

# LUBRICATION SYSTEM

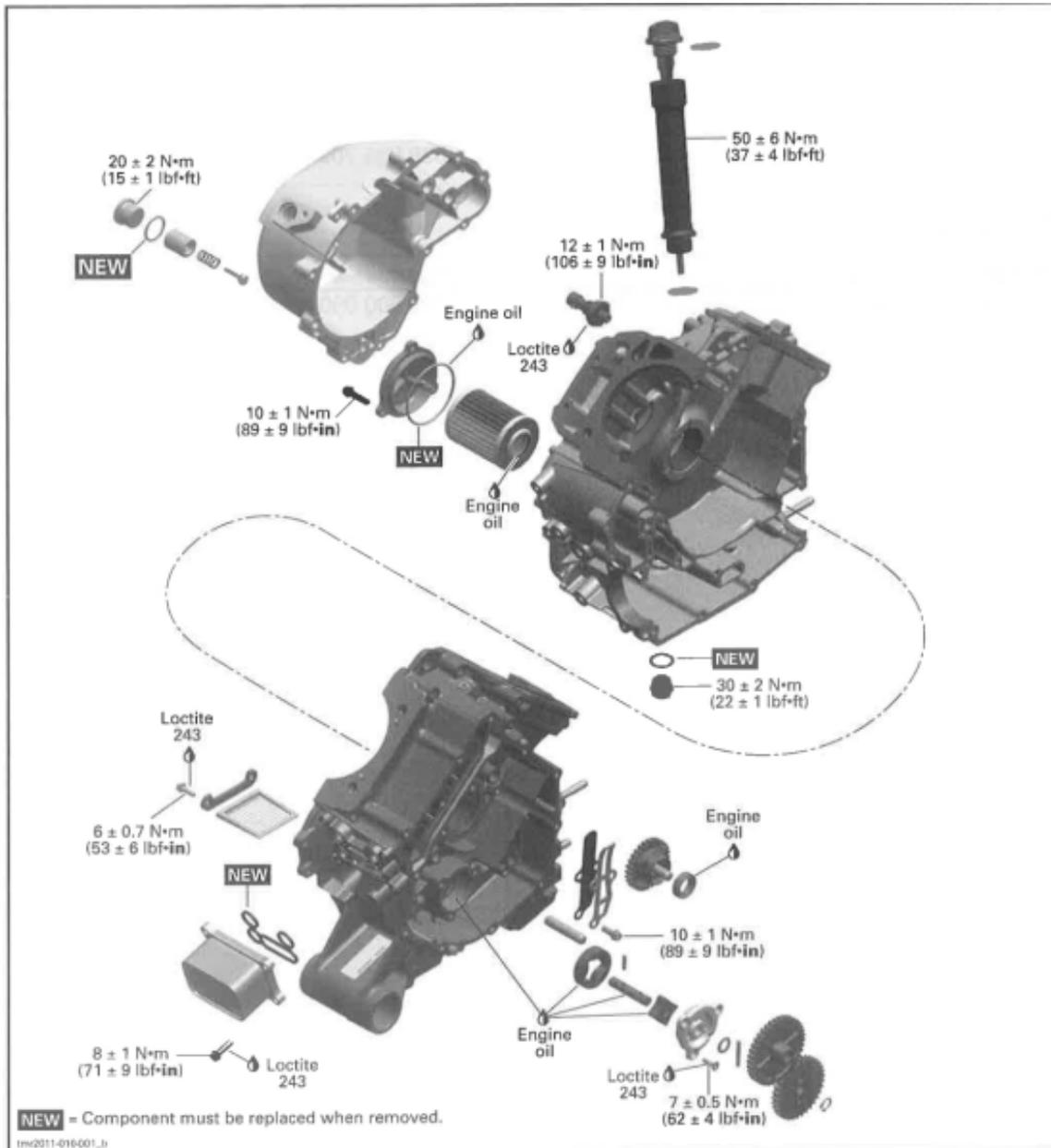
## SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE .....		
DISCONNECT TOOL .....		
PRESSURE GAUGE .....		

## SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE243 (BLUE) .....		

# COMPONENTS





## 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/N529 035 709)	
ADAPTER HOSE (P/N529 035 652)	

The engine oil pressure should be within the following values.

OIL PRESSURE	1250 RPM	6000 RPM
MINIMAL	70kPa(10PSI)	300kPa(44PSI)
NOMINAL	150kPa(22PSI)	350kPa(51PSI)
MAXIMAL	250kPa(36PSI)	450kPa(65PSI)

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

Remove oil pressure gauge and adapter hose.

**NOTE:** To remove adapter hose from oil pressure gauge, use the disconnect tool.

REQUIRED TOOL	
DISCONNECT TOOL (P/N 529 035 714)	

Reinstall the oil pressure switch,

## TROUBLESHOOTING

### LOW OR NO OIL PRESSURE

1. Oil level is too low.

-Refill engine with recommended engine oil Refer to OIL LEVEL VERIFICATION in the PERIODIC MAINTENANCE PROCEDURES subsection.

-Check for high oil consumption ,refer to HIGH OIL CONSUMPTION in the TROUBLESHOOTING subsection.

-Check for engine oil leaks. For leak indicator hole, refer to COOLING SYSTEM INSPECTION in the PERIODIC MAINTENANCE PROCEDURES subsection. Repair if necessary.

2. Use of unsuitable engine oil type.

-Replace engine oil by the recommended engine oil.

3. Clogged oil filter.

-Replace oil and oil filter at the same time.

4. Defective oil pressure switch.

-Test oil pressure switch, see procedure in this subsection.

5. Defective or worn oil pump.

-Check oil pump, see procedure in this subsection.

6. Defective engine oil pressure regulator.

Check engine oil pressure regulator ,see procedure in this subsection.

7. Worn plain bearings in crankcase.

-Check plain bearings clearance, refer to BOTTOM subsection.

8. Clogged engine oil strainer.

Check engine oil strainer, see procedure in this subsection.

### OIL CONTAMINATION

1. Defective water pump seal ring or rotary seal.

- Check for oil or coolant leak from indicator hole near water pump, refer to COOLING SYSTEM INSPECTION in the PERIODIC MAINTENANCE PROCEDURES subsection. Replace seal if necessary.

2. Cylinder head or cylinder base gasket leak

-Retighten cylinder head to specified torque, refer to TOP END subsection .replace gasket if tightening does not solve the problem.

3. Engine internal damage.

-Repair engine.

4. Oil cooler gasket leak.

-Replace oil cooler gasket and change engine oil.

## HIGH OIL CONSUMPTION

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

## PROCEDURES

### OIL COOLER

#### Oil Cooler Access

Refer to BODY and remove:

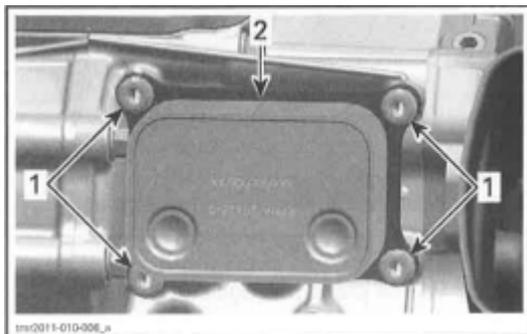
- Upper console
- Lower console
- RH lateral console panel
- RH inner panel
- Fuel tank cowl.

#### Oil Cooler Removal

Refer to the PERIODIC MAINTENANCE PROCEDURES subsection to:

- Drain engine oil.
- Drain engine coolant.

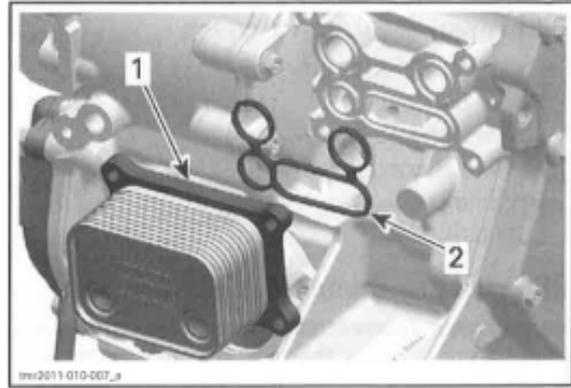
Remove oil cooler retaining screws.



