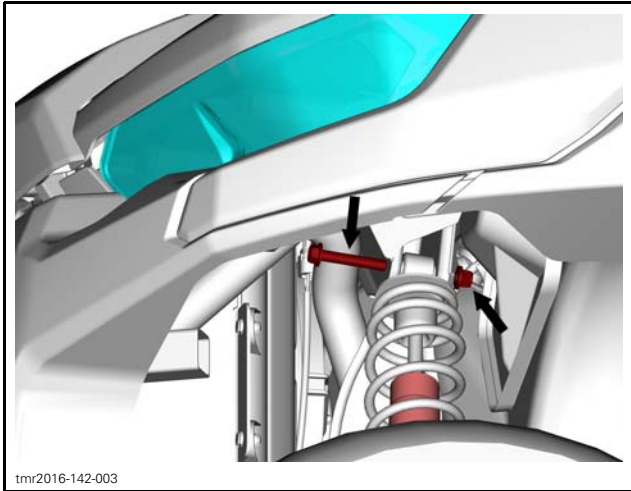
The procedure explained below is the same for the RH and LH sides unless otherwise noted.

PROCEDURES

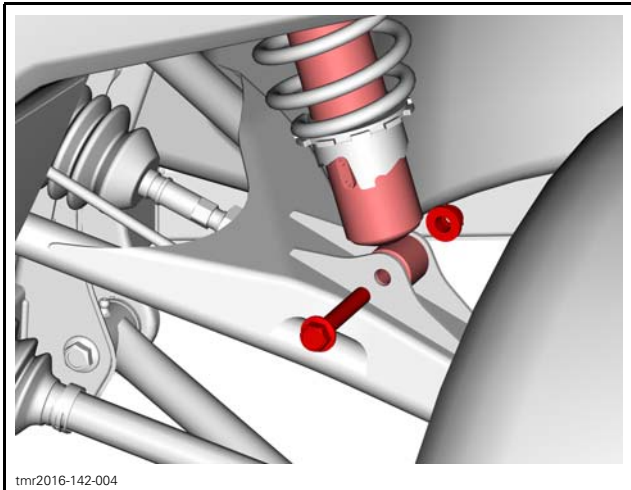
SHOCK ABSORBER

Removing the Shock Absorber

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



LH SIDE SHOWN - UPPER BOLT AND NUT



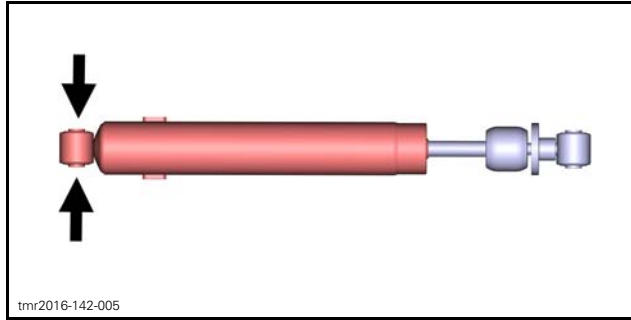
LH SIDE SHOWN - LOWER BOLT AND NUT

3. Remove shock absorber.

Inspect the Shock Absorber

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 - VICE JAWS POSITION

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.

Installing the Shock Absorber

The installation is the reverse of the removal procedure.

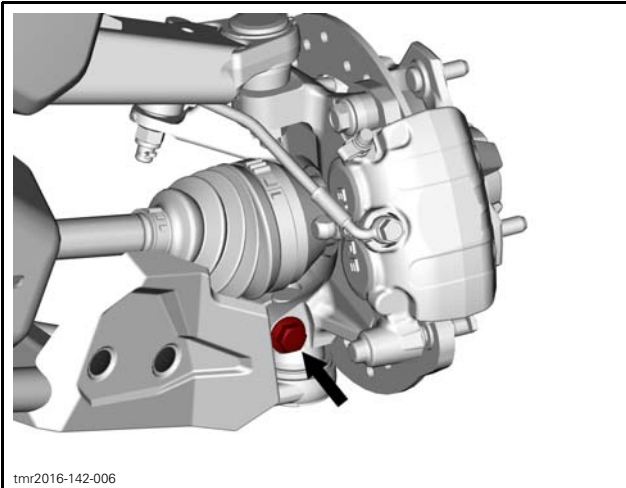
SHOCK ABSORBER SPRINGS

Refer to *SPRINGS* in *REAR SUSPENSION* subsection for complete procedures.

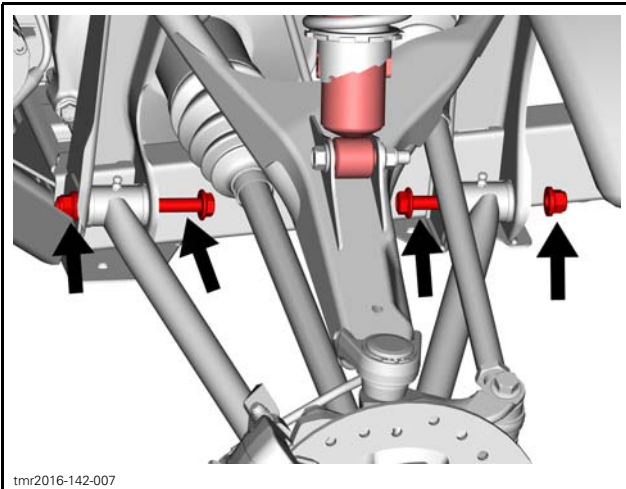
LOWER SUSPENSION ARM

Removing the Lower Suspension Arm

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 bolt and nut securing lower ball joint to knuckle.



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



5. Remove suspension arm.

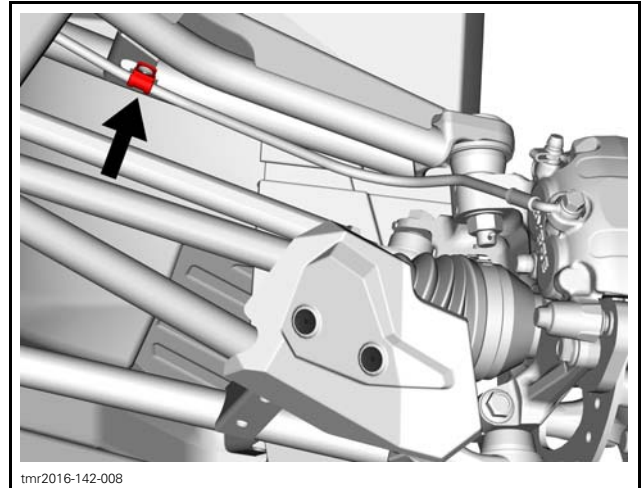
Installing the Lower Suspension Arm

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

UPPER SUSPENSION ARM

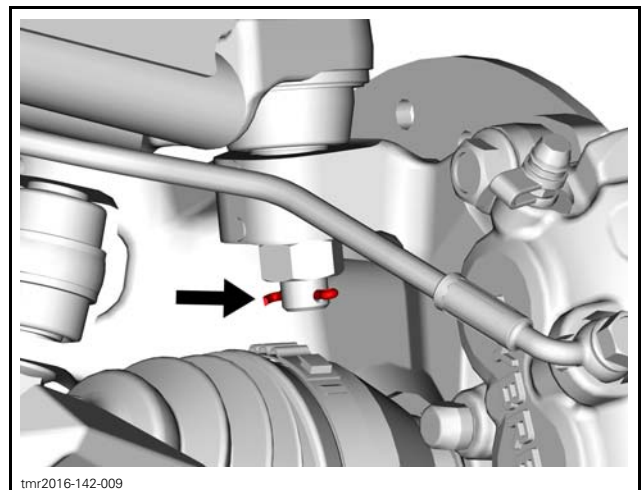
Removing the Upper Suspension Arm

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 the clamp retaining brake hose from the suspension arm.

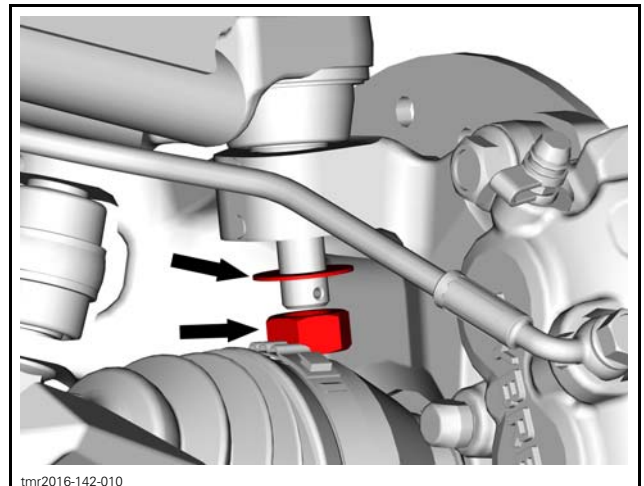


BRAKE HOSE CLAMP

4. Remove and discard cotter pin retaining ball joint.



5. Remove ball joint nut and washer.



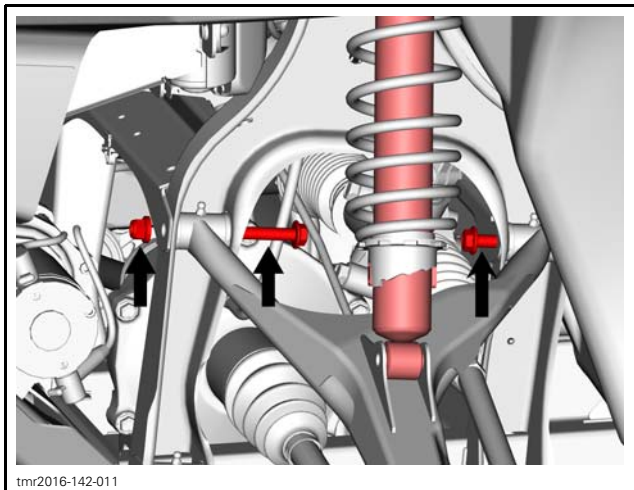
6. Using a plastic hammer, carefully hit on the knuckle side to separate ball joint from knuckle.

Subsection XX (FRONT SUSPENSION)

NOTE: A ball joint remover can be used if the ball joint is jammed into knuckle.

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

7. Remove the lower bolt securing the shock absorber.
8. Remove fasteners securing suspension arm to frame.



9. Remove suspension arm.

Installing the Upper Suspension Arm

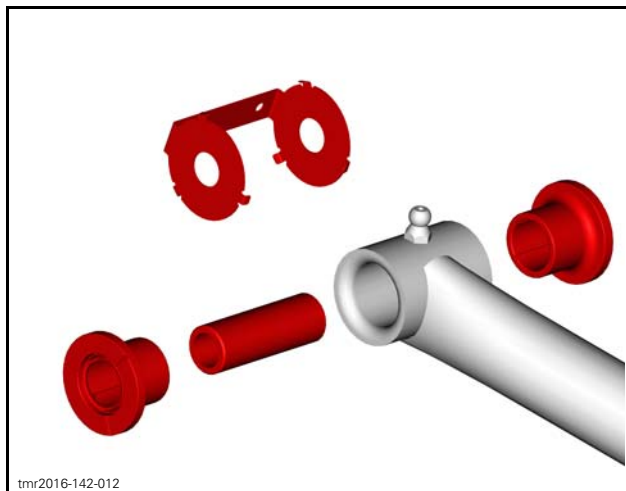
The installation is the reverse of the removal procedure. However, pay attention to the following. Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

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

SUSPENSION ARM BUSHINGS

Removing the Suspension Arm Bushings

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



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TYPICAL

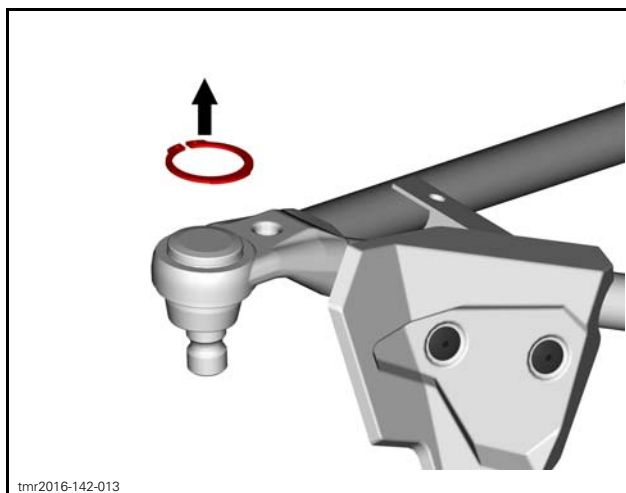
Installing the Suspension Arm Bushings

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

BALL JOINTS

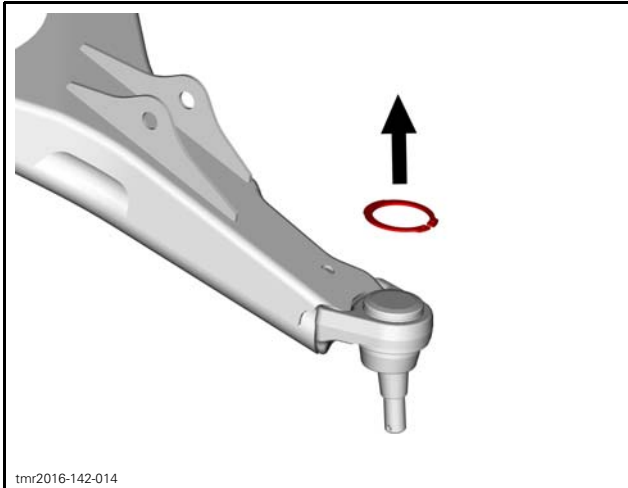
Removing the Ball Joint

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



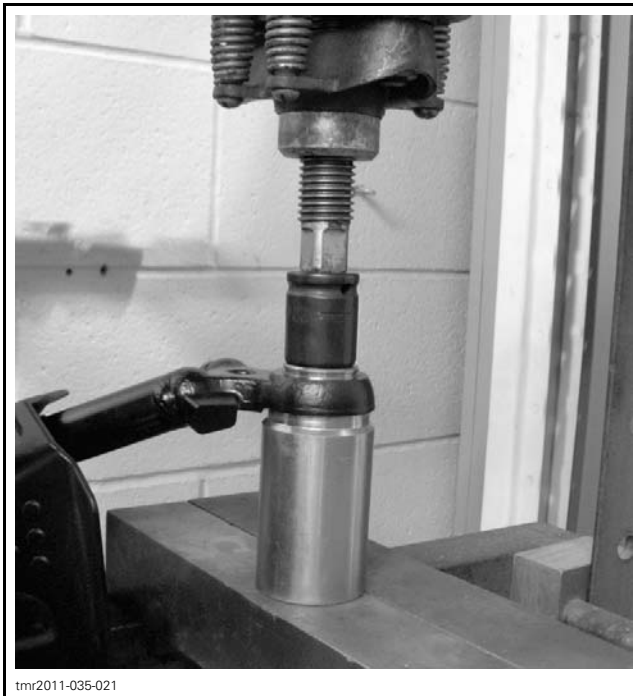
tmr2016-142-013

LOWER BALL JOINT



UPPER BALL JOINT

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.

Installing the Ball Joint

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

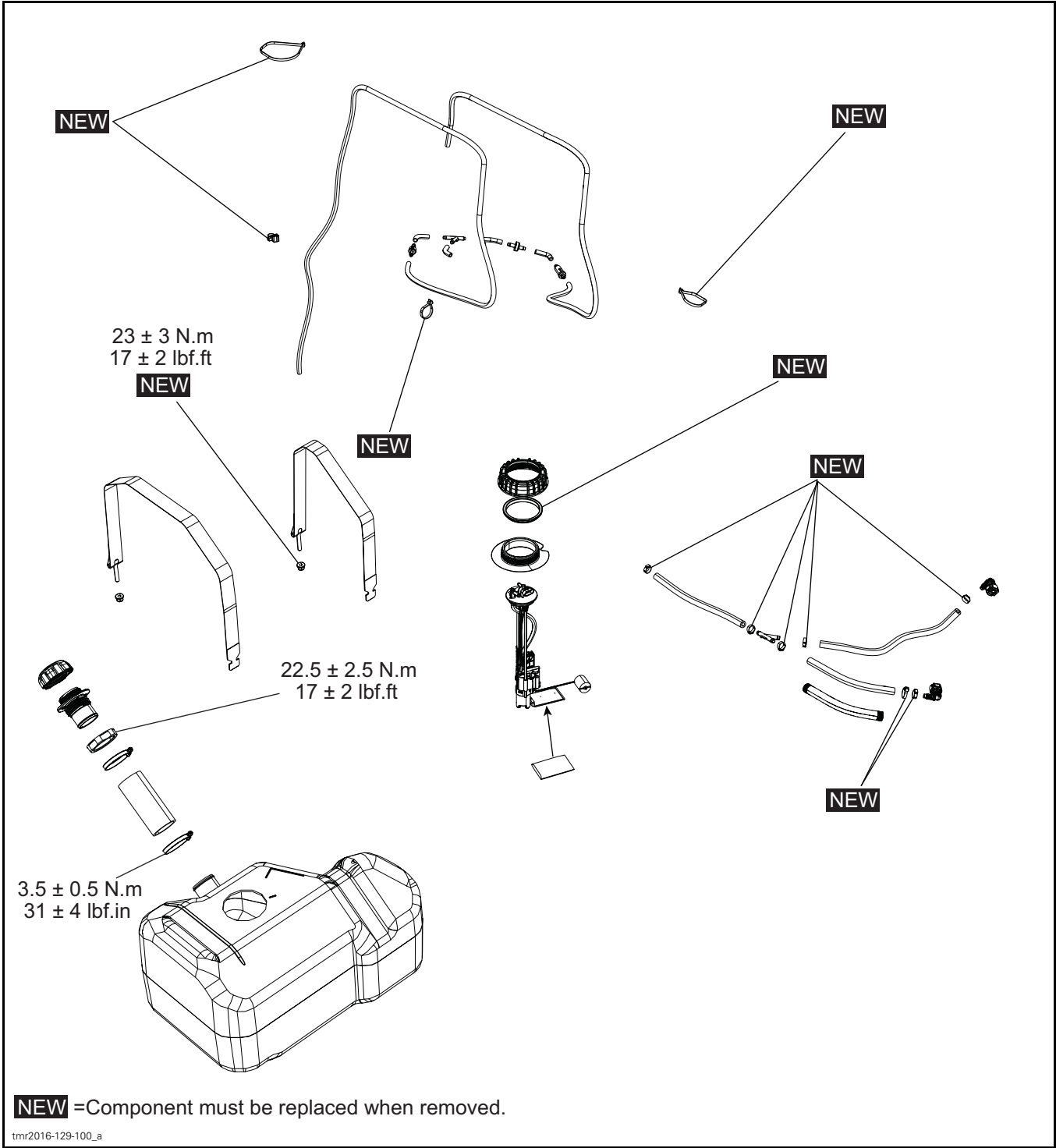
SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	8
FUEL HOSE ADAPTER.....	529 036 023	5
FUEL PUMP NUT TOOL	529 035 899	9
OETIKER PLIER.....	295 000 070	7
PRESSURE GAUGE.....	529 035 709	5
SMALL HOSE PINCHER	295 000 076	13
VACUUM/PRESSURE PUMP	529 021 800	4, 13

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBE	TP88	8

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 disconnecting a fuel system pressure hose.

⚠ 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.

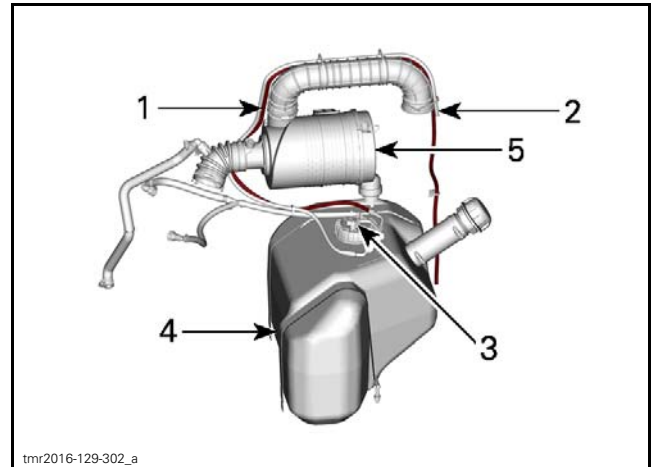
When the repair is completed, ensure that all hoses are connected and secured. Perform the *FUEL PRESSURE TEST* and the *FUEL TANK LEAK TEST* as explained in this subsection.

Fuel lines remain under pressure at all times. Proceed with care when removing/installing high pressure test equipment.

SYSTEM DESCRIPTION

Fuel Tank Vent System

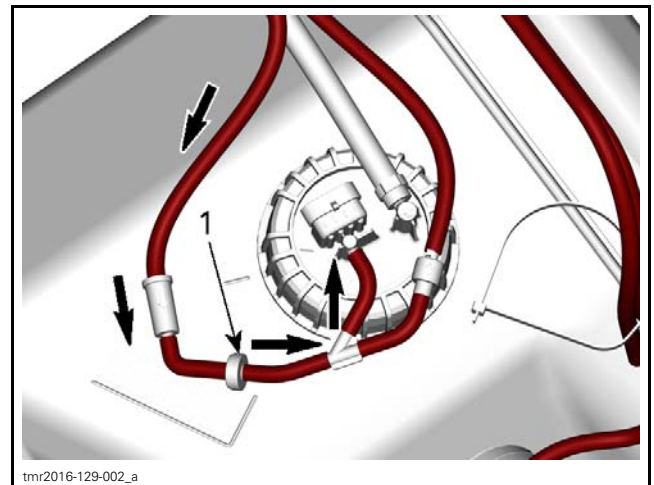
The fuel tank is equipped with a vent system that provides over pressure relief and negative pressure relief of the fuel tank.



TYPICAL - FUEL TANK VENT SYSTEM

1. Vent hose
2. Vent system hose inlet
3. Vent system connected to fuel pump
4. Fuel tank
5. Engine air intake system

Air can enter the fuel tank at all times through the vent system INLET check valve. This prevents negative pressure within the fuel tank which could cause fuel starvation.

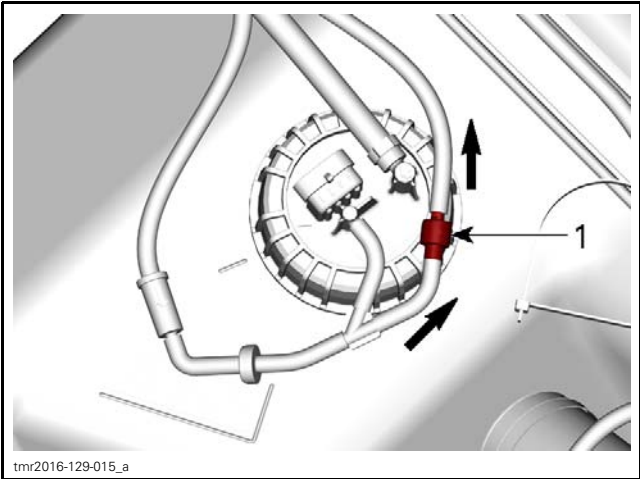


TYPICAL - AMBIENT AIR PRESSURE IN

1. Vent inlet check valve

The vent inlet check valve also prevents fuel from flowing out through the inlet of the vent system.

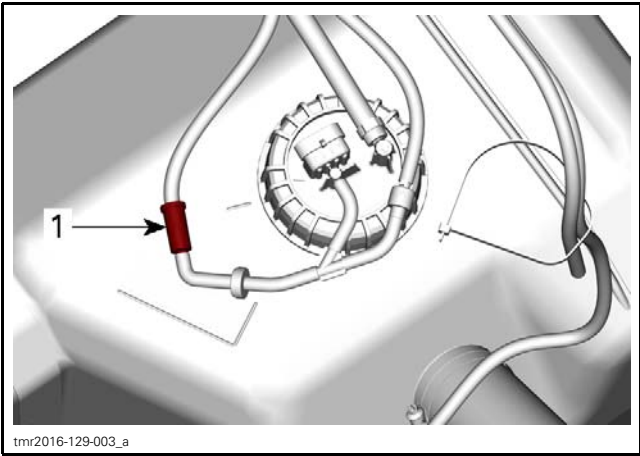
If the pressure in the fuel tank builds up and exceeds 2.5 kPa - 7.6 kPa (.36 PSI - 1.1 PSI), the pressure relief valve opens and lets the excess pressure evacuate through the vent system OUT-LET hose.



TYPICAL - OVER PRESSURE RELIEF
1. Outlet pressure relief valve

Fuel Tank Vent Breather Filter

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 next to the fuel pump, on the inlet hose, before the air inlet check valve.



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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 pump pre-filter
- Fuel pressure regulator
- Fuel level sender.

Fuel Filters

The system comprises one level of filtration:

- A replaceable pre-filter element attached to the bottom of the fuel pump.

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

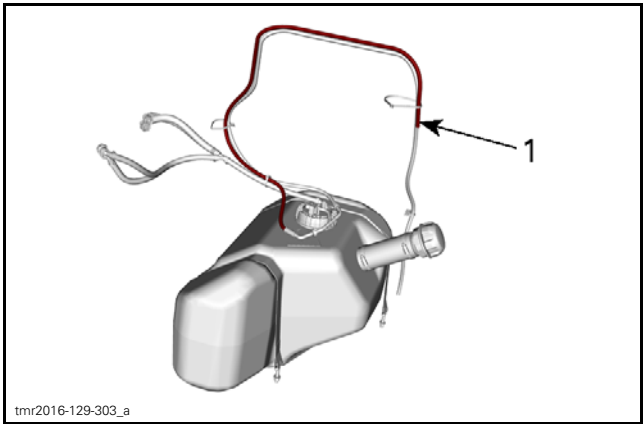
FUEL TANK LEAK TEST

 **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. Pressurize the fuel tank through the vent hose.

REQUIRED TOOL	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	



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1. Fuel tank vent hose inlet

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

If pressure drops, locate fuel leak(s) and repair or replace leaking component(s).

To locate a leak, check for a fuel smell or leaking fuel.

To ease locating leak(s), spray soapy water on all hose connections and components; bubbles will indicate the leak location(s).

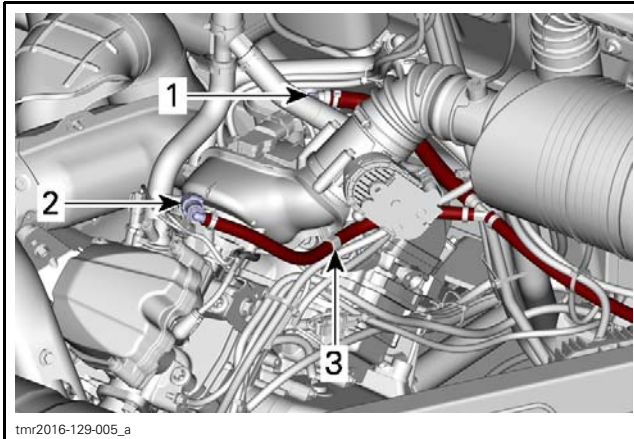
FUEL SYSTEM PRESSURE TEST

The pressure test will show the available pressure in the system. It validates the pressure regulator and the fuel pump, and allows for checking the fuel system for leaks (high pressure side).

Ensure there are no leaks from hoses and fittings. Repair any leaks.

NOTE: Refer to the *FUEL SYSTEM DIAGNOSTIC FLOW CHART* in this subsection to help diagnose a fuel system related problem.

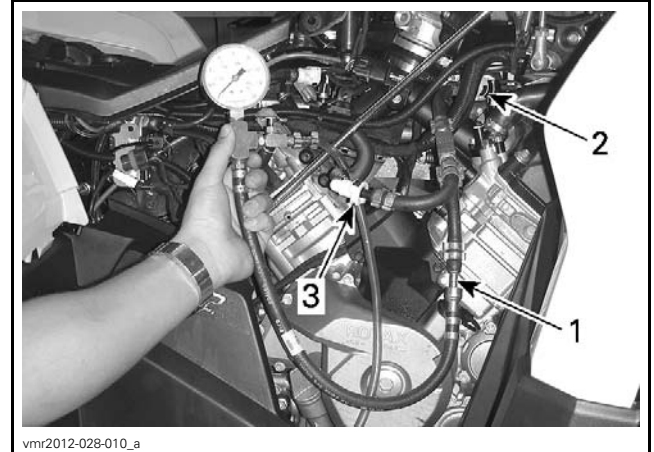
1. Ensure the fuel level in the tank is sufficient.
2. Ensure the battery voltage is over 12 volts.
3. Disconnect fuel pump electric connector
4. Release fuel pressure by running the engine until it runs out of gas.
5. Disconnect both fuel pressure hoses. Refer to *DISCONNECTING A FUEL PRESSURE HOSE* in *FUEL HOSE AND OETIKER CLAMPS*.



1. Front cylinder injector fitting
2. Rear cylinder injector fitting
3. Hose retaining hook

6. Install the fuel pressure gauge and fuel hose adapter between the disconnected injector fitting and fuel rail (in-line installation).

REQUIRED TOOLS	
PRESSURE GAUGE (P/N 529 035 709)	
FUEL HOSE ADAPTER (P/N 529 036 023)	



TYPICAL - PRESSURE GAUGE SETUP

1. Pressure gauge to fuel hose adapter
2. Fuel hose adapter to fuel rail
3. Fuel hose adapter to fuel pump pressure hose

7. Reconnect the fuel pump electric connector. Clear all fault codes using B.U.D.S..
8. Turn ignition key ON and observe fuel pressure.

FUEL PRESSURE (Valid at 12v $\pm$ 0.1v)	350 kPa $\pm$ 10 kPa (51 PSI $\pm$ 1 PSI)
---	--

9. Start engine and observe fuel pressure.
10. Stop engine.
11. Remove test equipment and reconnect fuel hose to injector fuel rail by proceeding in the same manner as for its installation.

Test Conclusion

The fuel pressure should be within specification in static or dynamic tests.

Rapid Pressure Drop

If there is a rapid pressure drop after the engine is stopped, check for leakage at:

- A fuel hose
- A fuel rail.

NOTE: The fuel pump check valve integral to the fuel pump module may also be at fault.

If no leak is detected, replace fuel pump.

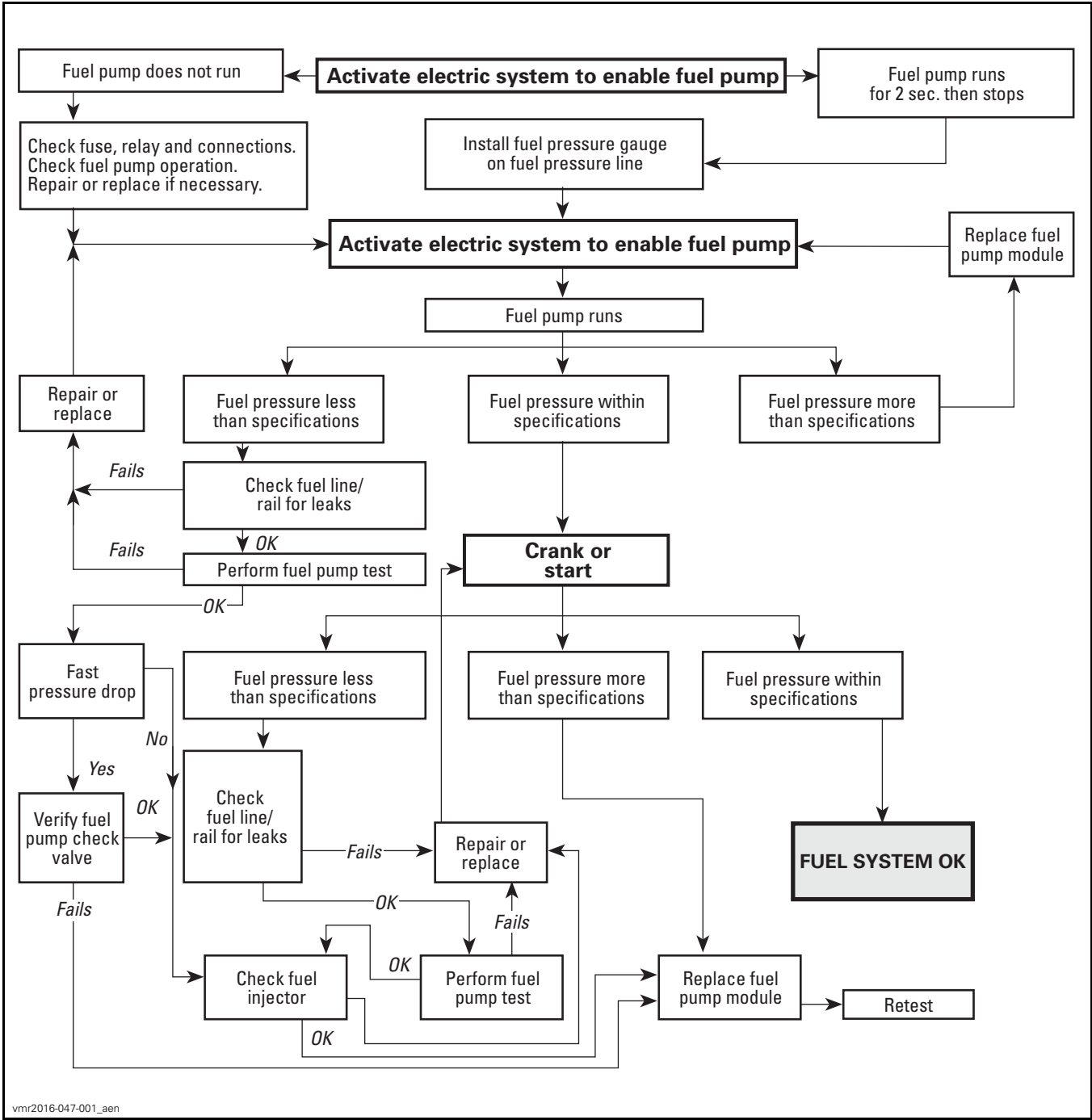
Slow Pressure Drop

If there is a slow pressure drop after the engine is stopped, check for a fuel injector leak. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

NOTE: The fuel pressure regulator or fuel pump check valve integral to the fuel pump module may also be at fault.

If no leak is detected, replace fuel pump.

TROUBLESHOOTING
FUEL SYSTEM DIAGNOSTIC FLOW CHART



PROCEDURES

FUEL HOSE AND OETIKER CLAMPS

Disconnecting a Fuel Pressure Hose

1. Drain fuel tank. Refer to *FUEL TANK DRAINING*.
2. Release fuel pressure by running engine until it runs out of fuel.
3. Carefully disconnect the fuel hose fitting from the injector by pressing on the release tab of the quick disconnect fitting.

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

REQUIRED TOOL	
OETIKER PLIER (P/N 295 000 070)	

FUEL TANK

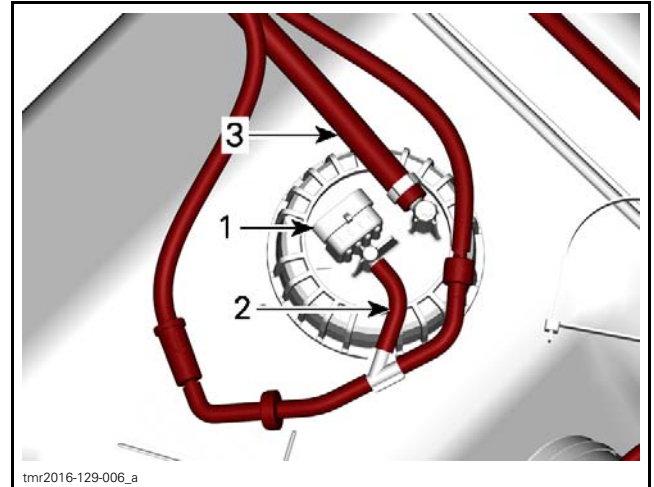
Fuel Tank Draining

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

Fuel Tank Removal

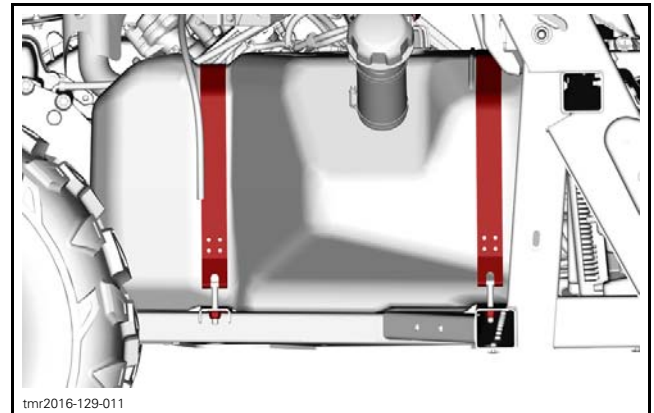
1. Drain fuel tank. Refer to *FUEL TANK DRAINING* in this subsection.
2. Disconnect fuel pressure hoses from the fuel injector fuel rails. Refer to *DISCONNECTING A FUEL PRESSURE HOSE* in *FUEL HOSE AND OETIKER CLAMPS*.

3. Disconnect the following from the fuel pump module:
 - Fuel pump electric connector
 - Fuel system vent hose



1. Fuel pump connector
2. Vent hose
3. High pressure fuel hose

4. Unscrew fuel tank retaining nuts (2) and unhook straps.



5. Loosen fuel filler neck hose clamp.
6. Remove fuel tank.

Fuel Tank Inspection

Inspect fuel tank for any damages or cracks which may result in fuel leaks.

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

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

Use **NEW** retaining nuts.

Subsection XX (FUEL TANK AND FUEL PUMP)

Apply specified torque to fuel tank retaining nuts.

TIGHTENING TORQUE	
Fuel tank retaining nuts	23 N•m ± 3 N•m (17 lbf•ft ± 2 lbf•ft)

Be sure to properly connect and route:

- Fuel tank vent tube
- Fuel pump pressure hose
- Electrical connector.

Refuel tank and ensure there are no leaks by performing a *FUEL TANK LEAK TEST* and a *FUEL PUMP 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.

NOTE: Fuel pump should come ON for a few seconds, then stop.

If fuel pump does not come ON, carry out the following:

- Check fuel pump relay fuse (F5) and Main relay (R2).
- 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.

Fuel Pump Input Voltage Test

1. Disconnect the fuel pump connector.
2. Turn ignition key ON.
3. Read voltage as follows.

NOTE: The fuel pump voltage will be read only when the fuel pump is activated.

REQUIRED TOOLS	
FLUKE 115 MULTIMETER (P/N 529 035 868)	
FLUKE RIGID BACK PROBE (P/N TP88)	

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 FP-4 and battery ground.

If battery voltage is still not read, check the following:

- Fuse (F5)
- Main relay (R2)
- Fuel pump relay input voltage (control and power circuits)
- Fuel pump relay control circuit continuity to ECM-M1
- Wiring and connectors.

Fuel Pump Resistance Test

1. Ensure fuel pump connector is properly connected.
2. Remove main relay (R2).

Disconnect fuel pump connector and measure resistance at fuel pump connector.

FUEL PUMP RESISTANCE TEST (AT FUEL PUMP CONNECTOR)	
Pins 3 and 4	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 fuel pump
- Fuel pump to battery ground.

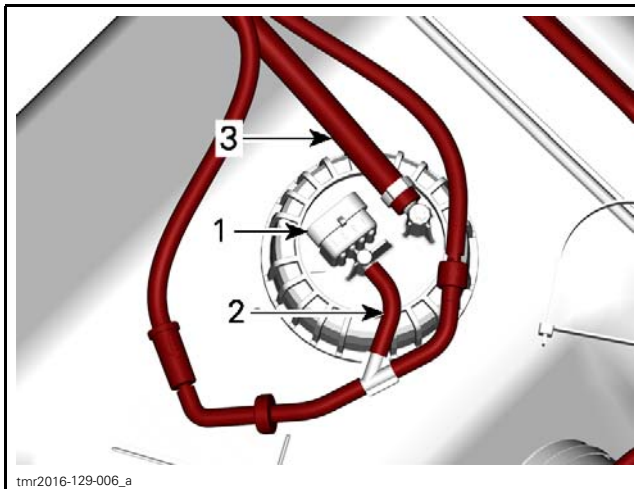
Repair or replace as necessary.

Fuel System Pressure Release

Refer to *DISCONNECTING A FUEL PRESSURE HOSE* in this subsection.

Fuel Pump Removal

1. Release the pressure of the fuel system.
2. Disconnect the following from the fuel pump:
 - Fuel pump electric connector
 - Fuel system vent hose
 - Fuel pump pressure hose.



1. Fuel pump connector
2. Vent hose
3. High pressure fuel hose

3. Remove fuel pump retaining nut.

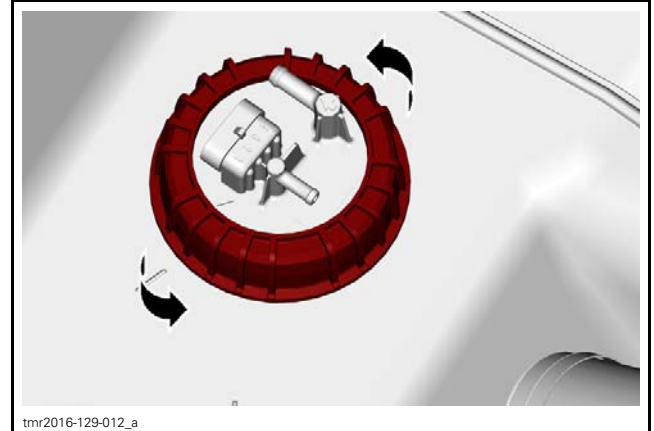
⚠ WARNING

Fuel vapors are flammable and explosive under certain conditions. Use only non-sparking tools.

⚠ CAUTION Replace fuel pump gasket whenever fuel pump retaining nut is loosened.

REQUIRED TOOL

FUEL PUMP NUT TOOL
(P/N 529 035 899)



TYPICAL - FUEL PUMP REMOVAL

1. Fuel pump retaining nut

4. Carefully pull out and rotate fuel pump as required.

NOTICE Pay attention not to damage fuel sender and fuel pump prefilter.

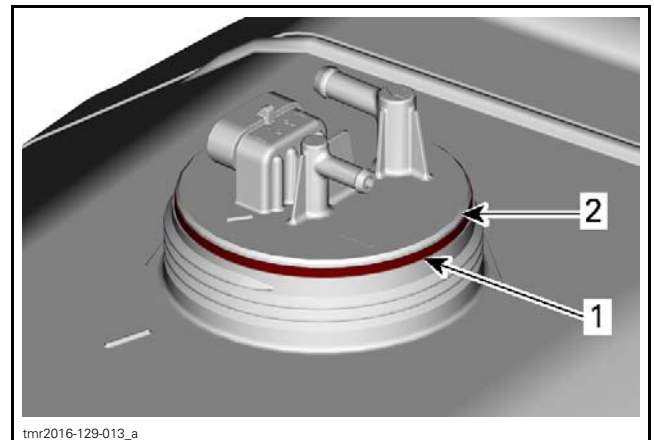
5. Discard gasket ring.
6. Wipe off any fuel spillage.

Fuel Pump Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Rotate fuel pump during insertion as per removal procedure.

⚠ CAUTION Pay attention not to damage fuel sender and fuel pump pre-filter.

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



TYPICAL

1. Gasket ring here
2. Fuel pump flange

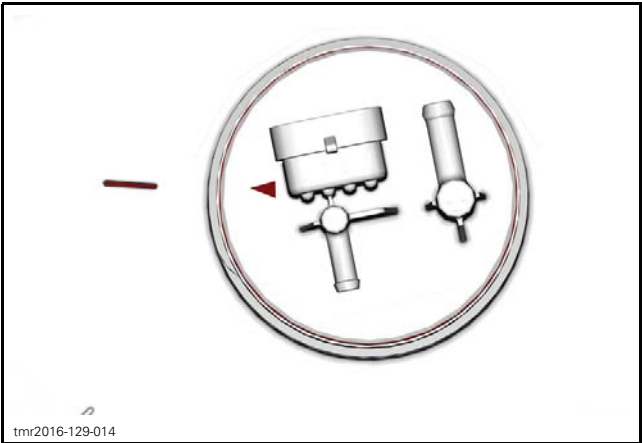
Subsection XX (FUEL TANK AND FUEL PUMP)



WARNING

Ensure gasket ring makes good contact all around fuel pump and fuel pump mounting neck on fuel tank.

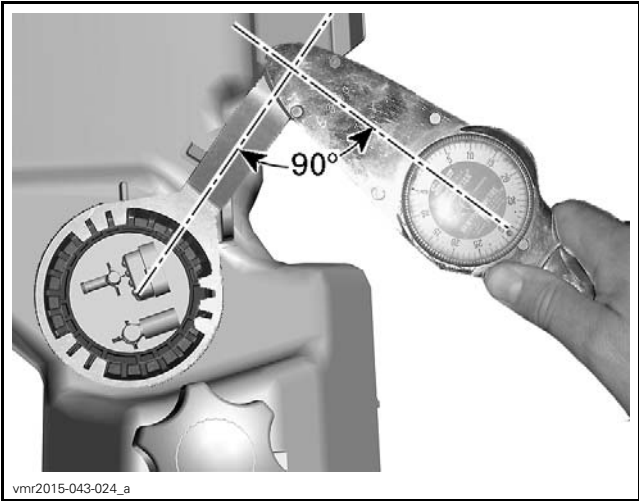
3. Ensure proper fuel pump orientation as in following illustration.



4. Insert fuel pump retaining nut over the fuel pressure hose and electrical wiring connector.
5. While firmly holding pump against tank, engage fuel pump retaining nut on fuel tank flange.

NOTE: If necessary, move the pump in order to ensure the flange is sitting completely flat on the tank.

6. Tighten fuel pump retaining nut to specification.
- 6.1 Ensure pump locking ring is fully engaged.
- 6.2 To apply the proper torque to the fuel pump retaining nut, install the fuel pump nut tool on a torque wrench with it's handle perpendicularly (90°) to the torque wrench.
- 6.3 Ensure pump is properly aligned with index marks after nut it tightened to specification.



TYPICAL - TORQUE WRENCH PERPENDICULAR TO TOOL HANDLE

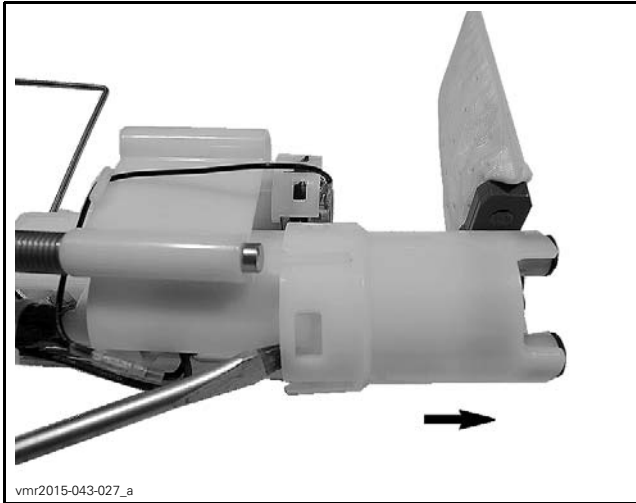
TIGHTENING TORQUE	
Fuel pump retaining nut	29 N•m ± 1 N•m (21 lbf•ft ± 1 lbf•ft)

7. Install fuel pressure hose on fuel pump using a **NEW** Oetiker clamp.
8. Install fuel vent tube on fuel pump.
9. Install electrical connector on fuel pump.
10. Install main relay (R2).
11. Refuel tank and ensure there are no leaks by performing a *FUEL TANK LEAK TEST* and a *FUEL PUMP PRESSURE TEST* as described in this subsection.
12. Check fuel level sender operation.

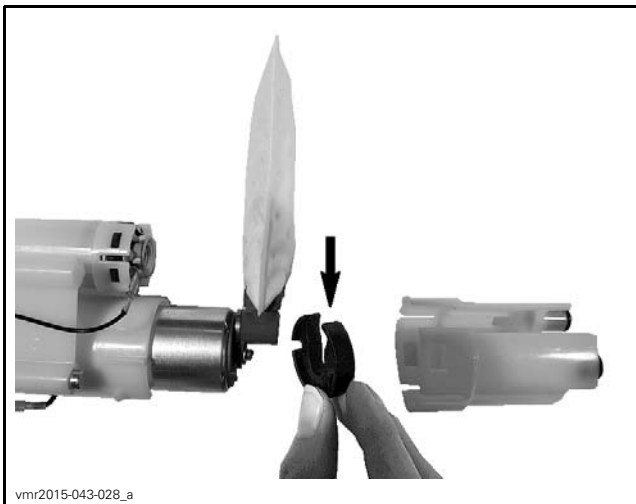
FUEL PUMP PRE-FILTER
(STRAINER)

Fuel Pump Pre-filter Replacement

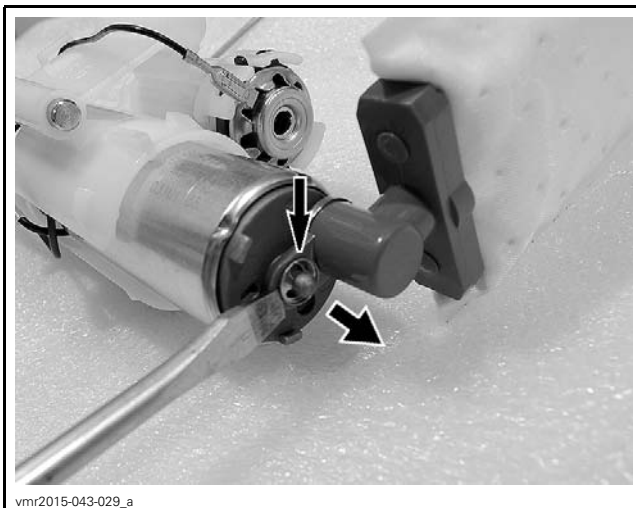
1. Remove *FUEL PUMP*, see *REMOVING THE FUEL PUMP* in this subsection.
2. Unlock 3 tabs on strainer plastic ring.



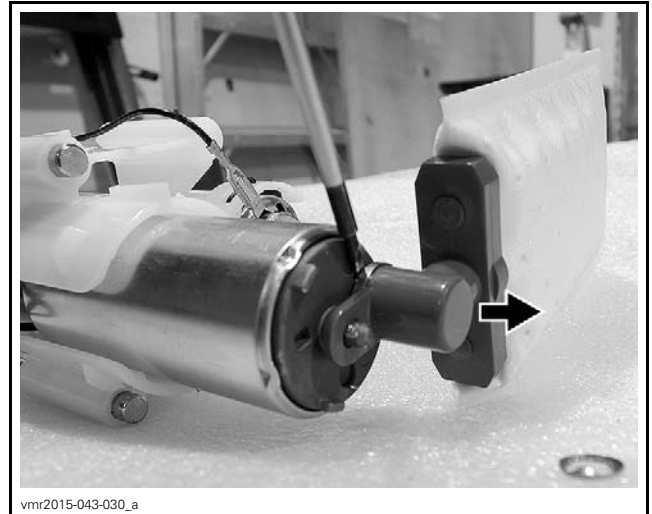
3. Remove rubber pad.



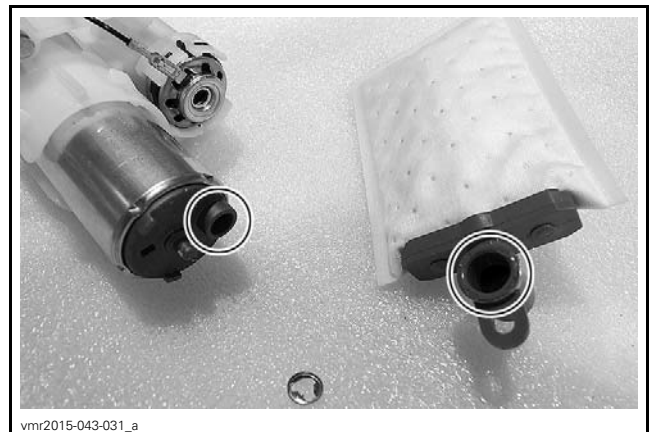
4. Remove push nut securing strainer to fuel pump. Be careful not to break the assembly locator pin.



5. Pull strainer off fuel pump.



6. Before installing new strainer on fuel pump, lubricate assembly areas circled, with o-ring lubricant or clean oil.



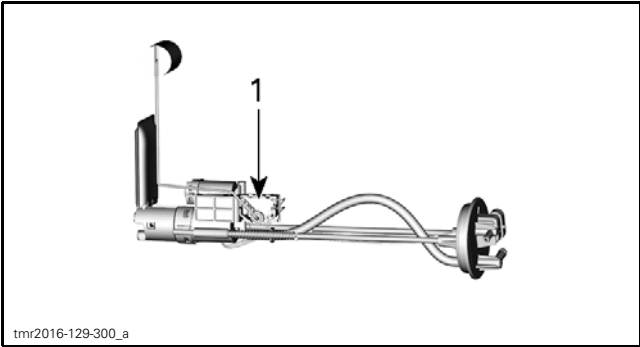
7. Insert the new strainer on fuel pump making sure to press it in fully and tightly against the fuel pump surface.

8. Using a small nut driver or socket, press in a **NEW** push nut to secure strainer.

9. 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.

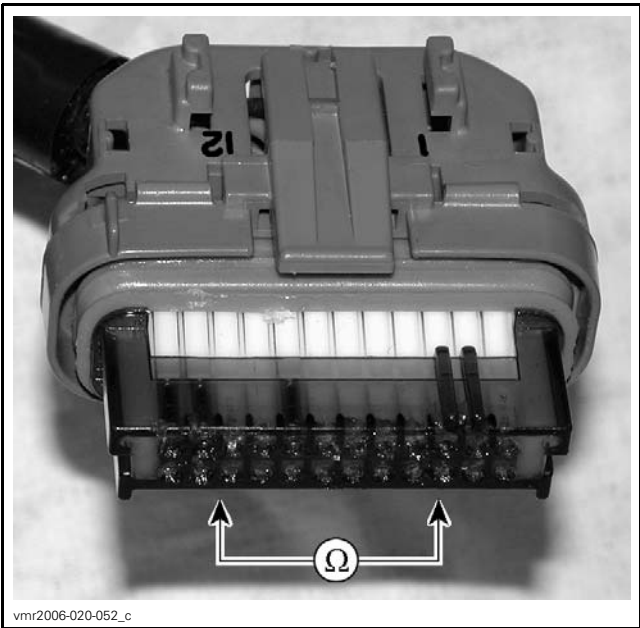


1. Fuel level sender

Fuel Level Sender Resistance Test (Fuel Pump Module Installed)

- 1. Disconnect multifunction gauge, refer to the *LIGHTS/GAUGE/ACCESSORIES* subsection.
- 2. Measure the resistance of the fuel level sender as follows.

FUEL LEVEL SENDER RESISTANCE TEST		
FUEL LEVEL	FUEL PUMP CONNECTOR	RESISTANCE Ω @ 20°C (68°F)
Full	Pins 1 and 2	6 Ω ± 1
Empty		90 Ω ± 4.5



If readings are out of specification, refer to *FUEL LEVEL SENDER RESISTANCE TEST (AT FUEL PUMP CONNECTOR)*.

If readings are as specified, refer to *FUEL LEVEL SENDER INPUT VOLTAGE TEST*.

Fuel Level Sender Resistance Test (at Fuel Pump Connector)

FUEL LEVEL SENDER RESISTANCE TEST		
FUEL LEVEL	FUEL PUMP CONNECTOR	RESISTANCE Ω @ 20°C (68°F)
Full	Pins 1 and 2	6 Ω ± 1
Empty		90 Ω ± 4.5

If resistance test at fuel pump connector is failed, replace fuel pump module.

Fuel Level Sender Input Voltage Test

- 1. Set ignition switch to ON.
- 2. Disconnect fuel pump connector, refer to *FUEL PUMP CONNECTOR ACCESS* in this subsection.
- 3. Measure for input voltage as follows.

FUEL LEVEL SENDER INPUT VOLTAGE TEST		
FUEL PUMP CONNECTOR	BATTERY	VOLTAGE
Pin 2	Negative terminal	5V

TEST RESULT	SERVICE ACTION
5V is not read	Test wiring continuity between fuel level sender and multifunction gauge
Wiring continuity is good	Replace multifunction gauge
Wiring continuity is not obtained	Repair or replace wiring

Fuel Level Sender Replacement

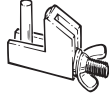
Replace fuel pump. Refer to *FUEL PUMP* in this subsection.

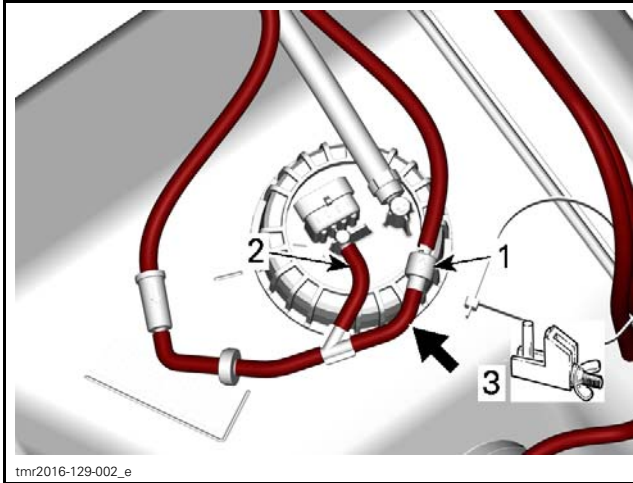
FUEL TANK VENT VALVES

Fuel Tank Vent Valve Test

Inlet Check Valve Test

- 1. Remove rear body module, refer to *BODY* subsection.
- 2. Install a small hose pincher between the vent pressure relief valve and the fuel pump vent inlet.

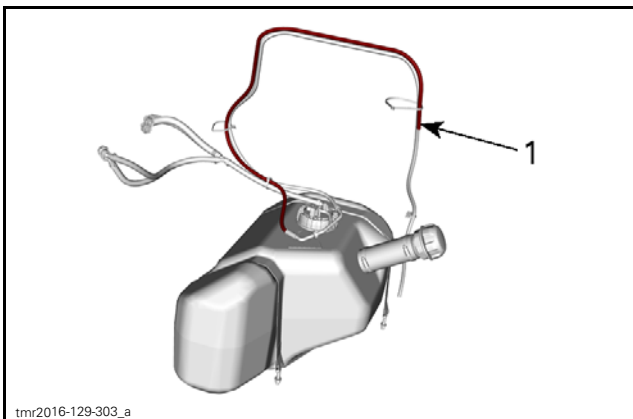
REQUIRED TOOL	
SMALL HOSE PINCHER (P/N 295 000 076)	



- TYPICAL**
1. Pressure relief valve
 2. Fuel pump vent inlet
 3. Install small hose pincher here

3. Connect the vacuum/pressure pump to the fuel tank vent hose inlet.

REQUIRED TOOL	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	



- TYPICAL**
1. Fuel tank vent hose inlet

4. Remove fuel tank cap.
5. Set vacuum/pressure pump to **PRESSURE** and activate pump. The gauge on the pump **should not change in reading**.

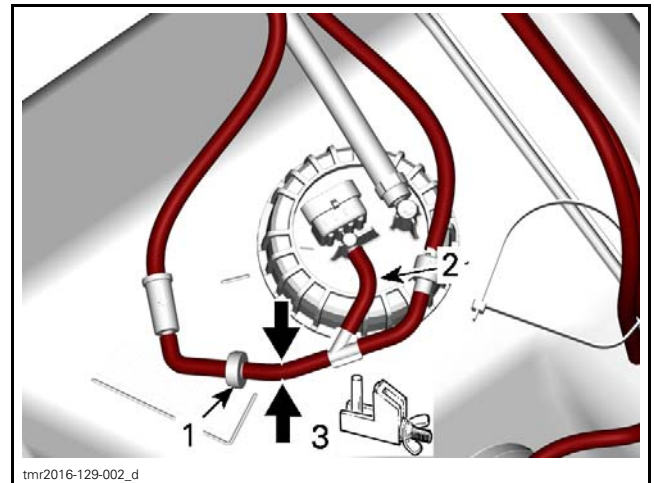
6. Set vacuum/pressure pump to **VACUUM** and activate pump. The **gauge should increase in reading**.

If the test failed, carry out the following:

- Ensure breather filter is properly installed, refer to *PERIODIC MAINTENANCE PROCEDURES*.
- Ensure inlet check valve is properly installed, refer to *FUEL TANK VENT VALVE INSTALLATION* in this subsection.
- Test inlet check valve separately. If good, replace the breather filter, refer to *PERIODIC MAINTENANCE PROCEDURES*.

Pressure Relief Valve Test

1. Install the small hose pincher between the inlet check valve and the fuel pump vent inlet fitting.

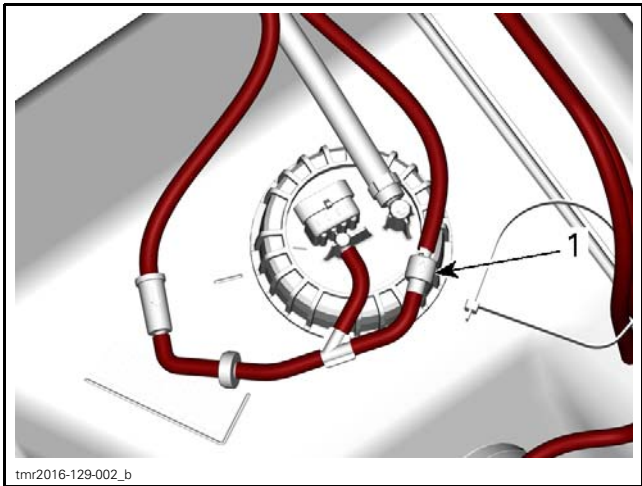


- TYPICAL**
1. Inlet check valve
 2. Fuel pump vent inlet fitting
 3. Install small hose pincher here

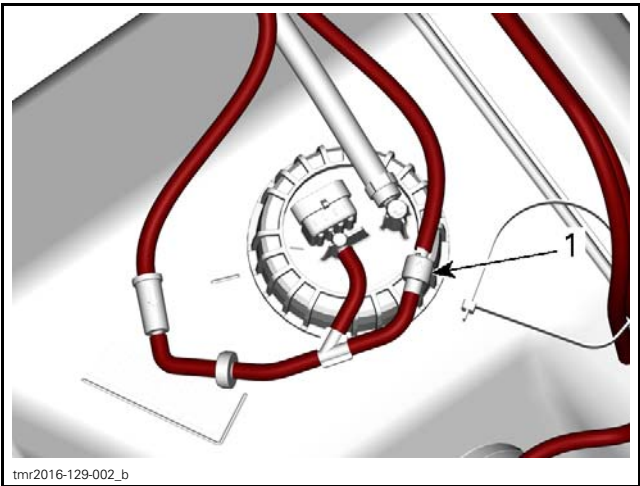
2. Set vacuum/pressure pump to **PRESSURE** and activate pump. The **gauge should increase in reading**.
3. Set vacuum/pressure pump to **VACUUM** and activate pump. The gauge on the pump **should not change in reading**.

If the test failed, carry out the following:

- Ensure pressure relief valve is properly installed, refer to *PRESSURE RELIEF VALVE INSTALLATION* in this subsection.
- Replace pressure relief valve if it fails the test.



TYPICAL
1. Pressure relief valve flow direction arrow

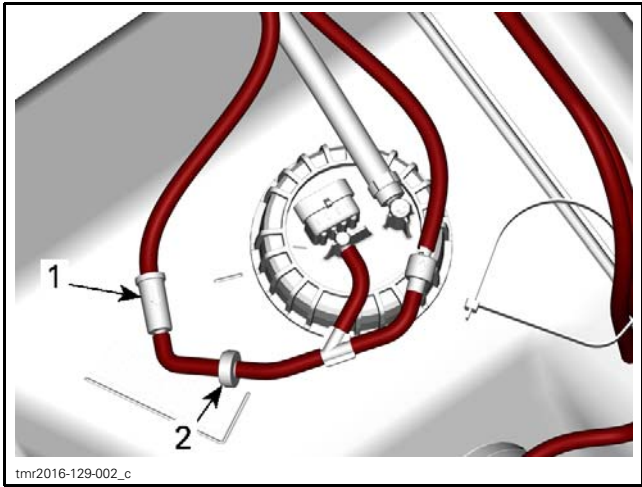


TYPICAL
1. Pressure relief valve flow direction arrow

Fuel Tank Vent Valve Installation

Inlet Check Valve Installation

Ensure white portion of inlet check valve is towards the vent breather filter.



TYPICAL
1. Vent breather filter
2. White portion of inlet check valve

Pressure Relief Valve Installation

Ensure pressure relief valve flow arrow is pointing away from fuel pump vent fitting.

GEARBOX AND 4X4 COUPLING UNIT (with lockable rear differential)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	8, 12
FLUKE 115 MULTIMETER	529 035 868	5, 9, 11
HANDLE	420 877 650	14
M34 SOCKET	529 036 388	16, 21
OIL SEAL INSTALLER (COUNTERSHAFT)	529 036 391	13
OIL SEAL INSTALLER (DIFFERENTIAL OUTPUT)	529 036 390	14
OIL SEAL INSTALLER (GEARBOX)	529 035 758	14
SLEEVE INSTALLER.....	529 036 381	14, 19, 33
SPLINES SOCKET 1/2"	529 036 389	16, 21

SERVICE TOOLS – OTHER SUPPLIER

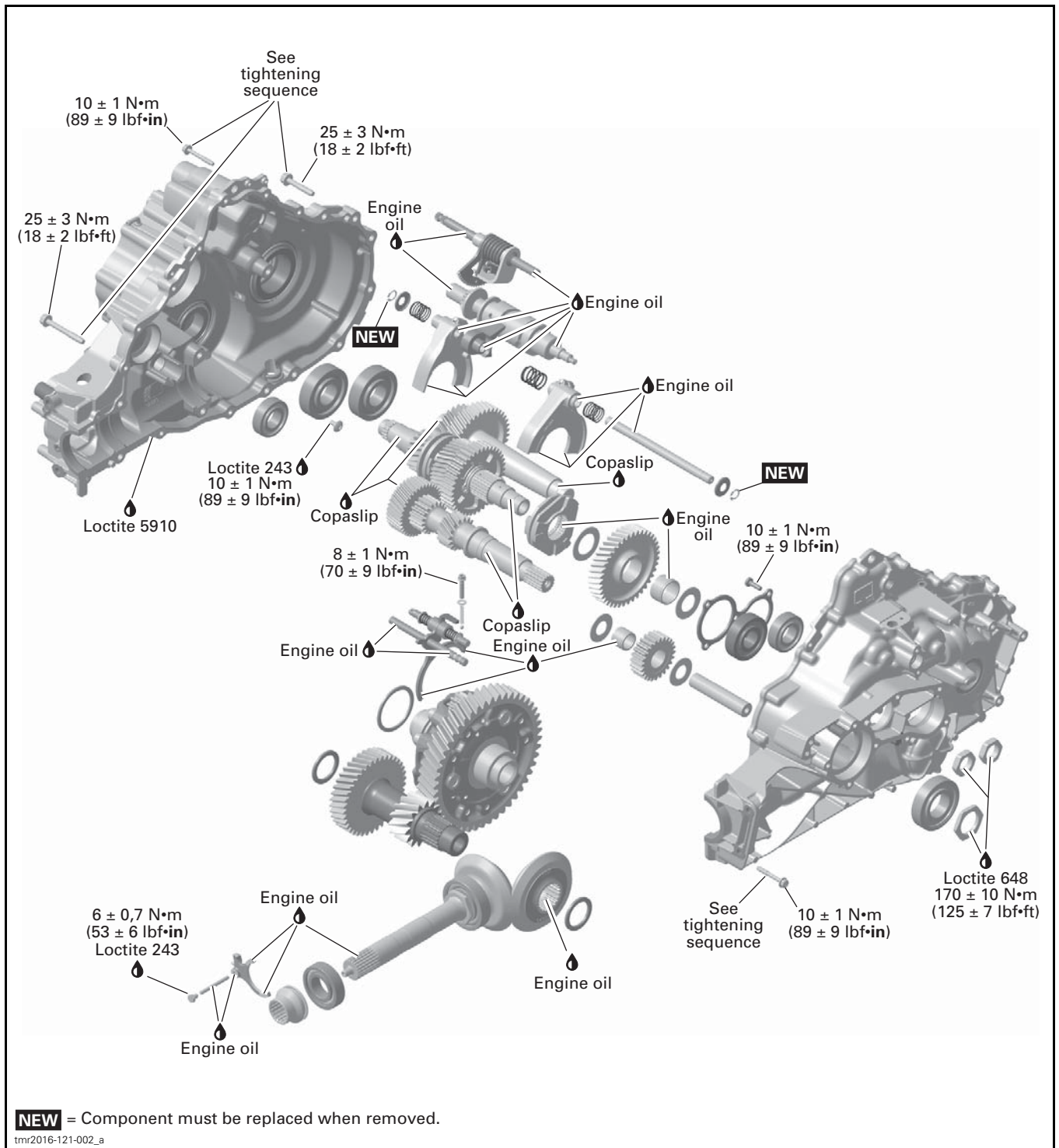
Description	Part Number	Page
BACK PROBE TEST WIRES	529 036 063	5, 7

SERVICE PRODUCTS

Description	Part Number	Page
COPASLIP.....	420 297 430	27
LOCTITE 243 (BLUE).....	293 800 060	15, 19, 29–30, 32
LOCTITE 5910	293 800 081	9, 19, 21
LOCTITE 648 (GREEN)	413 711 400	20–21, 30
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	19
PETAMO GREASE GHY 133N	420 899 271	13
SUPER LUBE GREASE.....	293 550 030	6, 9, 12

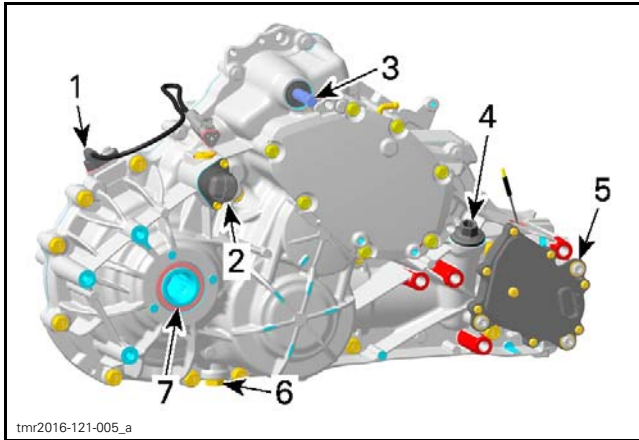


Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

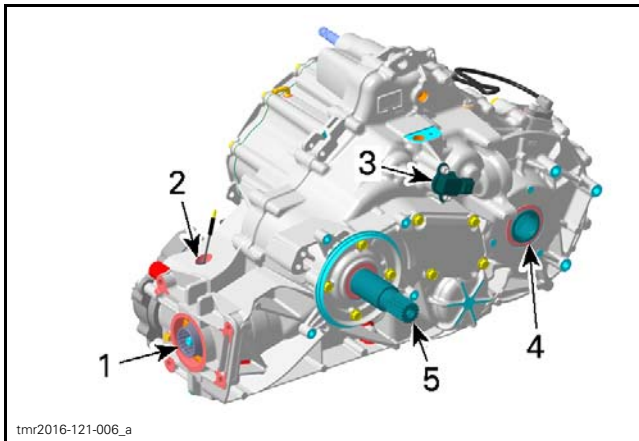


GENERAL

GEARBOX OVERVIEW



1. Vehicle speed sensor (VSS)
2. Differential locking actuator
3. Shift shaft
4. Gearbox oil dipstick
5. 4WD actuator
6. Magnetic drain plug
7. Rear differential output shaft



1. 4WD coupling sleeve
2. 4WD indicator switch
3. Gearbox position sensor (GBPS)
4. Rear differential output shaft
5. Countershaft

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 4WD actuator.

- Test 4WD actuator.

3. Damaged or worn shifting fork or sleeve.

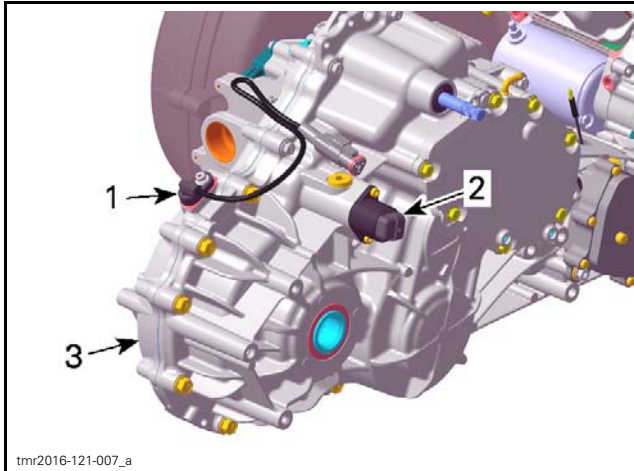
- Remove 4WD actuator and inspect shifting fork and sleeve.

PROCEDURES

VSS (VEHICLE SPEED SENSOR)

VSS Location

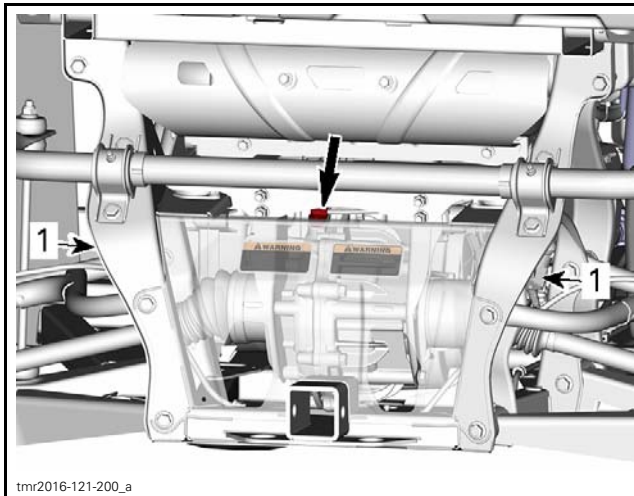
The vehicle speed sensor is located on the rear top side of the left gearbox housing.



1. VSS (Vehicle Speed Sensor)
2. Differential locking actuator
3. Left housing of gearbox

VSS Access

The VSS is accessible by the rear of the vehicle.



1. Go through the sides to access the VSS

VSS Wire Identification

FUNCTION	PIN	COLOR SENSOR CONNECTOR
12-volt input from fuse F5	A	RED
Speed signal (to ECM-A E1)	B	WHITE
Ground (to ECM-A D4)	C	BLACK

VSS Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay activated	Fuse 5 of fuse block 2 (from main relay R2)

Testing the VSS Input Voltage

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 wire)	Battery voltage

If voltage is not as specified, test positive and ground separately.

Testing the VSS Signal

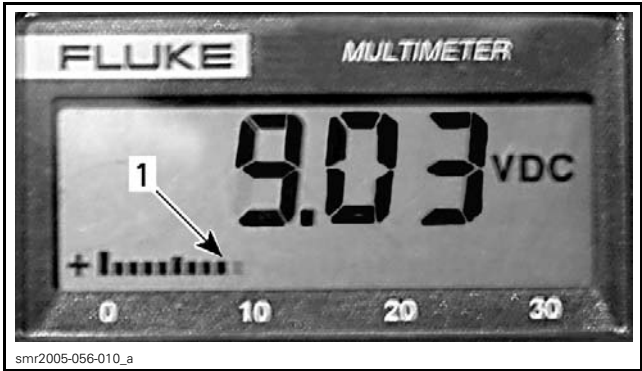
1. Lift rear of vehicle so that rear wheels are off the ground.
2. Set transmission to 2WD and to Neutral.
3. Turn ignition switch ON.
4. Back-probe the VSS connector and measure voltage while slowly rotating rear wheels by hand.

REQUIRED TOOLS	
BACK PROBE TEST WIRES (P/N 529 036 063)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

VSS SIGNAL TEST		
TEST PROBES		RESULT (WHILE ROTATING WHEELS)
PIN B (WHITE wire)	PIN C (BLACK wire)	Alternate reading between battery voltage and 0 Vdc

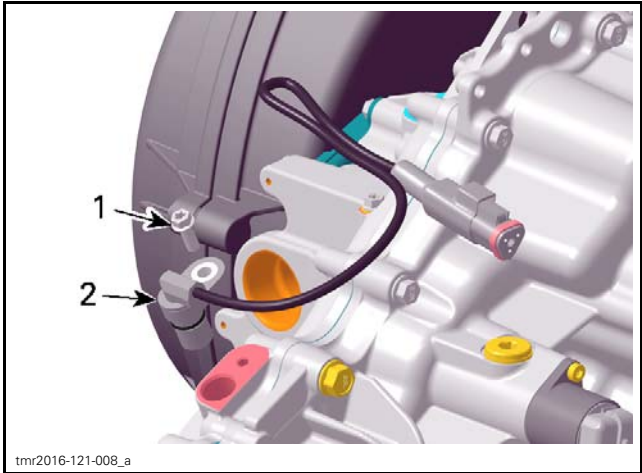
NOTE: Since we measure pulsating voltage, the numeric display will continuously change. The analog display may be easier to follow.



1. Analog display

Removing the VSS

Disconnect VSS connector.
Remove screw retaining the VSS.
Using a long screwdriver, pull out the VSS.



SEVERAL PARTS REMOVED FOR CLARITY
1. Screw
2. VSS

Installing the VSS

For installation, reverse the removal procedure.
Pay attention to the following.
Lubricate VSS O-ring.

VSS O-RING	
Service product	SUPER LUBE GREASE (P/N 293 550 030)

Tighten retaining screw to specification.

TIGHTENING TORQUE	
VSS retaining screw	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

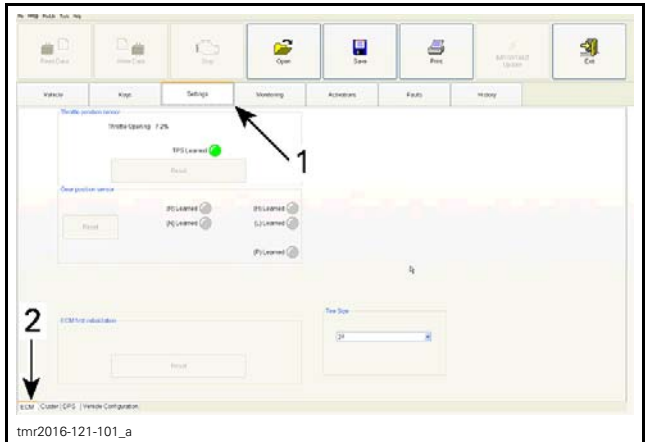
GEARBOX POSITION SENSOR (GBPS)

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:

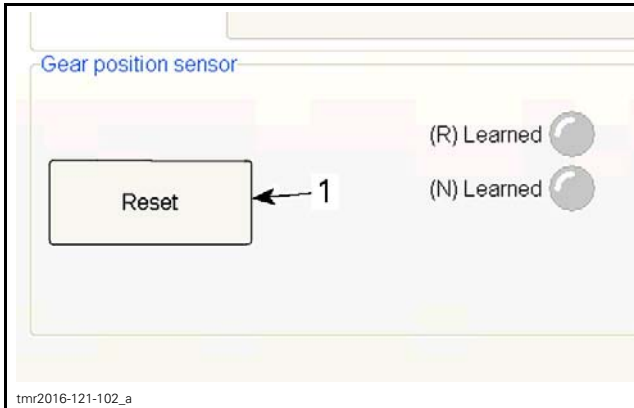
- Gearbox assembly
 - Shift drum
 - GBPS
 - ECM.
1. Connect vehicle to the latest applicable version of B.U.D.S. software, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
 2. In B.U.D.S., select the following:
 - **Setting** page tab
 - **ECM** tab.



1. Setting page tab
2. ECM tab

3. Set shift lever in NEUTRAL position.
4. In the **Gear Position Sensor** field, click on the **Reset** button.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))



GEAR POSITION SENSOR FIELD
1. Reset button

A message will be displayed if the operation is successful.

If an error occurred or the GBPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

5. If a fault message is displayed, follow the instructions in the message(s).

6. Check for fault codes.

If a fault code is generated:

- Carry out the service action.
- Reset the fault code.
- Repeat the reset procedure.

7. Close and disconnect B.U.D.S.

NOTE: Do not turn ignition key OFF.

8. Verify gears engagement.

8.1 With the vehicle on ground and in 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

Tilt the cargo box.

Testing the GBPS Input Voltage

NOTE: Prior to conduct testing, check fault codes in B.U.D.S.

Set shift lever in NEUTRAL position.

Back-probe the GBPS connector.

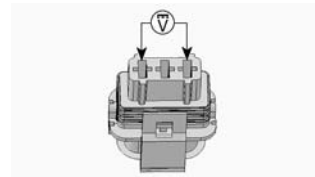
REQUIRED TOOL

BACK PROBE TEST WIRES
(P/N 529 036 063)



Test as follow:

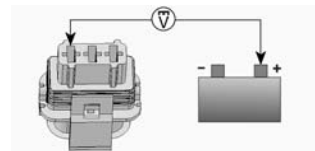
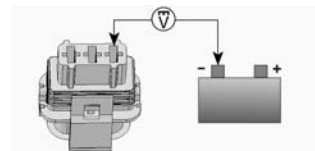
MULTIMETER PROBE POSITIONS	VOLTAGE
PIN 2 and PIN 3 of the GBPS connector	5 volts



If voltage is adequate, check GBPS signal wire.

If there is no voltage, check each GBPS input as follows.

MULTIMETER PROBE POSITIONS	VOLTAGE
GBPS connector (pin 3) and battery ground	5 volts
GBPS connector (pin 2) and battery + terminal	Battery voltage

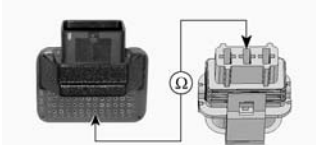


If there is no voltage, check wires and connector pins. Replace or repair defective parts and reset fault codes.

Testing the GBPS Communication Link Continuity

Unplug connector "A" from ECM and connect it to the ECM adapter tool.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

REQUIRED TOOL	
ECM ADAPTER TOOL (P/N 529 036 166)	
MULTIMETER PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
GBPS connector (pin 1) and ECM adapter tool (pin F4) 	Below 1 Ω

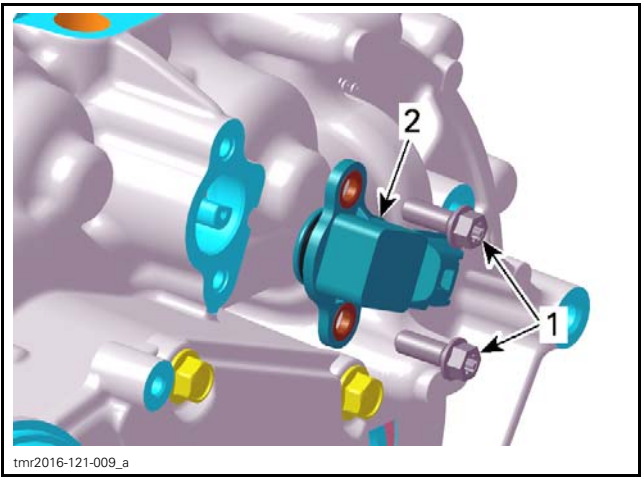
If resistance is out of specification, check wires and connectors. Repair and reset fault codes.

If resistance is good and the other tests succeeded, replace the GBPS and reset fault codes.

NOTE: The GBPS must be reset.

Removing the GBPS

- Set shift lever in NEUTRAL position.
- Unplug GBPS connector.
- Remove screws and withdraw GBPS.



- 1. Screws
- 2. Gearbox Position Sensor (GBPS)

Installing the GBPS

- 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.

NOTE: Do not force to install GBPS if shaft flat is not properly aligned. If alignment is incorrect, check shift rod adjustment.

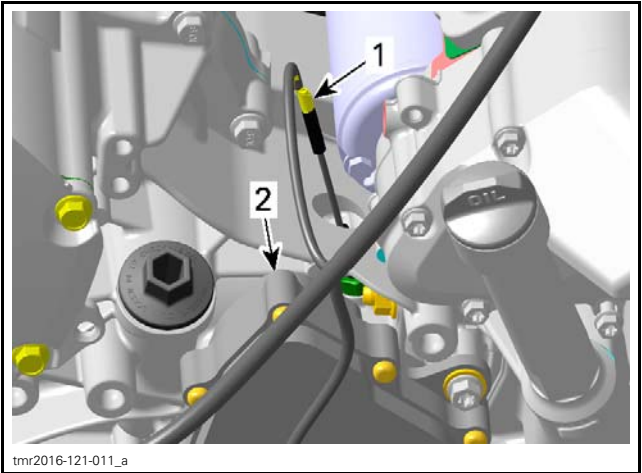


Reset the GBPS. Refer to *GBPS RESET* in this subsection.

4WD INDICATOR SWITCH

Testing the 4WD Indicator Switch

Disconnect 4WD indicator switch connector.



- 1. 4WD indicator switch
- 2. 4WD actuator

Measure switch resistance as follows.

SWITCH POSITION	SWITCH WIRE		RESISTANCE
2WD	BLACK/ BEIGE	Engine ground	Infinite (OL)

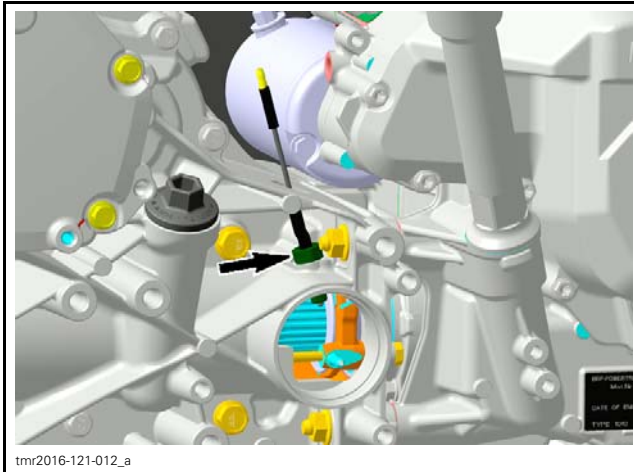
If the resistance is out of specification, replace the 4WD indicator switch.

4WD Indicator Switch Access

Remove *4WD ACTUATOR*, refer to procedure in this subsection.

Removing the 4WD Indicator Switch

Disconnect 4WD indicator switch connector and unscrew 4WD indicator switch.



Installing the 4WD Indicator Switch

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 sealant on threads of indicator switch.

NOTICE Do not apply Loctite 5910 on switch plunger, as it will lead to switch malfunction.

TIGHTENING TORQUE	
Service product	LOCTITE 5910 (P/N 293 800 081)
4WD indicator switch	1.5 N•m to 2 N•m (13 lbf•in to 18 lbf•in)

4WD ACTUATOR

4WD Actuator Access

Tilt the cargo box.

Testing the 4WD Actuator

Check if the 2WD/4WD selector works properly.

Unplug 4WD 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	WHITE/BLUE	Battery voltage
4WD			

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 4WD actuator.

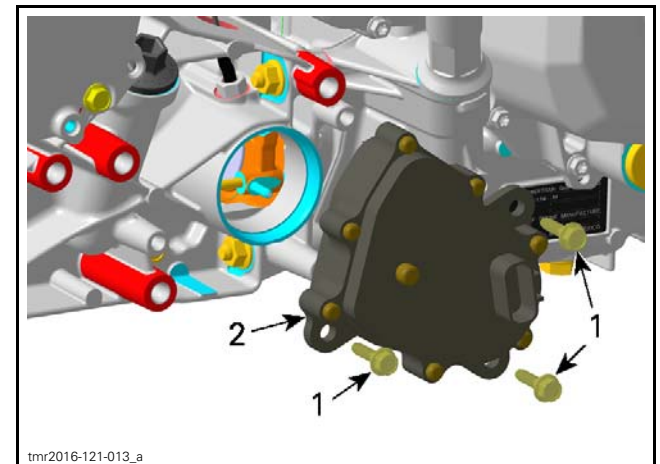
Removing the 4WD Actuator

NOTE: Before beginning any servicing on the 4WD actuator, make sure the vehicle is in 4WD position. No need to remove engine from vehicle.

Place a drain pan under 4WD actuator.

Remove:

- 4WD actuator screws
- 4WD actuator.

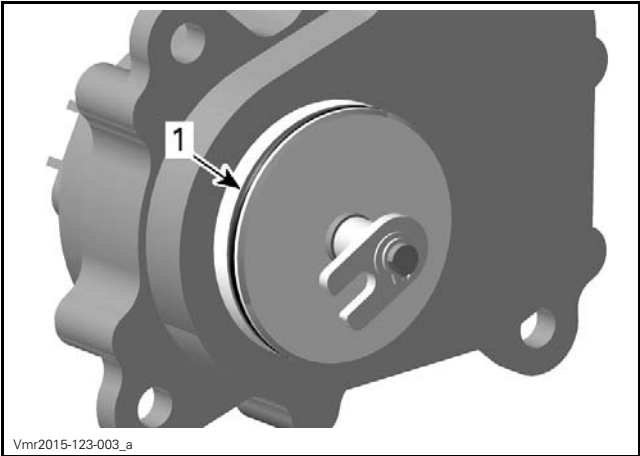


1. Screws
2. 4WD actuator

Installing the 4WD Actuator

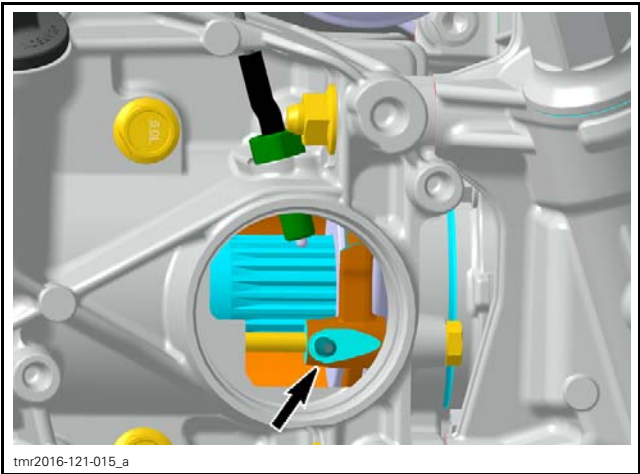
Lubricate 4WD actuator O-ring.

4WD ACTUATOR O-RING	
Service product	SUPER LUBE GREASE (P/N 293 550 030)



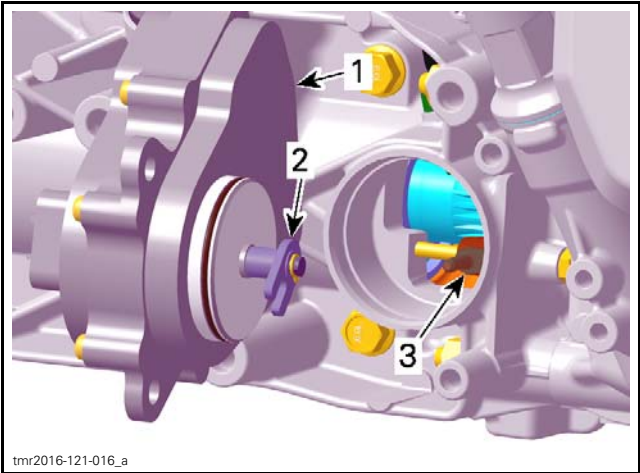
1. 4WD actuator O-ring

Ensure coupling fork is in 4WD position (toward the front of vehicle).



1. Coupling fork in 4WD position

Align the 4WD actuator fork with the pin on coupling fork then push the 4WD actuator in the housing. See the following illustration to position the 4WD actuator correctly.



1. 4WD actuator
2. 4WD actuator fork
3. Coupling fork

Rotate the 4WD actuator counterclockwise until it orients itself to mounting position.

NOTICE Do not cut or break the 4WD actuator O-ring.

Install all 4WD actuator screws and tighten them.

TIGHTENING TORQUE	
4WD actuator screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Connect 4WD actuator.

Set gearbox to PARK position.

Lift the front of vehicle.

Turn front wheels. The front propeller shaft should not turn.

If the front propeller shaft turns, the 4WD actuator is not installed correctly. Remove 4WD 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 4WD actuator is not installed correctly. Remove 4WD actuator and reinstall it.

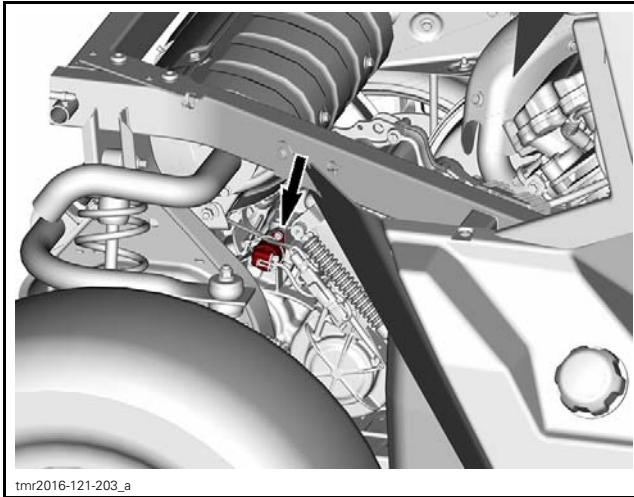
NOTICE Refill missing gearbox oil, refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

Install all other removed parts.

DIFFERENTIAL LOCKING ACTUATOR

Differential Locking Actuator Access

Tilt the cargo box.



Testing the Differential Locking Actuator

Testing the Differential Locking Actuator Function

1. Set shift lever on NEUTRAL.
2. Turn ignition switch to ON. Do not start the engine.
3. Place the rear differential switch in LOCK position.

NOTE: The rear differential is locked when the switch is pushed upwards.

4. Lift the rear of the vehicle until rear wheels are off the ground.

5. Turn a rear wheel.

- If both wheels turn, the actuator is in LOCK position. Continue with step 6
- If only one wheel turns, check the switch position and turn the wheel again. If the result is the same, carry out *TESTING THE DIFFERENTIAL LOCKING ACTUATOR RESISTANCE*.

6. Move the rear differential switch in UNLOCK position.

NOTE: The rear differential is unlocked when the switch is pushed downwards.

7. Turn a rear wheel.

- If only one wheel turns the actuator and its electrical system work properly.
- If both wheels turn, check the switch position and turn the wheel again. If the result is same, carry out *TESTING THE DIFFERENTIAL LOCKING ACTUATOR RESISTANCE*.

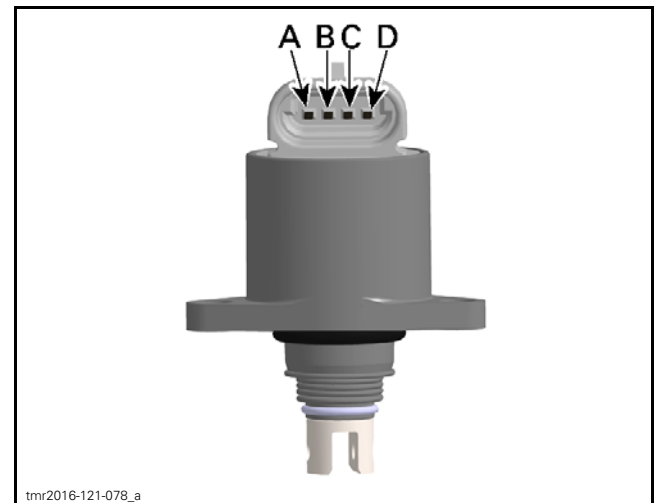
Testing the Differential Locking Actuator Resistance

Disconnect differential locking actuator connector.

Set multimeter to Ω .

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

Probe terminals as per following table.



ACTUATOR CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
A	D	28 - 34 Ω
B	C	

If resistance is not within specifications, replace the actuator.

If resistance tests good, **reconnect** the actuator connector.

Install ECM-A connector on ECM adapter.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

REQUIRED TOOLS	
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-C2	A-C1	28 - 34 Ω
A-B2	A-A4	

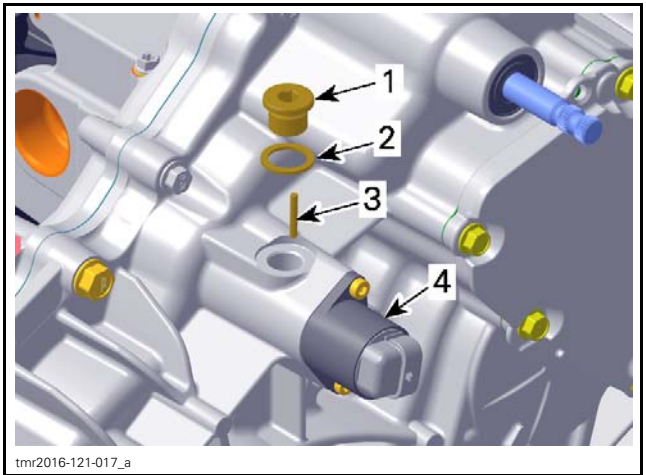
If resistance value is correct replace ECM, refer to *ECM REPLACEMENT* in the *ELECTRONIC FUEL INJECTION (EFI)* subsection.

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

Removing the Differential Locking Actuator

Remove:

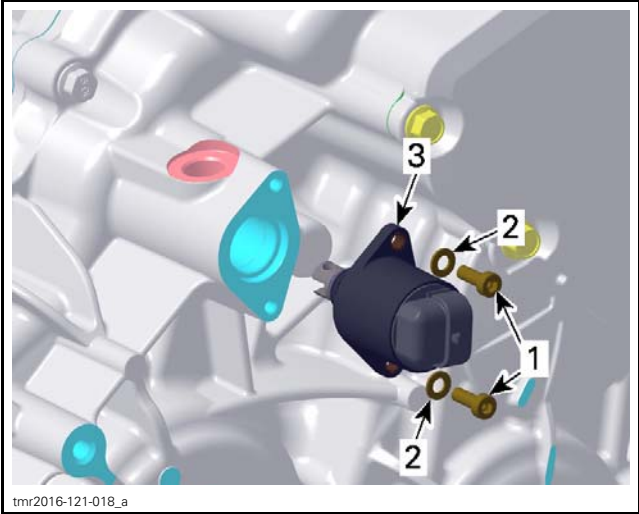
- Plug screw
- Sealing ring (discard it)
- Pin.



1. Plug screw
2. Sealing ring
3. Pin
4. Differential locking actuator

Remove:

- Retaining screws
- Washers
- Differential locking actuator.

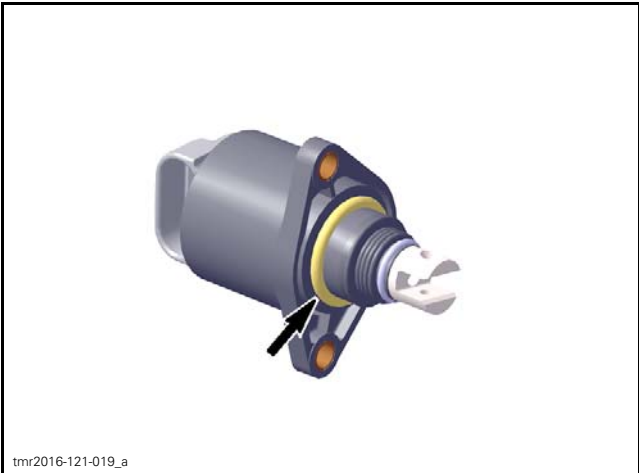


1. Retaining screws
2. Washers
3. Differential locking actuator

Installing the Differential Locking Actuator

Lubricate actuator O-ring.

DIFFERENTIAL LOCKING ACTUATOR O-RING	
Service product	SUPER LUBE GREASE (P/N 293 550 030)



Tighten retaining screws to specification.

TIGHTENING TORQUE	
Differential locking actuator retaining screws	3 N•m ± 0.2 N•m (27 lbf•in ± 2 lbf•in)

Install a **NEW** sealing ring and tighten plug screw to specification.

TIGHTENING TORQUE	
Plug screw	30 N•m ± 3 N•m (22 lbf•ft ± 2 lbf•ft)

GEARBOX OIL SEALS

Replacing the Gearbox Oil Seal

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.

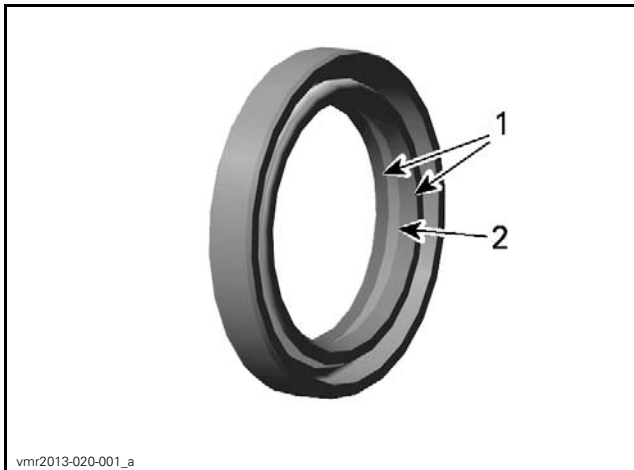
When replacing an oil seal, take this opportunity to inspect the following:

- Check bearings behind each oil seal for contamination and/or metal shavings.
- Check oil seal running surfaces for scratches.