1. Retaining screws
2. Oil cooler

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

Remove oil cooler and discard gasket.



1. Oil cooler
2. Gasket

#### Oil Cooler Inspection

Check oil cooler for cracks or other damage.

Replace if necessary.

#### Oil Cooler Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

Wipe off any oil and coolant spillage.

Install a NEW gasket.

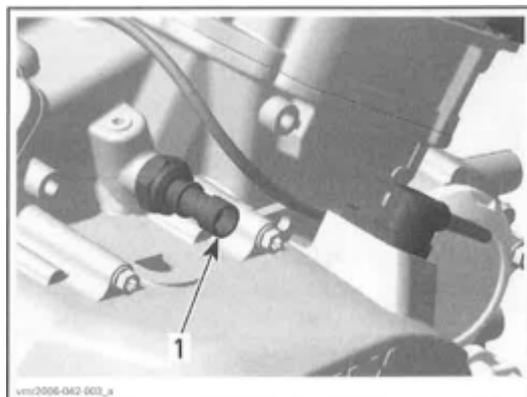
Refer to PERIODIC MAINTENANCE PROCEDURES subsection and carry out the following:

- Refill engine oil with recommended oil and at the proper oil level.
- Refill and bleed cooling system.

### OIL PRESSURE SWITCH (OPS)

#### Oil Pressure Switch Location

The oil pressure switch is located at engine MAG side above the magneto cover.



7. Oil pressure switch

### Oil Pressure Switch Access

Refer to BODY and remove:

- Upper console
- Lower console
- RH lateral console panel
- RH inner panel
- Fuel tank cowl.

### Oil Pressure Switch Activation

The oil pressure switch activates when the engine oil pressure is lower than the operating pressure.

<b>OIL PRESSURE SWITCH OPEATING PRESSURE</b>
30kpa ± 10kap (4.35PSI ± 1.45 PSI)

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

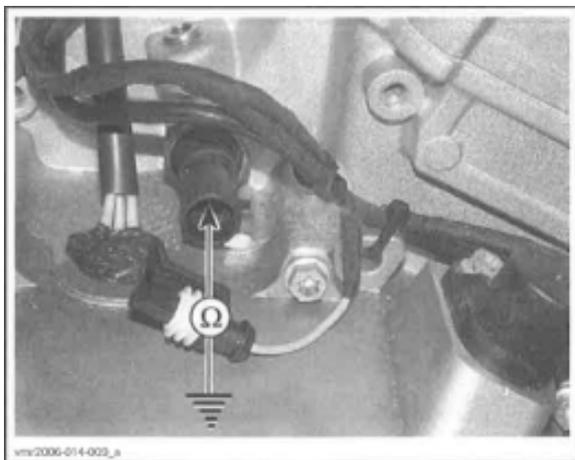
If the engine oil pressure is good perform the oil pressure switch resistance test.

### Oil Pressure Switch Resistance Test

Disconnect the connector from the oil pressure switch.

Use a multimeter to check the resistance between as shown.

OPS CONNECTOR		ENGINE NOT RUNNING	ENGINE RUNNING
PIN		RESISTANCE(Ω)	
4	Engine ground	Close to 0Ω (normally reaches	Infinite(open) when pressure reaches 30kPa±10kPa (4.35PSI±1.45PSI)



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

If the values are correct, check wiring.

### Oil Pressure Switch Removal

Unplug the oil pressure switch connector.

Unscrew and remove oil pressure switch.

### Oil Pressure Switch Installation

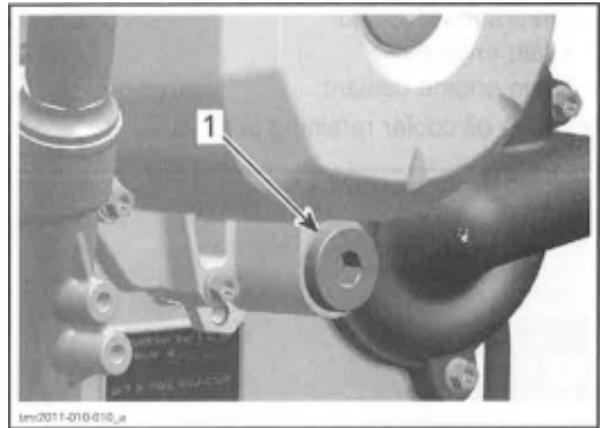
Tighten oil pressure switch to specified torque.

OIL PRESSURE SWITCH	
Service product	LOCTITE243 (BLUE) (P/N293 800 060)
Tightening torque	12N·m±1 N·m (106lbf·in±9lbf·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 400kPa (58PSI).

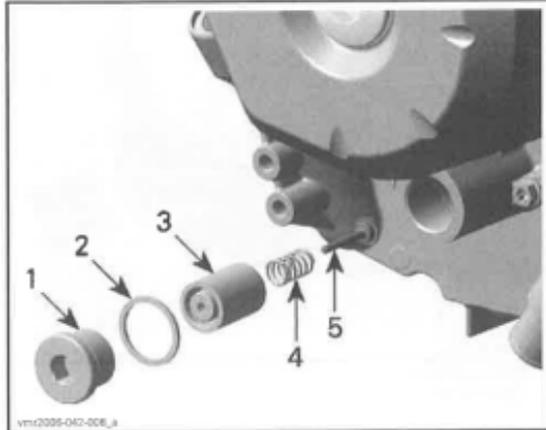
### Oil Pressure Regulator Access

Refer to BODY and remove:

- Upper console
- Lower console
- RH lateral console panel
- RH inner panel
- Fuel tank cowl.

## Oil Pressure Regulator Removal

Remove plug screw and pull oil pressure regulator out.



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

## Oil Pressure Regulator Inspection

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

Check spring for free length.

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

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

## Oil Pressure Regulator Installation

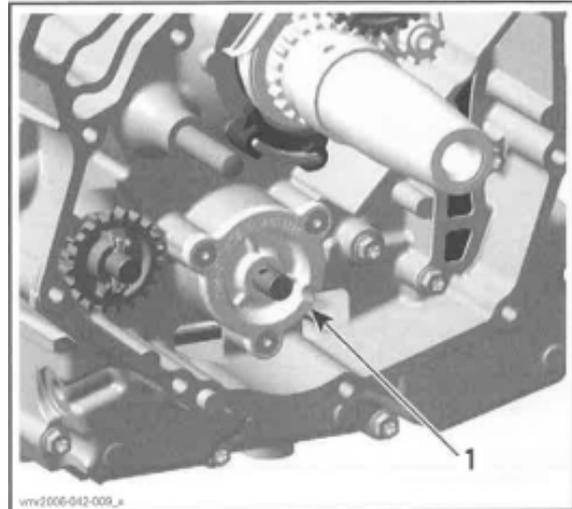
For installation, reverse the removal procedure. Pay attention to the following details.

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

## OIL PUMP

### Oil Pump Location

The oil pump is located on the engine PT0 side (behind PT0 cover).

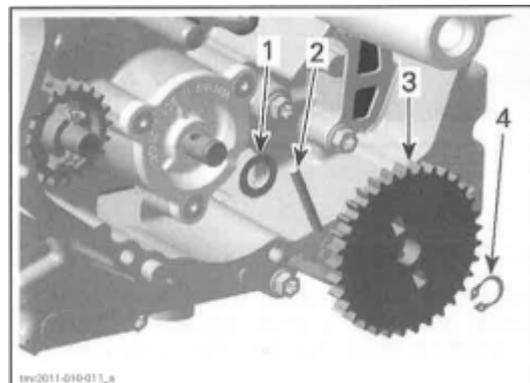


1. Oil pump

## Oil Pump Removal

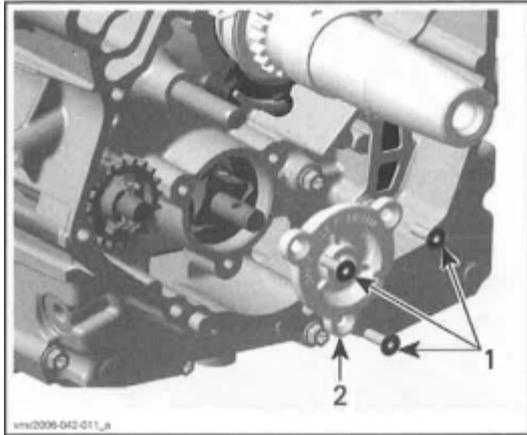
Remove the PT0 cover. Refer to PT0 COVER in the BOTTOM END subsection.

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

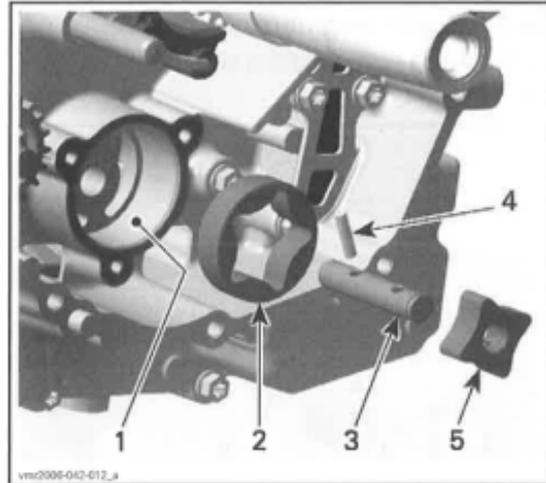


1. Thrust washer
2. Needle pin
3. Oil pump gear
4. Retaining ring

2. Remove oil pump cover screws and pull oil pump cover out..

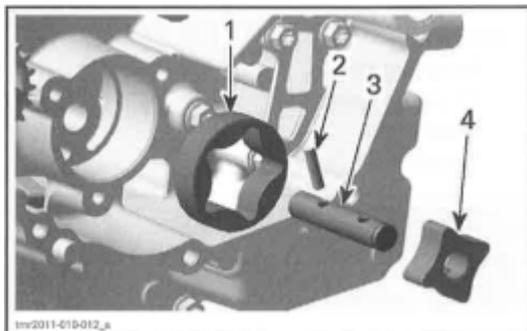


1. Retaining screws
2. Oil pump cover
3. Remove oil pump shaft with needle pin and inner rotor.
4. Remove outer rotor.

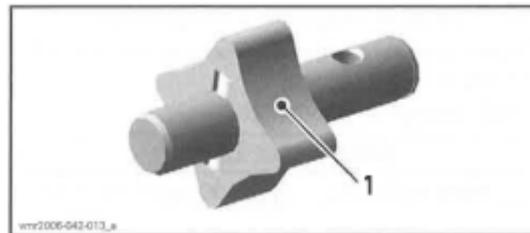


1. Oil pump bore
2. Outer rotor
3. Oil pump shaft
4. Needle pin
5. Inner rotor

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



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



1. Pittings on the teeth

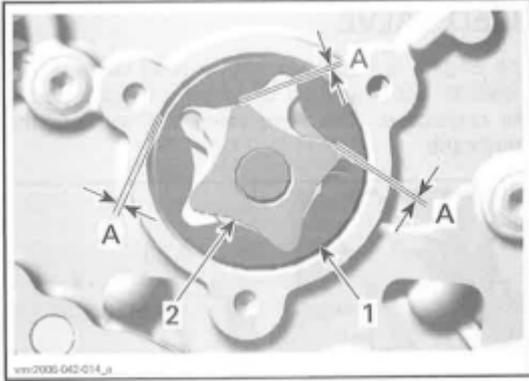
Using a feeler gauge, measure the clearance of inner and outer rotors as shown.

### Oil Pump Inspection

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

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

CLEARANCE OF INNER AND OUTER ROTOR	
SERNICE LIMIT	0.25mm (.0098in)



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

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 COVER- MEASUREMENT "B"

Subtract measurement "B" from measurement "A" to obtain axial clearance.

OIL PUMP AXIAL CLEARANCE	
SERVICE LIMIT	0.2 mm(.0079in)

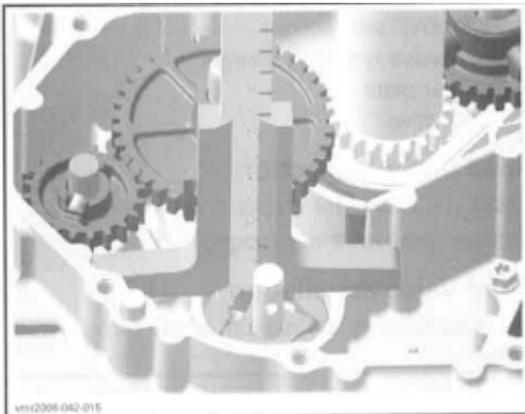
NOTE: When the axial clearance of the oil pump shaft assembly increases, the oil pressure decreases.

### Oil Pump Installation

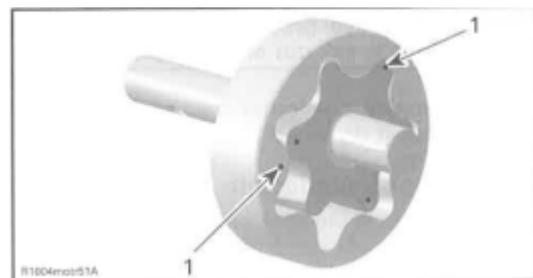
For installation, reverse the removal procedure.

Pay attention to the following details.

NOTE: When installing the oil pump rotors, make sure both markings are on the outer side.



OIL PUMP- MEASUREMENT "A"



### TYPICAL

#### 1. Markings

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

### Oil Pump Final Test

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

## ENGINE OIL STRAINER

### Oil Strainer Location

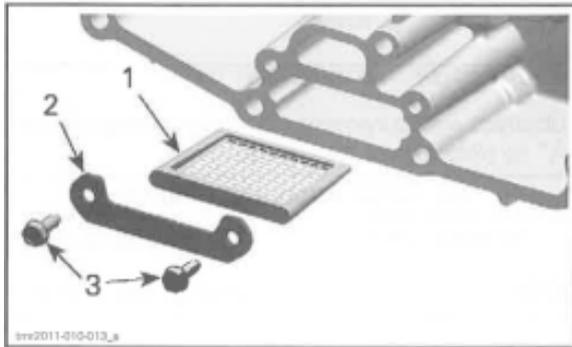
The engine oil strainer is located between both crankcase halves.

### Oil Strainer Removal

Separate crankcase halves .Refer to BOTTOM END subsection.

Remove screws and retaining plate.

Pull out engine oil strainer.



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

### Oil Strainer Cleaning and Inspection

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

#### ▲WARNING

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

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

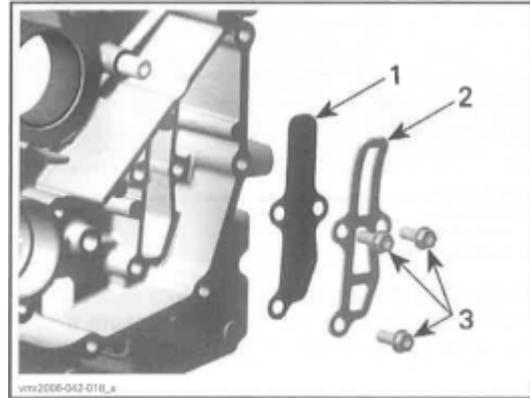
### Oil Strainer Installation

The installation is the reverse of the removal procedure.

OIL STRAINER RETAINING SCREWS	
Service product	LOCTITE243 (BLUE) (P/N293 800 060)
Tightening torque	6N·m± 0.7N·m (53lbf·in±6lbf·in)

## REED VALVE

The engine is equipped with a reed valve which prevents accumulation of larger oil quantities in the crankcase. The reed valve is fitted into the crankcase.