Lubricating the Oil Seal

When installing or reinstalling oil seals, use PETAMO GREASE GHY 133N (P/N 420 899 271) to:

- Lubricate sealing lips all around.
- Fill up the room between sealing lips halfway around the perimeter.

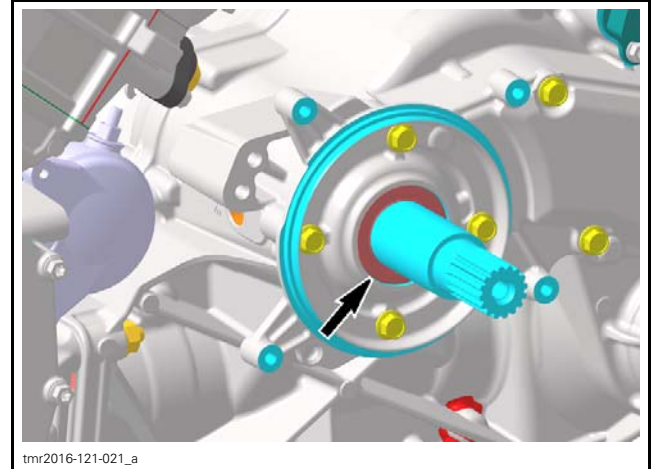


1. Sealing lips
2. Room between sealing lips

Countershaft Oil Seal

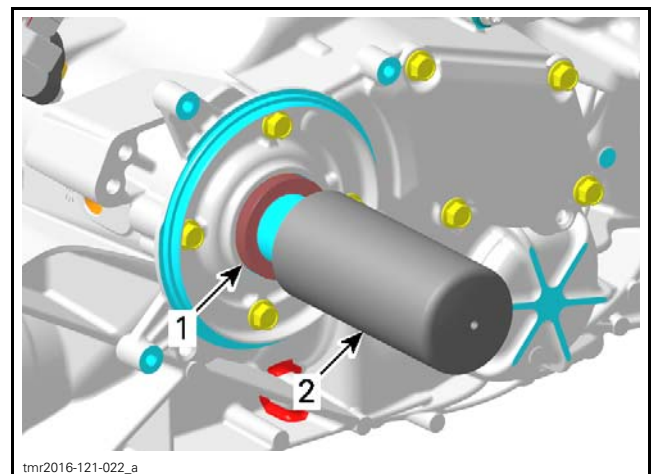
To replace the countershaft oil seal, remove:

- Drive and driven pulleys
- CVT air guide.



Install countershaft oil seal.

REQUIRED TOOL	
OIL SEAL INSTALLER (COUNTERSHAFT) (P/N 529 036 391)	



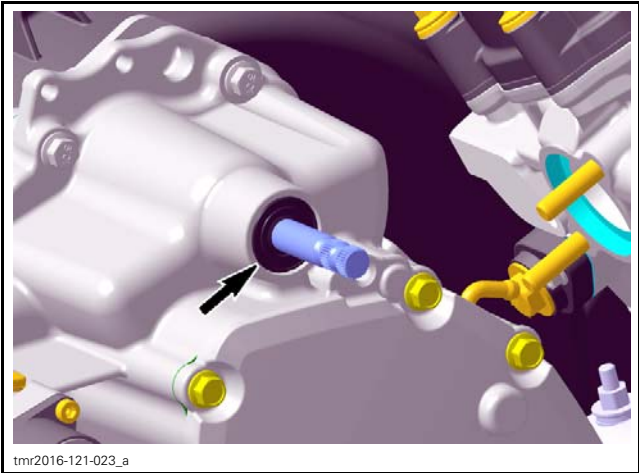
1. Countershaft oil seal
2. Oil seal installer

Shift Shaft Oil Seal

Remove the shift plate. Refer to *SHIFTER* subsection.

The shift shaft oil seal can be removed without removing the gearbox from the vehicle.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))



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.

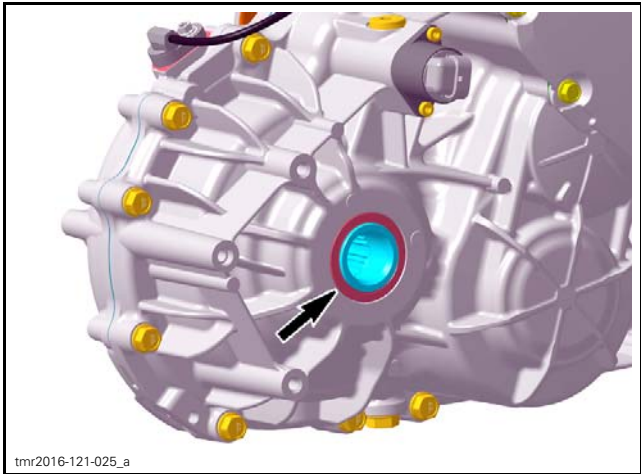


Use a suitable tube with the proper diameter to install the oil seal.

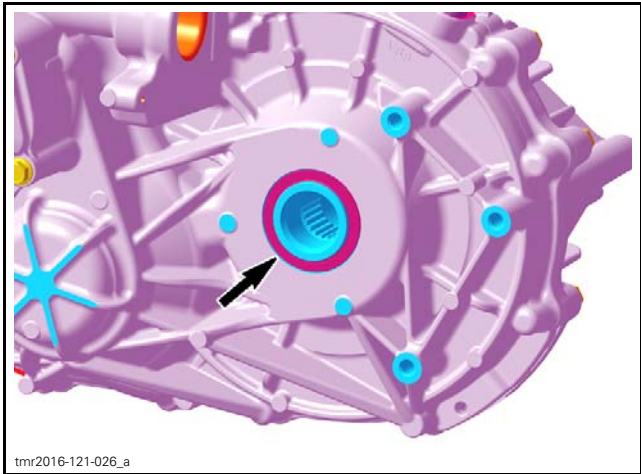
NOTICE Oil seal must be installed with sealing lip toward gearbox.

Output Shaft Oil Seals

Remove the appropriate drive shaft. Refer to *REAR DRIVE* subsection.



RIGHT SIDE

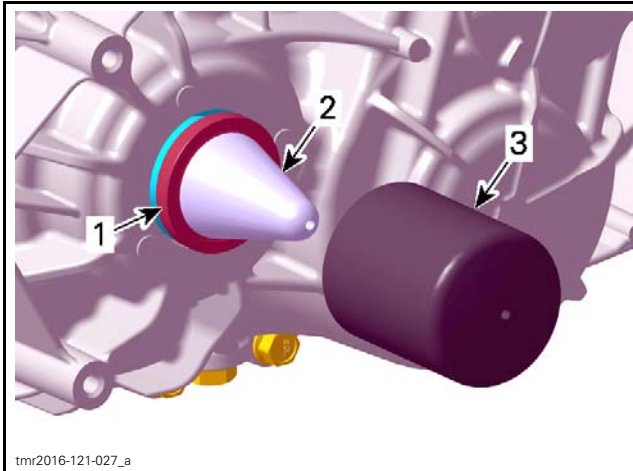


LEFT SIDE

Punch a sharp screwdriver through oil seal for removal.

Place oil seal on output shaft and install it using the following tools.

REQUIRED TOOL	
SLEEVE INSTALLER (P/N 529 036 381)	
OIL SEAL INSTALLER (DIFFERENTIAL OUTPUT) (P/N 529 036 390)	



1. Output shaft oil seal
2. Sleeve installer
3. Oil seal installer

GEARBOX ASSEMBLY

Removing the Gearbox Assembly

Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* for the procedure.

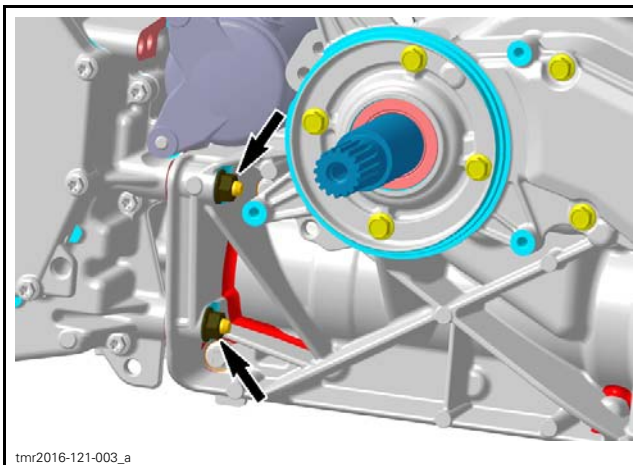
Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection to remove following parts:

- CVT cover
- Drive and driven pulleys
- CVT air guide.

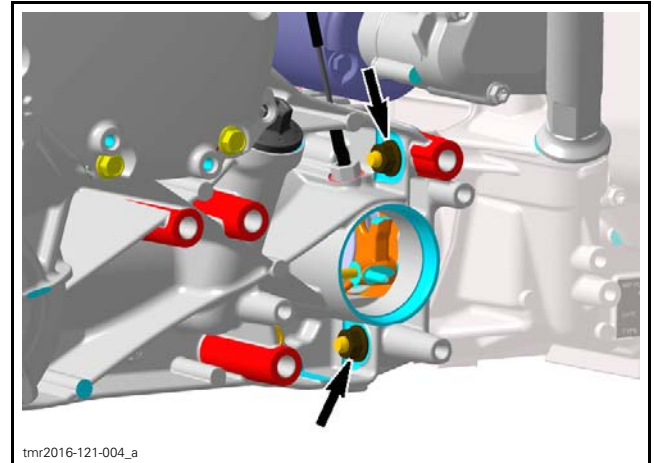
Drain gearbox oil. Refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove *4WD ACTUATOR*, see procedure in this subsection.

Unscrew the four (4) gearbox retaining nuts.



LH SIDE OF ENGINE



RH SIDE OF ENGINE

Pull gearbox to separate it from engine.

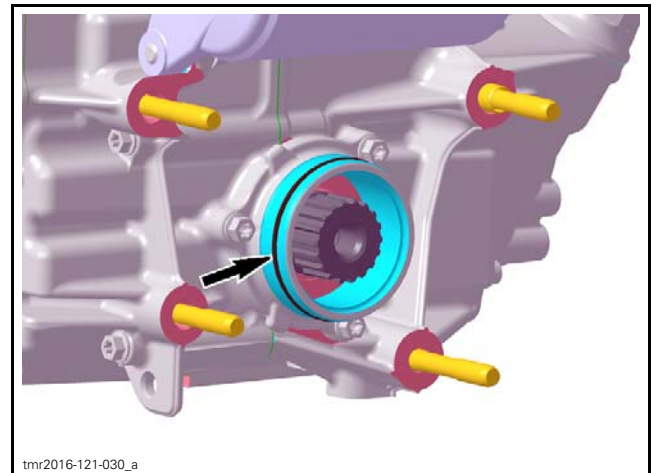
Installing the Gearbox

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

Before gearbox installation check O-ring on bearing cover if brittle, hard or damaged. Replace if necessary.

Lubricate O-ring on rear bearing cover.

O-RING LUBRICATION	
Service product	Engine oil



Tighten gearbox retaining nuts to specification.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Gearbox retaining nuts	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)

After installation refill gearbox oil, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

GEARBOX HOUSING

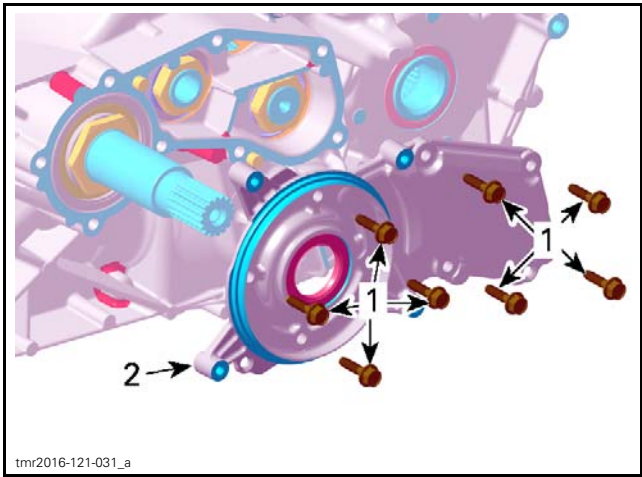
Disassembling the Gearbox Housing

See procedures in this subsection to remove:

- 4WD ACTUATOR
- GBPS (GEARBOX POSITION SENSOR)
- DIFFERENTIAL LOCKING ACTUATOR.

Set gearbox to PARK position.

Remove bearing cover.

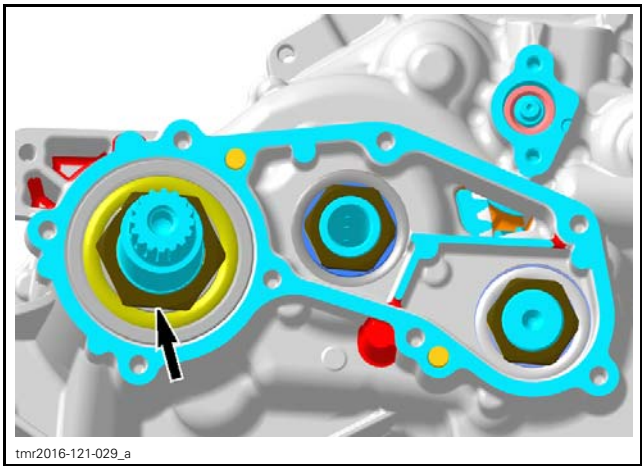


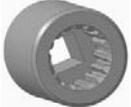
- 1. Retaining screws
- 2. Bearing cover

Remove countershaft nut.

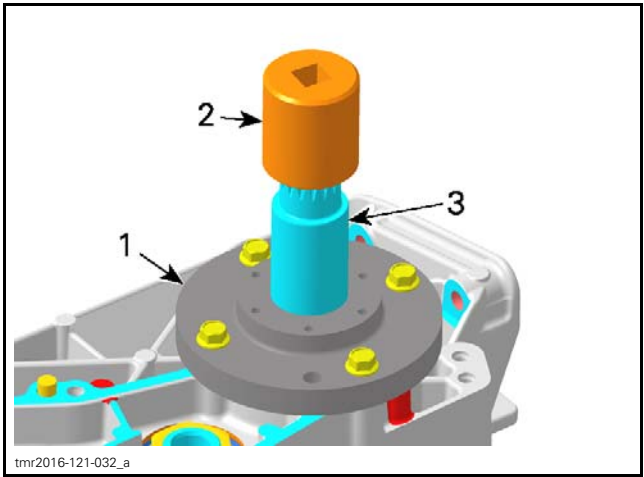
NOTE: Heat up nut with a heat gun to break threadlocker.

CAUTION Nut can loosen abruptly.



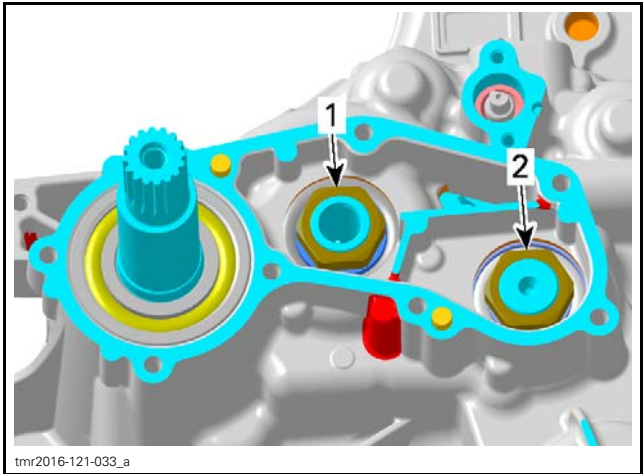
REQUIRED TOOL	
M34 SOCKET (P/N 529 036 388)	
SPLINES SOCKET 1/2" (P/N 529 036 389)	

NOTICE Turn spline socket clockwise to loosen the nut.



- 1. M34 socket
- 2. Spline socket
- 3. Countershaft

Remove nuts of main shaft and intermediate shaft.



- 1. Main shaft nut
- 2. Intermediate shaft nut

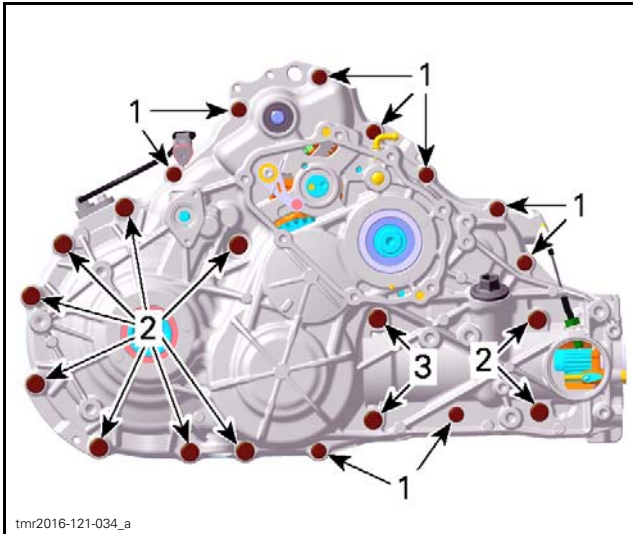
Refer to *GEARBOX AND SHIFTING MECHANISM* in this subsection and remove:

- Parking lock gear
- Index washer.

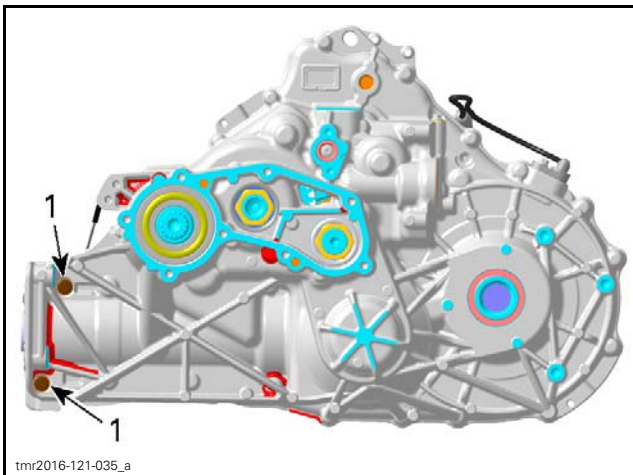
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

Remove all gearbox housing screws:

1. Start removing the M6 screws.
2. Then remove the M8 screws.

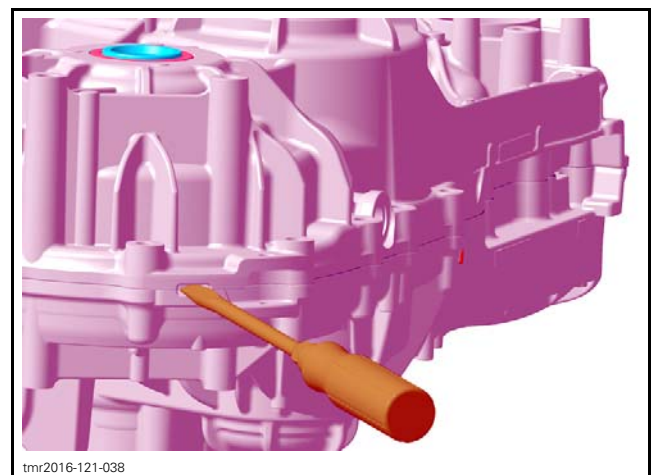
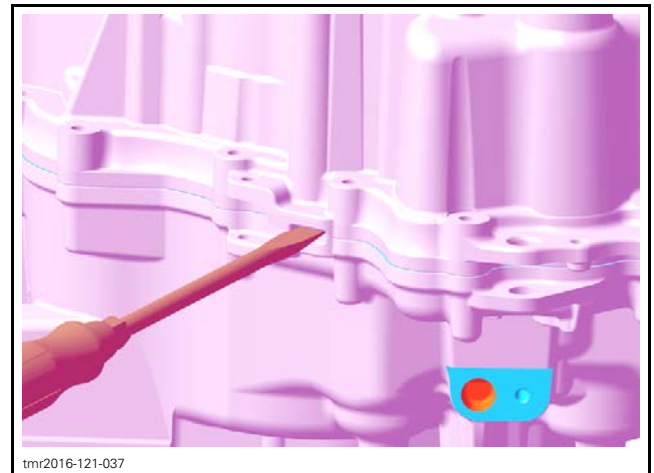
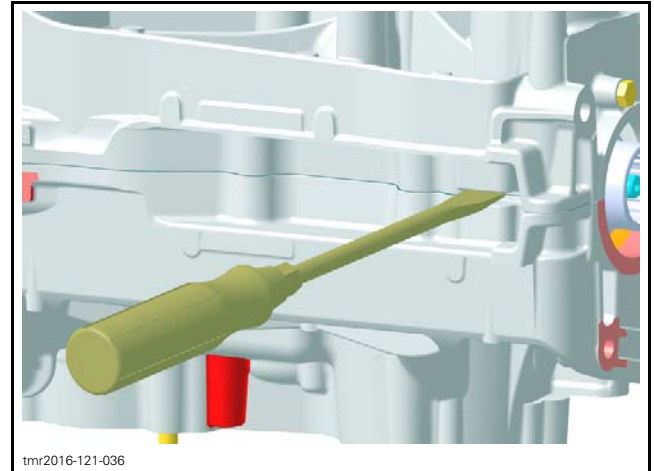


1. 11 screws M6 x 45
2. 10 screws M8 x 45
3. 2 screws M8 x 65



1. 2 screws M6 x 45

Separate gearbox housing, use 2 big screwdrivers.



If necessary, refer to procedures in this subsection and remove:

- GEARBOX AND SHIFTING MECHANISM
- OUTPUT SHAFT AND COUPLING MECHANISM
- REAR DIFFERENTIAL AND LOCKING MECHANISM.

Inspecting the Gearbox Housing

Check gearbox ball bearings for: contamination and/or metal shavings.

Check if ball bearings turn freely and smoothly. Replace if necessary.

Bearing Replacement

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.

Use a blind hole bearing puller to remove ball bearings of:

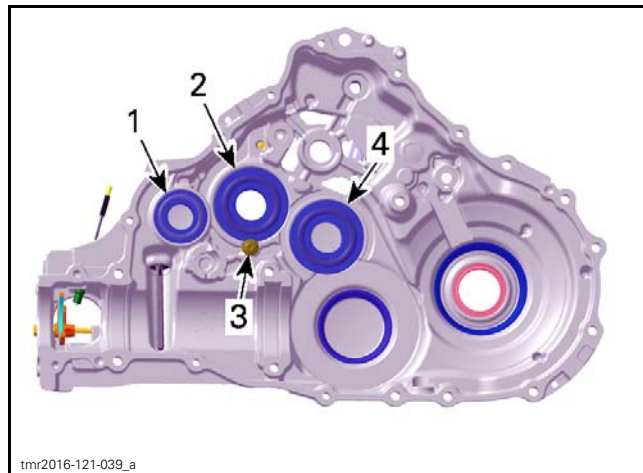
- Countershaft (right cover)
- Intermediate shaft (right cover).

Remove retaining plate securing the main shaft and intermediate shaft bearings in the left housing.

Remove screw securing the main shaft bearing in the right cover.

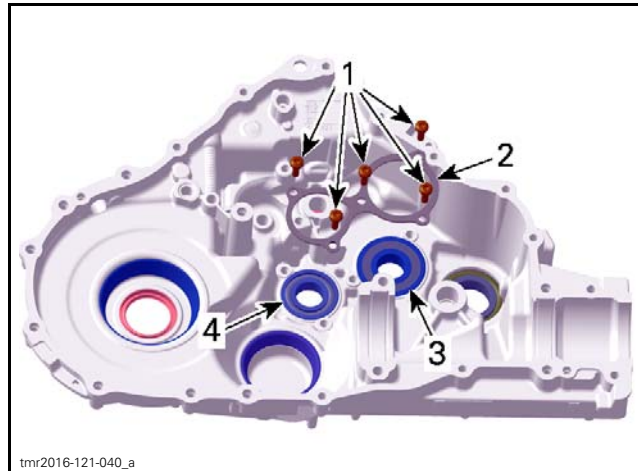
Use a suitable puller to remove ball bearings of:

- Main shaft (right and left cover)
- Countershaft (left cover)
- Intermediate shaft (left cover).



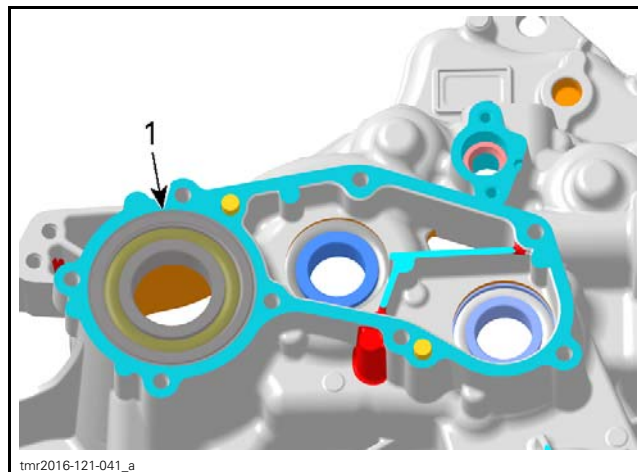
RIGHT GEARBOX HOUSING

1. Ball bearing countershaft
2. Ball bearing main shaft
3. Screw
4. Ball bearing intermediate shaft



LEFT GEARBOX HOUSING

1. Screws
2. Retaining plate
3. Ball bearing main shaft
4. Ball bearing intermediate shaft



LEFT GEARBOX HOUSING

1. Ball bearing countershaft

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, main shaft and intermediate shaft.

NOTE: Place gearbox housings on a wood stand before installing ball bearings.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

TIGHTENING TORQUE	
Retaining plate screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Retaining screw main shaft bearing (right cover)	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Install new oil seals with the proper installer (refer to *GEARBOX OIL SEALS* in this subsection).

Assembling the Gearbox Housing

Clean all metal components in a solvent.

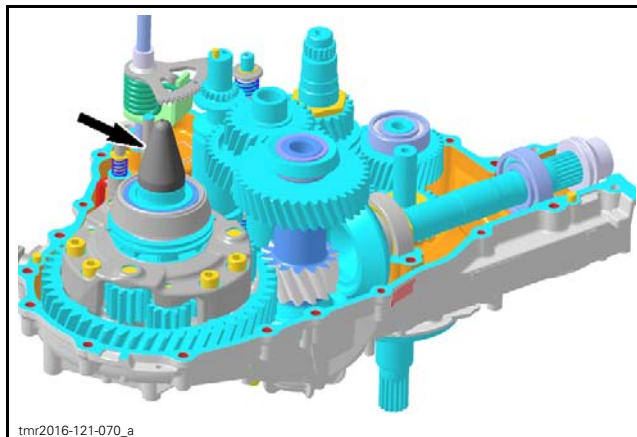
Gearbox housing mating surfaces are best cleaned using a combination of LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

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.

Place sleeve installer on rear differential.

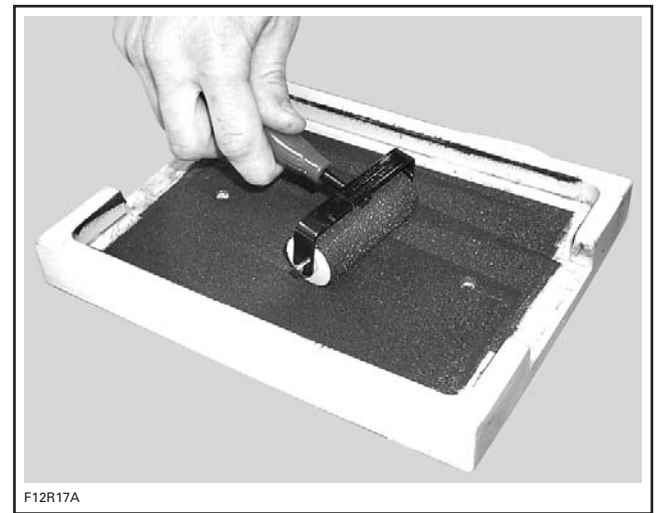
REQUIRED TOOL	
SLEEVE INSTALLER (P/N 529 036 381)	



Apply sealant on mating surface.

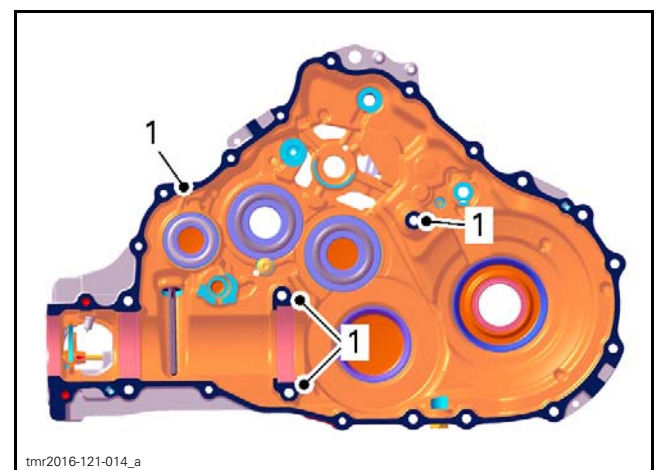
GEARBOX HOUSING MATING SURFACE SEALANT	
Service product	LOCTITE 5910 (P/N 293 800 081)

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 gearbox housing mating surfaces.



Do not apply in excess as it will spread out inside gearbox housing.

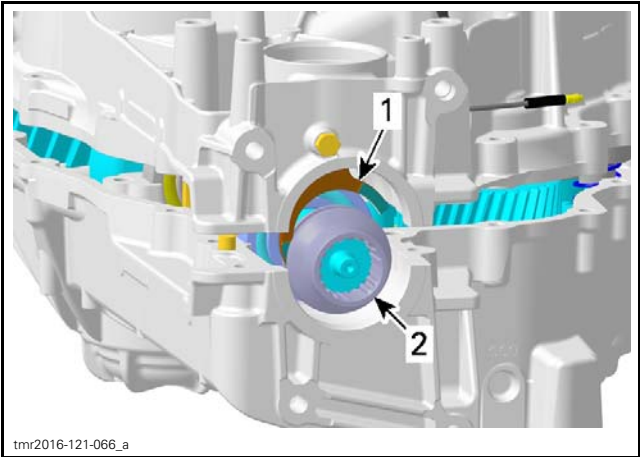
NOTE: It is recommended to apply this specific sealant as described here to get a uniform application without lumps. If you do not use the roller method, you may use your finger to uniformly distribute the sealant (using a finger will not affect the adhesion).



1. Apply sealant here

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

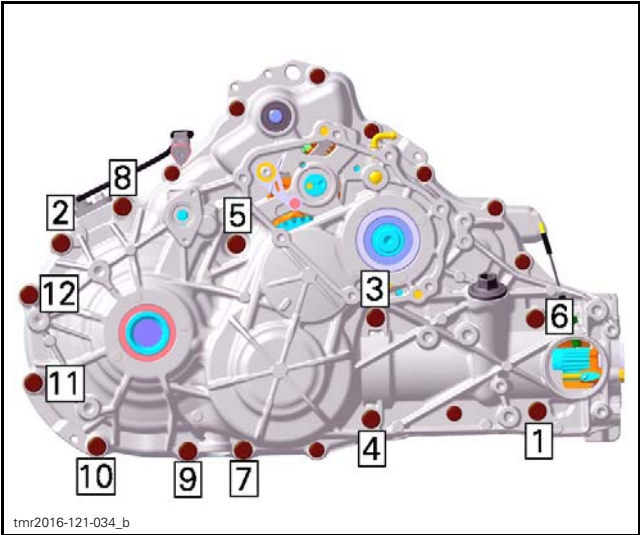
During installation of the right gearbox housing align the coupling fork with the groove in the coupling sleeve.



1. Coupling fork
2. Coupling sleeve

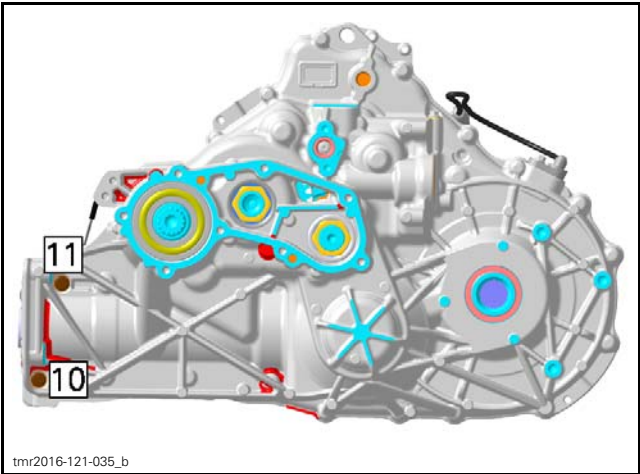
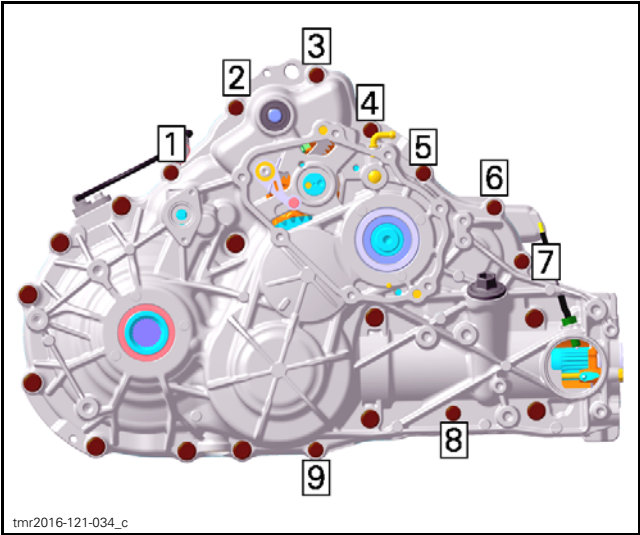
Install all gearbox housing screws.
Tighten M8 gearbox housing screws as per following sequence.

TIGHTENING TORQUE	
M8 gearbox housing screws	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)



Tighten M6 gearbox housing screws as per following sequence.

TIGHTENING TORQUE	
M6 gearbox housing screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)



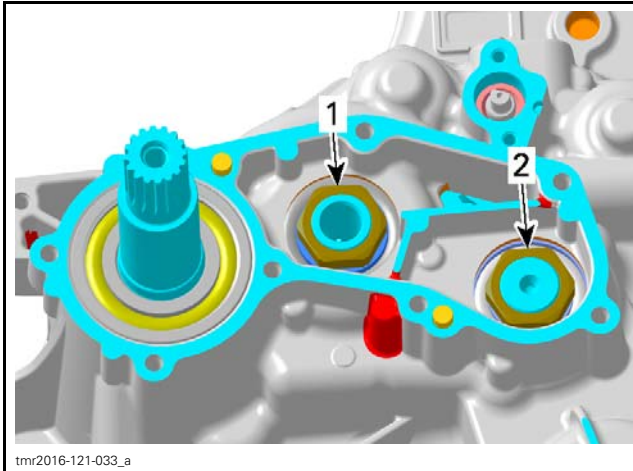
Refer to *GEARBOX AND SHIFTING MECHANISM* in this subsection to install:

- Index lever
- Index washer
- Parking lock gear
- Parking lock lever.

Set gearbox to PARK position.

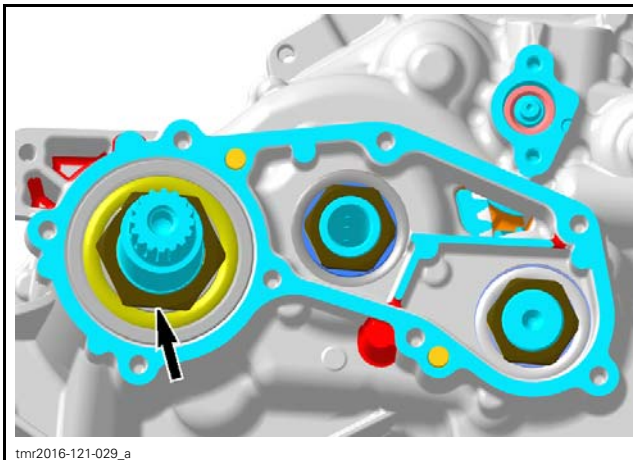
Tighten main shaft and intermediate shaft nuts to specification.

TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Main shaft and intermediate shaft nuts	170 N•m ± 10 N•m (125 lbf•ft ± 7 lbf•ft)

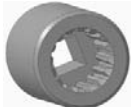


1. Main shaft nut
2. Intermediate shaft nut

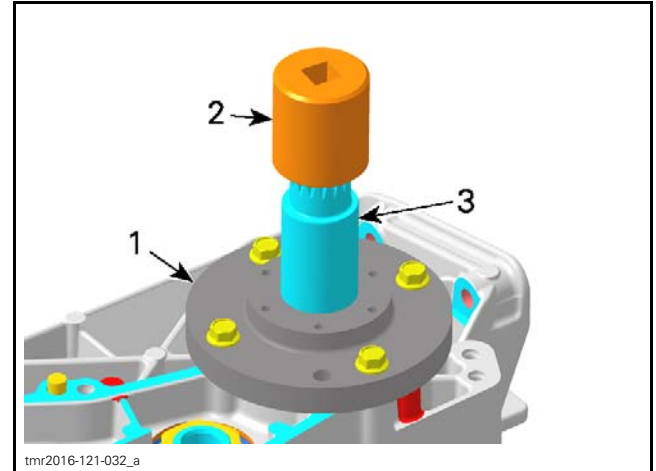
Tighten countershaft nut to specification.



TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Countershaft nut	170 N•m ± 10 N•m (125 lbf•ft ± 7 lbf•ft)

REQUIRED TOOL	
M34 SOCKET (P/N 529 036 388)	
SPLINES SOCKET 1/2" (P/N 529 036 389)	

NOTICE Turn spline socket counterclockwise to tighten the nut.



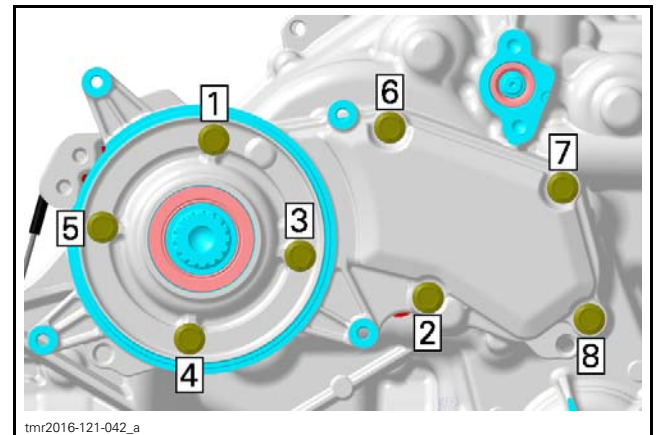
1. M34 socket
2. Spline socket
3. Countershaft

Apply sealant on mating surface of bearing housing.

BEARING HOUSING MATING SURFACE SEALANT	
Service product	LOCTITE 5910 (P/N 293 800 081)

Install bearing housing screws and tighten them as per following sequence.

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



GEARBOX AND SHIFTING MECHANISM

Disassembling the Gearbox and Shifting Mechanism

NOTE: During gearbox and shifting mechanism disassembly, inspect the condition of each part closely.

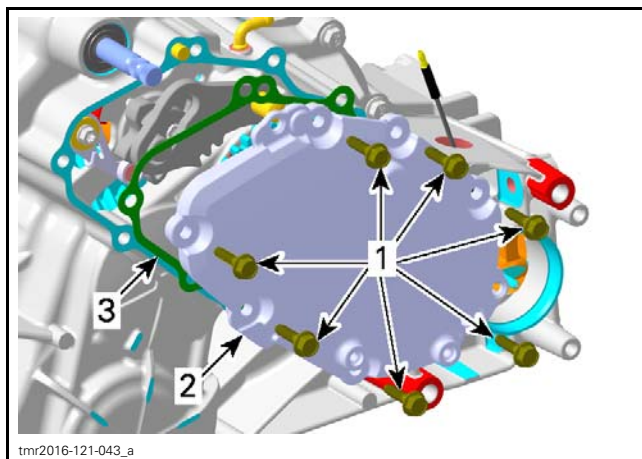
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

Index Lever, Index Washer and Parking Lock Lever

Set gearbox to PARK position.

Remove:

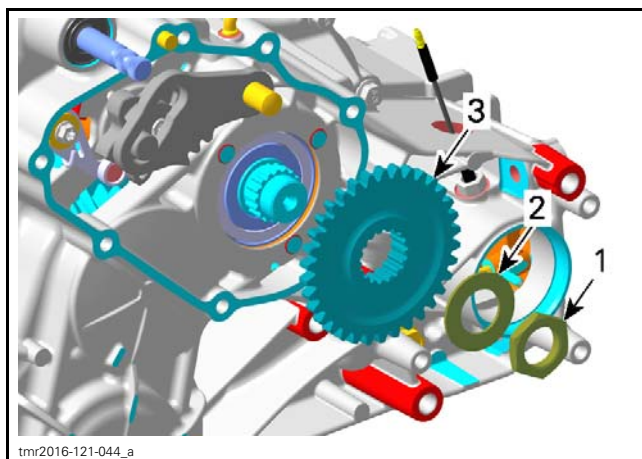
- Retaining screws
- Gearbox cover
- Gasket (discard it).



1. Retaining screws
2. Gearbox cover
3. Gasket

Remove:

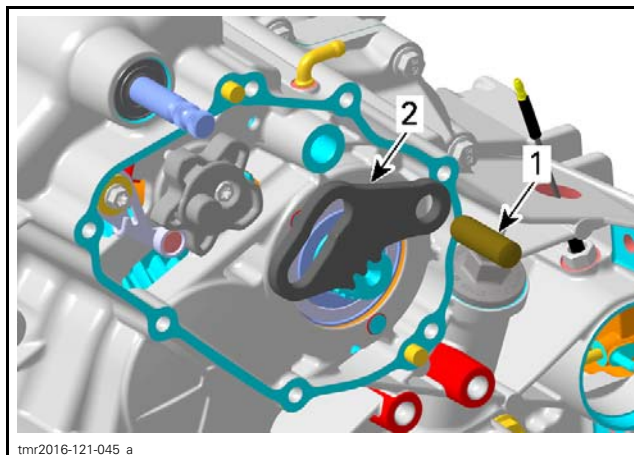
- Nut
- Spring washer
- Park locking gear.



1. Nut
2. Spring washer
3. Park locking gear

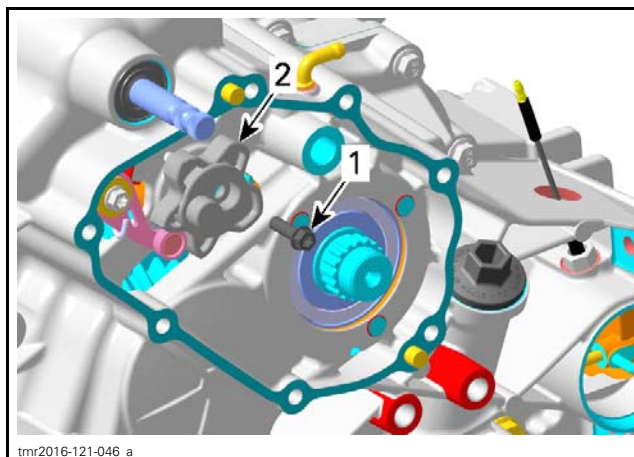
Remove:

- Pin
- Park locking lever.



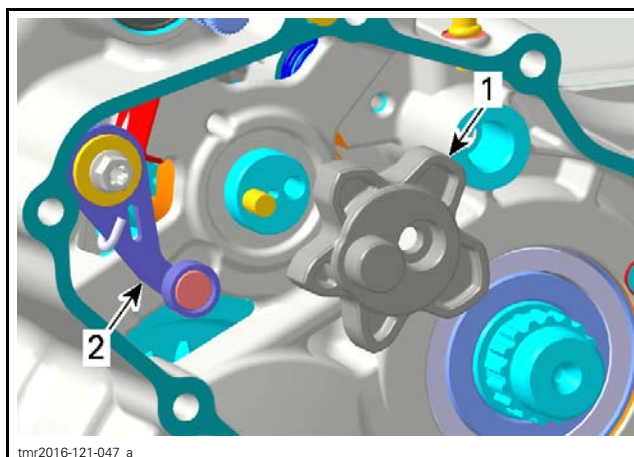
1. Pin
2. Park locking lever

Remove screw retaining the index washer to the shift drum.



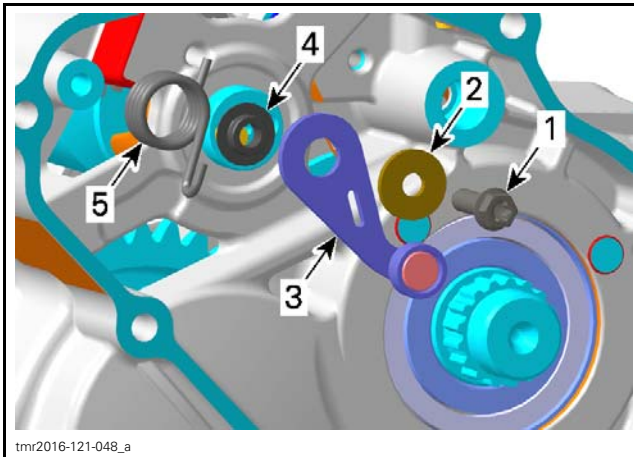
1. Screw
2. Index washer

Insert a flat screwdriver in the slot of index lever. Turn screwdriver clockwise and remove index washer.



1. Index washer
2. Index lever

Remove the index lever with washer, step ring and spring.

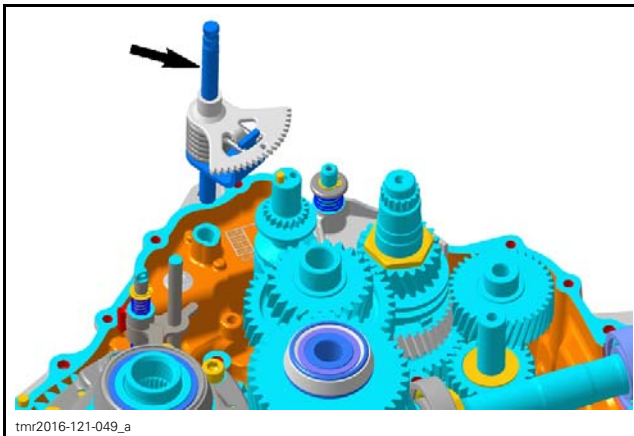


1. Screw
2. Washer
3. Index lever
4. Step ring
5. Index spring

Shift Shaft Assembly

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

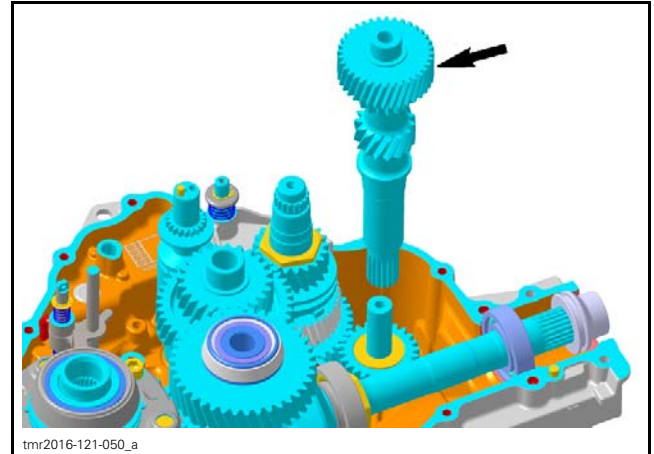
Withdraw shift shaft assembly.



Countershaft and Reverse Intermediate Gear

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

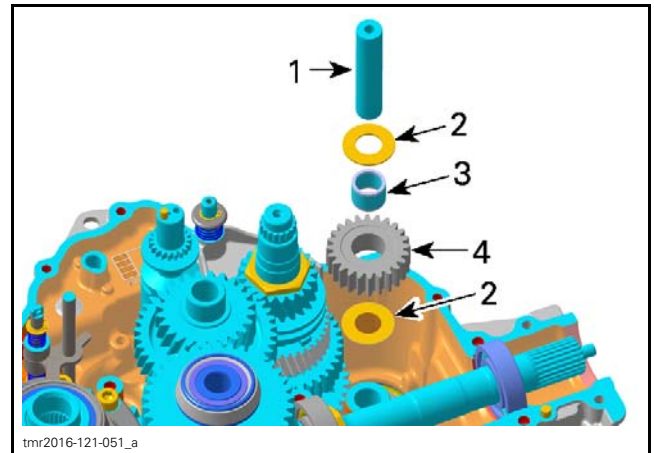
Use a soft hammer to push out countershaft from gearbox housing CVT side.



Remove:

- Bearing pin
- Reverse intermediate gear
- Needle bearing
- Thrust washers.

NOTE: Take care not to lose lower thrust washer during removal.



1. Bearing pin
2. Thrust washers
3. Needle bearing
4. Reverse intermediate gear

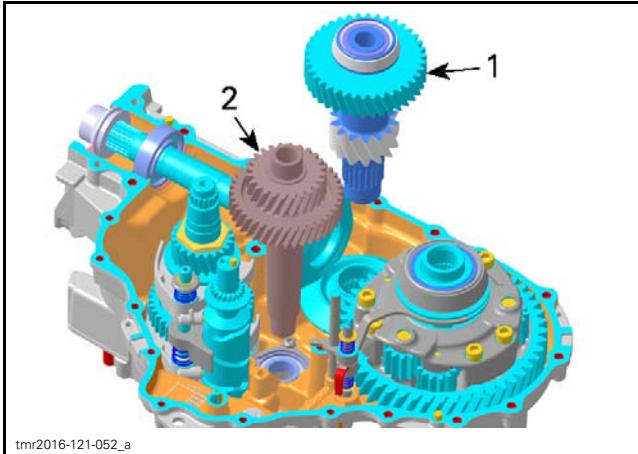
Pinion Drive Shaft and Intermediate Shaft

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

Remove:

1. Pinion drive shaft
2. Intermediate shaft.

NOTE: Bevel gear and distance shim remain in gearbox housing.



1. Pinion drive shaft
2. Intermediate shaft

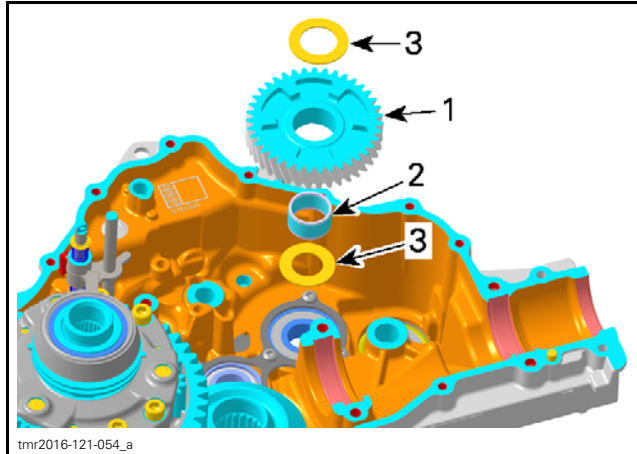
Main Shaft, Shift Fork Shaft Assembly and Shift Drum

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

See procedures in this subsection to remove:

- Pinion drive shaft
- Intermediate shaft
- Countershaft
- Reverse intermediate gear.

Remove main shaft assembly together with shift fork shaft assembly and shift drum.



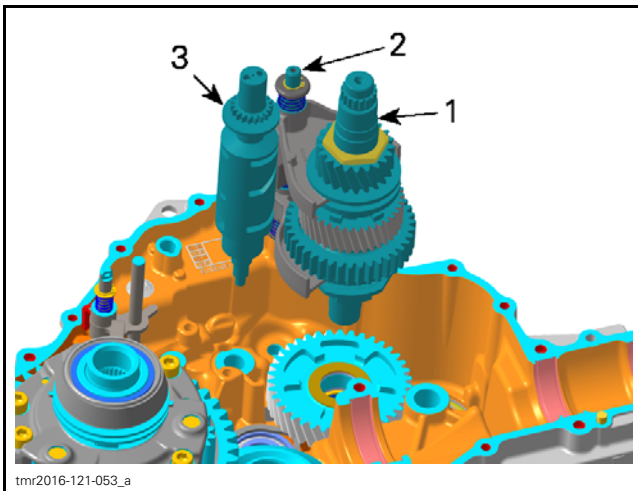
1. Free pinion LOW range gear
2. Needle bearing
3. Thrust washer

Disassembling the Shift Fork Shaft Assembly

NOTICE Springs are not identical. Mark them to reinstall them in their original position.

Remove:

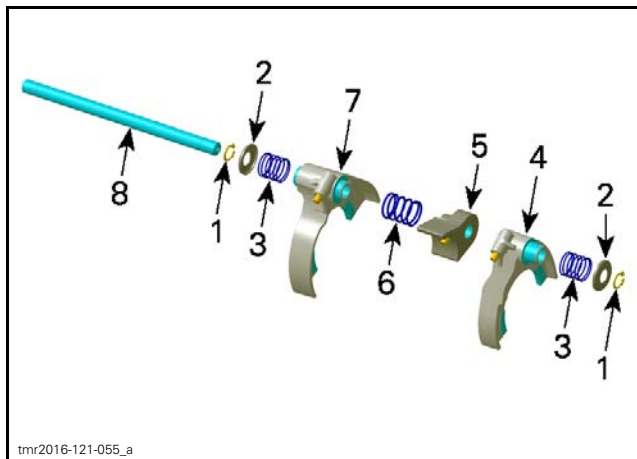
- Snap rings (discard them)
- Spring seats
- Springs
- Shift forks
- Shifting block.



1. Main shaft assembly
2. Shift fork shaft assembly
3. Shift drum

Remove:

- LOW range gear
- Needle bearing
- Thrust washers.



1. Snap rings
2. Spring seat
3. Outer springs
4. Shift fork HIGH
5. Shifting block
6. Center spring
7. Shift fork LOW/REVERSE
8. Shift fork shaft

Inspecting the Gearbox and Shifting Mechanism

Always verify for the following when inspecting gearbox components:

- Gear teeth damage
- Worn or scoured bearing surfaces

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))

- Rounded engagement dogs and slots
- Worn shift fork engagement groove
- Worn splines on shafts and shifting sleeves.

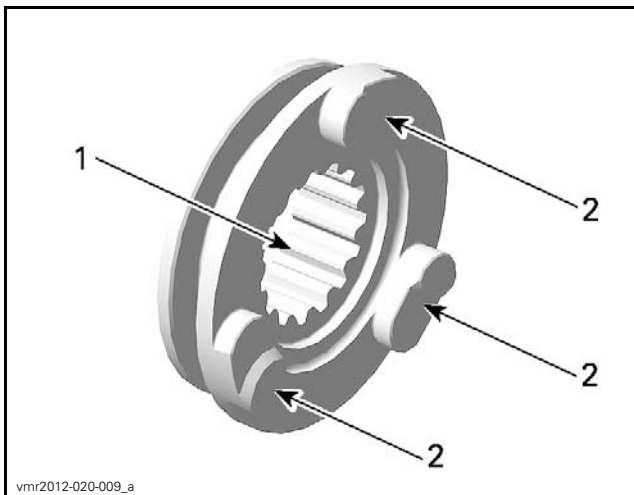
Bearings

When gearbox is removed check gearbox ball bearings for contamination and/or metal shavings.

Check if ball bearings turn freely and smoothly. Replace if necessary, refer to *GEARBOX HOUSING* in this subsection.

Shifting Sleeves

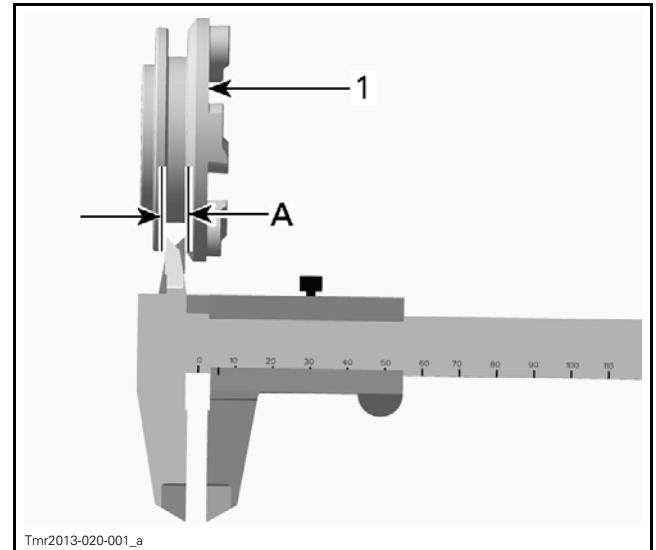
Check shifting sleeves for worn inner splines and rounded or damaged engagement dogs.



TYPICAL

1. Inner splines
2. Engagement dogs

Measure the width of shift fork engagement groove.



TYPICAL

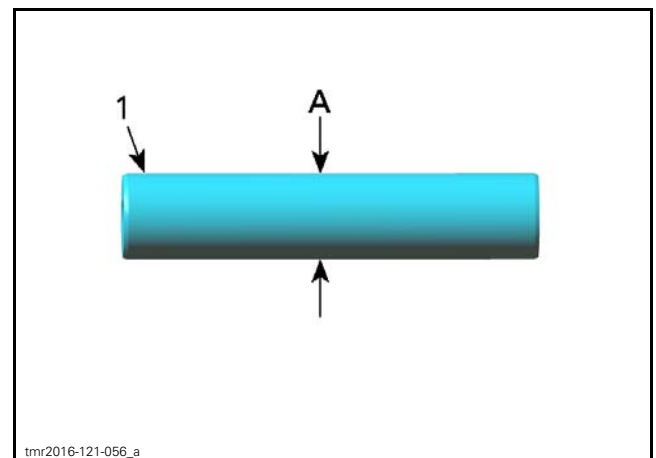
1. Shifting sleeve
- A. Width of shift fork engagement groove

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.



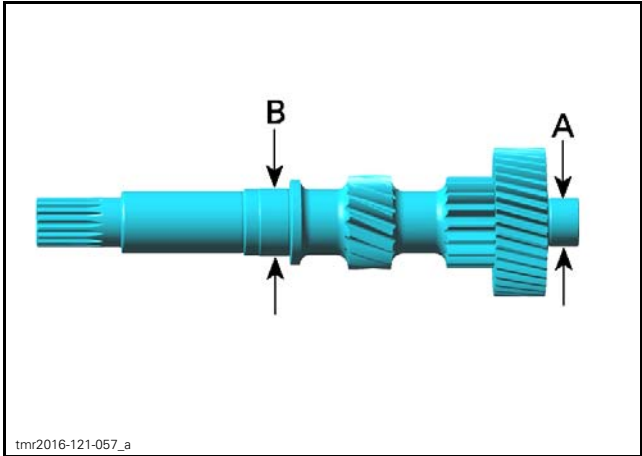
1. Bearing pin
- A. Outer diameter

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.

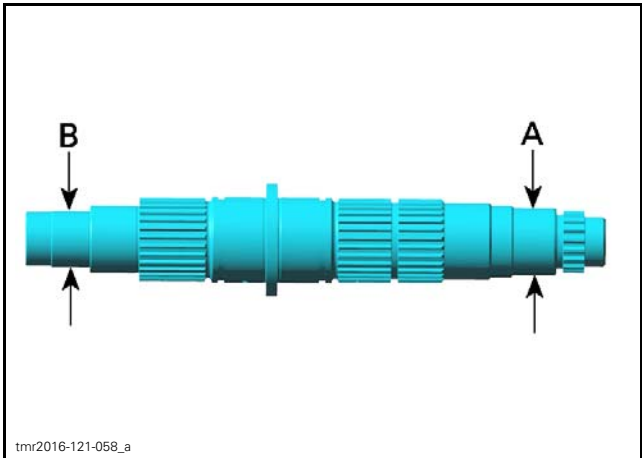
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))



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. Bearing journal CVT side

MAIN SHAFT 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

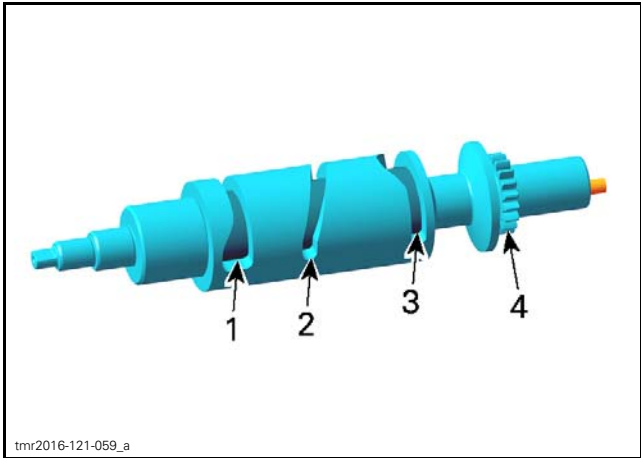
Check shift shaft for worn splines and gears.

Check shift shaft spring for damages.

Shift Drum

NOTICE Do not disassemble shift drum.

Check shift drum tracks for scouring or heavy wear, like rounded engagement slots.



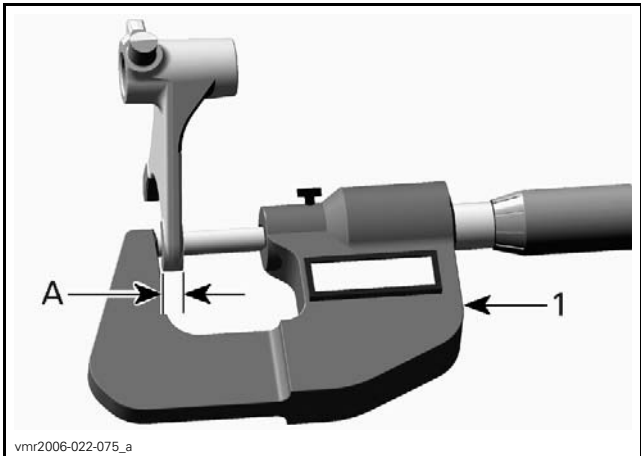
1. Track for the low/reverse range gear shift fork
2. Track for the shifting block
3. Track for the high range gear shift fork
4. Shift drum gear

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.



- TYPICAL
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.

Assembling the Gearbox and Shifting Mechanism

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

Prior to assembly lubricate ball bearing seats of:

- Main shaft
- Countershaft
- Intermediate shaft.

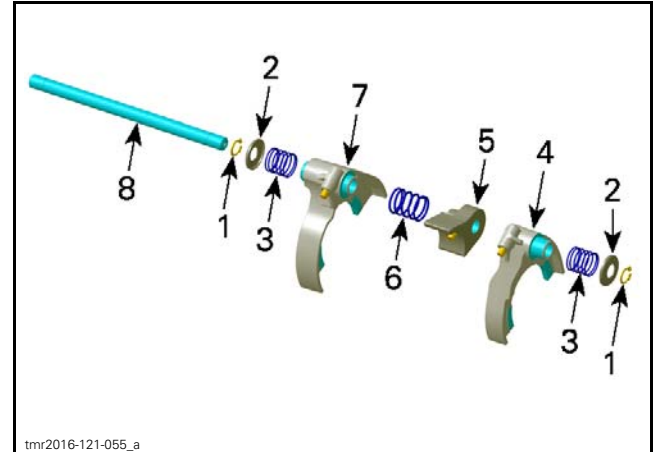
BALL BEARING SEATS LUBRICATION	
Service product	COPASLIP (P/N 420 297 430)

Assembling the Shift Fork Shaft Assembly

NOTICE Springs are not identical.

Install:

- NEW snap rings
- Spring seats
- Springs
- Shift forks
- Shifting block.

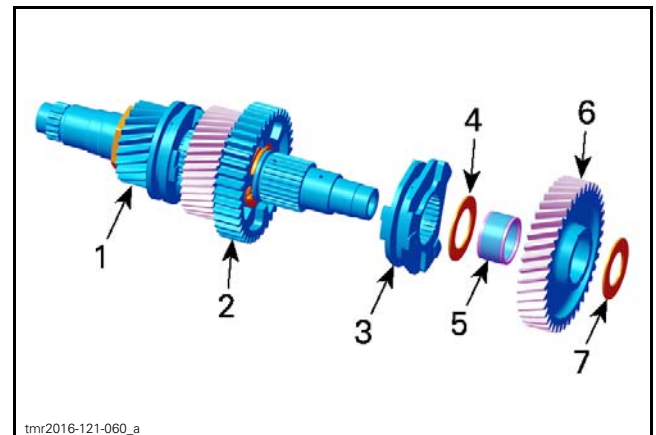


1. Snap rings
2. Spring seat
3. Outer springs
4. Shift fork HIGH
5. Shifting block
6. Center spring
7. Shift fork LOW/REVERSE
8. Shift fork shaft

Main Shaft, Shift Fork Shaft Assembly and Shift Drum

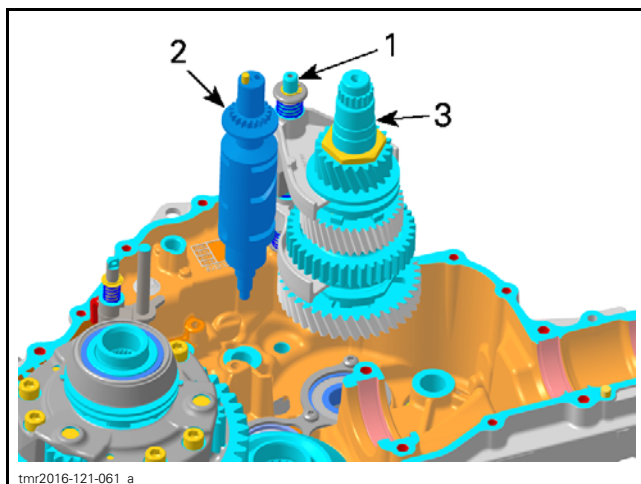
Install shifting sleeve, thrust washer and LOW gear pinion on main shaft assembly.

NOTE: Check if shifting sleeve engages correctly in reverse gear.



1. Main shaft assembly
2. Reverse gear
3. Shifting sleeve
4. Thrust washer
5. Needle bearing
6. LOW gear pinion
7. Thrust washer

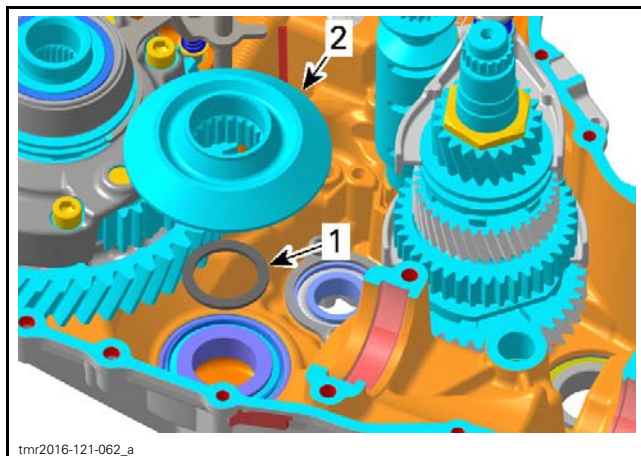
Install shift fork shaft assembly, shift drum and main shaft assembly together into gearbox housing.



1. Shift fork shaft assembly
2. Shift drum
3. Main shaft assembly

Pinion Drive Shaft and Intermediate Shaft

Ensure distance shim and bevel gear are placed on the pinion drive shaft bearing in gearbox housing.

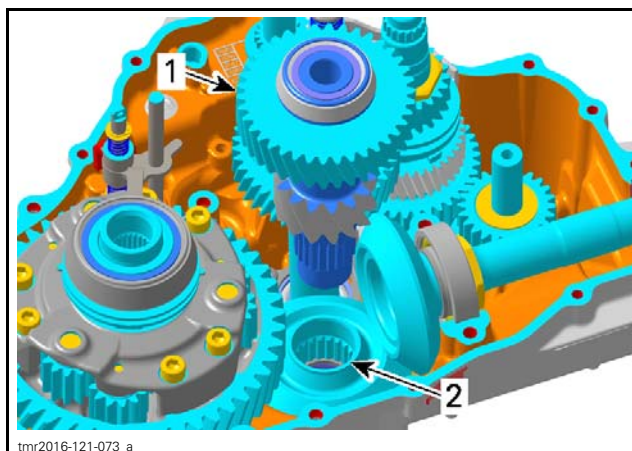


1. Distance shim
2. Bevel gear

Install:

1. Intermediate shaft
2. Pinion drive shaft.

Carefully fit pinion drive shaft into inner splines of bevel gear.

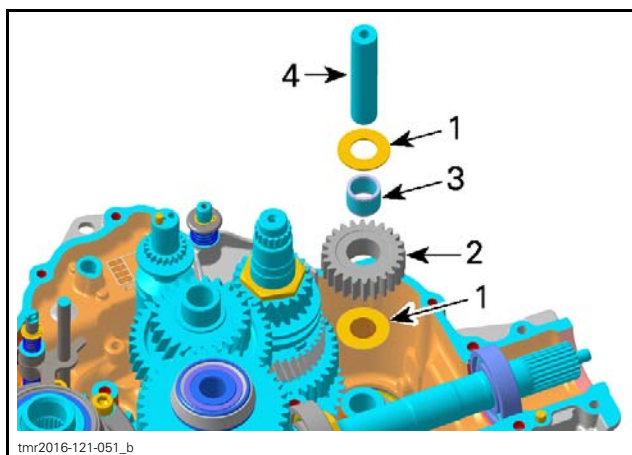


1. Pinion drive shaft
2. Bevel gear splines

Countershaft and Reverse Intermediate Gear

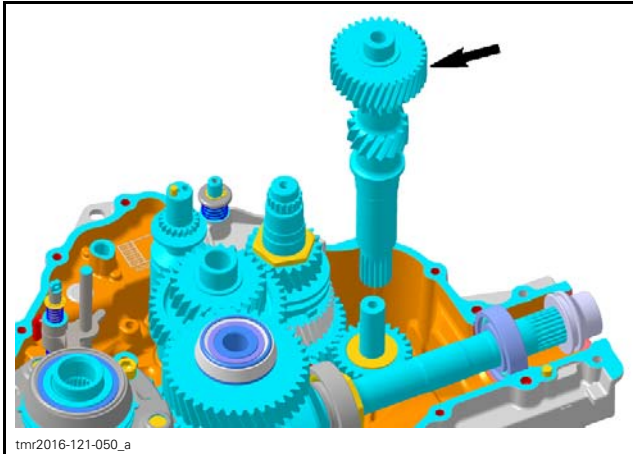
Install:

- Reverse intermediate gear
- Needle bearing
- Thrust washers
- Bearing pin.



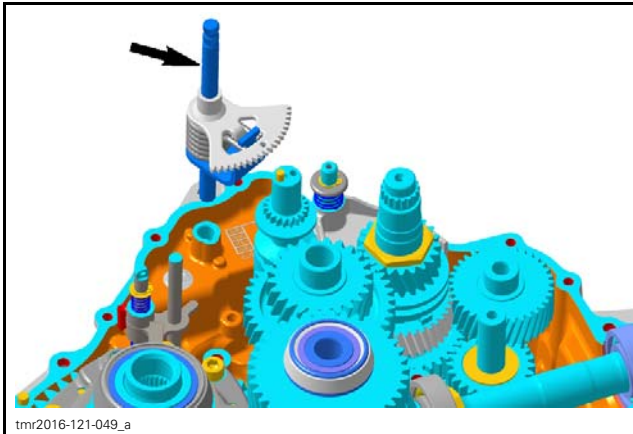
1. Thrust washers
2. Reverse intermediate gear
3. Needle bearing
4. Bearing pin

Install countershaft from.

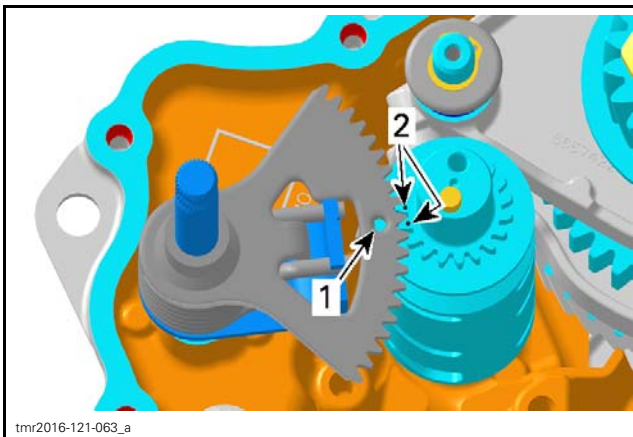


Shift Shaft Assembly

Install shift shaft assembly.



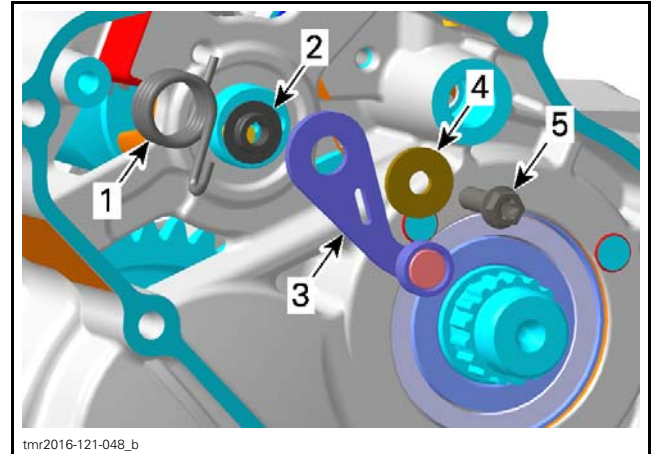
Align mark on shift shaft with marks on shift drum gear.



1. Mark on shift shaft
2. Marks on shift drum gear

Index Lever, Index Washer and Parking Lock Lever

Fit step ring into index lever.

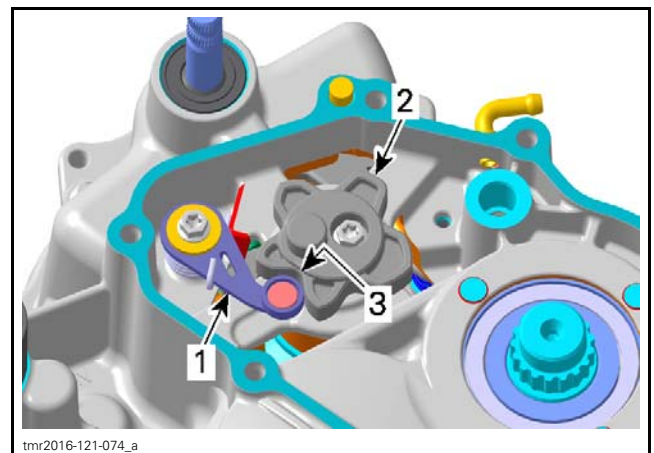


1. Index spring
2. Step ring
3. Index lever
4. Washer
5. Screw

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Index lever retaining screw	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Install index washer on shift drum.

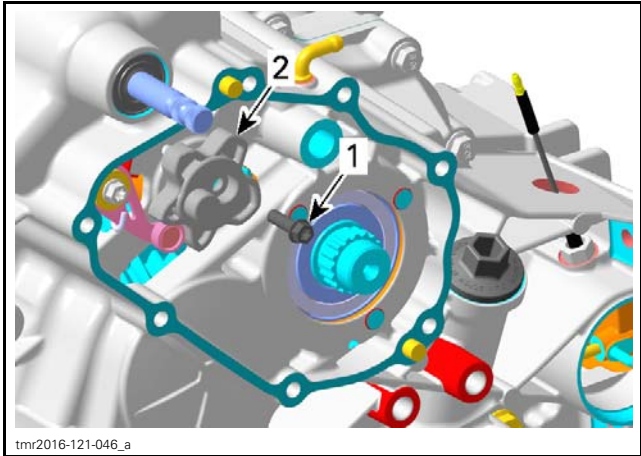
Insert a flat screwdriver in the slot of the index lever, turn screwdriver clockwise and engage lever in index washer in NEUTRAL position as per following illustration.



1. Index lever
2. Index washer
3. Neutral position

Install screw retaining the index washer to the shift drum.

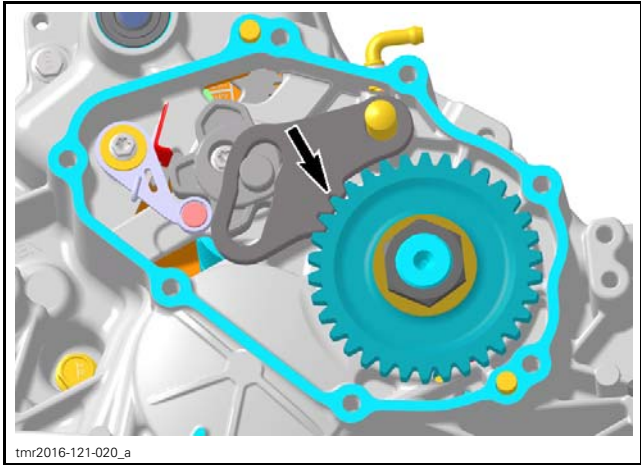
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(with lockable rear differential))



- 1. Screw
- 2. Index washer

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Index washer retaining screw	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

- Install:
- Park locking gear
 - Spring washer
 - Nut
 - Pin
 - Park locking lever.
- Set gearbox to PARK position.



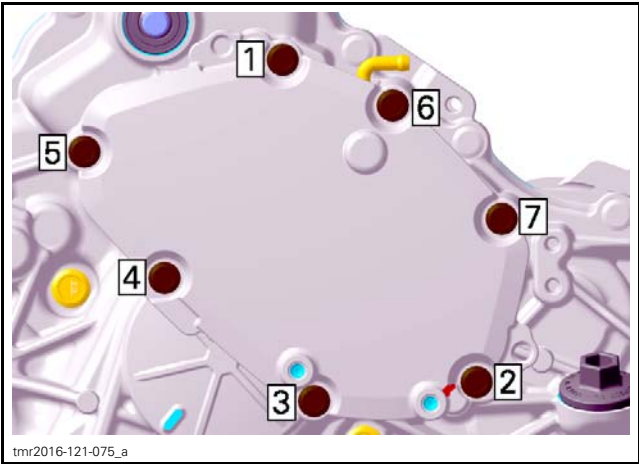
PARK LOCKING LEVER ENGAGED

Tighten nut to specification.

TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Park locking gear nut	170 N•m ± 10 N•m (125 lbf•ft ± 7 lbf•ft)

Install gearbox cover with **NEW** gasket.
Tighten gearbox cover screws as per following sequence.

TIGHTENING TORQUE	
Gearbox cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)



OUTPUT SHAFT AND 4X4 COUPLING MECHANISM

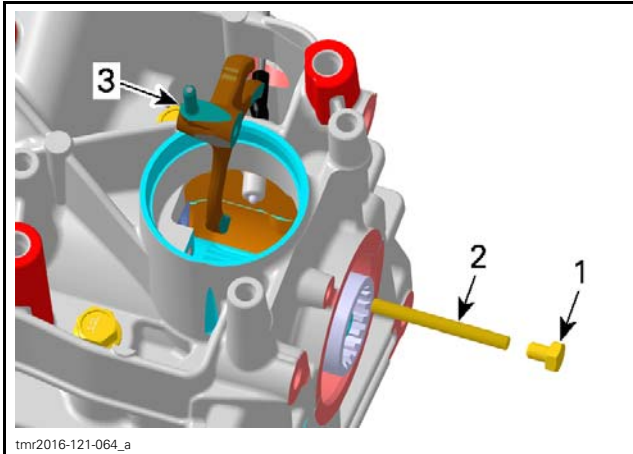
Removing the Output Shaft and 4X4 Coupling Mechanism

Drain gearbox oil. Refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove *4WD ACTUATOR*, refer to procedure in this subsection.

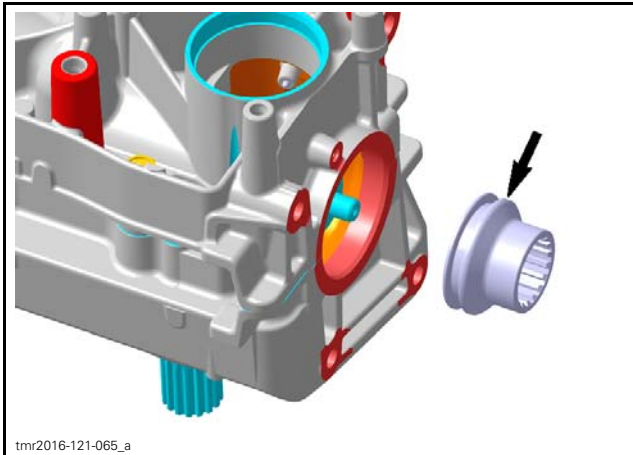
Detach *GEARBOX ASSEMBLY* from engine, refer to procedure in this subsection.

- Remove:
- Screw
 - Coupling fork shaft
 - Coupling fork.



1. Screw
2. Coupling fork shaft
3. Coupling fork

Pull out 4X4 coupling sleeve.



Inspecting the Output Shaft and 4X4 Coupling Mechanism

Output Shaft

Check output shaft and its gear for cracks, bend, pitting or other visible damages.

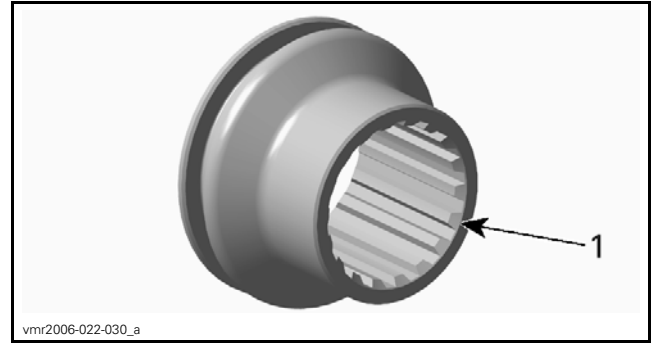
Check output shaft splines for wear or other damages.

Check if the output shaft bearings turn freely and smoothly.

Replace oil seal if brittle, hard or damaged.

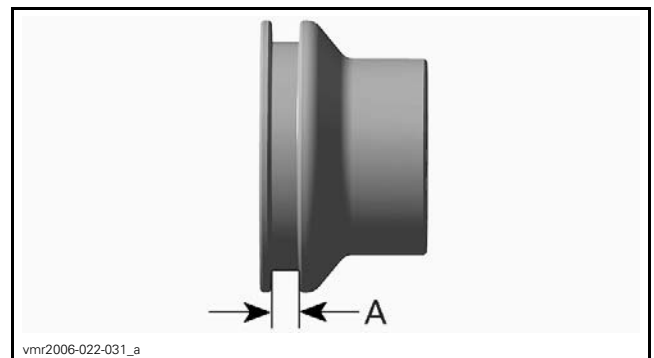
4X4 Coupling Sleeve

Check splines of coupling sleeve for wear or other damages.



1. Inspect splines

Measure the coupling sleeve groove width.



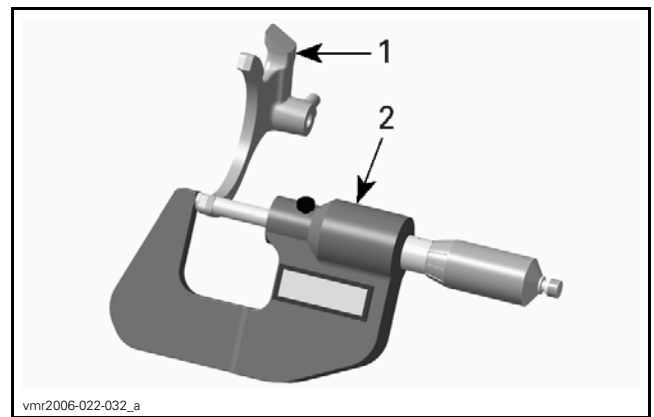
- A. Groove width

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)

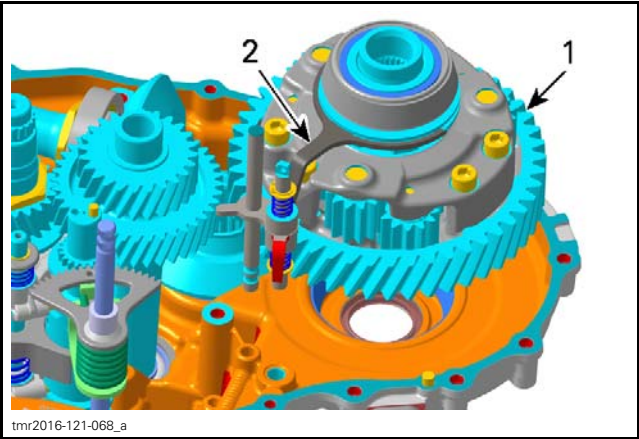
Installing the Output Shaft and 4X4 Coupling Mechanism

Install coupling sleeve onto the output shaft.

Install:

- Coupling fork
- Coupling fork shaft
- Screw.

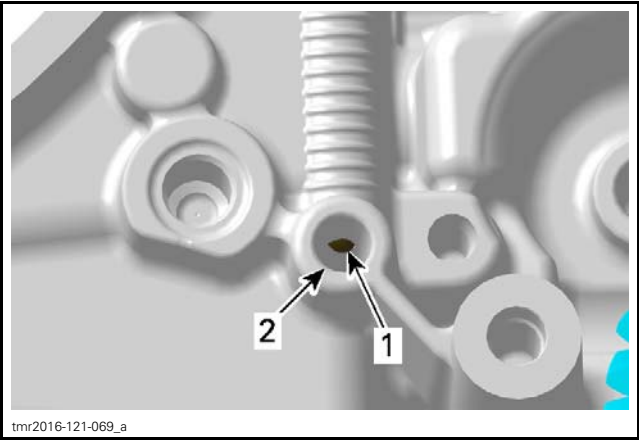
Ensure that coupling fork engages into the coupling sleeve groove.



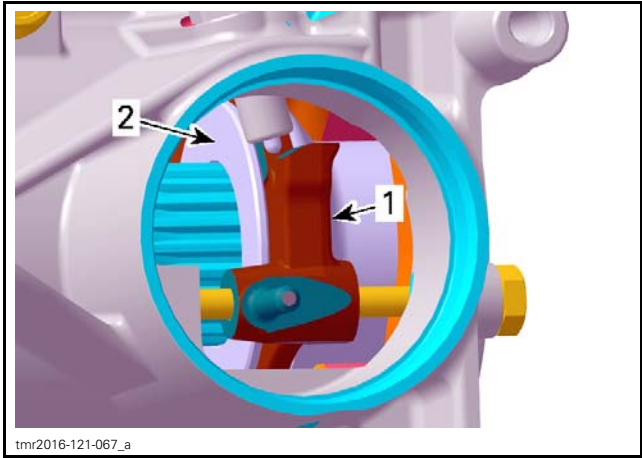
1. Rear differential
2. Locking mechanism

Inspecting the Rear Differential and Locking Mechanism

Check for ball of locking mechanism setting in gearbox housing.



1. Ball
2. Bore of locking mechanism in gearbox housing



1. Coupling fork
2. Coupling sleeve

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Coupling fork shaft screw	6 N•m ± 0.7 N•m (53 lbf•in ± 6 lbf•in)

REAR DIFFERENTIAL AND LOCKING MECHANISM

Removing the Rear Differential and Locking Mechanism

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

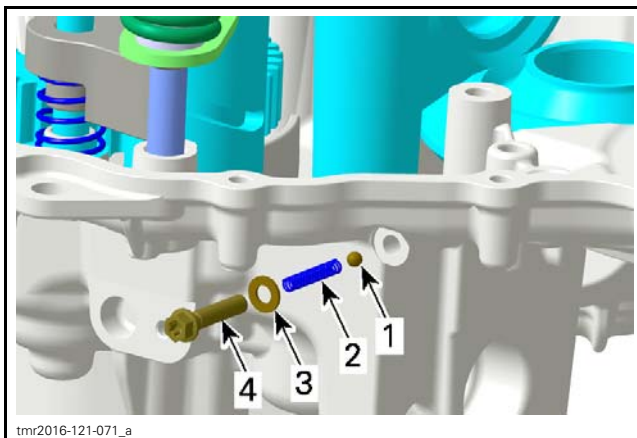
Remove rear differential together with locking mechanism.

Take care not losing the distance shim underneath tapered roller bearing.

Installing the Rear Differential and Locking Mechanism

Install:

- Ball
- Spring
- Sealing ring
- Screw.

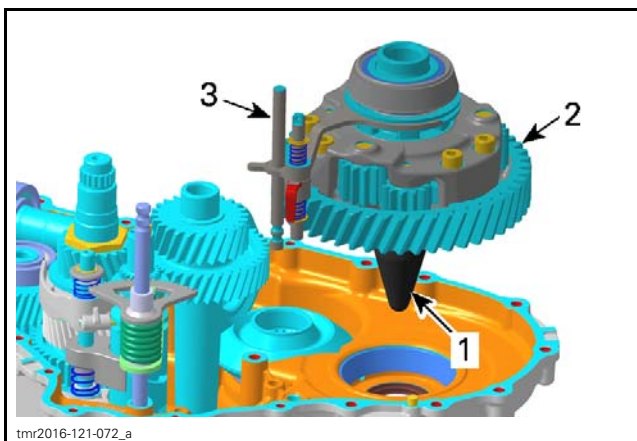


1. Ball
2. Spring
3. Sealing ring
4. Screw

TIGHTENING TORQUE	
Screw	$8 \text{ N}\cdot\text{m} \pm 1 \text{ N}\cdot\text{m}$ $(71 \text{ lbf}\cdot\text{in} \pm 9 \text{ lbf}\cdot\text{in})$

Install rear differential together with locking mechanism.

REQUIRED TOOL	
SLEEVE INSTALLER (P/N 529 036 381)	



1. Sleeve installer
2. Rear differential
3. Locking mechanism

GEARBOX AND 4X4 COUPLING UNIT (without rear lockable differential)

SERVICE TOOLS

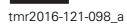
Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	8
FLUKE 115 MULTIMETER	529 035 868	5, 9
HANDLE	420 877 650	12
M34 SOCKET	529 036 388	14, 19
OIL SEAL INSTALLER (COUNTERSHAFT)	529 036 391	11
OIL SEAL INSTALLER (DIFFERENTIAL OUTPUT)	529 036 390	12
OIL SEAL INSTALLER (GEARBOX)	529 035 758	12
SLEEVE INSTALLER.....	529 036 381	12, 17, 30
SPLINES SOCKET 1/2"	529 036 389	14, 19

SERVICE TOOLS – OTHER SUPPLIER

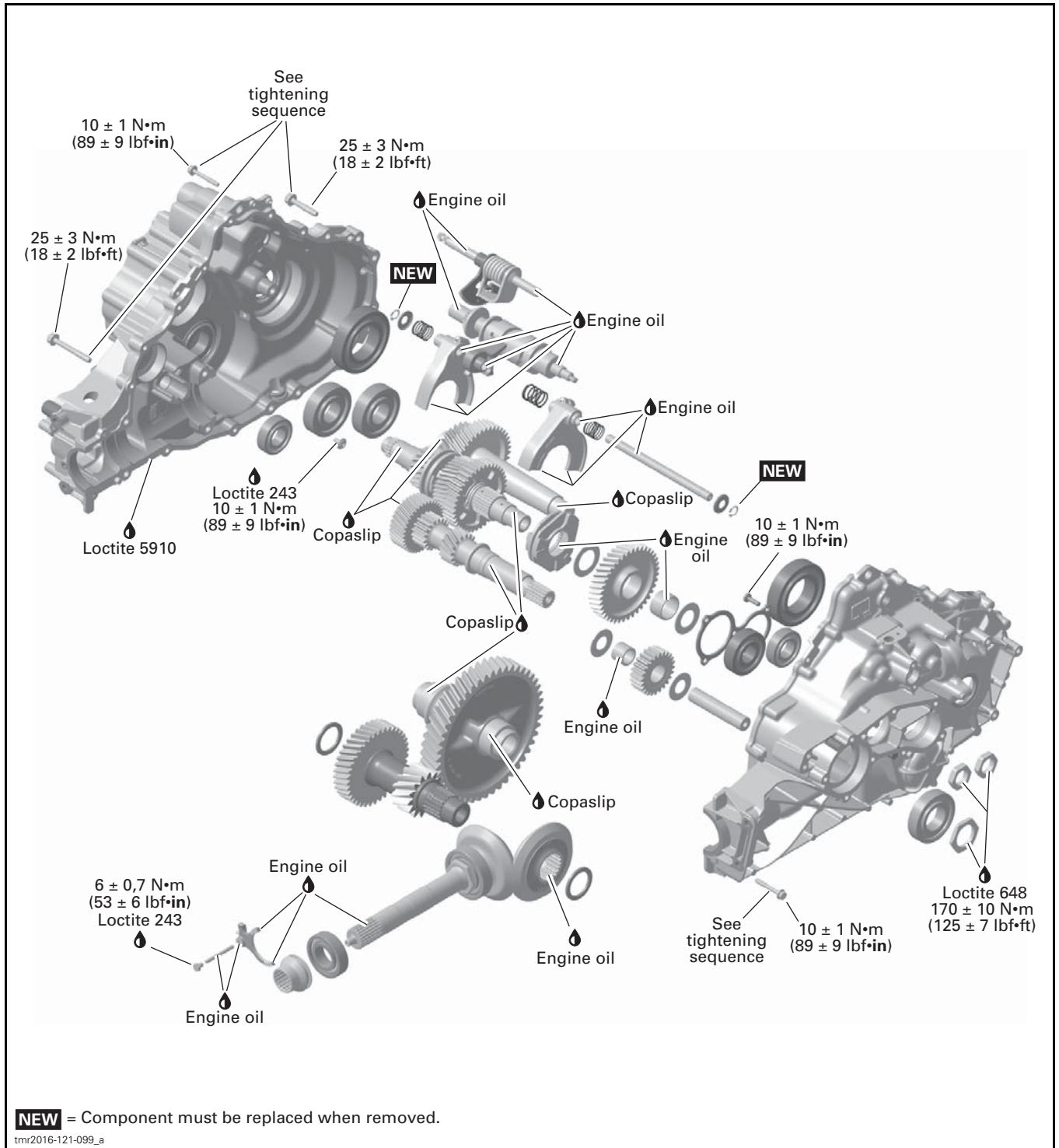
Description	Part Number	Page
BACK PROBE TEST WIRES	529 036 063	5, 7

SERVICE PRODUCTS

Description	Part Number	Page
COPASLIP.....	420 297 430	25
LOCTITE 243 (BLUE).....	293 800 060	13, 17, 27–28, 30
LOCTITE 5910	293 800 081	9, 17, 19
LOCTITE 648 (GREEN)	413 711 400	19, 28
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	17
PETAMO GREASE GHY 133N	420 899 271	11
SUPER LUBE GREASE.....	293 550 030	6, 9

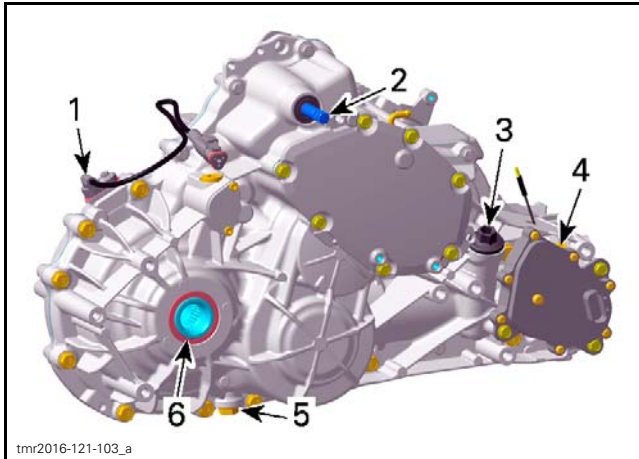


GEARBOX COMPONENTS AND 4X4 COUPLING MECHANISM

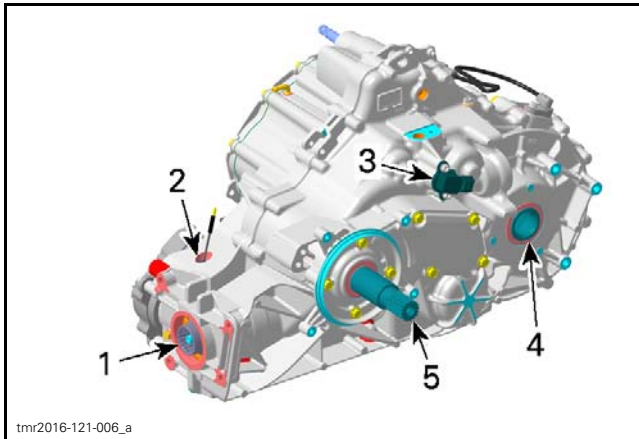


GENERAL

GEARBOX OVERVIEW



1. Vehicle speed sensor (VSS)
2. Shift shaft
3. Gearbox oil dipstick
4. 4WD actuator
5. Magnetic drain plug
6. Drive gear



1. 4WD coupling sleeve
2. 4WD indicator switch
3. Gearbox position sensor (GBPS)
4. Drive gear
5. Countershaft

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 4WD actuator.
 - Test 4WD actuator.
3. Damaged or worn shifting fork or sleeve.
 - Remove 4WD actuator and inspect shifting fork and sleeve.

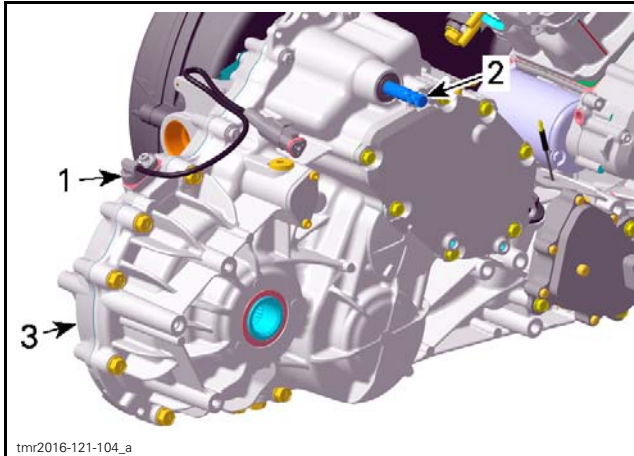
PROCEDURES

VSS (VEHICLE SPEED SENSOR)

VSS Location

The vehicle speed sensor is located on the rear top side of the left gearbox housing.

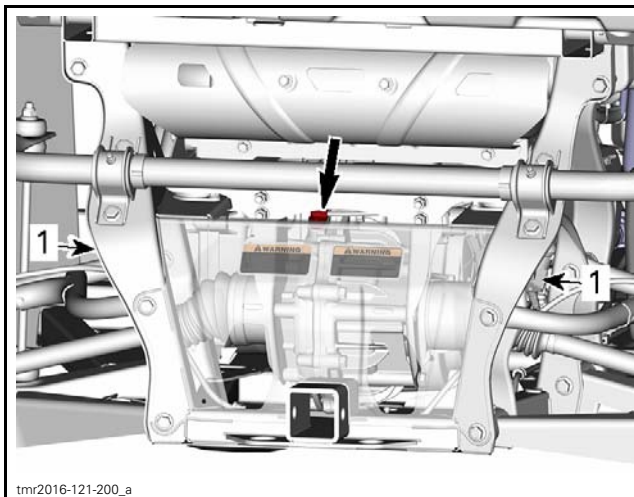
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))



1. VSS (Vehicle Speed Sensor)
2. Shift shaft
3. Left housing of gearbox

VSS Access

The VSS is accessible by the rear of the vehicle.



1. Go through the sides to access the VSS

VSS Wire Identification

FUNCTION	PIN	COLOR SENSOR CONNECTOR
12-volt input from fuse F5	A	RED
Speed signal (to ECM-A E1)	B	WHITE
Ground (to ECM-A D4)	C	BLACK

VSS Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay activated	Fuse 5 of fuse block 2 (from main relay R2)

Testing the VSS Input Voltage

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 wire)	Battery voltage

If voltage is not as specified, test positive and ground separately.