1. Reed valve
2. Stopper
3. Screws

### Reed Valve Removal

Remove:

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

### Reed Valve Inspection

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

### Reed Valve Installation

The installation is the reverse of the removal procedure.

REED VALVE RETAINING SCREW	
Tightening torque	10N·m±1N·m (89lbf·in±9lbf·in)

**COOLING SYSTEM**

**SERVICE TOOLS**

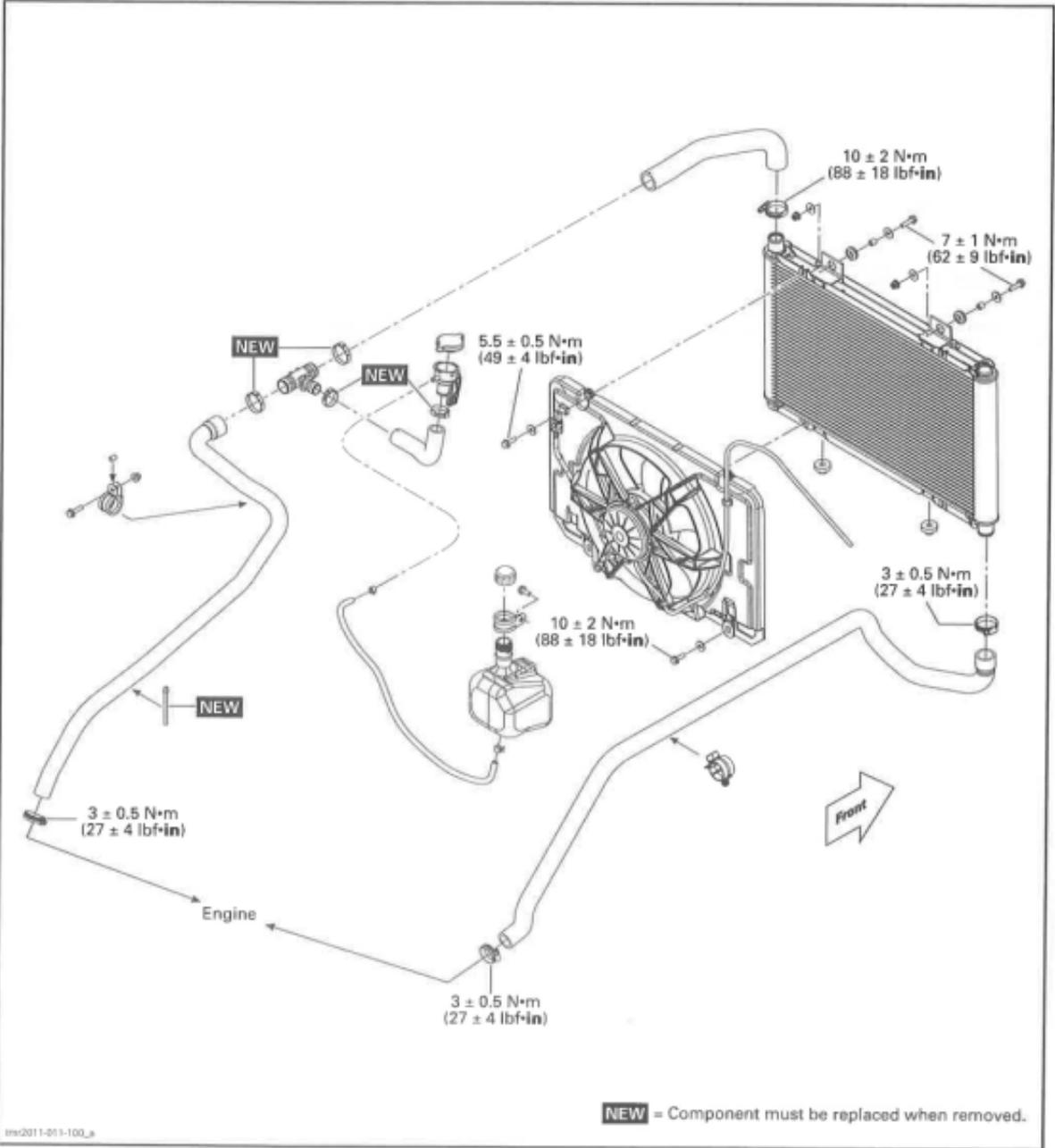
Description	Part Number	Page
BLIND HOLE PULLER KIT .....		
HANDLE .....		
LARGE HOSE PINCHER .....		
OIL SEAL PUSHER .....		
ROTARY SEAL PUSHER PLATE .....		
SEAL PUSHER .....		

**SERVICE PRODUCTS**

Description	Part Number	Page
DOW CORNING111 .....		
LOCTITE243 (BLUE) .....		

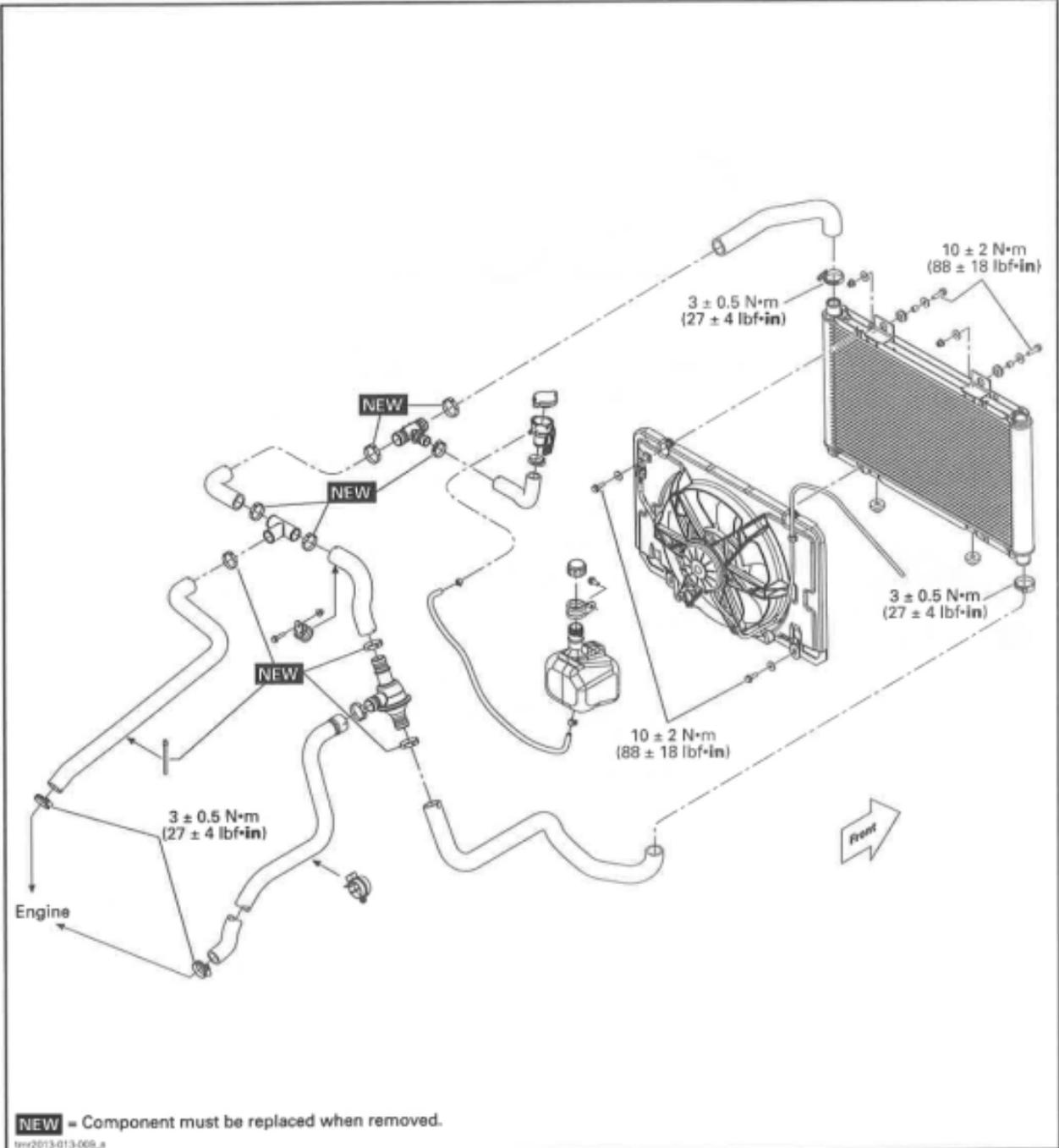
# RADIATOR

800R Engine



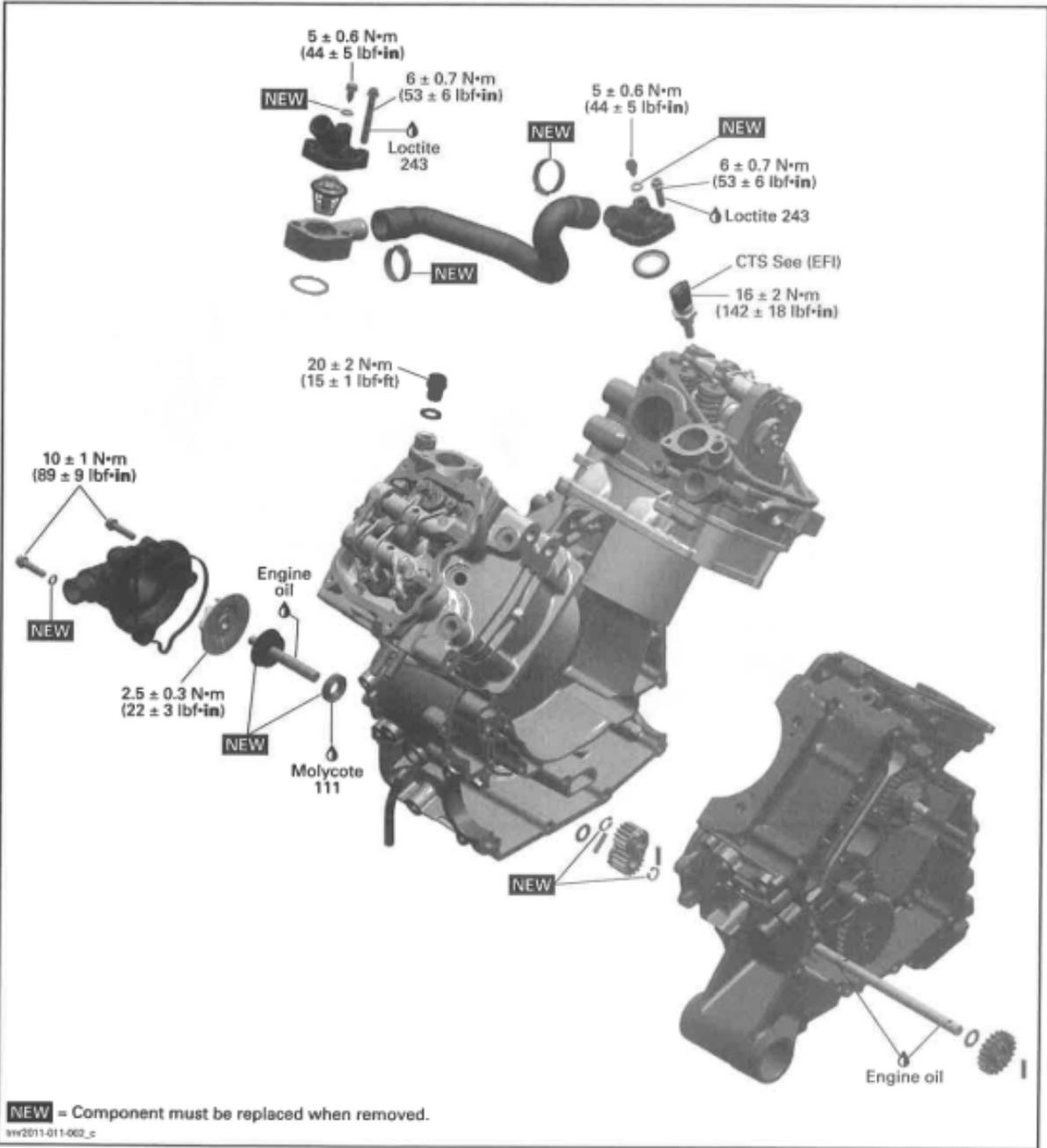
# RADIATOR

1000R Engine



# WATER PUMP

800R Engine





## GENERAL

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

## PROCEDURES

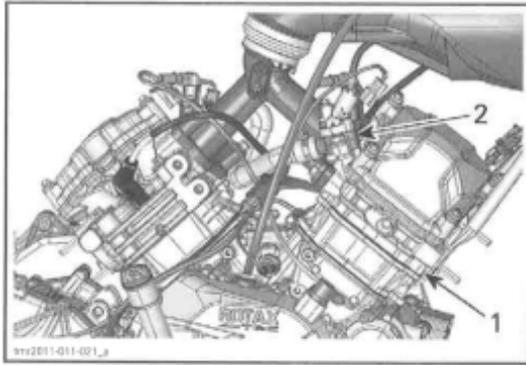
### THERMOSTAT

The thermostat is a single action type.

#### Thermostat Location

##### 800R Model

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

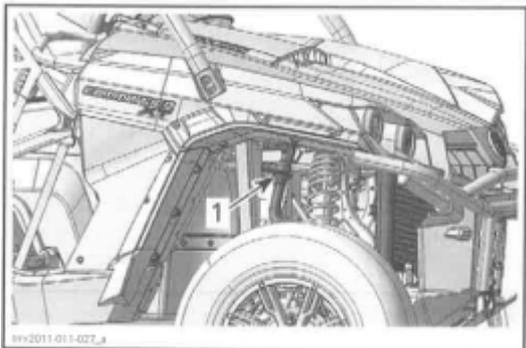


TYPICAL-THERMOSTAL LOCATION 800R MODEL

1. Front cylinder
2. Thermostat housing

##### 1000 Models

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



THERMOSTAT LOCATION -RH FRONT WHELL WELL ACCESS

1. In-line thermostat

## Thermostat Removal

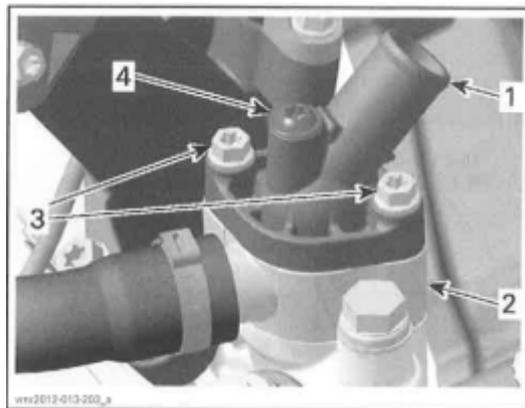
### 800R Models

1. Install a hose pincher on both radiator hoses

REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 520 032 500)	

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

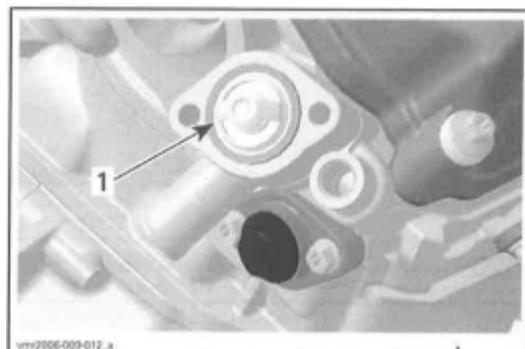
3. Remove thermostat housing screws and remove thermostat cover.