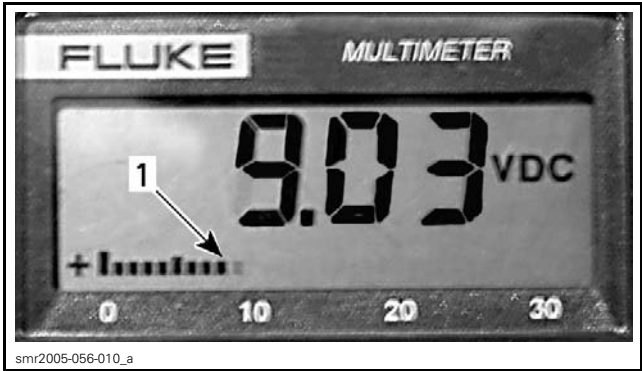
Testing the VSS Signal

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 wire)	Alternate reading between battery voltage and 0 Vdc

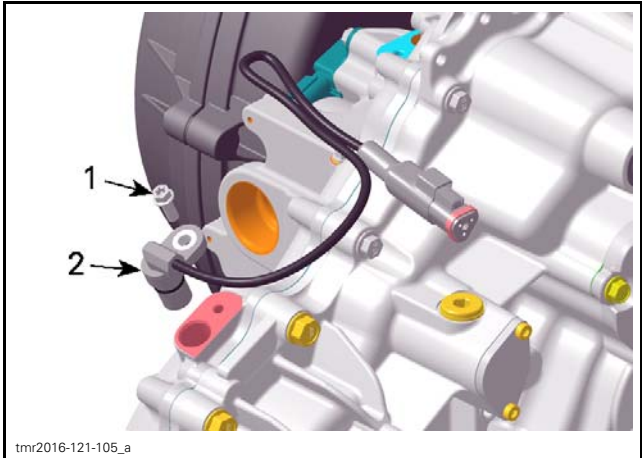
NOTE: Since we measure pulsating voltage, the numeric display will continuously change. The analog display may be easier to follow.



1. Analog display

Removing the VSS

- Disconnect VSS connector.
- Remove screw retaining the VSS.
- Using a long screwdriver, pull out the VSS.



SEVERAL PARTS REMOVED FOR CLARITY
1. Screw
2. VSS

Installing the VSS

- For installation, reverse the removal procedure. Pay attention to the following.
- Lubricate VSS O-ring.

VSS O-RING	
Service product	SUPER LUBE GREASE (P/N 293 550 030)

Tighten retaining screw to specification.

TIGHTENING TORQUE	
VSS screw retaining	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

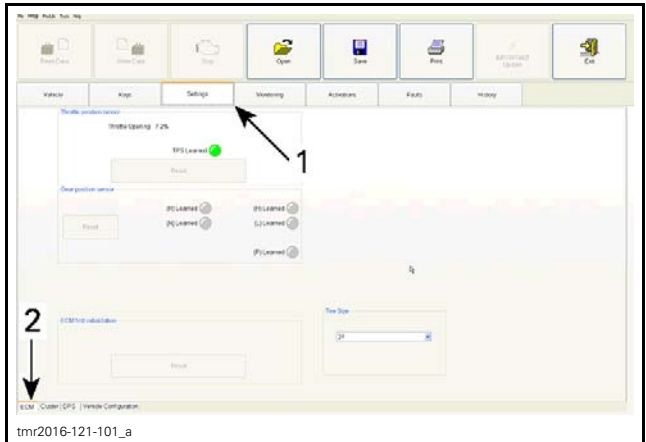
GBPS (GEARBOX POSITION SENSOR)

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:

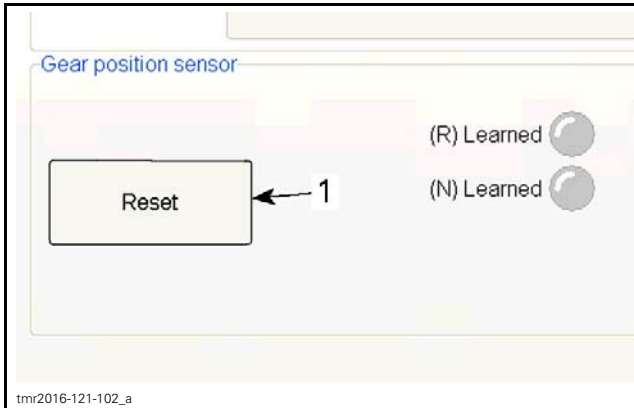
- Gearbox assembly
 - Shift drum
 - GBPS
 - ECM.
1. Connect vehicle to the latest applicable version of B.U.D.S. software, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
 2. In B.U.D.S., select the following:
 - **Setting** page tab
 - **ECM** tab.



1. Setting page tab
2. ECM tab

3. Set shift lever in NEUTRAL position.
4. In the **Gear Position Sensor** field, click on the **Reset** button.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))



tmr2016-121-102_a
GEAR POSITION SENSOR FIELD
1. Reset button

A message will be displayed if the operation is successful.

If an error occurred or the GBPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

5. If a fault message is displayed, follow the instructions in the message(s).

6. Check for fault codes.

If a fault code is generated:

- Carry out the service action.
- Reset the fault code.
- Repeat the reset procedure.

7. Close and disconnect B.U.D.S.

NOTE: Do not turn ignition key OFF.

8. Verify gears engagement.

8.1 With the vehicle on ground and in 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

Tilt the cargo box.

Testing the GBPS Input Voltage

NOTE: Prior to conduct testing, check fault codes in B.U.D.S.

Set shift lever in NEUTRAL position.

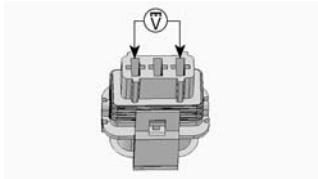
Back-probe the GBPS connector.

REQUIRED TOOL

BACK PROBE TEST WIRES
(P/N 529 036 063)

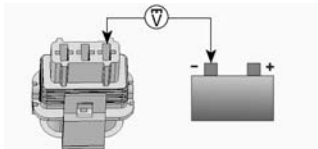
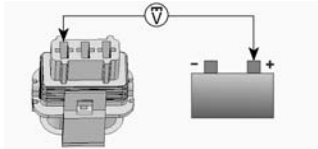


Test as follow:

MULTIMETER PROBE POSITIONS	VOLTAGE
PIN 2 and PIN 3 of the GBPS connector 	5 volts

If voltage is adequate, check GBPS signal wire.

If there is no voltage, check each GBPS input as follows.

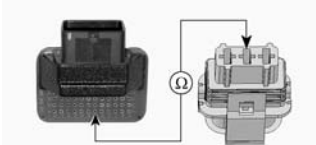
MULTIMETER PROBE POSITIONS	VOLTAGE
GBPS connector (pin 3) and battery ground 	5 volts
GBPS connector (pin 2) and battery + terminal 	Battery voltage

If there is no voltage, check wires and connector pins. Replace or repair defective parts and reset fault codes.

Testing the GBPS Communication Link Continuity

Unplug connector "A" from ECM and connect it to the ECM adapter tool.

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))

REQUIRED TOOL	
#ECM ADAPTER TOOL (P/N 529 036 166)	
MULTIMETER PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
GBPS connector (pin 1) 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.

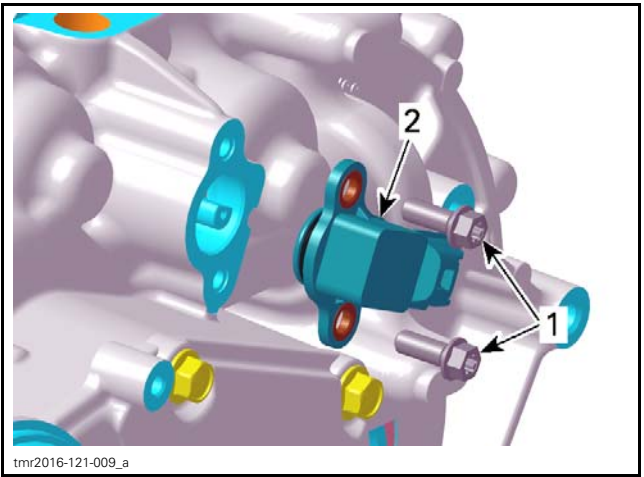
NOTE: The GBPS must be reset.

Removing the GBPS

Set shift lever in NEUTRAL position.

Unplug GBPS connector.

Remove screws and withdraw GBPS.



- 1. Screws
- 2. Gearbox Position Sensor (GBPS)

Installing the GBPS

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.

NOTE: Do not force to install GBPS if shaft flat is not properly aligned. If alignment is incorrect, check shift rod adjustment.

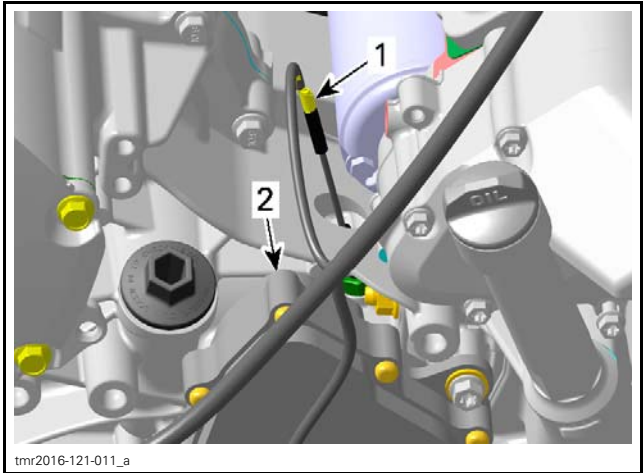


Reset the GBPS. Refer to *GBPS RESET* in this subsection.

4WD INDICATOR SWITCH

Testing the 4WD Indicator Switch

Disconnect 4WD indicator switch connector.



- 1. 4WD indicator switch
- 2. 4WD actuator

Measure switch resistance as follows.

SWITCH POSITION	SWITCH WIRE		RESISTANCE
2WD	BLACK/ BEIGE	Engine ground	Infinite (OL)

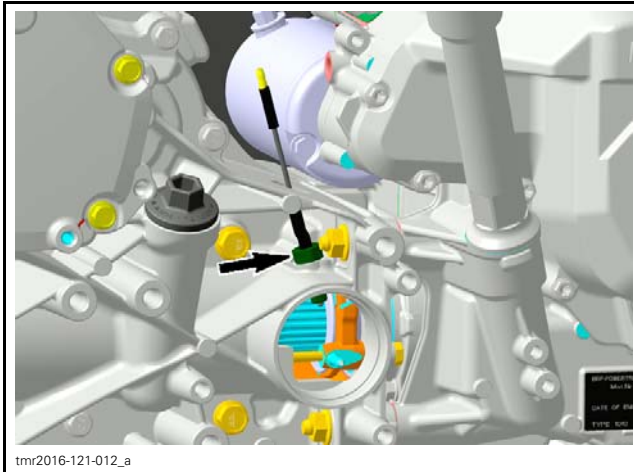
If the resistance is out of specification, replace the 4WD indicator switch.

4WD Indicator Switch Access

Remove *4WD ACTUATOR*, refer to procedure in this subsection.

Removing the 4WD Indicator Switch

Disconnect 4WD indicator switch connector and unscrew 4WD indicator switch.



Installing the 4WD Indicator Switch

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 sealant on threads of indicator switch.

NOTICE Do not apply Loctite 5910 on switch plunger, as it will lead to switch malfunction.

TIGHTENING TORQUE	
Service product	LOCTITE 5910 (P/N 293 800 081)
4WD indicator switch	1.5 N•m to 2 N•m (13 lbf•in to 18 lbf•in)

4WD ACTUATOR

4WD Actuator Access

Tilt the cargo box.

Testing the 4WD Actuator

Check if the 2WD/4WD selector works properly.

Unplug 4WD 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	WHITE/BLUE	Battery voltage
4WD			

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 4WD actuator.

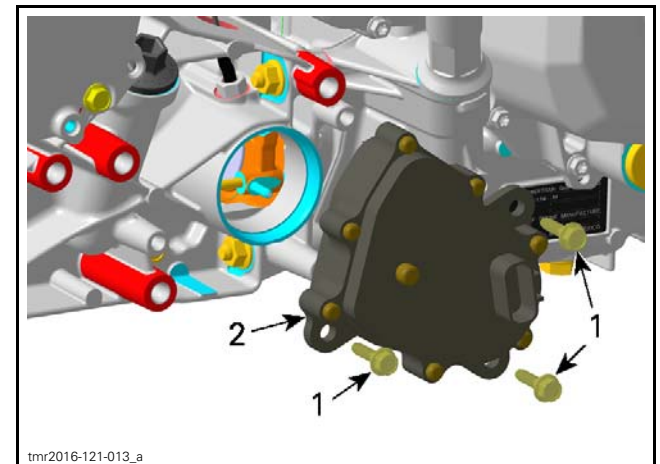
Removing the 4WD Actuator

NOTE: Before beginning any servicing on the 4WD actuator, make sure the vehicle is in 4WD position. No need to remove engine from vehicle.

Place a drain pan under 4WD actuator.

Remove:

- 4WD actuator screws
- 4WD actuator.

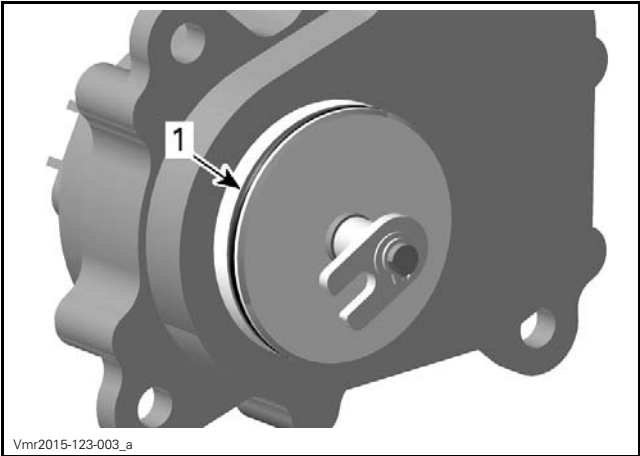


1. Screws
2. 4WD actuator

Installing the 4WD Actuator

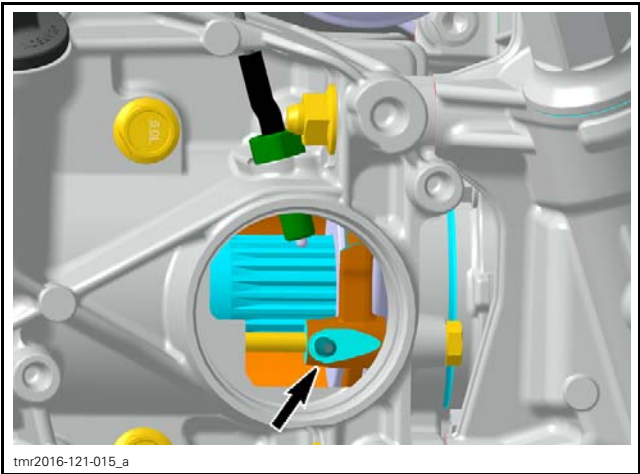
Lubricate 4WD actuator O-ring.

4WD ACTUATOR O-RING	
Service product	SUPER LUBE GREASE (P/N 293 550 030)



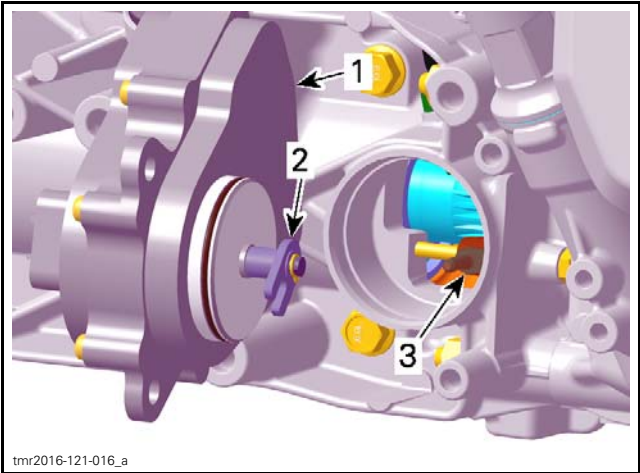
1. 4WD actuator O-ring

Ensure coupling fork is in 4WD position (toward the front of vehicle).



1. Coupling fork in 4WD position

Align the 4WD actuator fork with the pin on coupling fork then push the 4WD actuator in the housing. See the following illustration to position the 4WD actuator correctly.



1. 4WD actuator
2. 4WD actuator fork
3. Coupling fork

Rotate the 4WD actuator counterclockwise until it orients itself to mounting position.

NOTICE Do not cut or break the 4WD actuator O-ring.

Install all 4WD actuator screws and tighten them.

TIGHTENING TORQUE	
4WD actuator screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Connect 4WD actuator.

Set gearbox to PARK position.

Lift the front of vehicle.

Turn front wheels. The front propeller shaft should not turn.

If the front propeller shaft turns, the 4WD actuator is not installed correctly. Remove 4WD 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 4WD actuator is not installed correctly. Remove 4WD 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.

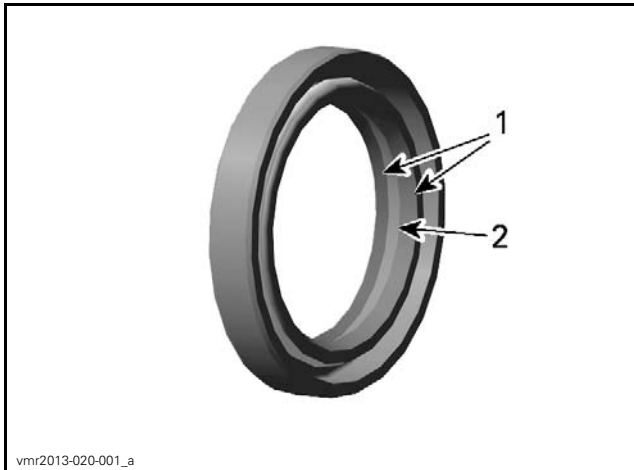
When replacing an oil seal, take this opportunity to inspect the following:

- Check bearings behind each oil seal for contamination and/or metal shavings.
- Check oil seal running surfaces for scratches.

Oil Seal Lubrication

When installing or reinstalling oil seals, use PETAMO GREASE GHY 133N (P/N 420 899 271) to:

- Lubricate sealing lips all around.
- Fill up the room between sealing lips halfway around the perimeter.

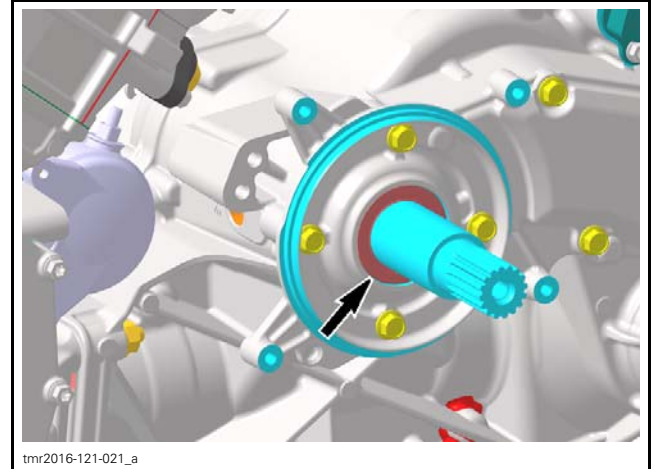


1. Sealing lips
2. Room between sealing lips

Countershaft Oil Seal

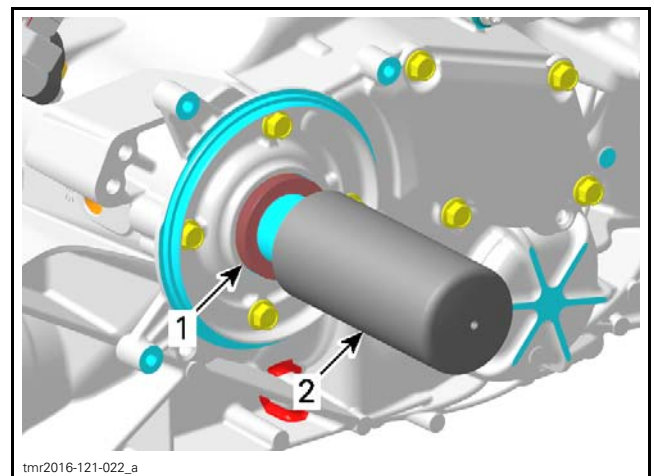
To replace the countershaft oil seal, remove:

- Drive and driven pulleys
- CVT air guide.



Install countershaft oil seal.

REQUIRED TOOL	
OIL SEAL INSTALLER (COUNTERSHAFT) (P/N 529 036 391)	

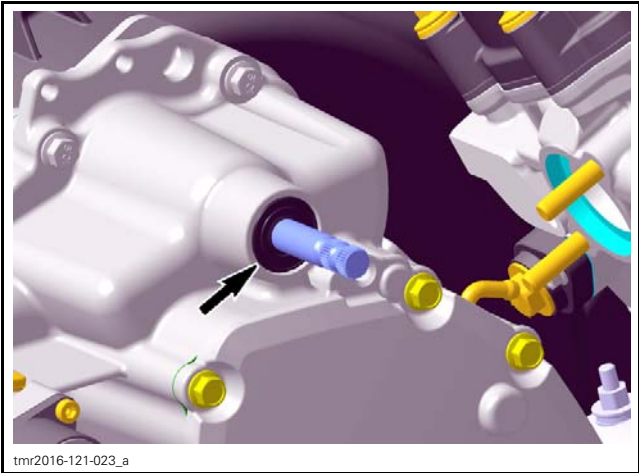


1. Countershaft oil seal
2. Oil seal installer

Shift Shaft Oil Seal

Remove the shift plate. Refer to *SHIFTER* subsection.

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.

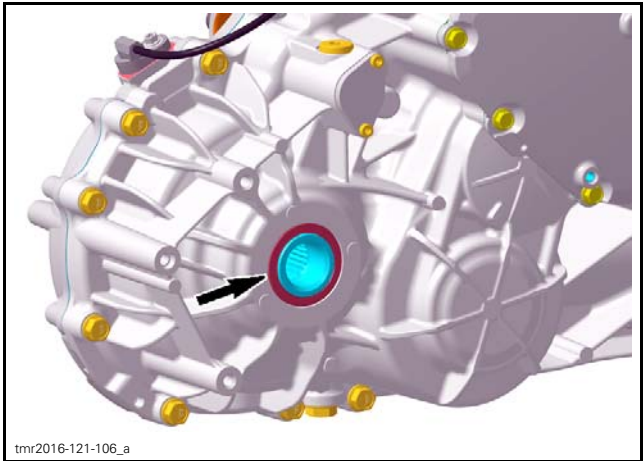


Use a suitable tube with the proper diameter to install the oil seal.

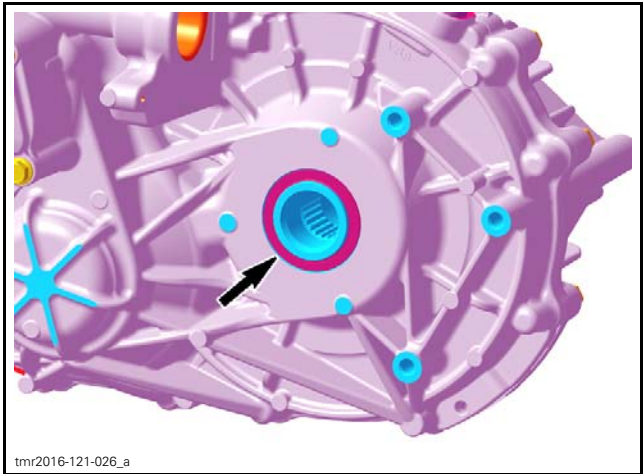
NOTICE Oil seal must be installed with sealing lip toward gearbox.

Drive Geart Oil Seals

Remove the appropriate drive shaft. Refer to *REAR DRIVE* subsection.



RIGHT SIDE

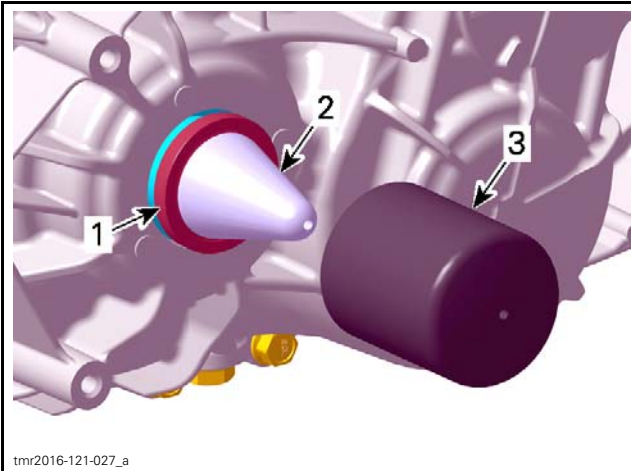


LEFT SIDE

Punch a sharp screwdriver through oil seal for removal.

Place oil seal on output shaft and install it using the following tools.

REQUIRED TOOL	
SLEEVE INSTALLER (P/N 529 036 381)	
OIL SEAL INSTALLER (DIFFERENTIAL OUTPUT) (P/N 529 036 390)	



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1. Output shaft oil seal
2. Sleeve installer
3. Oil seal installer

GEARBOX ASSEMBLY

Removing the Gearbox Assembly

Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* for the procedure.

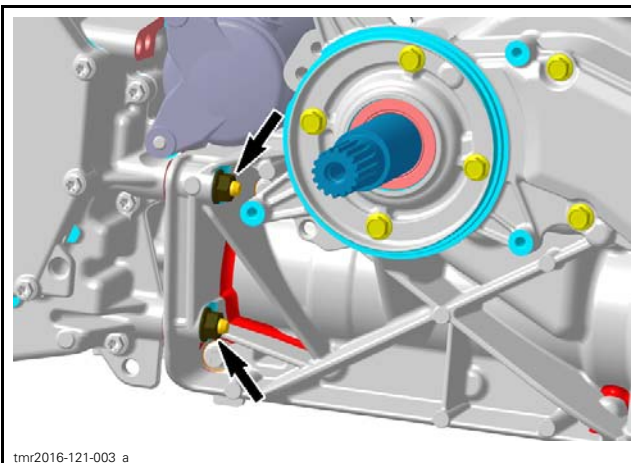
Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection to remove following parts:

- CVT cover
- Drive and driven pulleys
- CVT air guide.

Drain gearbox oil. Refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

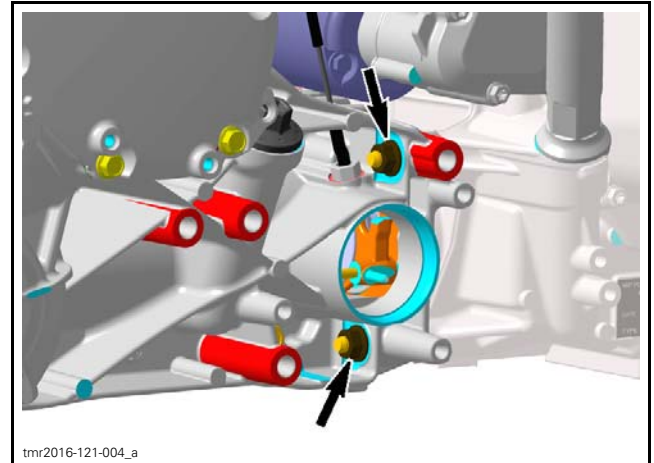
Remove *4WD ACTUATOR*, see procedure in this subsection.

Unscrew the four (4) gearbox retaining nuts.



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LH SIDE OF ENGINE



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RH SIDE OF ENGINE

Pull gearbox to separate it from engine.

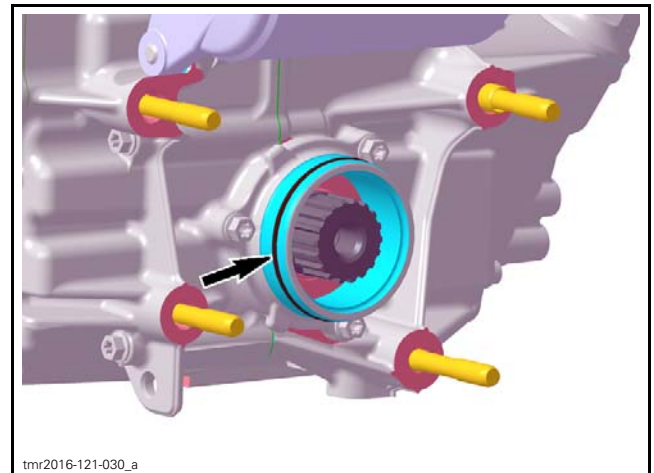
Installing the Gearbox

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

Before gearbox installation check O-ring on bearing cover if brittle, hard or damaged. Replace if necessary.

Lubricate O-ring on rear bearing cover.

O-RING LUBRICATION	
Service product	Engine oil



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Tighten gearbox retaining nuts to specification.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Gearbox retaining nuts	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)

After installation refill gearbox oil, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

GEARBOX HOUSING

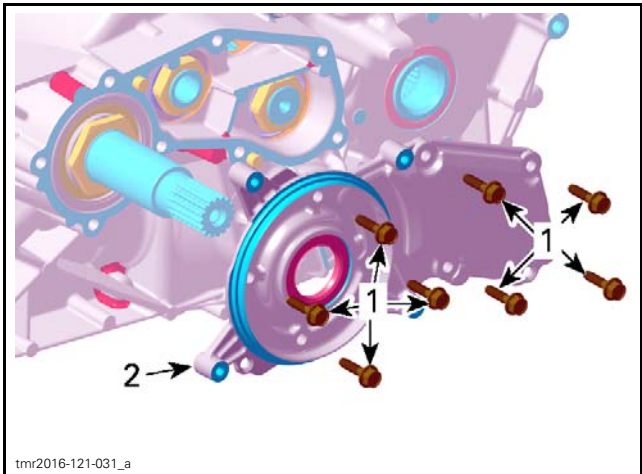
Disassembling the Gearbox Housing

See procedures in this subsection to remove:

- 4WD ACTUATOR
- GBPS (GEARBOX POSITION SENSOR).

Set gearbox to PARK position.

Remove bearing cover.

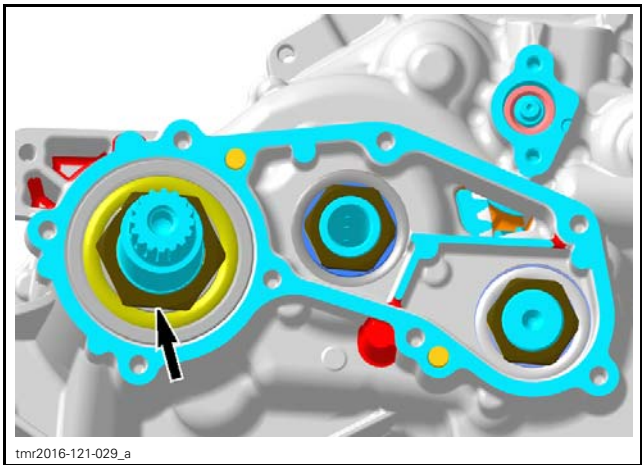


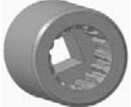
- 1. Retaining screws
- 2. Bearing cover

Remove countershaft nut.

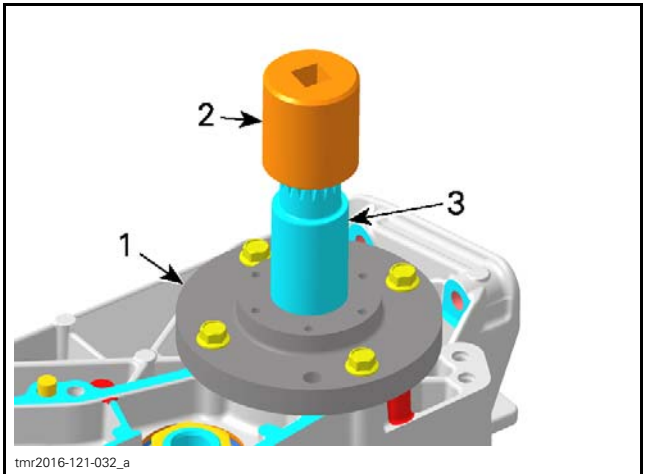
NOTE: Heat up nut with a heat gun to break threadlocker.

CAUTION Nut can loosen abruptly.



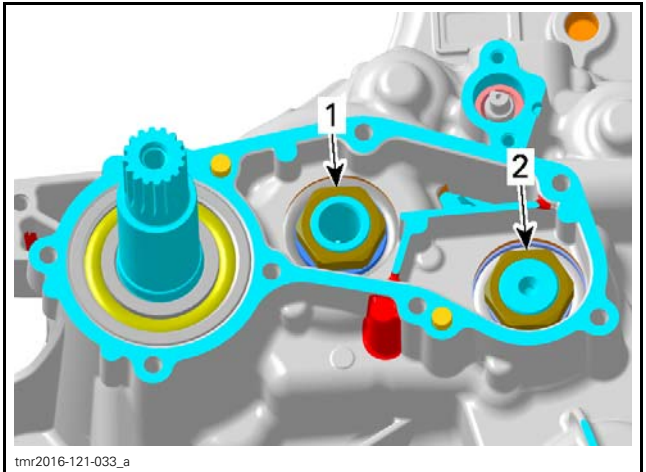
REQUIRED TOOL	
M34 SOCKET (P/N 529 036 388)	
SPLINES SOCKET 1/2" (P/N 529 036 389)	

NOTICE Turn spline socket clockwise to loosen the nut.



- 1. M34 socket
- 2. Spline socket
- 3. Countershaft

Remove nuts of main shaft and intermediate shaft.



- 1. Main shaft nut
- 2. Intermediate shaft nut

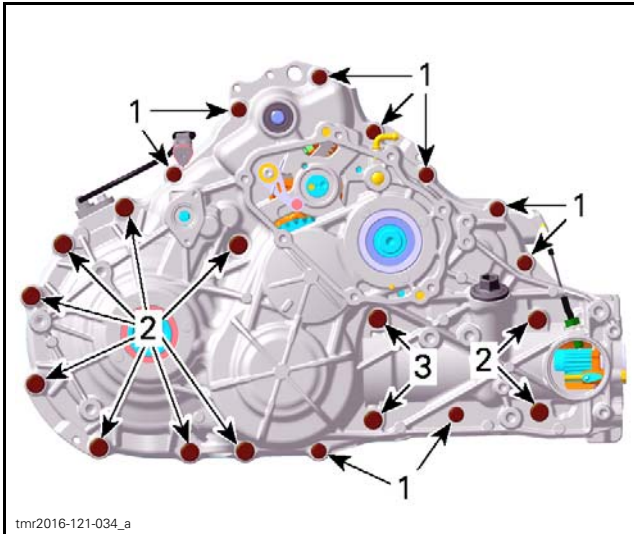
Refer to *GEARBOX AND SHIFTING MECHANISM* in this subsection and remove:

- Parking lock gear
- Index washer.

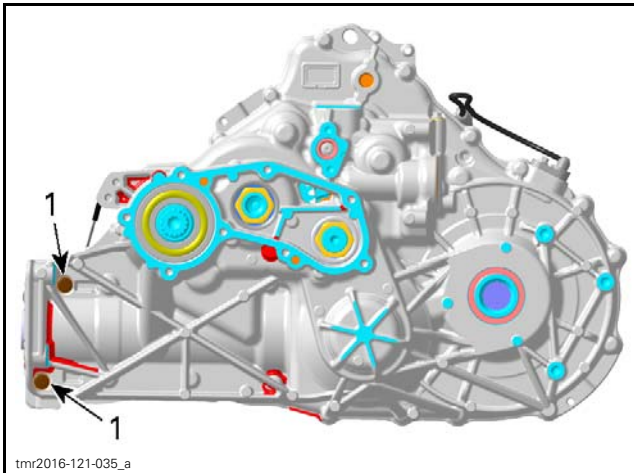
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))

Remove all gearbox housing screws:

1. Start removing the M6 screws.
2. Then remove the M8 screws.

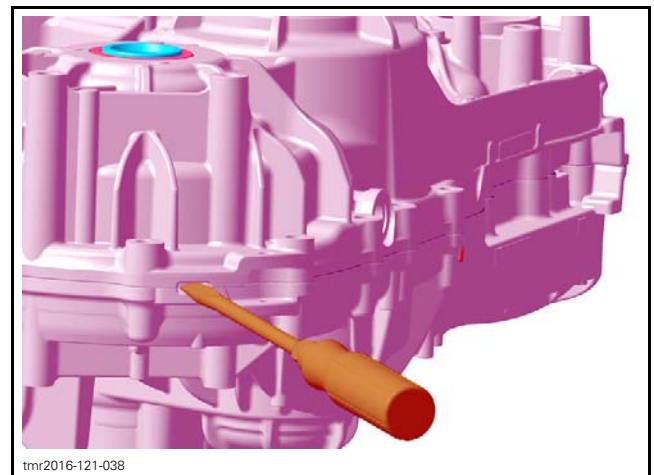
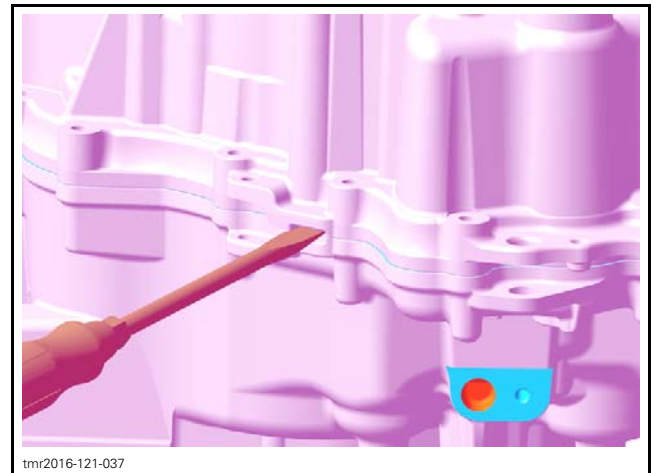
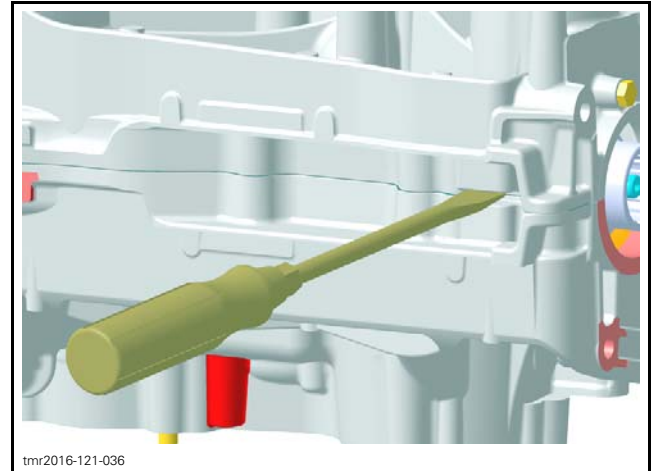


1. 11 screws M6 x 45
2. 10 screws M8 x 45
3. 2 screws M8 x 65



1. 2 screws M6 x 45

Separate gearbox housing, use 2 big screwdrivers.



If necessary, refer to procedures in this subsection and remove:

- GEARBOX AND SHIFTING MECHANISM
- OUTPUT SHAFT AND COUPLING MECHANISM
- DRIVE GEAR.

Inspecting the Gearbox Housing

Check gearbox ball bearings for: contamination and/or metal shavings.

Check if ball bearings turn freely and smoothly. Replace if necessary.

Bearing Replacement

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.

Use a blind hole bearing puller to remove ball bearings of:

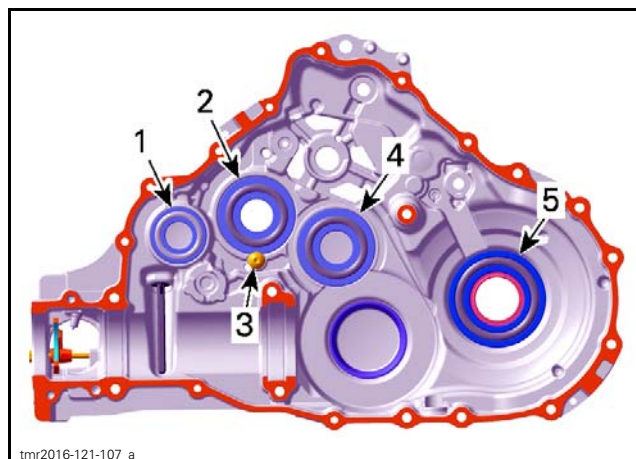
- Countershaft (right cover)
- Intermediate shaft (right cover).

Remove retaining plate securing the main shaft and intermediate shaft bearings in the left housing.

Remove screw securing the main shaft bearing in the right cover.

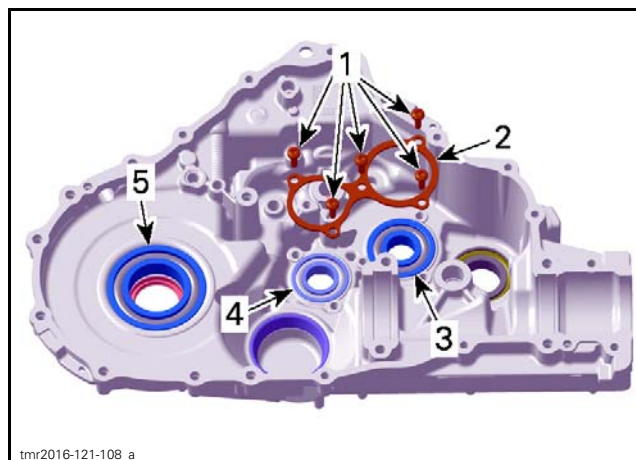
Use a suitable puller to remove ball bearings of:

- Main shaft (right and left cover)
- Countershaft (left cover)
- Intermediate shaft (left cover)
- Drive gear ball bearings (right and left cover).



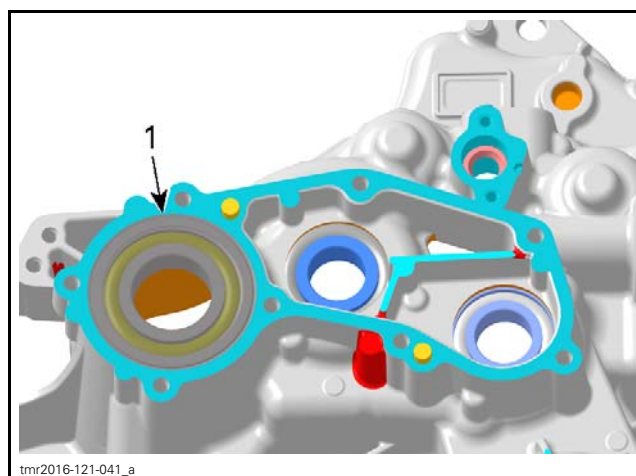
RIGHT GEARBOX HOUSING

1. Ball bearing countershaft
2. Ball bearing main shaft
3. Screw
4. Ball bearing intermediate shaft
5. Ball bearing drive gear



LEFT GEARBOX HOUSING

1. Screws
2. Retaining plate
3. Ball bearing main shaft
4. Ball bearing intermediate shaft
5. Ball bearing drive gear



LEFT GEARBOX HOUSING

1. Ball bearing countershaft

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))

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, main shaft and intermediate shaft.

NOTE: Place gearbox housings on a wood stand before installing ball bearings.

TIGHTENING TORQUE	
Retaining plate screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Retaining screw main shaft bearing (right cover)	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Install new oil seals with the proper installer (refer to *GEARBOX OIL SEALS* in this subsection).

Assembling the Gearbox Housing

Clean all metal components in a solvent.

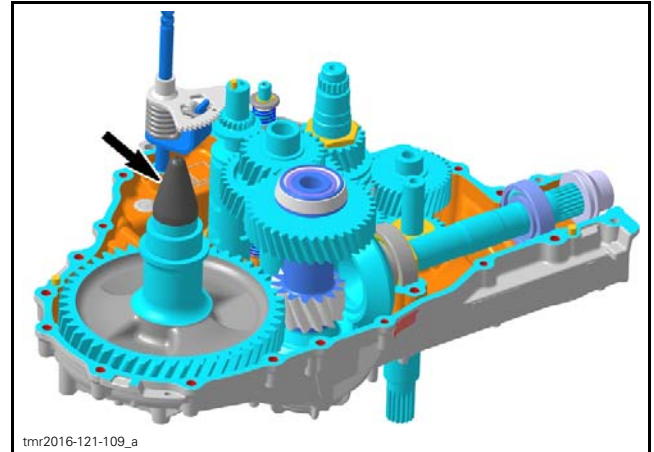
Gearbox housing mating surfaces are best cleaned using a combination of LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass cross (hatch).

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.

Place sleeve installer on drive gear.

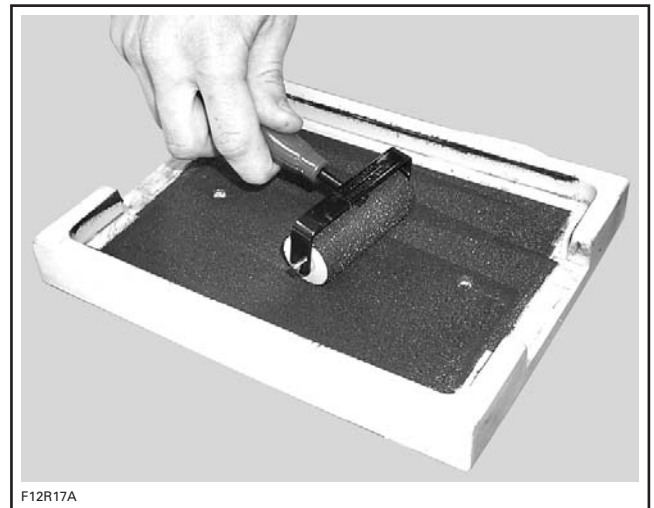
REQUIRED TOOL	
SLEEVE INSTALLER (P/N 529 036 381)	



Apply sealant on mating surface.

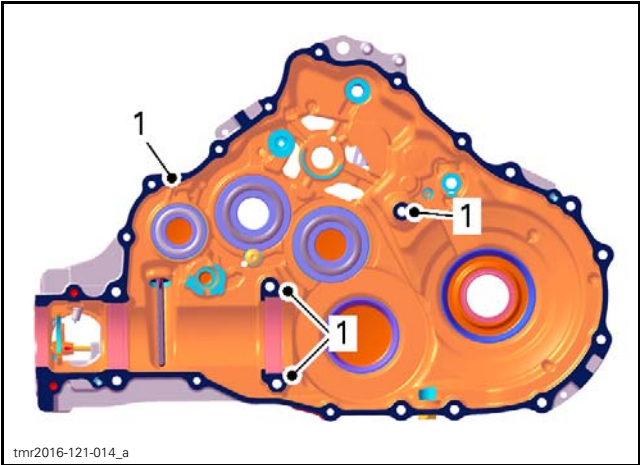
GEARBOX HOUSING MATING SURFACE SEALANT	
Service product	LOCTITE 5910 (P/N 293 800 081)

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 gearbox housing mating surfaces.



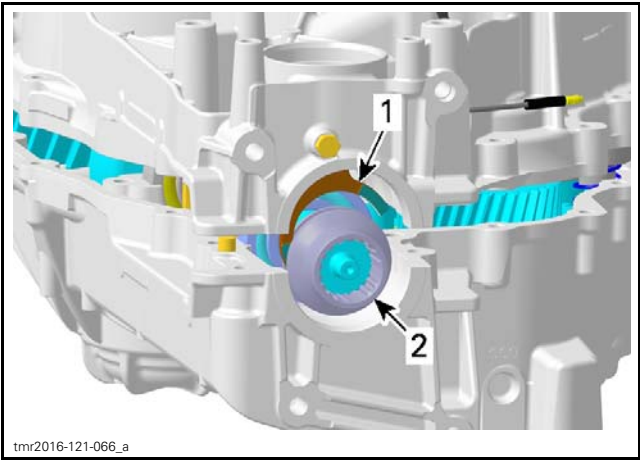
Do not apply in excess as it will spread out inside gearbox housing.

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).



1. Apply sealant here

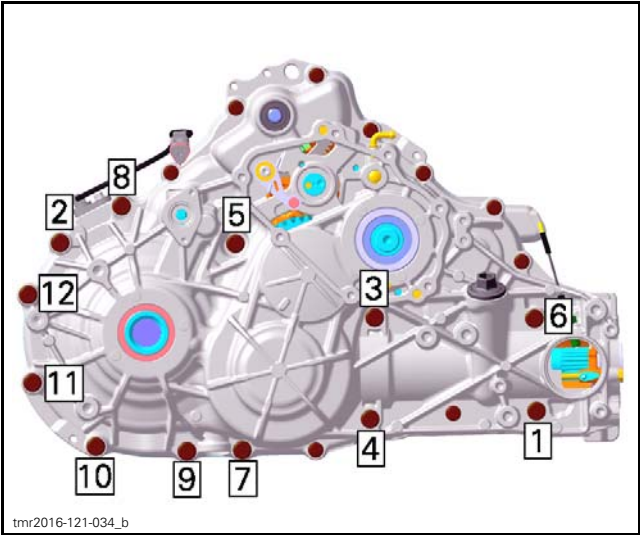
During installation of the right gearbox housing align the coupling fork with the groove in the coupling sleeve.



1. Coupling fork
2. Coupling sleeve

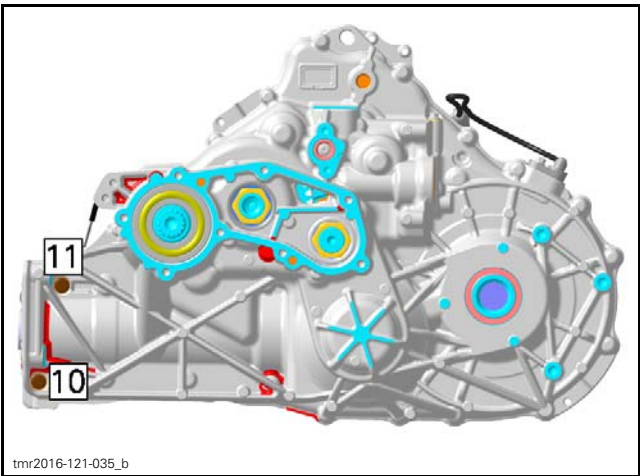
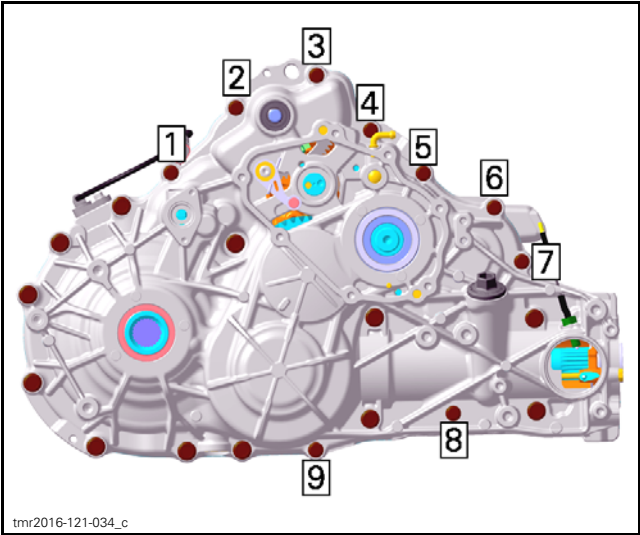
Install all gearbox housing screws.
Tighten M8 gearbox housing screws as per following sequence.

TIGHTENING TORQUE	
M8 gearbox housing screws	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)



Tighten M6 gearbox housing screws as per following sequence.

TIGHTENING TORQUE	
M6 gearbox housing screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)



Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))

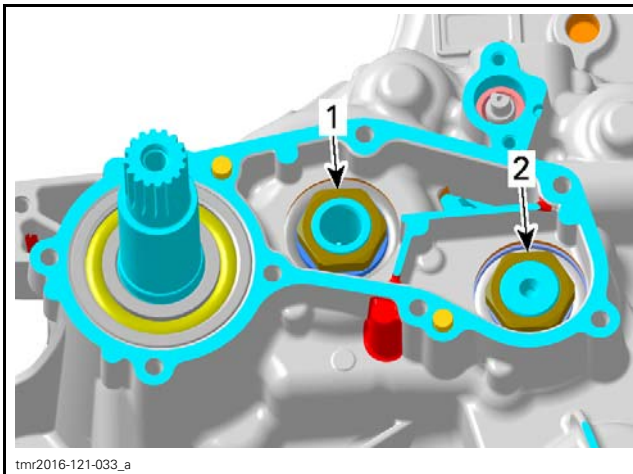
Refer to *GEARBOX AND SHIFTING MECHANISM* in this subsection to install:

- Index lever
- Index washer
- Parking lock gear
- Parking lock lever.

Set gearbox to PARK position.

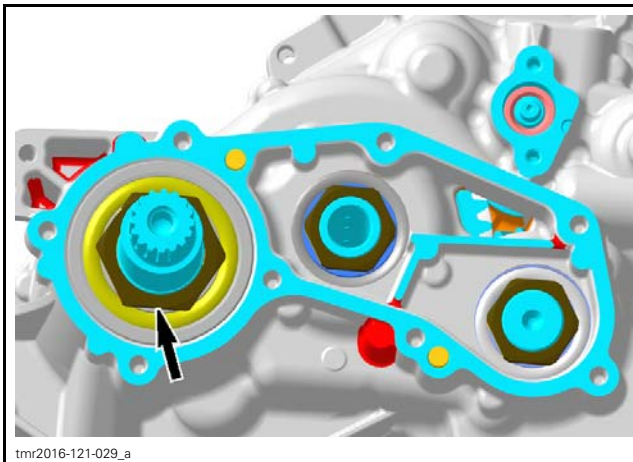
Tighten main shaft and intermediate shaft nuts to specification.

TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Main shaft and intermediate shaft nuts	170 N•m ± 10 N•m (125 lbf•ft ± 7 lbf•ft)

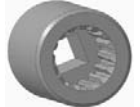


1. Main shaft nut
2. Intermediate shaft nut

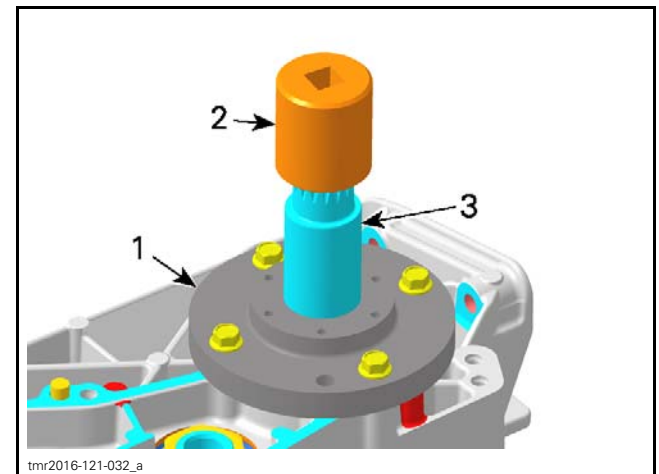
Tighten countershaft nut to specification.



TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Countershaft nut	170 N•m ± 10 N•m (125 lbf•ft ± 7 lbf•ft)

REQUIRED TOOL	
M34 SOCKET (P/N 529 036 388)	
SPLINES SOCKET 1/2" (P/N 529 036 389)	

NOTICE Turn spline socket counterclockwise to tighten the nut.



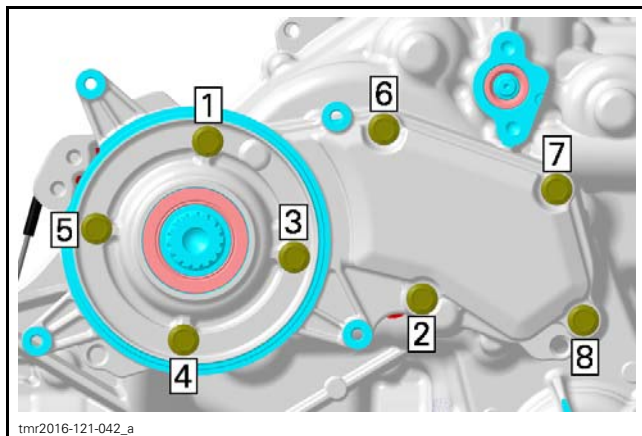
1. M34 socket
2. Spline socket
3. Countershaft

Apply sealant on mating surface of bearing housing.

BEARING HOUSING MATING SURFACE SEALANT	
Service product	LOCTITE 5910 (P/N 293 800 081)

Install bearing housing screws and tighten them as per following sequence.

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



GEARBOX AND SHIFTING MECHANISM

Disassembling the Gearbox and Shifting Mechanism

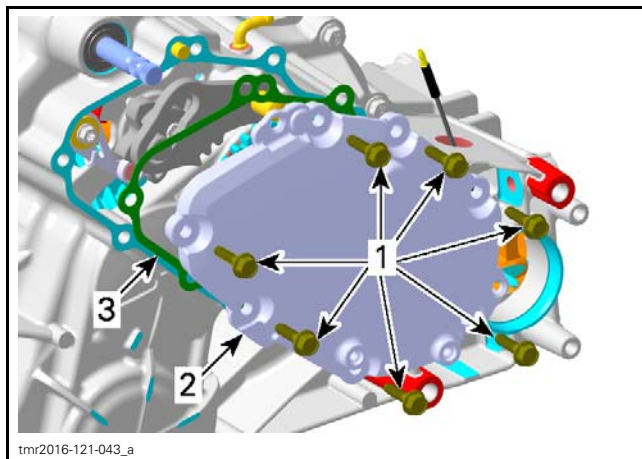
NOTE: During gearbox and shifting mechanism disassembly, inspect the condition of each part closely.

Index Lever, Index Washer and Parking Lock Lever

Set gearbox to PARK position.

Remove:

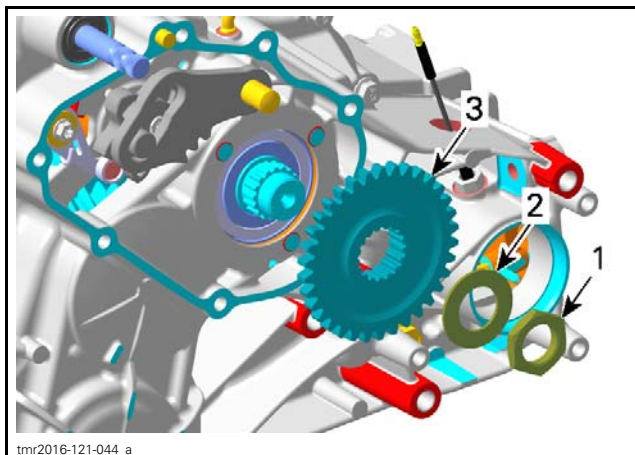
- Retaining screws
- Gearbox cover
- Gasket (discard it).



1. Retaining screws
2. Gearbox cover
3. Gasket

Remove:

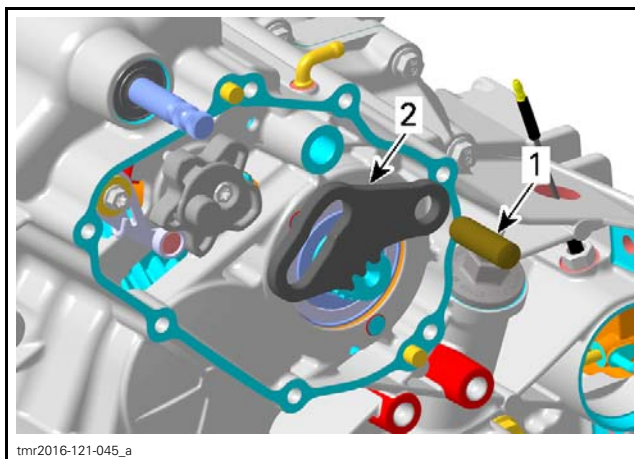
- Nut
- Spring washer
- Park locking gear.



1. Nut
2. Spring washer
3. Park locking gear

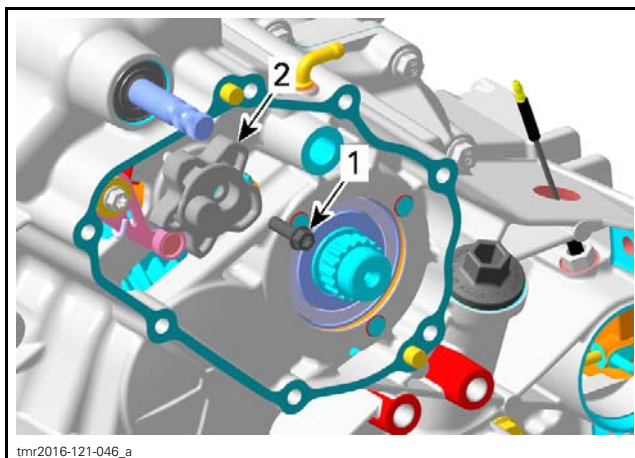
Remove:

- Pin
- Park locking lever.



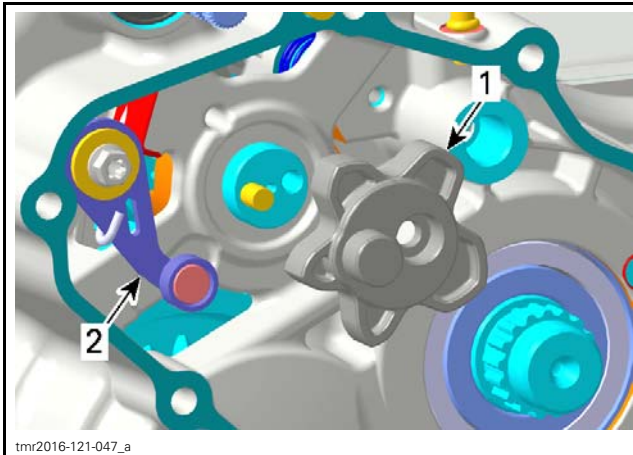
1. Pin
2. Park locking lever

Remove screw retaining the index washer to the shift drum.



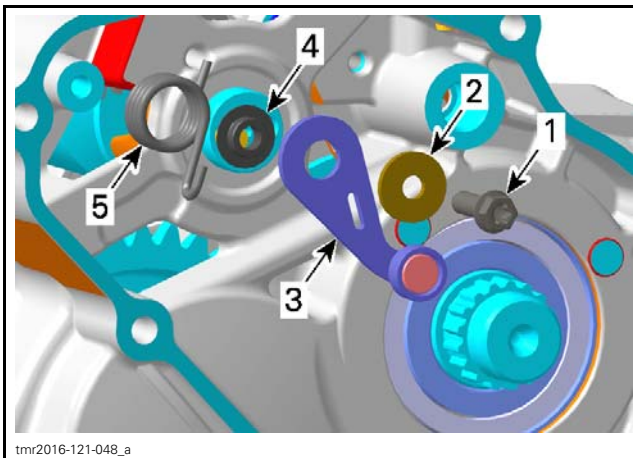
1. Screw
2. Index washer

Insert a flat screwdriver in the slot of index lever. Turn screwdriver clockwise and remove index washer.



1. Index washer
2. Index lever

Remove the index lever with washer, step ring and spring.

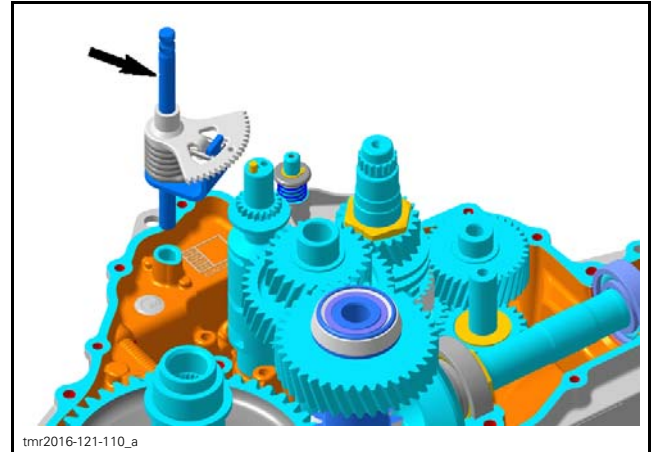


1. Screw
2. Washer
3. Index lever
4. Step ring
5. Index spring

Shift Shaft Assembly

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

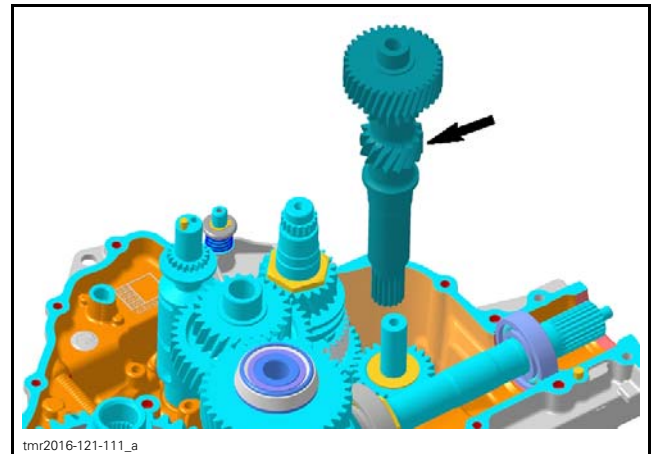
Withdraw shift shaft assembly.



Countershaft and Reverse Intermediate Gear

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

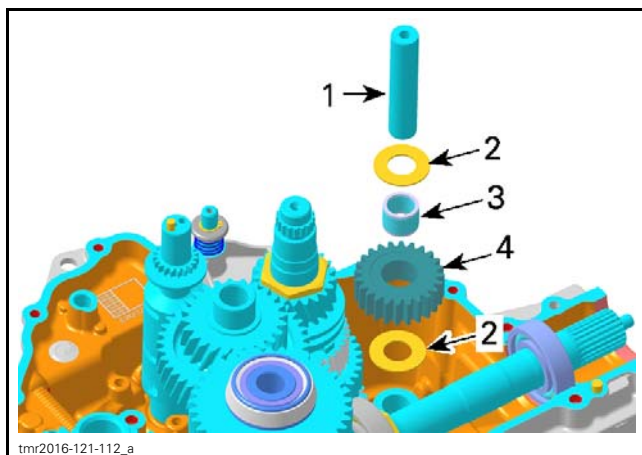
Use a soft hammer to push out countershaft from gearbox housing CVT side.



Remove:

- Bearing pin
- Reverse intermediate gear
- Needle bearing
- Thrust washers.

NOTE: Take care not to lose lower thrust washer during removal.



1. Bearing pin
2. Thrust washers
3. Needle bearing
4. Reverse intermediate gear

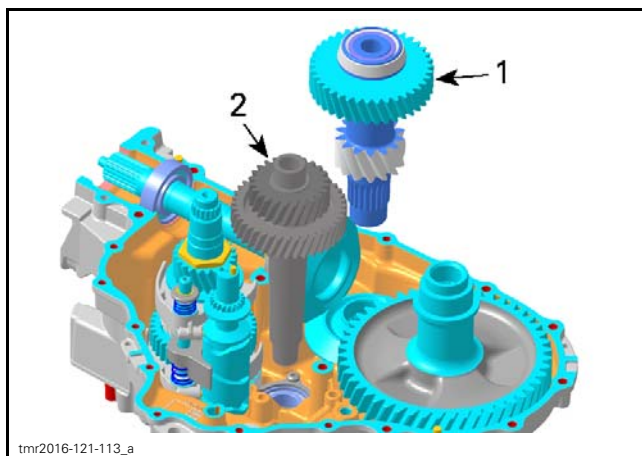
Pinion Drive Shaft and Intermediate Shaft

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

Remove:

1. Pinion drive shaft
2. Intermediate shaft.

NOTE: Bevel gear and distance shim remain in gearbox housing.



1. Pinion drive shaft
2. Intermediate shaft

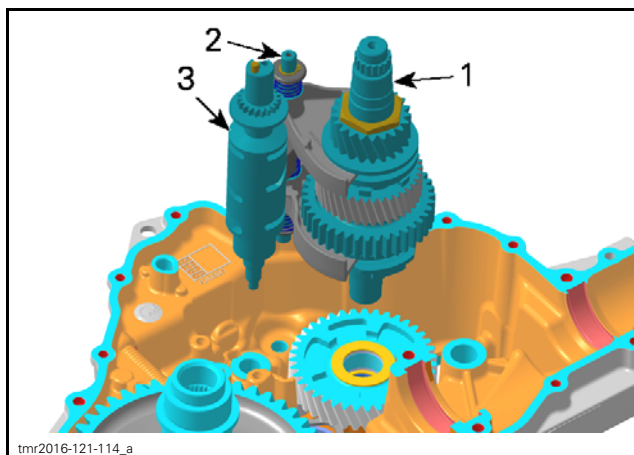
Main Shaft, Shift Fork Shaft Assembly and Shift Drum

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

See procedures in this subsection to remove:

- Pinion drive shaft
- Intermediate shaft
- Countershaft
- Reverse intermediate gear.

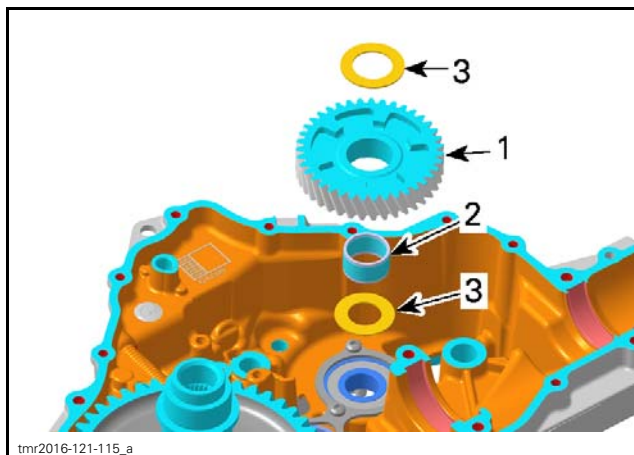
Remove main shaft assembly together with shift fork shaft assembly and shift drum.



1. Main shaft assembly
2. Shift fork shaft assembly
3. Shift drum

Remove:

- LOW range gear
- Needle bearing
- Thrust washers.



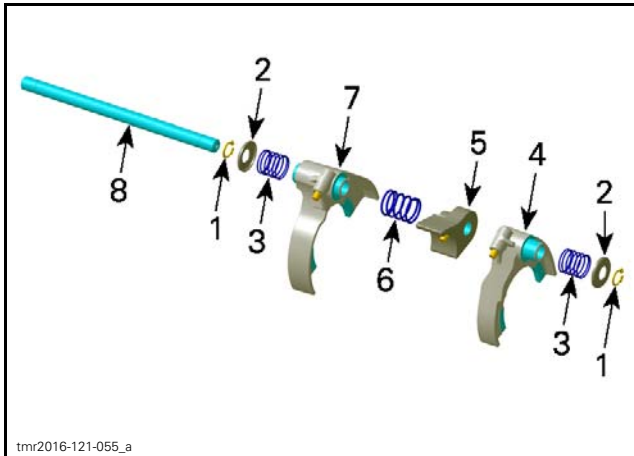
1. Free pinion LOW range gear
2. Needle bearing
3. Thrust washer

Disassembling the Shift Fork Shaft Assembly

NOTICE Springs are not identical. Mark them to reinstall them in their original position.

Remove:

- Snap rings (discard them)
- Spring seats
- Springs
- Shift forks
- Shifting block.



1. Snap rings
2. Spring seat
3. Outer springs
4. Shift fork HIGH
5. Shifting block
6. Center spring
7. Shift fork LOW/REVERSE
8. Shift fork shaft

Inspecting the Gearbox and Shifting Mechanism

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.

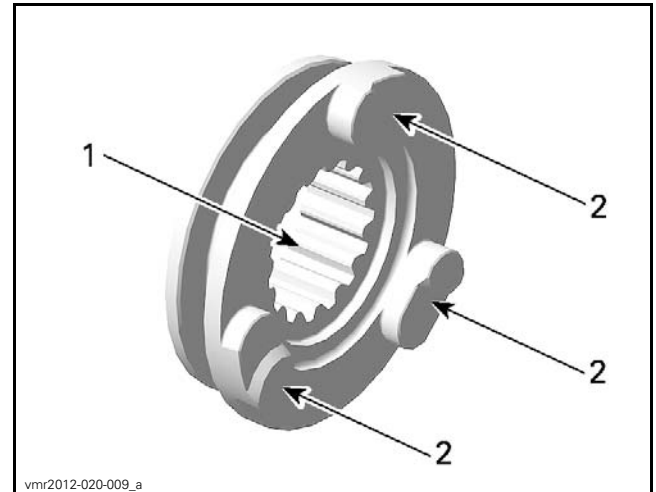
Bearings

When gearbox is removed check gearbox ball bearings for contamination and/or metal shavings.

Check if ball bearings turn freely and smoothly. Replace if necessary, refer to *GEARBOX HOUSING* in this subsection.

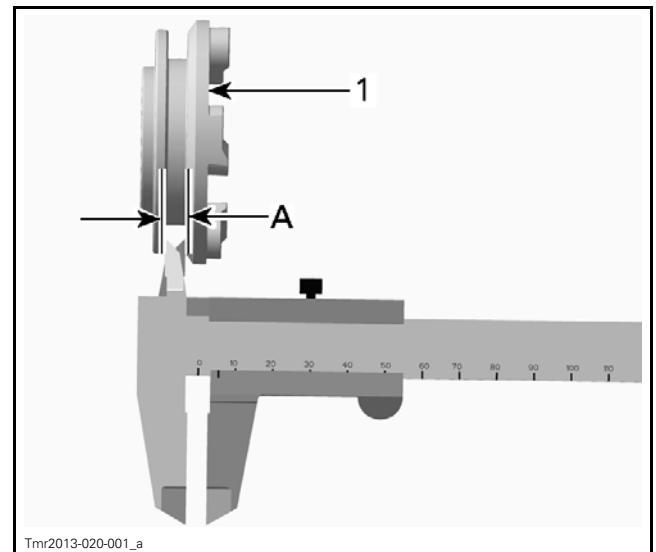
Shifting Sleeves

Check shifting sleeves for worn inner splines and rounded or damaged engagement dogs.



- TYPICAL**
1. Inner splines
2. Engagement dogs

Measure the width of shift fork engagement groove.

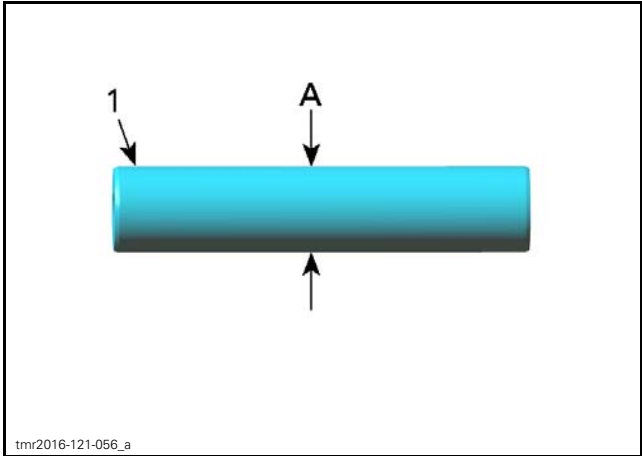


- TYPICAL**
1. Shifting sleeve
A. Width of shift fork engagement groove

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

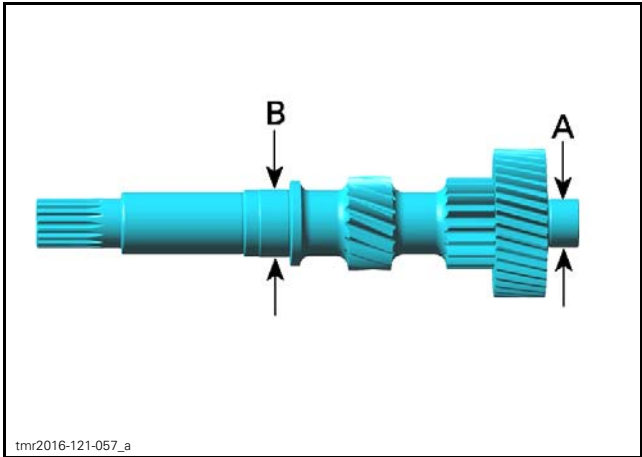
Check bearing pin of reverse intermediate gear for wear.



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)

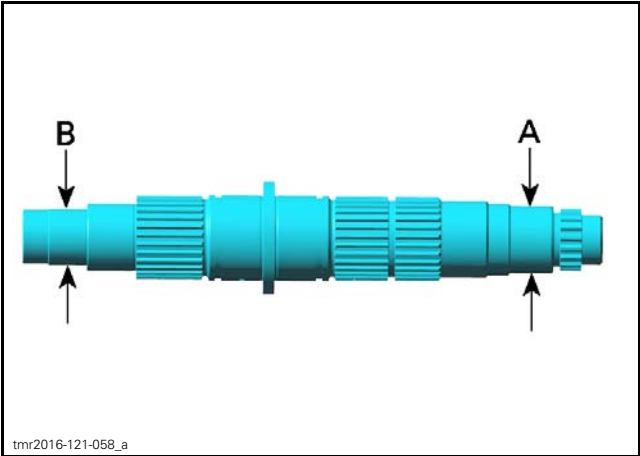
Check countershaft bearing journals for wear.



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. Bearing journal CVT side

MAIN SHAFT 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)

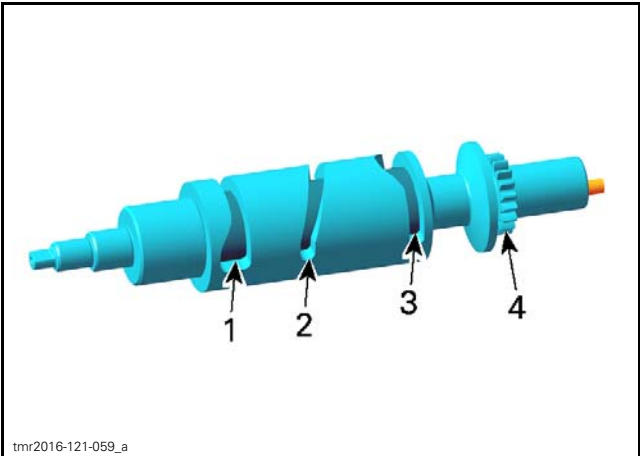
Shift Shaft

Check shift shaft for worn splines and gears.
Check shift shaft spring for damages.

Shift Drum

NOTICE Do not disassemble shift drum.

Check shift drum tracks for scouring or heavy wear, like rounded engagement slots.



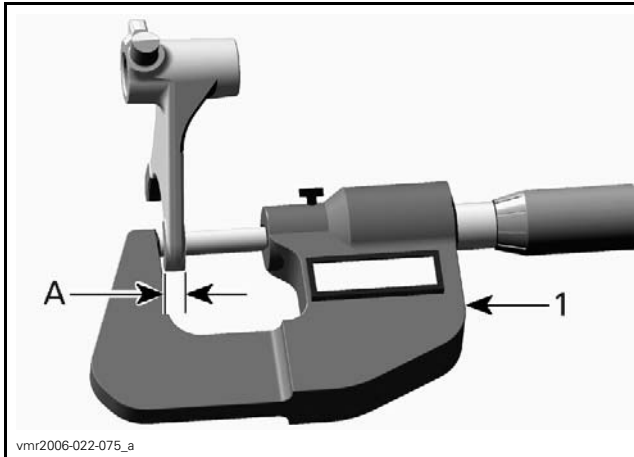
1. Track for the low/reverse range gear shift fork
2. Track for the shifting block
3. Track for the high range gear shift fork
4. Shift drum gear

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.



TYPICAL

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.

Assembling the Gearbox and Shifting Mechanism

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

Prior to assembly lubricate ball bearing seats of:

- Main shaft
- Countershaft
- Intermediate shaft.

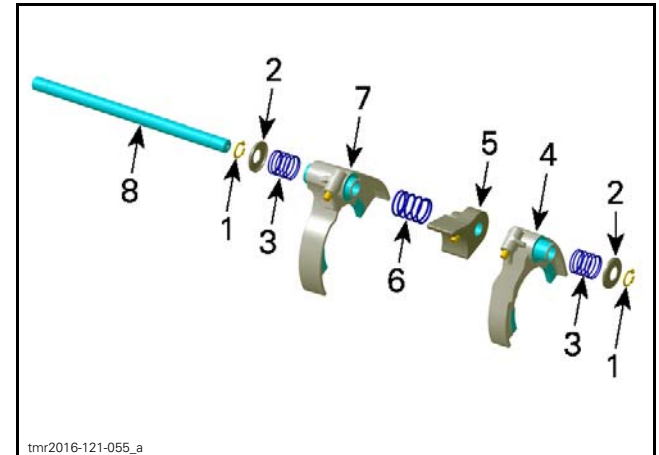
BALL BEARING SEATS LUBRICATION	
Service product	COPASLIP (P/N 420 297 430)

Assembling the Shift Fork Shaft Assembly

NOTICE Springs are not identical.

Install:

- NEW snap rings
- Spring seats
- Springs
- Shift forks
- Shifting block.

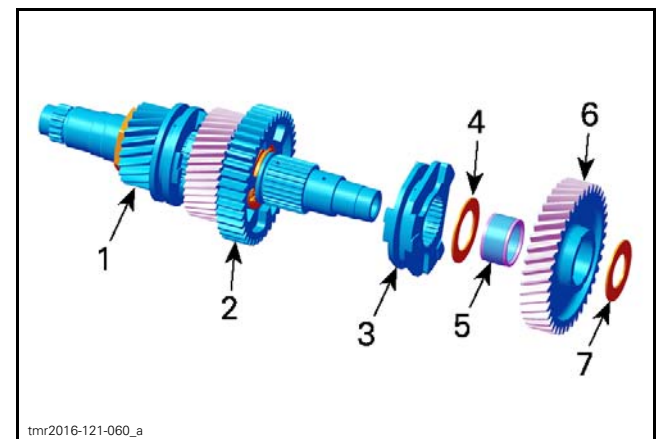


1. Snap rings
2. Spring seat
3. Outer springs
4. Shift fork HIGH
5. Shifting block
6. Center spring
7. Shift fork LOW/REVERSE
8. Shift fork shaft

Main Shaft, Shift Fork Shaft Assembly and Shift Drum

Install shifting sleeve, thrust washer and LOW gear pinion on main shaft assembly.

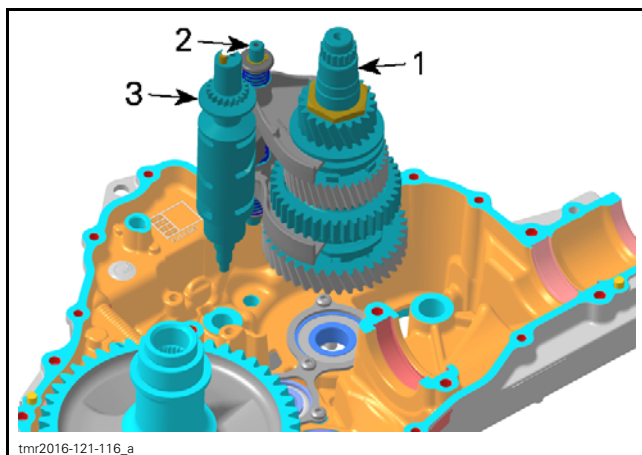
NOTE: Check if shifting sleeve engages correctly in reverse gear.



1. Main shaft assembly
2. Reverse gear
3. Shifting sleeve
4. Thrust washer
5. Needle bearing
6. LOW gear pinion
7. Thrust washer

Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))

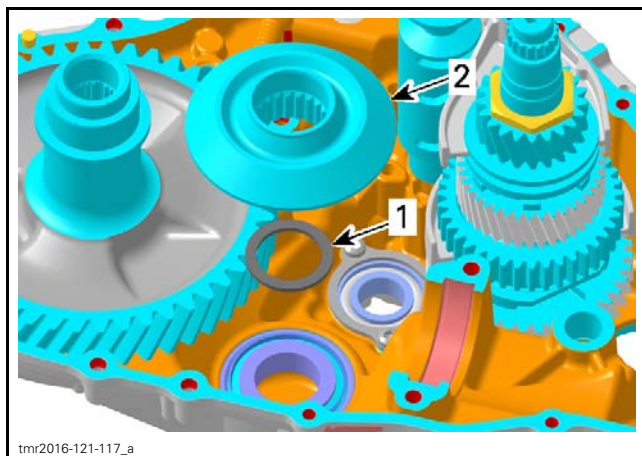
Install shift fork shaft assembly, shift drum and main shaft assembly together into gearbox housing.



1. Main shaft assembly
2. Shift fork shaft assembly
3. Shift drum

Pinion Drive Shaft and Intermediate Shaft

Ensure distance shim and bevel gear are placed on the pinion drive shaft bearing in gearbox housing.

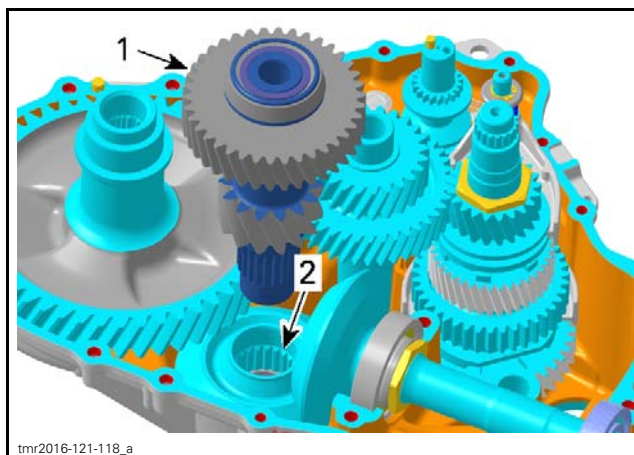


1. Distance shim
2. Bevel gear

Install:

1. Intermediate shaft
2. Pinion drive shaft.

Carefully fit pinion drive shaft into inner splines of bevel gear.

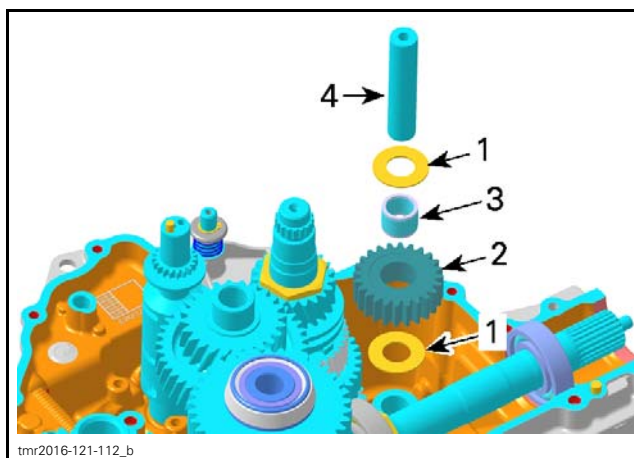


1. Pinion drive shaft
2. Bevel gear splines

Countershaft and Reverse Intermediate Gear

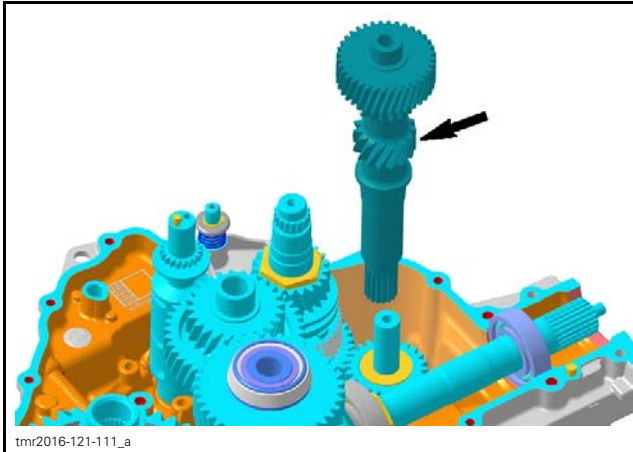
Install:

- Reverse intermediate gear
- Needle bearing
- Thrust washers
- Bearing pin.



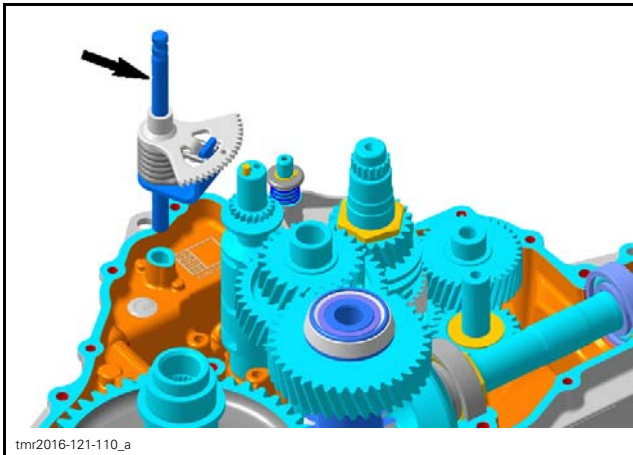
1. Thrust washers
2. Reverse intermediate gear
3. Needle bearing
4. Bearing pin

Install countershaft from.

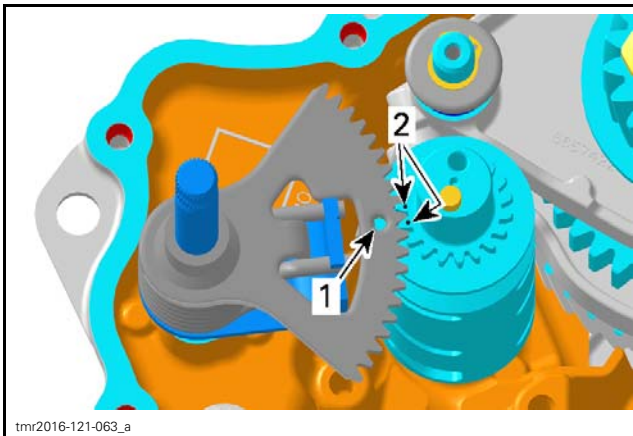


Shift Shaft Assembly

Install shift shaft assembly.



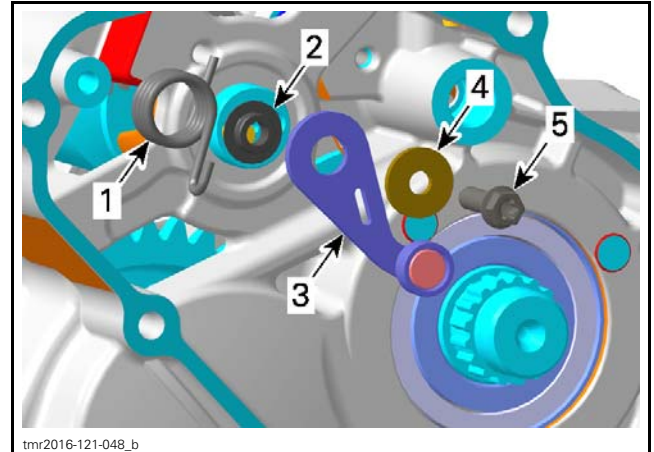
Align mark on shift shaft with marks on shift drum gear.



1. Mark on shift shaft
2. Marks on shift drum gear

Index Lever, Index Washer and Parking Lock Lever

Fit step ring into index lever.



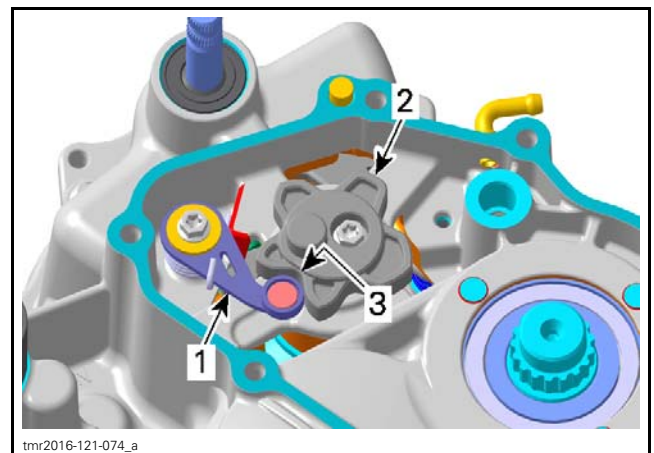
1. Index spring
2. Step ring
3. Index lever
4. Washer
5. Screw

TIGHTENING TORQUE

Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Index lever retaining screw	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Install index washer on shift drum.

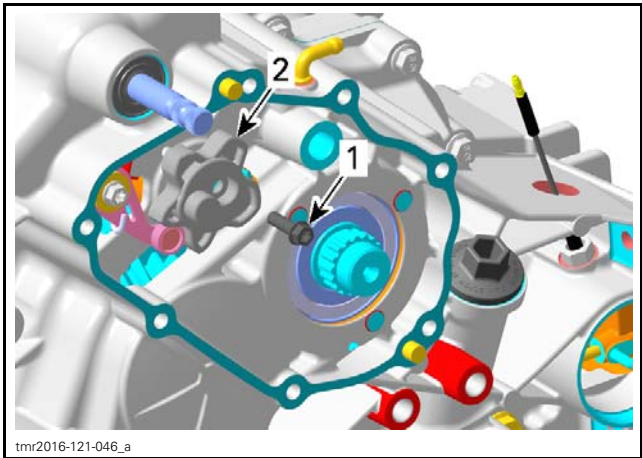
Insert a flat screwdriver in the slot of the index lever, turn screwdriver clockwise and engage lever in index washer in NEUTRAL position as per following illustration.



1. Index lever
2. Index washer
3. Neutral position

Install screw retaining the index washer to the shift drum.

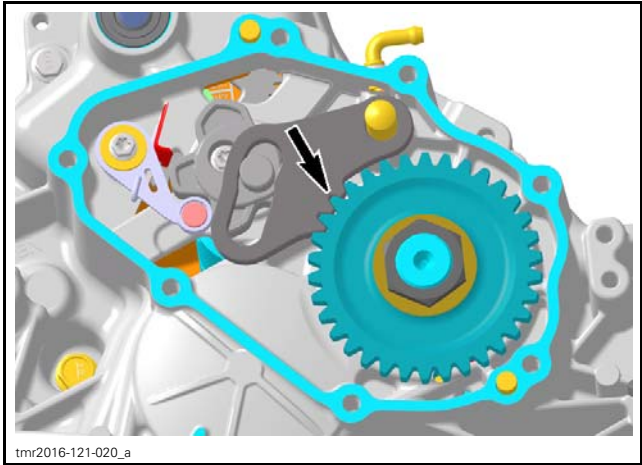
Subsection XX (GEARBOX AND 4X4 COUPLING UNIT(without rear lockable differential))



- 1. Screw
- 2. Index washer

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Index washer retaining screw	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

- Install:
- Park locking gear
 - Spring washer
 - Nut
 - Pin
 - Park locking lever.
- Set gearbox to PARK position.



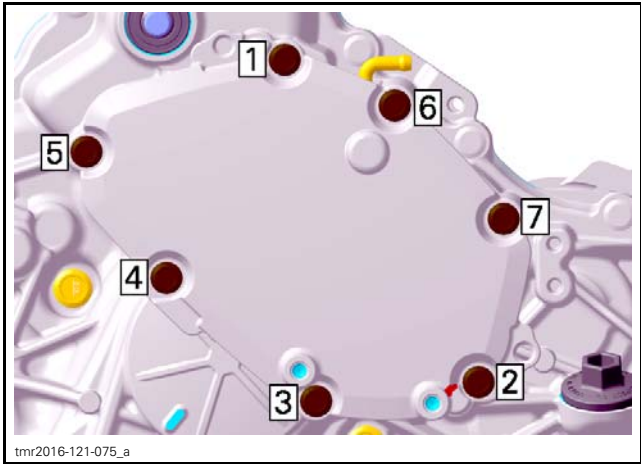
PARK LOCKING LEVER ENGAGED

Tighten nut to specification.

TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Park locking gear nut	170 N•m ± 10 N•m (125 lbf•ft ± 7 lbf•ft)

Install gearbox cover with **NEW** gasket.
Tighten gearbox cover screws as per following sequence.

TIGHTENING TORQUE	
Gearbox cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)



OUTPUT SHAFT AND 4X4 COUPLING MECHANISM

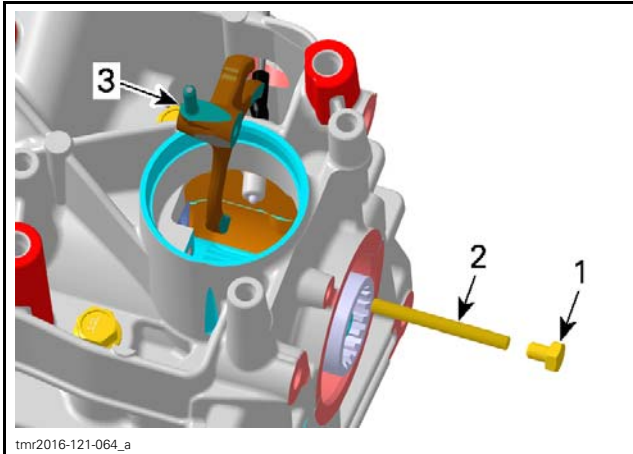
Removing the Output Shaft and 4X4 Coupling Mechanism

Drain gearbox oil. Refer to *GEARBOX OIL REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.

Remove *4WD ACTUATOR*, refer to procedure in this subsection.

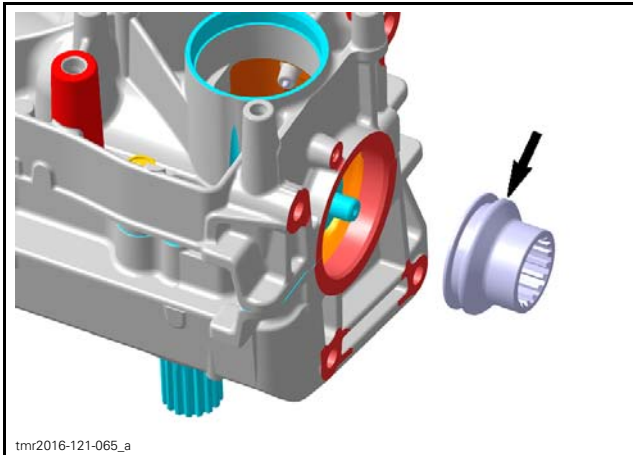
Detach *GEARBOX ASSEMBLY* from engine, refer to procedure in this subsection.

- Remove:
- Screw
 - Coupling fork shaft
 - Coupling fork.



1. Screw
2. Coupling fork shaft
3. Coupling fork

Pull out 4X4 coupling sleeve.



Inspecting the Output Shaft and 4X4 Coupling Mechanism

Output Shaft

Check output shaft and its gear for cracks, bend, pitting or other visible damages.

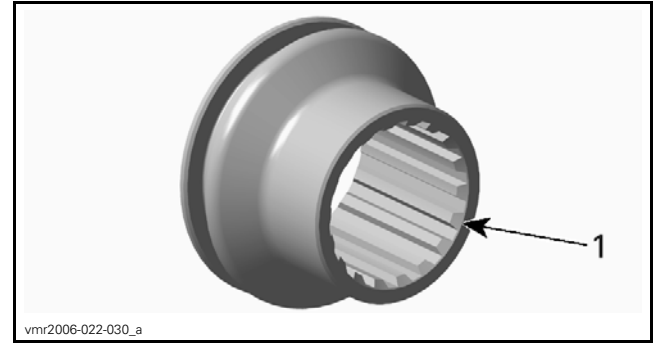
Check output shaft splines for wear or other damages.

Check if the output shaft bearings turn freely and smoothly.

Replace oil seal if brittle, hard or damaged.

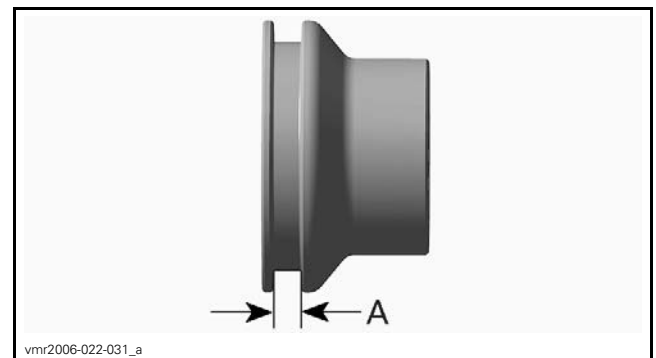
4X4 Coupling Sleeve

Check splines of coupling sleeve for wear or other damages.



1. Inspect splines

Measure the coupling sleeve groove width.



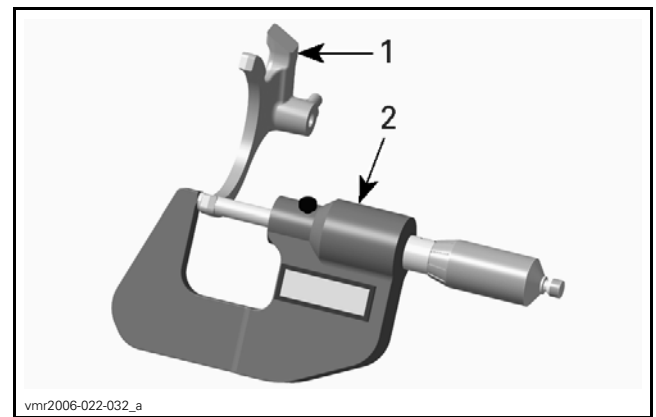
- A. Groove width

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)

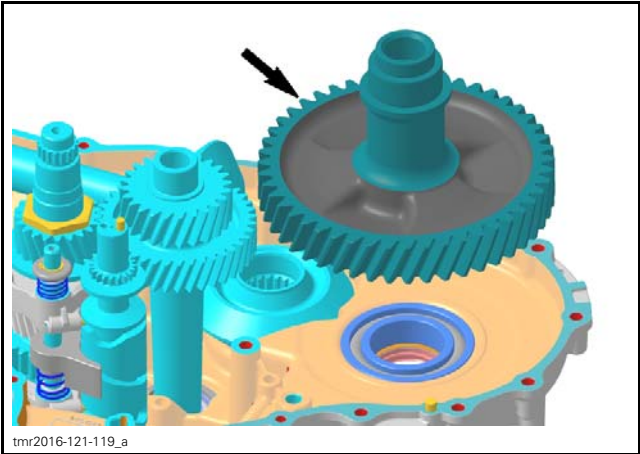
Installing the Output Shaft and 4X4 Coupling Mechanism

Install coupling sleeve onto the output shaft.

Install:

- Coupling fork
- Coupling fork shaft
- Screw.

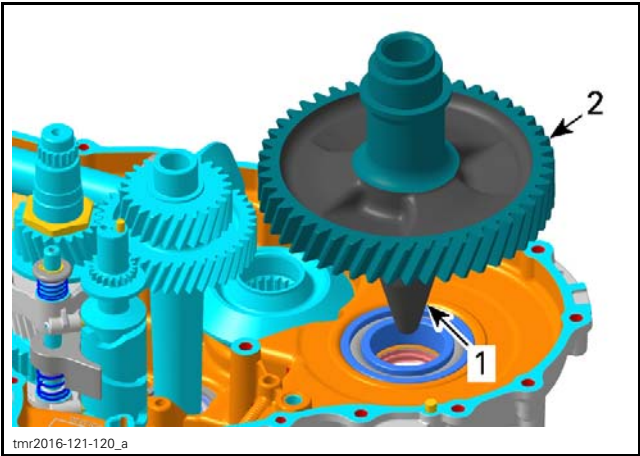
Ensure that coupling fork engages into the coupling sleeve groove.



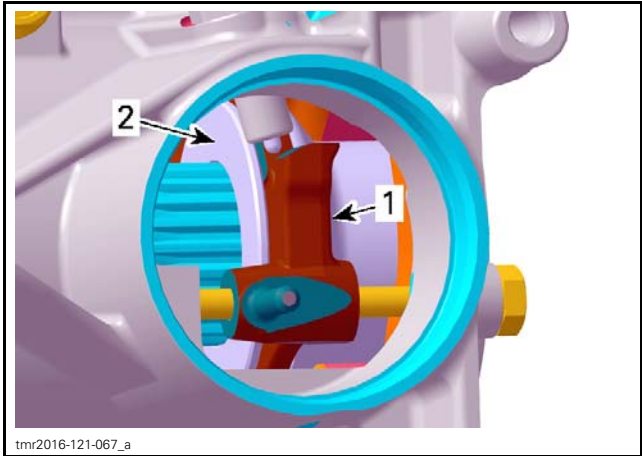
Installing the Drive Gear

Install drive gear.

REQUIRED TOOL	
SLEEVE INSTALLER (P/N 529 036 381)	



- 1. Sleeve installer
- 2. Drive gear



- 1. Coupling fork
- 2. Coupling sleeve

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Coupling fork shaft screw	6 N•m ± 0.7 N•m (53 lbf•in ± 6 lbf•in)

DRIVE GEAR

Removing the Drive Gear

Separate gearbox housing, refer to *GEARBOX HOUSING* in this subsection.

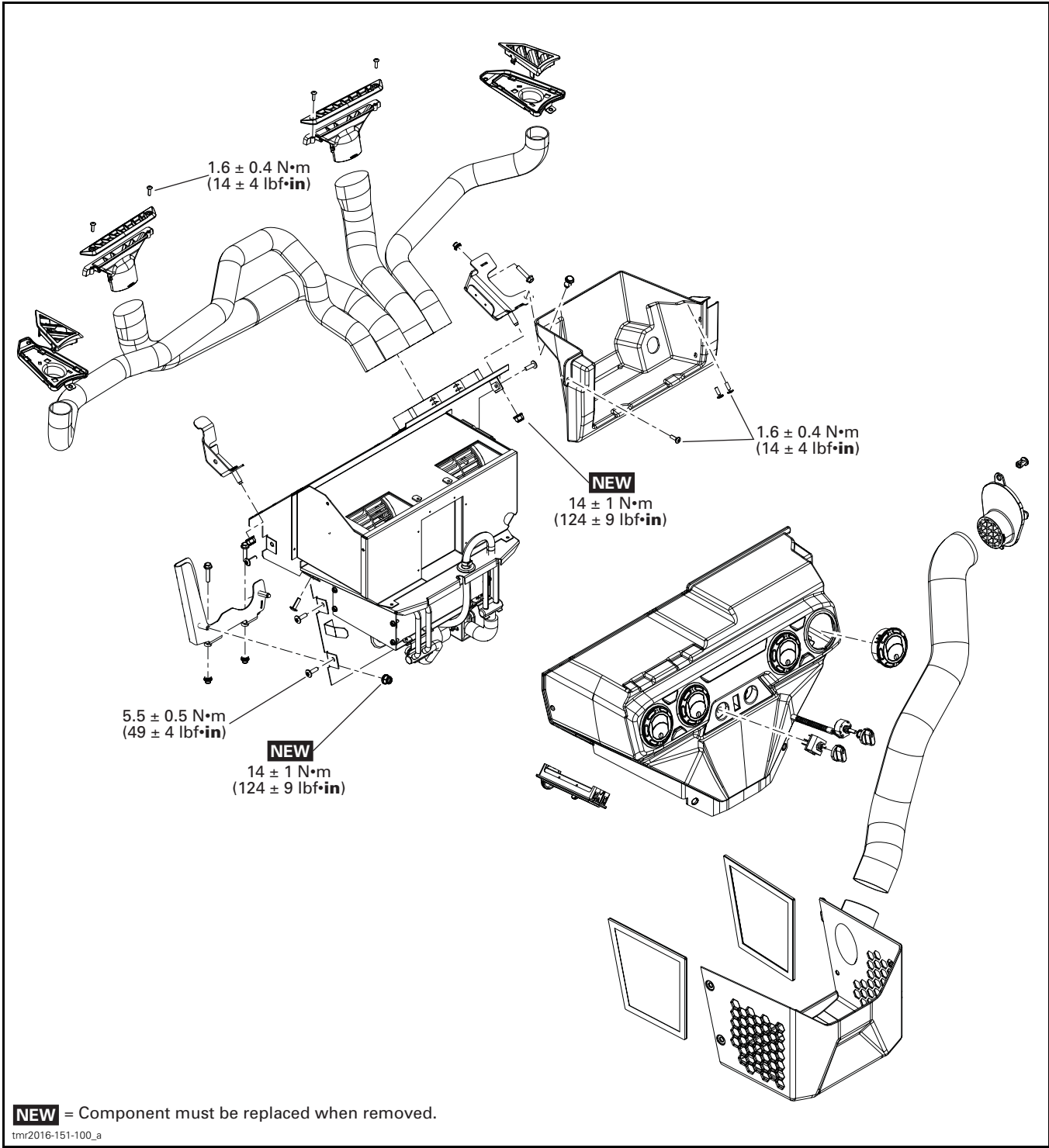
Remove drive gear.

HEATING SYSTEM

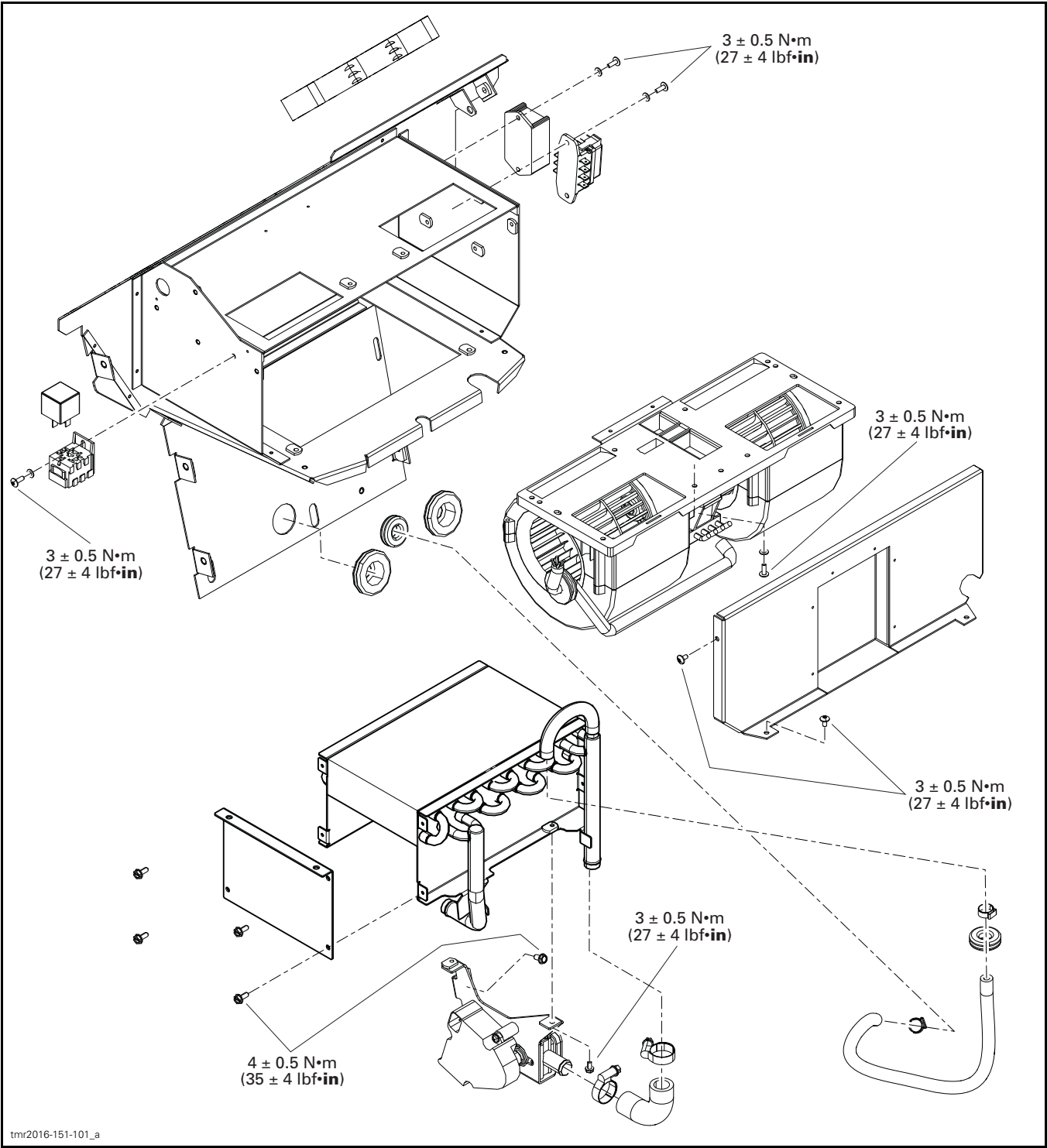
SERVICE TOOLS

Description	Part Number	Page
LARGE HOSE PINCHER.....	529 032 500	7

DUCT AND CONSOLE



HEATING UNIT



GENERAL

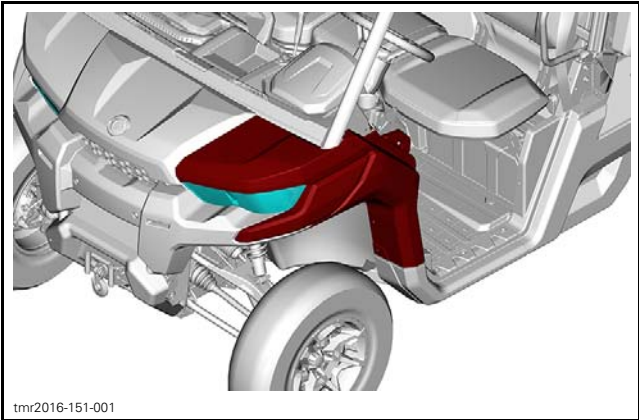
In the following procedures the vehicle cab is removed for clarity.

PROCEDURES

AIR OUTLET LOUVER AND ADAPTER

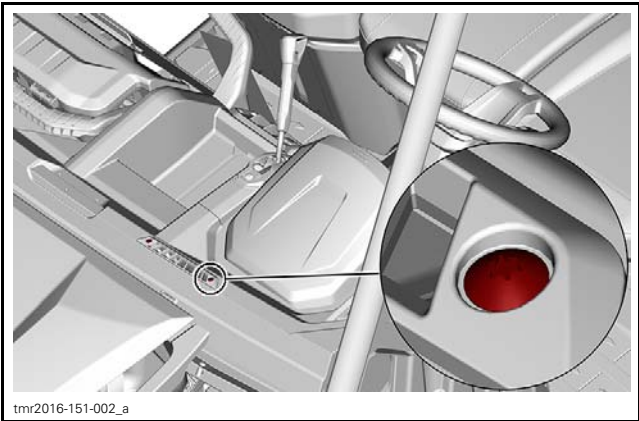
Removing the Outlet Louver

- 1. Refer to *BODY* subsection and remove the following parts to reach the ducts:
 - Front fender
 - Front side panel.



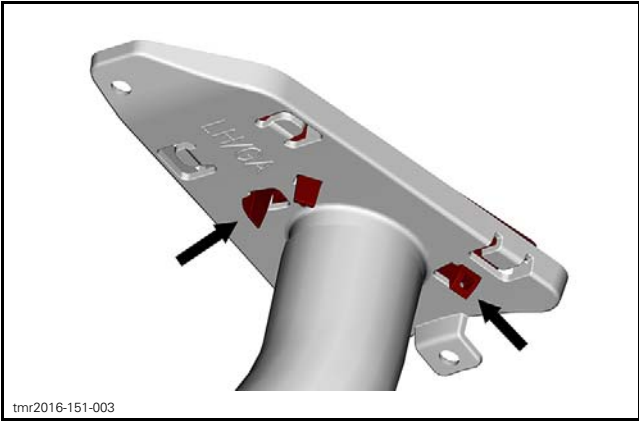
Central Louver

- 2. Remove louver screws, then the louver.



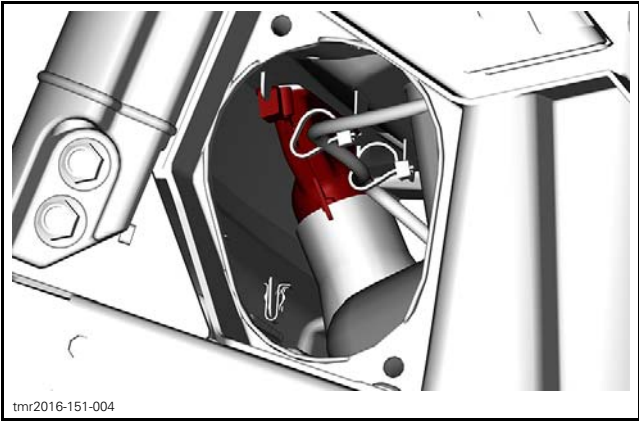
Lateral Louver

- 3. From inside the dashboard release both snap tabs.



Central and Lateral Louver

- 4. Cut the locking tie.
- 5. Hold the adapter from outside the dashboard and pull the duct off the adapter from inside.



- 6. Take the adapter out of the dashboard through the side opening.

Installing the Outlet Louver

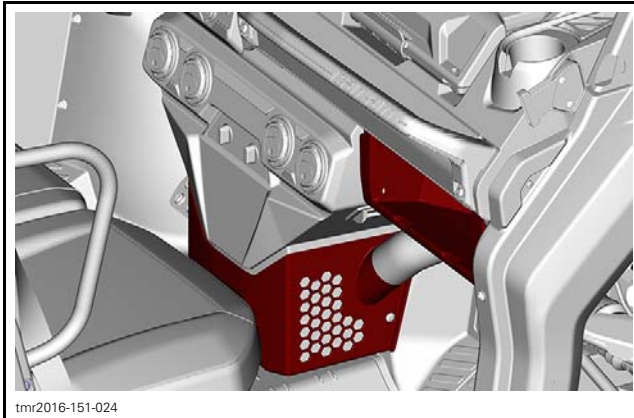
The installation is the reverse of the removal procedure. However, pay attention to the following.

TIGHTENING TORQUE	
Central louver screw	1.6 N•m ± 0.4 N•m (14 lbf•in ± 4 lbf•in)

AIR DUCTS

Removing the Air Ducts

- 1. Remove the following parts to reach the ducts:
 - RH lower dashboard
 - Lower cover.



Installing the Air Ducts

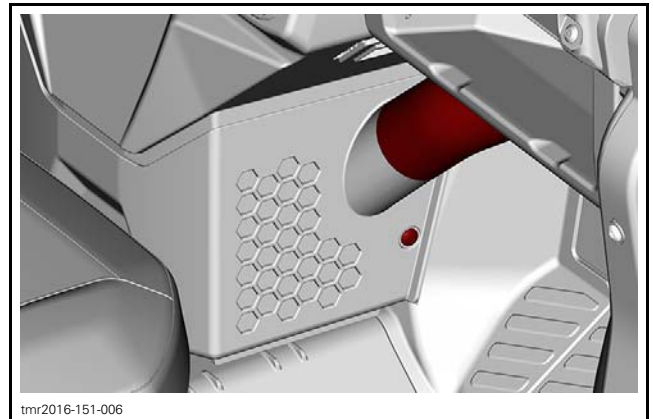
The installation is the reverse of the removal procedure.

HEATING SYSTEM CONSOLE

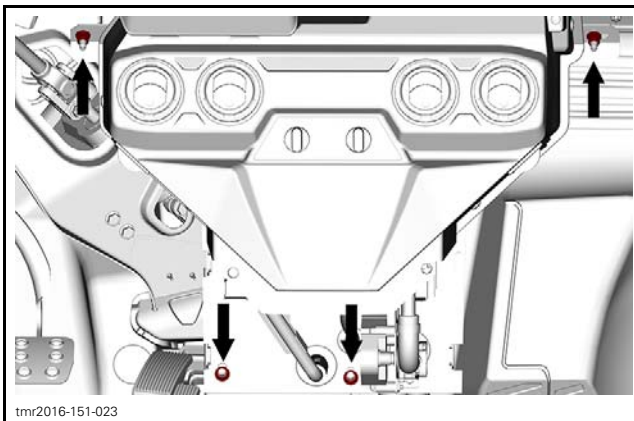
Lower Cover

Removing the Lower Cover

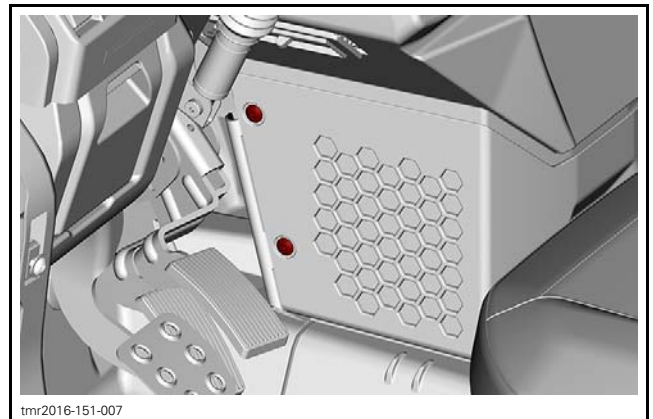
1. Disconnect the air inlet duct.



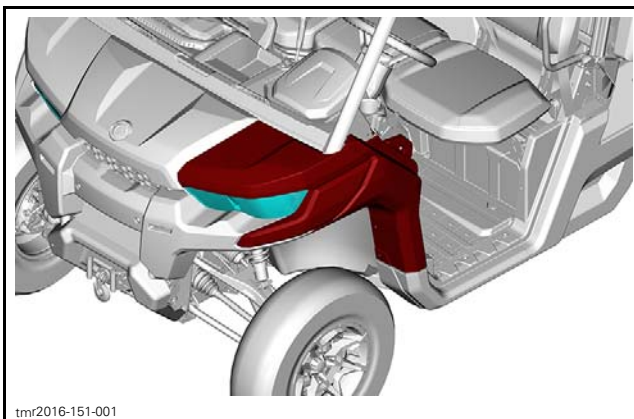
2. Remove the following nuts.



2. Remove the screws (3).



3. Tilt the unit towards the seats.
4. Cut locking ties and disconnect the ducts from the heating unit.
5. Refer to *BODY* subsection and remove the following parts to disconnect ducts from louvers:
 - Front fender
 - Front side panel.



3. Pull the cover towards the seats.

Installing the Lower Cover

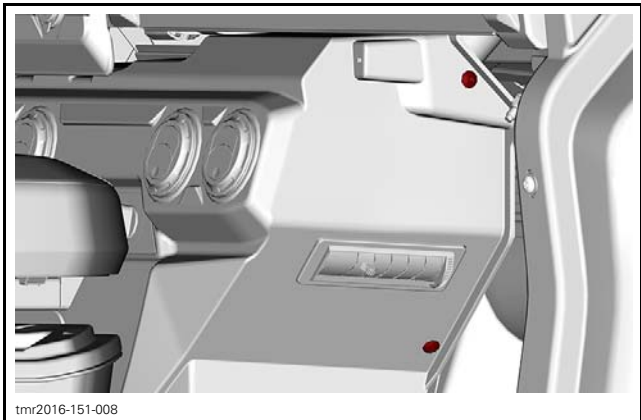
The installation is the reverse of the removal procedure. However, pay attention to the following.

TIGHTENING TORQUE	
Lower cover screw	5.5 N•m ± 0.5 N•m (49 lbf•in ± 4 lbf•in)

Console

Removing the Console

1. Remove the lower cover.
2. Remove the console screws on both sides.



3. Pull on the console.
4. From under the console, disconnect the blower switch connector.
5. Disconnect the potentiometer connector.
6. Remove the console.

Installing the Console

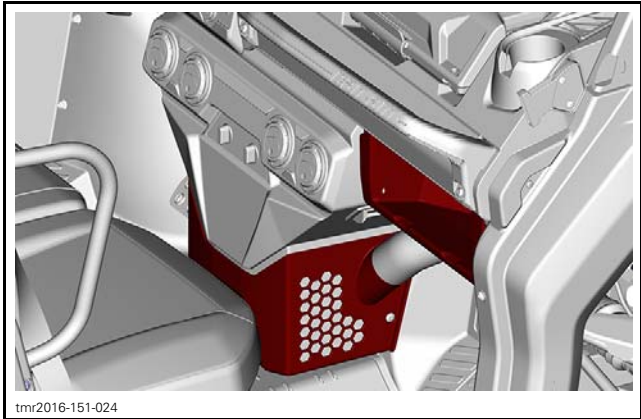
The installation is the reverse of the removal procedure. However, pay attention to the following.

TIGHTENING TORQUE	
Console screw	5.5 N•m ± 0.5 N•m (49 lbf•in ± 4 lbf•in)

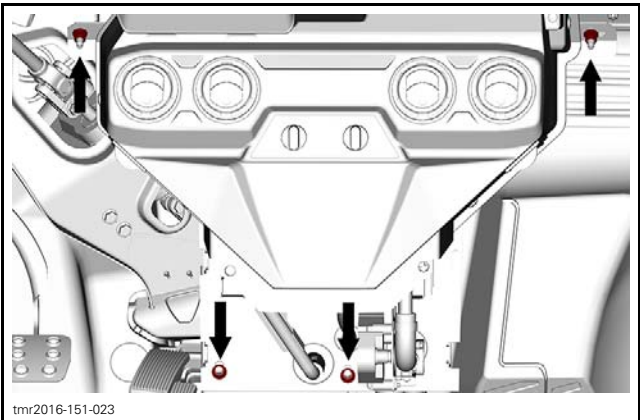
HEATING UNIT ASSEMBLY

Accessing the Under Dash Accessory Post

1. Remove The following parts:
 - RH lower dashboard
 - Lower cover



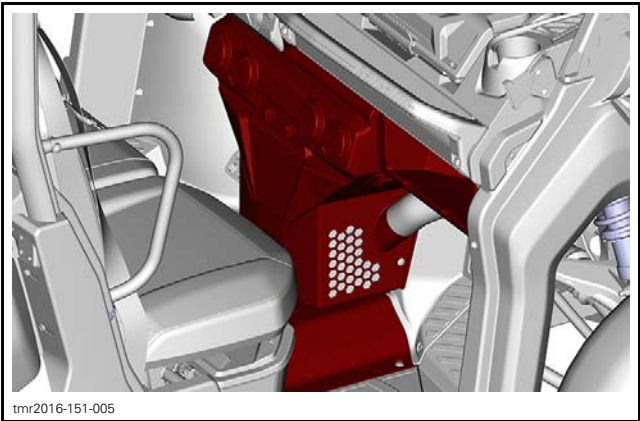
2. Remove the following nuts.



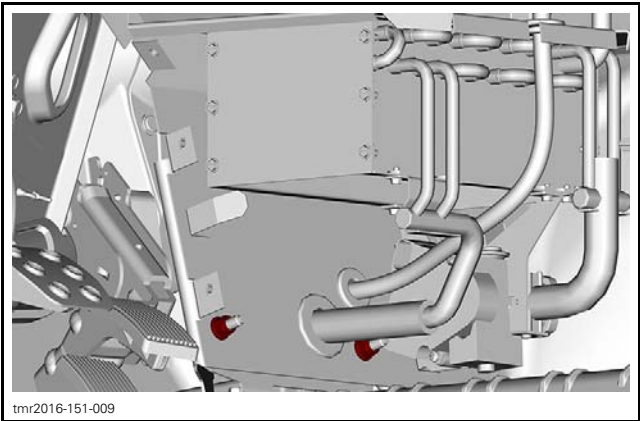
3. Tilt the unit towards the seats.

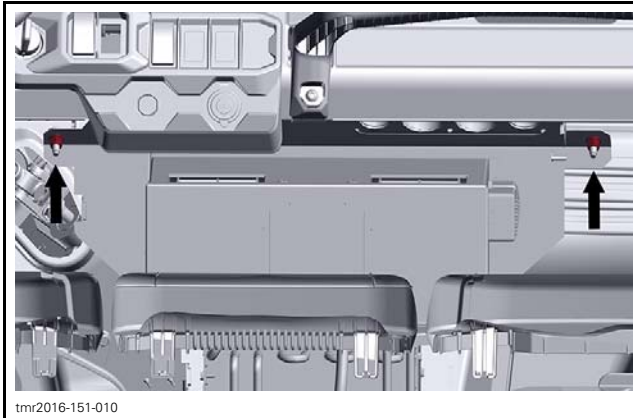
Removing the Heating Unit Assembly

1. Remove The following parts:
 - RH lower dashboard
 - Lower cover
 - Console
 - Floor cover



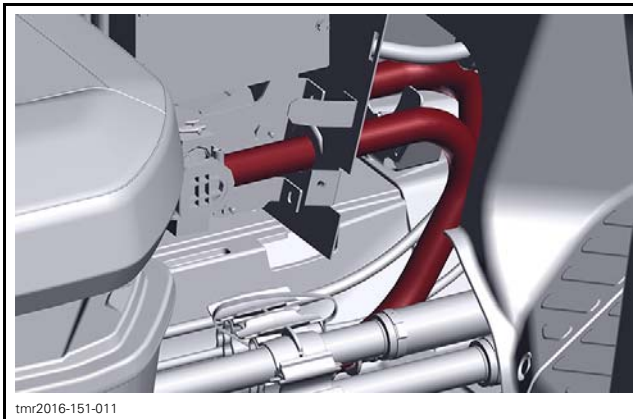
2. Disconnect the air ducts.
3. Remove the following nuts.



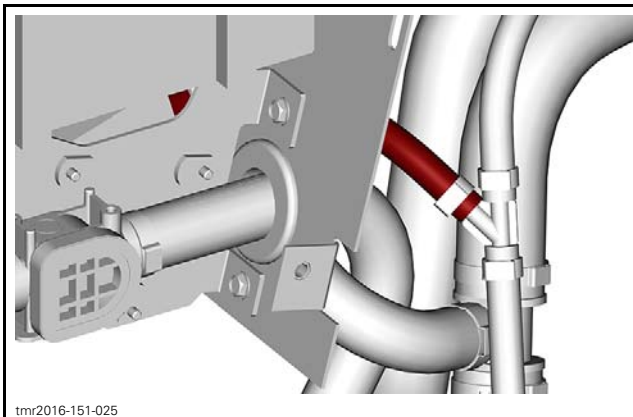


4. Pull on the heating unit assembly.
5. Install a hose pincher on both heater core hoses behind the unit back plate.

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



6. Place a drain pan under the heating unit.
7. Disconnect bleeding hose at Y fitting, behind the unit back plate.



8. Disconnect coolant hoses from the heater core and heat control valve.

9. Disconnect the heating unit harness connector.
10. Remove the heating unit from the vehicle.

Installing the Heating Unit Assembly

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

TIGHTENING TORQUE	
Heating unit retaining nut	14 N•m ± 1 N•m (124 lbf•in ± 9 lbf•in)

Install new Oetiker clamp.

Fill the cooling system with the recommended coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Check for coolant leaks from radiator and hoses.

BLOWER

The blower assembly includes the blower resistor, the blower motor and the blower fans.

Heating Unit Fuses Location

The fuse box is located on the RH side of the heating unit, behind the console.



Testing the Blower Motor

Turn the vehicle key switch to ON.

Turn the blower speed switch to low, medium, then high.

Subsection XX (HEATING SYSTEM)

HEATING UNIT TROUBLESHOOTING CHART		
Is blower working?	YES →	Everything is OK
NO ↓		
Check for power on main accessory posts under dashboard	NO →	Refer to <i>POWER DISTRIBUTION AND GROUNDS</i> subsection
YES ↓		
Check blower fuse (20A). Is fuse burnt?	YES →	Replace fuse Is blower working?
NO ↓		
Bypass 18A current module		
↓		
Blower turns?	YES →	Replace 18A current module Is blower working?
NO ↓		
Bypass blower speed switch		
↓		
Blower turns?	YES →	Replace blower speed switch Is blower working?
	NO →	Replace blower and motor assembly Is blower working?
NO ↓		
Check wiring harness, connectors, and ground		
↓		
Harness and connectors good?	NO →	Repair or replace defective part(s)

Blower Motor resistor

The blower motor resistor provides electrical resistance in series to the blower motor.

The fan speed control switch sends current to one blower resistor pin based on selected fan speed.

Adding resistance to the circuit slows the blower motor.

Removing resistance from the circuit speeds the blower motor.

Testing the Blower Motor Resistor

Refer to *WIRING DIAGRAM*.

The blower motor resistor cannot be tested independently from the blower motor.

1. Turn the fan on to low, medium, then high.
2. Read the voltage at the blower assembly connector for each speed.

If battery voltage is available at each pin of the blower assembly connector and the blower motor does not come on. Ensure there is a good ground.

If all electrical tests are ok. Replace the blower assembly.

Blower speed switch

The blower speed switch sends current to one pin of the blower motor resistor depending on selected speed.

The blower speed switch also activates the relay which allows the temperature control sensor signal to reach the heater control valve actuator.

Testing the Blower Speed Switch

Refer to *WIRING DIAGRAM*.

Remove console.

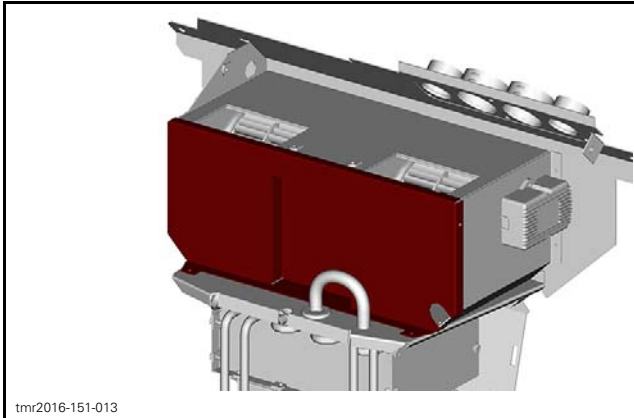
1. Disconnect blower speed switch.
2. Ensure battery voltage is available at pin B (harness side).
3. Disconnect blower speed switch.
4. Test resistance as per following table.

SPEED	PINS	SPECIFICATION
Off	B and C	O.L.
Any speed	B and C	0 Ω
Low	B and 9	0 Ω
Medium	B and 8	0 Ω
High	B and 7	0 Ω

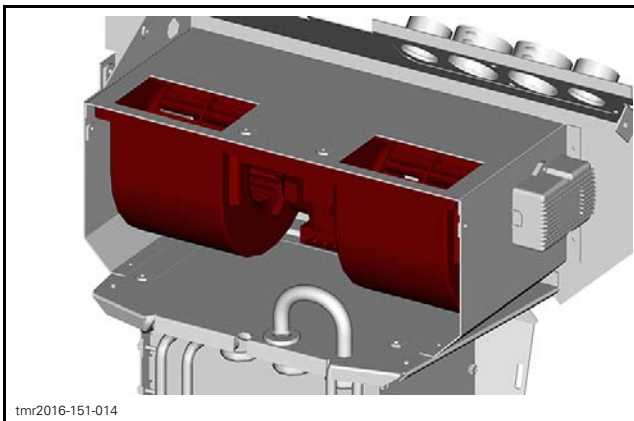
Replace blower speed switch if test is not as per specifications.

Removing the Blower Assembly

1. Remove the heating unit and place it on a work bench.
2. Remove the blower cover.



3. Disconnect the blower motor connector.
4. Remove the blower.



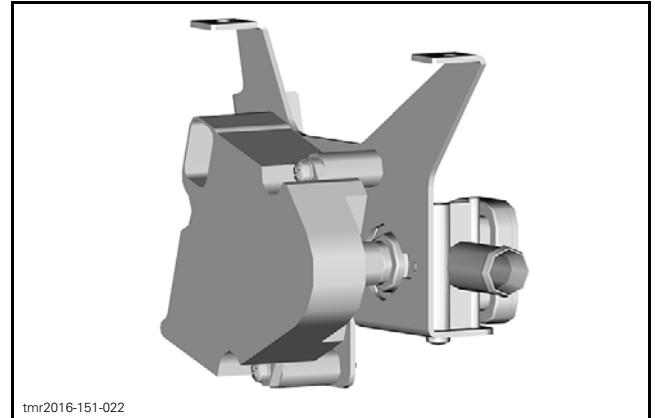
Installing the Blower Assembly

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

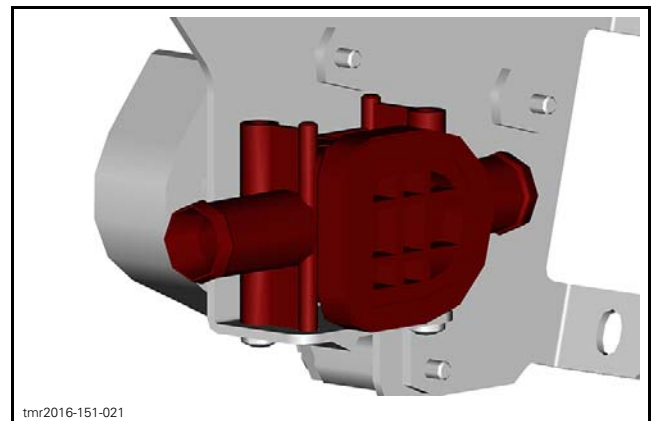
TIGHTENING TORQUE	
Blower assembly screw	$3 \text{ N}\cdot\text{m} \pm 0.5 \text{ N}\cdot\text{m}$ $(27 \text{ lbf}\cdot\text{in} \pm 4 \text{ lbf}\cdot\text{in})$

HEATER CONTROL VALVE

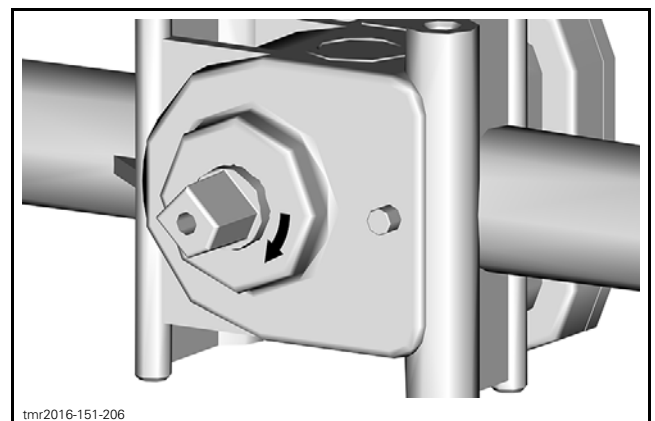
The heater control valve assembly includes the valve and the actuator.



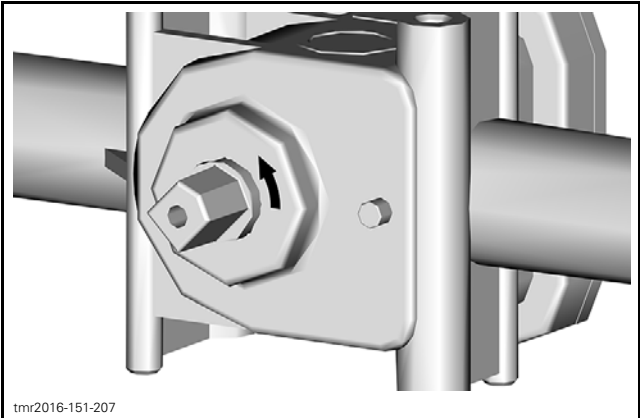
Heater control valve



The heater control valve opens to allow coolant to pass through. When the coolant circulates, it heats up the unit.



The heater control valve closes to prevent coolant from passing through. When the coolant circulation stops, it cools down the unit.



The heater control valve actuator turns the heater control valve.

Testing the Heater Control Valve

- 1. Remove the heater control valve actuator.
- 2. Turn the heater control valve to full open and full closed positions.

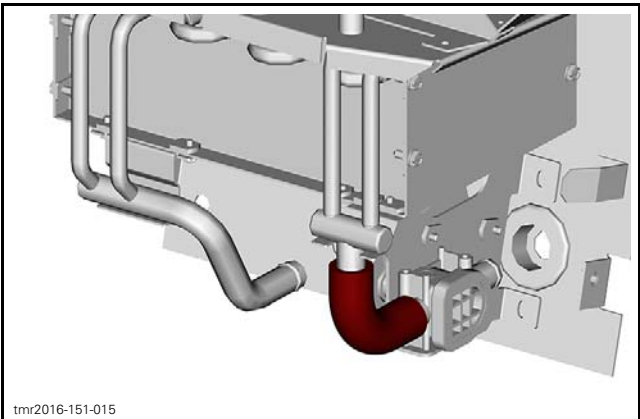
If the heater control valve does not:

- Fully open;
- Fully close;

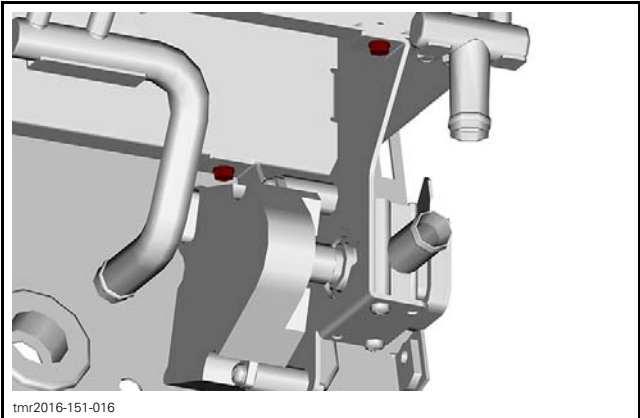
replace the heater control valve assembly.

Removing the Heater Valve Assembly

- 1. Remove the heating unit and place it on a work bench. Refer to *REMOVING THE HEATING UNIT ASSEMBLY*.
- 2. Disconnect valve connector.
- 3. Remove the elbow hose.



- 4. Remove the heater control valve assembly screws.



- 5. Remove the heater valve.

Installing the Heater Control Valve Assembly

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

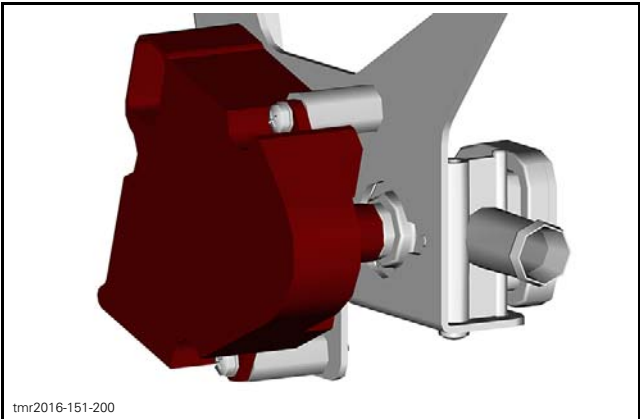
TIGHTENING TORQUE	
Button head screw	3 N•m ± 0.5 N•m (27 lbf•in ± 4 lbf•in)
Hexagonal screw	4 N•m ± 0.5 N•m (35 lbf•in ± 4 lbf•in)

Fill the cooling system with the recommended coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

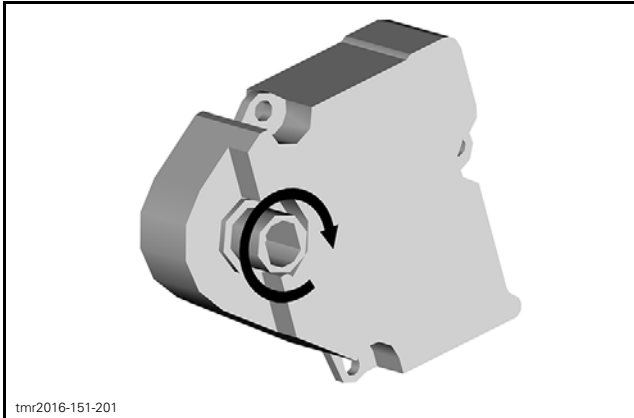
Check for coolant leaks from radiator and hoses.

Heater control valve actuator

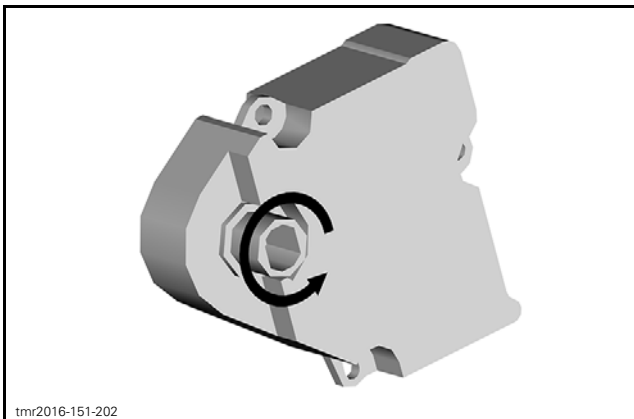


The heater control valve actuator turns when voltage is sent to the signal wire.

As voltage to the signal wire increases, the heater control valve actuator turns clockwise.



As voltage to the signal wire decreases, the heater control valve actuator turns counterclockwise.



Testing the Heater Control Valve Actuator

Refer to *WIRING DIAGRAM*.

Turn blower motor on to any speed.

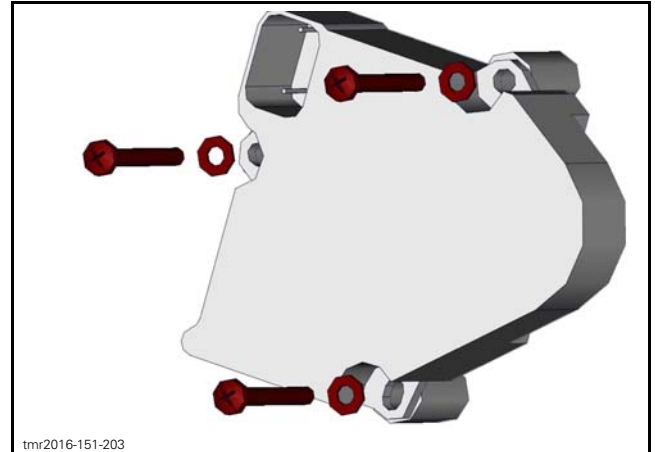
Remove the heater control valve actuator.

1. Ensure battery voltage is available at pin A.
2. Ensure a good ground is available at pin C.
3. Backprobe pin D.
 - 3.1 Voltage should vary when turning the temperature control knob.
 - 3.2 The heater control valve actuator shaft should turn when turning the temperature control knob.

If the valve actuator is defect, replace the control valve assembly.

Removing the Heater Control Valve Actuator

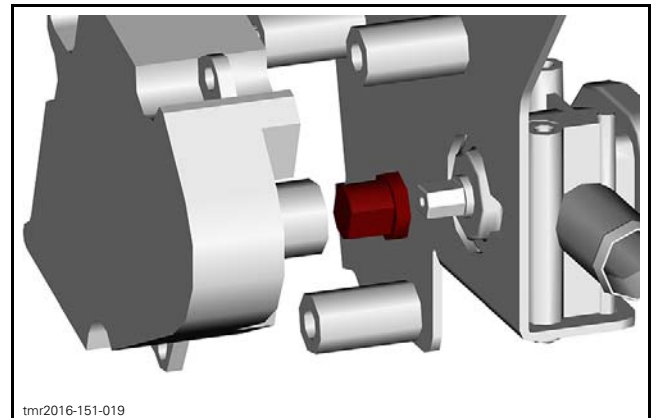
1. Remove the lower cover.
2. Remove the retaining screws and washers.



Installing the Heater Control Valve Actuator

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

Ensure to correctly position the adaptor between valve and actuator shafts.



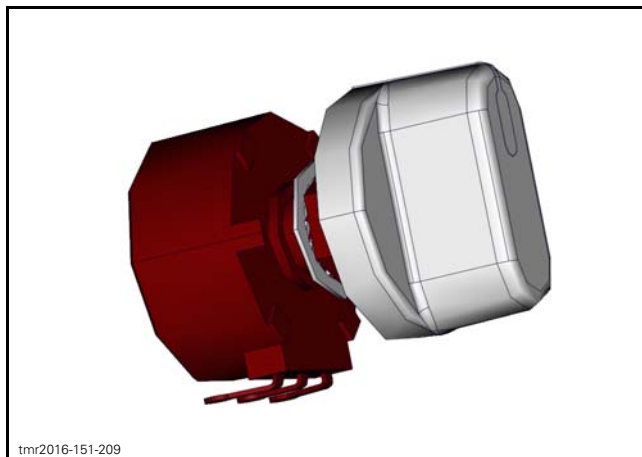
TIGHTENING TORQUE

Actuator screw	3 N•m ± 0.5 N•m (27 lbf•in ± 4 lbf•in)
----------------	---

Temperature control

The temperature control knob turns a potentiometer.

Subsection XX (HEATING SYSTEM)



The potentiometer varies the voltage output through the signal wire.

Testing the Temperature Control Potentiometer

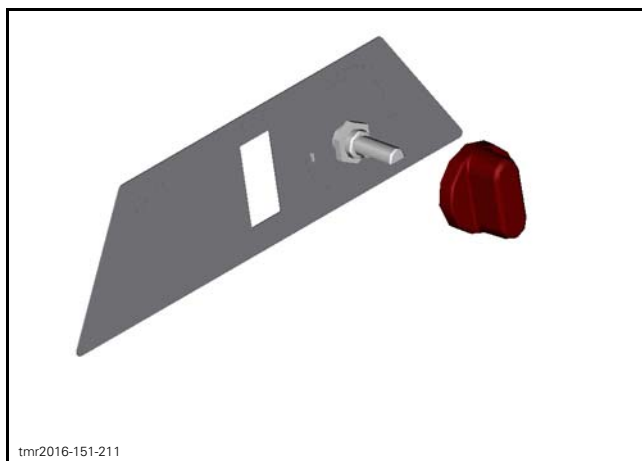
Refer to *WIRING DIAGRAM*.

Turn blower motor on to any speed.

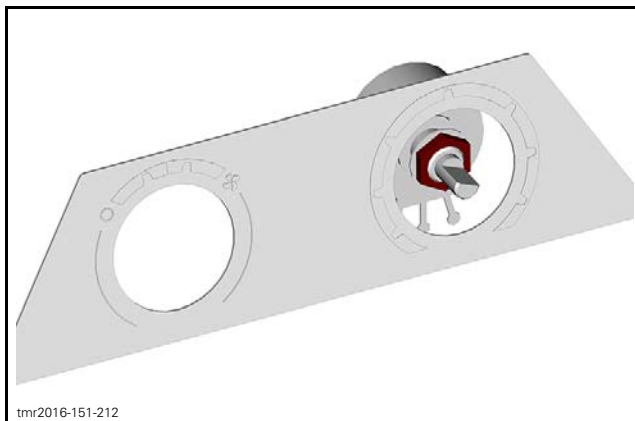
1. Ensure battery voltage is available at pin A.
2. Ensure a good ground is available at pin C.
3. Backprobe pin B.
 - 3.1 Voltage should vary when turning the temperature control knob.

Removing the Temperature Control Potentiometer

1. Remove console.
2. Pull control knob off potentiometer.



3. Remove the retaining nut.



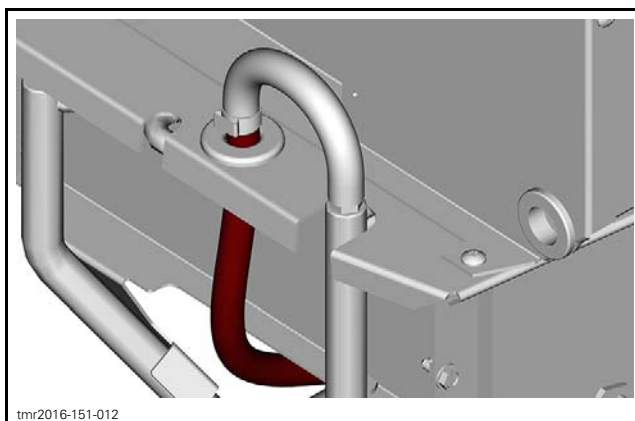
Installing the Temperature Control Potentiometer

Reverse removal procedure.

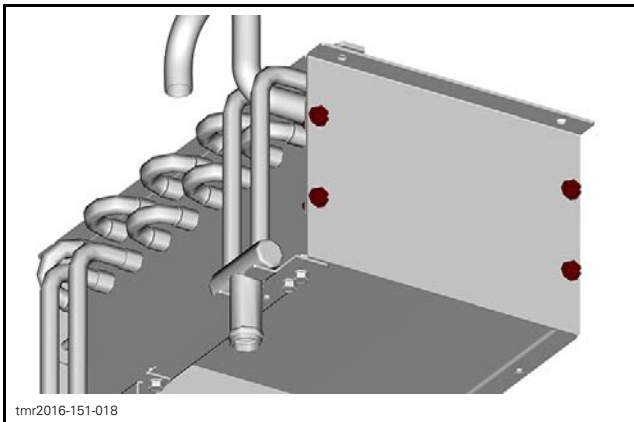
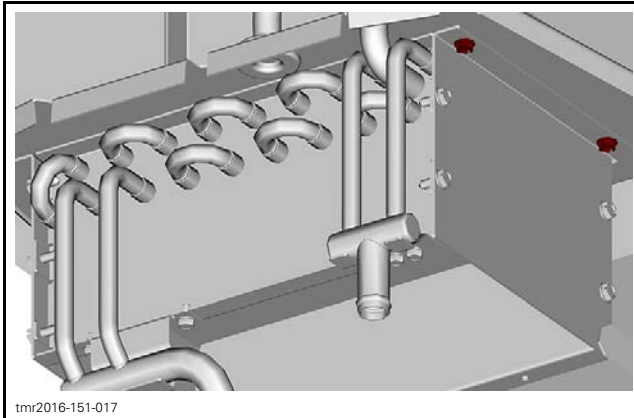
HEATER CORE

Removing the Heater Core

1. Remove the heating unit and place it on a work bench. Refer to *REMOVING THE HEATING UNIT ASSEMBLY*.
2. Remove the heater control valve assembly with elbow hose.
3. Remove the bleeding hose.



4. Remove the heater core end plate screws on both sides.



5. Remove the heater core.

Installing the Heater Core

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

TIGHTENING TORQUE	
Button head screw	$3 \text{ N}\cdot\text{m} \pm 0.5 \text{ N}\cdot\text{m}$ (27 lbf•in $\pm$ 4 lbf•in)
Hexagonal screw	$4 \text{ N}\cdot\text{m} \pm 0.5 \text{ N}\cdot\text{m}$ (35 lbf•in $\pm$ 4 lbf•in)

Install new Oetiker clamp.

Fill the cooling system with the recommended coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Check for coolant leaks from radiator and hoses.

IGNITION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	3
FLUKE 115 MULTIMETER	529 035 868	3

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 ECM 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 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 (EFI)*.

3. Defective trigger wheel / Damaged trigger wheel.
 - Check, refer to *ROTOR* in the *MAGNETO AND STARTER* subsection.
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 *ELECTRONIC FUEL INJECTION (EFI)*.

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. Defective or loose CPS
 - Check. Refer to *ELECTRONIC FUEL INJECTION (EFI)*.
3. Damaged trigger wheel.
 - Check. Refer to *ROTOR* in the *MAGNETO AND STARTER* subsection.
4. Defective ignition circuit
 - Check ignition coil, fuse 5, and wiring condition.
5. Poor engine grounds
 - Check/clean/repair.
6. Fuel level indicator lamp is ON
 - Check fuel level.

ENGINE CONTINUALLY BACKFIRES

1. Fouled, defective spark plugs
 - Clean/replace.

Subsection XX (IGNITION SYSTEM)

- 2. Defective or loose CPS
 - Check, refer to *ELECTRONIC FUEL INJECTION (EFI)*.
- 3. Damaged trigger wheel.
 - Check, refer to *ROTOR in the MAGNETO AND STARTER subsection*.

PROCEDURES

IGNITION SWITCH

Testing the Ignition Switch (Quick Test)

Turn ignition switch to ON position.

If multifunction gauge turns on (assuming it works), the ignition switch is good.

If multifunction gauge does not turn on, check the following in this order:

- Battery
- Fusible links between starter solenoid and fuse box 2
- Fuses 4 and 8 of fuse box 2
- ECM is properly powered (refer to *ENGINE MANAGEMENT*)
- Ignition switch.

Ignition Switch Wire Identification

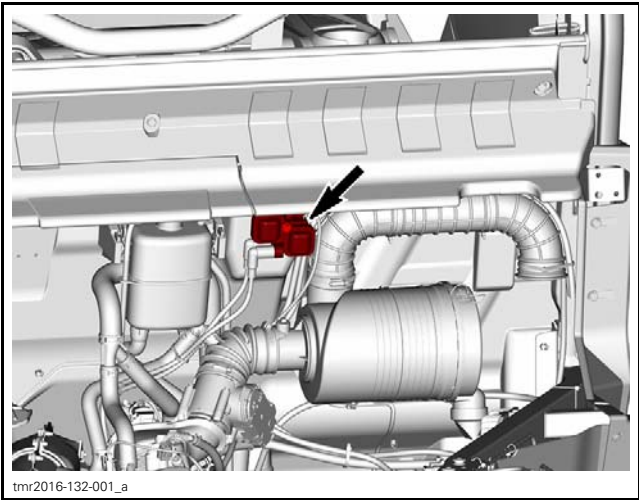
FUNCTION	PIN	WIRE COLOR
Ground signal to ECM in OFF position	A	YE/OG
12 Vdc input	B	BE/WH
12 Vdc output (lights)	C	YE/BU
12 Vdc output (ECM, starter solenoid and start switch)	D	BK/YE
Ground (through ECM)	F	OG/VI

IGNITION COIL



Ignition Coil Access

Tilt the cargo box to reach the ignition coils.



Installing the Ignition Coil

Install a new elastic nut and tighten to the specified torque.

TIGHTENING TORQUE	
Ignition coil retaining bolt	10 N•m ± 1 N•m (89 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.

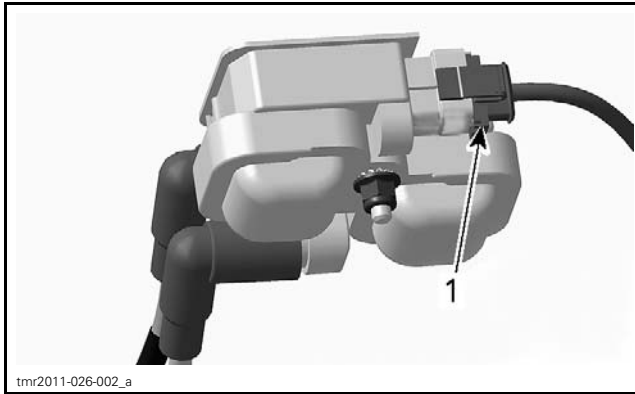
In B.U.D.S., select the **Activation** tab and the **ECM** tab.

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. Ensure spark plug cable is on the appropriate cylinder.

Testing the Ignition Coil Input Voltage

Disconnect the 3-pin connector from the ignition coil.



1. Ignition coil connector

Turn ignition switch to ON.

Check voltage.

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

Testing the Ignition Coil Ground Circuit Continuity

Disconnect the ECM connector "A" and connect it to the ECM adapter tool.

REQUIRED TOOL	
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-M2
Cylinder 2 (rear)	3	A-M1

Testing the Ignition Coil Resistance

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)	Fuse F5	A-M2	.3 - .6 Ω
Cylinder 2 (rear)		A-M1	

If any resistance is not good, measure resistance directly on coil. If second test is ok, check wiring.

Secondary Windings

Due to the integrated diode, it is not possible to take any resistance measurement of the secondary winding.

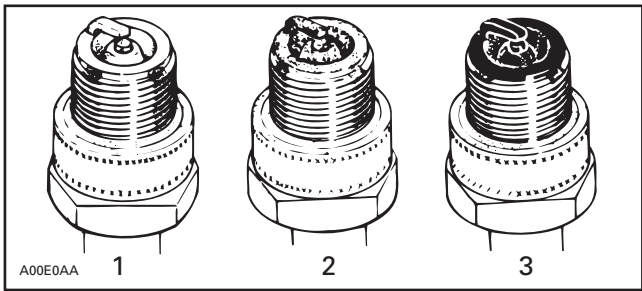
SPARK PLUG

For spark plug replacement procedure, refer to *PERIODIC MAINTENANCE PROCEDURE* subsection.

Troubleshooting Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption. This is due to a loss of compression. Other possible causes are: prolonged idling or low-speed riding, a clogged air filter, incorrect fuel, defective ignition system, incorrect spark plug gap, lubricating oil entering the combustion chamber, or too cold spark plug. The plug face of a fouled spark plug has either a wet black deposit or a black carbon fouling. Such coatings form a conductive connection between the center electrode and ground.

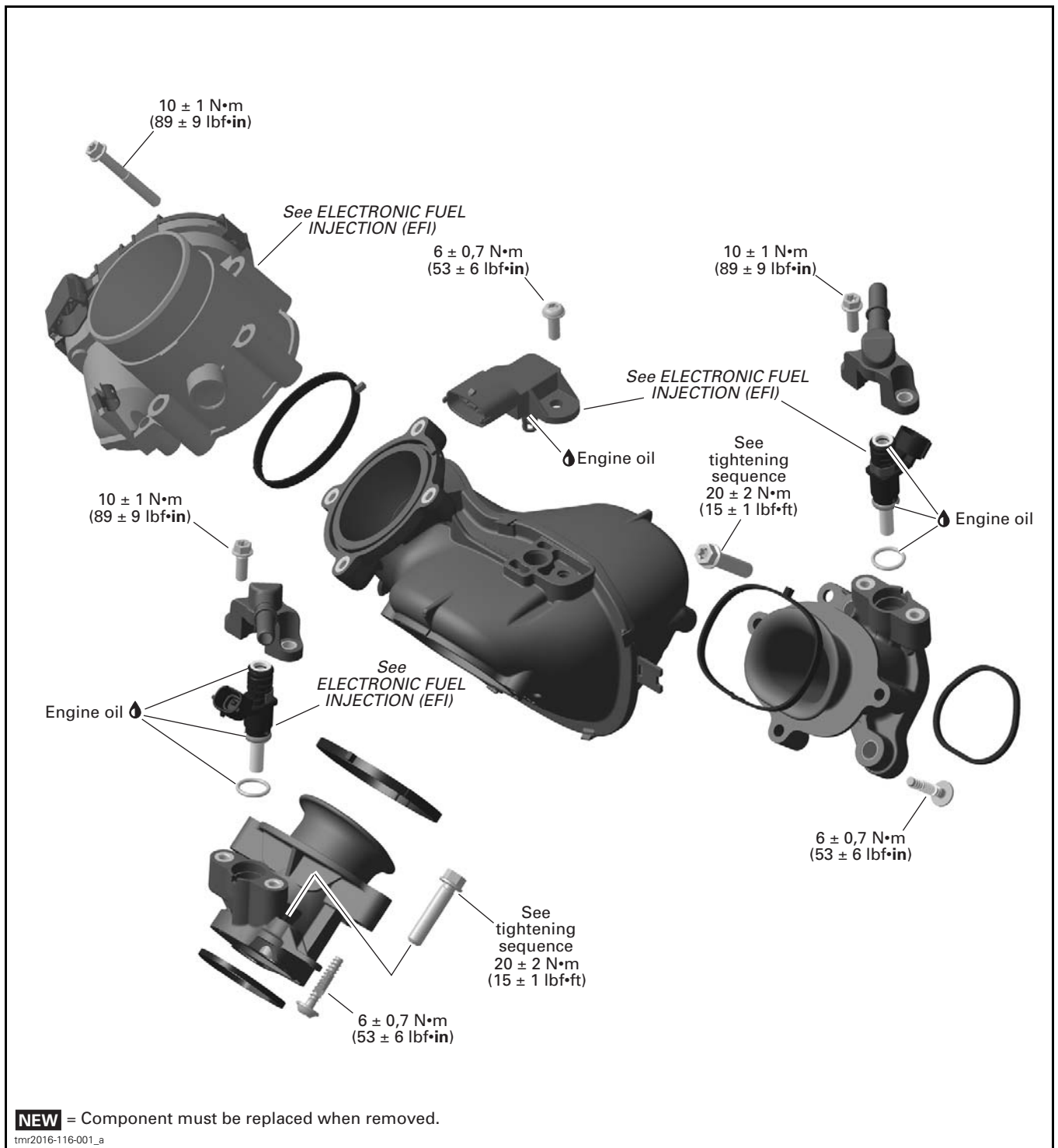
Spark Plug Analysis



- TYPICAL**
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).

INTAKE MANIFOLD



PROCEDURES

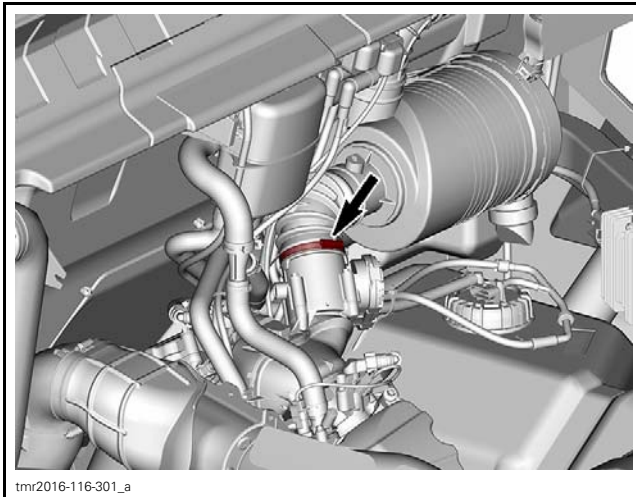
PLENUM

Plenum Access

Tilt the cargo box to reach the plenum.

Removing the Plenum

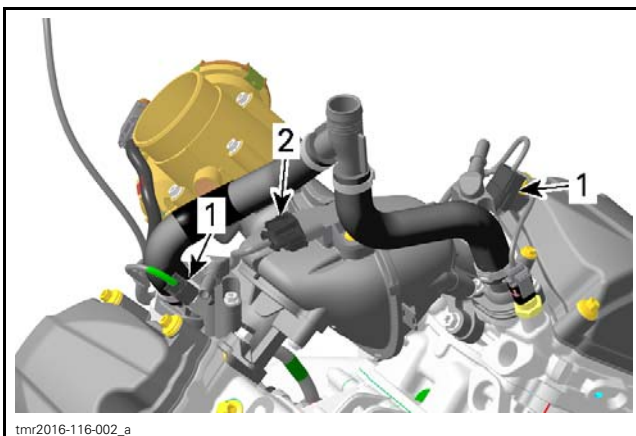
1. Unplug the fuel pump connector.
2. Release fuel pressure by running engine until it runs out of gas.
3. Disconnect the air filter housing hose from throttle body.



4. Disconnect the fuel hoses at the fuel injectors, refer to *ELECTRONIC FUEL INJECTION (EFI)*.

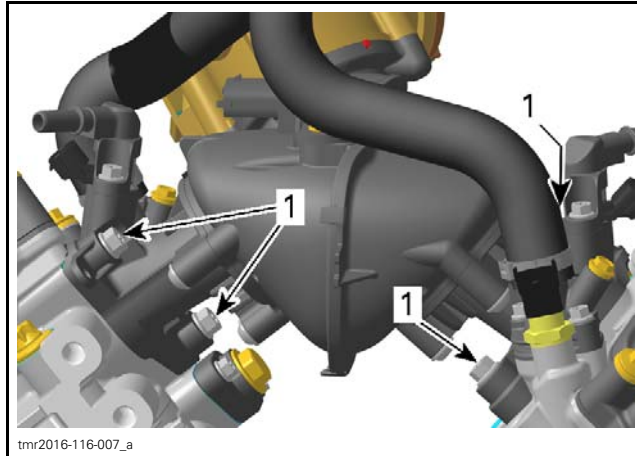
⚠ CAUTION The fuel hose may still be under pressure.

5. Disconnect fuel injectors connectors.
6. Disconnect MAPTS connector.



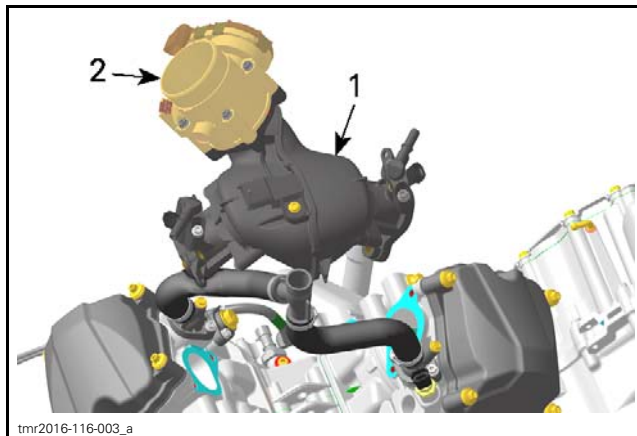
1. Fuel injectors connectors
2. MAPTS connector

7. Remove plenum retaining screws.



1. Plenum retaining screws

8. Remove plenum with throttle body from engine.

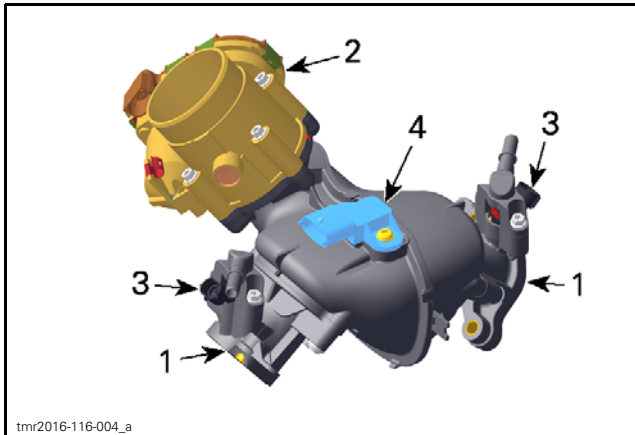


SOME PARTS REMOVED FOR CLARITY

1. Plenum
2. Throttle body

9. Disassemble the following parts only if required. Refer to *ELECTRONIC FUEL INJECTION (EFI)* for completed procedure.

- Intake sockets
- Throttle body
- Fuel injectors
- MAPTS.



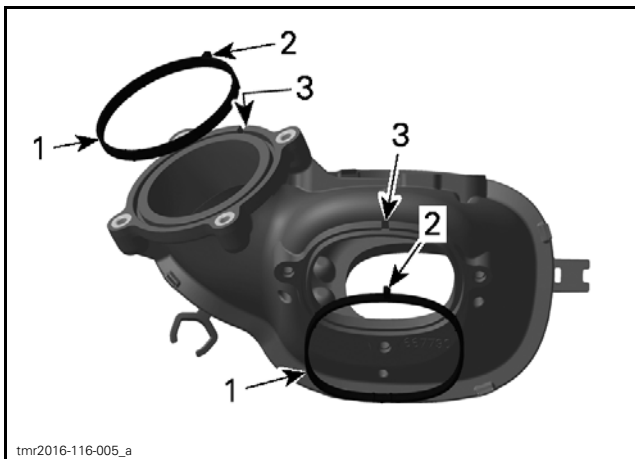
1. Intake sockets
2. Throttle body
3. Fuel injectors
4. MAPTS

Inspecting the Plenum

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

Installing the Plenum

The installation is the reverse of the removal procedure. However, pay attention to the following. Install gaskets with tab properly inserted into notch.

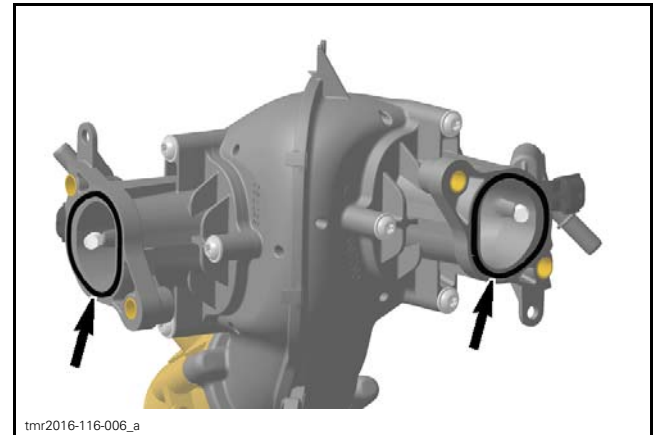


1. Gasket
2. Tab
3. Notch

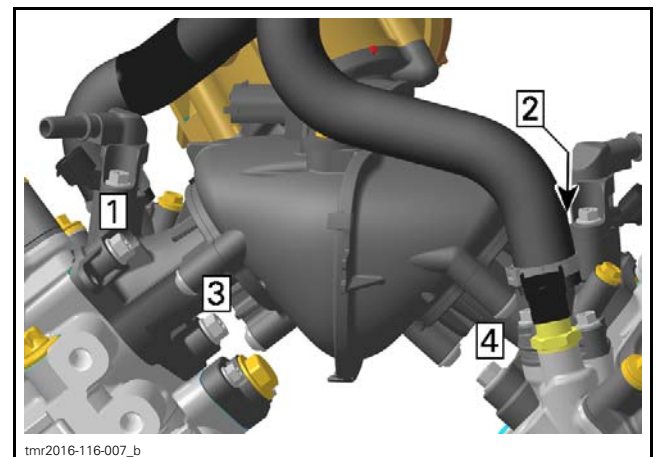
Tighten intake socket screws to specification.

TIGHTENING TORQUE	
Intake socket screws	6 N•m ± 0.7 N•m (53 lbf•in ± 6 lbf•in)

NOTE: To prevent air leakage check if gaskets of the intake sockets are exactly in groove.



Tighten plenum retaining screws as per following sequence.



TIGHTENING TORQUE	
Plenum retaining screws	20 N•m ± 2.5 N•m (15 lbf•ft ± 2 lbf•ft)

Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection to install:

- MAPTS
- Throttle body
- Fuel rail with injectors.

Tighten air filter housing hose clamp to specification.

TIGHTENING TORQUE	
Air filter housing clamp	2.5 N•m ± 0.5 N•m (22 lbf•in ± 4 lbf•in)

Connect the fuel pump connector.

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:

- Types of keys
- ECO/Normal/Work modes

Types of Keys

Optional Performance Key

No limitation, just like the non-DESS keys that come with the Defender.

Optional Normal Key

Limits vehicle speed to maximum 70 km/h (43 MPH) with only 90% engine torque available.

Optional Work Key

Limits vehicle speed to maximum 40 km/h (25 MPH) with full engine torque available.

ECO/Normal/Work Modes

The ECO (fuel economy mode) setting reduces fuel consumption by limiting throttle response and maximum throttle opening to maintain an optimal cruising setting. Use ECO mode on bumpy trails to provide smoother ride conditions

The normal mode offers no engine torque reduction as well as a sportier driving experience.

The work mode is optimized to be able to work with high loads in a smooth way but still with the full engine torque available. This mode is also effective for getting over obstacles and rough terrain.

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.

NOTE: All three driving modes are available in LOW 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. .

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 1350 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 50% 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

ECO/NORMAL/WORK MODE SWITCH

ECO/Normal/Work Mode Switch Wire Information

FUNCTION	PIN	COLOR
ECO signal (to ECM B pin D4)	1	BROWN/GREEN
Ground	2	BLACK
WORK signal (to ECM B pin C4)	3	BROWN/GRAY

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

THROTTLE ACCELERATOR SENSOR (TAS)

TAS Description

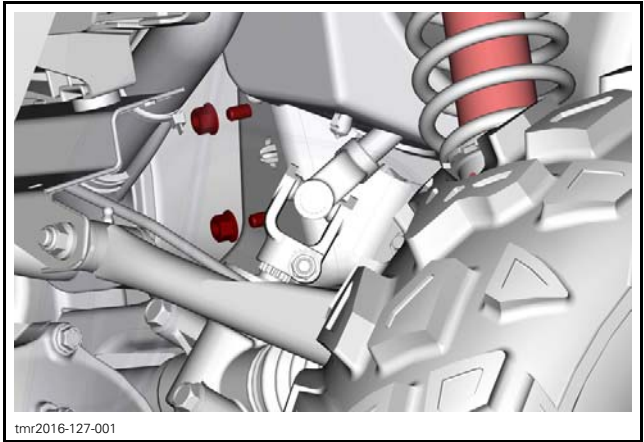
The throttle accelerator sensor (TAS) is a double hall effect sensor that sends a signal to the ECM which is proportional to the accelerator pedal. The redundancy is used for security purposes.

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 locking tie position.
- 2. Disconnect electrical connector.
- 3. Remove both accelerator pedal retaining nuts by outside near the steering column. Reach nuts by the LH side of the vehicle.



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

FUNCTION	PIN	COLOR
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.

If both TAS signals fail, the engine speed will drop to idle.

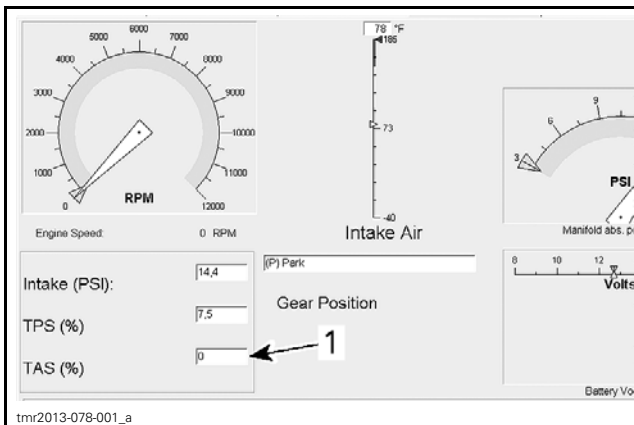
TAS Test with B.U.D.S.

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.* 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 and selected driving mode, which confirms the TAS signal reaches the ECM.

If the TAS signal is above 2% with the accelerator pedal at release, replace the accelerator pedal assembly.

SAFETY NOTICE

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

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

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.

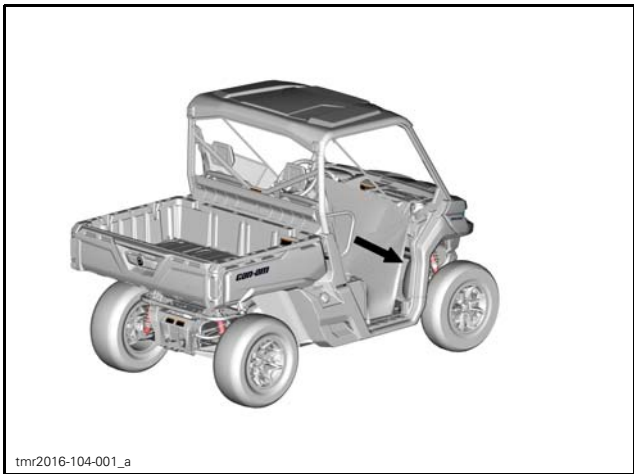
Due to late changes, there may be some differences between the manufactured product and the description and/or specifications in this document.

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)

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



VIN (VEHICLE IDENTIFICATION NUMBER) LOCATION

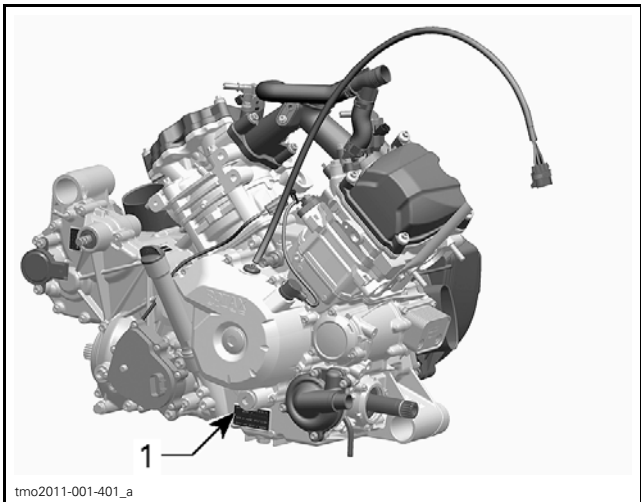
VIN Decal Description



TYPICAL — VEHICLE IDENTIFICATION NUMBER LABEL

- 1. VIN (Vehicle Identification Number)
- 2. Model number
- 3. Manufacturing date

ENGINE IDENTIFICATION NUMBER (EIN)



TYPICAL — ENGINE SERIAL NUMBER LABEL

- 1. EIN (Engine Identification Number)

LIFTING AND SUPPORTING THE VEHICLE

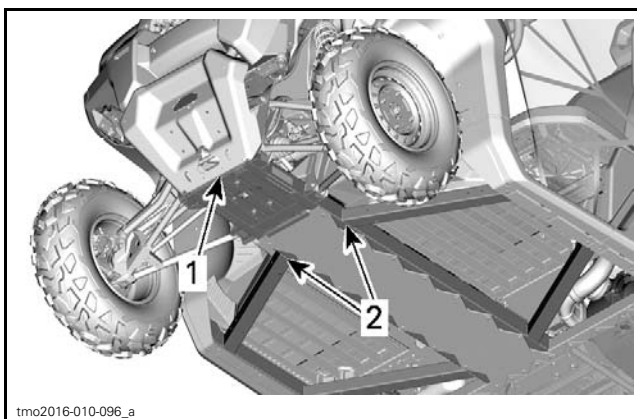
Front of Vehicle

Place vehicle on a flat non slippery ground.

Ensure vehicle shift lever is set to PARK.

Install an hydraulic jack under front skid plate.

Lift front of vehicle and install a jack stand on each side under frame section.



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1. Front of vehicle
2. Frame section

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

Rear of Vehicle

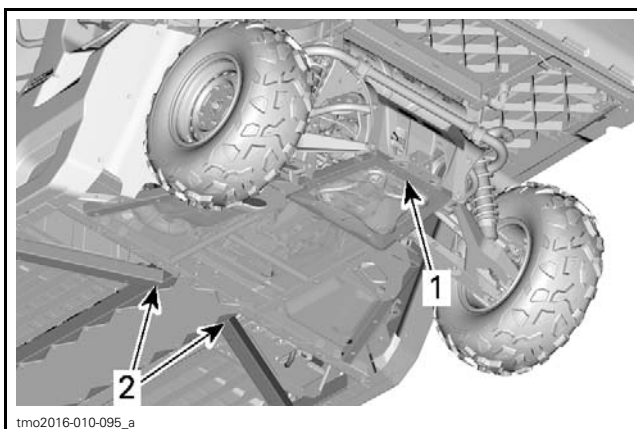
Place vehicle on a flat non slippery ground.

Activate 4WD mode.

Ensure vehicle shift lever is set to PARK.

Install an hydraulic jack under the trailer hitch.

Lift rear of vehicle and install a jack stand on each side under frame section in front of rear wheel.



tmo2016-010-095_a

1. Lifting location under trailer hitch
2. Frame section to install jacks under.

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

LIFTING THE VEHICLE WITH A LIFTING TABLE

Roll vehicle above lifting table.

Install two 4 x 4 horizontally across vehicle as close as possible to lifting points.

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

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



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⚠ 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 properly secured on a flatbed trailer of the appropriate size and capacity.

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

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

INTRODUCTION

WARNING

If the vehicle is equipped with a windshield, transport it facing forward to avoid damaging the windshield.

To load the vehicle on a platform for transport, proceed as follow:

1. Shift the vehicle into NEUTRAL (N).
2. If the vehicle is equipped with a winch, use the winch to roll the vehicle on the platform.
3. If the vehicle is not equipped with a winch, proceed as follows:
 - 3.1 Put a strap around the lower arm of each front suspension.
 - 3.2 Attach the straps to the winch cable of the towing vehicle.
 - 3.3 Pull the vehicle on the flatbed trailer with the winch.
4. Shift the vehicle into PARK (P).
5. Remove the key from the ignition switch.
6. Strap the front tires by using tire towing straps.
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 attached to the trailer.

WARNING

Make sure no loose objects are present inside vehicle during vehicle transportation.

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.

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.

EMISSION REGULATIONS

The vehicle you are servicing may have been certified to applicable emission regulations in your country or state. Not as an exhaustive list; this may include standards for engine exhaust emissions, crankcase emissions, permeation emissions and evaporative emissions. Servicing procedures in this manual must be strictly followed in order to keep the vehicle within the factory specifications. Failure to follow servicing procedures in this manual may lead a vehicle to be out of compliance with applicable emission regulations.

When servicing any vehicle; 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 applicable certification standards. Nobody is allowed 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.

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

The owner/operator is allowed 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.

MANUAL INFORMATION

MANUAL PROCEDURES

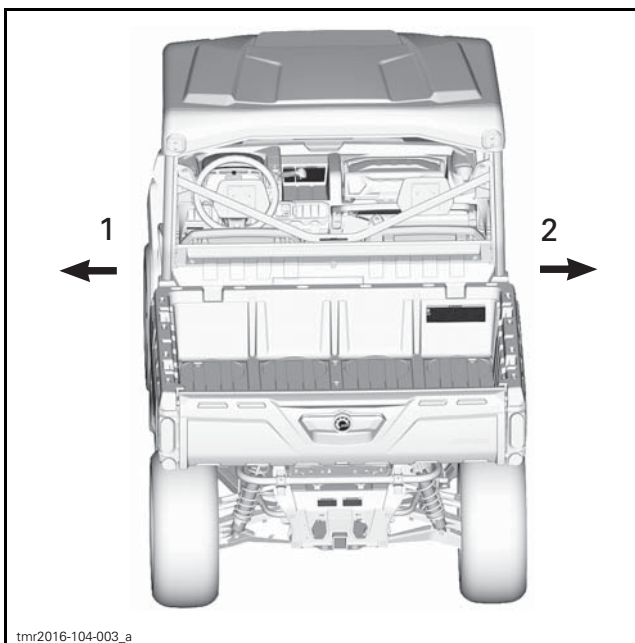
Many of the procedures in this manual are inter-related. Before undertaking any task, you should read and thoroughly understand the entire section or subsection in which the procedure is contained.

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.

TYPICAL PAGE

Section 06 ENGINE
Subsection 01 (MAGNETO)

MAGNETO

Models

Exploded view assists you in identifying parts and their related positions.

NEW indicates that the part must be replaced with a new one.

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)

Illustration number for publishing process.

Document number for publishing process.

NOTICE Pay attention to torque specifications. Some of these are in lbf·in instead of lbf·ft. Use appropriate torque wrench.

Page number

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.

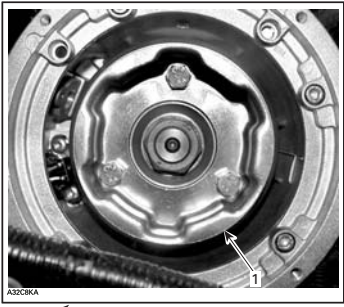
Magneto Flywheel Removal

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

Remove acoustic panel.

Remove rewind starter.

Remove starting pulley no. 2.



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



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).

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

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57

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 

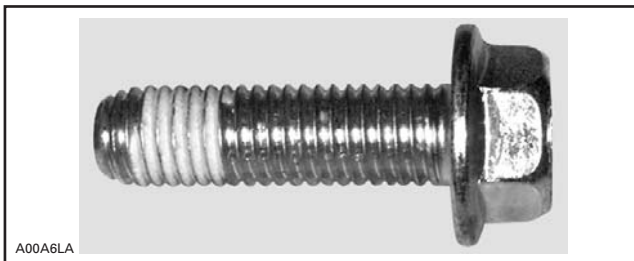
A00A8BS

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.

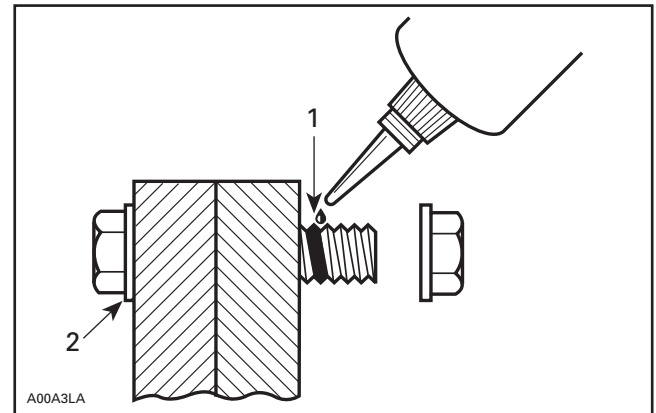
Use a metal brush or a tap to properly clean a threaded hole, then use a solvent. Allow the solvent time to act, approximately 30 minutes, then wipe off. Solvent utilization is to ensure proper adhesion of the product used for locking the fastener.

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.

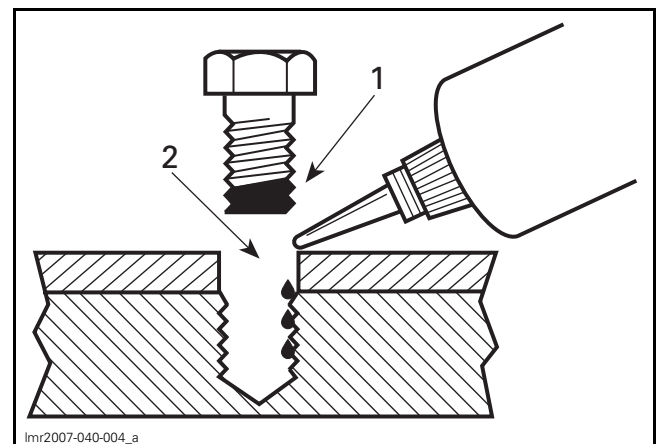
Threadlocker Application for Uncovered Holes (Bolts and Nuts)



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



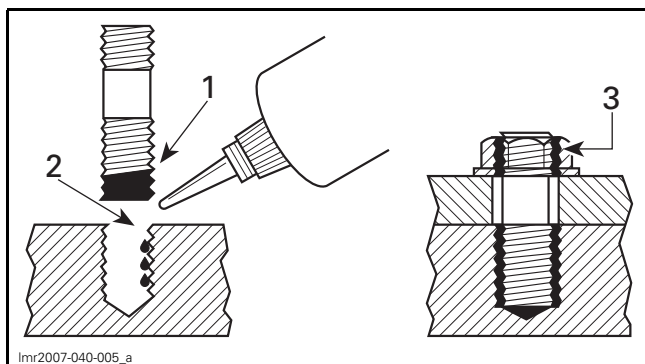
1. On fastener threads
2. On threads and at the bottom of hole

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



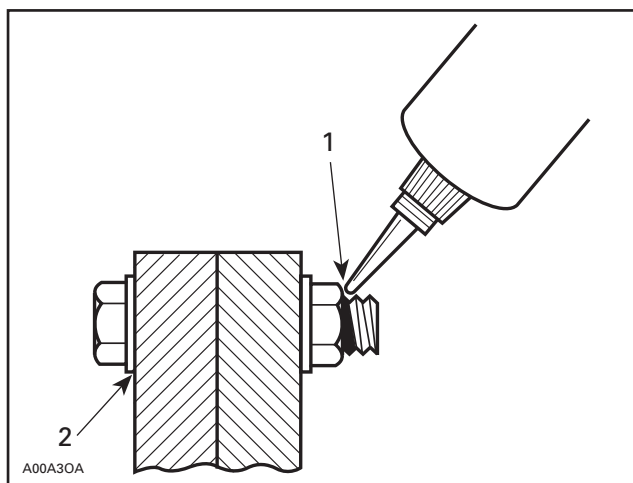
1. On stud threads
2. On threads and in the hole
3. On retaining nut threads

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

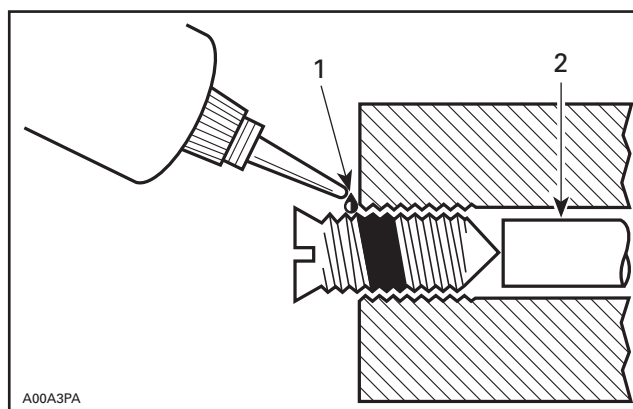


1. Apply here
2. Do not apply

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

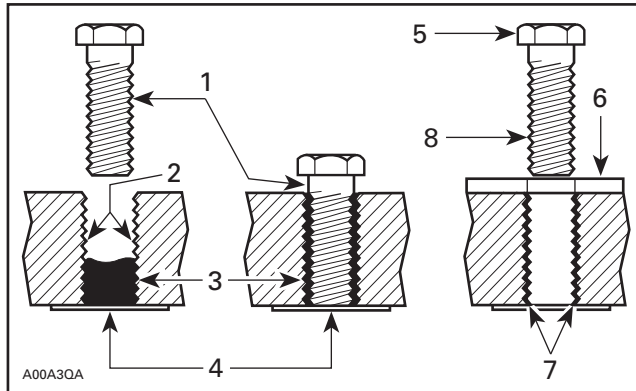


1. Apply here
2. Plunger

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

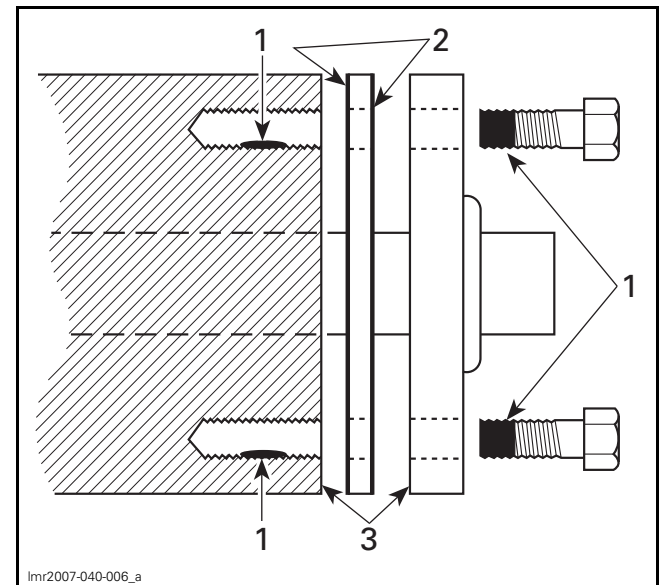
Option 1: Enlarge damaged hole, then follow *STANDARD THREAD REPAIR* procedure.

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.

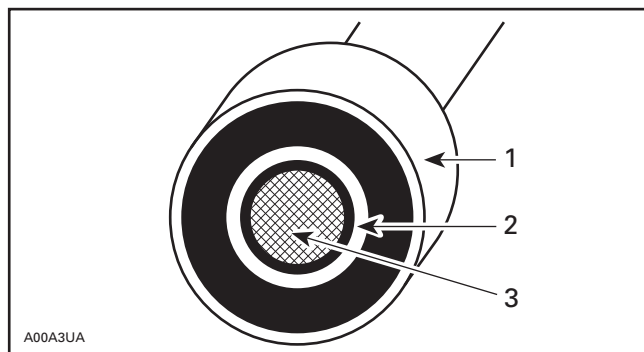
If holes are sunken, apply proper strength Loctite on bolt threads.

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.

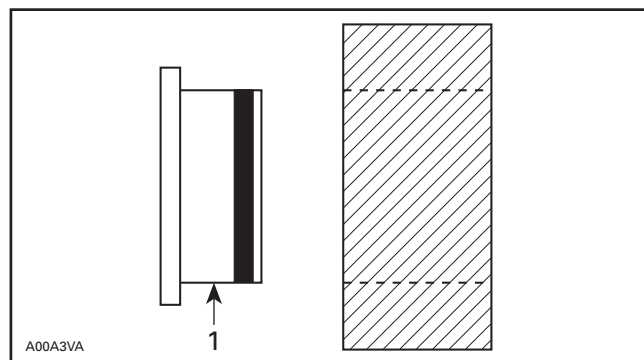
NOTE: Retaining compound is always forced out when applied on shaft.

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.

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.

Testing a Circuit

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.

Inspecting an Electrical Connection

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

The switches connectors can be reached by the openings underneath the dash.

Replacing a Switch

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	RD/BK

NOTE: The illumination circuit of all console switches is supplied by the RD/BK 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

Multifunction Gauge Wire Identification

FUNCTION	PIN	COLOR
12 volt input from fuse F4	17	OR/GN
12 volt input from fuse F13	16	OR/BE
Ground	20	BK
CAN LO	18	WH/BK
CAN HI	19	WH/BE
Fuel level gauge supply	4	BR/PK
Fuel level gauge ground	21	VI/PK
2WD/4WD switch signal (-)	7	BK/BE
HI beam signal (+)	5	BU

Multifunction Gauge Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied at all times	Fuse 13 of fuse block 1 (from fuse link 2)
Supplied with main relay activated	Fuse 4 of fuse block 2 (from main relay R2)

Removing the Multifunction Gauge

1. Release retaining clips at the top of gauge.



2. Disconnect the gauge connector.



Installing the Multifunction Gauge

The installation is the reverse of the removal procedure.

Maintenance Soon Message

Resetting the Maintenance Soon Message Manually

1. Select PARK.
2. Turn ignition switch to ON. Do NOT start engine.
3. Using the MODE button, display the odometer (vehicle total mileage).
4. Press and hold the MODE button.
5. Switch HI and LOW beam 3 times quickly.
6. Release the MODE button.
7. Turn ignition switch to OFF.

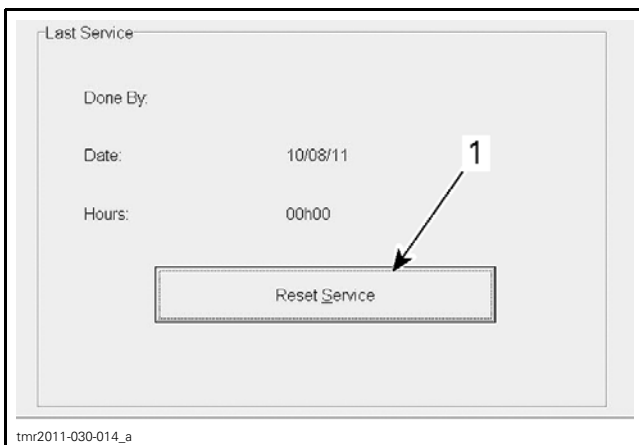
NOTE: Do not turn ignition switch to ON before the multifunction gauge turns off.

Resetting the Maintenance Soon Message 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.

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.



1. Cluster Units

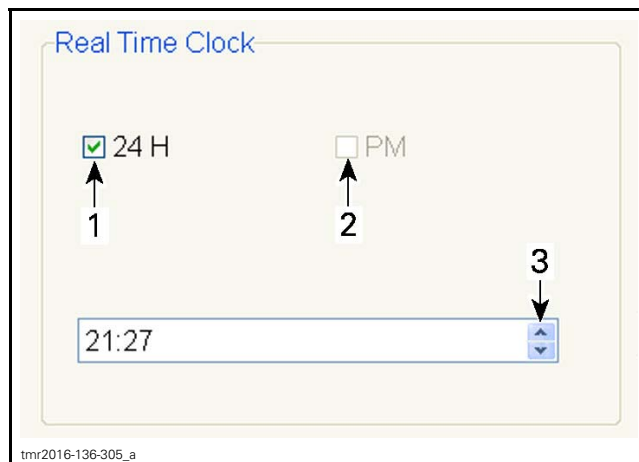
Clock Setting

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

Tire Size Selection

Select **Setting** and **ECM** tabs.

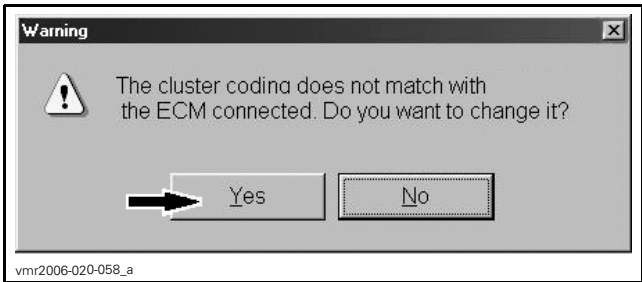
Scroll and select the appropriate tire diameter (see inscriptions on the tires) in the **Tire Size** box.



1. Tire Size box

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.**

Testing the Multifunction Gauge with B.U.D.S.

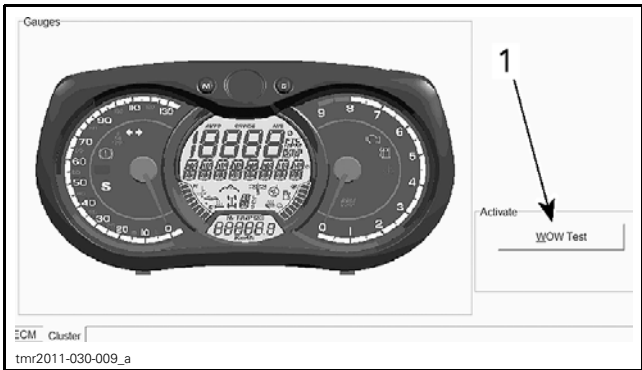
Connect to the applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

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

Replacing a 12 Volt Power Outlet

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	RD/BR
Ground (to ground terminal BK3)	1	BK

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

VEHICLE WIRE AT HEADLIGHT CONNECTOR	SELECTION	APPLICATION
GREEN (GN)	Low beams	12 Vdc Bulb power
BLUE (BU)	High beams	12 Vdc Bulb power
BLACK (BK)	High/Low beams	Hi/LO beams ground

Headlights Circuit Protection

SELECTION	CIRCUIT PROTECTION
High beams	Fuse 11 of fuse block 1 (from relay #3)
Low beams	Fuse JCT of fuse block 1 (from relay #3)

Testing the Headlight

Disconnect headlight connector.