THERMOSTAT LOCATION FRONT CYLINDER HEAD

1. Thermostat cover
2. Thermostat housing
3. Cover screws
4. Bleed screw

4. Pull thermostat and gasket from thermostat housing.



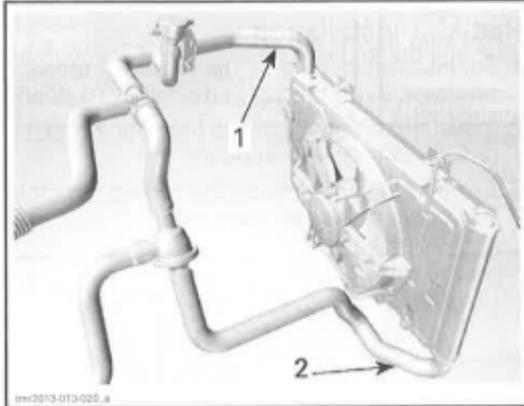
TYPICAL

1. Thermostat with gasket

1000 Models

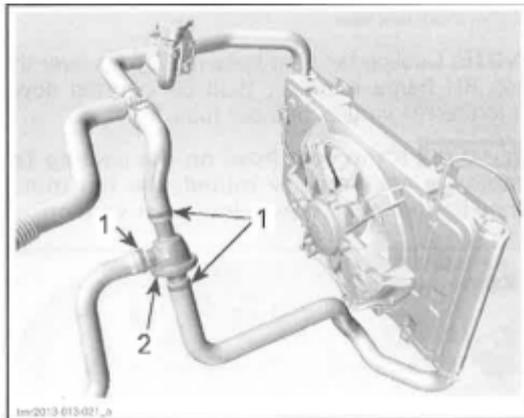
1. Install a hose pincher on both radiator hoses

REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 520 032 500)	



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

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



1. Clamps
2. Thermostat

#### Thermostat Test

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

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

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

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

#### Thermostat Installation

##### 800R Models

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

THERMOSTAT COVER INSTALLATION		
GASKET	PRODUCT	TIGHTENING TIRQUE
New	LOCTITE 243 (BLUE) (P/N293800060) on screws	6N·m± 0.6N·m (53lbf·in±5lbf·in)

1000 Models

Reverse removal procedures.

All Models

Refill cooling system.

Bleed cooling system, refer to PERIDOC MAIN PROCEDURES subsection.

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

Check for coolant leaks.

#### RADATIR

##### Radiator inspection

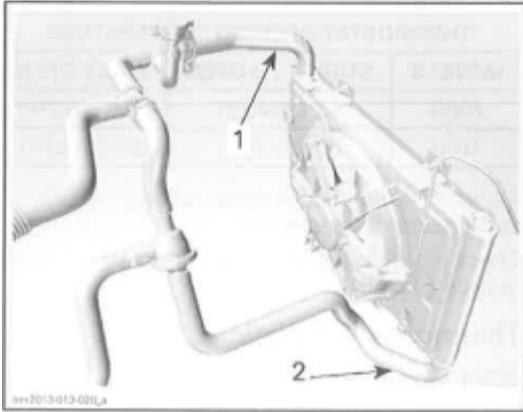
Check radiating fins for clogging or damage.

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

##### Radiator Removal

1. Install a hose pincher on both radiator hoses.

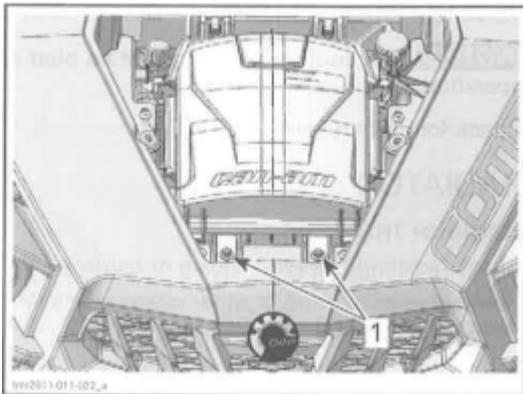
REQUIRED TOOL	
LARGE HOSE PINCHER (P/N 520 032 500)	



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

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

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



1. Forward air filter housing mounting screws to remove

Model Equipped with a Winch

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

All Models

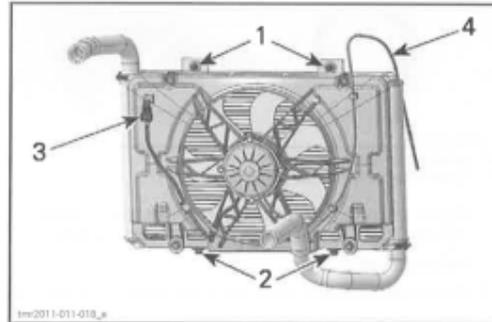
8. Lift radiator and tilt its lower end towards the front of the vehicle.

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

9. Carefully remove radiator through LH wheel well.

#### Radiator Installation

1. For installation, reverse the removal procedure however, pay attention to the following details.
2. install the rubber bushings between bottom of radiator and radiator support.
3. Ensure the vent hose on the cooling fan motor is properly routed as illustrated.

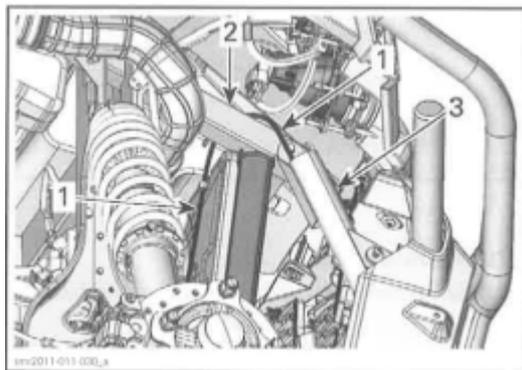


#### RADIATOR – REAR VIEW

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

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

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



1. Cooling fan vent hose
2. RH top frame member
3. RH vertical bumper tube

4. Fill radiator with the recommended coolant.  
Refer to PERIODIC MAINTENANCE PROCEDURE subsection.

5. Bleed the cooling system, refer to MAINTENANCE PROCEDURE subsection.

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

6. Check for coolant leaks from radiator and hoses.

### COOLANT TEMPERATURE SENSOR (CTS)

Refer to ELECTRONIC FUEL INJECTION (EFI) subsection.

### RADIATOR COOLING FAN RELAY (R1)

#### Relay Installation

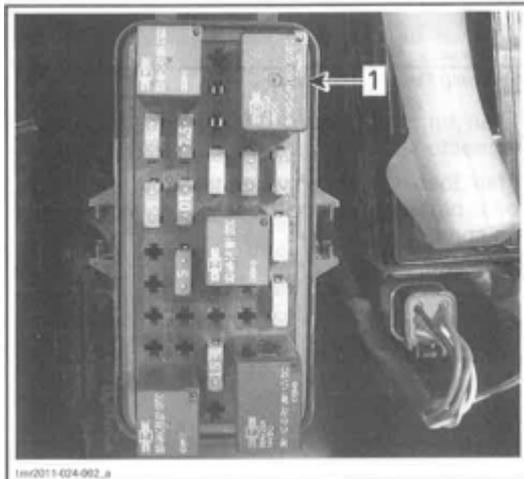
#### (Radiator Cooling Fan)

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

### RADIATOR COOLING FAN

#### Radiator Cooling Fan Operation

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



1. R1: Radiator cooling fan relay

#### Relay Operation Test

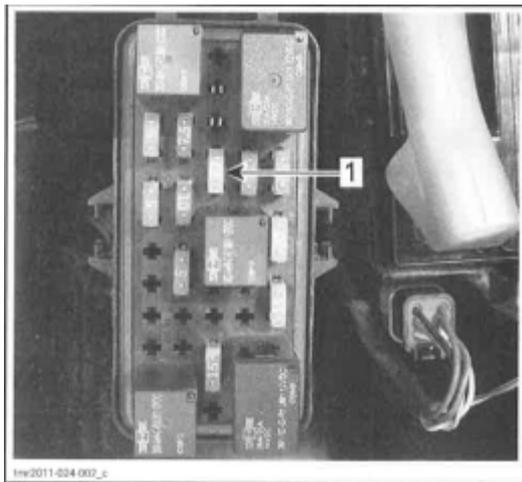
#### (Radiator Cooling Fan)