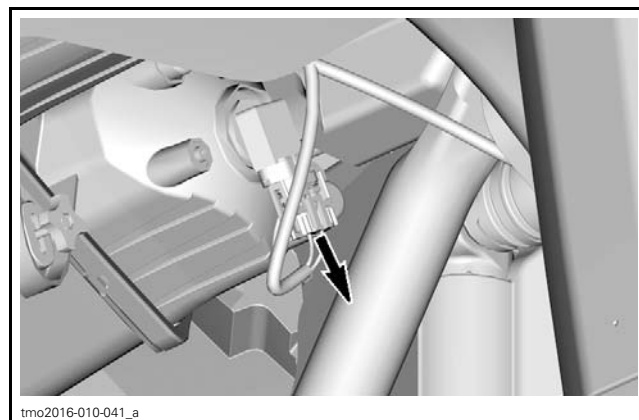
Using a multimeter, measure the voltage on headlight connector as follows.

SWITCH POSITION	WIRE COLOR		VOLTAGE
LO beam	GN	BK	Battery voltage
HI beam	BU	BK	

Replacing the Headlight Bulb

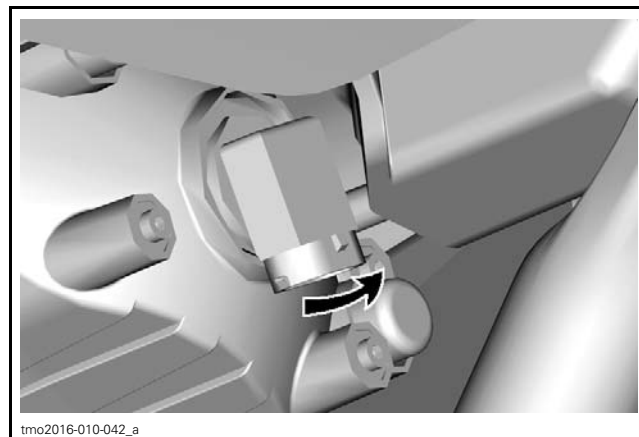
NOTICE Never touch glass portion of a halogen bulb with bare fingers, it shortens its operating life. If glass is touched, clean it with isopropyl alcohol which will not leave a film on the bulb.

Unplug connector from bulb.



TYPICAL

Rotate bulb.



TYPICAL

Pull out bulb.

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

Validate headlights operation.

Headlamp Beam Aiming

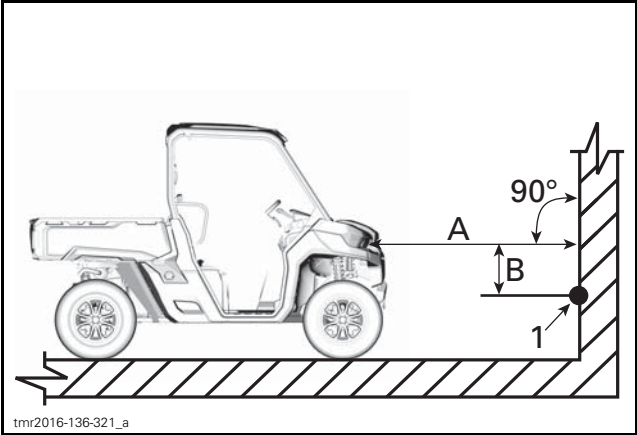
Select high beam.

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.

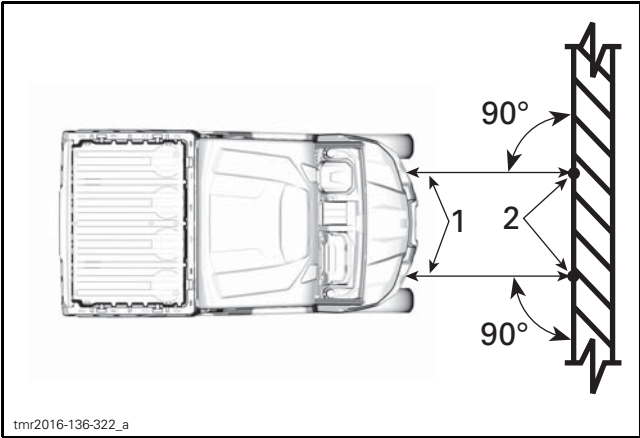
NOTE: Load vehicle as per normal use.

Subsection XX (LIGHTS, GAUGE AND ACCESSORIES)

Measure headlight center distance from the ground. Scribe a line at this height on test surface (wall or screen). Light beam center should be 130 mm (5 in) below scribed line.



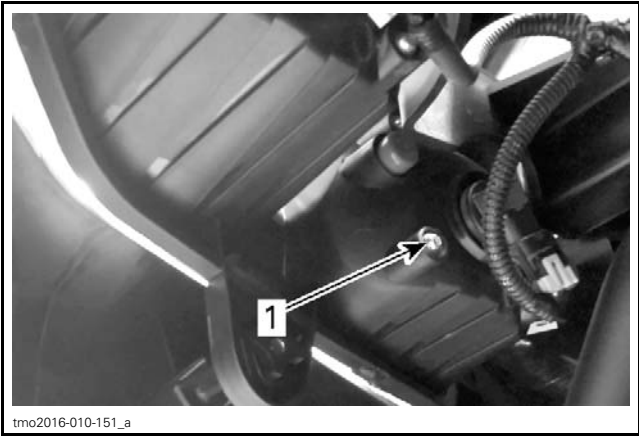
1. Light beam center
A. 5 m (17 ft)
B. 131 mm (5 in)



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

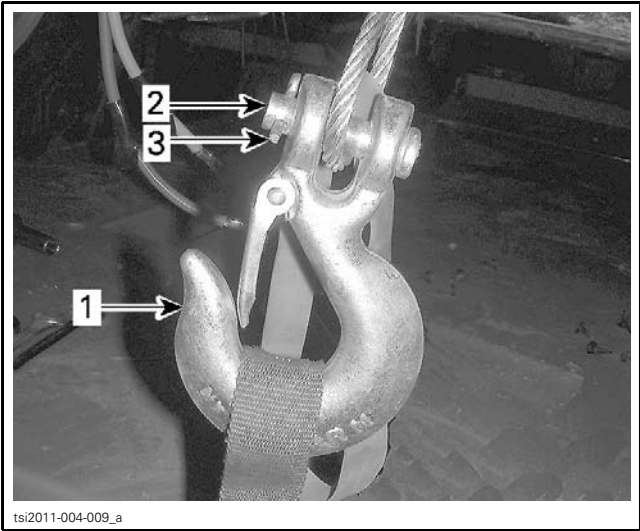
Taillight/Brake Light Wire Identification

BRAKE LIGHT RELAY (R8)		
FUNCTION	PIN	COLOR
12 volt input from fuse F16	7	VT/WH
12 volt input from brake light switch (relay winding input)	15	RD/OR
12 volt output to brake lights	10	WH/OR
Relay winding ground (to ground terminal BN1)	13	BK

BRAKE LIGHT SWITCH		
FUNCTION	PIN	COLOR
12 volt input from fuse F4	2	OR/GN
12 volt output to R8 relay winding	1	RD/OR

Taillight/Brake Light Circuit Protection

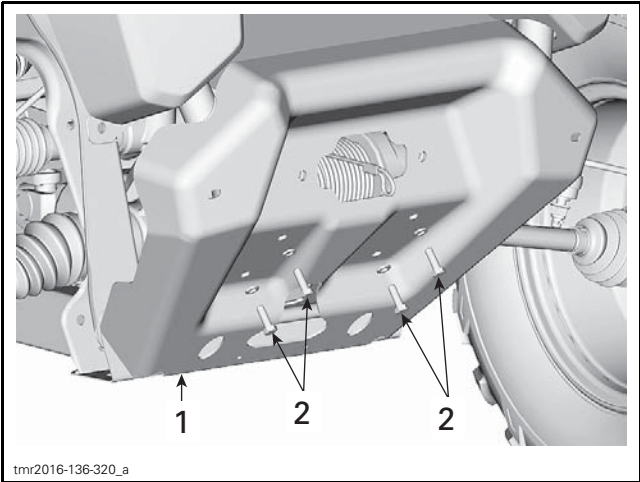
CONDITION	CIRCUIT PROTECTION
Supplied with main relay activated	Fuse 16 of fuse block 1 and Fuse 4 of fuse block 2 (from main relay R2)



1. Hook
2. Hook pin
3. Cotter pin

Connect wires the YELLOW wire at front and the BLUE one at back.
Install a **NEW** cotter pin on the hook pin.

3. Remove the four retaining screws from underneath the winch motor.



1. Bumper plate
2. Retaining screws

4. Disconnect both winch power cables.
- NOTE:** Note the position of the power cables for reinstallation.
5. Pass the cable through the roller fairlead.
6. Remove winch.

Installing the Winch

For the installation, reverse the removal procedure, however pay attention to the following.
Tighten winch retaining screws to specification.

TIGHTENING TORQUE	
M8 x 25 Bolt	16 N•m ± 2 N•m (142 lbf•in ± 18 lbf•in)

LUBRICATION SYSTEM

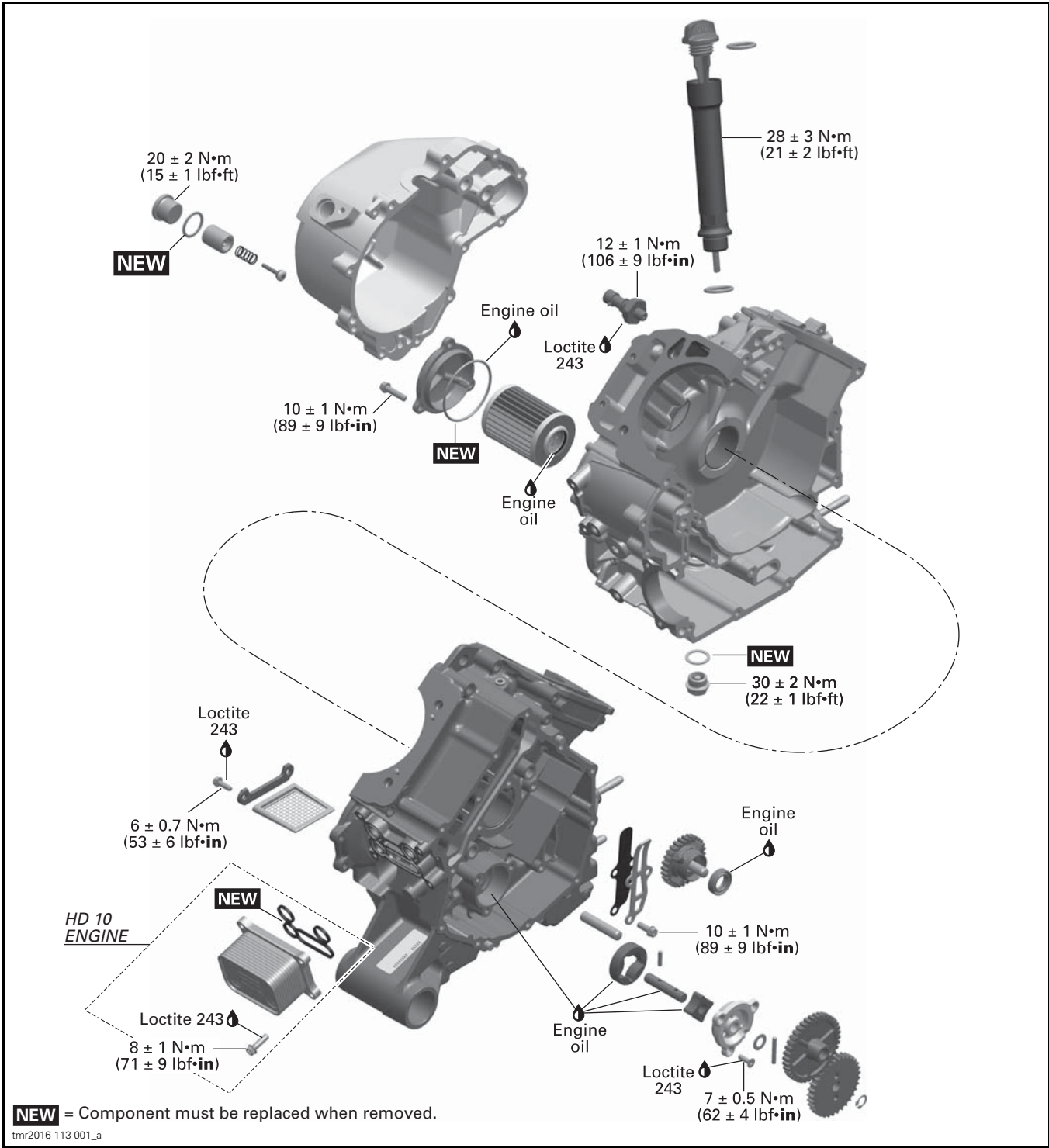
SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE	529 035 652	4
DISCONNECT TOOL	529 035 714	4
PRESSURE GAUGE.....	529 035 709	4

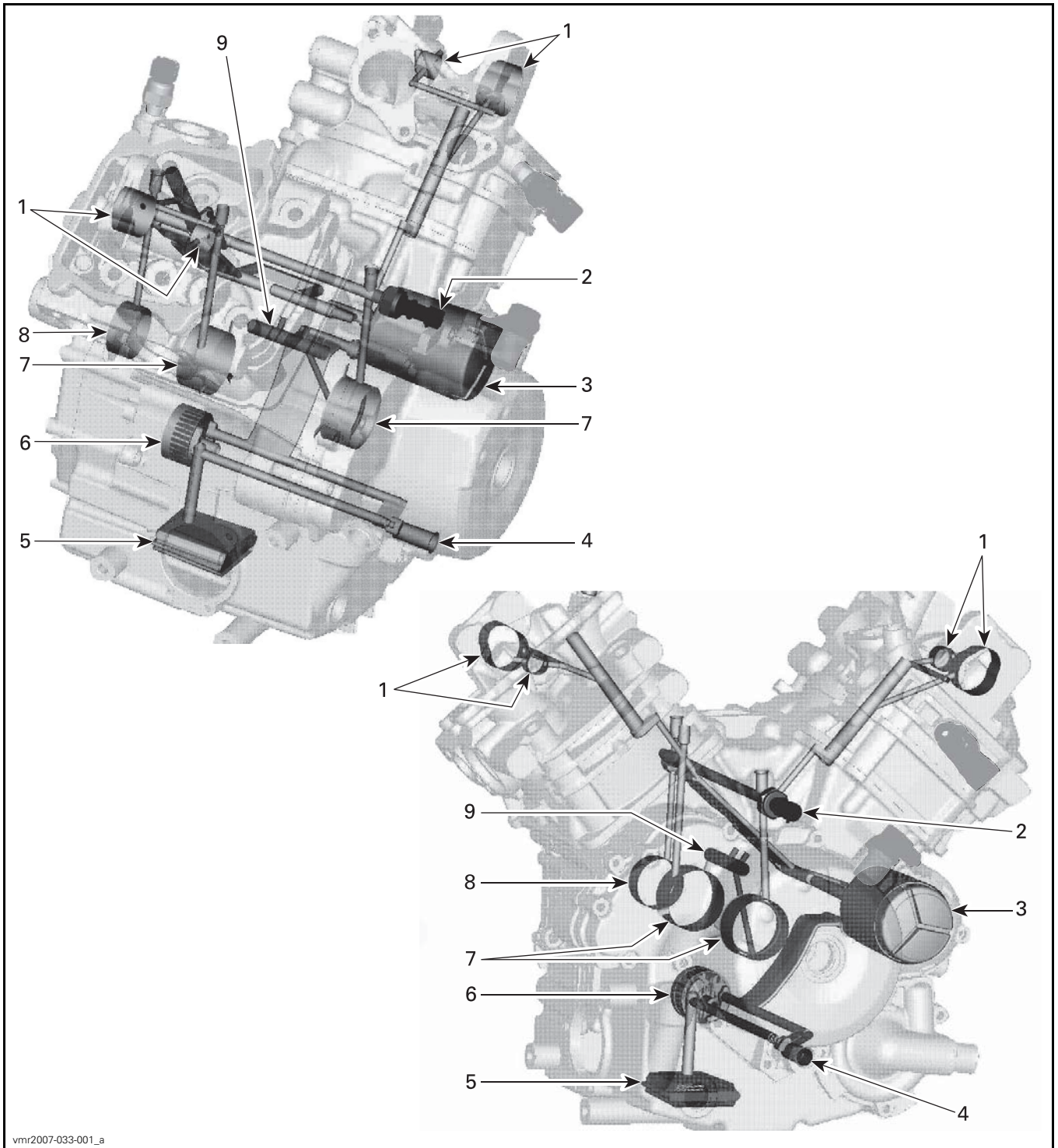
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	6, 10

COMPONENTS



ENGINE LUBRICATION CIRCUIT



vmr2007-033-001_a

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

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.

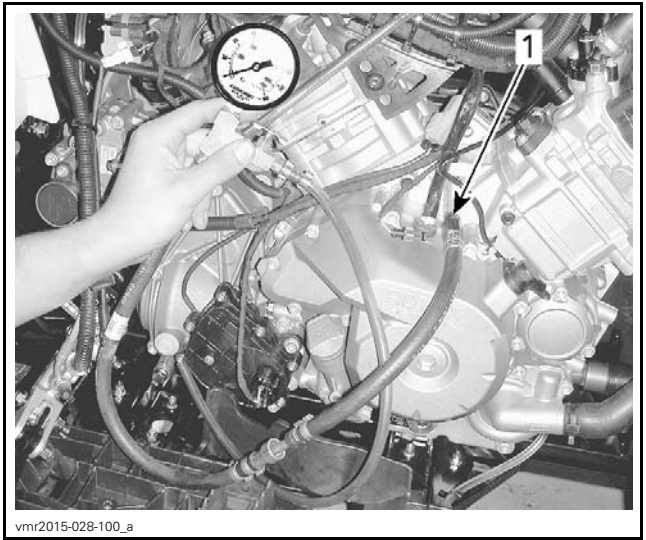
Remove the oil pressure switch. Refer to *OIL PRESSURE SWITCH* in this subsection.

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.

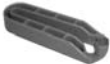
OIL PRESSURE	1250 RPM	6000 RPM
MINIMAL	70 kPa (10 PSI)	300 kPa (44 PSI)
NOMINAL	150 kPa (22 PSI)	350 kPa (51 PSI)
MAXIMAL	250 kPa (36 PSI)	450 kPa (65 PSI)



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

- 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 this *TROUBLESHOOTING*.
 - Check for engine oil leaks. For leak indicator hole, refer to *COOLING SYSTEM INSPECTION* in the *PERIODIC MAINTENANCE PROCEDURES* subsection. Repair if necessary.
- Use of unsuitable engine oil type.
 - Replace engine oil by the recommended engine oil.
- Clogged oil filter.
 - Replace oil and oil filter at the same time.
- Defective oil pressure switch.
 - Test oil pressure switch, see procedure in this subsection.
- Defective or worn oil pump.
 - Check oil pump, see procedure in this subsection.
- Defective engine oil pressure regulator.
 - Check engine oil pressure regulator, see procedure in this subsection.
- Worn plain bearings in crankcase.
 - Check plain bearings clearance, refer to *BOTTOM END* subsection.
- Clogged engine oil strainer.
 - Clean engine oil strainer, see procedure in this subsection.

OIL CONTAMINATION

- 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.
- 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 (HD 10 ENGINE ONLY)

Oil Cooler Access

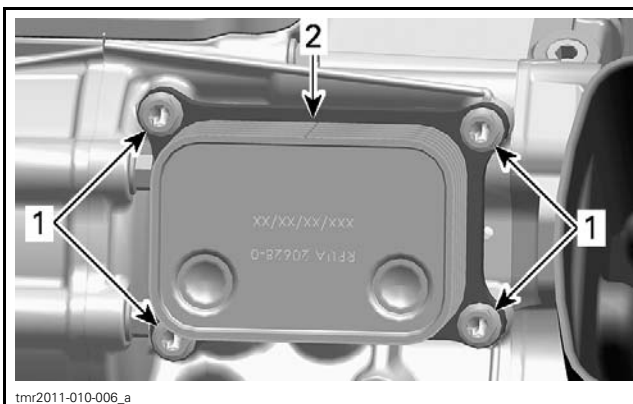
Remove the fuel tank to reach the oil cooler. Refer to *FUEL TANK AND FUEL PUMP* subsection.

Removing the Oil Cooler

Refer to the *PERIODIC MAINTENANCE PROCEDURES* subsection to:

- Drain engine oil.
- Drain engine coolant.

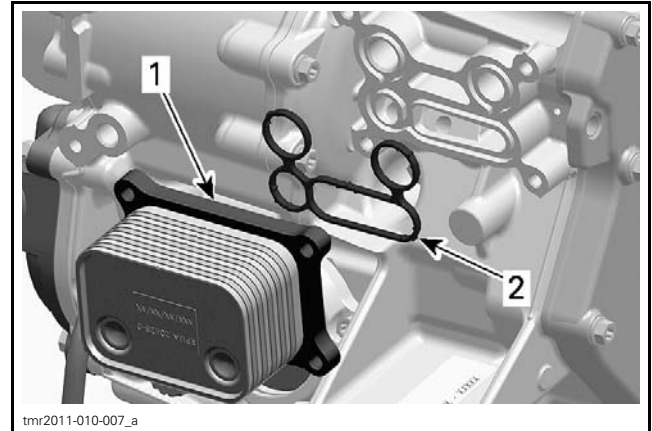
Remove oil cooler retaining screws.



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

Inspecting the Oil Cooler

Check oil cooler for cracks or other damage.

Replace if necessary.

Installing the Oil Cooler

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

Wipe off any oil and coolant spillage.

Install a **NEW** gasket.

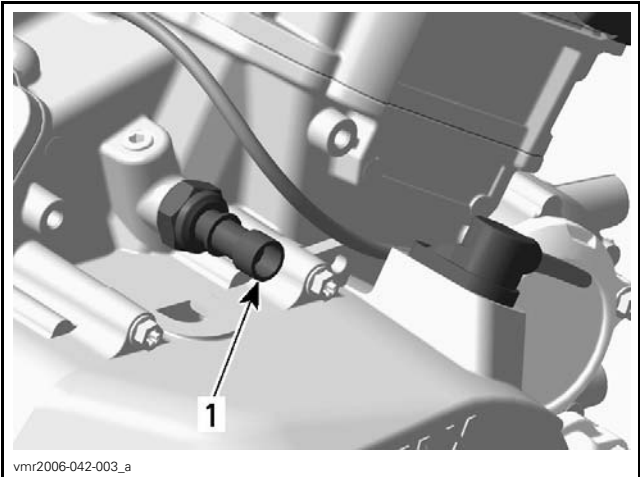
Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection and carry out the following:

- 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

Oil Pressure Switch Access

Open the cargo box to reach the engine.

Oil Pressure Switch Activation

The oil pressure switch activates when the engine oil pressure is lower than following specified pressure range.

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.

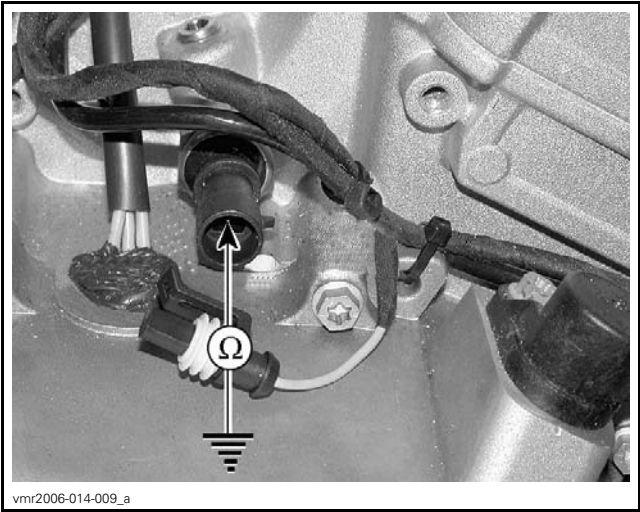
If the engine oil pressure is good perform the oil pressure switch resistance test.

Testing the Oil Pressure Switch Resistance

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)	
1	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.

Removing the Oil Pressure Switch

Unplug the oil pressure switch connector.

Unscrew and remove oil pressure switch.

Installing the Oil Pressure Switch

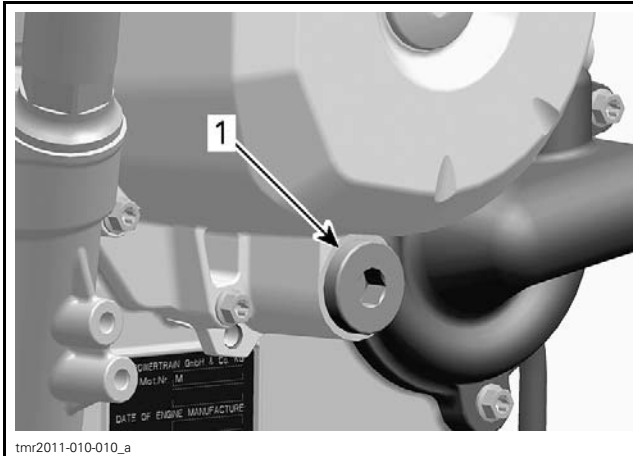
Tighten oil pressure switch to specified torque.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Oil pressure switch	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

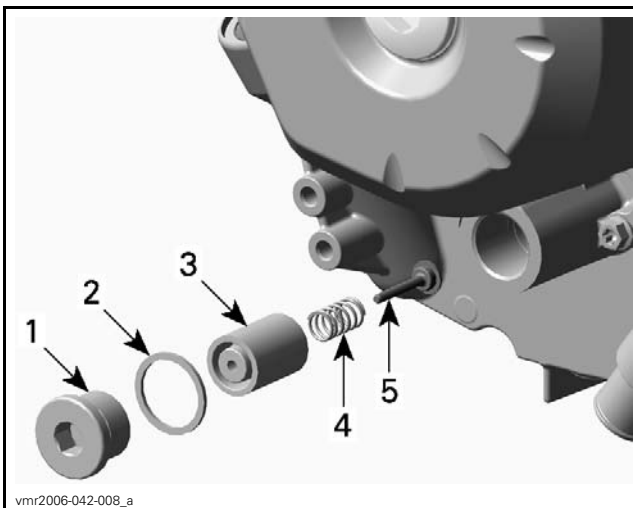
NOTE: The oil pressure regulator system works when the oil pressure exceeds 400 kPa (58 PSI).

Oil Pressure Regulator Access

Open the cargo box to reach the engine.

Removing the Oil Pressure Regulator

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

Inspecting the Oil Pressure Regulator

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.

Installing the Oil Pressure Regulator

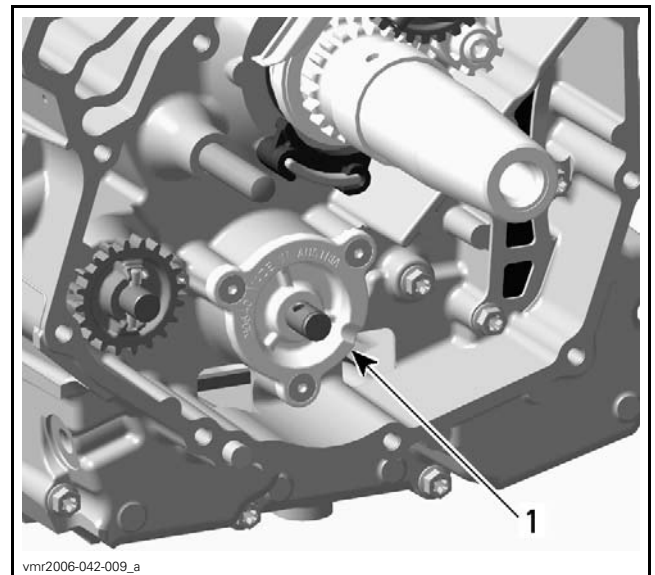
For installation, reverse the removal procedure. Pay attention to the following details.

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).



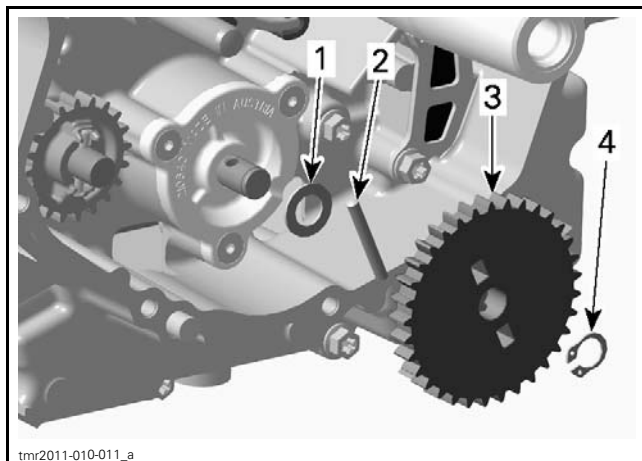
1. Oil pump

Removing the Oil Pump

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

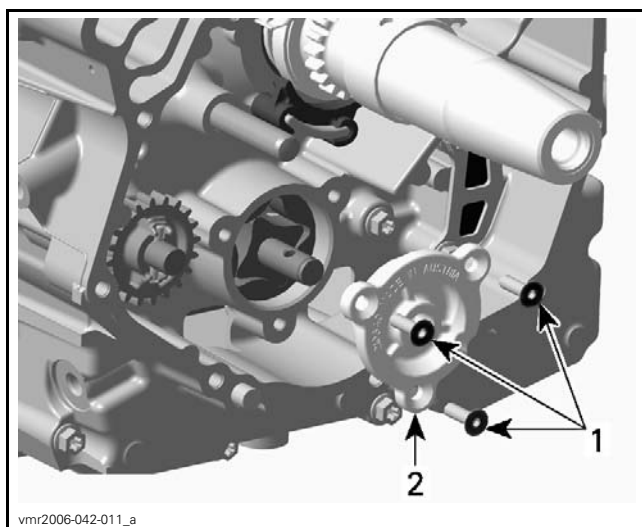
1. Remove:
 - Retaining ring
 - Oil pump gear
 - Needle pin
 - Thrust washer.

Subsection XX (LUBRICATION SYSTEM)



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

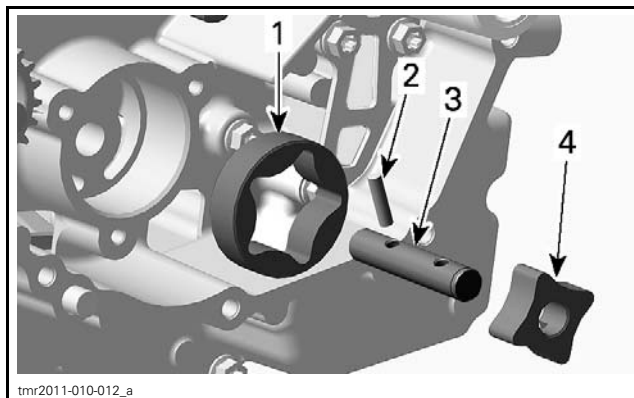
2. Remove oil pump cover screws and pull oil pump cover out.



1. Retaining screws
2. Oil pump cover

3. Remove oil pump shaft with needle pin and inner rotor.

4. Remove outer rotor.

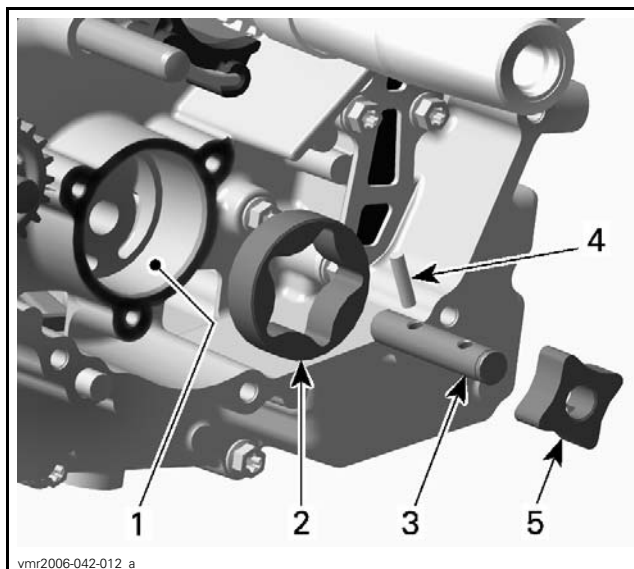


1. Outer rotor
2. Needle pin
3. Oil pump shaft
4. Inner rotor

Inspecting the Oil Pump

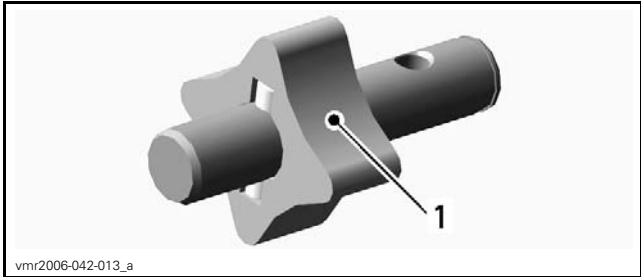
Inspect oil pump and oil pump cover bore for marks, scratches or other damages. Check for scratches in crankcase between outer rotor and oil pump bore. If so, replace damaged parts.

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

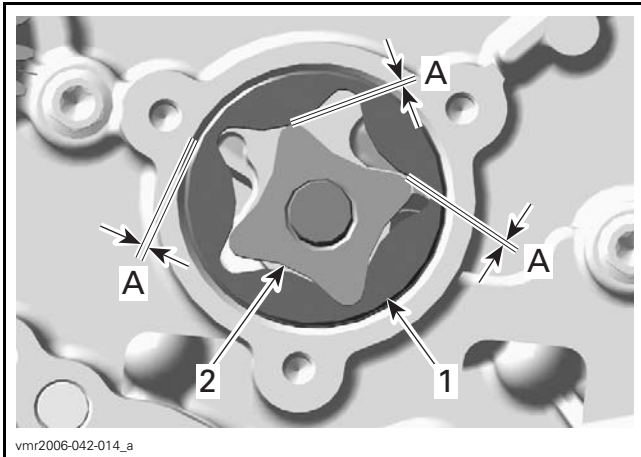
Check inner rotor for corrosion pin holes or other damages. If so, replace oil pump shaft assembly.



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)

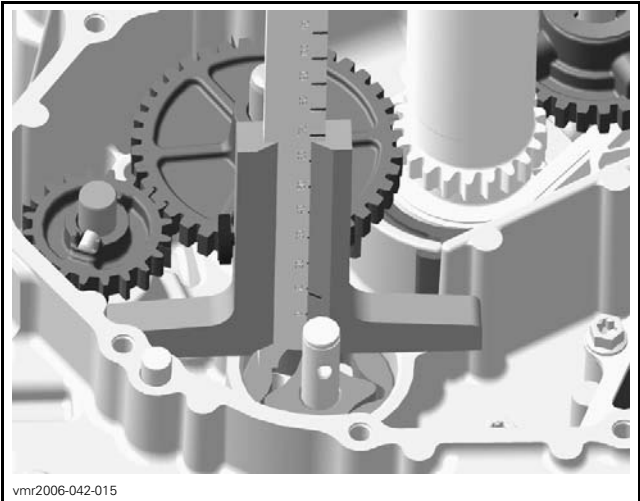


1. Outer rotor
2. Inner rotor
A. 0.25 mm (.0098 in)

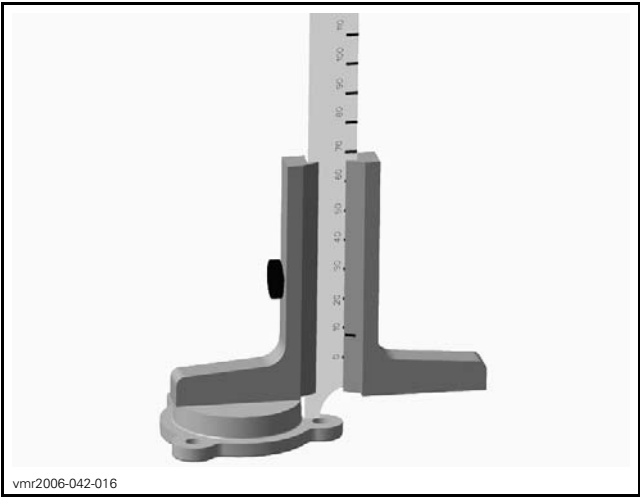
If clearance of inner and outer rotors exceeds the tolerance, replace oil pump rotors. Ensure to also check oil pump cover. If damaged, replace the complete oil pump assembly.

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.

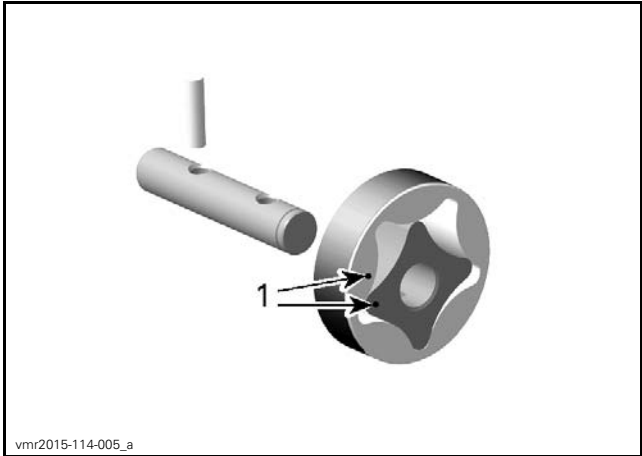
OIL PUMP AXIAL CLEARANCE	
SERVICE LIMIT	0.20 mm (.0079 in)

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

Installing the Oil Pump

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.



1. Markings

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

Testing the Oil Pump Function

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

ENGINE OIL STRAINER

Oil Strainer Location

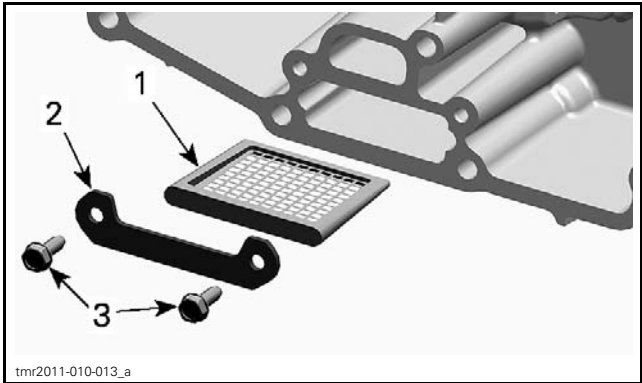
The engine oil strainer is located between both crankcase halves.

Removing the Oil Strainer

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

Remove:

- Screws
- Retaining plate
- Engine oil strainer.



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

Cleaning and Inspecting the Oil Strainer

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.

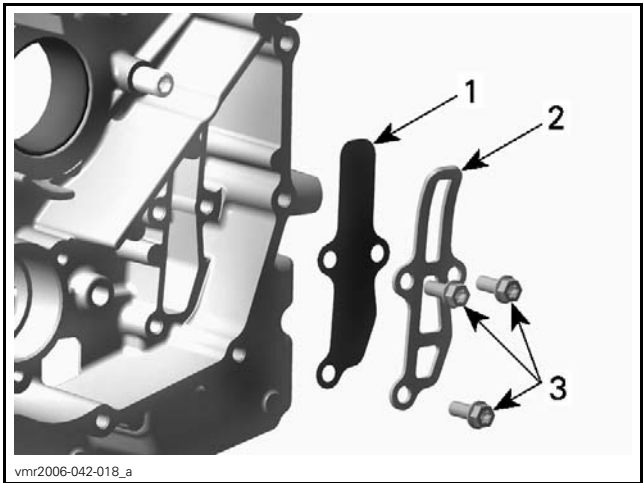
Installing the Oil Strainer

The installation is the reverse of the removal procedure.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Oil strainer retaining screws	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

Removing the Reed Valve

Remove:

- PTO cover (refer to *PTO COVER* in the *BOTTOM END* subsection)
- Reed valve retaining screws

- Stopper plate
- Reed valve.

Inspecting the Reed Valve

Check reed valve for cracks or other damage.

Replace reed valve if damaged.

Installing the Reed Valve

The installation is the reverse of the removal procedure.

TIGHTENING TORQUE	
Reed valve retaining screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

MAGNETO AND STARTER

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT	529 035 617	6
CRANKSHAFT PROTECTOR	529 036 034	6
FLUKE 115 MULTIMETER	529 035 868	4-5
MAGNETO PULLER	529 035 748	6

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	10
DREI BOND SEALING COMPOUND	420 297 906	3
LOCTITE 243 (BLUE)	293 800 060	6
LOCTITE 648 (GREEN)	413 711 400	7-8
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	9
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	3
PULLEY FLANGE CLEANER	413 711 809	7-8

PROCEDURES

MAGNETO COVER

Magneto Cover Access

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

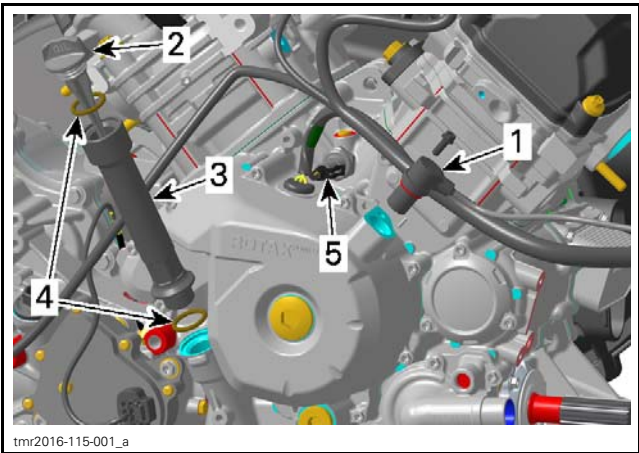
Removing the Magneto Cover

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.

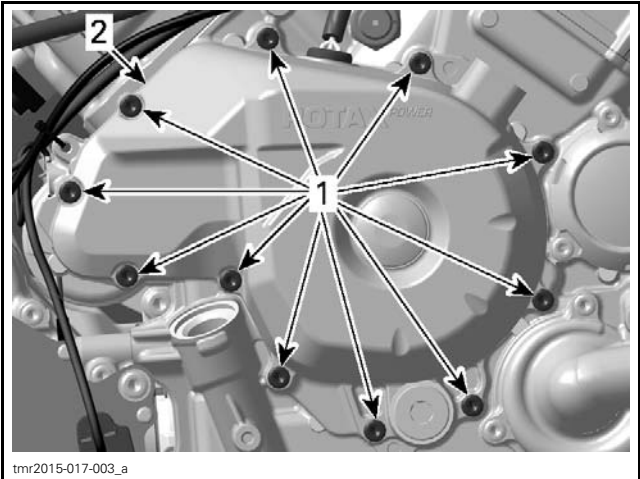
Disconnect oil pressure switch (OPS) connector.



- 1. Crank position sensor (CPS)
- 2. Dipstick
- 3. Oil level tube
- 4. O-rings
- 5. Oil pressure switch (OPS) connector

Disconnect stator connector from voltage regulator/ rectifier, refer to *STATOR CONNECTOR ACCESS* in this subsection.

Remove magneto cover retaining screws.



- 1. Retaining screws
- 2. Magneto cover

Pull out magneto cover.

NOTE: If required, remove stator and harness from magneto cover.

Inspecting and Cleaning the Magneto Cover

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.

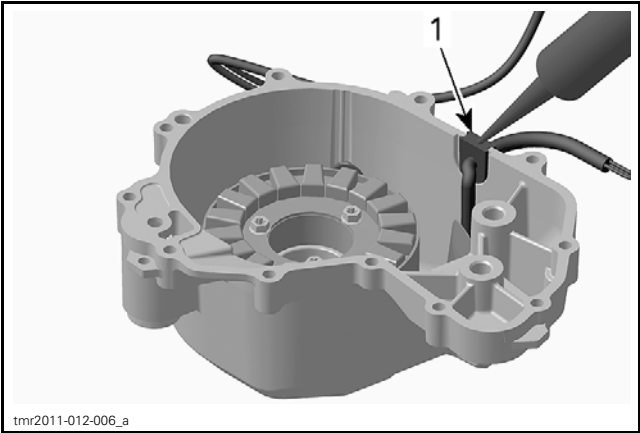
Installing the Magneto Cover

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

NOTE: Install a **NEW** magneto cover gasket.

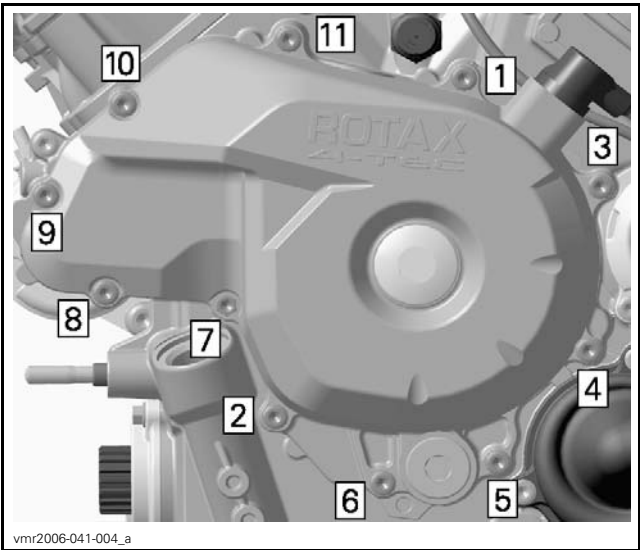
Apply sealant on stator cable grommet as shown in next illustration.

SERVICE PRODUCT	
Stator cable grommet	DREI BOND SEALING COMPOUND (P/N 420 297 906)



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

Tighten screws using the following sequence.



TIGHTENING SEQUENCE

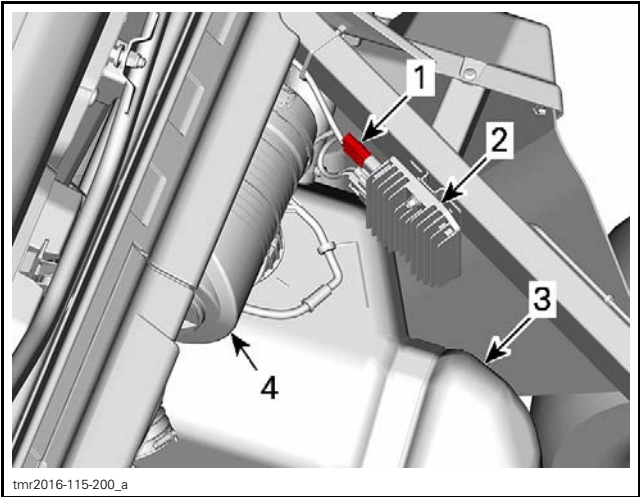
TIGHTENING TORQUE	
Magneto cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Refill engine with recommended oil.

STATOR

Stator Connector Access

The stator is directly connected to the voltage regulator/rectifier.

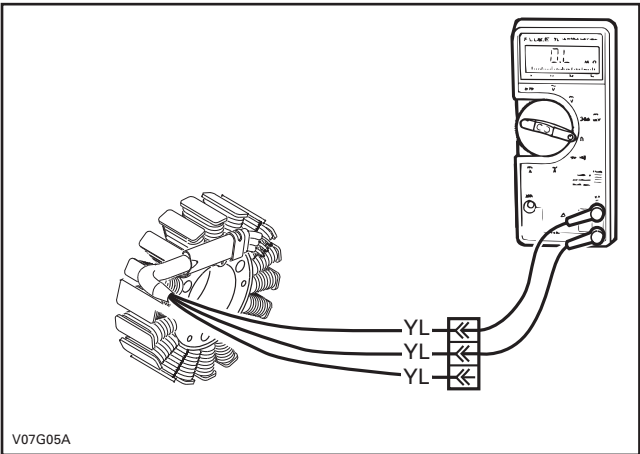


1. Stator connector
2. Voltage regulator/rectifier
3. Fuel tank
4. Air filter housing

Testing the Stator 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.

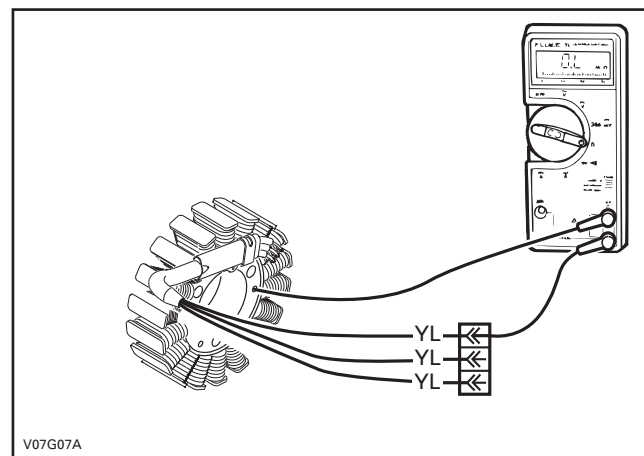
Testing the Stator Static Insulation

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)	

NOTICE Never insert a multimeter probe into a terminal as it would ruin the terminal. Probe terminals only by touching.

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



TYPICAL

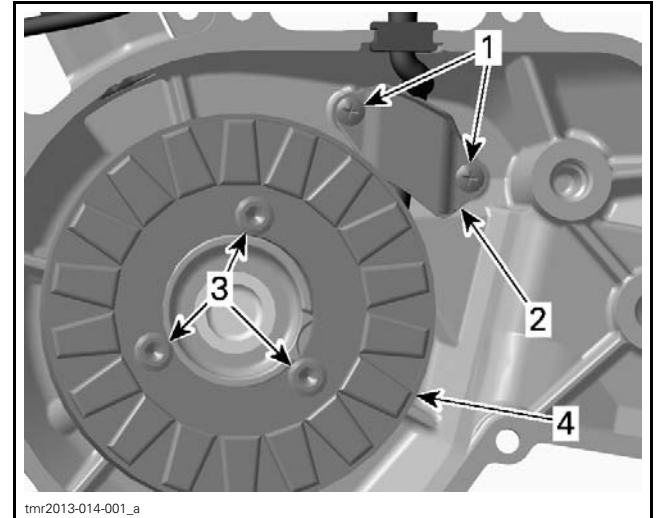
3. If there is a resistance or continuity, the stator coils and/or the wiring is shorted to ground and needs to be repaired or replaced.
4. Re-plug connectors properly.

Removing the Stator

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

Remove:

- Holding strip screws
- Stator retaining screws
- Stator.



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

Inspecting the Stator

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

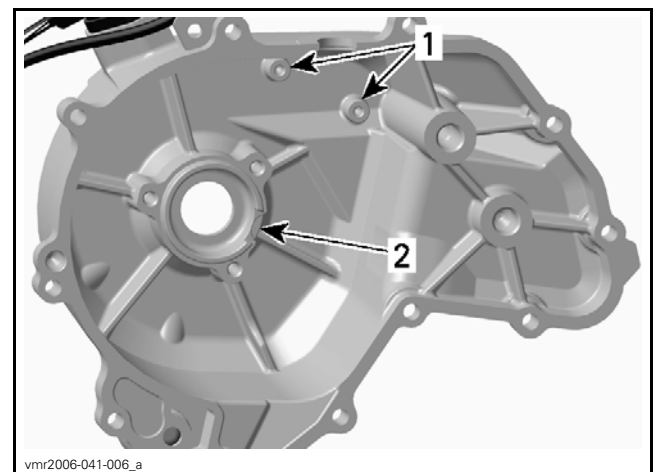
Check if stator wires are brittle, hard or otherwise damaged.

Installing the Stator

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

Subsection XX (MAGNETO AND STARTER)

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Holding strip screws	4 N•m ± 0.3 N•m (35 lbf•in ± 3 lbf•in)

TIGHTENING TORQUE	
Stator retaining screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

ROTOR

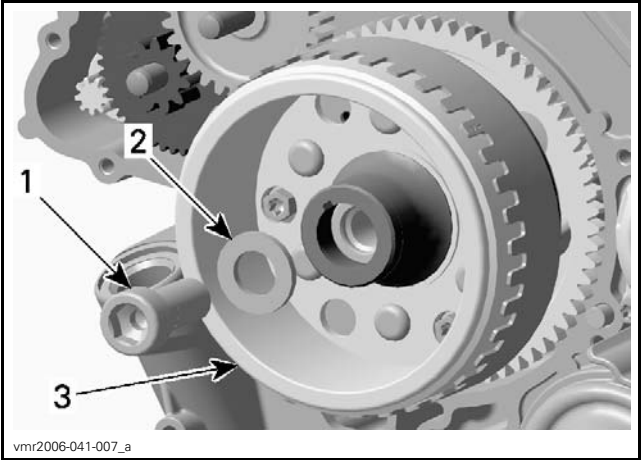
Removing the Rotor

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.

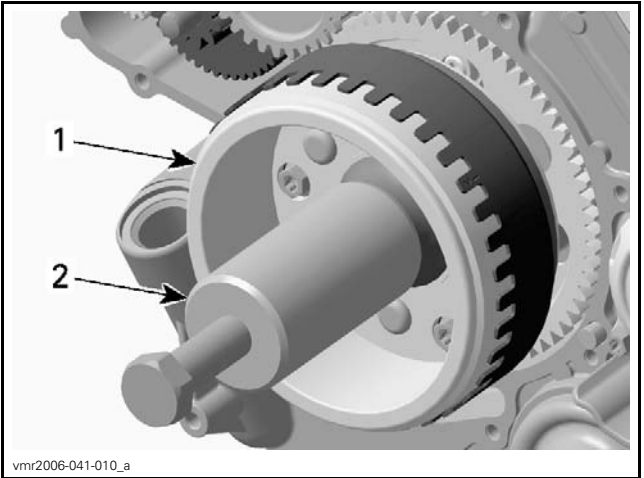


- 1. Screw M16
- 2. Washer
- 3. Rotor

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.



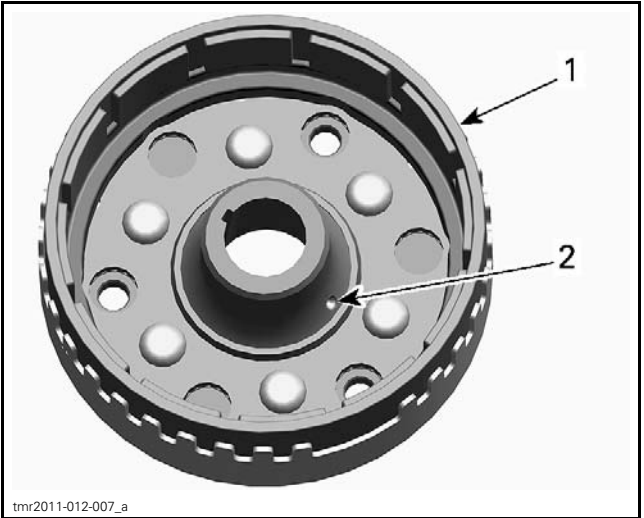
- 1. Rotor
- 2. Magneto puller

Screw magneto puller bolt to remove rotor.

Inspecting the Rotor

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.

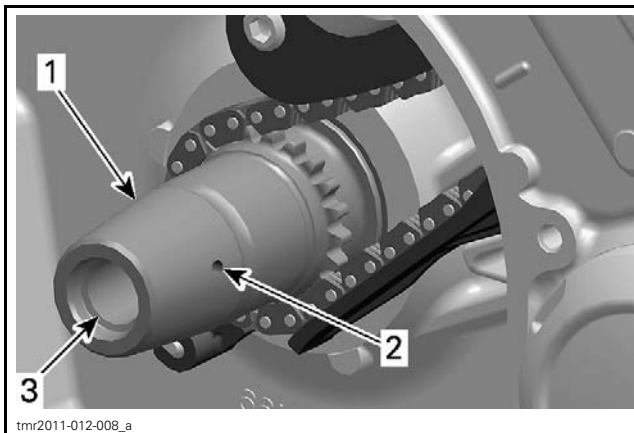
Installing the Rotor

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

Use PULLEY FLANGE CLEANER (P/N 413 711 809) to clean following:

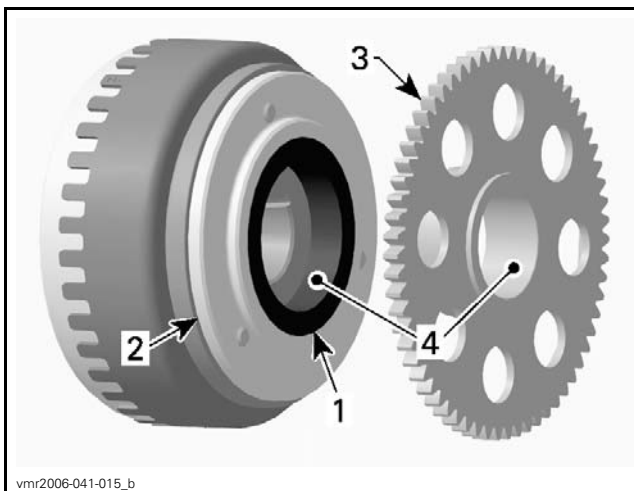
- Crankshaft taper
- Oil passage in crankshaft taper
- Thread in crankshaft
- Rotor taper
- Oil bore in rotor.

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



1. Crankshaft (MAG side)
2. Oil passage
3. Threads

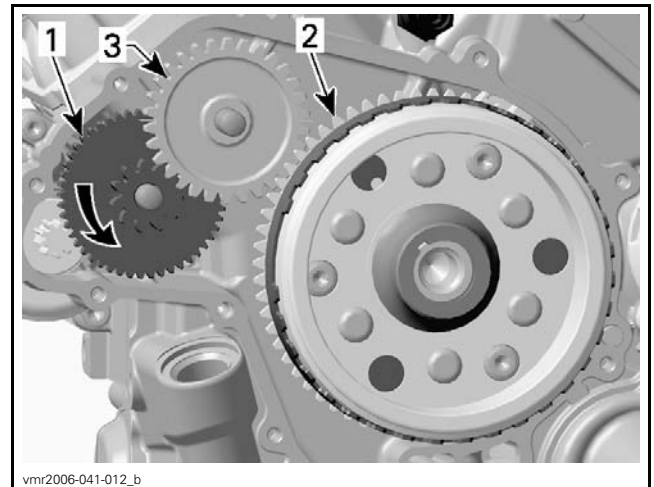
Oil sprag clutch and install sprag clutch gear.



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

TIGHTENING TORQUE	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)
Rotor retaining screw	150 N•m ± 10 N•m (111 lbf•ft ± 7 lbf•ft)

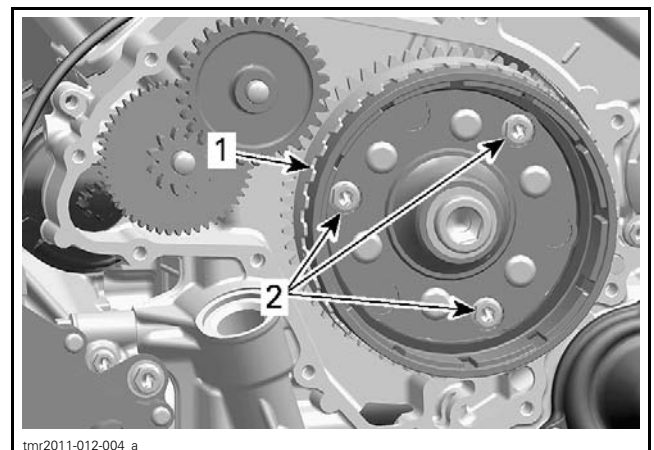
SPRAG CLUTCH

Removing the Sprag Clutch

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

Heat sprag clutch housing screws in order to break the Loctite.

Loosen screws.

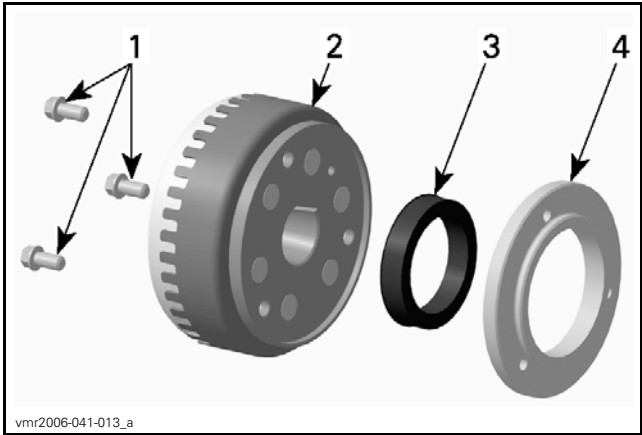


1. Rotor
2. Sprag clutch housing screws

Remove rotor, refer to *ROTOR* in this subsection.

Subsection XX (MAGNETO AND STARTER)

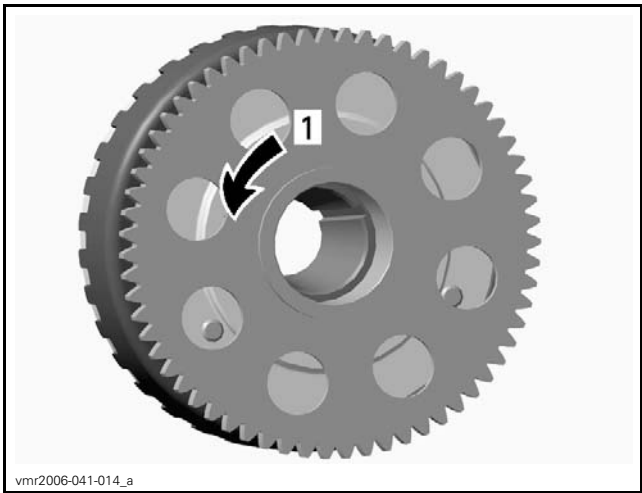
Remove sprag clutch gear.
Remove sprag clutch housing screws and sprag clutch housing.



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

Inspecting the Sprag Clutch

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.



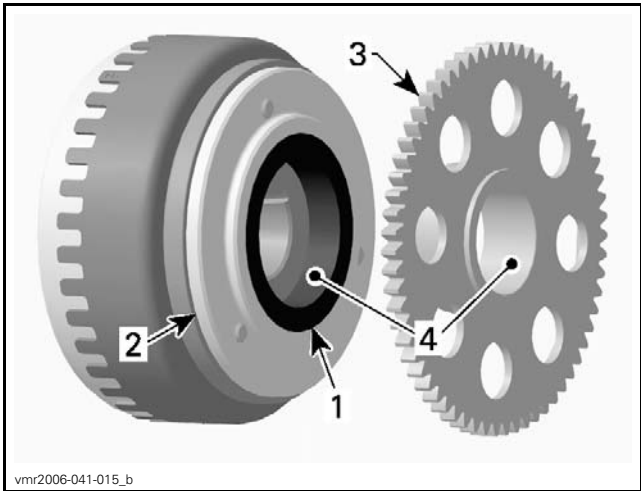
SPRAG CLUTCH FUNCTIONAL TEST
1. Lock

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

Installing the Sprag Clutch

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

Use PULLEY FLANGE CLEANER (P/N 413 711 809) to clean following:
– Threads in sprag clutch housing
– Threads of sprag clutch housing screws.
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.



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

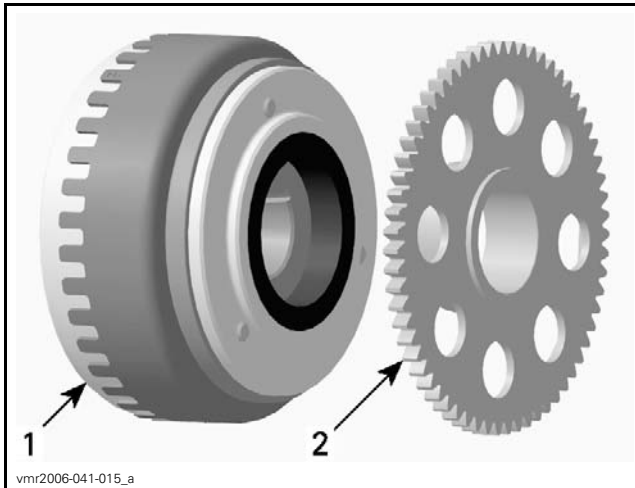
Install rotor, refer to *ROTOR* in this subsection.
Tighten sprag clutch housing screws to specification.

TIGHTENING TORQUE	
Sprag clutch housing screws	30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

SPRAG CLUTCH GEAR

Removing the Sprag Clutch Gear

Remove *ROTOR*. See procedure in this subsection.
Pull sprag clutch gear out of the rotor.

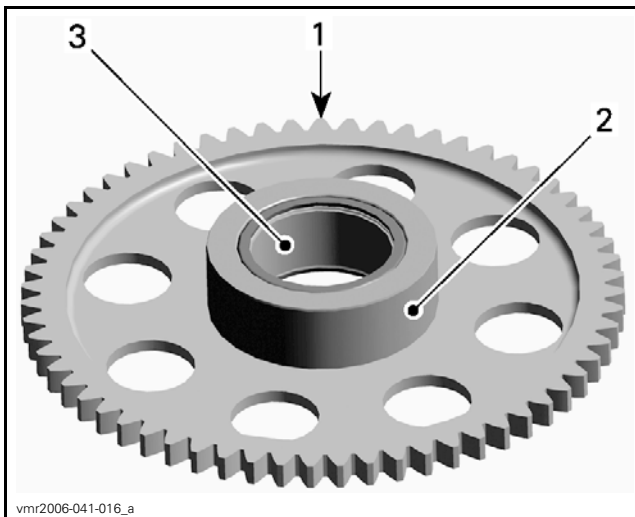


1. Rotor
2. Sprag clutch gear

Inspecting the Sprag Clutch Gear

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

Installing the Sprag Clutch Gear

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

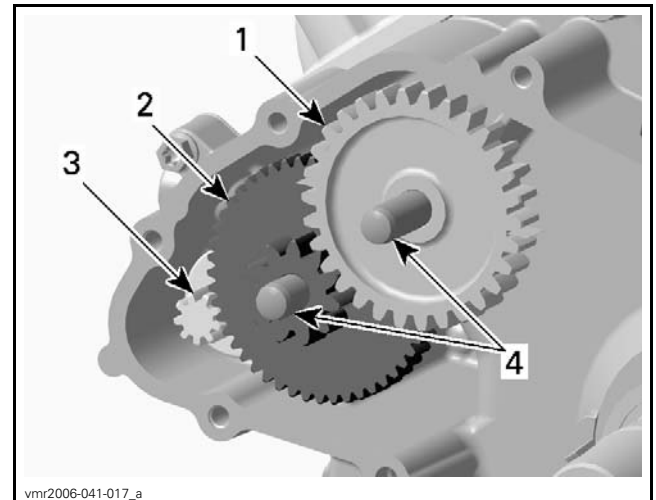
Starter Drive Gear Location

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

Removing the Starter Drive Gear

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

Inspecting the Starter Drive Gear

Inspect gears and location pins for wear and damage.

Replace parts as necessary.

Installing the Starter Drive Gear

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.

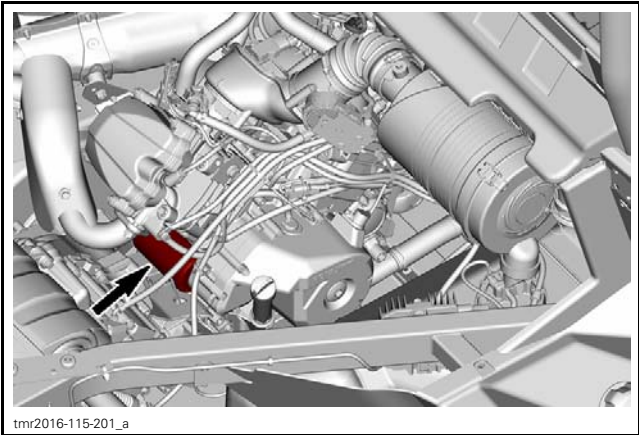
Apply engine oil on location pins.

ELECTRIC STARTER

Starter Access

To reach the starter, open the cargo box.

Starter is located under rear cylinder.



Testing the Starter Operation

Ensure the starter power cable is properly connect from the starter solenoid to the starter terminal (clean, tight, no corrosion).

Using booster cables, carefully supply current from a 12 volt battery directly to the starter. First connect the BLACK (-) cable to the engine ground. Then, momentarily connect the remaining jumper cable from the battery to the starter terminal on the starter solenoid.

If starter turns, test other starting system components.

Removing the Starter

Turn OFF ignition switch.

Disconnect BLACK (-) cable from battery.

 **WARNING**

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

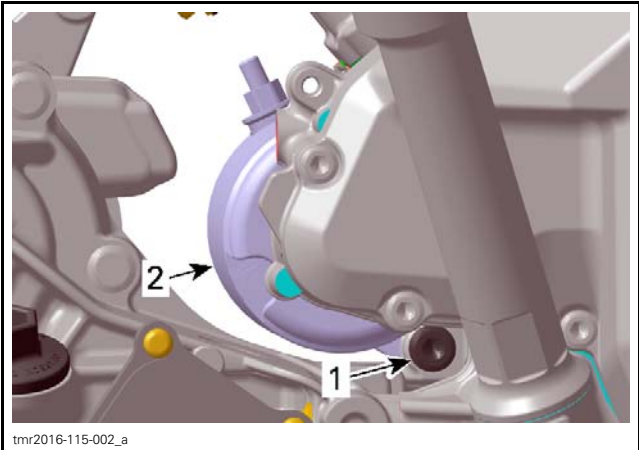
Disconnect RED (+) cable from starter.

Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection and remove:

- CVT cover
- Drive pulley
- Driven pulley
- CVT air guide.

Clean starter area.

Remove starter retaining screw.



1. Starter retaining screw
2. Starter

Carefully pry starter out of the crankcase.

Installing the Starter

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.

TIGHTENING TORQUE	
Starter mounting screw	25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)

Connect the RED (+) cable to the starter, tighten nut, and apply specified product.

 **CAUTION** When connecting the RED (+) cable to the starter motor, make sure the battery cables are disconnected.

TIGHTENING TORQUE	
Service product	DIELECTRIC GREASE (P/N 293 550 004)
Starter cable nut	6 N•m ± 0.7 N•m (53 lbf•in ± 6 lbf•in)

Connect RED (+) cable to battery first, then connect the BLACK (-) cable.

 **WARNING**

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

Test starter operation.

PERIODIC MAINTENANCE PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
TEST CAP	529 035 991	8
VACUUM/PRESSURE PUMP	529 021 800	8, 17

SERVICE PRODUCTS

Description	Part Number	Page
BRAKE FLUID GTLMA DOT4.....	293 600 131	17
COSMO RUBBER GREASE	715 900 399	16
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	13
LONG LIFE ANTIFREEZE	219 702 685	5
SUSPENSION GREASE.....	293 550 033	15
XPS 4-STROKE SYNTH. BLEND OIL.....	293 600 121	4
XPS 4-STROKE SYNTHETIC OIL.....	293 600 112	4
XPS BRAKES AND PARTS CLEANER (USA)	219 701 705	12, 16
XPS BRAKES AND PARTS CLEANER	219 701 776	16
XPS SYNTHETIC GEAR OIL (75W 140)	293 600 140	12
XPS SYNTHETIC GEAR OIL (75W 90)	293 600 043	14
XPS SYNTHETIC GREASE.....	293 550 010	16

GENERAL

This subsection provides:

- Fluid level verifications
- Maintenance procedures.

The following systems should be serviced according to the *PERIODIC MAINTENANCE SCHEDULE*.

PROCEDURES

AIR INTAKE SYSTEM

Replacing the Air Filter

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

Air Filter Replacement Guideline

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

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

- Riding on dry sand

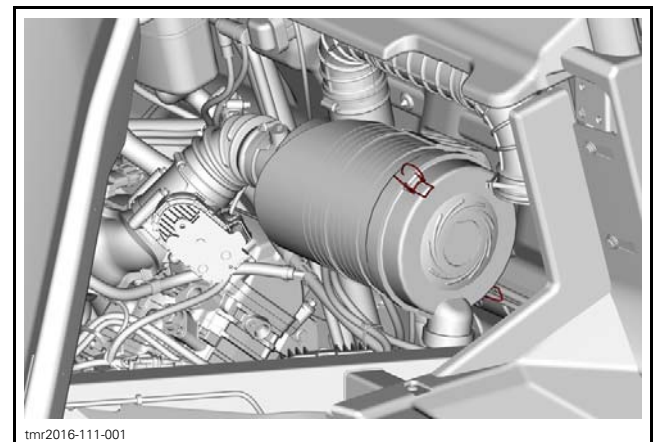
- Riding on dry dirt covered surfaces
- Riding on dry gravel roads or similar conditions.

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

Removing the Air Filter

Tilt cargo box.

Unlatch air filter cover and remove air filter.



Subsection XX (PERIODIC MAINTENANCE PROCEDURES)

The filter fits tightly over the outlet tube and there will be some initial resistance. Gently move the end of the filter back and forth to break the seal, then rotate while pulling straight out. Avoid knocking the filter against the housing.

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

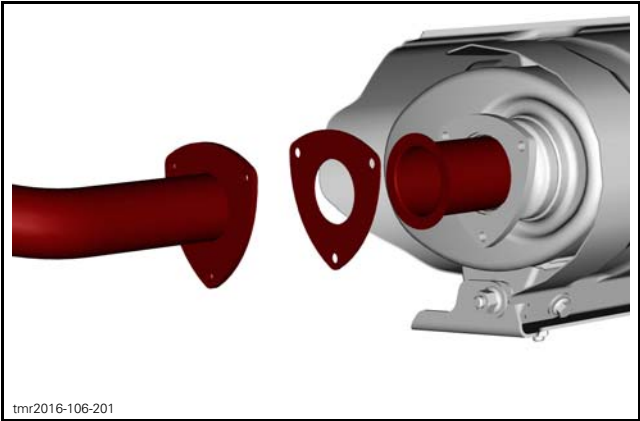
Cleaning the Duckbill Valve

Visually check and physically squeeze the duckbill valve. Make sure the valve is flexible and not inverted, damaged or plugged.

Installing the Air Filter

Insert the filter carefully. Seat the filter by hand, making certain it is inserted completely into the air cleaner housing. Apply pressure by hand at the outer rim of the filter, not the flexible center.

Secure air filter cover with latches.



Remove carbon deposits from the spark arrester using a brush.

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

EXHAUST SYSTEM

Cleaning and Inspecting the Muffler Spark Arrester

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

Remove and discard tail pipe fasteners.



TYPICAL
1. Clean spark arrester

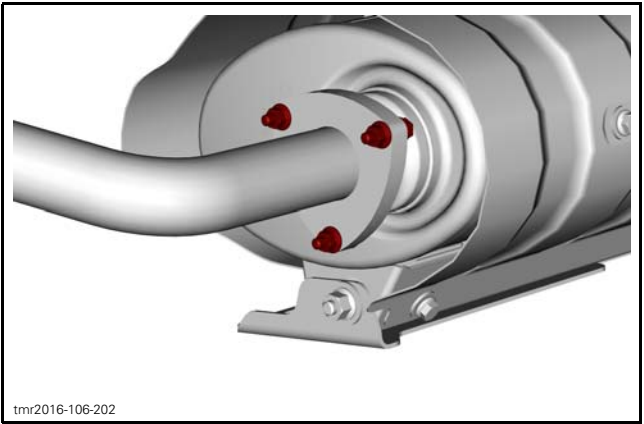
Inspect mesh of spark arrester for any damage. Replace as required.

Inspect spark arrester chamber in muffler. Clean off any debris as required.

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

Install new gasket and fasteners.

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



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

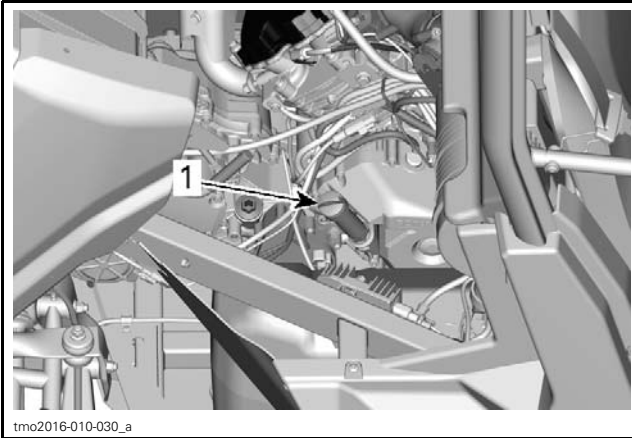
LUBRICATION SYSTEM

Verifying the Engine Oil Level

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

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

1. Open cargo box.
2. Remove dipstick and wipe it clean.



1. Dipstick

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



TYPICAL

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

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

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

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

NOTE: Do not overfill. Wipe off any spillage.

Properly tighten dipstick.

Close cargo box.

Changing the Engine Oil

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.

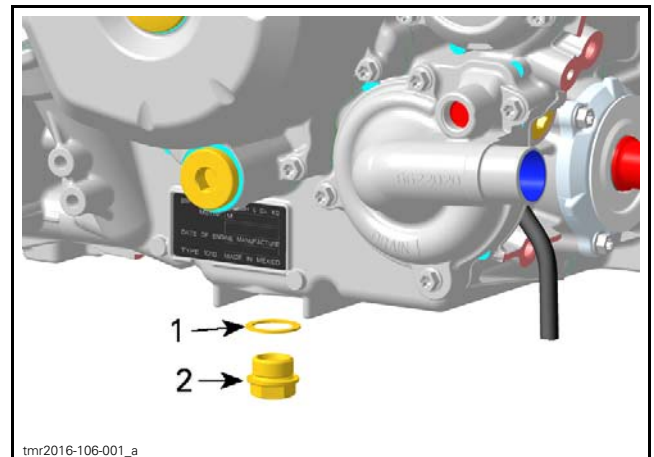
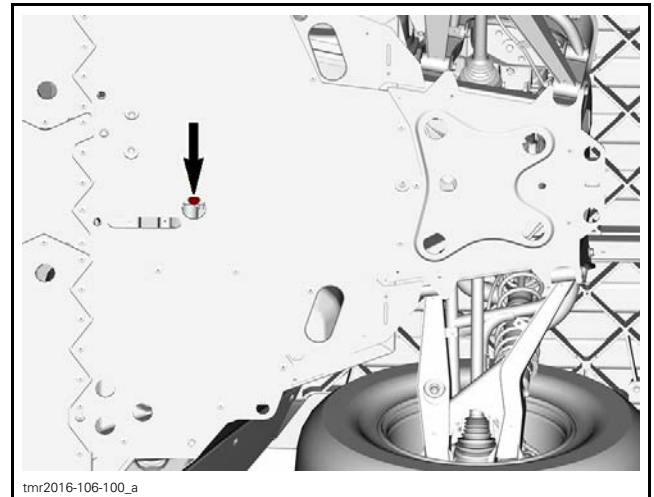
Ensure vehicle is on a level surface.

Remove dipstick.

Place a drain pan under the engine drain plug area.

Clean the drain plug area.

Unscrew magnetic drain plug and discard the gasket ring.



1. Gasket ring
2. Magnetic 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 magnetic drain plug.

Subsection XX (PERIODIC MAINTENANCE PROCEDURES)

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

Tighten magnetic drain plug to the specification.

TIGHTENING TORQUE	
Magnetic drain plug	30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

Replace oil filter. Refer to *REPLACING THE ENGINE OIL FILTER* 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 (P/N 293 600 121)
Winter	XPS 4-STROKE SYNTHETIC OIL (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 *VERIFYING THE ENGINE OIL LEVEL* in this subsection.

Start engine and let it idle for a few minutes.

Ensure oil filter and drain plug areas are not leaking.

Stop engine.

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

Dispose oil and filter as per your local environmental regulations.

Engine Oil Filter Replacement

Oil Filter Access

Remove the engine service cover located on the rear upper bulkhead.

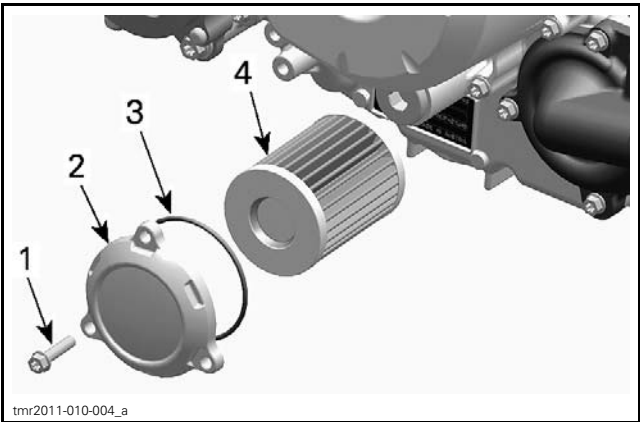
Removing the Oil Filter

Clean oil filter area.

Remove:

- Oil filter cover screws
- Oil filter cover

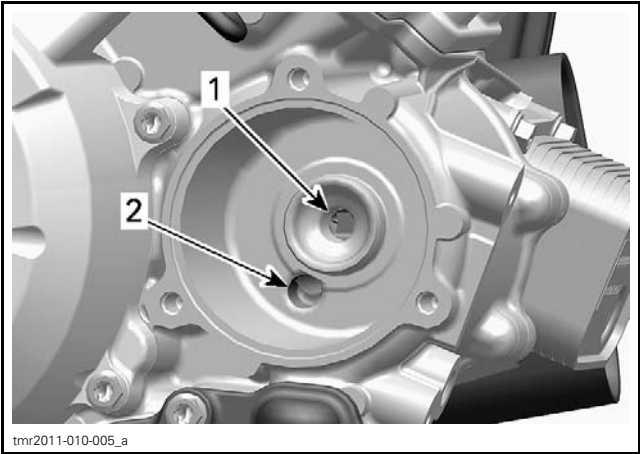
- O-ring
- Oil filter.



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

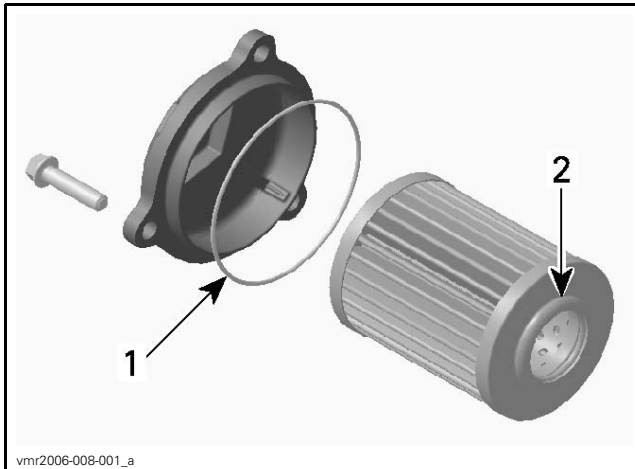
Installing the Oil Filter

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



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

Install a **NEW** O-ring on oil filter cover.
Install the filter into the cover.
Apply engine oil on O-ring and oil filter seal.



1. Slightly oil
2. Slightly oil

Install the cover on the engine.

Tighten oil filter cover screws to specification.

TIGHTENING TORQUE	
Oil filter cover screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

COOLING SYSTEM

Recommended Engine Coolant

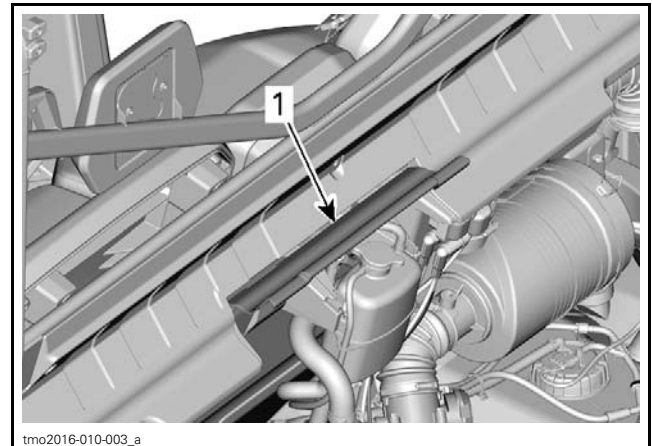
COOLANT	
BRP RECOMMENDED PRODUCT	LONG LIFE ANTIFREEZE (P/N 219 702 685)
ALTERNATIVE, OR IF NOT AVAILABLE	Distilled water and antifreeze solution (50% demineralized water, 50% antifreeze)

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

Verifying the Engine Coolant Level

WARNING
Check coolant level with engine cold.

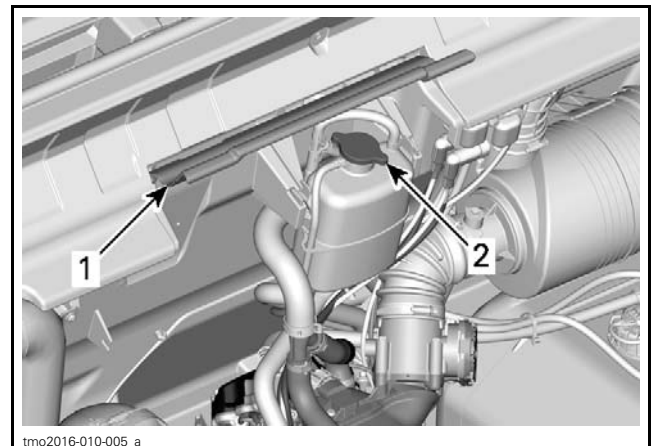
1. Place vehicle on a level surface.
2. Tilt cargo box.
3. Open the rear service cover



1. Rear service cover

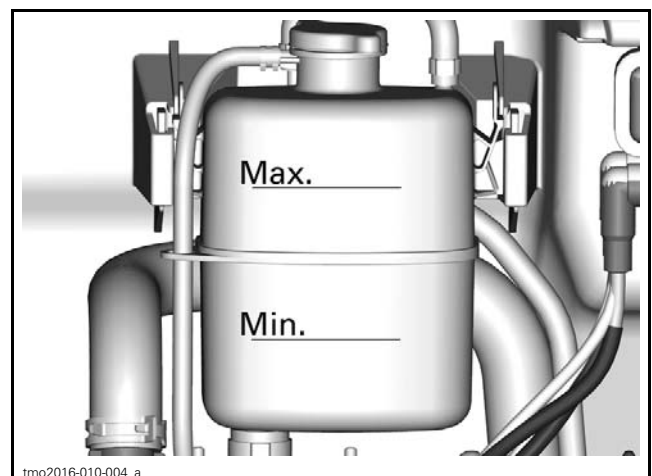
4. Remove the pressure cap.

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



1. Rear service cover
2. Cooling system pressure cap

5. Ensure cooling system is full up to the MAX line.



Subsection XX (PERIODIC MAINTENANCE PROCEDURES)

6. Add coolant in system as necessary. **Do not overfill.**

7. Properly reinstall pressure cap.

8. Close the rear service cover and the cargo box.

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

Checking the Engine Coolant Specific Gravity

Remove pressure cap.

Use an antifreeze tester to test coolant strength.

MINIMUM RECOMMENDED COOLANT STRENGTH
-30°C (-22°F)

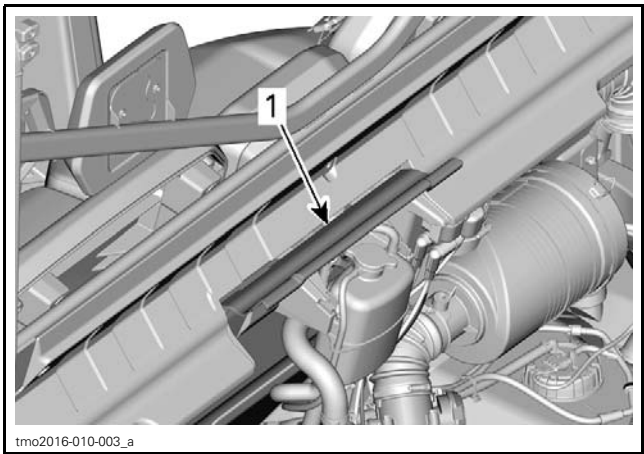
Replacing the Engine Coolant

Draining the Cooling System

**WARNING**

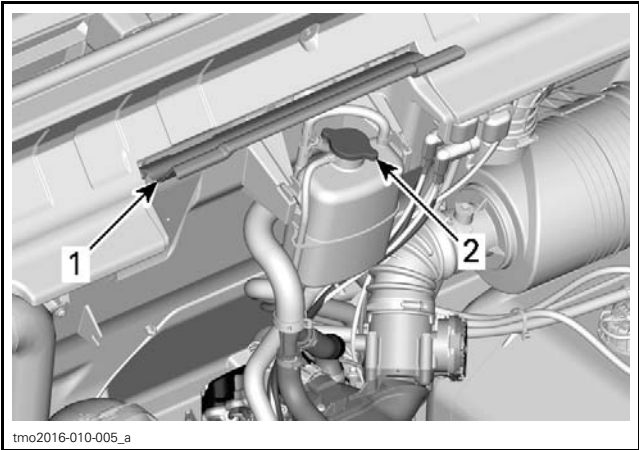
In order to avoid potential burns, do not remove the pressure cap or loosen the coolant drain plug if the engine is hot.

- 1. Tilt the cargo box.
- 2. Open the rear service cover.



1. Rear service cover

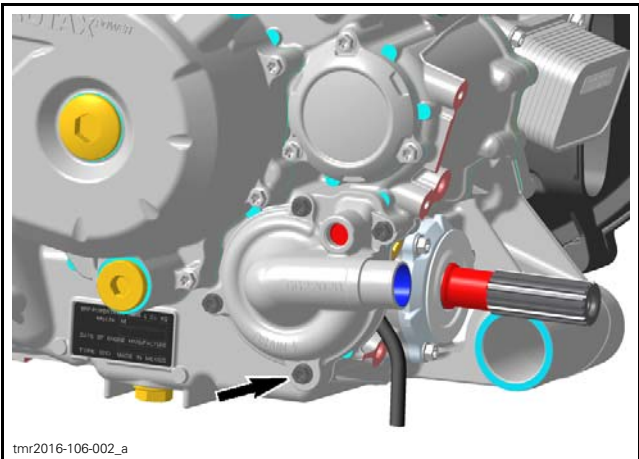
- 3. Remove the cooling system pressure cap.



1. Rear service cover
2. Cooling system pressure cap

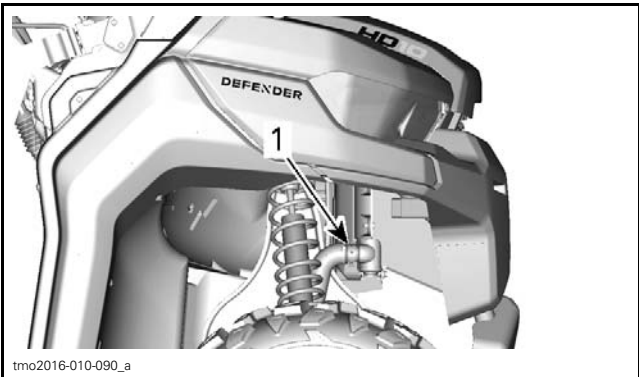
- 4. Place a drain pan underneath the vehicle.
- 5. Unscrew coolant drain plug and drain the coolant into a suitable container.

NOTE: Do not unscrew the coolant drain plug completely.



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

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



1. Lower radiator hose to disconnect

7. Drain cooling system completely.
8. Reinstall coolant drain plug.

TIGHTENING TORQUE	
Coolant drain plug	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

9. Reinstall radiator hose as noted prior to removal.

TIGHTENING TORQUE	
Radiator clamp	3 N•m ± 0.5 N•m (27 lbf•in ± 4 lbf•in)

10. Fill cooling system with coolant, refer to *BLEEDING THE COOLING SYSTEM* procedure.

Bleeding the Cooling System

Models with Heating System

Activate heater fan and put heating level to maximum.



1. Heater fan speed control button
2. Heating level button

All Models

1. Remove the pressure cap.
2. Fill the cooling system until coolant is full up to the MAX line of the coolant reservoir.
3. Install pressure cap.
4. Run engine at idle with the pressure cap **ON** until the cooling fan cycles on for a second time.
5. Stop the engine and let it cool down.

⚠ WARNING

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

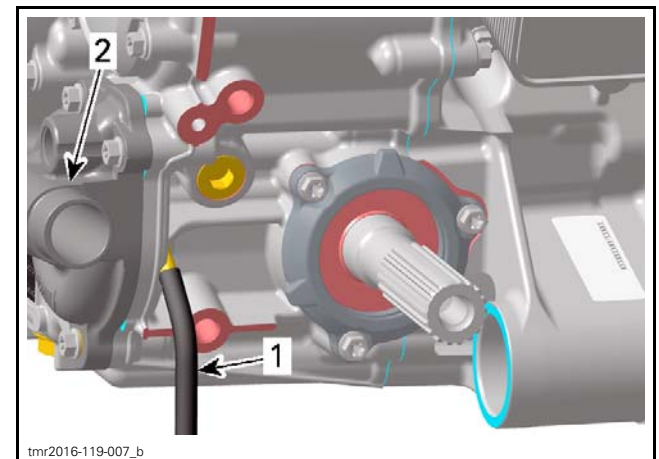
6. When the engine is cool, check coolant level. Add coolant if required.
7. After the next ride following this procedure, check coolant level. Add coolant as required. Refer to *VERIFYING THE ENGINE COOLANT LEVEL* in this subsection.

Inspecting the Cooling System

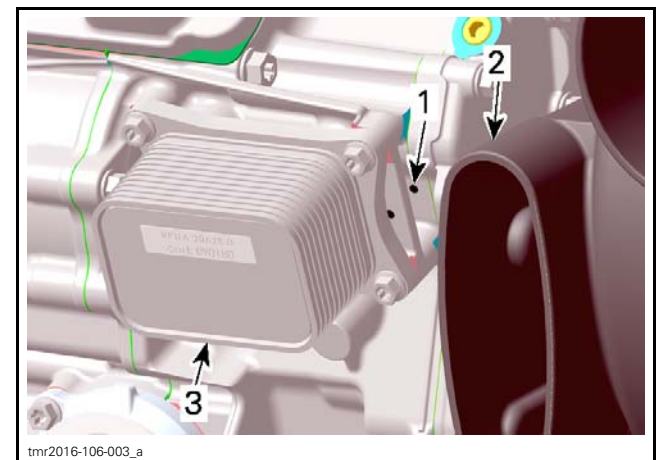
1. Check general condition of hoses and clamps for tightness.

2. Check the leak indicator hose for oil or coolant.

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

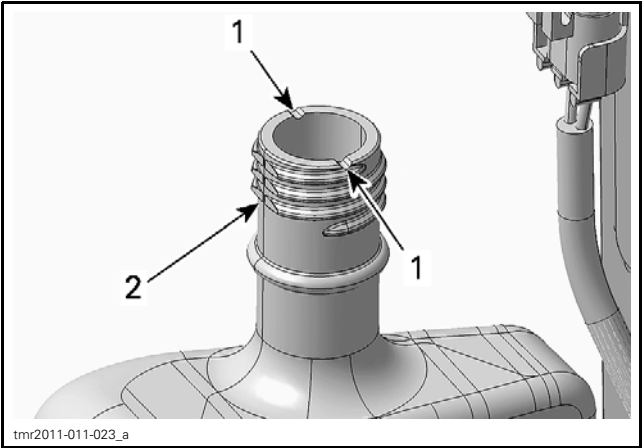


1. Leak indicator hose
2. Water pump cover



1. Leak indicator hole
2. CVT air outlet
3. Oil cooler (HD10 engine only)

3. Ensure vents on coolant expansion tank neck are not obstructed (see following illustration).



COOLANT EXPANSION TANK VENTS

- 1. Slots atop neck
- 2. Flat threadless portion on tank neck

- 4. Carry out the *CHECKING THE ENGINE COOLANT SPECIFIC GRAVITY* as detailed in this subsection.
- 5. Carry out the *TESTING THE PRESSURE CAP* as detailed in this subsection.
- 6. Replace engine coolant if contaminated.

NOTE: Engine coolant should be replaced every 5 years or if contaminated.

Performing a Cooling System Leak Test

**WARNING**

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

- 1. Tilt the cargo box
- 2. Open the rear service cover.
- 3. Replace the pressure cap by the following test cap.
- 4. Install the vacuum/pressure pump on the test cap.

REQUIRED TOOL	
TEST CAP (P/N 529 035 991)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

- 5. Pressurize cooling system.

COOLING SYSTEM LEAK TEST
103 kPa (15 PSI)

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

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

Testing the Pressure Cap

Test the pressure cap using a cooling system tester.

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

PRESSURE CAP RELIEF PRESSURE
Approximately 110 kPa (16 PSI)

TOP END

Inspecting and Adjusting the Engine Valve Clearance

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

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

Turn crankshaft to TDC ignition of the respective cylinder, refer to *CAMSHAFT TIMING GEAR* in the *TIMING CHAIN* subsection.

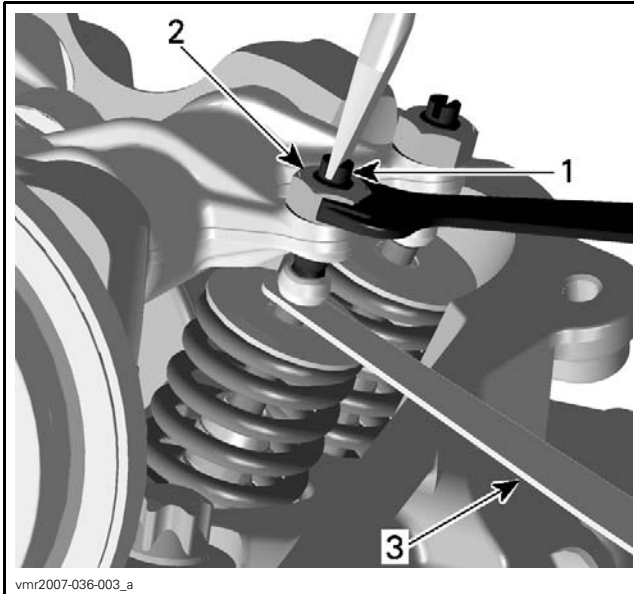
Using feeler gauge, check the valve clearance.

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

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

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

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



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

Repeat the procedure for each valve.

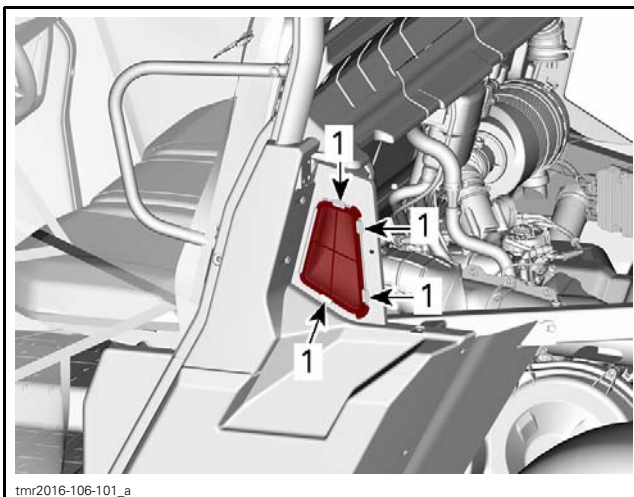
Before installing valve covers, recheck valve clearance.

CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

CVT Air Filter Cleaning

Removing the CVT Air Filter

1. Tilt the cargo box.
2. Press the filter tabs to release it.



1. Press here

Cleaning the CVT Air Filter

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

3. Gently shake off excess water and allow filter to dry at room temperature.
4. Clean inside the CVT air inlet end.

Installing the CVT Air Filter

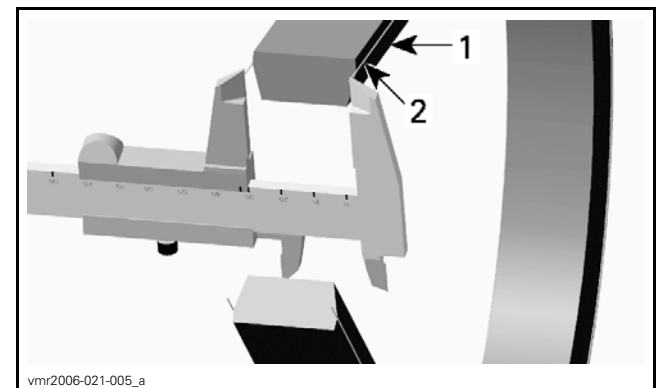
The installation is the reverse of the removal procedure.

Inspecting the Drive Belt

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

Check drive belt width at cord level. Replace if it is out of specification (see table below).