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

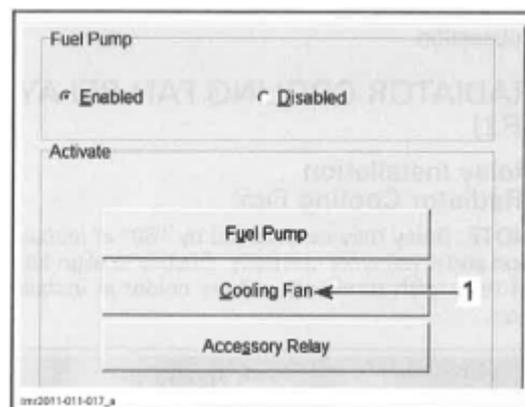
ENGINE TEMPERATURE	INTAKE TEMPERATURE	COOLING FAN	CHECK ENGINE LIGHT	MESSAGE IN MULTIFUNCTION GAUGE	LIMP HOME MODE
—	88°C(190°F)	Turns ON	—	—	—
—	85°C(185°F)	Turn OFF	—	—	—
96°C(205°F)	—	Turns ON	—	—	—
962°C(198°F)	—	Turn OFF	—	—	—
115°C(239°F)	—	ON	Turns ON	-Check engine -HI Temp	—
118°C(244°F)	—	ON	Flashes	Limp Home	Engine limited to4000

### Radiator Cooling Fan Fuse Location

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



1. Cooling fan fuse



1. Cooling fan activation button

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

### Radiator Cooling Fan Test

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

COOLING FAN TROUBLESHOOTING CHART		
Is fan working?	YES→	Everything is OK
NO		
Check "Relay driver fuse(5A) and fan fuse (30A). Is fuse burnt?"	YES→	Replace fuse Is fan working?
NO		
Bypass fan relay R1		
箭头		
Fan turns?	YES→	Replace relay Is fan working?
NO		
Apply 12 Vdc to fan connector		
箭头		
Fan turns?	NO→	Replace fan Is fan working?
YES		
Check CTS		
箭头		
CTS works ?	NO→	Replace CTS Is fan working?
YES		
Check wiring harness and connectors		
箭头		
Harness and connectors good?	NO→	Repair or replace defective part(s)
YES		
Try a new ECM	→	Is fan working?

### Radiator Cooling Fan Removal

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

### Radiator Cooling Fan Installation

For the installation, reverse the removal procedure.

## WATER PUMP HOUSING

### Water Pump Housing Location

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

### Water Pump Housing Access

Remove fuel tank. Refer to FUEL SYSTEM subsection.

### Water Pump Housing Removal

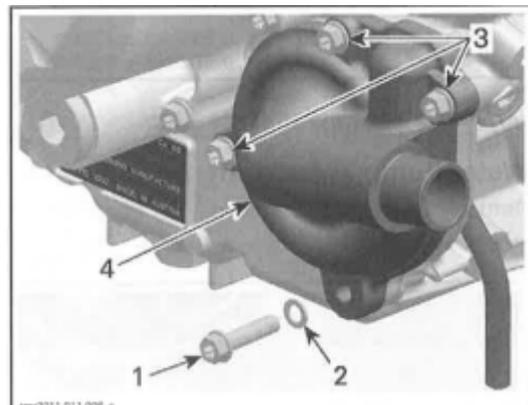
#### △WARNING

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

Drain cooling system. Refer to PERIODIC MAINTENANCE PROCEDURES subsection.

Remove radiator outlet hose from water pump housing.

Remove screws retaining water pump housing.

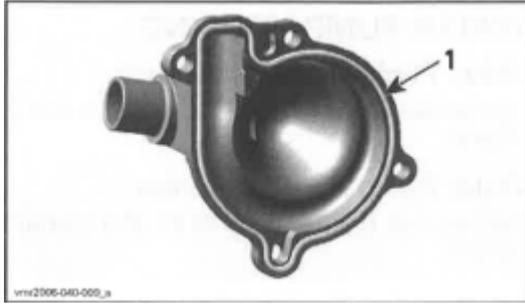


1. Coolant drain plug
2. Sealing ring,
3. Screws
4. Water pump housing

Pull water pump housing to remove it.

### Water Pump Housing Inspection

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



TYPICAL  
1. Gasket

### Water Pump Housing Installation

The installation is the opposite of the removal procedure.

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

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

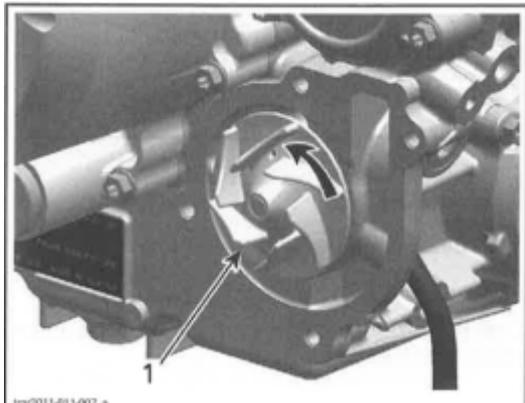
TIGHTENING TORQUE	
Water pump housing screws	10N·m±1 N.m (89lbf·in±9lbf·in)

## WATER PUMP IMPELLER

### Water Pump Impeller Removal

Remove water pump housing.

Unscrew impeller.



1. Turn counterclockwise unscrew

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

### Water Pump Impeller Inspection

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

### Water Pump Impeller Installation

The installation is the opposite of the removal procedure.