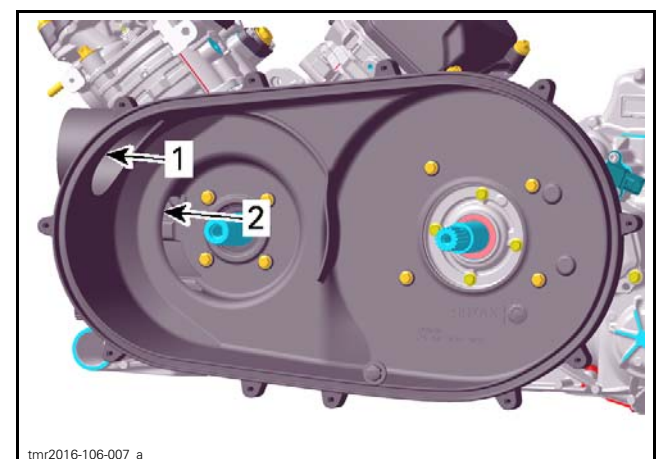
DRIVE BELT WIDTH	
SERVICE LIMIT	36.7 mm (1.445 in)



1. Drive belt
2. Cord in drive belt

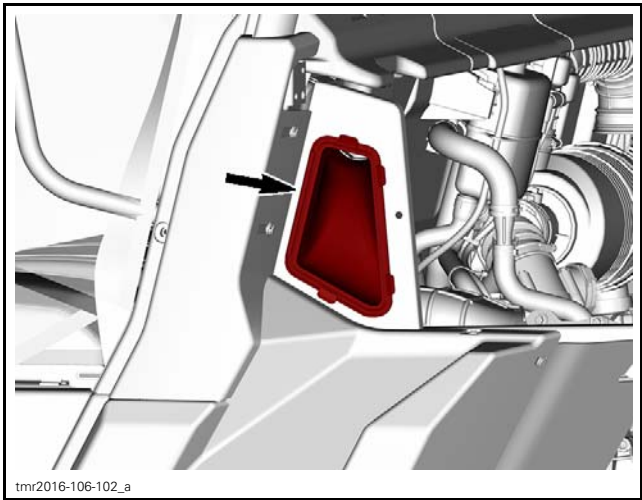
Cleaning the CVT Air Inlet/Outlet

1. Remove CVT cover, refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection.
2. Inspect and clean the air inlet and outlet openings from inside the CVT air guide.



1. CVT air inlet
2. CVT air outlet

3. Inspect and clean the CVT air inlet end.



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

4. Reinstall CVT cover.

Drive Pulley, Driven Pulley and One-Way Bearing Maintenance

Drive and Driven Pulley

Clean and inspect drive and drive pulley sheaves. Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)* subsection.

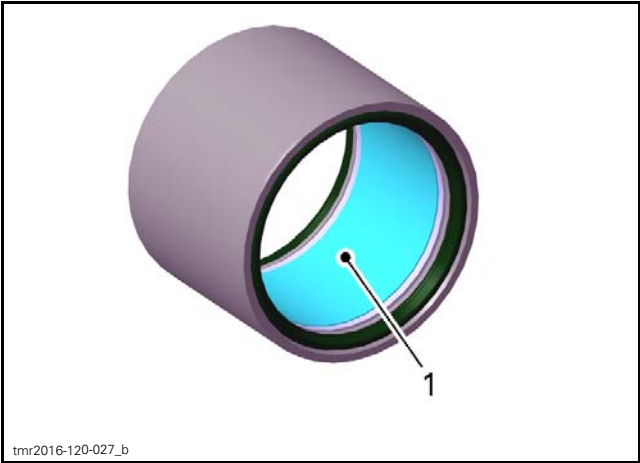
Hub

Clean parts.

Lubricate needle bearing.

NOTICE Only slightly grease the needle bearing. Do not apply in excess as it will spread out and lead to CVT malfunction.

NEEDLE BEARING LUBRICATION	
Service product	Ball bearing grase



1. Lubricate needle bearing

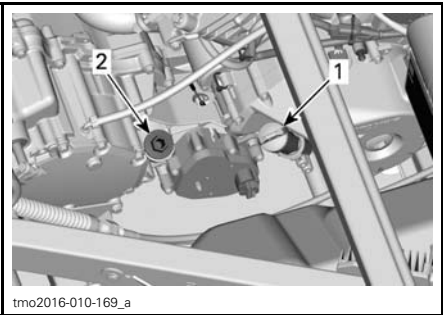
GEARBOX

Verifying the Gearbox Oil Level

Tilt the cargo box.

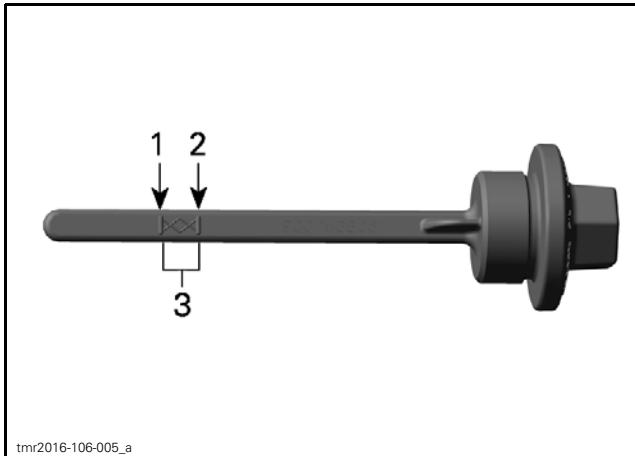
Unscrew and remove the gearbox oil dipstick wipe clean.

NOTICE Pay attention not to loose O-ring on oil dipstick.



1. Engine oil dipstick
2. Gearbox oil dipstick

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



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

To add oil, place a funnel into the dipstick hole. Add a small amount of recommended oil and recheck oil level.

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

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

NOTE: Do not overfill. Wipe off any spillage. Properly tighten oil dipstick.

Replacing the Gearbox Oil

Draining Procedure

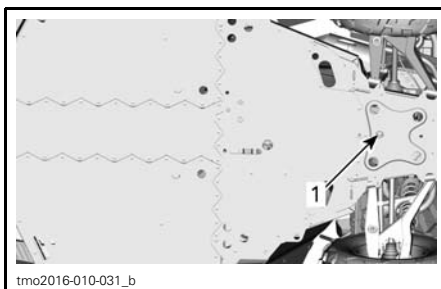
Prior to change the oil, ensure vehicle is on a level surface.

Oil change should be done with a warm engine.

⚠ WARNING

The gearbox oil can be very hot.

Place a drain pan under the gearbox drain plug area.



1. Oil drain plug

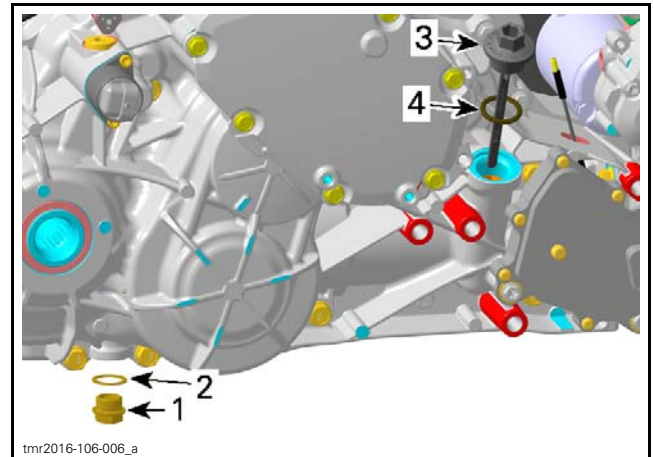
Clean drain plug area.

Remove magnetic drain plug and discard sealing ring.

Remove oil dipstick.

NOTICE Pay attention not to loose O-ring on oil dipstick.

Wait a while to allow oil flow out of gearbox.



1. Magnetic drain plug
2. Sealing ring
3. Oil dipstick
4. O-ring

Dispose gearbox oil as per your local environmental regulations.

Inspection

Oil condition gives information about the teeth condition inside the gearbox. See *TROUBLESHOOTING* in the appropriate *GEARBOX AND 4X4 COUPLING UNIT* subsection.

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

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

Filling Procedure

Ensure vehicle on a level surface.

Make sure that magnetic drain plug is reinstalled and tight.

Always install a **NEW** sealing ring.

TIGHTENING TORQUE	
Magnetic drain plug	30 N•m ± 3 N•m (22 lbf•ft ± 2 lbf•ft)

Fill the gearbox through the oil dipstick hole.

Subsection XX (PERIODIC MAINTENANCE PROCEDURES)

GEARBOX OIL	
Type	XPS SYNTHETIC GEAR OIL (75W 140) (P/N 293 600 140) or a gearbox oil that meets the requirements of 75W 140 API GL-5 synthetic gear oil
Capacity	1.25 L (42.27 U.S. oz)

After filling check the oil level, refer to *VERIFYING THE GEARBOX OIL LEVEL* in this subsection.

NOTE: Wait a while to allow oil to flow down to the gearbox housing.

Install the oil dipstick with its O-ring.

Tighten oil dipstick to specification.

TIGHTENING TORQUE	
Oil dipstick	5 N•m ± 0.6 N•m (44 lbf•in ± 5 lbf•in)

Cleaning the Vehicle Speed Sensor (VSS)

Remove the VSS. Refer to *REMOVING THE VSS* in the appropriate *GEARBOX AND 4X4 COUPLING UNIT* subsection.

Remove all metal particles and oil from the VSS magnet.

NOTE: A dirty VSS will cause erratic speedometer readings.

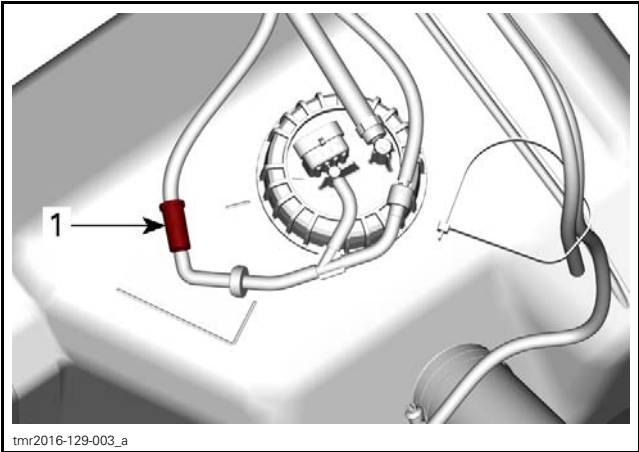
FUEL SYSTEM

Inspecting the Throttle Body

- 1. Visually inspect throttle plate and throttle body venturi for cleanliness.
- 2. Clean inside throttle body using a common throttle body cleaner if necessary.

Replacing Fuel Tank Vent Breather Filter

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



1. Fuel tank vent breather filter

Inspecting Fuel System

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

⚠ WARNING

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

Fuel Pump Pressure Test

Refer to *FUEL TANK AND FUEL PUMP* subsection for procedure.

Cleaning Fuel Pump Prefilter

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

ELECTRICAL SYSTEM

Inspecting the Battery

Visually inspect battery casing for cracks or other damage. If casing is damaged, replace battery and thoroughly clean battery rack with water and baking soda.

Inspect battery posts condition, battery rack mounting, straps and strap attachment points.

For battery testing, refer to *CHARGING SYSTEM* subsection.

Replacing the Spark Plug

Removing the Spark Plug

Unplug the spark plug cable.

Clean the spark plug area with pressurized air.

Unscrew spark plug.

Installing the Spark Plug

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

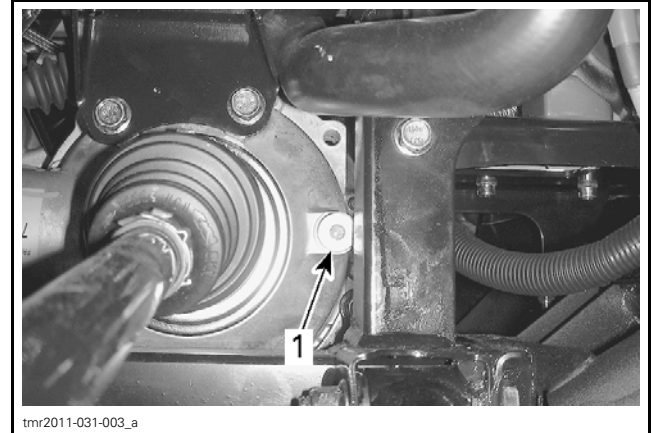
1. Using a wire feeler gauge, verify the electrode gap as specified in *TECHNICAL SPECIFICATIONS*.
2. Apply antiseize lubricant over the spark plug threads to prevent possible seizure.
3. Hand screw spark plug into cylinder head, then tighten with a torque wrench and an appropriate socket.

TIGHTENING TORQUE	
Service product	LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070)
Spark plug	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)

DRIVE SYSTEM

Verifying the Front Differential Oil Level

Clean filler plug prior to checking oil level.



TYPICAL - FRONT RIGHT SIDE OF VEHICLE

1. Filler plug

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

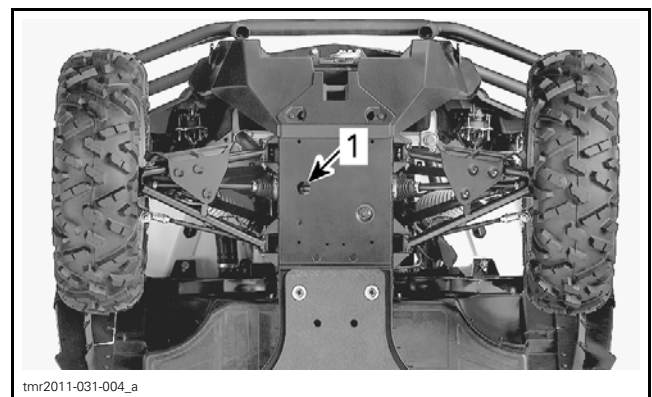
Reinstall filler plug with a new sealing ring.

TIGHTENING TORQUE	
Filler plug	16.5 N•m ± 2.5 N•m (146 lbf•in ± 22 lbf•in)

Replacing the Front Differential Oil

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

From underneath of vehicle, clean drain plug area.



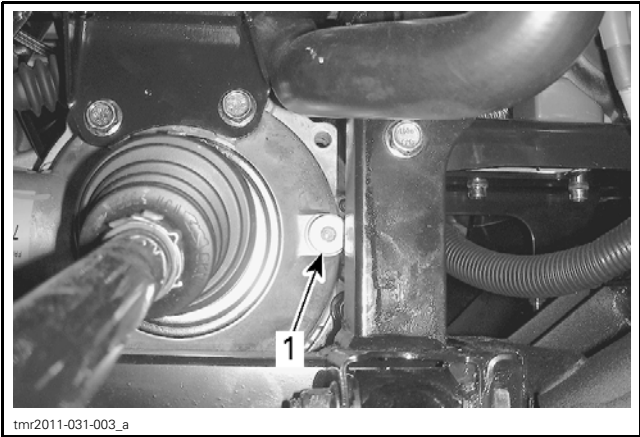
TYPICAL

1. Drain plug access hole

Place a drain pan under the front differential.

Remove drain plug.

Unscrew filler plug.



TYPICAL - FRONT RIGHT SIDE OF VEHICLE
1. Filler plug

Install drain plug.

TIGHTENING TORQUE	
Drain plug	2.7 N•m ± 0.3 N•m (24 lbf•in ± 3 lbf•in)

Refill front differential with recommended oil.

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

Reinstall filler plug with a new sealing ring.

TIGHTENING TORQUE	
Filler plug	16.5 N•m ± 2.5 N•m (146 lbf•in ± 22 lbf•in)

Inspecting the Drive Shaft Boot and Protector

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

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

Replace if necessary.

Inspecting the Drive Shaft Joint

Turn and move drive shaft to detect excessive play.

Inspecting the Propeller Shaft U-Joint

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

WHEELS AND TIRES

Wheel Lug Nut Torque Verification

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

TIGHTENING TORQUE	
Wheel lug nuts	100 N•m ± 10 N•m (74 lbf•ft ± 7 lbf•ft)



TIGHTENING SEQUENCE

STEERING SYSTEM

Inspecting the Wheel Bearing

- 1. Safely lift and support the front of vehicle. Refer to *INTRODUCTION* subsection.
- 2. Hold wheel by the top and the bottom and move it. Check for any play.
- 3. If there is any loose, replace wheel bearing, refer to *STEERING SYSTEM* subsection.

NOTE: To properly locate play during this inspection, be sure to check other components for wear or loose (ball joints, suspension pivots, etc). If necessary repair or replace all defective parts before checking the wheel bearing condition. Be careful not to misjudge loose in the ball joint and loose in the wheel bearing.

Inspecting the Steering System

Steering Column

Turn and move steering column to detect any play.

Rack and Pinion

Check rack and pinion boots for:

- Damage
- Cracks.

Replace if necessary.

Tie-Rod End

Check tie-rod end ball joint for:

- Damage
- Pitting
- Play.

Replace if necessary.

SUSPENSION

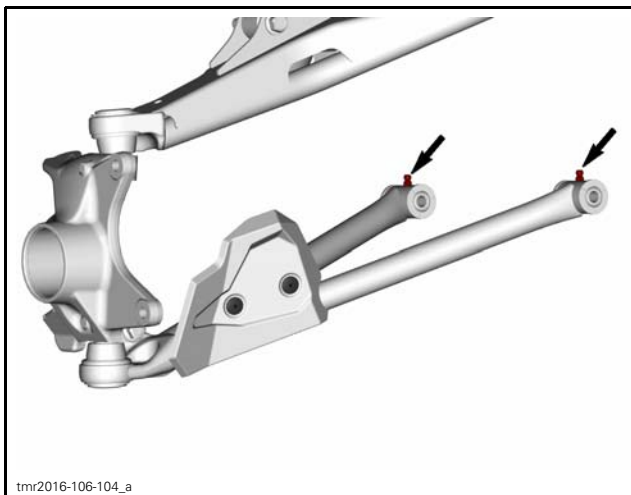
Inspecting the Shock Absorber

Check shock absorber for any leaks, replace if necessary.

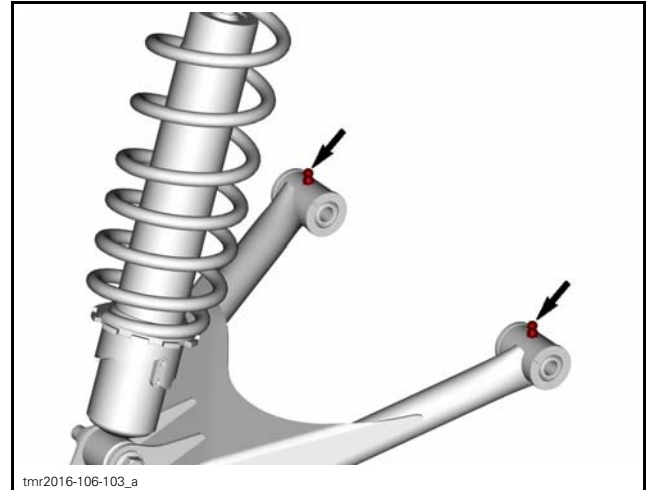
Lubricating the Suspension Arm

Lubricate suspension arm at grease fittings.

SUSPENSION ARM LUBRICATION
SUSPENSION GREASE (P/N 293 550 033)



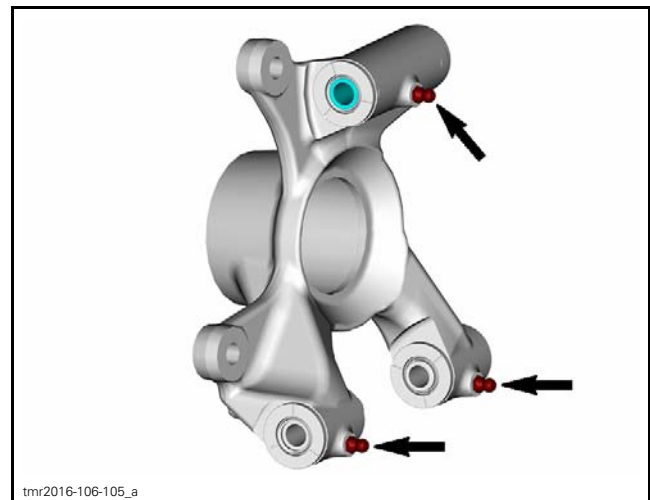
LOWER SUSPENSION ARM



UPPER SUSPENSION ARM

Lubricating the Rear Knuckle

KNUCKLE LUBRICATION
SUSPENSION GREASE (P/N 293 550 033)



Inspecting the Suspension Arm

Check suspension arm for:

- Cracks
- Pitting
- Bending
- Distortion.

Check suspension arm for abnormal play:

- Side to side
- Up and down.

If any play is detected, inspect:

- Bushings
- Cushions
- Wear plates.

Check ball joint for:

- Damage

Subsection XX (PERIODIC MAINTENANCE PROCEDURES)

- Pitting
- Play.

Check ball joint bellows for:

- Damage
- Cracks.

BRAKES

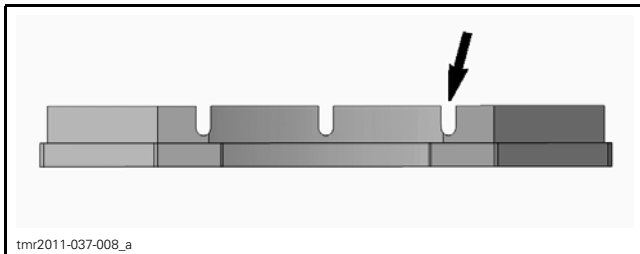
Cleaning and Inspecting the Brake System

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

Brake Pads

1. Measure brake pad lining thickness. Refer to *TECHNICAL SPECIFICATIONS*.

NOTE: The brake pad grooves are wear indicators.



BRAKE PAD GROOVE

⚠ WARNING

Brake pads must always be replaced in pairs.

Brake Caliper

1. Remove calipers then check the following components:
 - Check brake pad pins
 - Check caliper boot for cracks
 - Check caliper movement on its support
 - Check pistons movement
 - Check pistons for scratches, rust or other damages.
2. Clean the following components using XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705) or XPS BRAKES AND PARTS CLEANER (P/N 219 701 776):
 - Brake pads
 - Caliper support and slider
 - Caliper pistons, spring and pins.

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

3. Lubricate caliper sliders and pins using an appropriate brake caliper synthetic grease.

Brake Disc

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

NOTE: Refer to *TECHNICAL SPECIFICATIONS* for details.

2. Clean brake disc using XPS BRAKES AND PARTS CLEANER (USA) (P/N 219 701 705) or XPS BRAKES AND PARTS CLEANER (P/N 219 701 776).

Master Cylinder

1. Check master cylinder as follows:
 - Check cleanliness of master cylinder rod and boot.
 - Check master cylinder boot for cracks or damage.
2. If required, clean then lubricate master cylinder rod and boot using COSMO RUBBER GREASE (P/N 715 900 399).

Brake Pedal

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

Brake Hoses

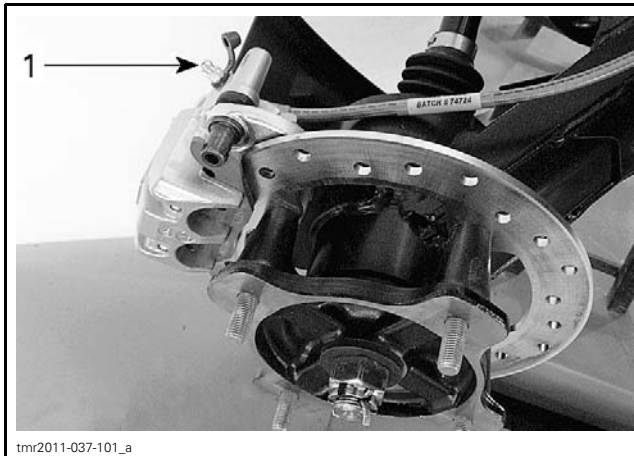
1. Check hoses for leaks, crushed, deformations, cracking or scrapes.

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

Replacing the Brake Fluid

Draining the Brake Fluid

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

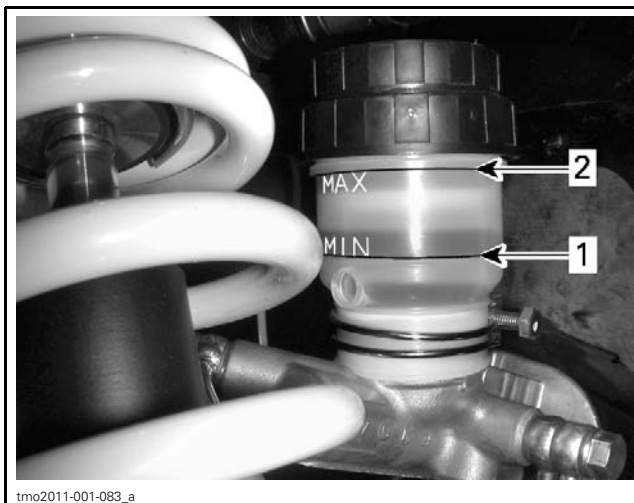


1. Caliper bleeder

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

Filling the Brake Fluid

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



TYPICAL
1. MIN.
2. MAX.

RECOMMENDED BRAKE FLUID
BRAKE FLUID GTLMA DOT4 (P/N 293 600 131)

⚠ WARNING

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

Bleeding the Brake System (Vacuum Pump)

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

1. On each caliper, unscrew bleeder until brake fluid comes out then close it.
2. Install the vacuum pump onto caliper bleeder.

REQUIRED TOOL	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

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

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

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

Bleeding the Brake System (Manual)

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

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

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

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

Subsection XX (PERIODIC MAINTENANCE PROCEDURES)

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

8. Perform bleeding procedure for the other caliper bleeders.
9. Check brake pedal operation:

– If brake pedal feels spongy, bleed system again then carry out the *BRAKE SYSTEM PRESSURE VALIDATION* as detailed in *BRAKES* subsection.

PASSENGER HANDHOLDS

Passenger Handhold Condition

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

Replace if necessary.

TOW HITCH

Inspecting the Tow Hitch

Ensure tow hitch receptacle module is solidly mounted.

Inspect hitch for cracks and other damages.

Repair or replace as necessary.

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 200 hours of operation, to remind you of maintenance requirements: **MAINTENANCE REQUIRED**. To erase message, use B.U.D.S.

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 YEAR OR EVERY 3 000 KM (2,000 MI) OR 200 HOURS (whichever comes first)

EVERY YEAR OR EVERY 1 500 KM (1,000 MI) OR 100 HOURS (whichever comes first)

Check fault codes

Perform all items indicated in the pre-ride inspection.

Replace engine oil and filter

Inspect gearbox oil level and look for contamination (every 3000 km)

Replace gearbox oil (Perform at the first 3000 km)

Inspect and clean engine air filter. Replace if needed

Inspect steering system for abnormal play and damages (column, rack and pinion, bellows)

Inspect the tie rod ends and ball joints for play and inspect boots condition

Inspect wheel bearings for abnormal play

Inspect suspension arm bushing and wear plates. Replace if needed

Inspect CV joints and rubber boots condition (check for abnormal play in the joints and for cuts in the rubber boots)

Lubricate suspension arms and rear sway bar bushings

Inspect and clean the brake system (fluid level, pads, discs, lines, calipers)

Inspect front differential oil level and look for contamination and overall condition (vents, mount bolt torque, seals)

Inspect battery condition and connections

Inspect propeller shaft U-joints for abnormal play

Clean exhaust pipes and muffler area

Clean muffler spark arrester

Adjust valve clearance

Replace fuel vent breather filter

Inspect CVT drive belt and clean CVT pulleys

Inspect centrifugal levers and rollers of drive pulley

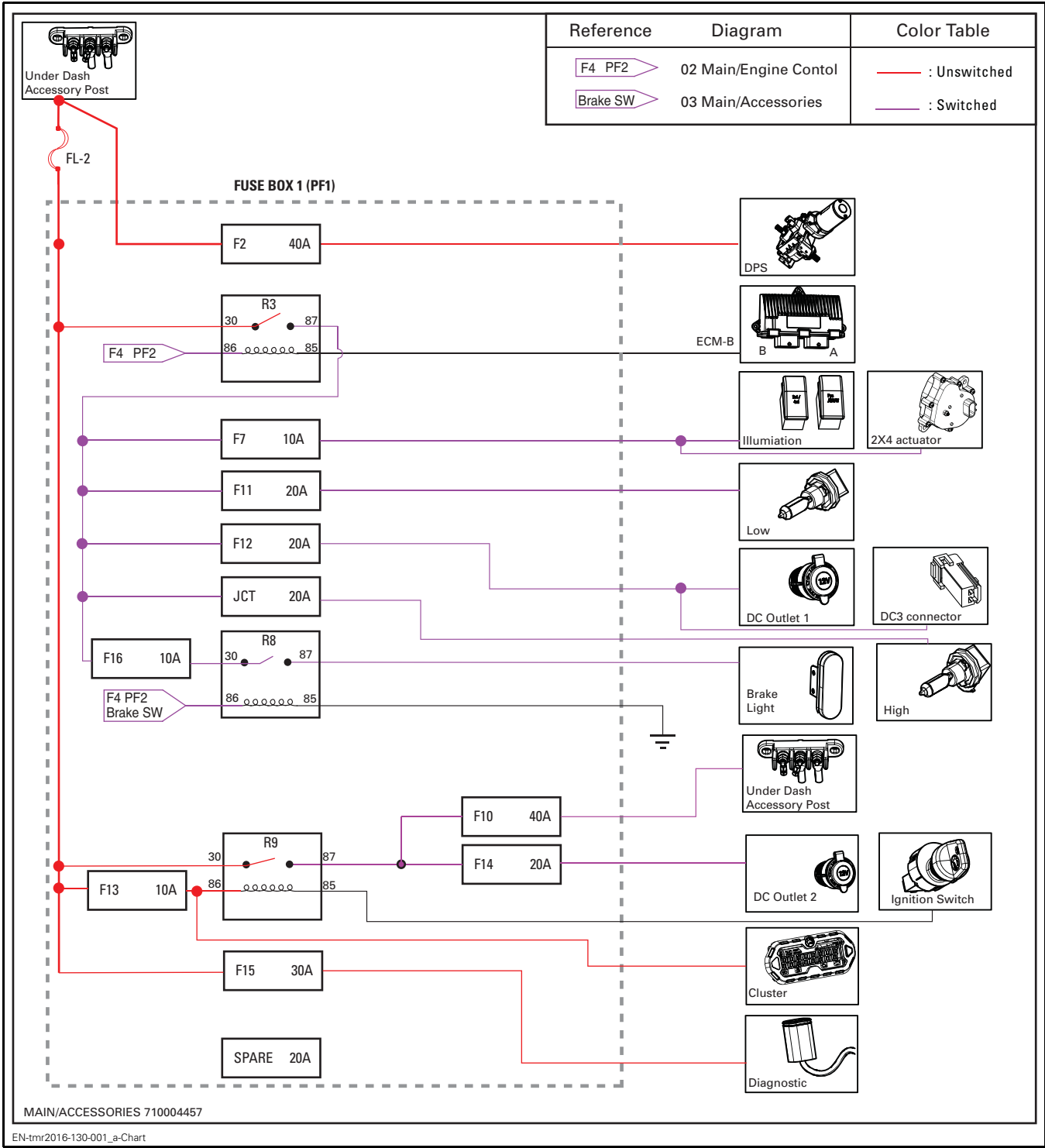
Inspect, clean and lubricate drive pulley needle bearing

Inspect input and output shaft seals (engine, gearbox, differential)

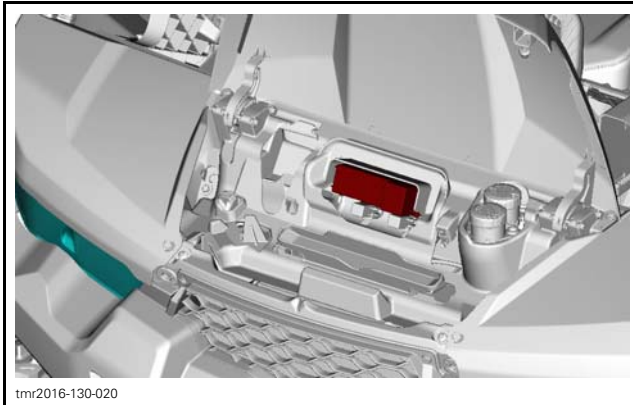
Subsection XX (PERIODIC MAINTENANCE SCHEDULE)

EVERY YEAR OR EVERY 3 000 KM (2,000 MI) OR 200 HOURS (whichever comes first)
EVERY YEAR OR EVERY 1 500 KM (1,000 MI) OR 100 HOURS (whichever comes first)
Tighten cage fasteners
Inspect and clean seat belts retractors and buckles
Verify coolant level and adjust if needed
EVERY TWO YEAR OR EVERY 6 000 KM (4,000 MI) OR 400 HOURS (whichever comes first)
EVERY TWO YEAR OR EVERY 3 000 KM (2,000 MI) OR 200 HOURS (whichever comes first)
Check fault codes
Perform all items indicated in the pre-ride inspection.
Replace front differential oil
Replace gearbox oil.
Replace brake fluid (must be performed every 2 years)
Verify cooling system
Test engine coolant strength + level
Verify fuel system for leaks
Verify fuel pump pressure (idle and WOT)
Replace spark plugs
Clean vehicle speed sensor
EVERY 5 YEARS OR EVERY 12 000 KM (8,000 MI) (whichever comes first)
EVERY 5 YEARS OR EVERY 6 000 KM (4,000 MI) (whichever comes first)
Replace engine coolant

ACCESSORY POWER DISTRIBUTION DIAGRAM



FUSE BOX 1 (PF1)



	F7	Spare	F16	R8			
R3	F15	F11	F12	JCT	F14	F13	R9
		F2					F10

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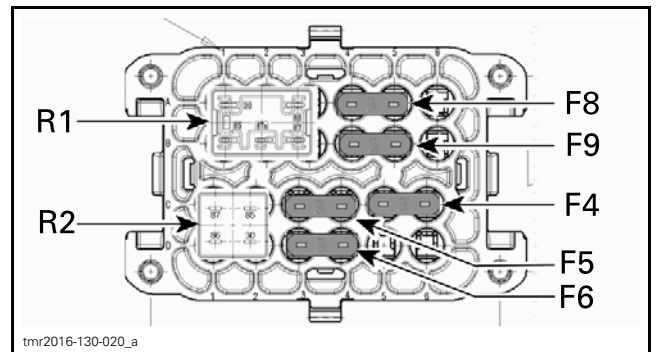
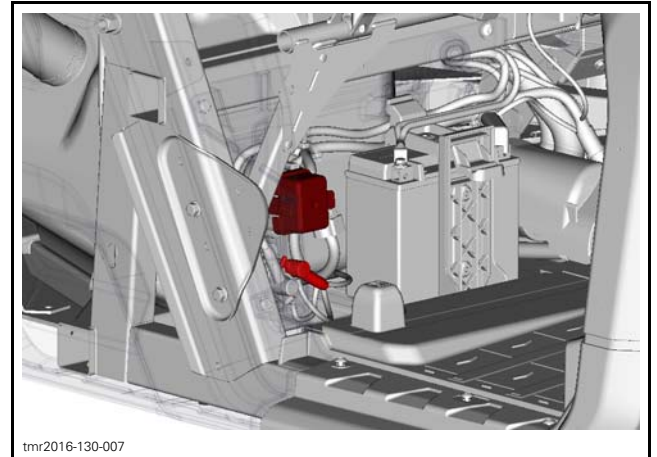
Fuses

FUSE IDENTIFICATION			
Fuse	F2	DPS	40 A
	F7	4X4, Illumination	10 A
	JCT	Headlamp low	20 A
	F10	Accessory output	40 A
	F11	Headlamp high	20 A
	F12	DC outlets 1 and 3	20 A
	F13	Clock / gauge	10 A
	F14	DC outlet 2	20 A
	F15	DB Protect	30 A
	F16	Tail lamps	10 A
	Spare	N/A	20 A

Relays

RELAY IDENTIFICATION		
Relays	R3	Accessory via ECM
	R8	Brake
	R9	Accessory via ignition switch

FUSE BOX 2 (PF2)



Subsection XX (POWER DISTRIBUTION AND GROUNDS)

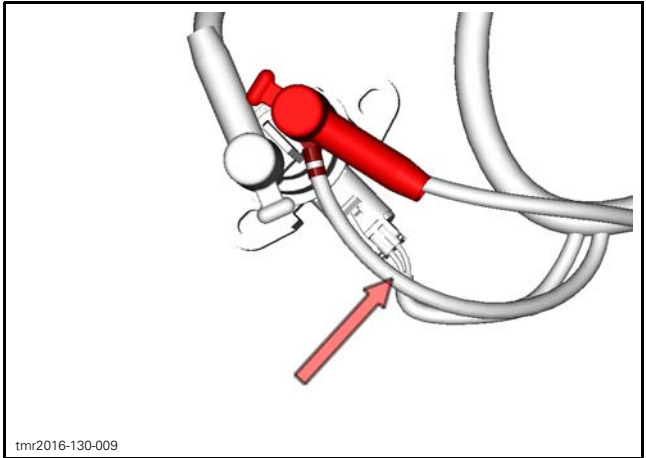
Fuses

FUSE IDENTIFICATION			
Fuse	F4	Relays in fuse box 1, speed sensor, brake switch, cluster	10 A
	F5	Injectors and ignition coils, fuel pump, speed sensor	10 A
	F6	ECM	10 A
	F8	Key switch	10 A
	F9	Fan (thermal fuse)	25 A
	Spare	N/A	10 A

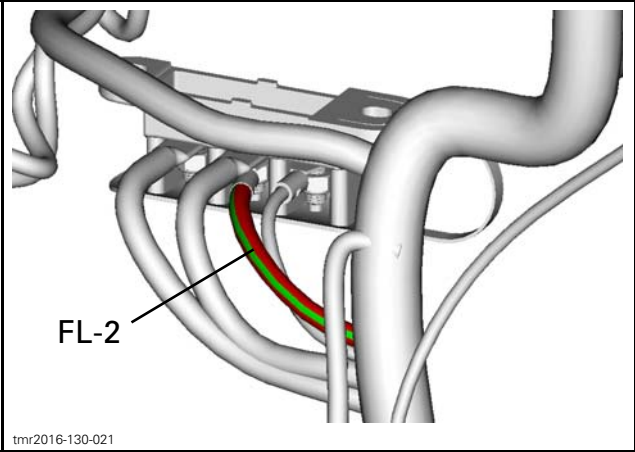
Relays

RELAY IDENTIFICATION		
Relays	R1	Fan
	R2	Main

FUSIBLE LINKS



FL-1 BETWEEN STARTER SOLENOID AND FUSE BOX 2



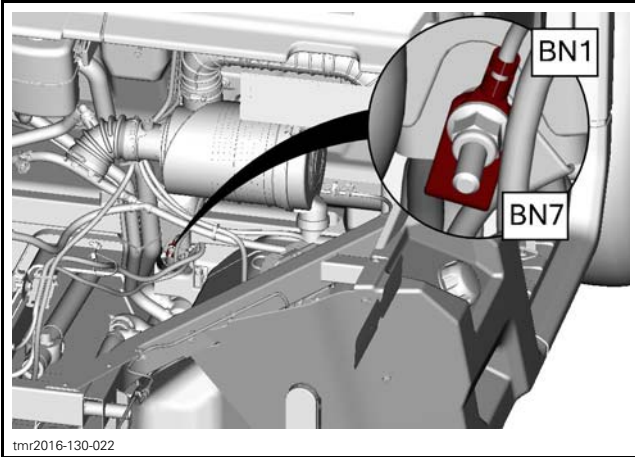
FL-2 BETWEEN UNDER DASH ACCESSORY POST AND FUSE BOX 1 (RD/GN WIRE)

Fusible link gauge (AWG) varies by current capacity.

FUSIBLE LINK IDENTIFICATION			
Fusible link (FL)	FL-1	Protects fuse box 2 (PF-2)	18 AWG
	FL-2	Protects fuse box 1 (PF-1)	14 AWG

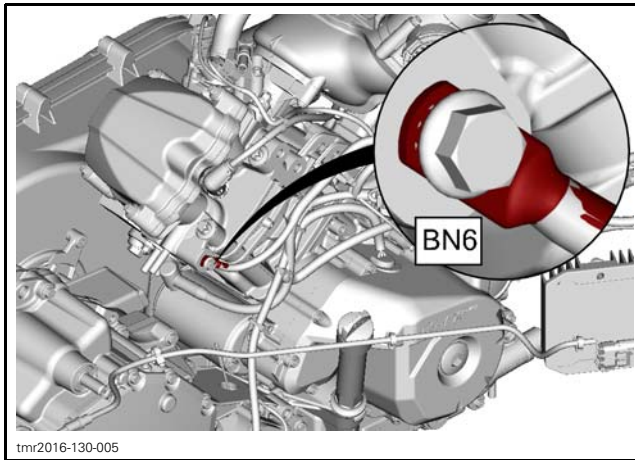
GROUND LOCATIONS

Chassis



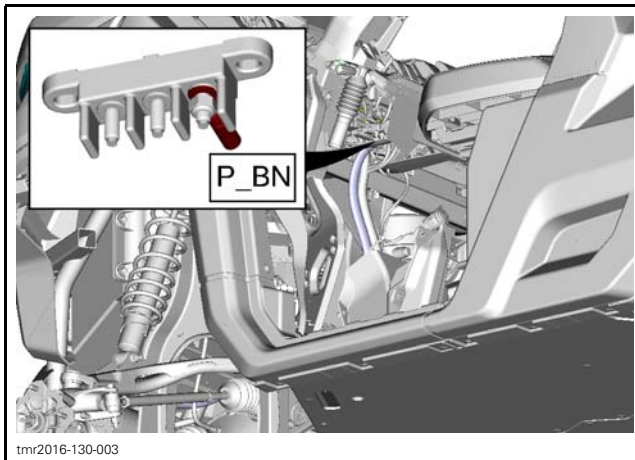
TIGHTENING TORQUE	
Ground terminal	10 N•m ± 2 N•m (89 lbf•in ± 18 lbf•in)

Engine HD8 and HD10



TIGHTENING TORQUE	
Ground terminal	$9 \text{ N}\cdot\text{m} \pm 1 \text{ N}\cdot\text{m}$ $(80 \text{ lbf}\cdot\text{in} \pm 9 \text{ lbf}\cdot\text{in})$

Accessories



UNDER DASH ACCESSORY POST (RD/BU WIRE)

TIGHTENING TORQUE	
Ground terminal	$3.5 \text{ N}\cdot\text{m} \pm 0.5 \text{ N}\cdot\text{m}$ $(31 \text{ lbf}\cdot\text{in} \pm 4 \text{ lbf}\cdot\text{in})$

PRESEASON PREPARATION

Proper vehicle preparation is required after a storage period.

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

Remove rags that were installed for storage: engine air inlet hose, CVT outlet hose and muffler.

Clean drive and driven pulleys to remove storage protective lubricant, then reinstall drive belt. Refer to *CONTINUOUSLY VARIABLE TRANSMISSION (CVT)*.

Remove parts required to allow inspection of entire engine air inlet system. Check for animal nests and other foreign material. Reinstall removed parts.

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

Reinstall battery. Refer to *CHARGING SYSTEM* subsection.

Inflate tires to the recommended pressure.

NOTE: Perform any due maintenance items as per the *MAINTENANCE SCHEDULE*.

Test drive vehicle.

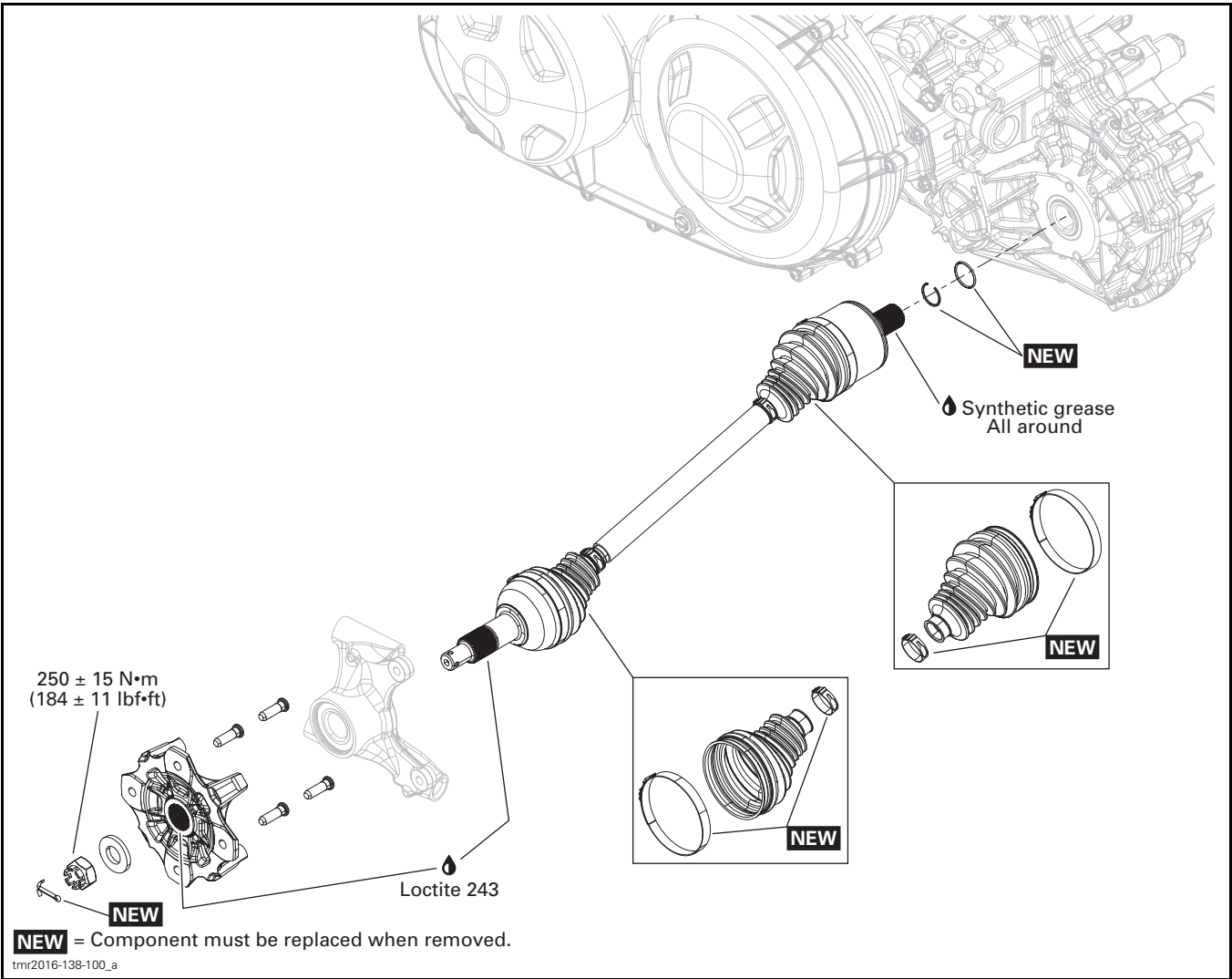
REAR DRIVE

SERVICE TOOLS

Description	Part Number	Page
CV BOOT CLAMP PLIER	529 036 120	3
CV JOINT EXTRACTOR.....	529 036 005	3

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	2
XPS SYNTHETIC GREASE.....	293 550 010	3

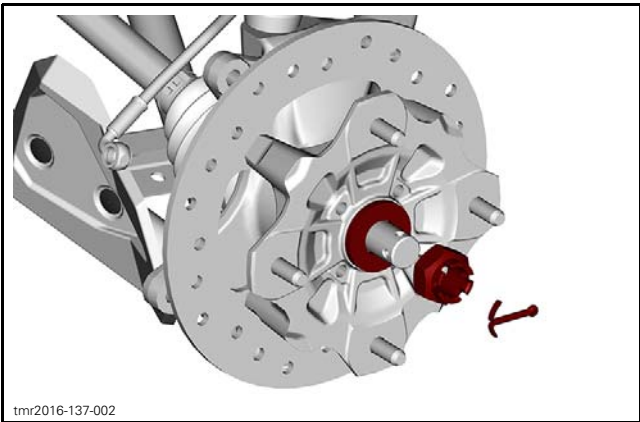


PROCEDURES

WHEEL HUB

Removing the Wheel Hub

- 1. Lift and support vehicle. Refer to *INTRODUCTION* section for proper procedure.
- 2. Select the 4WD position, place the transmission lever on "P", and make sure the rear differential is in **Lock** position.
- 3. Remove caliper from knuckle. Refer to *BRAKES* subsection.
- 4. Remove the following parts:
 - Cotter pin
 - Castellated nut
 - Belleville washer.



- 5. Remove wheel hub.

Inspecting the Wheel Hub

Check wheel studs for damaged threads and overall conditions

Check wheel hub for cracks or other damages.

Check inner splines for wear or other damages.

Replace wheel hub and / or studs if any damage is detected.

Installing the Wheel Hub

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

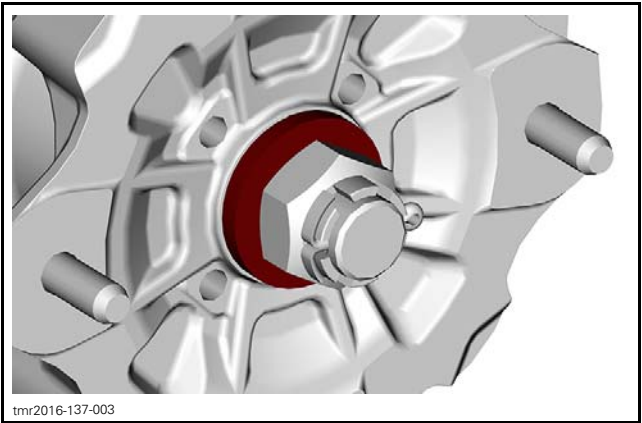
Apply LOCTITE 243 (BLUE) (P/N 293 800 060) all around drive shaft and wheel hub splines.

Install Belleville washer with its domed side outwards.

TIGHTENING TORQUE	
Castellated nut	250 N•m ± 15 N•m (184 lbf•ft ± 11 lbf•ft)

NOTE: Tighten further castellated nut if required to align grooves with drive shaft hole.

Install a new cotter pin.



DRIVE SHAFT

Removing the Rear Drive Shaft

- 1. Remove the wheel hub. Refer to procedure in this subsection.
 - 2. Remove the knuckle. Refer to *STEERING SYSTEM* subsection.
 - 3. Strongly pull drive shaft out of gearbox.
- NOTE:** Keep track of the O-ring between the drive shaft and the gearbox.
- 4. Discard the stop ring at the end of the shaft.

Inspecting the Rear Drive Shaft

Inspect the condition of boots. If there is any damage or evidence of leaking lubricant, replace them. Refer to *DRIVE SHAFT BOOT*.

Check splines for excessive wear. Replace if necessary.

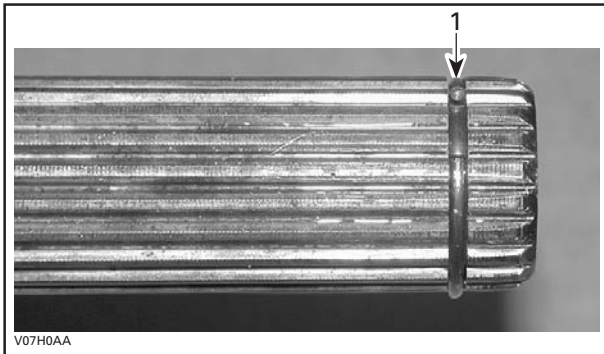
NOTE: If the splines on plunging joint are worn, a check of differential inner splines should be done.

Installing the Rear Drive Shaft

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

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) all around drive shaft and wheel hub splines.

Install a new stop ring.



1. Stop ring

Apply XPS SYNTHETIC GREASE (P/N 293 550 010) all around splines at the gearbox end, from the plunging joint up to the stop ring.

Ensure the O-ring is properly installed.

DRIVE SHAFT BOOT

Removing the Drive Shaft Boot

1. Remove the drive shaft from the vehicle.
2. Remove drive shaft boot clamps.

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

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

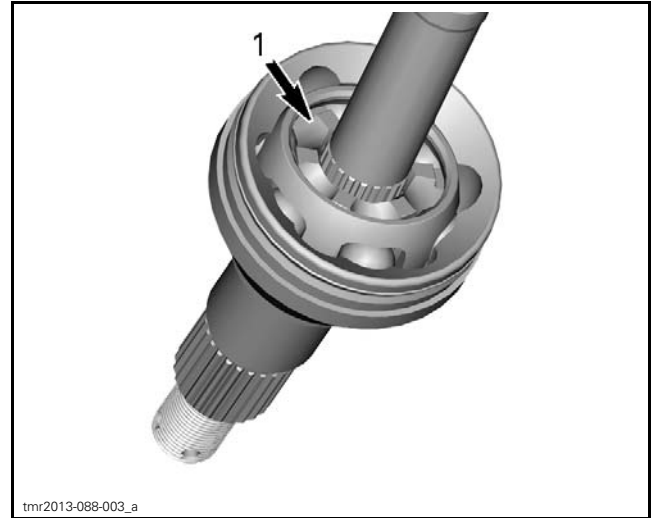
Without the Special Tool

1. Clamp joint housing in a vise.
2. Align shaft with joint.
3. Pull hard on shaft to remove from joint.
4. Remove boot from drive shaft.
5. Remove and discard the circlip.

With the Special Tool

REQUIRED TOOL	
CV JOINT EXTRACTOR (P/N 529 036 005)	

1. Place drive shaft in vice with the joint downward.
2. Install the cv joint extractor on the bearing.



TYPICAL - CV JOINT SHOWN

1. Position joint extractor tool here

3. With a hammer, hit on the tool to separate joint from shaft.
4. When joint and shaft are separated, remove boot from drive shaft.
5. Remove and discard the circlip.

Installing the Drive Shaft Boot

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

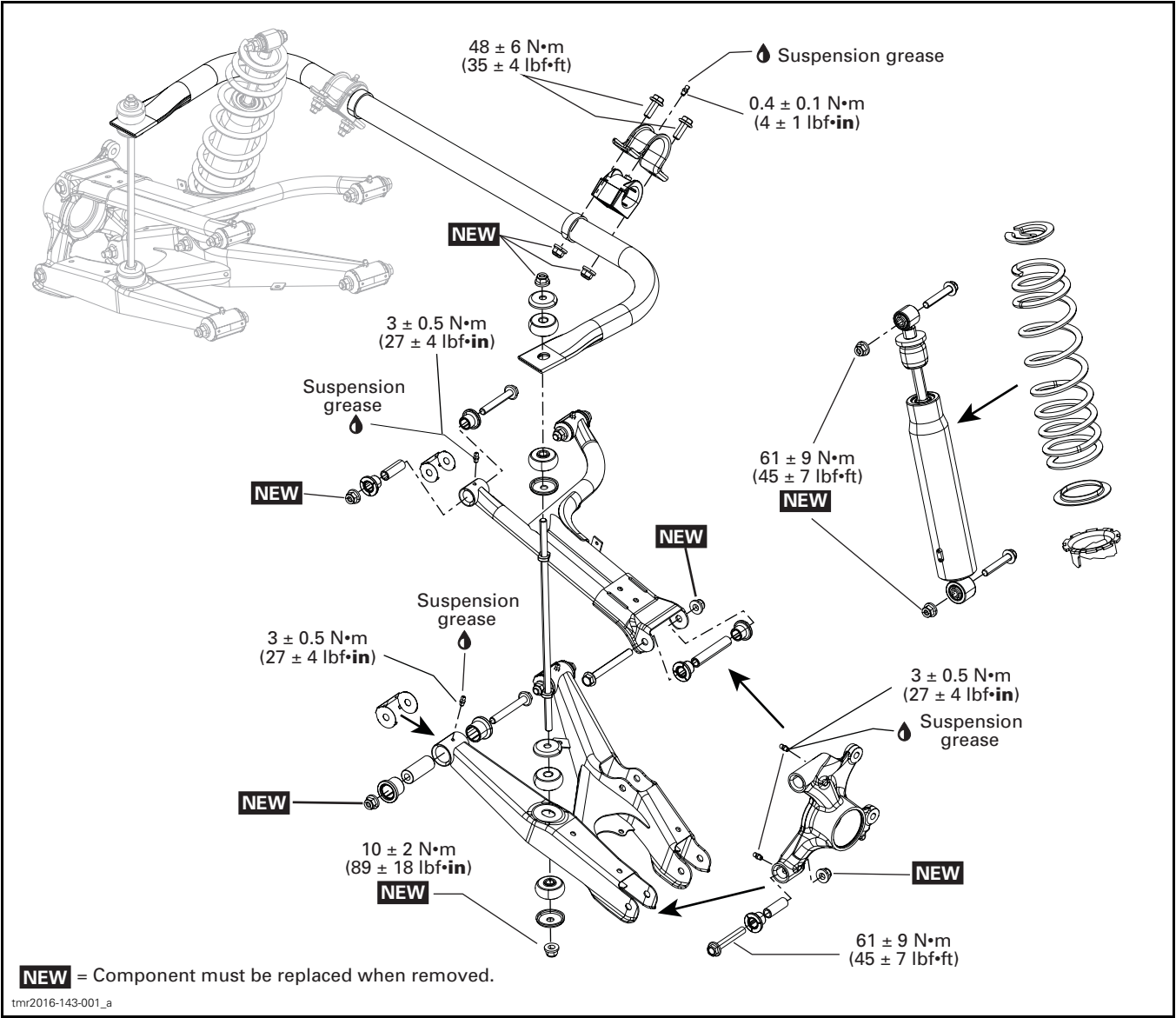
Pack bearing area with grease included with the new boot kit.

NOTE: Do not use or add other grease.

REAR SUSPENSION

SERVICE TOOLS

Description	Part Number	Page
SPRING COMPRESSOR	529 036 184	2



GENERAL

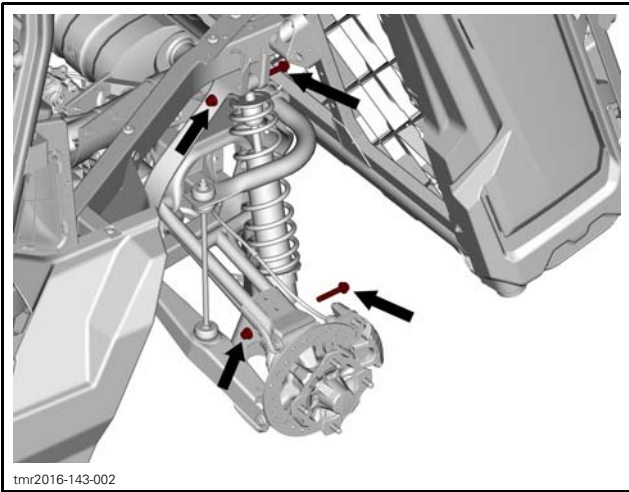
The procedure described below is the same for the RH and LH sides, unless otherwise instructed.

PROCEDURES

SHOCK ABSORBERS

Removing the Shock Absorber

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.



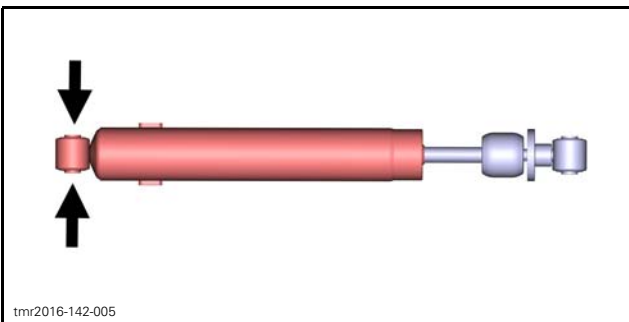
LH SIDE SHOWN - BOLTS AND NUTS

4. Remove shock absorber.

Inspecting the Shock Absorber

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 - VICE JAWS POSITION

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.

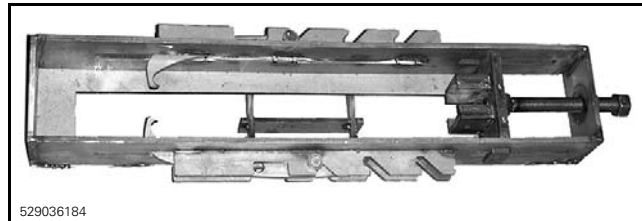
Installing the Shock Absorber

The installation is the reverse of the removal procedure.

SPRINGS

Removing the Spring

1. Remove shock absorber from vehicle. Refer to *SHOCK ABSORBERS* in this subsection.
2. Place the SPRING COMPRESSOR (P/N 529 036 184) in a vice.



3. Position the shock absorber in the tool.
4. Install the spring compressor pins.
5. Tighten spring remover screw until the spring is sufficiently compressed to remove spring cap.
6. Remove spring cap from shock absorber.
7. Release spring remover screw.
8. Remove spring from shock absorber.

Inspecting the Spring

Inspect the spring for damage.

Replace if necessary.

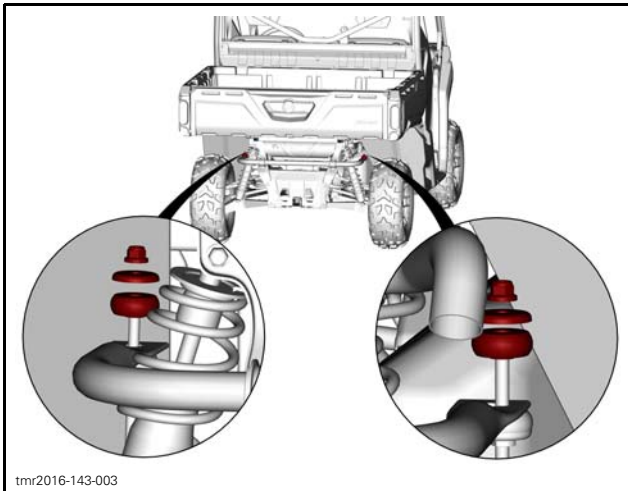
Installing the Spring

The installation is the reverse of the removal procedure.

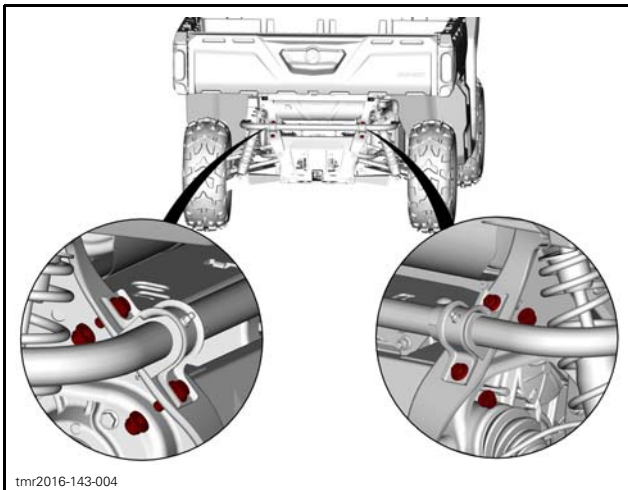
STABILIZER BAR

Removing the Stabilizer Bar

1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
2. Remove the stabilizer link upper nuts, stabilizer link bushing plates and stabilizer link bushings.



3. Remove stabilizer bar retaining screws.



4. Remove stabilizer bar.

Inspecting the Bar

Check stabilizer bar for cracks, bending or other damages.

Replace if necessary.

Installing the Bar

The installation is the reverse of the removal procedure. However, pay attention to the following. Install stabilizer link nuts and stabilizer bar screws loosely.

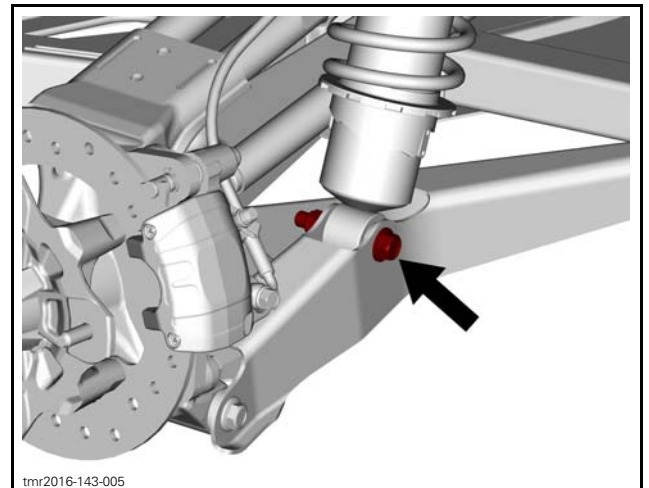
Using the following sequence, tighten fasteners as per the specification.

1. Stabilizer link nuts
2. Stabilizer bar screws

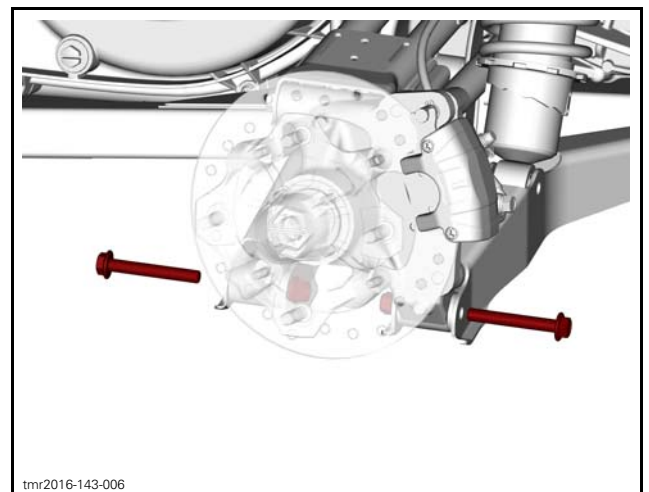
LOWER SUSPENSION ARM

Removing the Lower Suspension Arm

1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
2. Remove wheel.
3. Detach the shock absorber from the lower suspension arm.

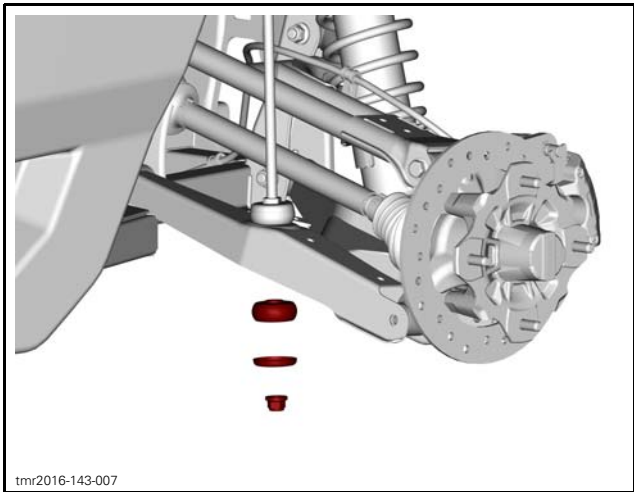


4. Remove bolts and nuts securing lower suspension arm to knuckle.

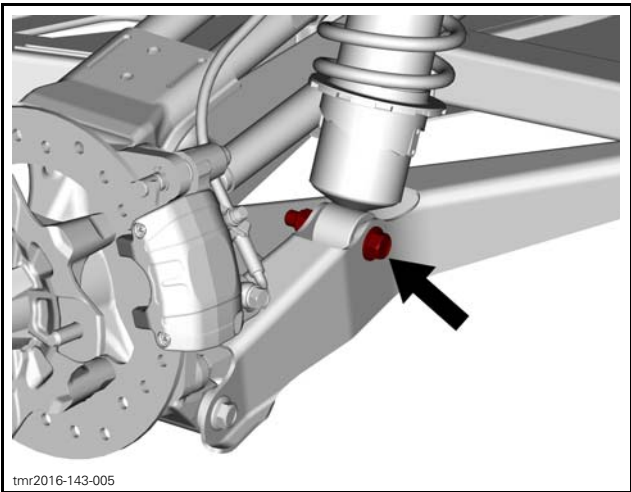


5. Detach the stabilizer link from the lower suspension arm.

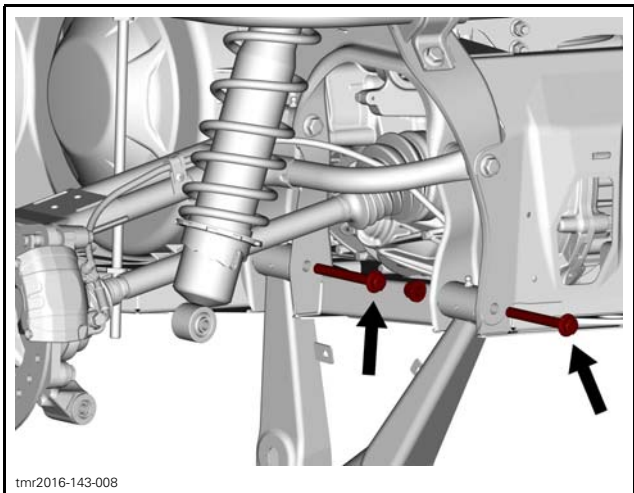
Subsection XX (REAR SUSPENSION)



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

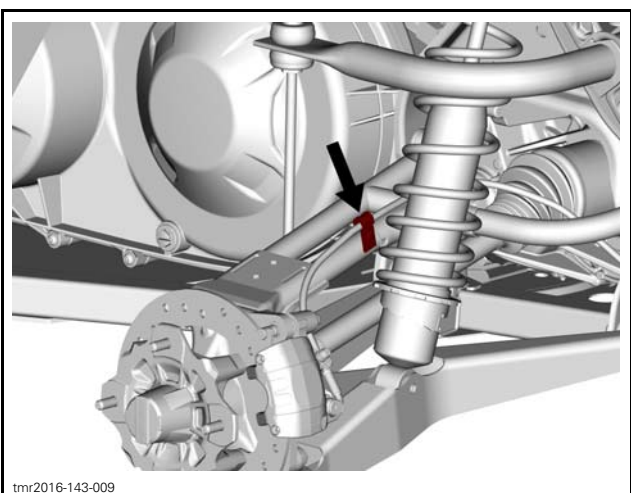


4. Remove the clamp retaining brake hose from the suspension arm.



SUSPENSION ARM TO THE FRAME - BOLTS AND NUTS

7. Remove suspension arm.



BRAKE HOSE CLAMP

5. Separate the suspension arm from the knuckle.

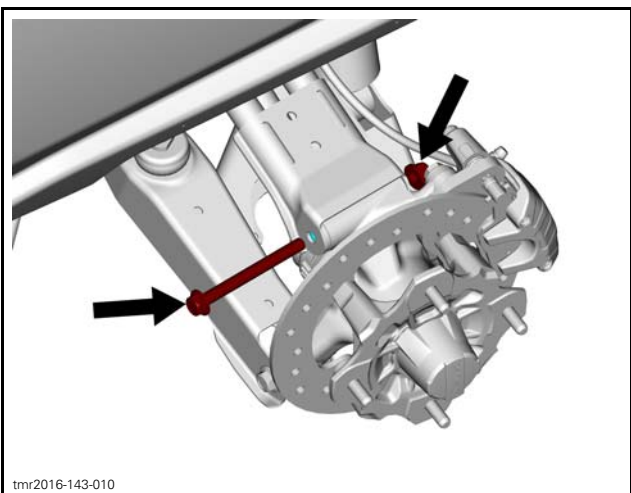
Installing the Lower Suspension Arm

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

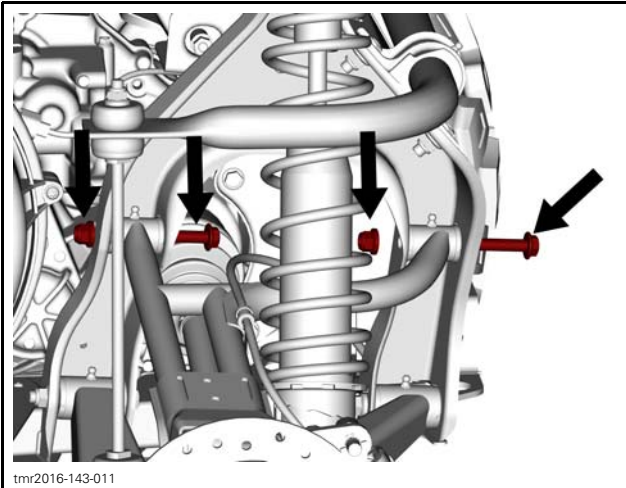
Removing the Upper Suspension Arm

1. Safely lift and support the vehicle off the ground. Refer to *INTRODUCTION* subsection.
2. Remove wheel.
3. Detach the shock absorber from the lower suspension arm.



SUSPENSION ARM TO THE KNUCKLE - BOLT AND NUT

6. Remove fasteners securing suspension arm to frame.



SUSPENSION ARM TO THE FRAME - BOLTS AND NUTS

7. Remove suspension arm.

Installing the Upper Suspension Arm

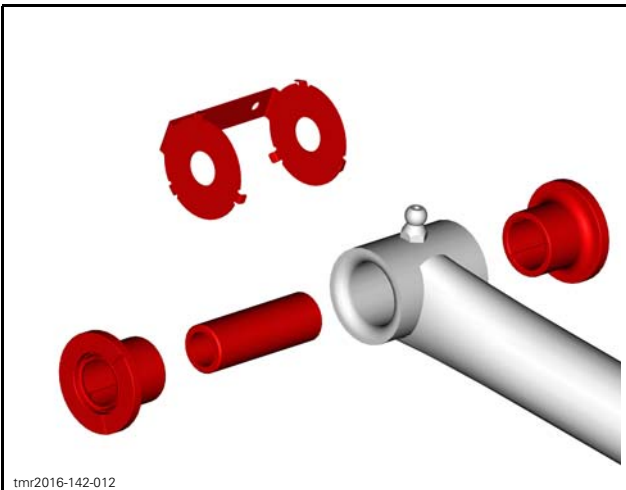
The installation is the reverse of the removal procedure. However, pay attention to the following.

Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

SUSPENSION ARM BUSHINGS

Removing the Suspension Arm Bushings

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



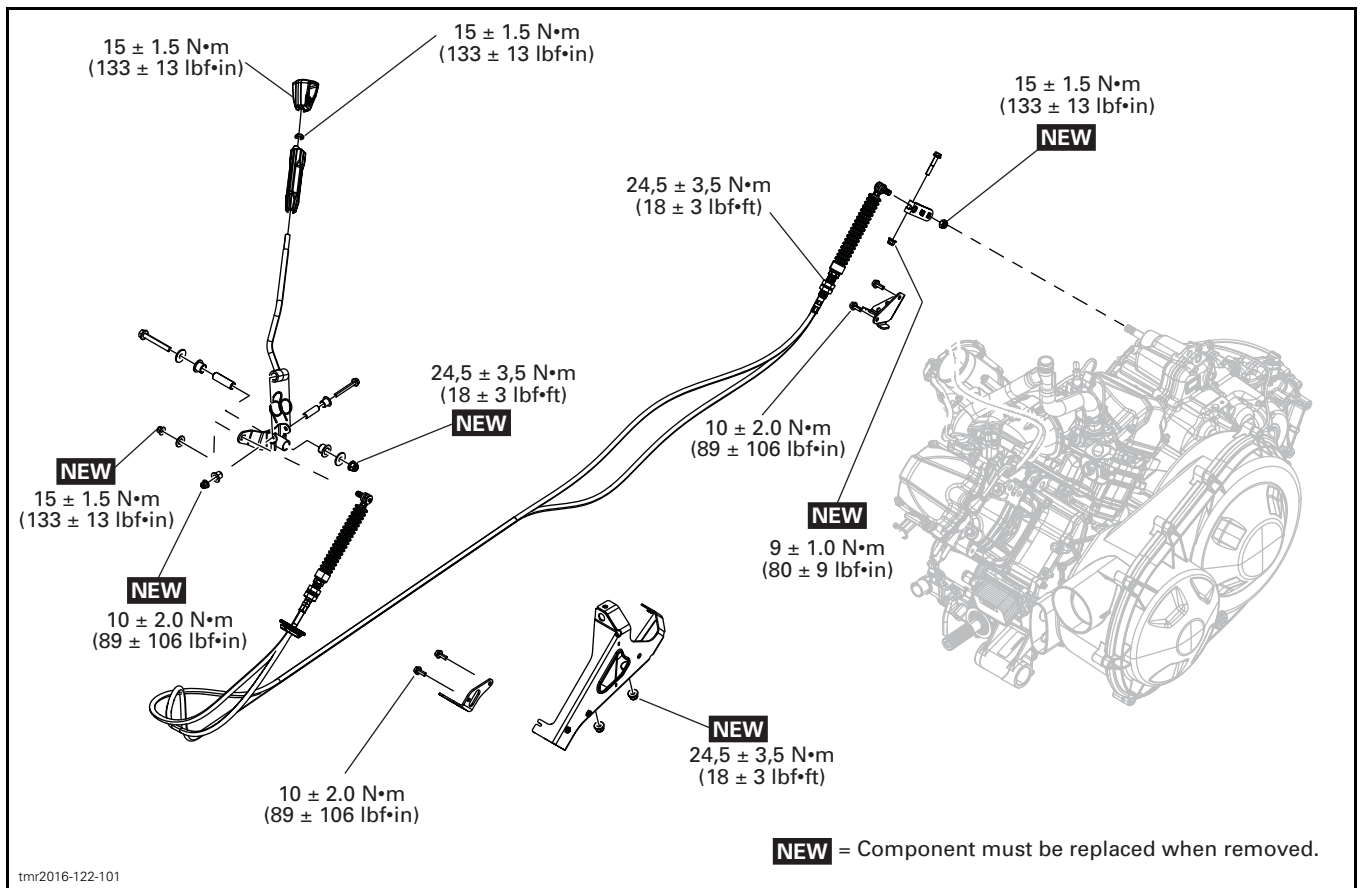
TYPICAL

Installing the Suspension Arm Bushings

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

Lubricate suspension arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

SHIFTER



tmr2016-122-101

PROCEDURES

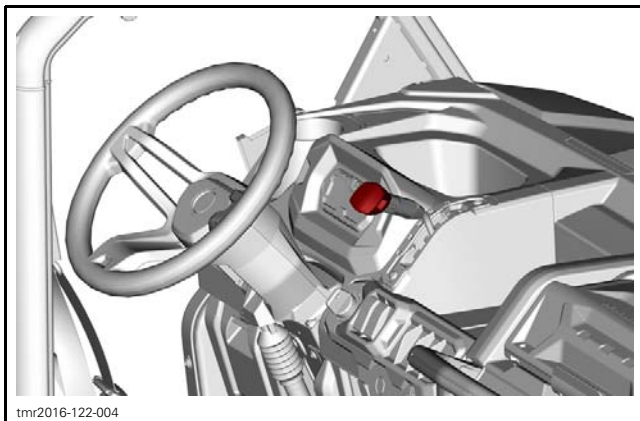
SHIFT LEVER

Shift Lever Access

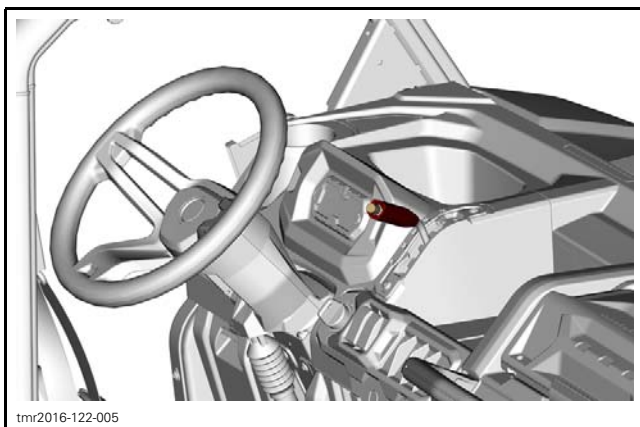
1. Refer to *BODY* subsection and remove the following components:
 - Shifter indicator

Shift Lever Removal

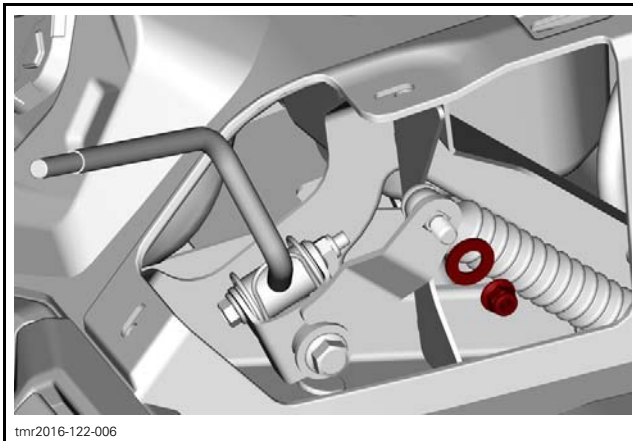
1. Remove body parts as required. Refer to *SHIFT LEVER ACCESS* in this subsection.
2. Place shift lever in **NEUTRAL** position.
3. Secure vehicle using wheel blocks.
4. Unscrew shift lever handle.



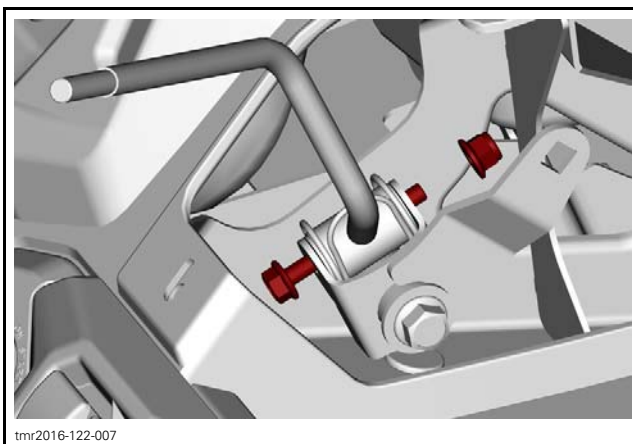
5. Remove shift lever trim



6. Detach shifter cable from shift lever by removing nut and washer.



7. Remove shift lever pivot bolt and nut.



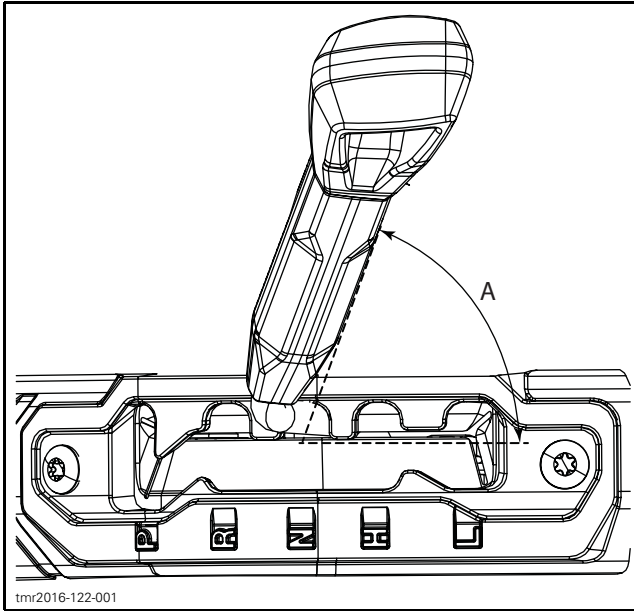
8. Remove shift lever.

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.
Ensure shift lever angle is within specifications



SHIFT LEVER HANDLE ANGLE
A. $72^\circ \pm 5^\circ$

Tighten shift lever handle nut to specification.

SHIFT LEVER HANDLE NUT TORQUE
15.5 N•m $\pm$ 1.5 N•m (137 lbf•in $\pm$ 13 lbf•in)

Adjust shifter cable, refer to *SHIFTER CABLE ADJUSTMENT* in this subsection.

Check if shift lever works properly in all positions.

SHIFTER CABLE

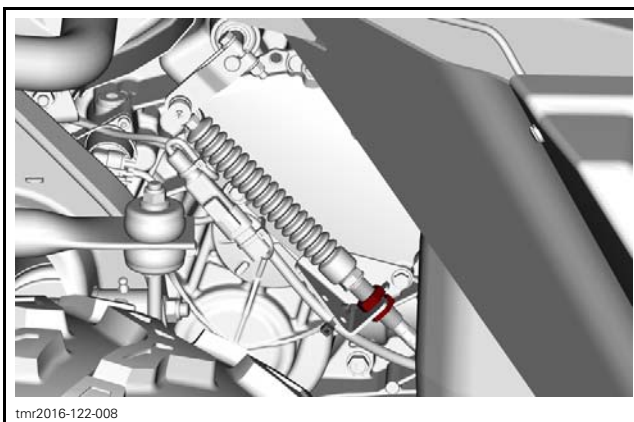
Shifter Cable Adjustment

1. Place shift lever in **NEUTRAL** position.

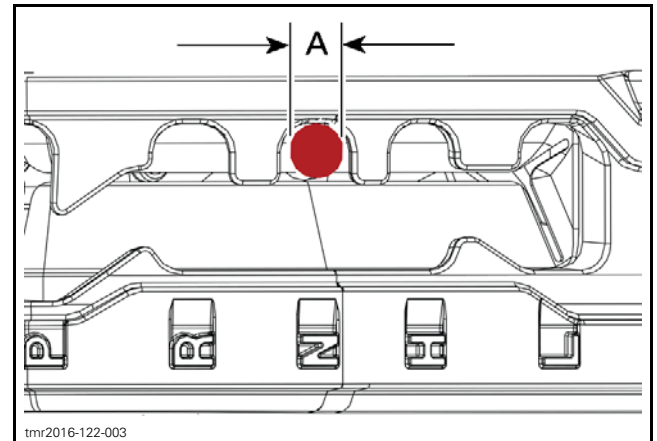
NOTICE Move vehicle back and forth to ensure gearbox is set in neutral position.

2. Secure vehicle using wheel blocks.

3. Loosen cable adjustment nuts at engine end of cable.

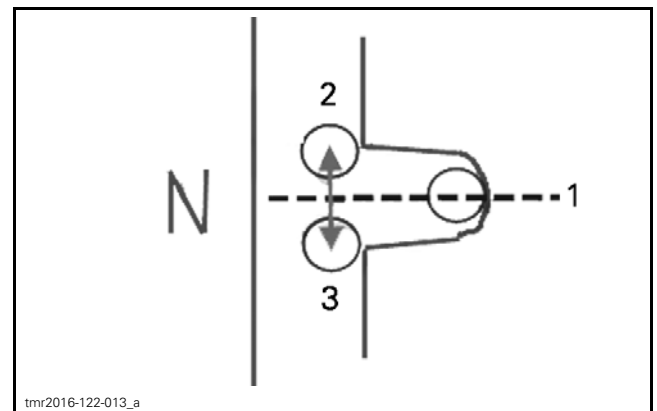


4. Adjust cable nuts in order to center shift lever in neutral notch.



CORRECT ADJUSTMENT
A. Shift lever centered in neutral notch

NOTE: UP and DOWN shifter arm freeplay must be symmetrical about the center line of neutral gate.



1. Center line
2. UP side of center line
3. DOWN side of center line

5. Tighten cable adjustment nuts to specification.

ADJUSTMENT NUTS TORQUE
24.5 N•m $\pm$ 3.5 N•m (18 lbf•ft $\pm$ 3 lbf•ft)

6. Move shift lever in **R** position then in **H** position.

7. Place shift lever in **NEUTRAL** position.

8. Check if shift lever is properly centered in neutral notch. Readjust as required.

NOTE: To properly check shift lever alignment into notch, move shift lever toward the LH side then let it return to position.

9. Test the shifter to confirm that the system works properly in all positions.



WARNING

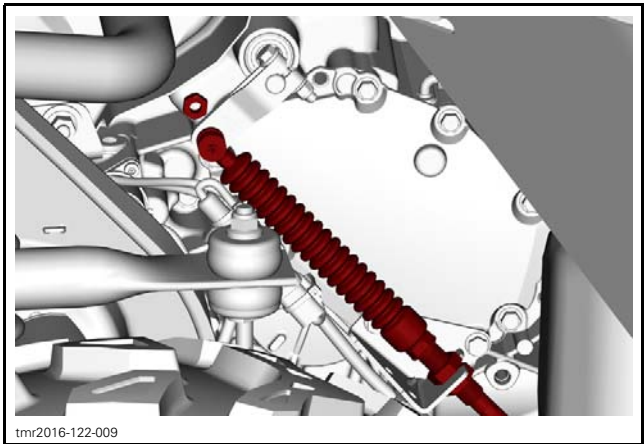
After adjustment, make sure that PARK position works properly.

SHIFT PLATE

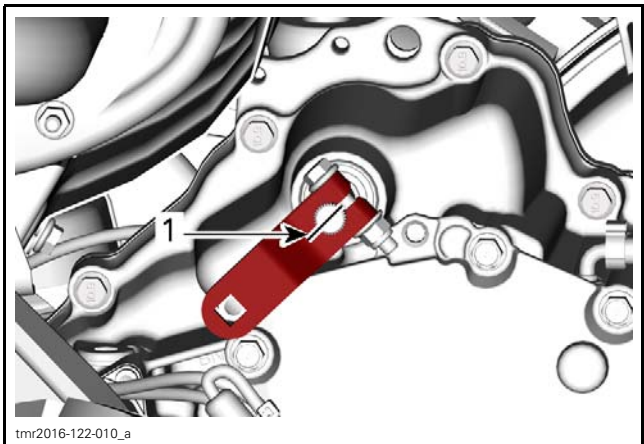
Shift Plate Removal

NOTE: Do not remove shift plate needlessly.

1. Remove shifter cable from shift plate.

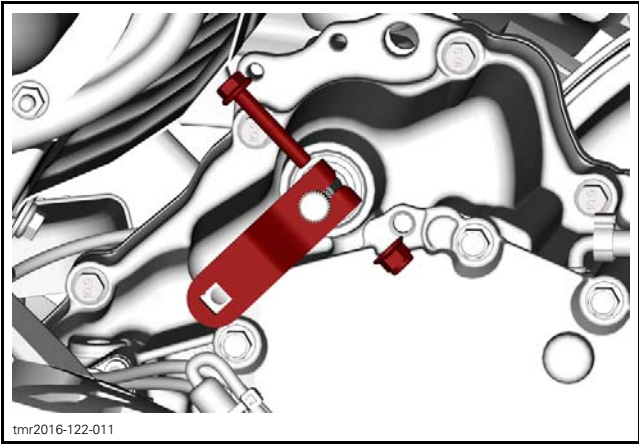


2. Index shift plate and shift shaft.



TYPICAL
1. Trace a mark on both parts

3. Remove shift plate nut and bolt.



4. Remove shift plate.

Shift Plate Inspection

Check shift plate for:

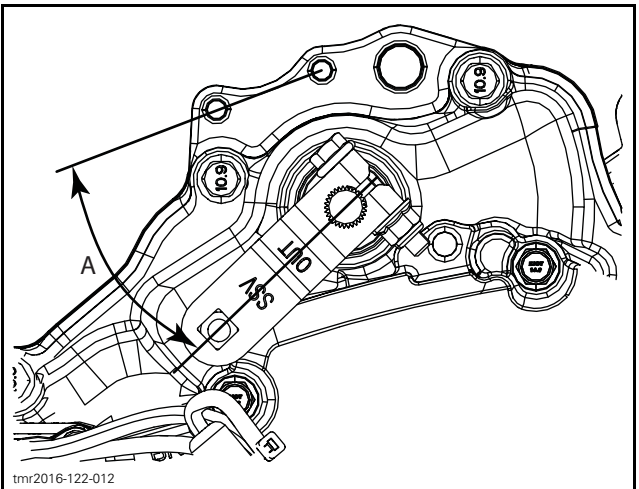
- Cracks
- Bending
- Spline condition.

Shift Plate Installation

The installation is the reverse of the removal procedure. However, pay attention to the following. Place gearbox in **NEUTRAL** position before shift plate installation.

Install and align shift plate using marks previously traced.

If shift plate is installed on a new engine, adjust it as per the following illustration.



SHIFT PLATE ANGLE FROM 2 HOLES ON ENGINE
A. $23^{\circ} \pm 2.5^{\circ}$

Adjust shifter cable, refer to *SHIFTER CABLE ADJUSTMENT* in this subsection.

Tighten shift plate nut to specification.

SHIFT PLATE NUT TORQUE
9 N•m ± 1 N•m (80 lbf•in ± 9 lbf•in)

SPECIAL PROCEDURES

SERVICE PRODUCTS

Description	Part Number	Page
XPS LUBE.....	293 600 016	2

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.

Check vent tubes. Clean if required.

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

Subsection XX (SPECIAL PROCEDURES)

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

STARTING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL.....	529 036 166	4

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.

- Transmission in Park or Neutral position and/or brake pedal held.
- Ignition switch turns to the start position and hold until the engine starts.

NOTE: If the ignition switch is left ON for more than 30 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 AND FAULT CODES* subsection.

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 IN FUSE 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 fuse F8 in fuse box 1
 - Check fuse.
2. Connection problem in the starting system
 - Check all connection and repair as necessary.
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

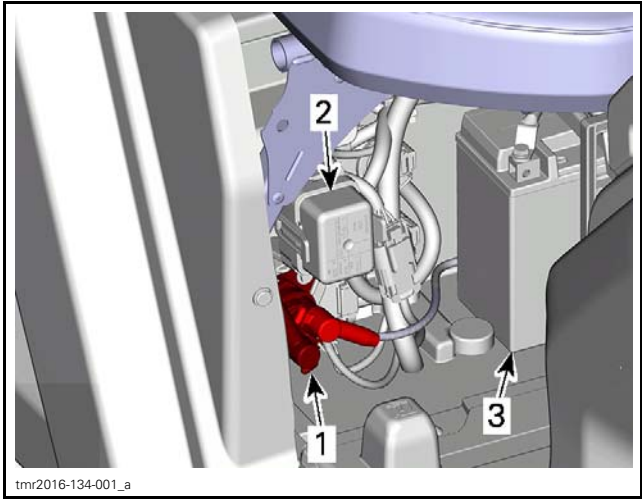
1. Defective brake switch
 - Check brake switch, refer to *BRAKES* section.
2. Defective gearbox position sensor (GPBS)
 - Check GPBS, refer to *GEARBOX AND 4X4 COUPLING UNIT* subsection.
3. Defective starter solenoid or circuit
 - Test starter solenoid, see procedure in this subsection.
4. Defective starter motor
 - Check starter motor, refer to *MAGNETO AND STARTER* subsection.

PROCEDURES

STARTER SOLENOID

Starter Solenoid Access

The starter solenoid is located beside the fuse box, underneath passenger seat.

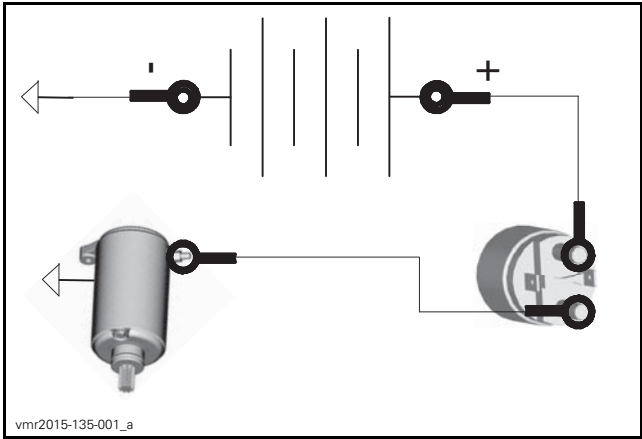


- 1. Starter solenoid
- 2. Fuse box
- 3. Battery

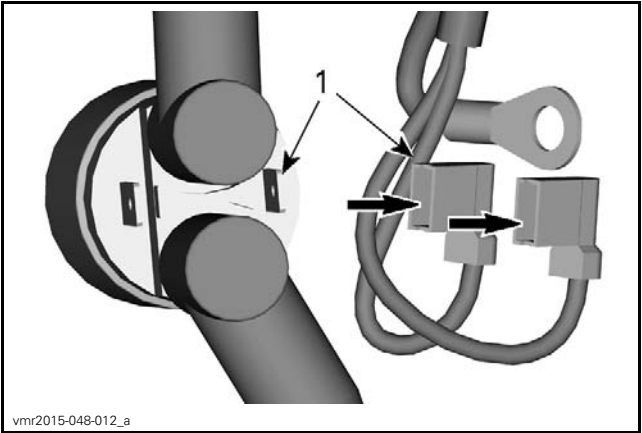
Starter Solenoid Wire Identification

FUNCTION	PIN	WIRE COLOR
12 volt input from ignition switch	SS1	BK/YE
Ground from ECM-B pin L4	SS2	OG/BN

Testing the Starter Solenoid Operational

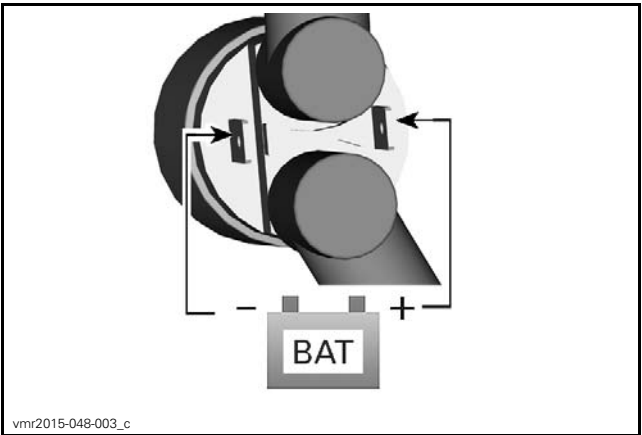


- 1. Disconnect SS1 and SS2



- 1. SS1

- 2. Activate the starter solenoid.
 - 2.1 Apply 12Vdc to SS1
 - 2.2 Ground SS2



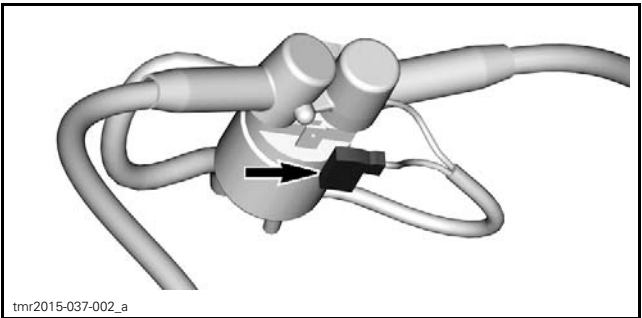
SS1 IS ON THE RIGHT

If starter runs, carry out the *TESTING THE STARTER SOLENOID INPUT VOLTAGE*.

If starter does not run, carry out the *TESTING THE STARTER SOLENOID WINDING RESISTANCE*.

Testing the Starter Solenoid Input Voltage

- 1. Disconnect connector with BLACK/YELLOW wire (SS1).



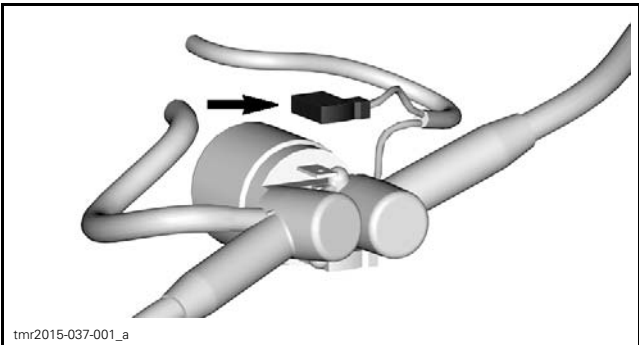
- 2. Turn ignition switch ON.

3. Measure voltage as per following table.

STARTER SOLENOID INPUT VOLTAGE TEST		
TEST PROBES		RESULT (START BUTTON RELEASED)
BK/YE wire	Battery ground	Battery voltage

Testing the Starter Solenoid Ground Signal

1. Disconnect ORANGE/BROWN wire (SS2) from solenoid.

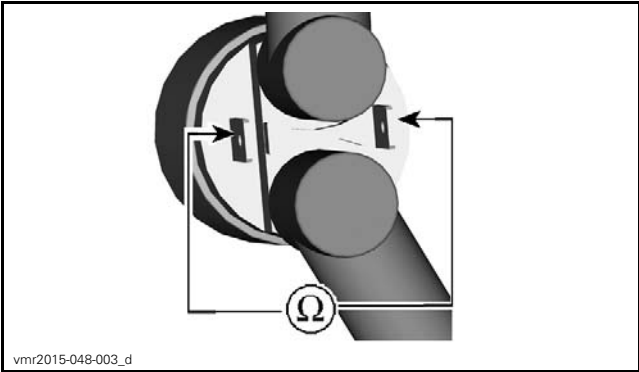


2. Turn ignition switch ON.
3. Measure voltage as per following table.

STARTER SOLENOID GROUND SIGNAL TEST		
TEST PROBES		RESULT (START BUTTON DEPRESSED)
OG/BN wire	Battery positive post	Battery voltage

Testing the Starter Solenoid Winding Resistance

Disconnect terminals from solenoid.
With a multimeter, check primary winding resistance as follows.



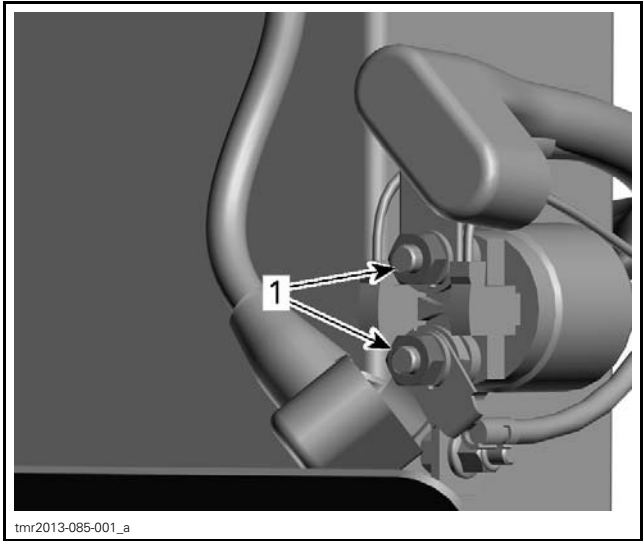
STARTER SOLENOID WINDING RESISTANCE TEST		
TEST PROBES		RESULT @ 20°C (68°F)
Starter solenoid SS1 pin	Starter solenoid SS2 pin	Approximately 5 Ω

If measurement is out of specification, replace solenoid.

Testing the Starter Solenoid Voltage Drop

Turn ignition key ON.
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.



1. VDC

If voltage is out of specification, replace solenoid.

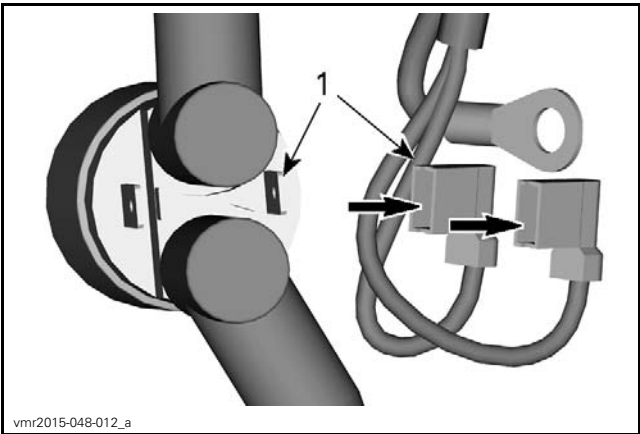
D2 DIODE (STARTER SOLENOID)

Diode Location

The diode is located in the main harness, near starter solenoid.

Testing the Diode

- 1. Make sure ignition switch is OFF.
- 2. Disconnect pins SS1 and SS2 from starter solenoid.



1. SS1

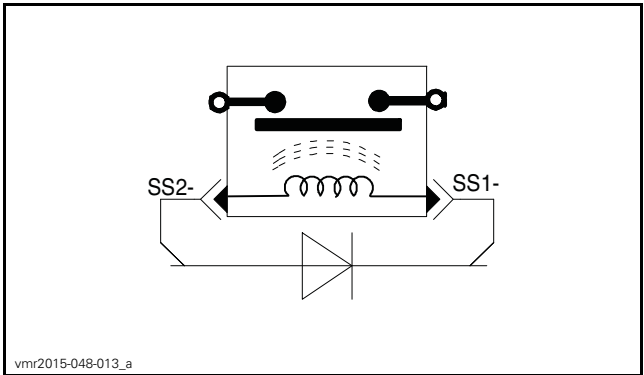
- 3. Disconnect ECM connector B.
- 4. Connect ECM ADAPTER TOOL (P/N 529 036 166) to the ECM connector B.



- 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.

GENERAL

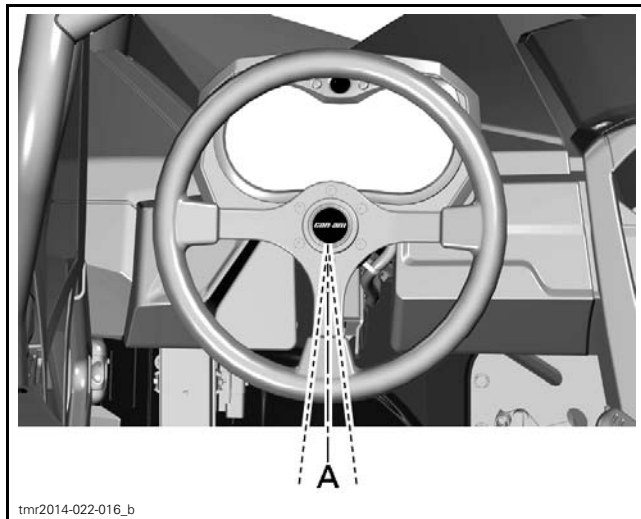
NOTICE Never perform arc welding in the DPS area. Otherwise, poor DPS operation might occur.

The procedures described below are the same for the RH and LH sides, unless otherwise instructed.

ADJUSTMENT

ALIGNING THE WHEELS

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 wheel is centered (within $\pm 5^\circ$), go to **step 6**.
 - 4.2 If steering wheel is offset more than 5° , go to **step 5**.



TYPICAL
A. Steering wheel angle $\pm 5^\circ$

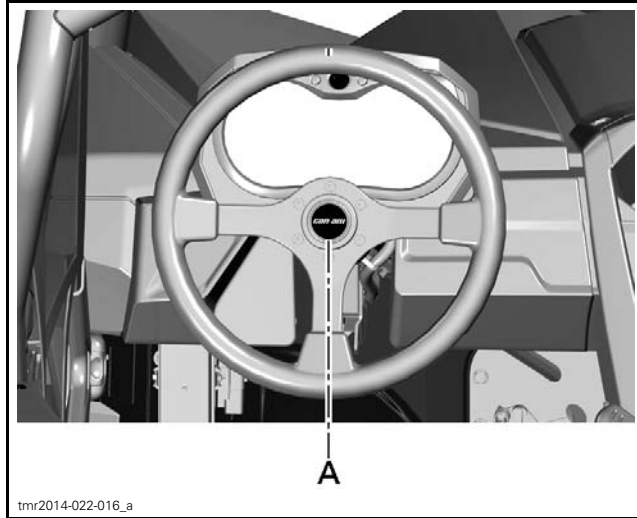
5. Reposition steering wheel on steering shaft as follows:

NOTICE Make sure rack and pinion does not move during steering wheel repositioning.

- 5.1 Remove steering wheel. Refer to *REMOVING THE STEERING COLUMN*.

- 5.2 Reinstall steering wheel to the closest centered position (nearest spline).

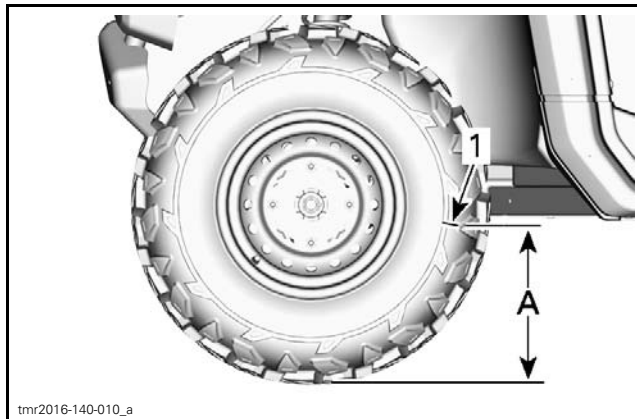
6. Center steering wheel.



TYPICAL
A. Steering wheel centered

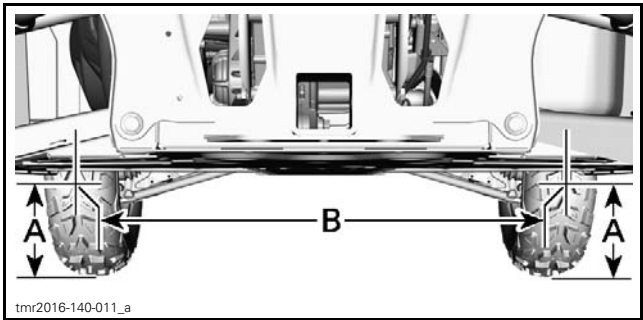
7. Place one mark on each front tire with a chalk at height of the center of the wheel. The mark must be under the frame, from a side point of view.

NOTE: The marks must be at the exact same height on each front tire.



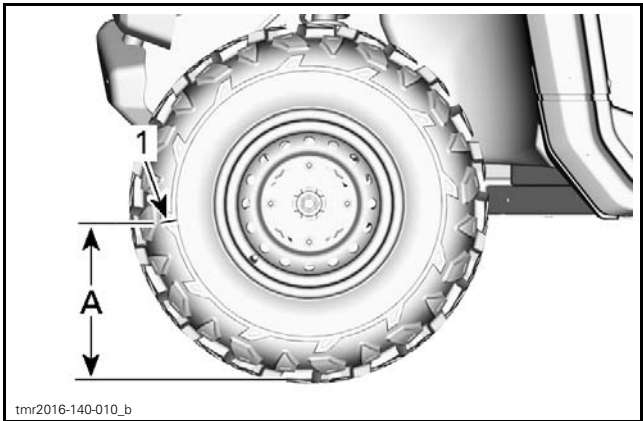
FRONT LH VIEW
1. Mark tire
A. Distance from ground to mark

8. Measure and note the distance between the center of the wheels, level with the marks on the tires.



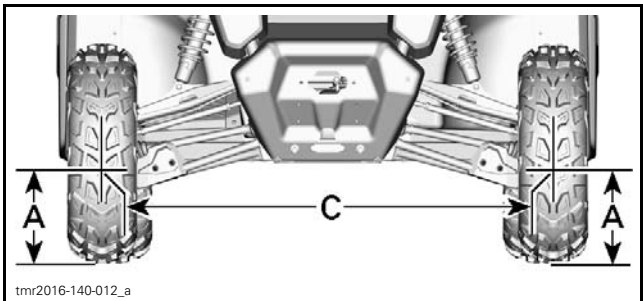
REAR VIEW
A. Height of mark
B. Measure distance

9. Move vehicle so that the marks are positioned towards front at the same height.



FRONT LH VIEW AFTER ROTATION
A. Height of mark

10. Measure and note the distance between the same two marks as step 8.



FRONT VIEW
A. Height of mark
C. Measure distance

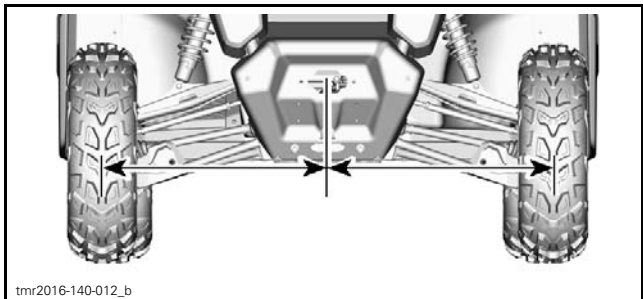
11. The difference between the front and the rear measurements must be as per the following specification:

MAXIMUM TOE
0 mm ± 4.8 mm (0 in ± .19 in)

Front Toe Adjustment

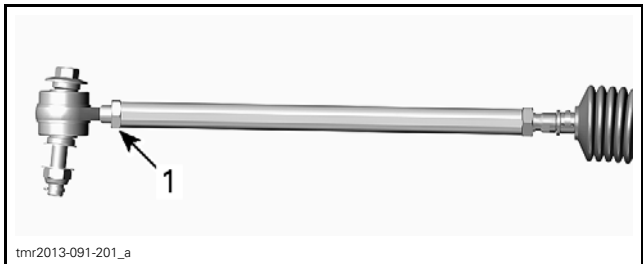
1. If the front wheel toe measurement is out of specification lock steering wheel at center.

2. Measure the distance between vehicle center and each wheel.



DISTANCE BETWEEN VEHICLE CENTER AND WHEEL

3. Loosen tie-rod end locking nut.



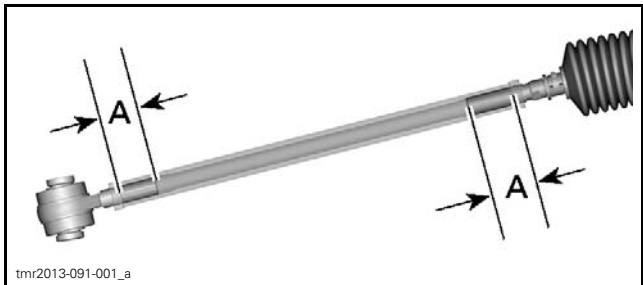
FRONT TIE ROD ASSEMBLY
1. Tie rod end locking nut

4. Turn tie-rod adjustment sleeve until distance measured in step 2 is equal for each wheel.

NOTE: Adjustment sleeve and inner tie rod will turn together.

⚠ WARNING

The minimum inner tie-rod and tie rod end engagement in adjustment sleeve must be 25 mm (1 in).



FRONT TIE ROD ASSEMBLY
A. Minimum engagement length

5. Tighten tie-rod adjustment sleeve locking nuts to specification.

TIGHTENING TORQUE	
Tie rod end locking nut	34 N•m ± 2 N•m (25 lbf•ft ± 1 lbf•ft)

6. Recheck that vehicle toe is within limits by repeating procedure.

TROUBLESHOOTING

UNEQUAL TURNING RADIUS

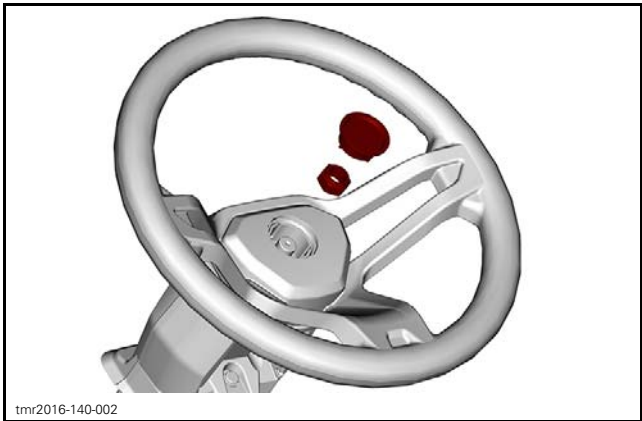
- 1. Rack and pinion not centered during steering system parts installation.
- Refer to *ALIGNING THE WHEELS* in this subsection.

PROCEDURES

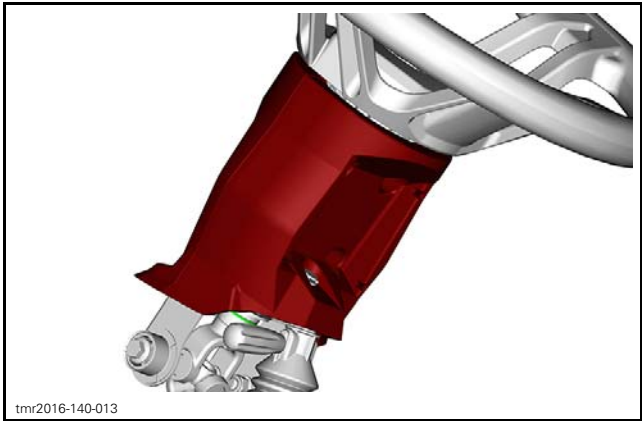
STEERING WHEEL

Removing the Steering Wheel

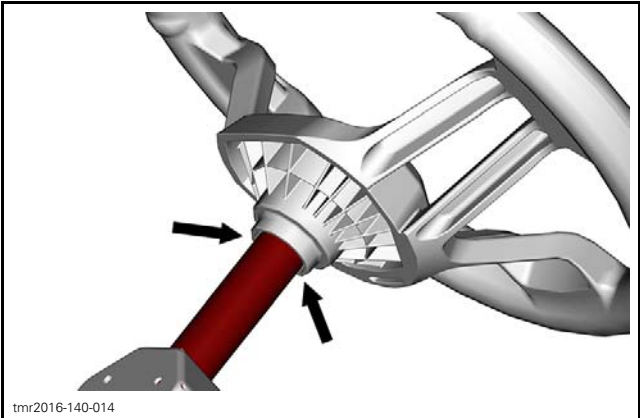
- 1. Remove steering wheel center cap and nut.



- 2. Remove the cover.



- 3. Use a suitable wheel extractor that sits on the steering wheel shoulder, around the pivot tube, to remove the steering wheel.



Installing the Steering Wheel

The installation is the reverse of the removal procedure. However, pay attention to the following. Install a new nut and tighten to specification.

TIGHTENING TORQUE	
Steering wheel nut	60 N•m ± 5 N•m (44 lbf•ft ± 4 lbf•ft)

STEERING COLUMN

Removing the Steering Column

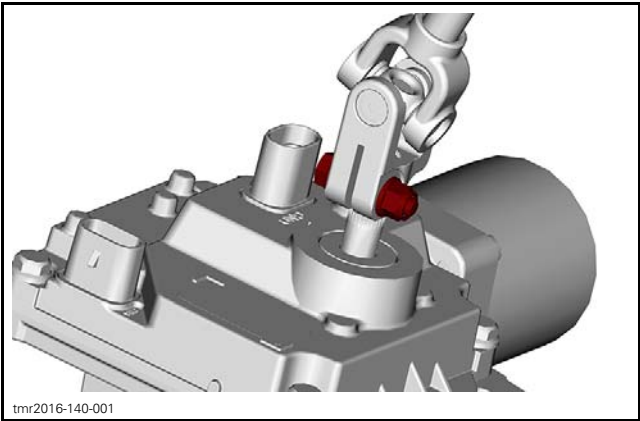
- 1. Position the front wheels parallel to the rear wheels.

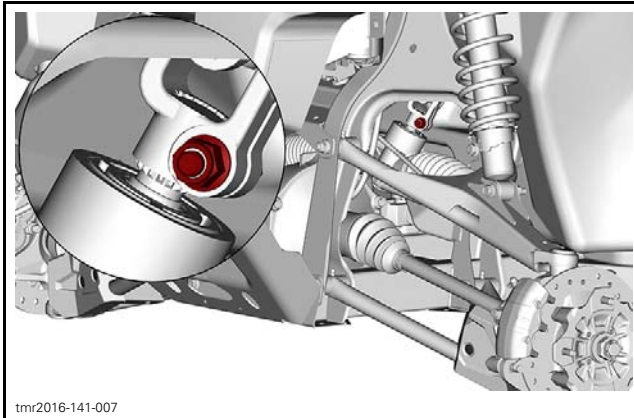
Models without DPS

- 2. Remove both front wheels.

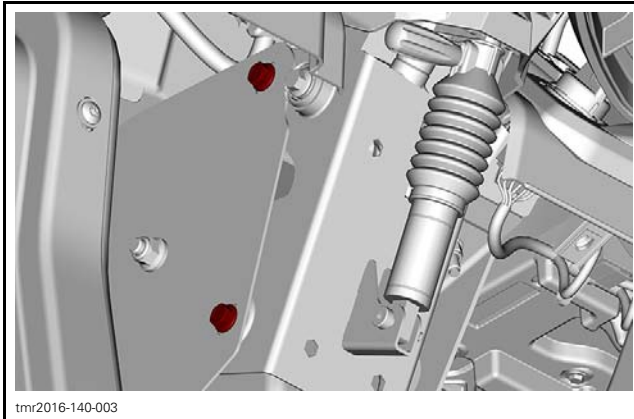
All Models

- 3. Remove the LH and RH lower dash boards. Refer to *BODY* subsection.
- 4. Remove bolt and nut securing lower U-joint to:
 - DPS unit input shaft, if equipped
 - Rack and pinion shaft (no DPS).





5. Remove screws on each side of the steering support.



6. Remove steering column from vehicle.
7. Remove steering support and cover if required.

Inspecting the Steering Column

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.

Ensure steering shaft O-rings are not worn, brittle, hard or otherwise damaged.

Replace if necessary.

Installing the Steering Column

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

Prior to installing the steering column, position front wheels parallel with longitudinal axis of the vehicle.

Refer to exploded view for proper grease and anti-seize application.

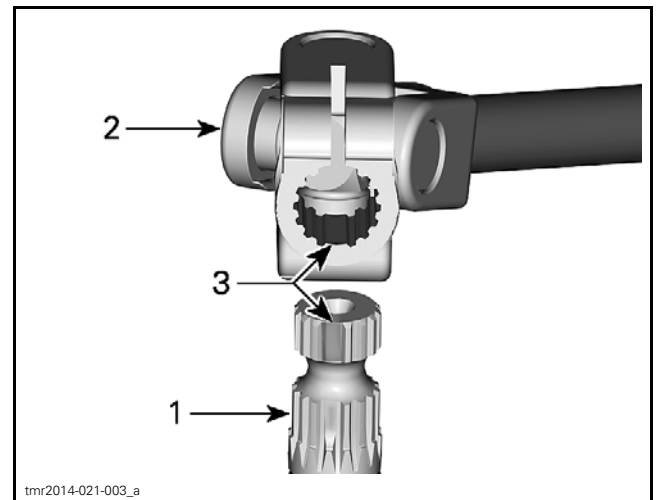
SERVICE PRODUCT REQUIRED

LOCTITE 767 (ANTISEIZE LUBRICANT)
(P/N 293 800 070)

XPS SYNTHETIC GREASE (P/N 293 550 010)

Model with DPS

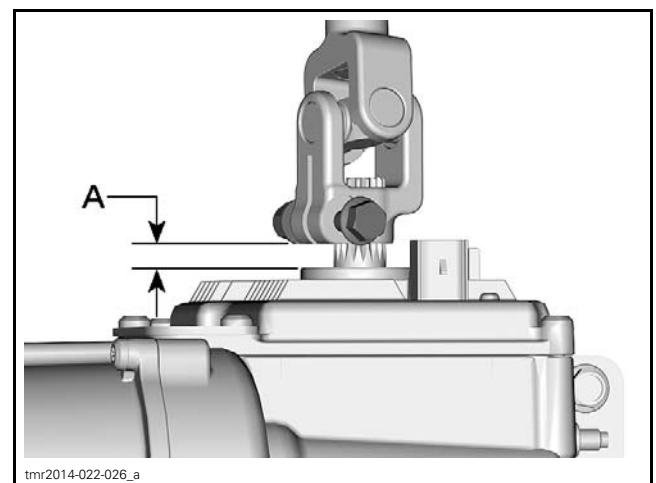
NOTE: Make sure to match blind spline between the DPS input shaft and the steering column lower U-joint.



1. DPS input shaft
2. Lower steering column U-joint
3. Blind splines (alignment keys)

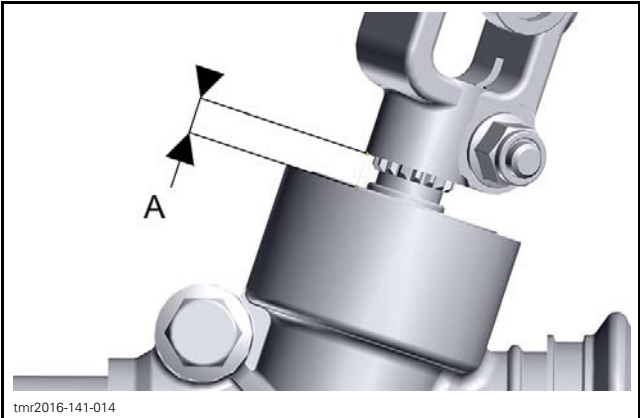
All Models

IMPORTANT: Before tightening lower U-joint bolt on steering column, ensure the following measurements for the steering column engagement depth.



WITH DPS

- A. Steering column engagement depth



WITHOUT DPS
A. Steering column engagement depth

STEERING COLUMN ENGAGEMENT DEPTH	
MODEL	MAXIMUM DISTANCE
With DPS	22 mm (.866 in)
Without DPS	11 mm (.433 in)

Check front wheel alignment. Refer to *ALIGNING THE WHEELS* in this subsection.

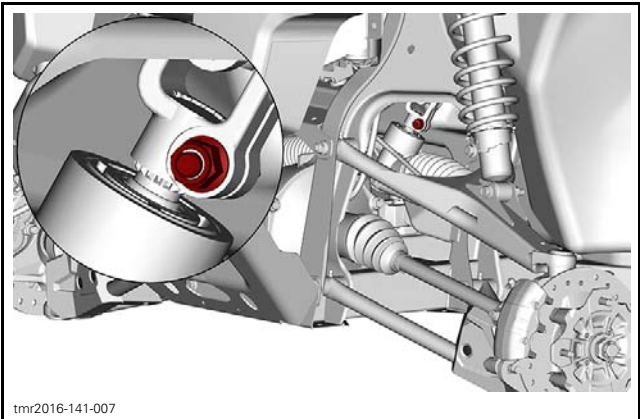
RACK AND PINION

Servicing the Rack and Pinion

The rack and pinion cannot be serviced except for replacement of the boots and tie rods.

Removing the Rack and Pinion

- 1. Remove both front wheels.
- 2. Detach tie-rod ends from knuckles. Refer to *REPLACING THE TIE ROD END* in this subsection.
- 3. Remove the lower yoke pinch bolt and nut.



- 4. Remove the bolts and nuts securing rack and pinion to frame.
- 5. Disengage the rack and pinion shaft from the lower yoke.

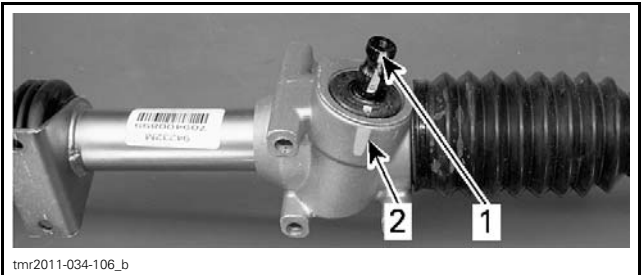
- 6. From the LH side, remove rack and pinion from vehicle.

Installing the Rack and Pinion

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. Alignment mark on pinion
2. Alignment mark on rack housing

Ensure steering wheel is centered (horizontal).

Apply antiseize on pinion shaft.

Position rack and pinion in frame and engage pinion in lower yoke. Make sure steering wheel remains centered.

Install rack and pinion retaining bolts and nuts.

Install lower yoke pinch bolt and nut.

Check steering alignment. Refer to *ALIGNING THE WHEELS* in this subsection.

TIE ROD ADJUSTMENT SLEEVE

Always perform a thorough inspection before replacing a tie rod adjustment sleeve. If any other components of the steering or suspension systems are damaged, replace the component(s).

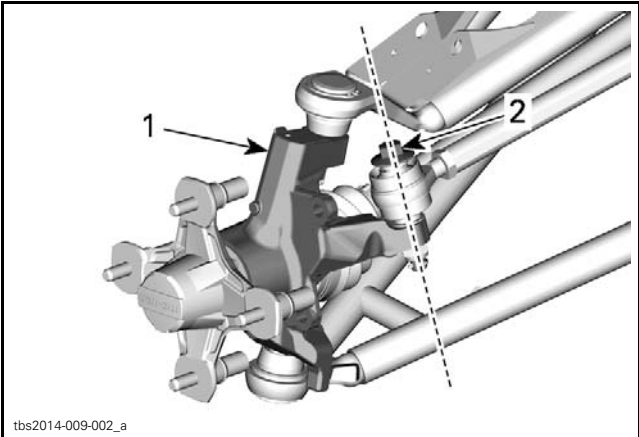
Inspecting the Steering components

Before removing any components:

- 1. Raise front wheels off the ground.
- 2. Turn steering wheel from stop to stop.
- 3. Ensure steering wheel turns smoothly.

Before replacing the tie rod adjustment sleeve, inspect the following:

- Knuckle must not be cracked
- Tie rod end bolt must not be bent

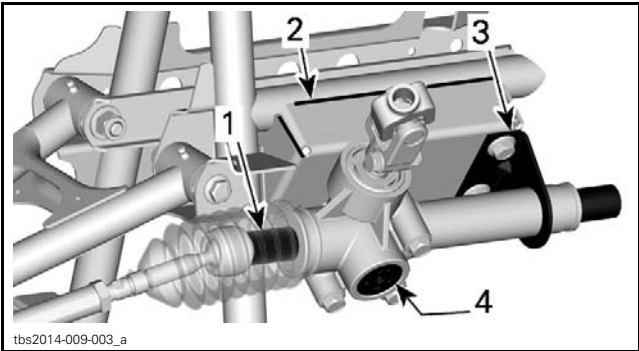


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TYPICAL

- 1. Knuckle
- 2. Tie rod end bolt

- Rack and pinion shaft must not be loose
- Frame welds must be intact
- Rack and pinion mounting bracket must not be cracked or deformed
- Rack and pinion cap must not be popped outward and should be square with the rack and pinion housing.



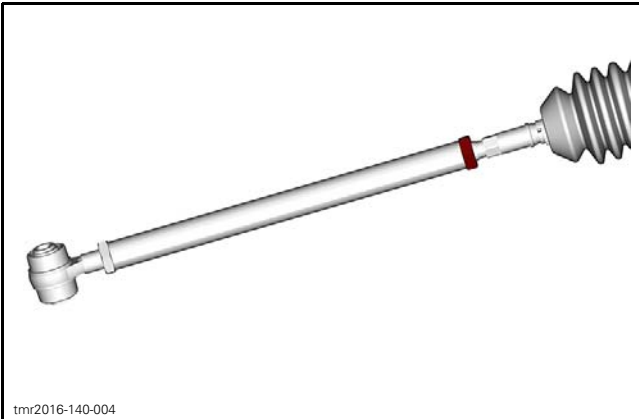
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TYPICAL

- 1. Rack and pinion shaft
- 2. Frame welds
- 3. Rack and pinion mounting bracket
- 4. Rack and pinion cap

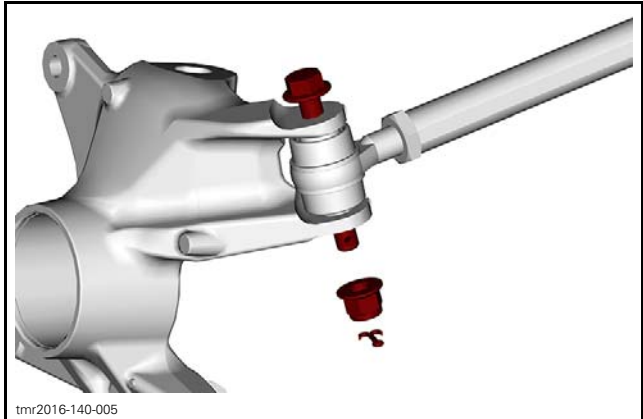
Removing the Tie Rod

- 1. Loosen inner tie rod adjustment sleeve locking nut.



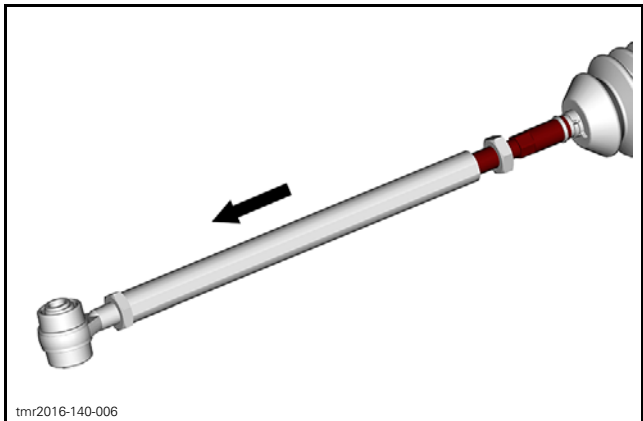
tmr2016-140-004

- 2. Remove tie rod end bolt.



tmr2016-140-005

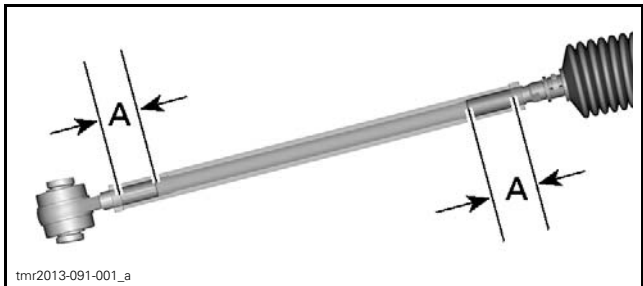
- 3. Hold inner tie rod and unscrew tie rod adjustment sleeve.



tmr2016-140-006

Installing the Tie Rod

The installation is the reverse of the removal procedure. However, pay attention to the following. Adjust inner and outer tie rods to the nominal engagement length.



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A. Tie rod engagement length

NOMINAL TIE ROD ENGAGEMENT LENGTH A
32 mm (1-1/4 in)



WARNING

The minimum tie-rod engagement length at both ends must be 25 mm (1 in).

1. Lock inner locking nut.

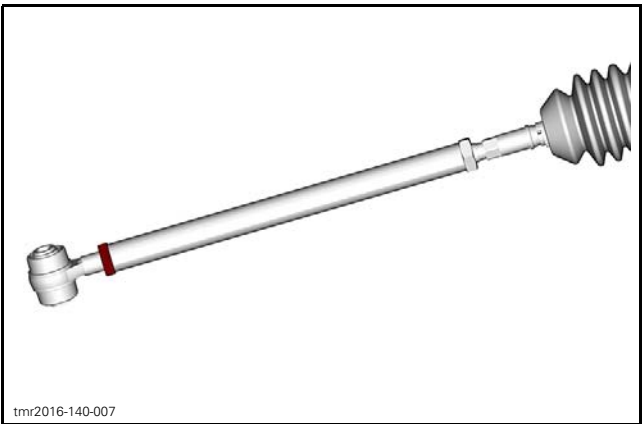
TIGHTENING TORQUE	
Tie rod locking nut	34 N•m ± 2 N•m (25 lbf•ft ± 1 lbf•ft)

Align vehicle. Refer to *ALIGNING THE WHEELS* in this subsection.

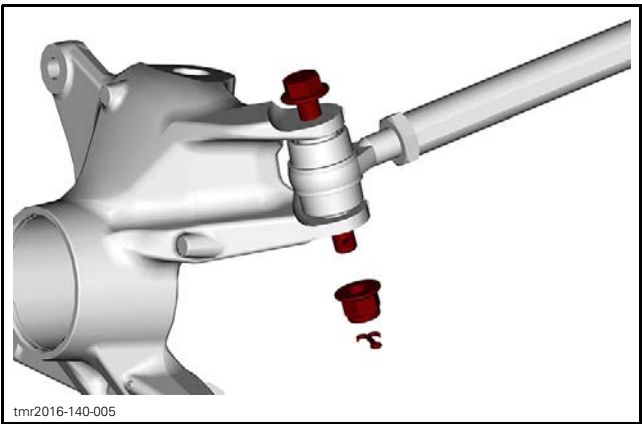
TIE-ROD ENDS

Replacing the Tie-Rod End

- 1. Remove front wheel.
- 2. Loosen tie rod locking nut.

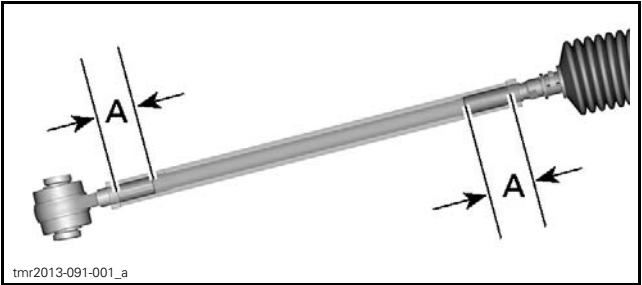


3. Detach tie-rod end.



- 4. Install new tie-rod end.
- 5. Adjust tie-rod end to the nominal engagement length.

NOTE: The tie rod must be engaged the same amount at both ends for the tie-rod adjustment to be centered.



RH TIE ROD ASSEMBLY SHOWN
A. Nominal engagement length

TIE-ROD END NOMINAL ENGAGEMENT LENGTH A
32 mm (1-1/4 in)



WARNING

The minimum tie-rod engagement length at both ends must be 25 mm (1 in).

6. Tighten tie-rod end locking nut to specification.

TIGHTENING TORQUE	
Tie rod end locking nut	34 N•m ± 2 N•m (25 lbf•ft ± 1 lbf•ft)

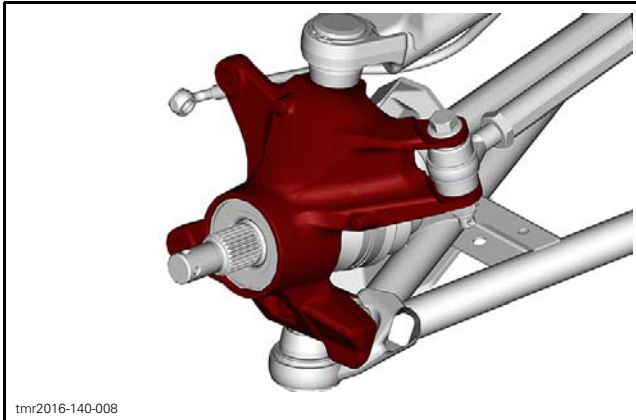
- 7. Attach tie-rod end to steering knuckle.
- 8. Install a new tie-rod end retaining nut and tighten to specification.

TIGHTENING TORQUE	
Tie rod end retaining nut	48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

- 9. Install a new cotter pin. Both ends of cotter pins must be folded.
- 10. Install front wheel.
- 11. Check steering alignment, refer to *ALIGNING THE WHEELS* in this subsection.

KNUCKLES

Removing the Knuckle



Remove front wheel.

1. Remove caliper, refer to *BRAKES* subsection.
2. Remove wheel hub, refer to *FRONT DRIVE* subsection.
3. Detach tie-rod end from knuckle (front knuckles). Refer to *TIE-ROD ENDS* in this subsection.
4. Detach upper and lower suspension arm from knuckle. Refer to *FRONT SUSPENSION* subsection.
5. Remove knuckle from vehicle.

Inspecting the Knuckle

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

Installing the Knuckle

The installation is the reverse of the removal procedure.

WHEEL BEARINGS

Inspecting the Wheel Bearing (Maintenance)

Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

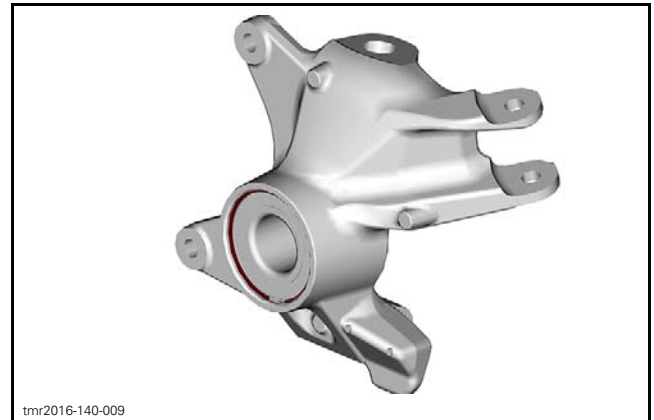
Inspecting the Wheel Bearing (During Component Removal)

Whenever the drive axle or knuckle is removed, check if wheel bearing turns freely and smoothly.
Replace if necessary.

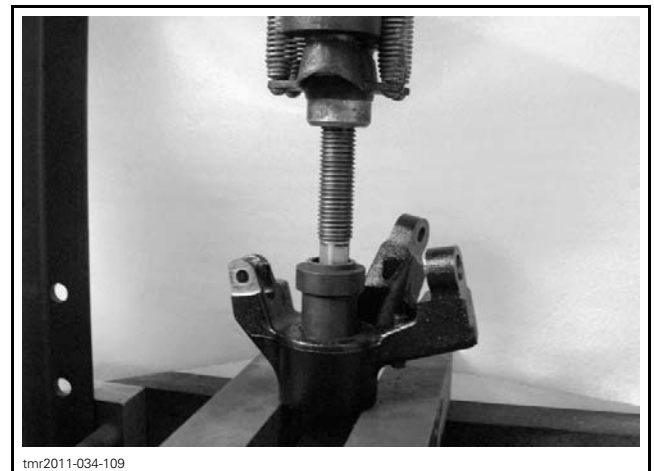
Removing the Wheel Bearing

1. Remove knuckle from vehicle, refer to *REMOVING THE KNUCKLE* in this subsection.

2. Remove and discard circlip.



3. Install knuckle on a press.
4. Remove bearing from knuckle with an appropriate bearing remover.



TYPICAL

NOTE: Heat the knuckle to ease bearing removal.

⚠ WARNING

Clean all grease, outside and inside, from knuckle before heating it.

Installing the Wheel Bearing

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.

STORAGE PROCEDURE

SERVICE PRODUCTS

Description	Part Number	Page
BRP HEAVY DUTY CLEANER	293 110 001	2
XPS ALL PURPOSE CLEANER	219 701 709	2
XPS FUEL STABILIZER.....	413 408 601	1
XPS LUBE.....	293 600 016	2
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 spark plugs.
2. 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)

3. Crank the engine over, 1 or 2 seconds maximum, to lubricate cylinders.

4. Reinstall the spark plugs.

NOTE: Do not run engine during storage period.

5. Block muffler outlet, engine air inlet and CVT outlet with a rags.

NOTICE To avoid causing damage to vehicle, use memory aid to make sure rags are removed from their installed location.

CVT Protection

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

Close CVT cover.

Block CVT outlet with a rag.

NOTE: To reach the CVT outlet, detach it from exhaust heat shield.

ELECTRICAL SYSTEM

Battery Removal

Remove the battery.

Charge and store battery.

CHASSIS

Lubrication

Lubricate front and rear suspension and rear sway bar.

Subsection XX (STORAGE PROCEDURE)

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.

VEHICLES

EXHAUST SYSTEM				
Exhaust system			Spark arrestor approved by USDA Forest Service	
ELECTRICAL SYSTEM				
Battery	Type		SLA (Sealed Lead Acid)	
	Voltage		12 volts	
	Nominal rating	Base Convenience DPS	18 A•h	
		XT XT with cab	30 A•h	
	Power starter output		0.7 KW	
Headlight		HIGH	4 x 35 H 8	
		LOW	2 x 35 H 8	
Taillight			2.3/3.5 W	
Fuses	DPS		F2	40 A
	4 WD actuator		F7	10 A
	Accessory post		F10	40 A
	Headlamps		F11	20 A
	DC3/12V accessory outlet 1		F12	20 A
	Relay driver/Gauge clock		F13	10 A
	12 V accessory outlet 2		F14	20 A
	Diagnostic connector		F15	30 A
	Tail lamps		F16	10 A
	Headlamp configuration		JCT	20 A
	Accessory post 12V/outlet 2		R9	70 A

Subsection XX (VEHICLES)

ELECTRICAL SYSTEM			
Fuses (cont'd)	ECM accessory 12V	R3	50 A
	Brake	R8	30 A
	Spare	Spare1	20 A
	Cluster/DPS/relays	F4	10 A
	Ignition/injection/fuel pump	F5	10 A
	Engine Control Module (ECM)	F6	10 A
	Key switch	F8	10 A
	Cooling fan	F9	25 A (PTC auto resettable)
	Fan	R1	30 A
	Main	R2	20 A
	Spare	Spare2	10 A
	Main	FL1	18 awg
	Accessory post	FL2	14 awg

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)
Idle speed			1250 RPM ± 100 (not adjustable)
Fuel	Type		Regular unleaded gasoline
	Octane rating	Inside North America	87 (R+M)/2 or higher
		Outside North America	92 RON or higher
Fuel tank capacity			40.2 L (10.6 U.S. gal.)
Fuel remaining when low fuel light turns ON			± 8.5 L (2.2 U.S. gal.)

DRIVE SYSTEM		
Front drive	Base and Convenience	Spiral bevel gear Visco-lok† front differential
	All models except Base and Convenience	Spiral bevel gear Visco-lok† QE front differential
Front drive ratio		3.6:1
Rear drive	Base models	no open rear differential switch
	All models except Base models	Lockable differential

DRIVE SYSTEM		
Rear drive ratio		3.43:1
Front differential oil	Capacity	400 ml (14 U.S. oz)
	Recommended	XPS synthetic gear oil (P/N 293 600 043) or synthetic gear oil 75W90 API GL-5
CV joint grease		CV joint grease (P/N 293 550 019)
Propeller shaft grease for spline connections		Grease applied to the spline connection. Apply grease 293550010 on splines

STEERING		
Type		Rack and pinion
Assisted steering system	All except base and convenience	Dynamic Power Steering (DPS)
Steering wheel		Adjustable tilt steering
Turning radius		3.98 m (13.06 ft)
Total toe (vehicle on ground)		0° ± 0.2°
Camber angle (vehicle on ground)		0°
Tie-rod maximum length unengaged threads		32 mm (1.26 in)

FRONT SUSPENSION		
Suspension type		Double A-arm suspension
Suspension travel		254 mm (10 in)
Shock absorber	Qty	2
	Type	Oil
Spring free length		355.6 mm (14 in)
Preload adjustment type		5 positions cam

REAR SUSPENSION		
Suspension type		Torsional Trailing A-arms (TTA) suspension
Suspension travel		254 mm (10 in)
Shock absorber	Qty	2
	Type	Oil
Spring free length		358 mm (14.09 in)
Preload adjustment type		5 positions cam

BRAKES		
Front brake	Qty	2
	Type	220 mm ventilated disc brakes with hydraulic twin-piston calipers

Subsection XX (VEHICLES)

BRAKES		
Rear brake	Qty	2
	Type	220 mm ventilated disc brake with hydraulic single-piston calipers
Brake fluid	Capacity	250 ml (8.5 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)

TIRE			
Pressure		Front	97 kPa (14 PSI)
		Rear	124 kPa (18 PSI)
Minimum tire thread depth			3 mm (.118 in)
Size	Front	Base Convenience	25 x 8 x 12 (in)
		DPS	25 x 8 x 12 (in)
		XT	27 x 9 x 14 (in)
	Rear	Base Convenience	25 x 10 x 12 (in)
		DPS	25 x 10 x 12 (in)
		XT	27 x 11 x 14 (in)

WHEELS			
Type		Base Convenience	Steel
		DPS	Cast Aluminum
		XT	Cast Aluminum
Rim size	Front	Base Convenience	12 x 6 (in)
		DPS	12 x 6 (in)
		XT	14 x 7 (in)
		XT with cab	14 x 6.5 (in)
	Rear	Base Convenience	12 x 8 (in)
		DPS	12 x 7.5 (in)
		XT	14 x 8.5 (in)
		XT with cab	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
Hitch support			50.8 mm (2 in) x 50.8 mm (2 in)
DIMENSION			
Overall length			305 cm (120 in)
Overall width		Base Convenience DPS XT	157.7 cm (62 in)
		XT with cab	170 cm (66 in)
Overall height		Base Convenience DPS XT with cab	193 cm (76 in)
		XT	198.1 cm (78 in)
Wheel base			211.5 cm (83 in)
Wheel track	Front	Base Convenience DPS	130 cm (51 in)
		XT	131 cm (51.5 in)
		XT with cab	140 cm (55 in)
	Rear	Base Convenience DPS XT	126 cm (49.5 in)
		XT with cab	132 cm (52 in)
Ground clearance		All models except XT with cab	28 cm (11 in)
		XT with cab	23 cm (9 in)
WEIGHT AND LOADING CAPACITY			
Dry weight		Base Convenience	632.7 kg (1,395 lb)
		DPS	641.4 kg (1,414 lb)
		XT	703 kg (1,550 lb)
		XT with cab	826.4 kg (1,822 lb)
Weight distribution	Front/rear	Base Convenience DPS	42/58
		XT	44/56
		XT with cab	47/53

Subsection XX (VEHICLES)

WEIGHT AND LOADING CAPACITY		
Cargo box capacity	All models except California	454 kg (1,000 lb)
	California models	272 kg (600 lb)
Total vehicle load allowed (including driver, passengers, all other loads and added accessories)	All models except XT with cab and California models	680 kg (1,500 lb)
	XT with cab and California model	545 kg (1,200 lb)
Gross vehicle weight rating	Base Convenience	1 345 kg (2,965 lb)
	DPS	1 350 kg (2,976 lb)
	XT XT with cab	1 410 kg (3,109 lb)
Towing capacity		907 kg (2,000 lb)
Tongue capacity		68 kg (150 lb)

ENGINES

ENGINE			
Engine type		HD8	ROTAX® 810, 4-stroke, 2 cylinders (V-twin), liquid cooled
		HD10	ROTAX® 1010, 4-stroke, 2 cylinders (V-twin), liquid cooled
Valve train			4 valves/cylinder (mechanical adjustment), Single Over Head Camshaft (SOHC) with timing chain
Bore			91 mm (3.58 in)
Stroke		HD8	61.5 mm (2.42 in)
		HD10	75 mm (2.95 in)
Displacement		HD8	800 cm³ (48.8 in³)
		HD10	976 cm³ (59.6 in³)
Compression ratio		HD8	10.3:1
		HD10	10.5:1
Maximum HP RPM		HD8	7000 RPM
		HD10	7000 RPM
Air filter			Flat corrugated composite fiber
Intake valve opening			5° BTDC
Intake valve closing		HD8	45° ABDC
		HD10	60° ABDC
Exhaust valve opening		HD8	55° BBDC
		HD10	50° BBDC
Exhaust valve closing		HD8	5° ATDC
		HD10	0° 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)

Subsection XX (ENGINES)

ENGINE			
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	1.80 mm (.071 in)
	Exhaust	New	1.25 mm to 1.55 mm (.049 in to .061 in)
		Service limit	2.00 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)
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	90.850 mm (3.5768 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		1 st	Upper compression ring, rectangular
		2 nd	Lower compression ring, tapered face
		3 rd	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)

ENGINE				
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	HD8	New	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)
			Service limit	32.870 mm (1.2941 in)
		HD10	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	HD8	New	31.730 mm to 31.930 mm (1.2492 in to 1.2571 in)
			Service limit	31.710 mm (1.2484 in)
		HD10	New	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)
			Service limit	32.930 mm (1.2965 in)

Subsection XX (ENGINES)

ENGINE			
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 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	HD8	New	40.001 mm to 40.025 mm (1.5748 in to 1.5758 in)
		Service limit	39.990 mm (1.5744 in)
	HD10	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	HD8	Service limit	40.100 mm (1.5787 in)
	HD10		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	HD8	New	0.200 mm to 0.500 mm (.008 in to .02 in)
		Service limit	0.600 mm (.024 in)
	HD10	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	HD8	New	20.010 mm to 20.020 mm (.7878 in to .7882 in)
		Service limit	20.060 mm (.7898 in)
	HD10	New	22.010 mm to 22.020 mm (.8665 in to .8669 in)
		Service limit	22.050 mm (.8681 in)

ENGINE			
Piston pin diameter	HD8	New	19.996 mm to 20.000 mm (.7872 in to .7874 in)
		Service limit	19.980 mm (786.614 in)
	HD10	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. Replaceable cartridge oil filter	
Oil filter		BRP Rotax paper type, replaceable	
Engine oil pressure		Minimum	300 kPa (44 PSI) at 6000 RPM
Engine oil	Capacity (oil change with filter)		2 L (2.11 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 (winter grade) (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
Oil pressure regulator spring free length		New	39 mm (1.535 in)
		Service limit	37 mm (1.457 in)
Clearance of inner and outer oil pump rotor		Service limit	0.25 mm (.0098 in)
Oil pump axial clearance		Service limit	0.20 mm (.0079 in)

COOLING SYSTEM			
Coolant	Type		Ethyl glycol/water mix (50%/50%). Use premixed coolant sold by BRP LONG LIFE ANTIFREEZE (P/N 219 702 685) or coolant specifically designed for aluminum engines
	Capacity	HD8	3.9 L (1 U.S. gal.)
		HD10	4.3 L (1.1 U.S. gal.)
Thermostat	Starts to open		65°C (149°F)
	Fully open	HD8	75°C (167°F)
		HD10	88°C (190°F)
Radiator cap opening pressure			110 kPa (16 PSI)

Subsection XX (ENGINES)

TRANSMISSION		
Type	CVT (Continuously Variable Transmission)	
Engagement RPM	1750 ± 100 RPM	
Drive belt width	Service limit	36.7 mm (1.445 in)
Governor cup roller outer diameter	New	13.80 mm to 14.00 mm (.543 in to .551 in)
	Service limit	13.20 mm (.52 in)
Governor cup roller inner diameter	New	8.025 mm to 8.175 mm (.3159 in to .3219 in)
	Service limit	9.000 mm (.3543 in)
Centrifugal lever pivot bolt diameter	New	6.063 mm to 6.091 mm (.2387 in to .2398 in)
	Service limit	6.000 mm (.2362 in)
Centrifugal lever bore diameter	New	6.000 mm to 6.120 mm (.236 in to .241 in)
	Service limit	6.200 mm (.244 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	46.950 mm to 47.130 mm (1.848 in to 1.856 in)
	Service limit	47.160 mm (1.857 in)
Drive pulley sliding half small bushing	New	32.010 mm to 32.135 mm (1.26 in to 1.265 in)
	Service limit	32.200 mm (1.268 in)
Driven pulley inner half bushing	New	41.278 mm to 41.363 mm (1.625 in to 1.628 in)
	Service limit	41.420 mm (1.631 in)
Driven pulley cam	New	41.278 mm to 41.363 mm (1.625 in to 1.628 in)
	Service limit	41.420 mm (1.631 in)

GEARBOX		
Type	Dual range (HI-LO) with park, neutral and reverse	
Gear ratios	Angle drive sub-transmission	37/15 = 2.467
	Intermediate	45/44 = 1.023
	High	36/27 = 1.333
	Low	44/19 = 2.316
	Reverse	34/12 = 2.833

GEARBOX			
Overall gear ratios		High	3.364
		Low	5.842
		Reverse	7.148
Gearbox oil		Capacity	1.25 L (42.27 U.S. oz)
		Recommended	XPS synthetic gear oil (P/N 293 600 140) or a 75W140 API GL-5 synthetic gearbox 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)
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	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			650 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

Subsection XX (ENGINES)

ELECTRICAL SYSTEM		
Spark plug	Quantity	2
	Make and type	NGK DCPR8E
	Gap	0.6 mm to 0.7 mm (.024 in to .028 in)
Engine RPM limiter setting	Forward	8000 RPM
	Reverse	20 km/h to 25 km/h (12 MPH to 16 MPH) (8000 RPM with Override)

TIMING CHAIN

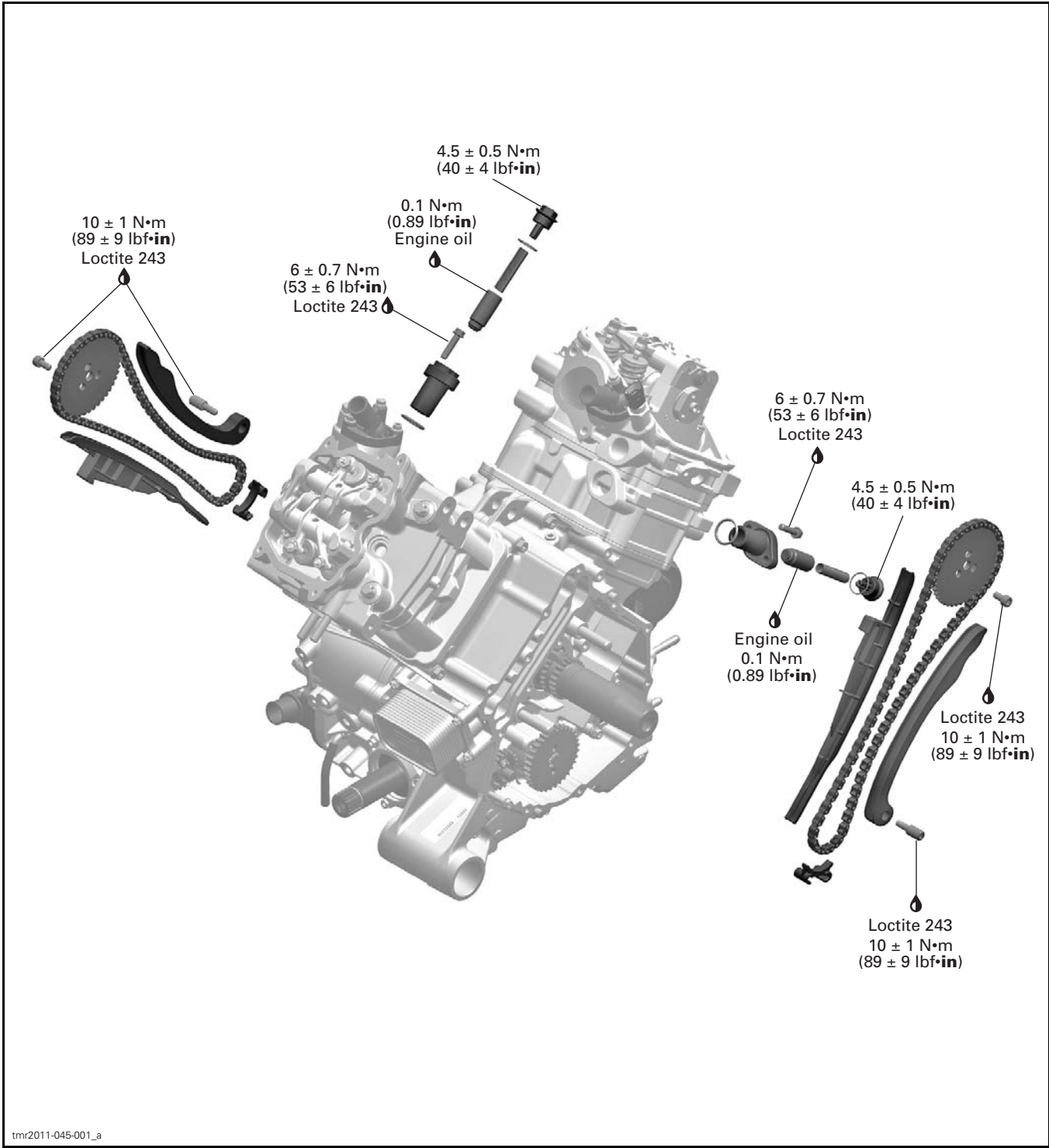
SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT TIMING TOOL.....	529 036 231	7
CAMSHAFT TIMING TOOL.....	529 036 268	6
CRANKSHAFT TDC POSITION TOOL.....	529 036 201	9

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE).....	293 800 060	7, 12

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.*

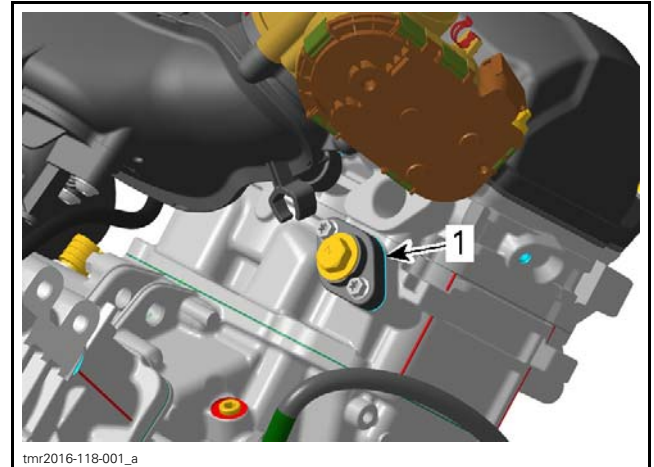
PROCEDURES

TIMING CHAIN TENSIONERS

Timing Chain Tensioner Location

HD8 Engine

The timing chain tensioner is located in the cylinder head.

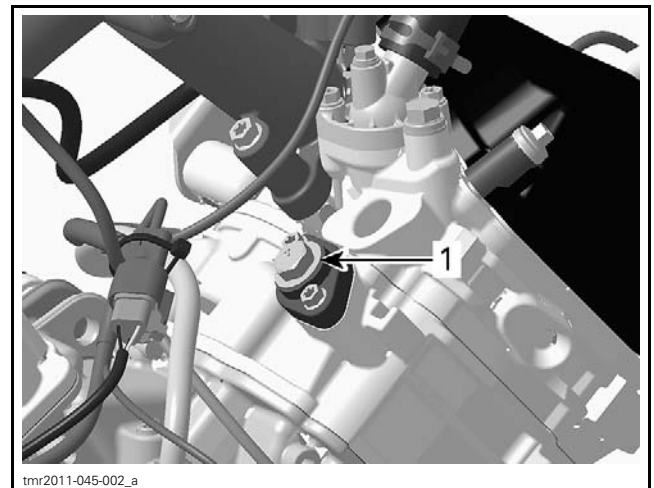


HD8 ENGINE - (FRONT CYLINDER SHOWN)

1. Timing chain tensioner

HD10 Engine

The timing chain tensioner is located in the cylinder.



HD10 ENGINE - (FRONT CYLINDER SHOWN)

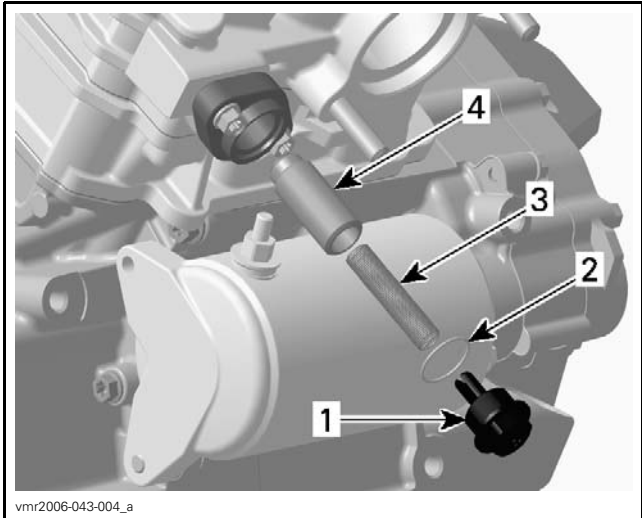
1. Timing chain tensioner

Removing the Timing Chain Tensioner

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.

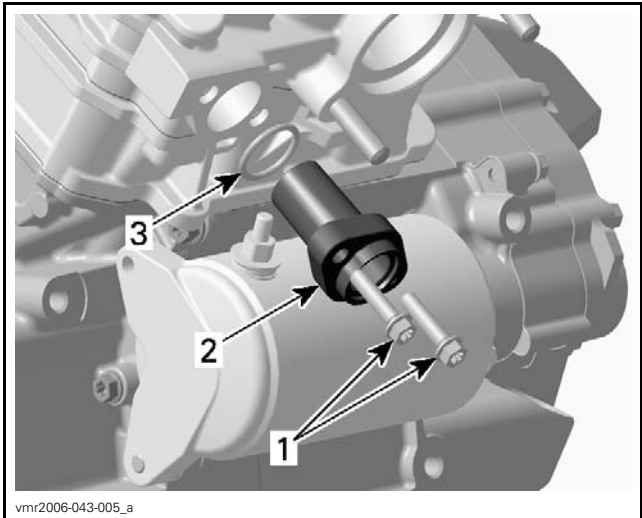
⚠ CAUTION Tensioner is spring loaded.

3. Remove:
 - O-ring
 - Spring
 - Chain tensioner plunger.



- 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

Inspecting the Timing Chain Tensioner

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

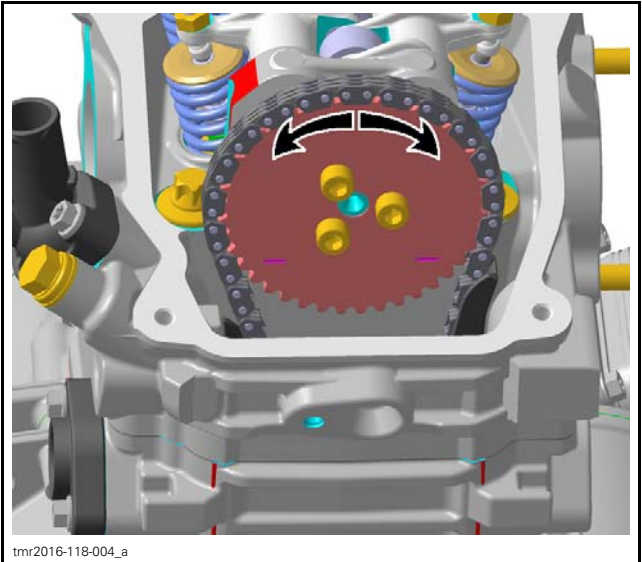
Check chain tensioner plunger for free movement and/or scoring.

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

Check spring condition. Replace if bent, broken or worn.

Installing the Timing Chain Tensioner

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.



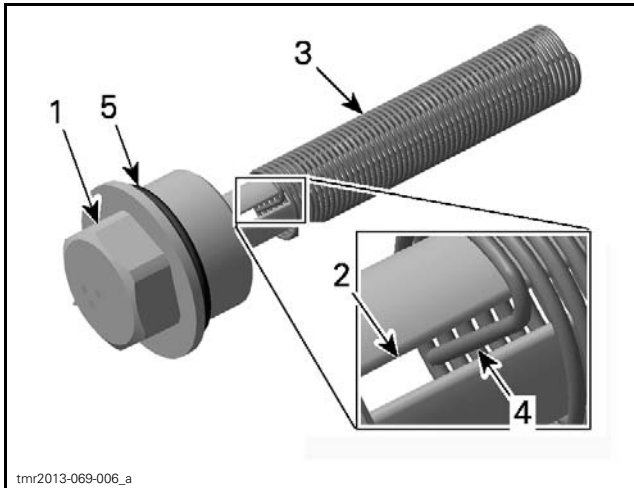
MOVE GEAR BACK AND FORTH

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)

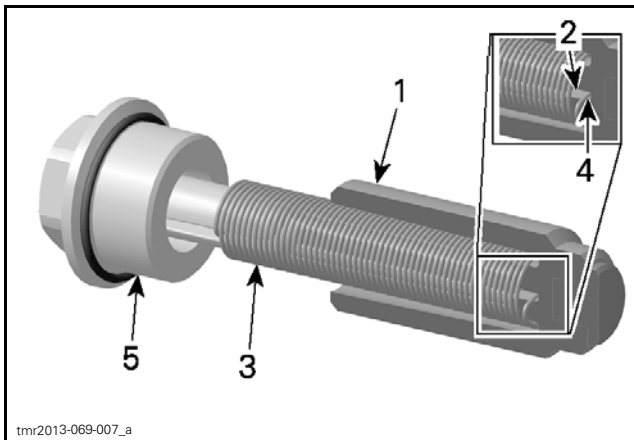
NOTICE Improper adjustment of the timing chain will lead to severe engine damage.

6. Place the O-ring on chain tensioner screw plug.
7. Fit the spring on one side into the slot of the plug.



1. Plug
2. Slot
3. Spring
4. Spring end
5. O-Ring

8. Fit the spring on the other side into the plunger.



FOR CLARITY PARTS ARE REMOVED FROM CYLINDER

1. Plunger
2. Notch
3. Spring
4. Spring end
5. Plug with O-ring

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.

9. 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.

10. Remove locking tool and install all other removed parts.

11. Finally, tighten the plug.

TIGHTENING TORQUE

Chain tensioner plug

4.5 N•m ± 0.5 N•m
(40 lbf•in ± 4 lbf•in)

CAMSHAFT TIMING GEARS

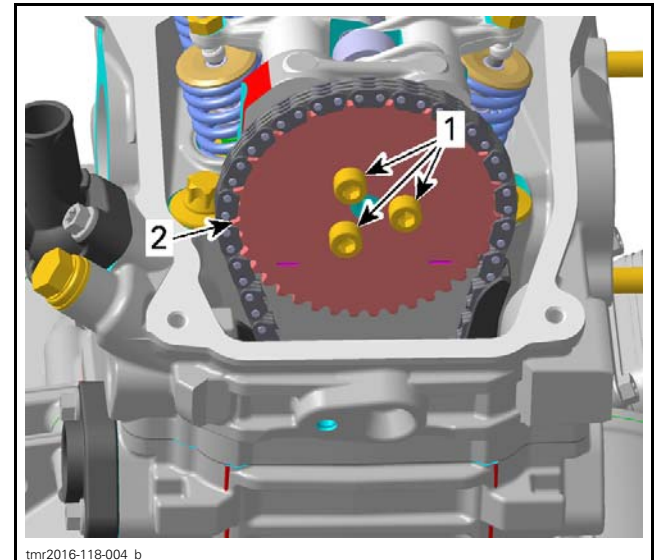
Removing the Camshaft Timing Gear

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 screws.



1. Camshaft timing gear screws
2. Camshaft timing gear

Remove the camshaft timing gear.

NOTE: Secure timing chain with a piece of wire.

Inspecting the Camshaft Timing Gear

Check camshaft timing gear for wear or deterioration.

If gear is worn or damaged, replace it as a set with the timing chain.

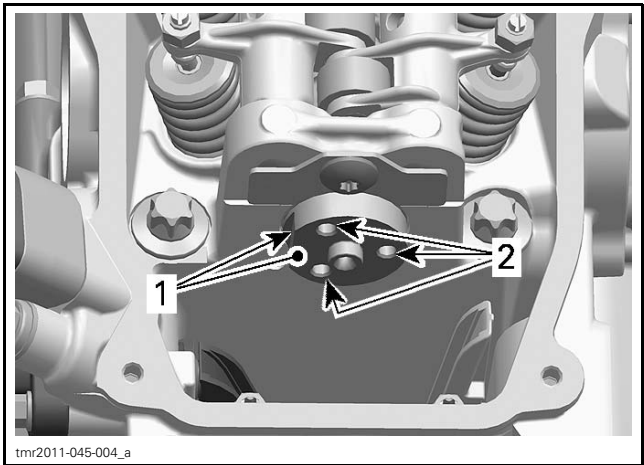
For crankshaft gear, refer to *BOTTOM END* subsection, see *CRANKSHAFT*.

Installing the Camshaft Timing Gear

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.

Subsection XX (TIMING CHAIN)

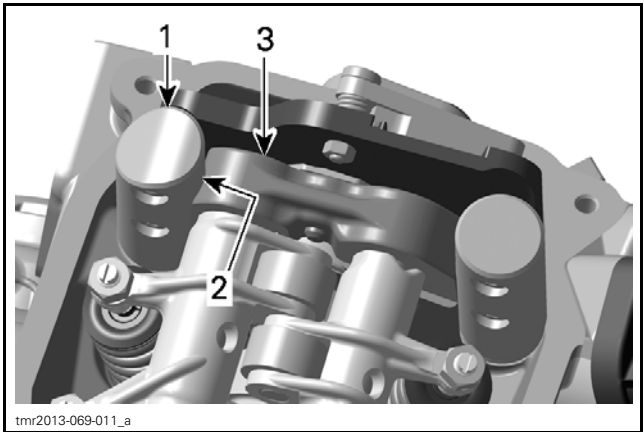


- 1. Mating surface on camshaft
- 2. Threads for camshaft screws

- 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	
ICAMSHAFT TIMING TOOL (P/N 529 036 268)	

NOTE: Align tube of camshaft adjustment tool properly with machined radius on cylinder head.

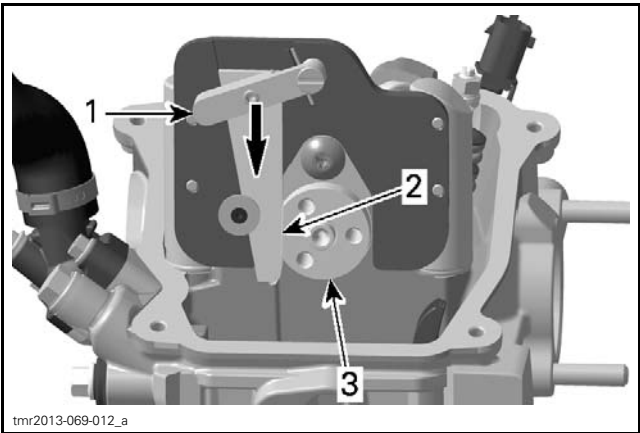


CAMSHAFT TIMING TOOL INSTALLED

- 1. Tube (camshaft adjustment tool)
- 2. Machined radius (camshaft adjustment tool)
- 3. Cylinder head

- 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.



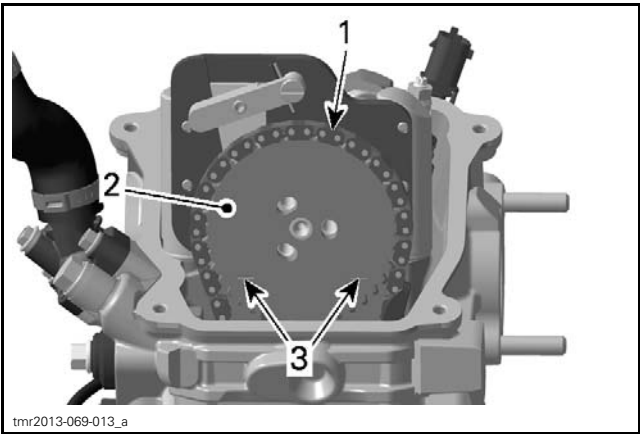
PRESS TOOL LEVER DOWN

- 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.

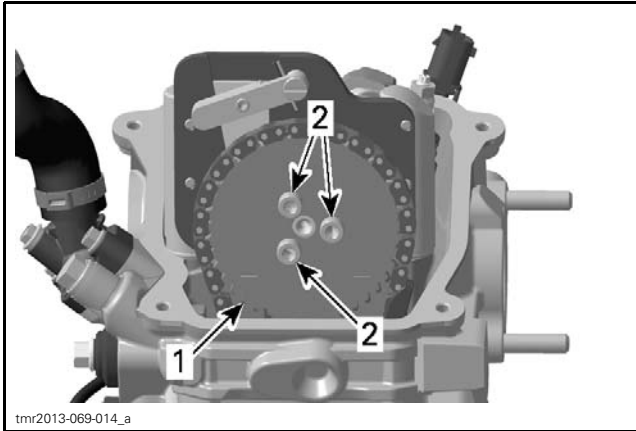
- 5. Place camshaft timing gear along with the timing chain on the camshaft.

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 screws to specified torque.



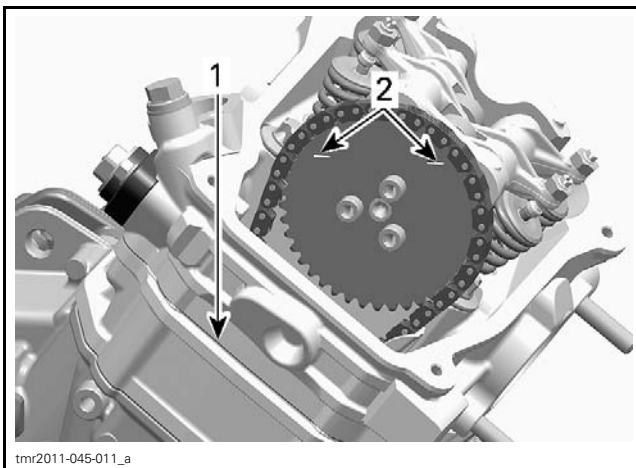
1. Camshaft timing gear
2. Camshaft timing gear screws

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Camshaft timing gear screws	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

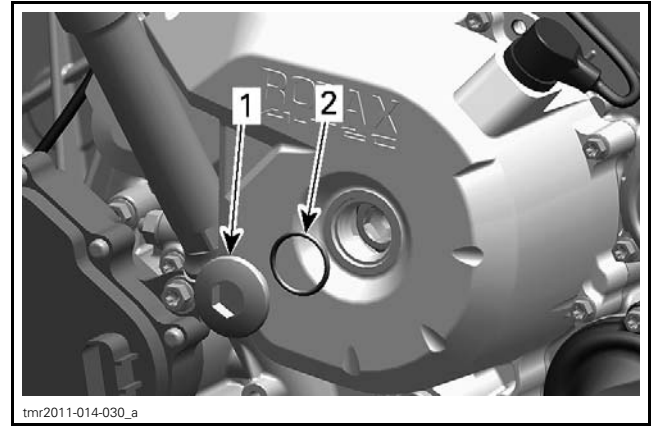
NOTE: If a piston (of cylinder 1 or 2) is set to TDC ignition, the camshaft timing gear of the opposite cylinder must be in the following position.



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

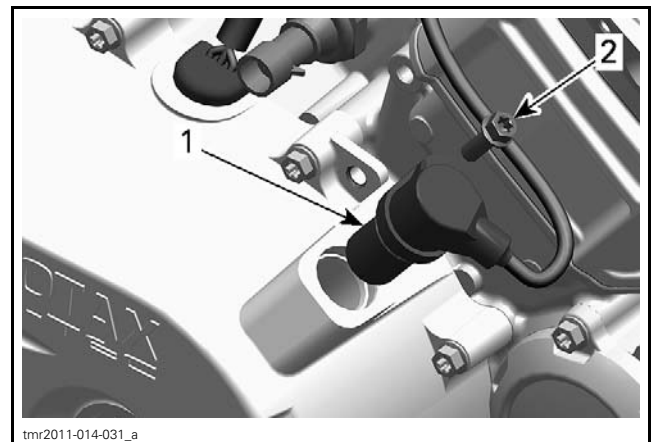
Camshaft Timing Piston No. 2 (rear)

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

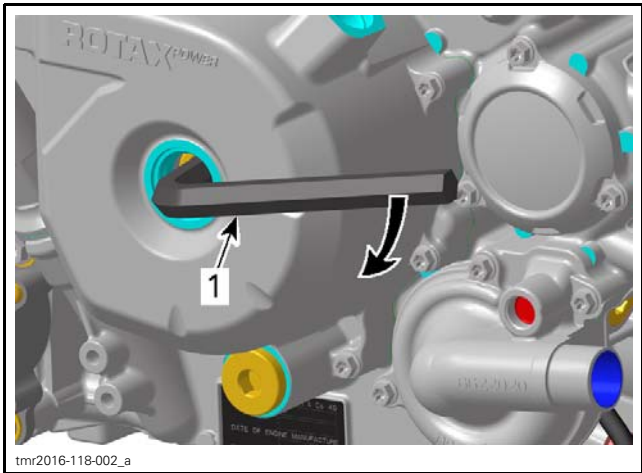
4. Remove the crankshaft position sensor (CPS).



1. CPS
2. Screw

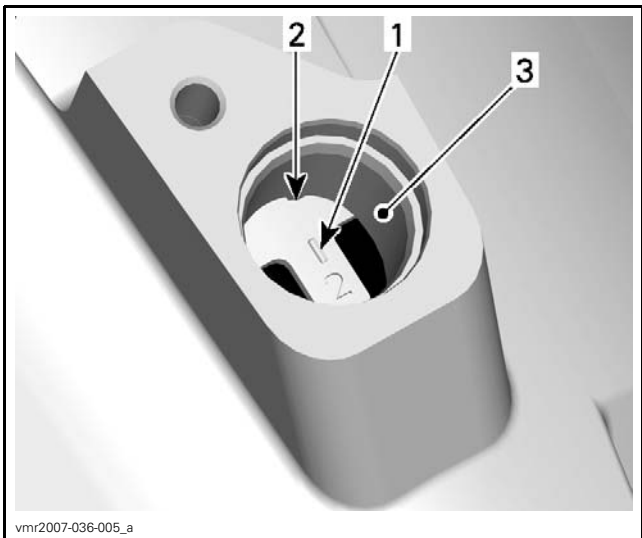
5. Set piston no. 2 to TDC ignition by turning the crankshaft.

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.

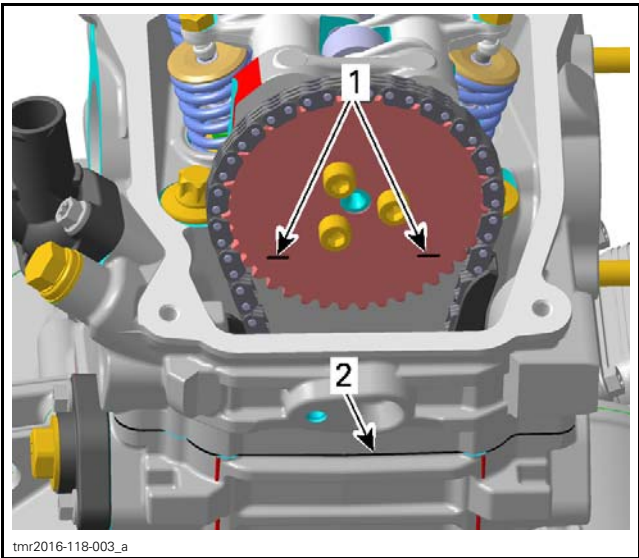


PISTON NO. 2 AT TDC
1. Mark "2" on magneto flywheel
2. Notch on magneto cover
3. Crankshaft position sensor location

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.



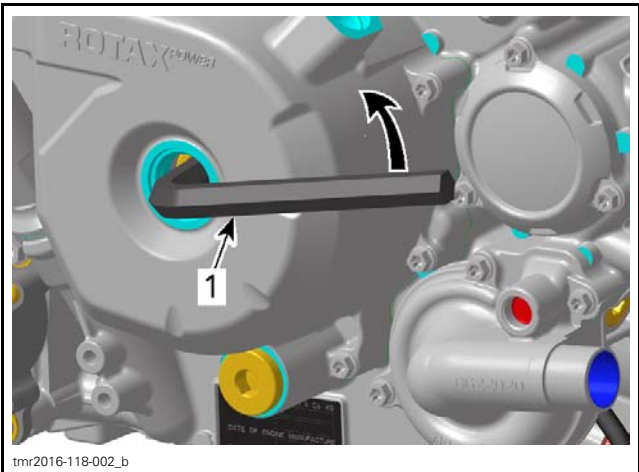
PISTON AT TDC IGNITION
1. Printed marks on camshaft timing gear
2. Cylinder head base

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)

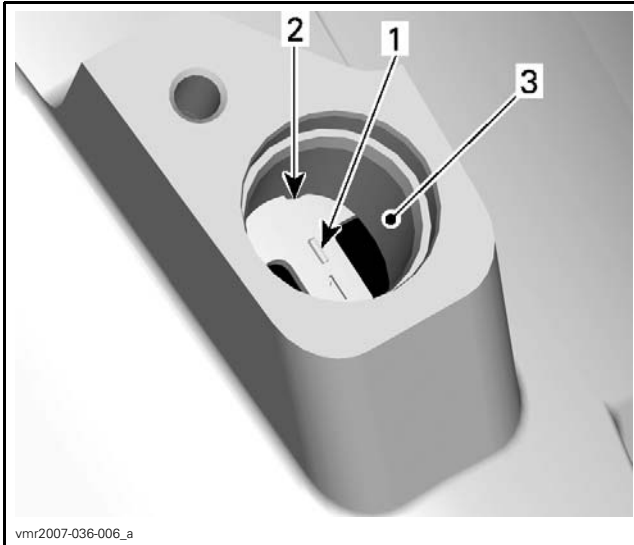
- 1. Set piston no. 2 (rear) to TDC ignition, see *CAMSHAFT TIMING PISTON NO. 2 (REAR)* in this subsection.
- 2. Remove crankshaft TDC position tool.
- 3. To set front piston no. 1 to TDC ignition turn crankshaft 280° counterclockwise.

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.

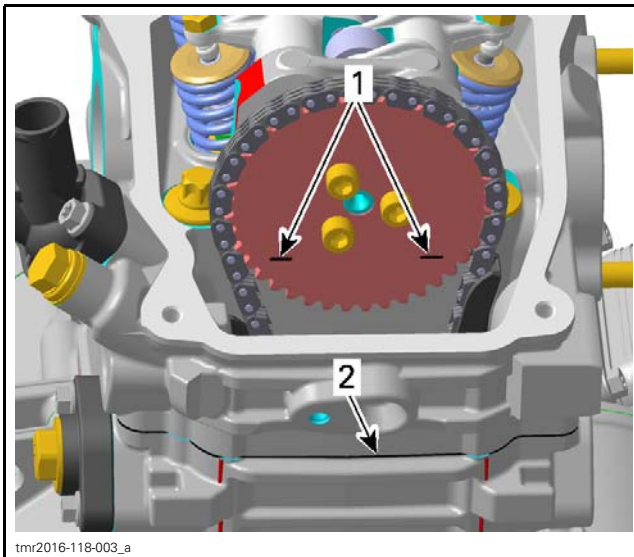


CYLINDER 1 AT TDC IGNITION

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.



PISTON AT TDC IGNITION

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

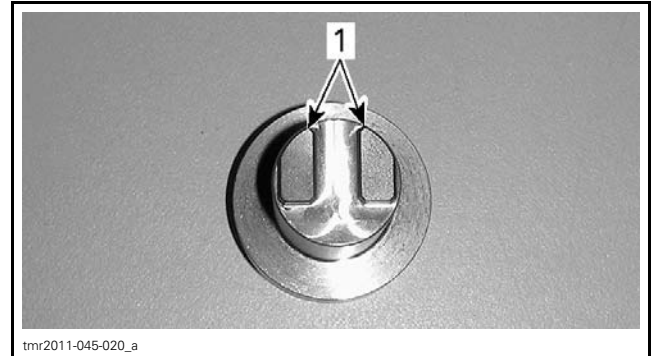
Crankshaft TDC Position Tool Installation

NOTICE Never use crankshaft TDC position tool to remove or tighten drive CVT screw or rotor retaining screw. Damage to the teeth of the trigger wheel on the rotor will occur.

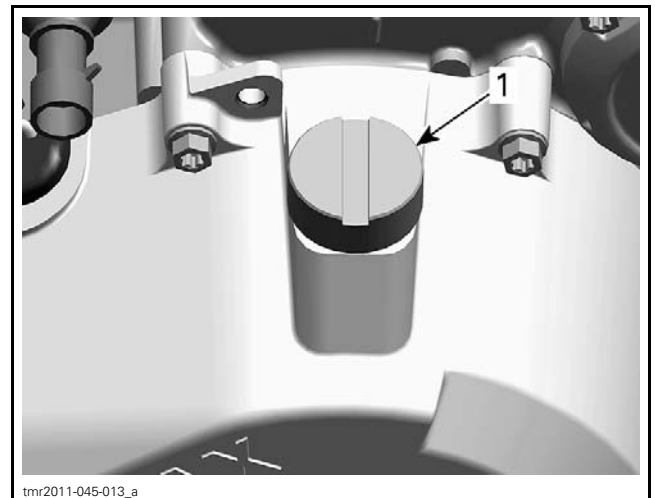
Install tool in magneto cover CPS bore.

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)

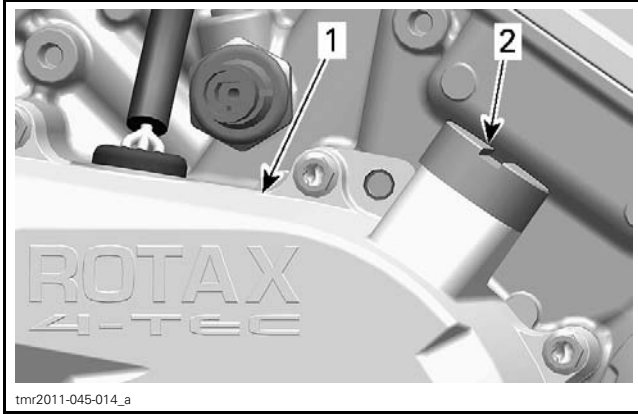


MAGNETO COVER

1. Crankshaft TDC position tool installed in CPS bore

NOTICE Tool must be fully inserted.

Subsection XX (TIMING CHAIN)



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.

Removing the Timing Chain (MAG Side)

NOTE: Mark the operating direction of the timing chain and check for excessive radial play before removal. Refer to *INSPECTING THE TIMING CHAIN*.

Refer to *MAGNETO SYSTEM* subsection and remove following parts:

- Magneto cover
- Rotor
- Sprag clutch gear.

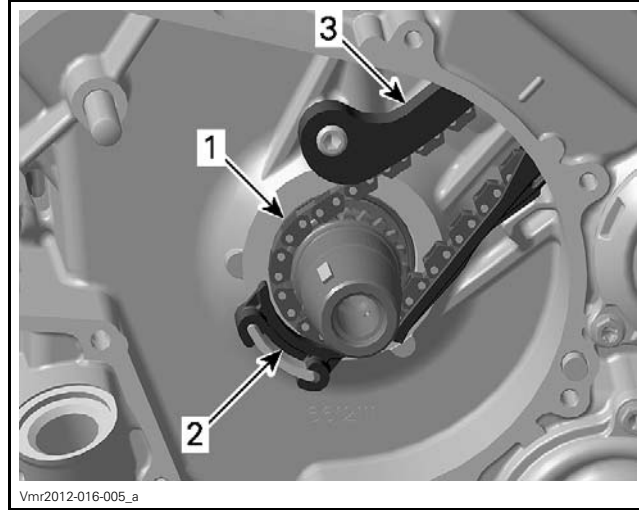
Refer to *TOP END* subsection and remove following parts:

- Valve cover.

Refer to following procedures in this subsection and remove following parts:

- Chain tensioner
- Camshaft timing gear.

Remove timing chain guide (tensioner side) and lower timing chain guide.



1. Timing chain
2. Lower timing chain guide
3. Timing chain guide (tensioner side)

Carefully pull the timing chain downwards and sideways, then out of the crankcase.

Removing the Timing Chain (PTO Side)

NOTE: Mark the operating direction of the timing chain and check for excessive radial play before removal. Refer to *INSPECTING THE TIMING CHAIN*.

Refer to *BOTTOM END* subsection and remove following parts:

- PTO cover
- Breather gear
- Intermediate gear.

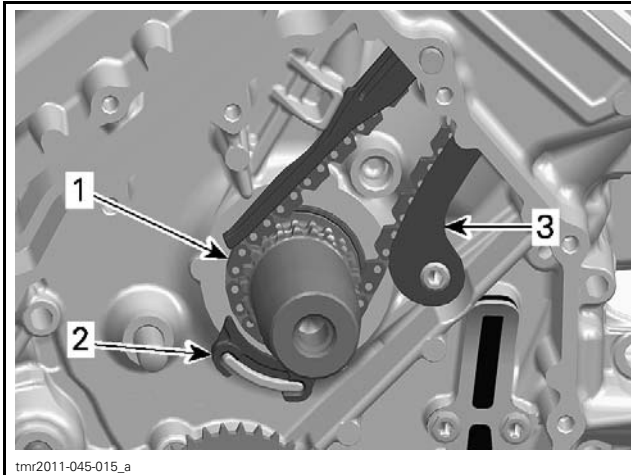
Refer to *TOP END* subsection and remove following parts:

- 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.



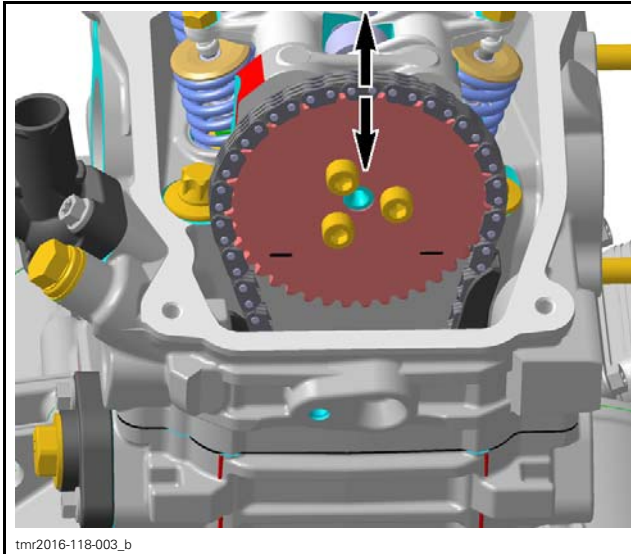
1. Timing chain
2. Lower timing chain guide
3. Timing chain guide (tensioner side)

Carefully pull the timing chain sideward and down from the crankcase.

Inspecting the Timing Chain

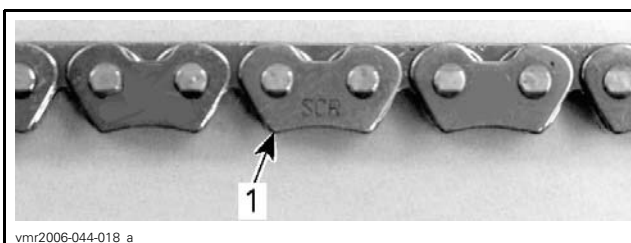
Inspection is the same for both timing chains.

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



CHECKING TIMING CHAIN RADIAL PLAY

Check chain condition for wear and teeth condition.



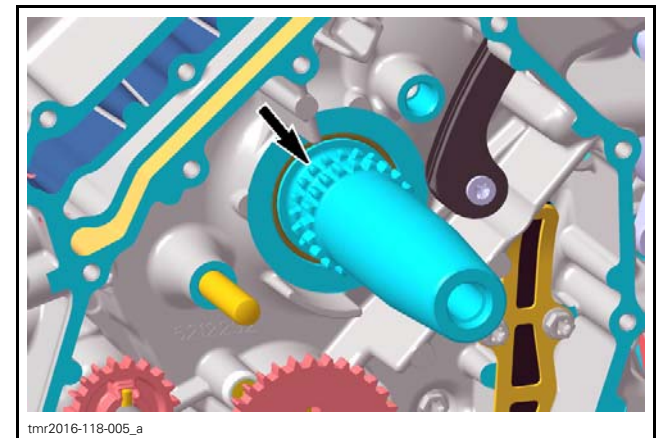
1. Timing chain

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).

Check if crankshaft timing gears are excessively worn or damaged.

Replace if necessary. Refer to *CRANKSHAFT* in the *BOTTOM END* subsection.



Installing the Timing Chain

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

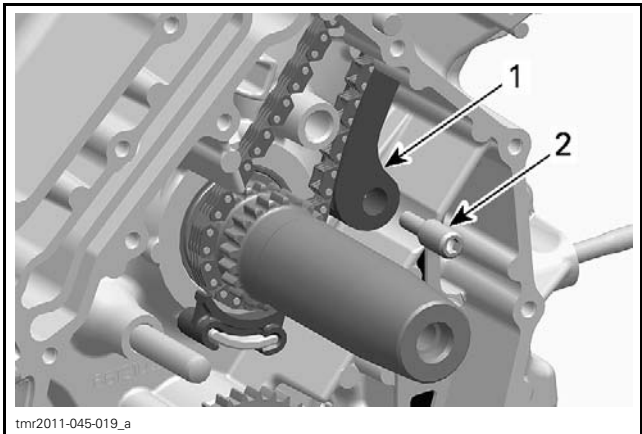
NOTE: Installation is the same for both timing chains.

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

Removing the Timing Chain Guide
(Tensioner Side)

Refer to *TIMING CHAIN* in this subsection.

Inspecting the Timing Chain Guide
(Tensioner Side)

Check timing chain guide for wear, cracks or de-forming. Replace if necessary.

Installing the Timing Chain Guide
(Tensioner Side)

The installation is the reverse of the removal pro-cedure.

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Timing chain guide bearing screw	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

TOP END

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT	529 035 617	20
ENGINE LEAK DOWN TEST KIT	529 035 661	6
PISTON CIRCLIP INSTALLER.....	529 035 921	23
PISTON CIRCLIP INSTALLER.....	529 036 153	23
PISTON RING COMPRESSOR	529 035 919	20
TDC DIAL INDICATOR	414 104 700	6
VALVE GUIDE INSTALLER	529 036 140	18
VALVE GUIDE REMOVER 5 MM	529 035 924	18
VALVE SPRING COMPRESSOR CUP	529 035 764	14
VALVE SPRING COMPRESSOR	529 035 724	14

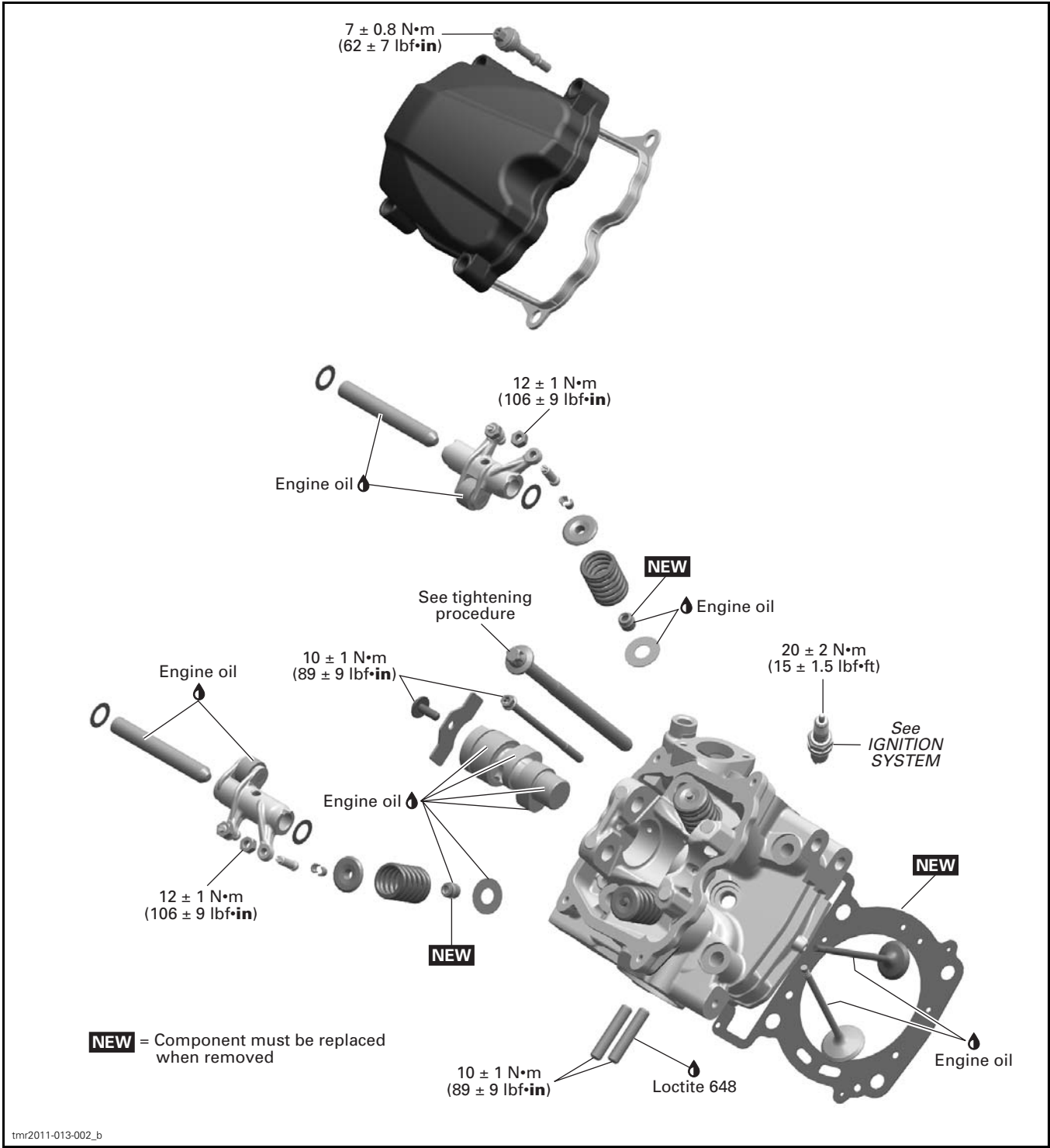
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON PLIERS.....	YA 8230	16

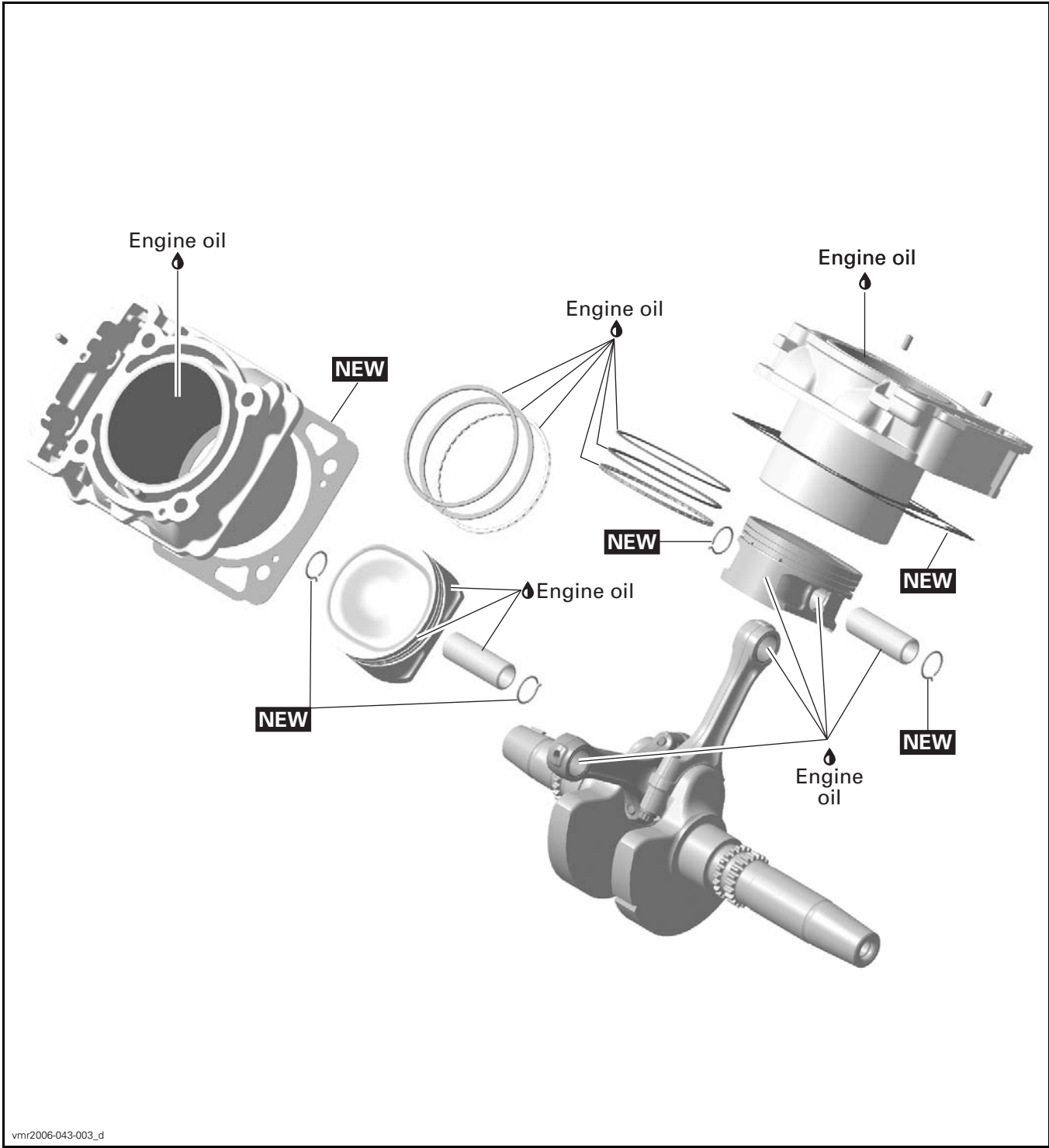
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	18

CYLINDER HEAD NO. 1

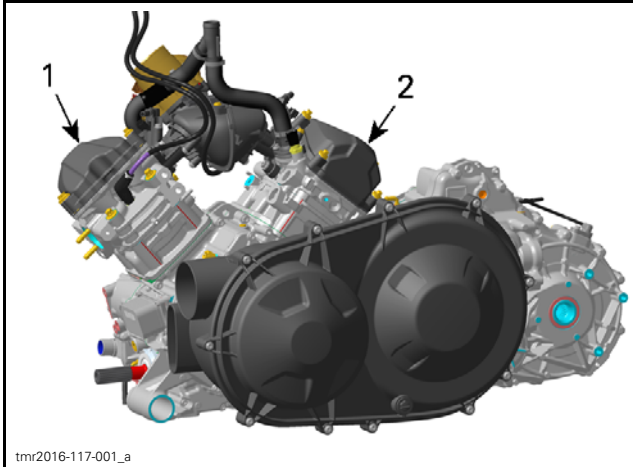


CYLINDERS AND PISTONS



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.

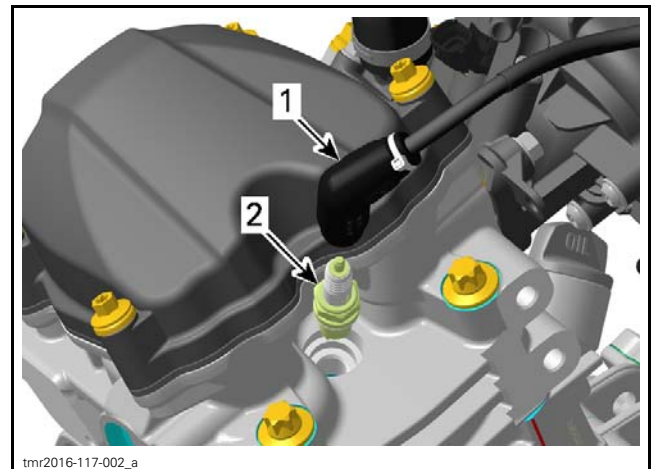
Remove radiator cap.

⚠ WARNING

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

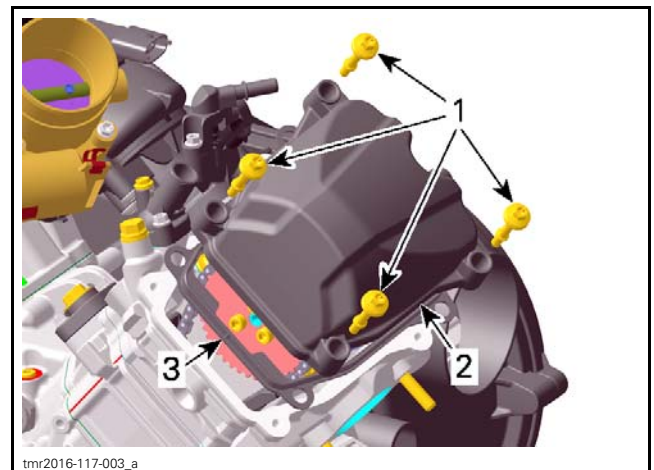
Unplug spark plug cable.

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



1. Spark plug connector
2. Spark plug

Remove valve cover.



1. Valve cover screws
2. Valve cover
3. Gasket

Rotate crankshaft until piston is at ignition TDC.

To turn crankshaft, there are two possible procedures.

Subsection XX (TOP END)

First Procedure

Turn the drive pulley.

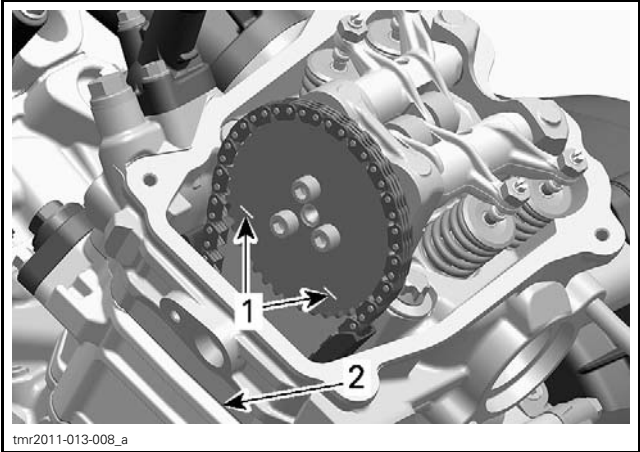
Second Procedure

- 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. Marks on camshaft timing gear
- 2. Cylinder head base

Leak Test

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

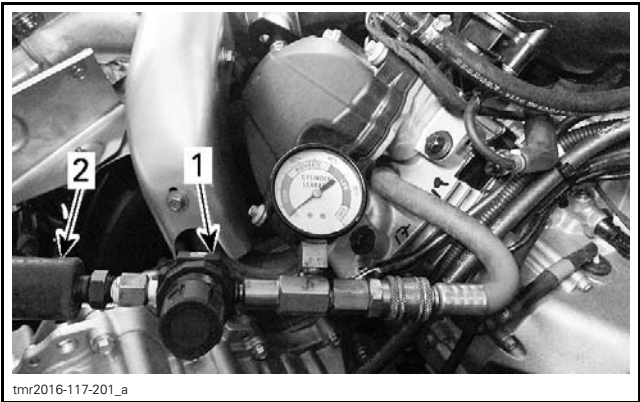
Connect leak tester to adequate air supply.

Set needle of measuring gauge to zero.

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

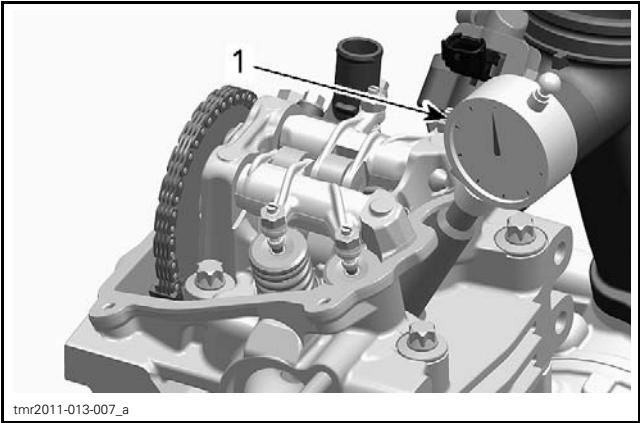
Install gauge adapter into previously cleaned spark plug hole.

Supply combustion chamber with air pressure.



- TYPICAL
- 1. Leak tester
 - 2. Air supply hose

Note the amount or percentage of leakage (depending on tester).



- 1. Dial gauge

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

NOTICE Do not scratch or damage piston/cylinder surface.

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

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

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

Diagnosis

Listen for air leaks.

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

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

Reassembly

Reverse the preparation procedure. Ensure to respect 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

Cylinder 1 (front)

Remove the engine service cover located on the rear upper bulkhead.

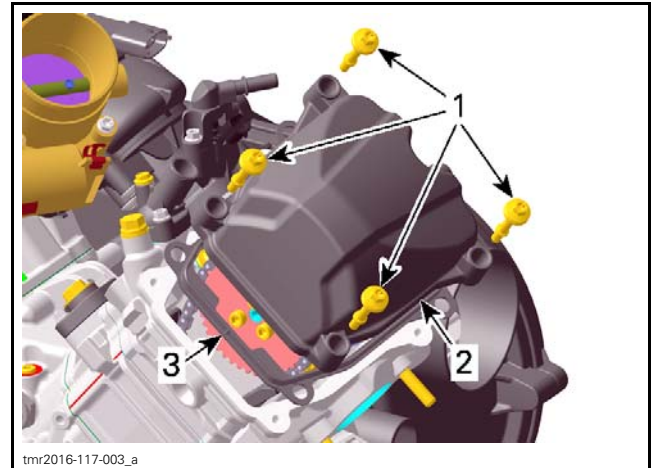
Cylinder 2 (rear)

Simply open the cargo box.

Removing the Valve Cover

Remove:

- Valve cover screws
- Valve cover
- Gasket.



1. Valve cover screws
2. Valve cover
3. Gasket

Repeat the procedure for the other valve cover if required.

Inspecting the Valve Cover

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

Installing the Valve Cover

For installation, reverse the removal procedure.

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

TIGHTENING TORQUE	
Valve cover screws	7 N•m ± 0.8 N•m (62 lbf•in ± 7 lbf•in)

ROCKER ARM

Removing the Rocker Arm

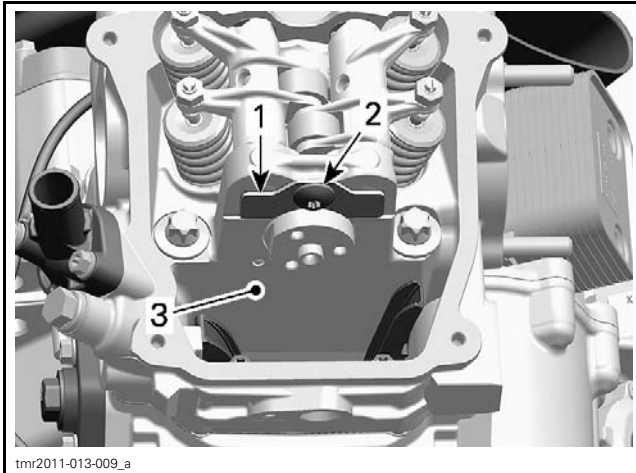
Remove valve cover.

Refer to *TIMING CHAIN* subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

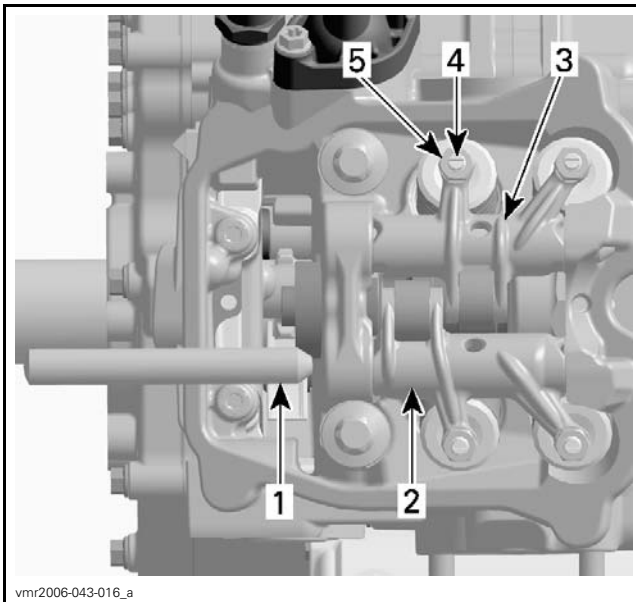
Remove pan head screw and camshaft retaining plate.

Subsection XX (TOP END)



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

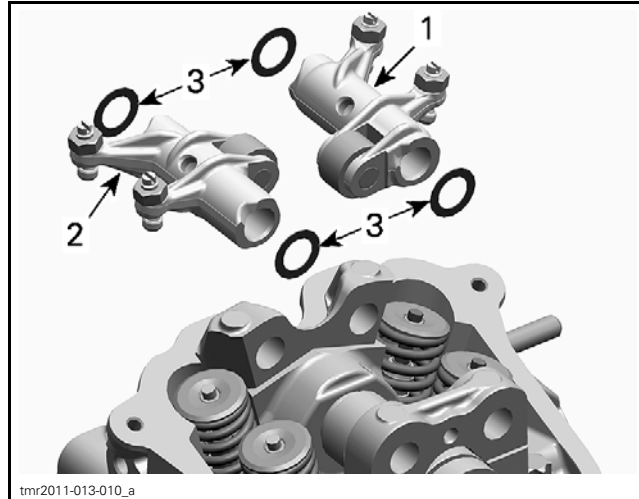
Remove rocker arm shafts.



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

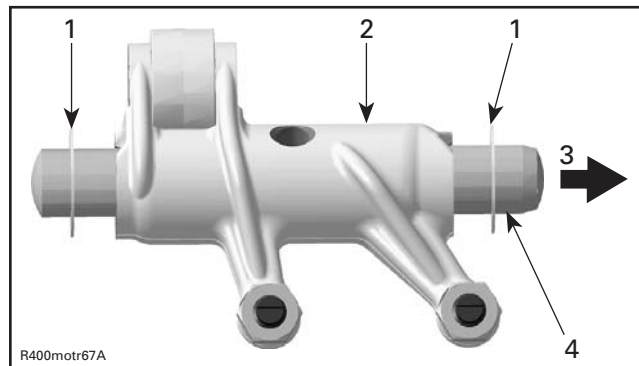
Remove rocker arm assembly (exhaust side and intake side) with adjustment screws and lock nuts.

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.

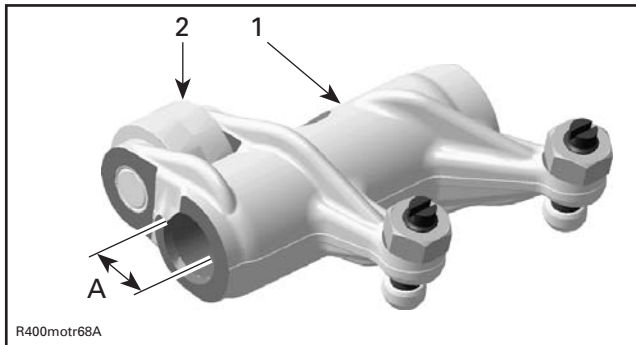


1. 2 thrust washers
2. Rocker arm (exhaust side)
3. Cylinder head (spark plug side)
4. Big taper to spark plug side

Inspecting the Rocker Arm

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.

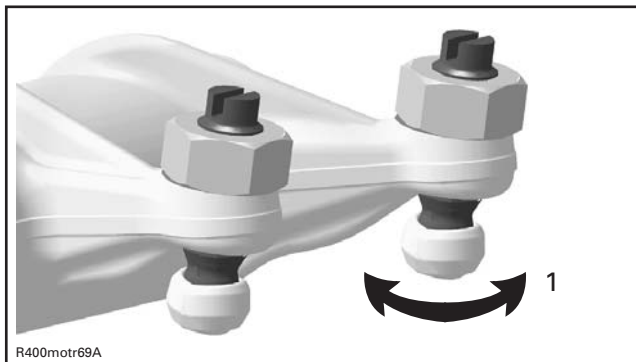


1. Rocker arm (exhaust side)
2. Roller
- A. Bore for rocker arm shaft

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.

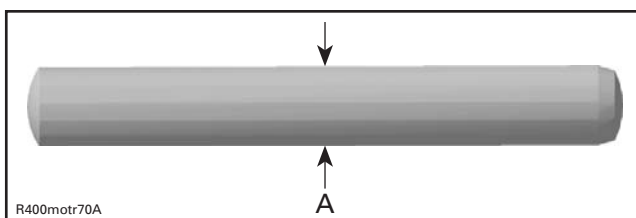


1. Free movement of adjustment screw top

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	12.000 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.

Installing the Rocker Arm

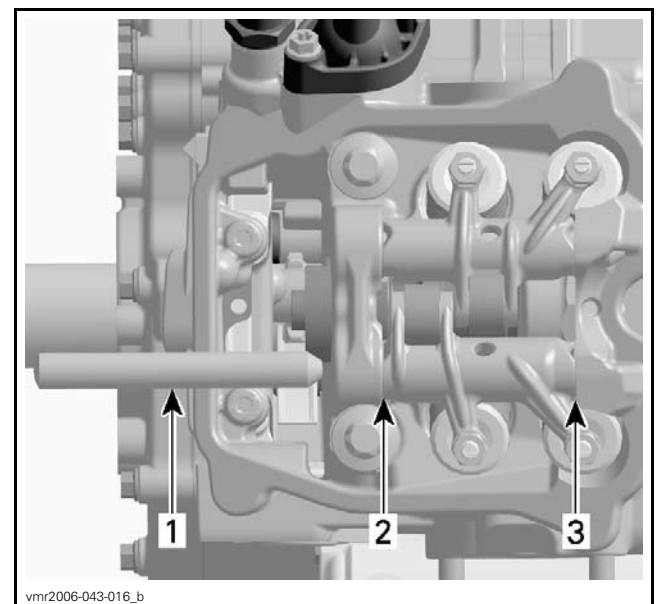
NOTE: Use the same procedure for exhaust and intake rocker arm.

Apply engine oil on rocker arm shaft.

Insert a rocker arm shaft with the chamfered edge first 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.

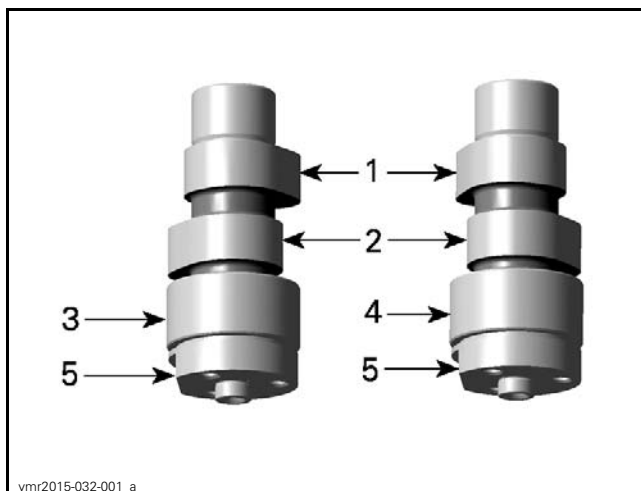
Install the camshaft retaining plate.

Adjust valve clearance, refer to *PERIODIC MAINTENANCE PROCEDURE*.

CAMSHAFT

NOTE: The engine is equipped with two different camshafts.

Subsection XX (TOP END)



vmr2015-032-001_a

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

Removing the Camshaft

The removal procedure is the same for both camshafts.

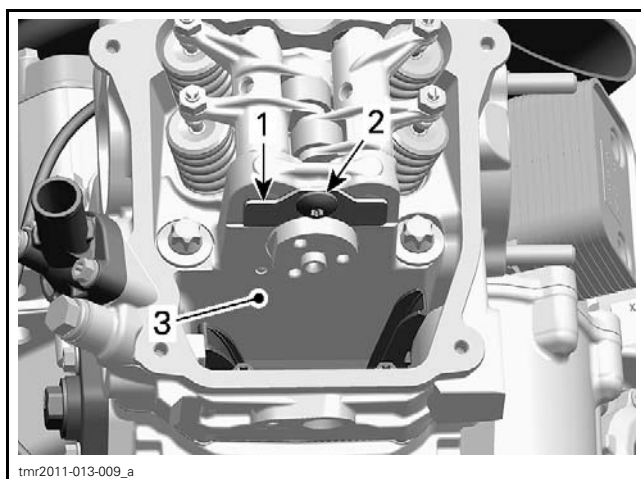
NOTICE Each camshaft is different in design. Thus, it is important not to mix up any parts of the camshaft assembly with that of the other cylinder. Keep parts as a group.

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.



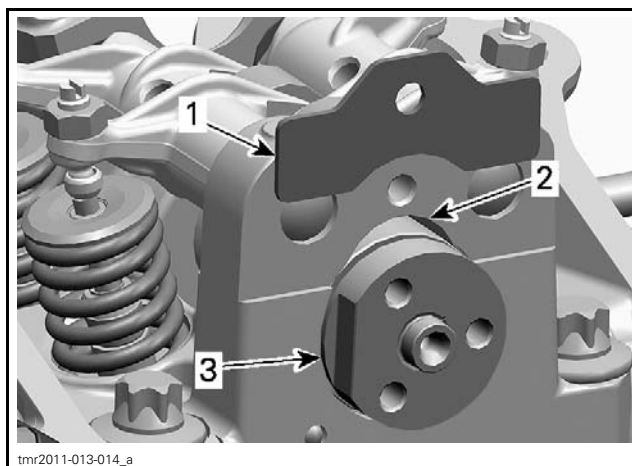
tmr2011-013-009_a

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.



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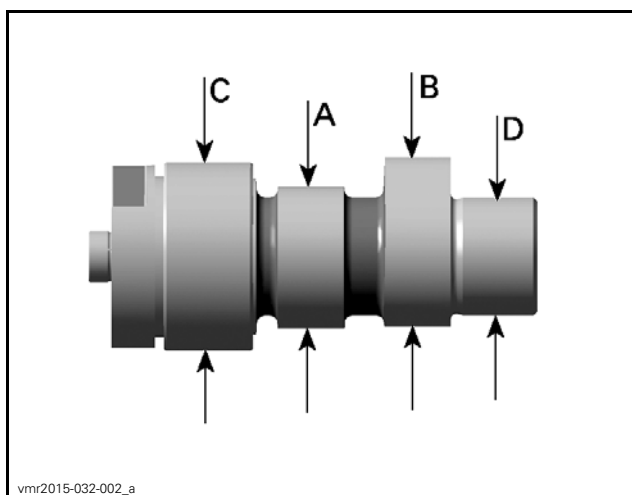
1. Camshaft retaining plate
2. Area for camshaft lobes
3. Camshaft

Inspecting the Camshaft

Inspecting the Camshaft Lobe

Check each lobe for scoring, scuffing, cracks or other signs of wear.

Measure camshaft lobe height using a micrometer.



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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)		
HD8 ENGINE	NEW	31.730 mm to 31.930 mm (1.2492 in to 1.2571 in)
	SERVICE LIMIT	31.710 mm (1.2484 in)
HD10 ENGINE	NEW	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)
	SERVICE LIMIT	32.930 mm (1.2965 in)

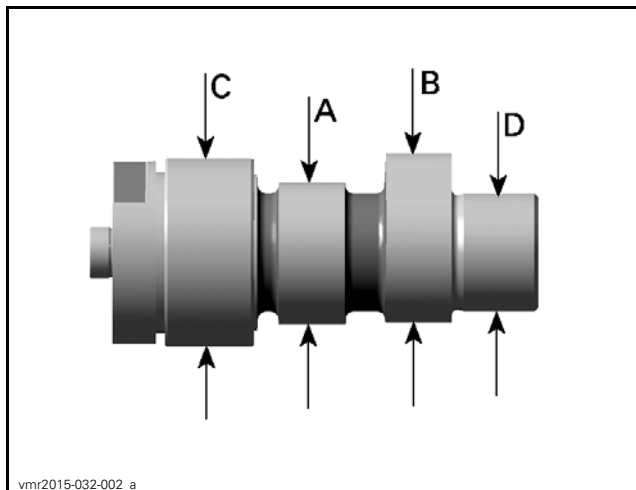
CAMSHAFT LOBE (INTAKE)		
HD8 ENGINE	NEW	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)
	SERVICE LIMIT	32.870 mm (1.2941 in)
HD10 ENGINE	NEW	32.960 mm to 33.160 mm (1.298 in to 1.306 in)
	SERVICE LIMIT	32.940 mm (1.297 in)

Measure camshaft bearing in cylinder head. Refer to *CYLINDER HEAD INSPECTION* in this subsection.

Inspecting the Camshaft Journal

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)

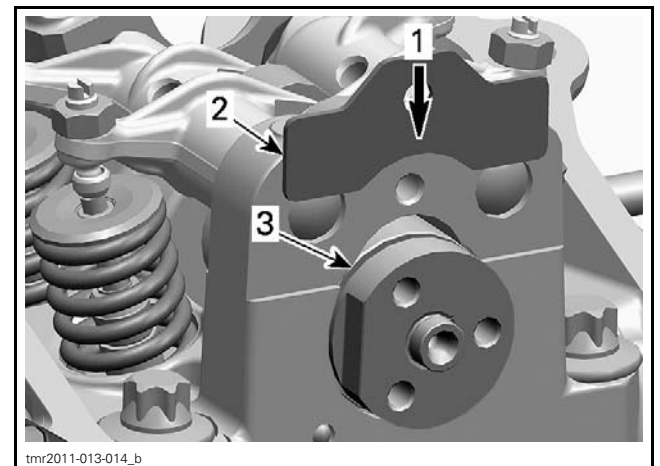
CAMSHAFT JOURNAL (SPARK PLUG SIDE)	
NEW	21.959 mm to 21.980 mm (.8645 in to .8654 in)
SERVICE LIMIT	21.950 mm (.8642 in)

Installing the Camshaft

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

Cylinder 1 (front)

The engine removal is required to work on cylinder 1.

Cylinder 2 (rear)

Simply open the cargo box.

Removing the Cylinder Head

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.

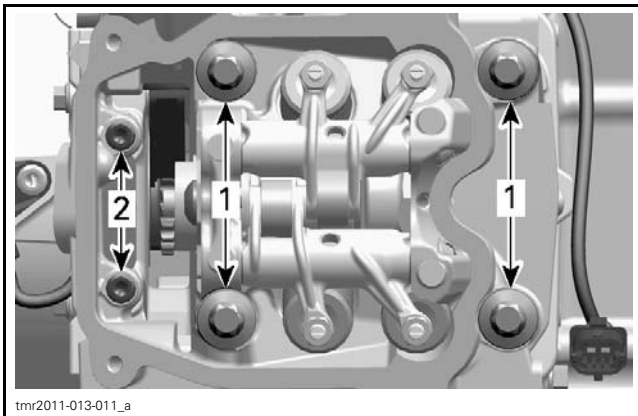
Disconnect temperature sensor connector, located at rear cylinder head.

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.

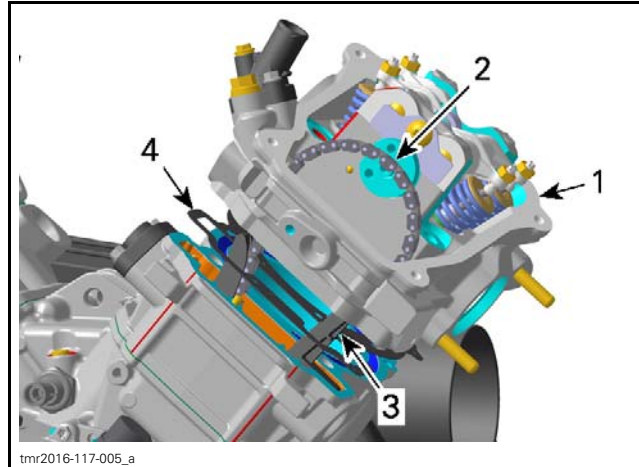


1. Cylinder head screws M10
2. Cylinder head screws M6

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

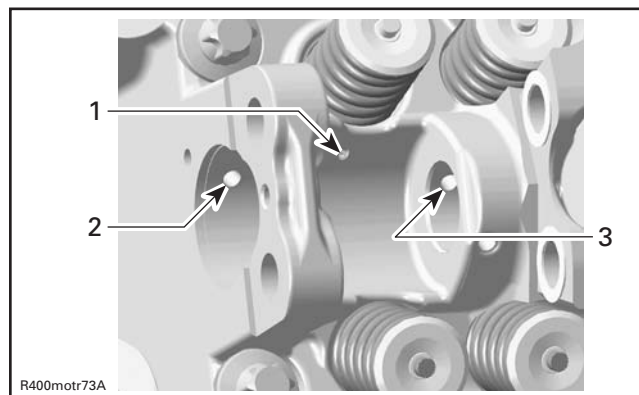
Inspecting the Cylinder Head

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.

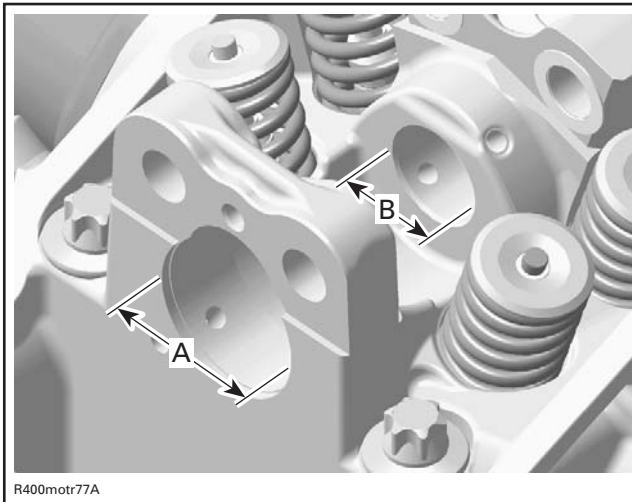
Clean oil support through the cylinder head from contamination.



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)

Inspecting the Cylinder Head Camshaft Bearing

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)

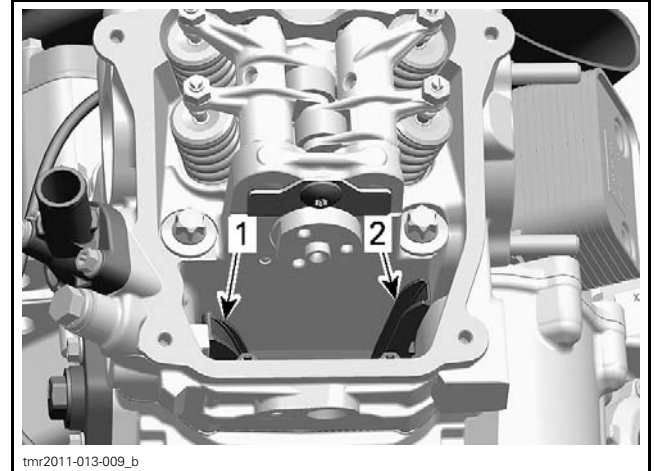
Installing the Cylinder Head

NOTE: Never invert front and rear cylinder heads. On the HD8, 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.



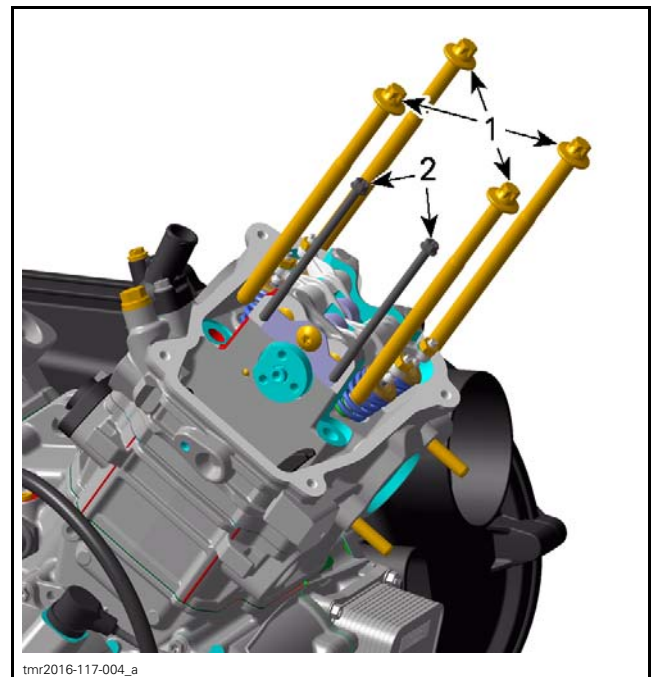
TYPICAL

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.



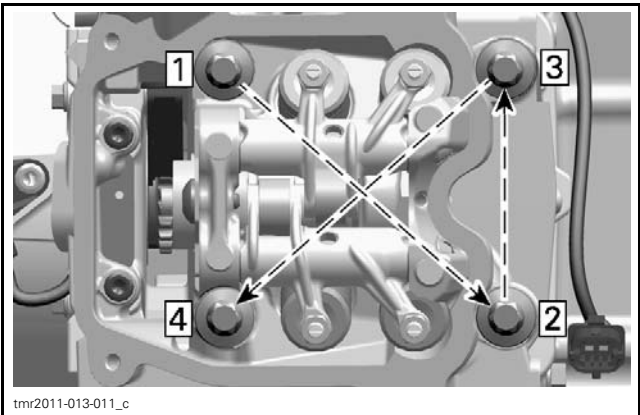
1. Location no. 1
2. Location no. 2

CYLINDER HEAD SCREW IDENTIFICATION		
HD8 engine	Location no. 1	M10 x 140
	Location no. 2	M6 x 85
HD10 engine	Location no. 1	M10 x 159
	Location no. 2	M6 x 105

Tighten M10 cylinder head screws FIRST as per following specifications.

Subsection XX (TOP END)

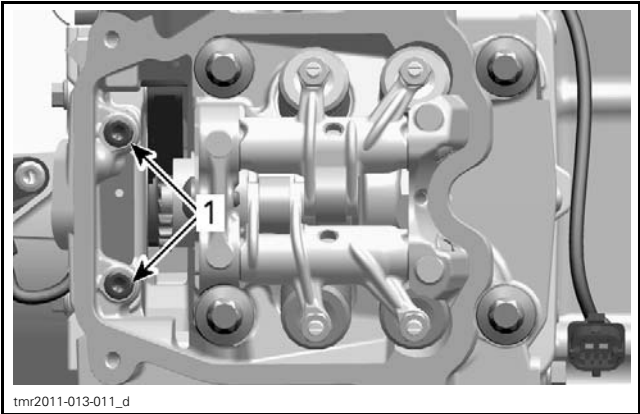
NOTE: Always perform one step on all M10 cylinder head screws before going to the next step.



TIGHTENING SEQUENCE - M10 CYLINDER HEAD SCREWS

TIGHTENING TORQUE		
M10 Cylinder head screws	Step A	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)
	Step B	180° +/- 5°

Tighten M6 cylinder head screws as per following specification.



1. M6 Screws

TIGHTENING TORQUE	
M6 Cylinder head screws	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

Removing the Valve Spring

Refer to following procedures in this subsection to remove:

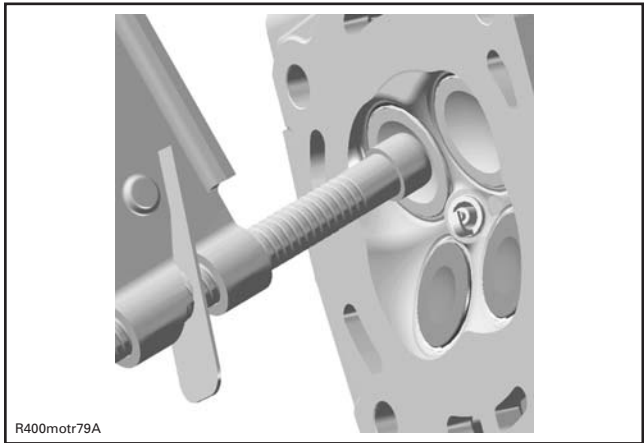
- CAMSHAFT
- CYLINDER HEAD.

Compress valve spring.

REQUIRED TOOL	
VALVE SPRING COMPRESSOR (P/N 529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N 529 035 764)	

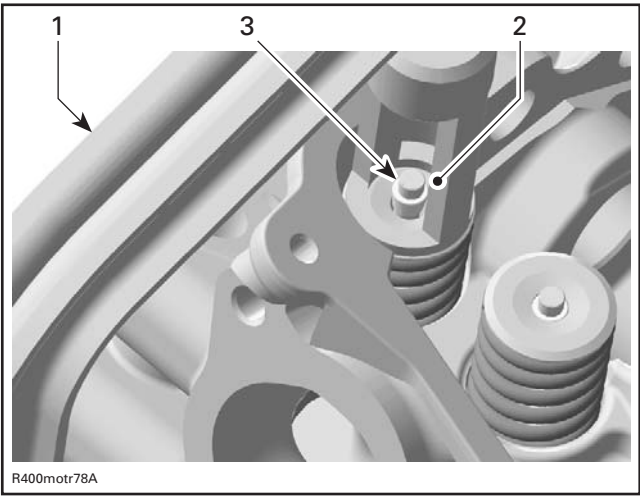
 **WARNING**

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



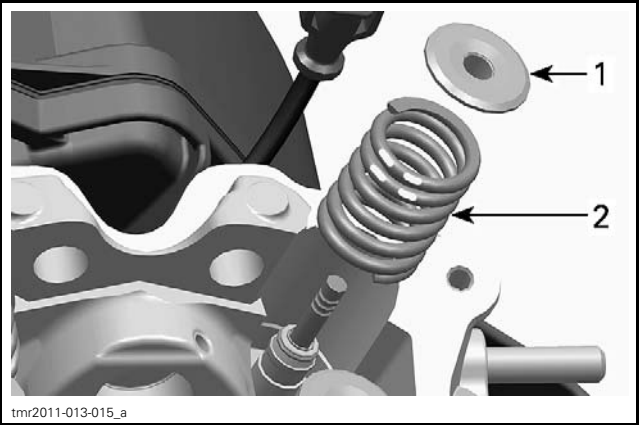
LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve cotters.



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

Remove tools and withdraw valve spring retainer and valve spring.

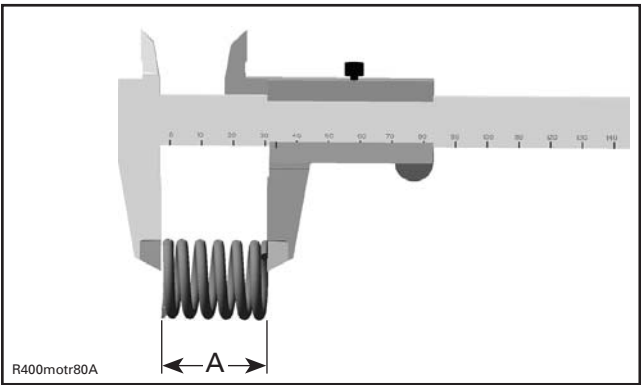


- 1. Valve spring retainer
- 2. Valve spring

Inspecting the Valve Spring

Check valve spring for visible damage. If so, replace valve spring.

Check valve spring for free length and straightness.



A. Valve spring length

VALVE SPRING FREE LENGTH	
NEW	40.81 mm (1.607 in)
SERVICE LIMIT	39.00 mm (1.535 in)

Replace valve springs if not within specifications.

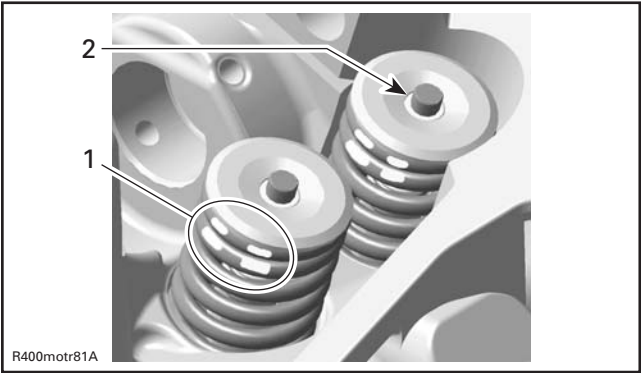
Installing the Valve Spring

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.

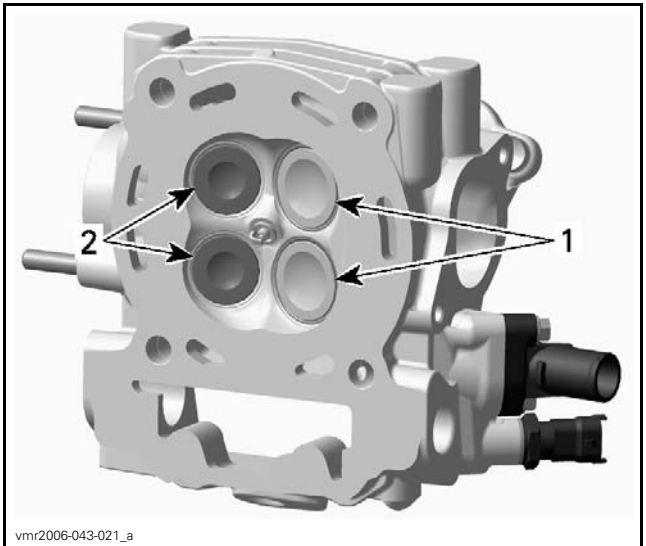
NOTICE An improperly locked valve spring will cause engine damage.

VALVES

Removing the Valve

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)	



Inspecting the Valve

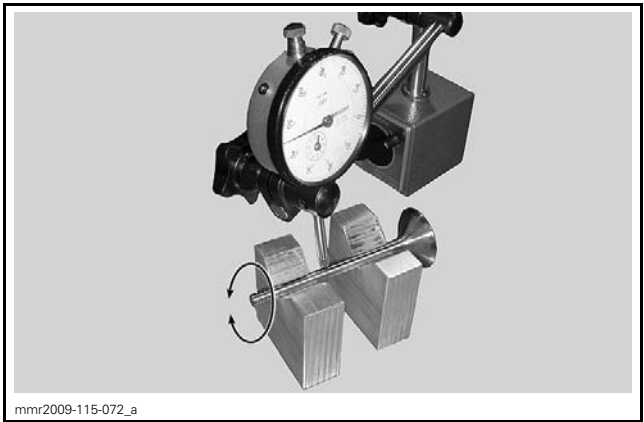
Whenever valves are removed always inspect valve guides. Refer to *VALVE GUIDES* in this subsection.

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.

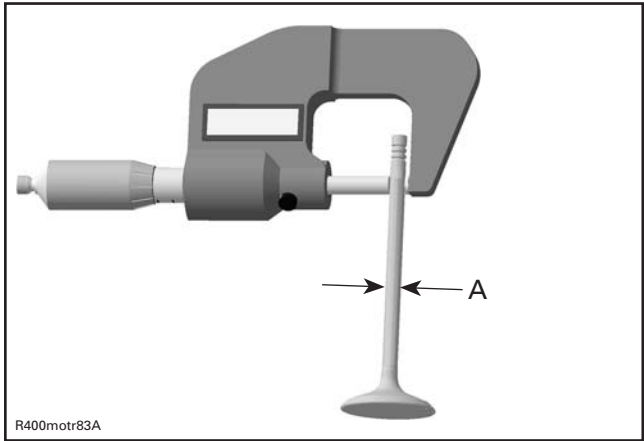


VALVE OUT OF ROUND (INTAKE AND EXHAUST VALVES)	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

Valve Stem

Measure valve stem in three places using a micrometer.

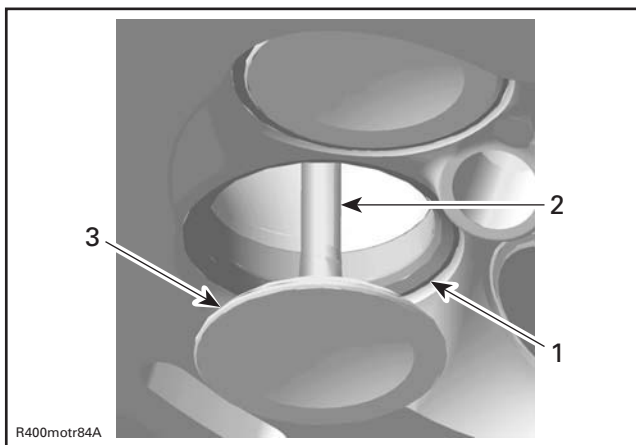
Replace valve if valve stem is out of specification or has other damages such as wear or friction surface.



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).

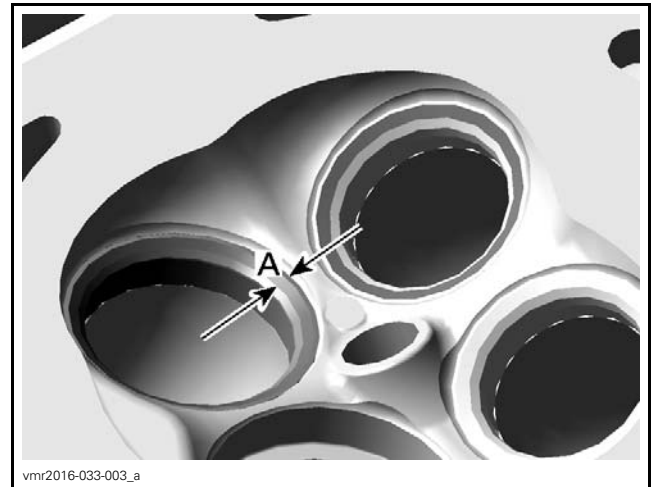
Measure valve face contact width.

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

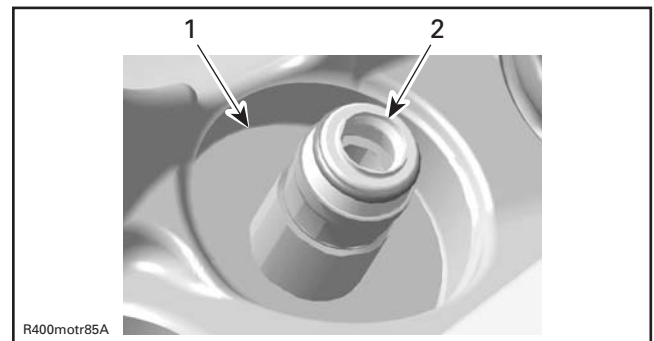
Installing the Valve

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

Inspecting the Valve Guide

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)

Removing the Valve Guide

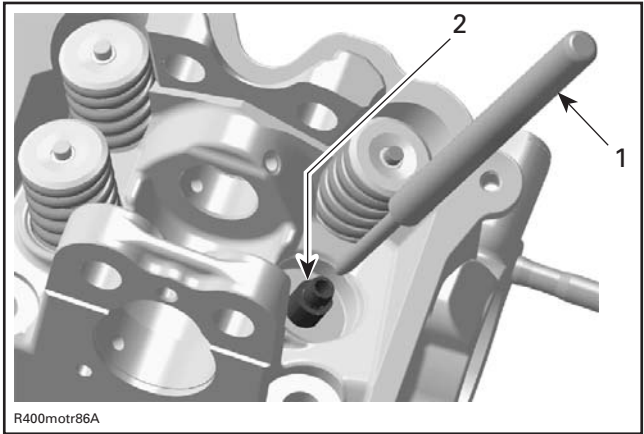
Refer to following procedures in this subsection to remove:

- 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

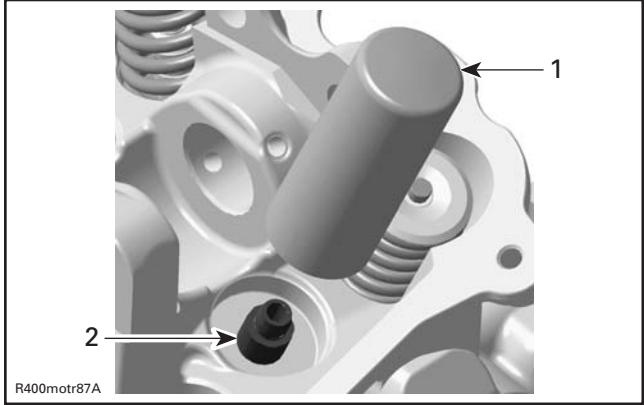
Installing the Valve Guide

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

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

Install valve guide.

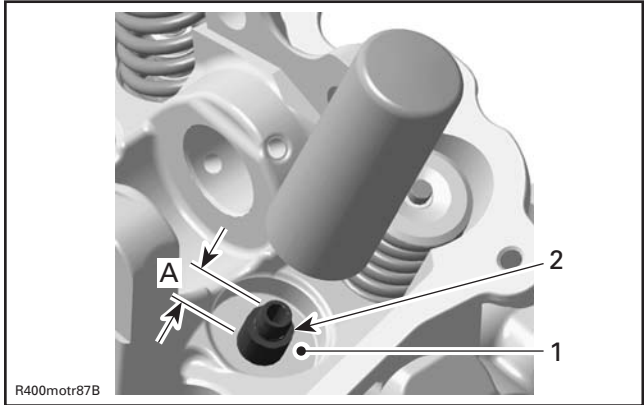
REQUIRED TOOL	
VALVE GUIDE INSTALLER (P/N 529 036 140)	



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.

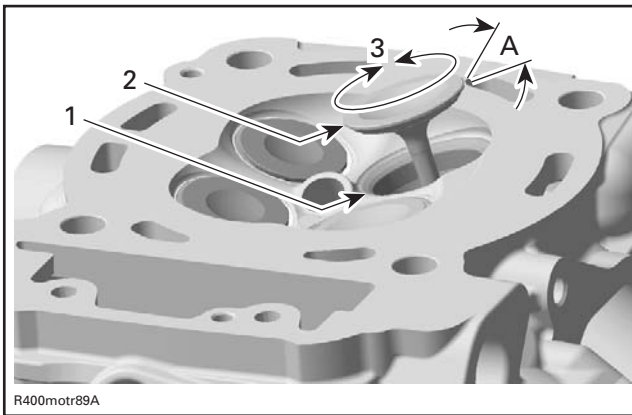
NOTICE Push valve guide in the cold cylinder head as per following illustration.



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

Removing the Cylinder

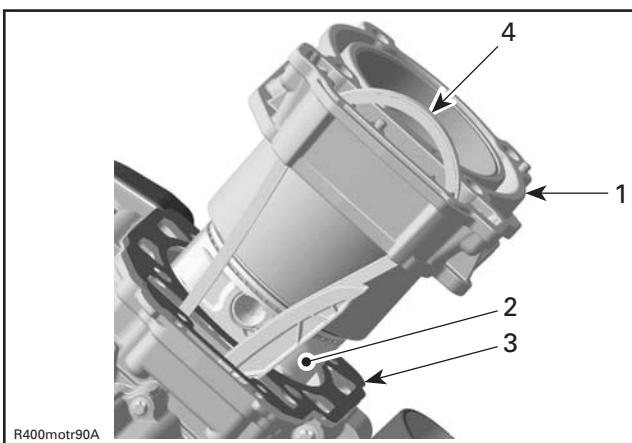
Refer to *TIMING CHAIN* subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

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

Pull cylinder.

Discard cylinder base gaskets.



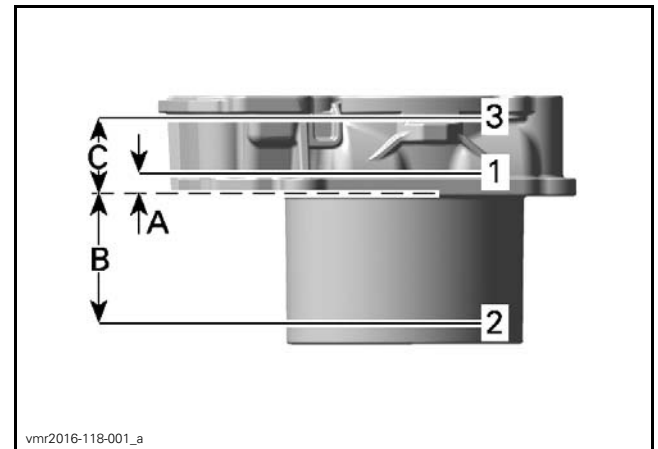
1. Cylinder
2. Piston assembly
3. Cylinder base gasket
4. Camshaft timing chain

Inspecting the Cylinder

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
HD8 engine	A	5 mm (.197 in)
	B	58 mm (2.283 in)
	C	37 mm (1.457 in)
HD10 engine	A	5 mm (.197 in)
	B	53 mm (2.087 in)
	C	57 mm (2.244 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.

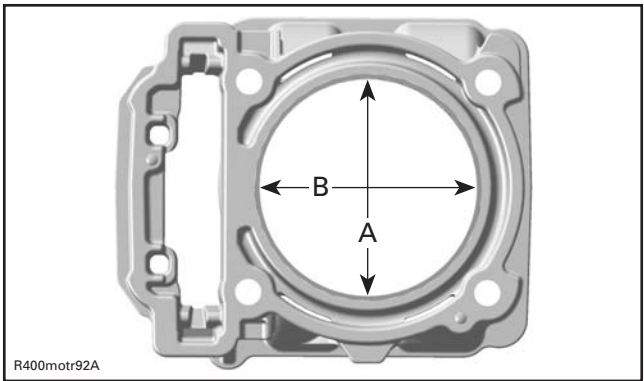
Cylinder Out of Round

Measure cylinder diameter:

- in piston axis
- perpendicular to piston pin axis.

NOTE: Use the same measuring points as described in *CYLINDER TAPER*.

Subsection XX (TOP END)



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)

Installing the Cylinder

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.

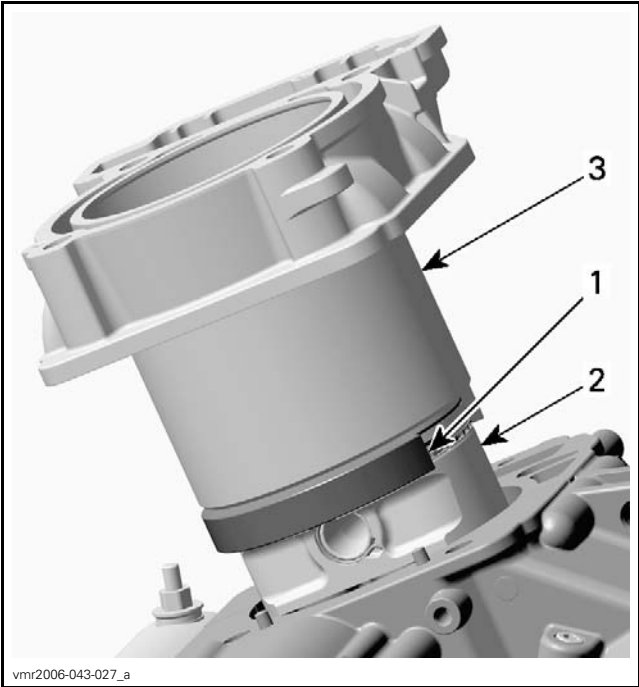
NOTE: The cylinder can not be pushed fully over the piston unless the piston is located at TDC.

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.



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

Removing the Piston

Refer to following procedures in this subsection to remove:

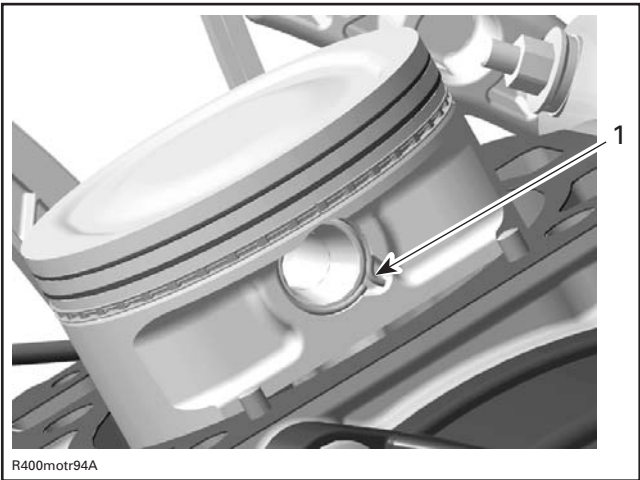
- Cylinder head
- Cylinder.

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

 **WARNING**

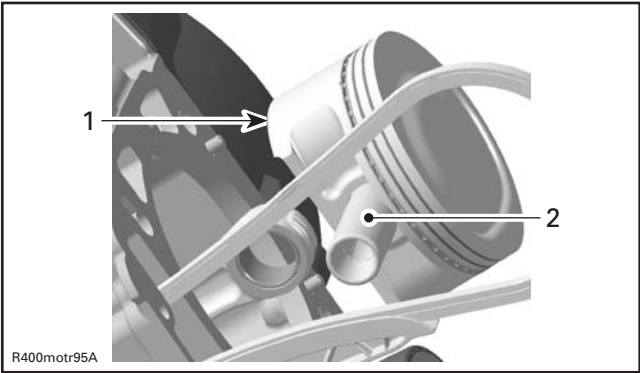
Piston circlips are spring loaded.

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.



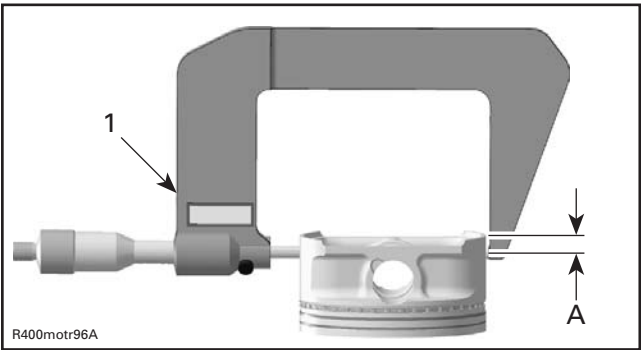
1. Piston
2. Piston pin

Detach piston from connecting rod.

Inspecting the Piston

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.



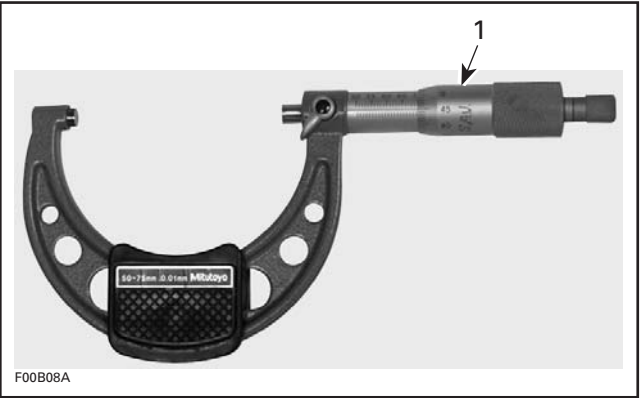
1. Measuring perpendicularly (90°) to piston pin
A. 8 mm (.315 in)

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)

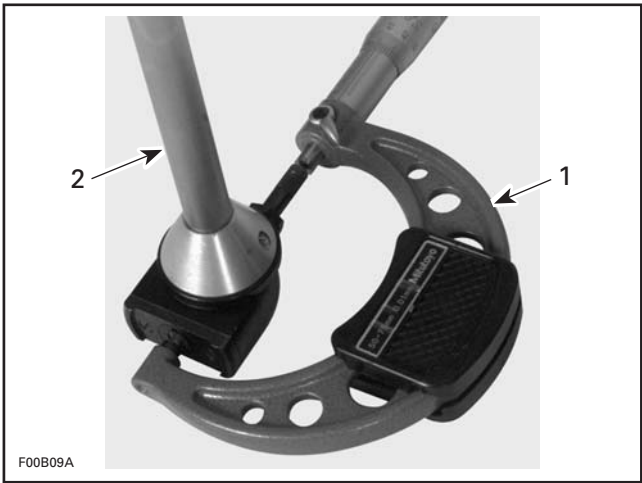
Piston/Cylinder Clearance

Adjust and lock a micrometer to the piston dimension.

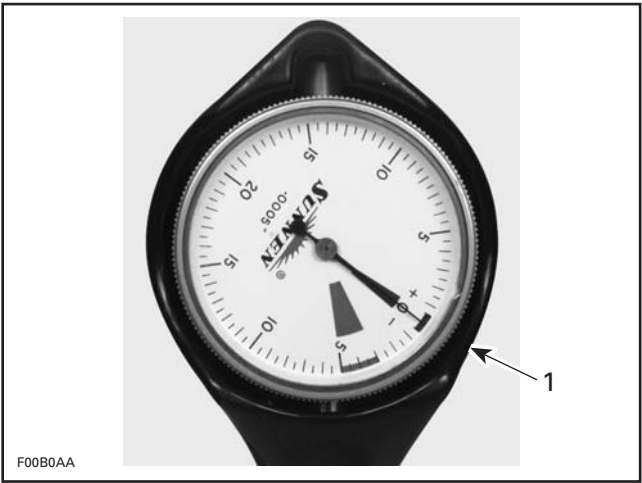


1. Micrometer set to the piston dimension

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.

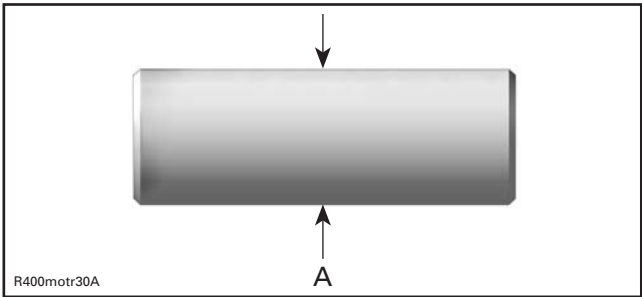
NOTE: Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

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.

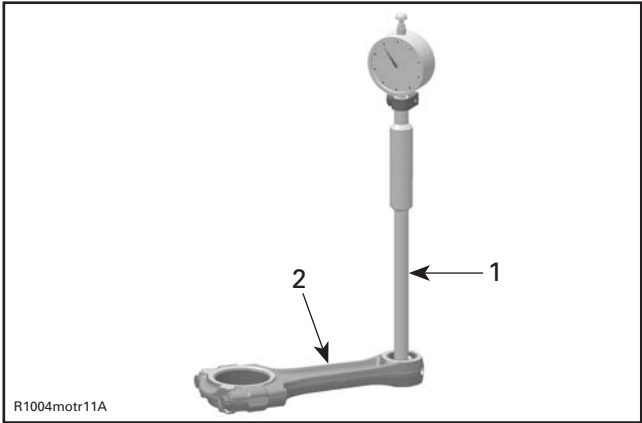


A. Piston pin diameter

PISTON PIN DIAMETER	
HD8	
NEW	19.996 mm to 20.000 mm (.7872 in to .7874 in)
SERVICE LIMIT	19.980 mm (.7866 in)
HD10	
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	
HD8	
NEW	20.010 mm to 20.020 mm (.7878 in to .7882 in)
SERVICE LIMIT	20.060 mm (.7898 in)
HD10	
NEW	22.010 mm to 22.020 mm (.8665 in to .8669 in)
SERVICE LIMIT	22.050 mm (.8681 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)

Installing the Piston

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

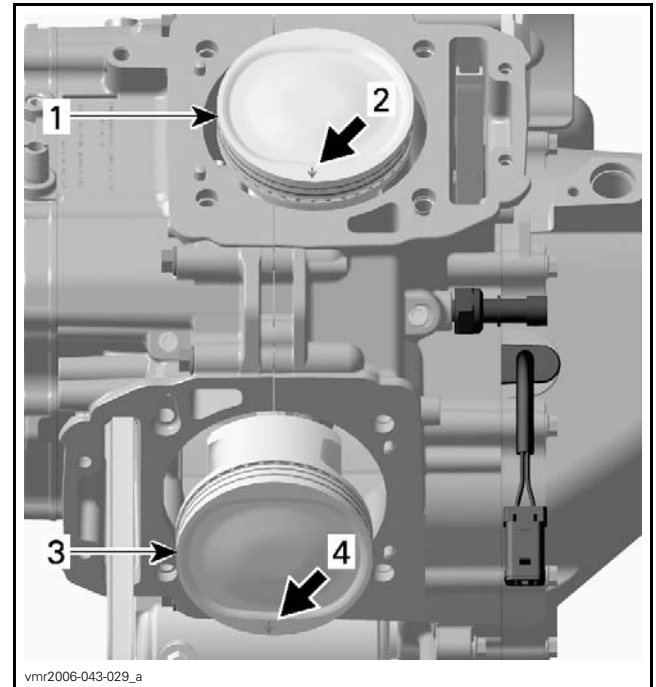
Apply engine oil on the piston pin.

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.

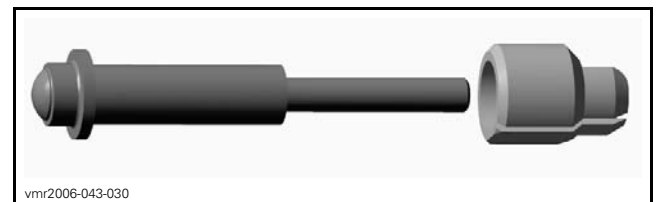
Rear cylinder: Mark on top of piston must show to exhaust side.



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
HD8	PISTON CIRCLIP INSTALLER (P/N 529 035 921)
HD10	PISTON CIRCLIP INSTALLER (P/N 529 036 153)

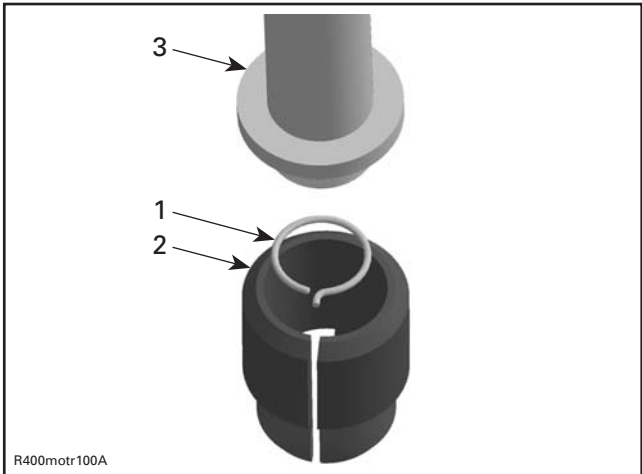


TYPICAL

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.

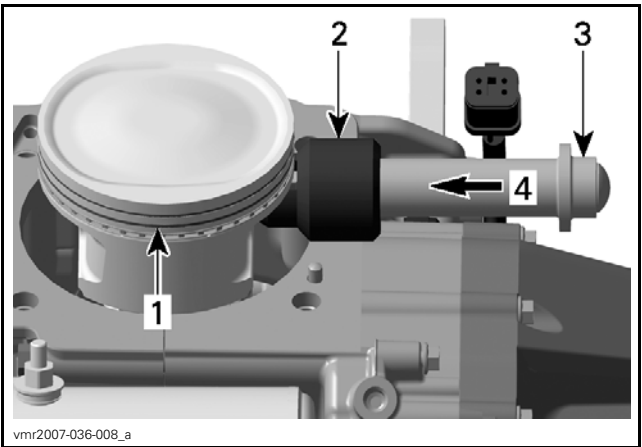
Subsection XX (TOP END)



- 1. Circlip
- 2. Sleeve
- 3. Assembly jig from piston clip installer

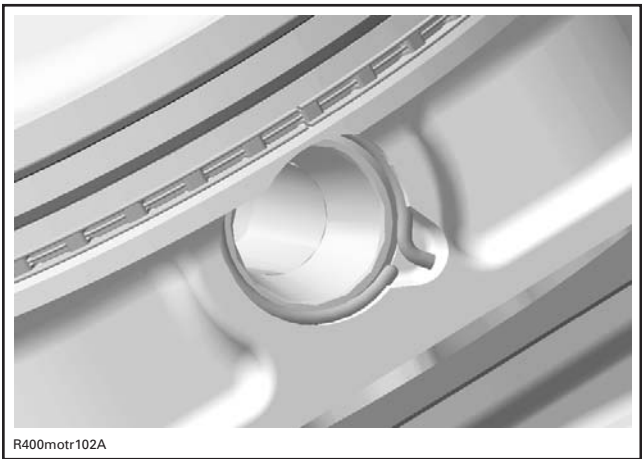
Push taper side of assembly jig until circlip reaches middle of sleeve.

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.



CORRECT POSITION OF THE PISTON CIRCLIP

PISTON RINGS

Removing the Ring

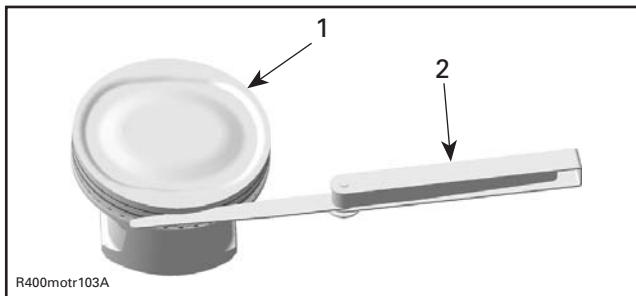
Remove the piston (see *PISTON* in this subsection).

Inspecting the Ring

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 8mm to 16mm (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.

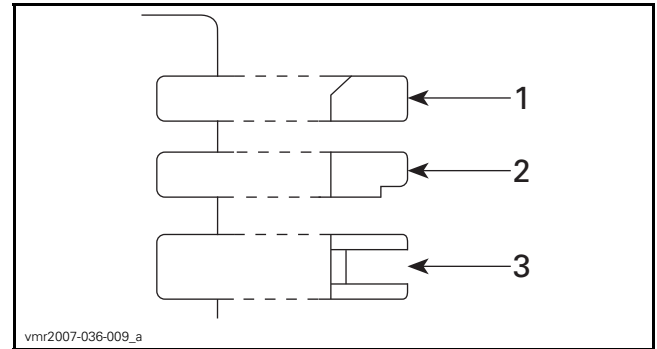
Installing the Ring

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.

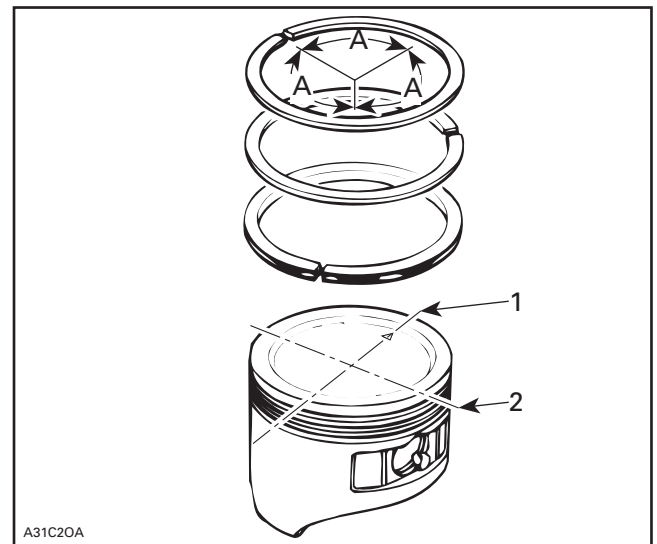
Install the oil scraper ring first, then the lower compression ring with the word "N and TOP " facing up, then the upper compression ring with the word "N and TOP" facing up.



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°

WHEELS AND TIRES

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.

Refer to technical specifications for tire pressure table.

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

WHEELS

Removing the Wheel

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.

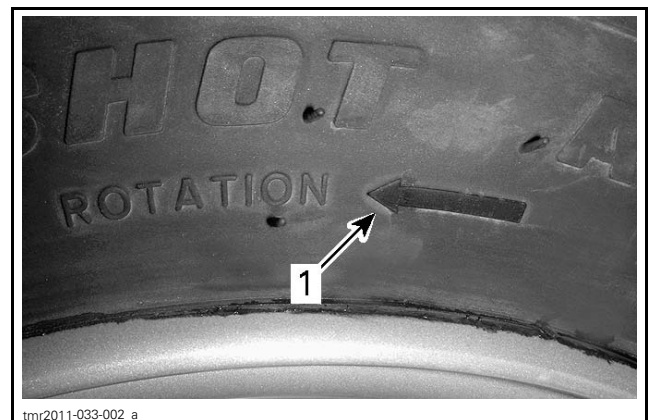
Inspecting the Wheel

Inspect wheel for wear or damage especially at the mounting holes.

Installing the Wheel

Check wheel studs and wheel nuts thread condition.

Check if tires are unidirectional.



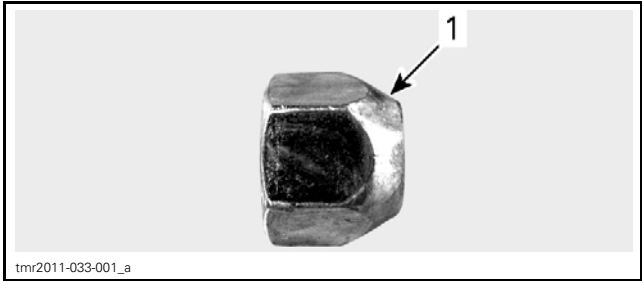
TYPICAL

1. Direction of rotation

Install in the right direction of rotation.

Install lug nuts with the taper towards the wheel.

Subsection XX (WHEELS AND TIRES)



TYPICAL
1. Taper (towards the wheel)

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

TIGHTENING TORQUE	
Wheel lug nuts	100 N•m ± 10 N•m (74 lbf•ft ± 7 lbf•ft)



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.

WIRING DIAGRAM INFORMATION

GENERAL

WIRING DIAGRAM LOCATION

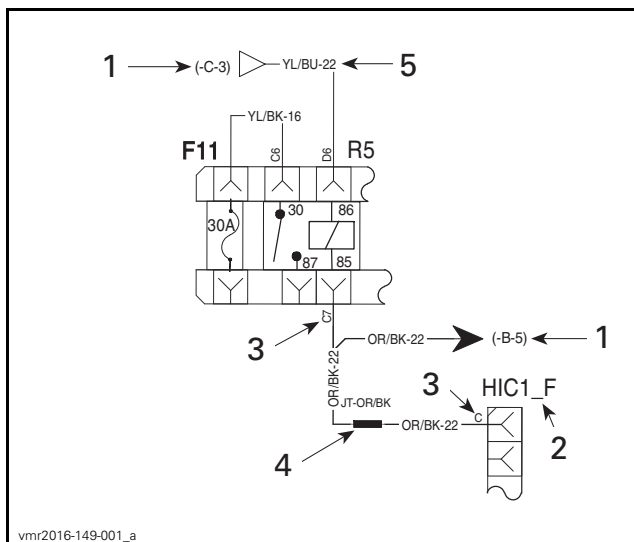
Wiring diagrams are found in the *WIRING DIAGRAM BOOKLET*.

WIRING DIAGRAM WITH COLORED LINES

The wiring diagram on the *KNOWLEDGE CENTER* is in color.

WIRING DIAGRAM CODES

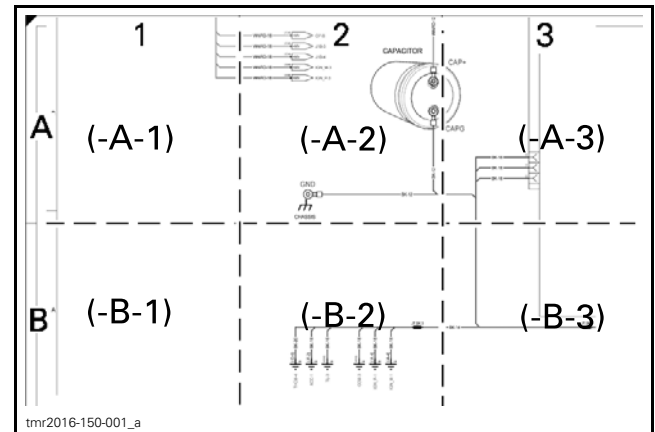
The wiring diagrams use the following codes.



1. Wiring diagram index
2. Connector code
3. Connector pin
4. Splice
5. Color and size

Wiring Diagram Index

The wiring diagram is separated by rows (letters) and columns (numbers).



WIRING DIAGRAM INDEX

Connector Code

The wire connects to the indicated connector.

Connector Pin

The wire is the indicated pin in the connector.

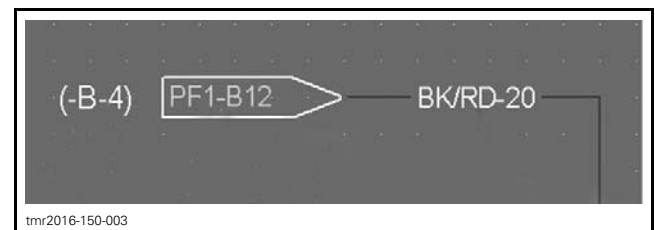
NOTE: Could be identified by either a number or by a letter depending on the type of connector used.

FOLLOWING A CIRCUIT

To follow a circuit, search in the section of the wiring diagram shown in the wiring diagram index.

NOTE: The arrow indicates the direction of the power in the circuit.

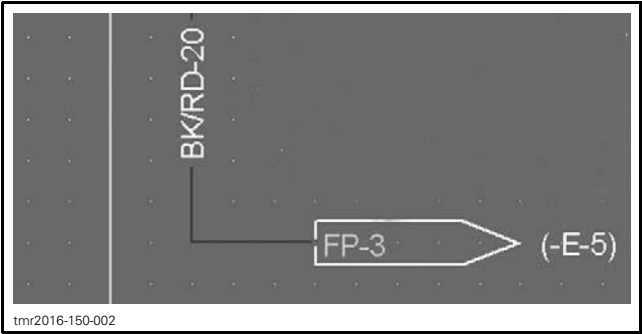
In this example, the power comes **from** section (-B-4).



TYPICAL

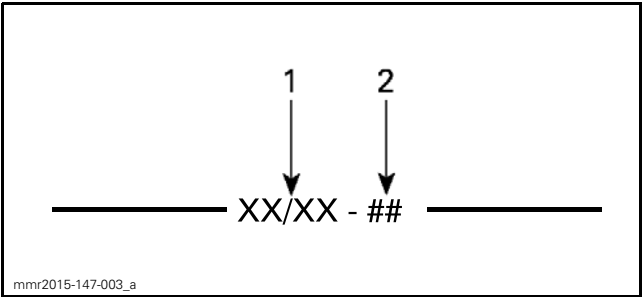
In following example, the power goes **to** the section (-E-5).

Subsection XX (WIRING DIAGRAM INFORMATION)



TYPICAL

WIRE COLORS AND SIZES



- 1. Wire color
- 2. Wire gauge (AWG)

The first color of a wire is the main color, second color is the stripe.

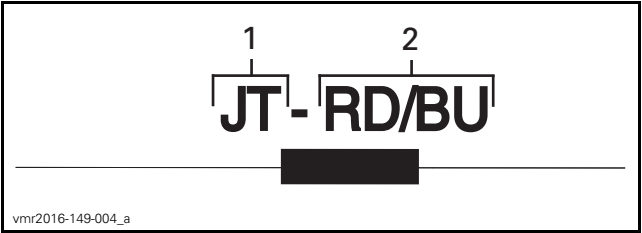
Example: YE/BK is a YELLOW wire with a BLACK stripe.

COLOR CODE					
BG	—	BEIGE	OG	—	ORANGE
BK	—	BLACK	RD	—	RED
BU	—	BLUE	VT	—	VIOLET
BN	—	BROWN	WH	—	WHITE
GN	—	GREEN	YE	—	YELLOW
GY	—	GRAY	PK	—	PINK

LT prefix means a "light" color. E.g: LT GN = Light green.

SPLICES IN WIRING HARNESS

Splices in wiring harness are indicated on the wiring diagram as follows.



- 1. JT: Splice indication
- 2. Spliced wire color

PROCEDURES

This section gives the procedures in order to quickly repair electrical harness splices.

1. Make sure to perform the usual tests described in *ELECTRICAL SYSTEM* sections before investigating the harness splices.
2. If an electrical issue can not be found with the usual tests, locate the main harness splice that is involved in the faulty circuit and repair it as per the *SPLICES REPAIR PROCEDURE*.
3. To repair a splice, we recommend the use of a tin solder meeting the followings requirements or an equivalent.

TIN SOLDER REQUIREMENTS
SN 60
PB 40
DIA 0.062
FLUX RA 2%

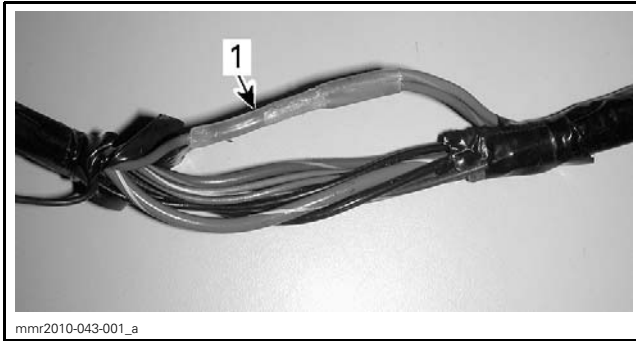
SPLICES REPAIR PROCEDURE

CASE 1: Wire Detached from Splice

 **WARNING**

Repairs described in this section should never be performed on harness sections that can be exposed to water.

1. Locate splice. Refer to splices location diagrams.
2. Remove wires from protector tube.
3. Locate the shrink tube protecting the defective splice.



1. Shrink tube

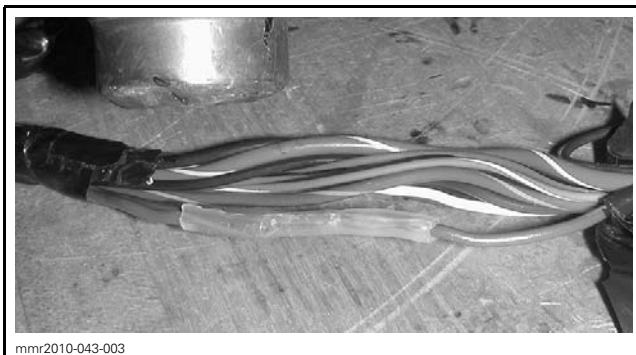
4. Remove the shrink tube.

4.1 Using a blade, cut the shrink tube.



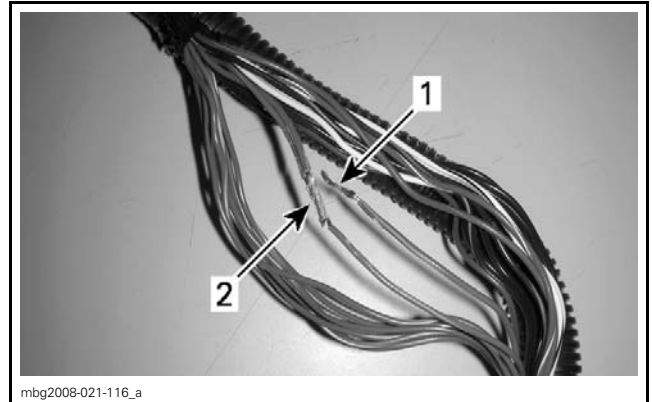
NOTICE Be careful with the blade to avoid cutting wires insulation.

4.2 Slightly heat the shrink tube using a heat gun.



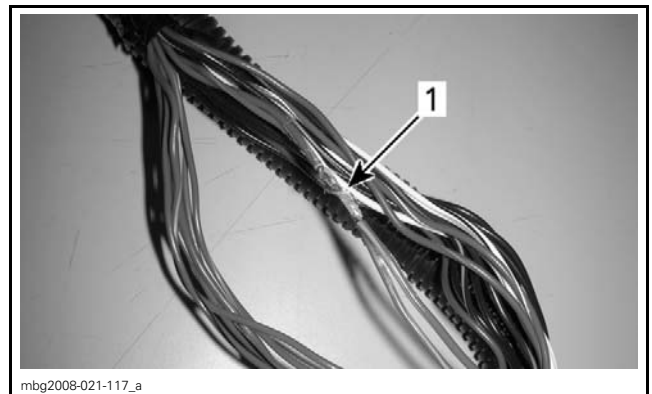
4.3 Remove the shrink tube with long nose pliers.

5. Locate detached wire from splice.



1. Detached wire
2. Splice

6. Twist detached wire around splice.



1. Twisted wire

7. Perform a tin solder on twisted wire.

8. Apply electrical tape to cover splice.

NOTE: Make sure tape overlaps on wire insulation, approximately 13 mm (1/2 in) each side.

9. Reinstall wires into protector tube.

CASE 2: Wire Broken from Splice

⚠ WARNING

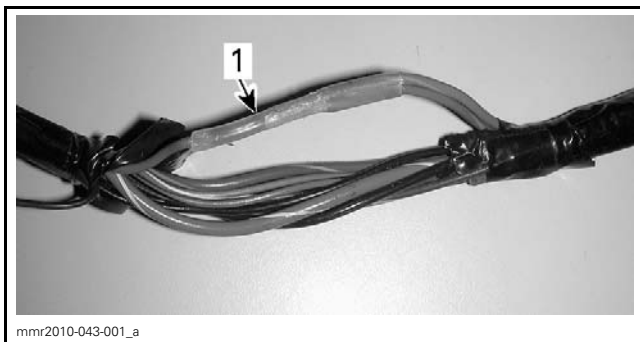
Repairs described in this section should never be performed on harness sections that can be exposed to water.

1. Locate splice. Refer to splices location diagrams.

2. Remove wires from protector tube.

3. Locate the shrink tube protecting the defective splice.

Subsection XX (WIRING DIAGRAM INFORMATION)



1. Shrink tube

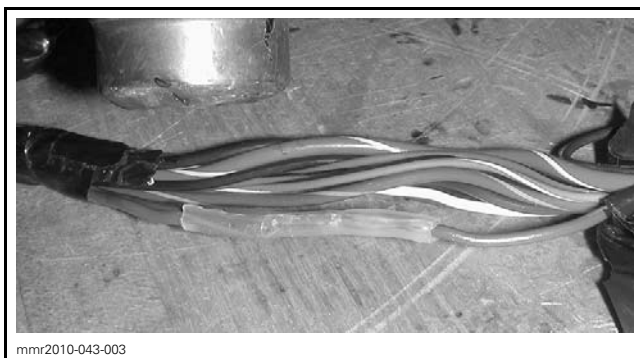
4. Remove the shrink tube.

4.1 Using a blade, cut the shrink tube.



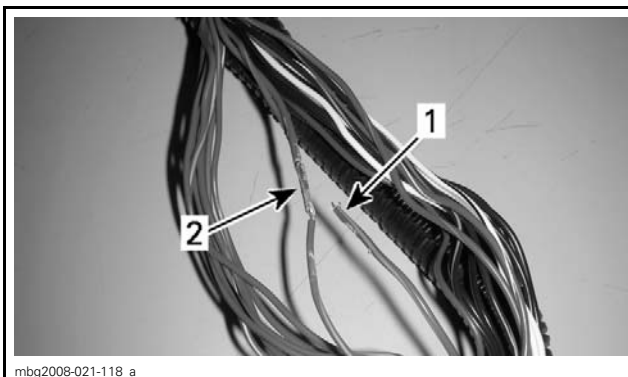
NOTICE Be careful with the blade to avoid cutting wires insulation.

4.2 Slightly heat the shrink tube using a heat gun.



4.3 Remove the shrink tube with long nose pliers.

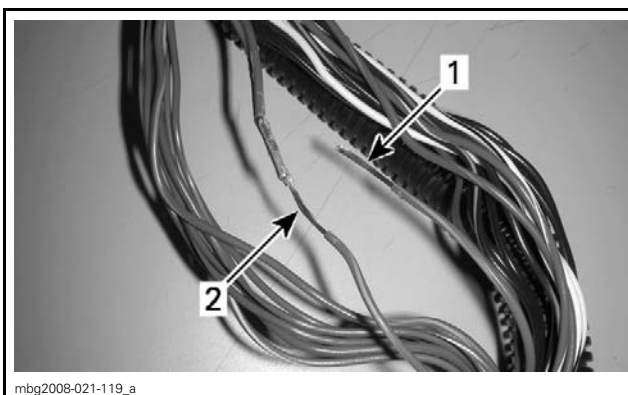
5. Locate broken wire from splice.



1. Broken wire
2. Splice

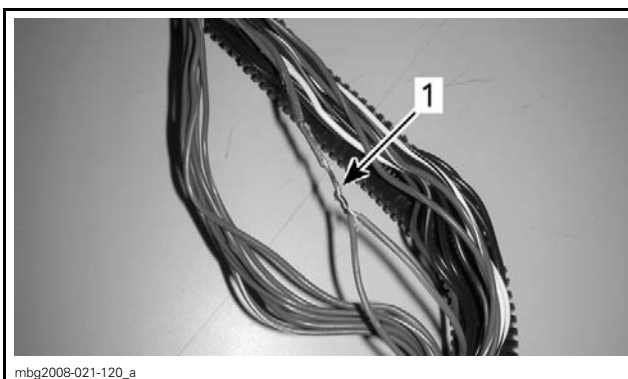
6. Strip wire insulation at the end of broken wire.

7. Strip wire insulation below the splice.



1. Broken wire stripped
2. Splice wire stripped

8. Twist wire around stripped wire.



1. Twisted wire

9. Perform a tin solder on twisted wire.

10. Apply electrical tape to cover splice.

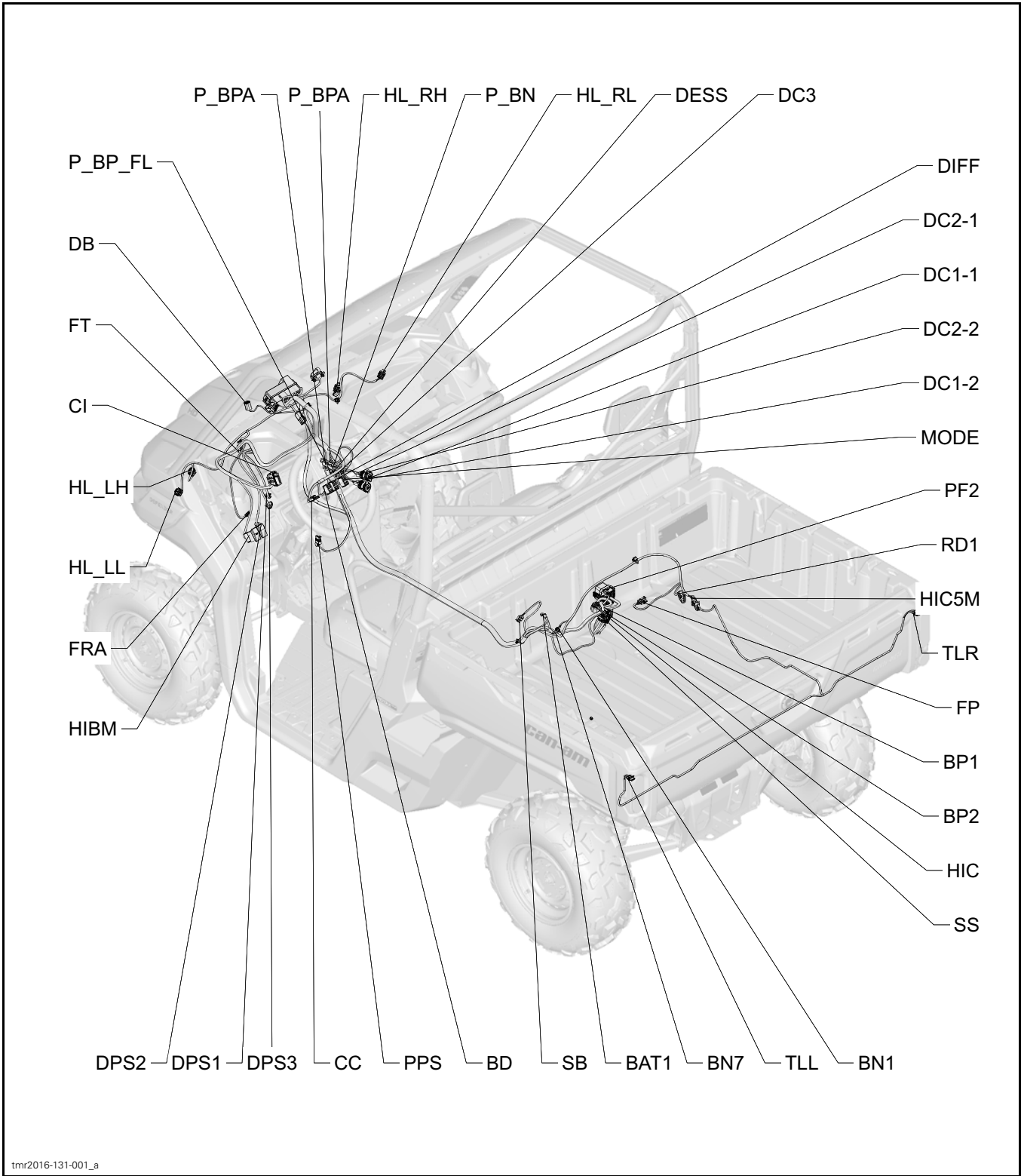
NOTE: Make sure tape overlaps on wire insulation, approximately 13 mm (1/2 in) each side.

11. Reinstall wires into protector tube.

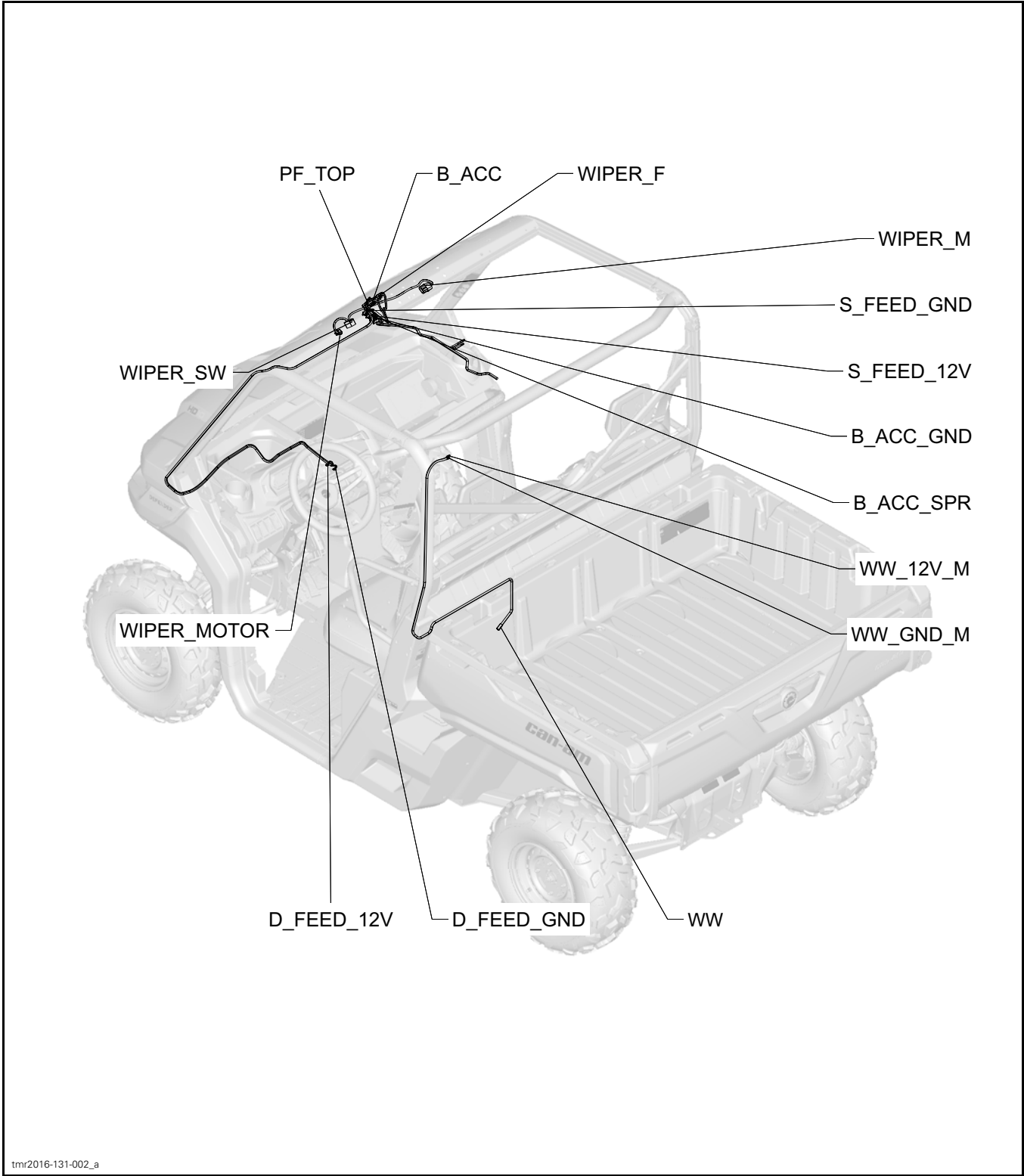
NOTE: Always perform a solder on a bigger wire (lower gage).

WIRING HARNESS AND CONNECTORS

MAIN HARNESS (XT MODEL SHOWN)

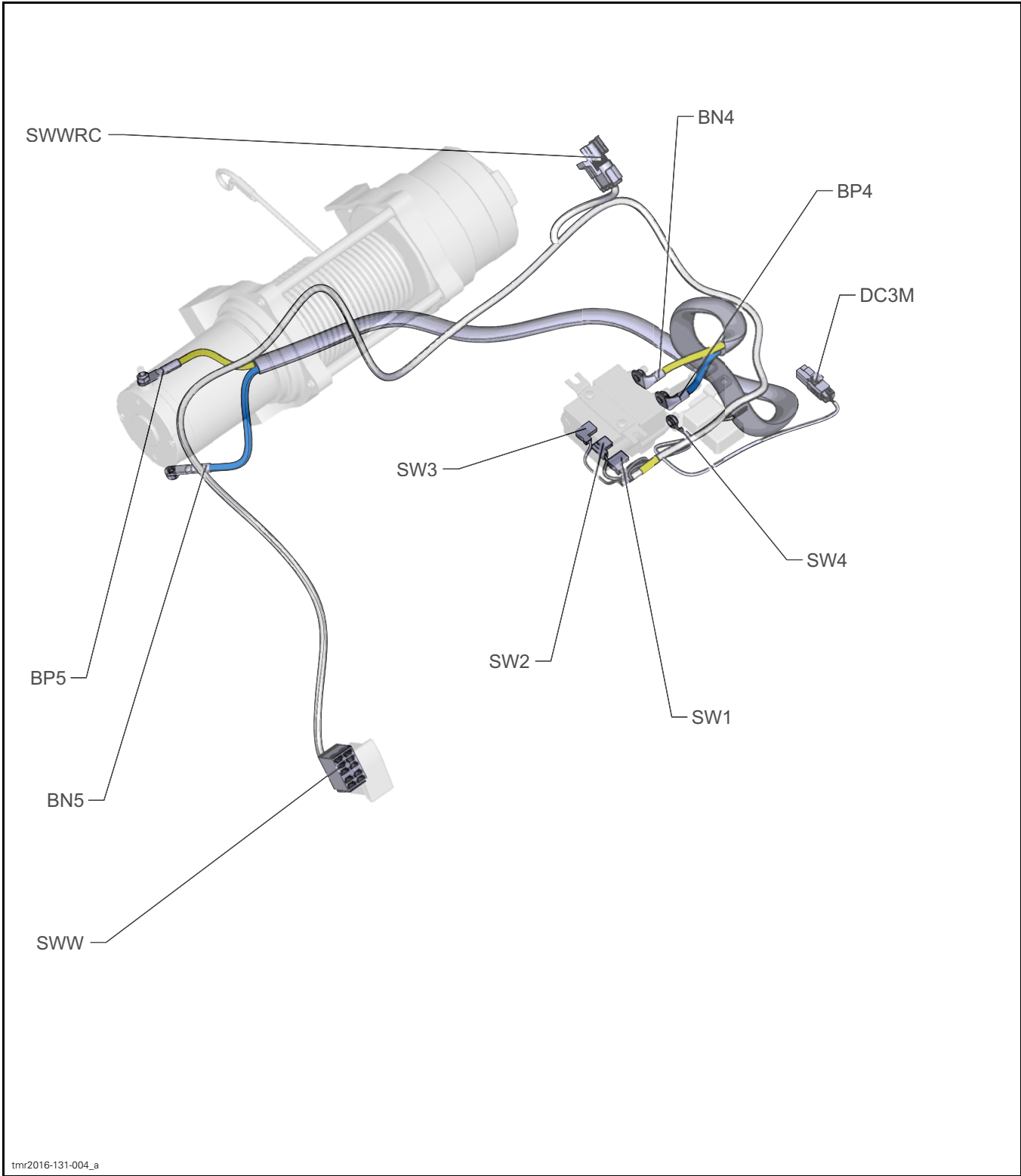


ROOF HARNESS (CAB MODELS)



tmr2016-131-002_a

WINCH HARNESS



GENERAL

For engine harness, consult applicable *ENGINE MANAGEMENT SYSTEM (EMS)* subsection.