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

## WATER PUMP SHAFT AND SEALS

Use these guidelines to service these parts

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

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

### Water Pump Seals Replacement (Assembled Engine)

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

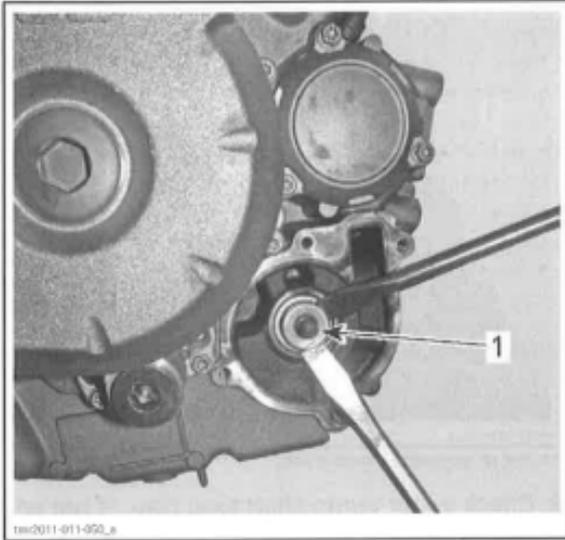
#### Seals Removal

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

1. Remove the following parts, see procedure in this subsection.

- WATER PUMP HOUSING
- WATER PUMP IMPELLER

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

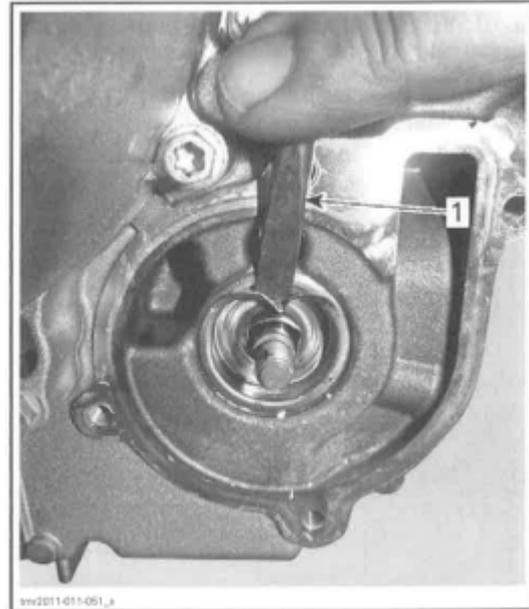


7. Inner part of rotary seal



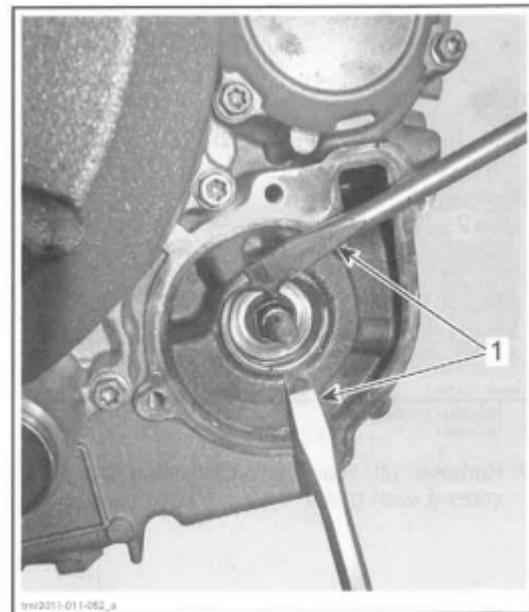
TYPICAL – INNER PARTS OF ROTARY SEAL REMOVED

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



1. Small chisel

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

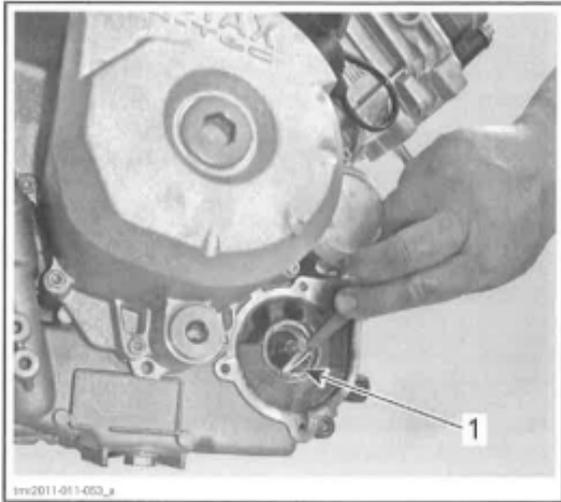


7. Screwdrivers

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

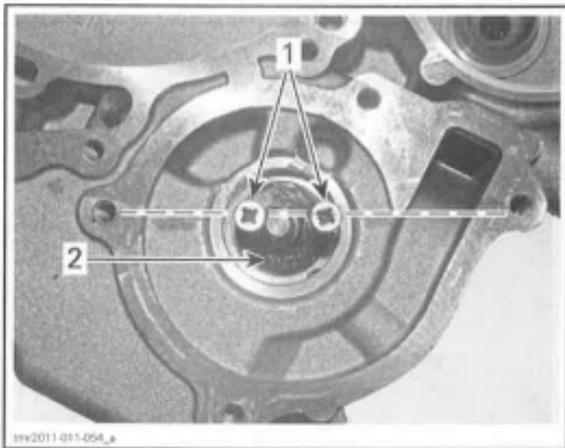
5. Thoroughly remove carefully sealing residue and burr of rotary seal using a scraper.

**NOTICE** Be careful not to damage water pump shaft.



1. Scraper

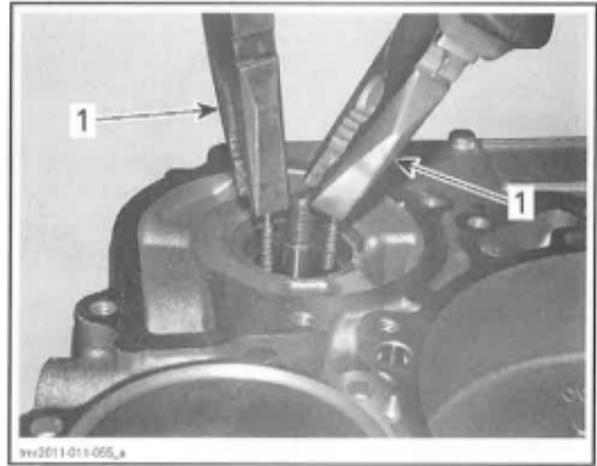
6. Install 2 wooden screws in the seal



1. Wooden screws

2. Oil seal

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



1. Pull on screws to remove seal

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

9. Clean oil seal seat.



### Seals Installation

1. Apply engine oil on water pump shaft.

2. Apply grease to the lips of the oil seal.

3. Carefully install the oil seal over the water pump shaft.

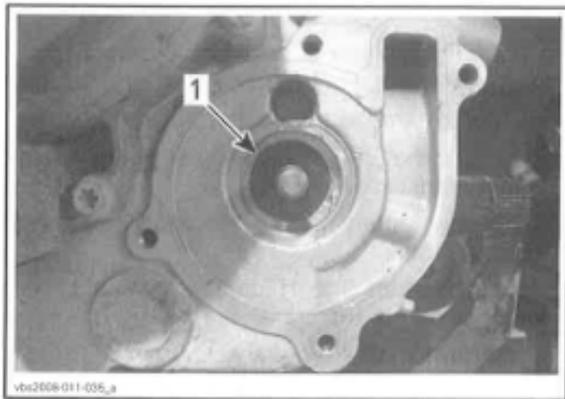
4. Push the oil seal into the water pump cavity.

REQUIRED TOOL
17mm(11/16in) deep socket



## OIL SEAL INSTALLATION

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



### TYPICAL

1. Oil seal properly seated

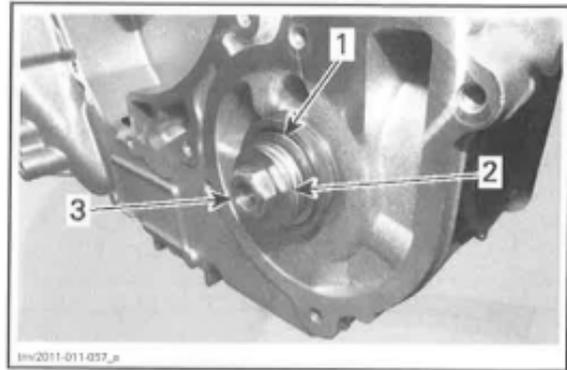
6. Apply engine oil on water pump shaft.  
7. Place rotary seal onto water pump shaft and pull out water pump shaft by hand.

**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/N420227935) onto water pump shaft.

9. Install a M8×1.25 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. M8×1.25 nut (P/N 233 281 414)

11. Remove M8 nut.

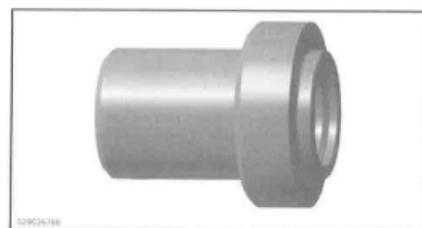
NOTE: The robust M8 flat washer remains on water pump shaft.

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

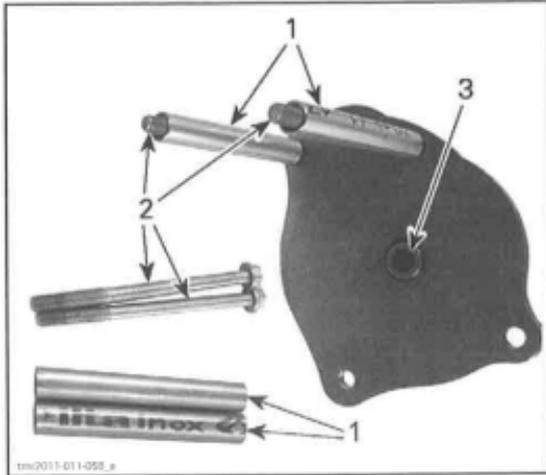
REQUIRED TOOLS
ROTARY SEAL PUSHER PLATE (P/N529 036 130)
4× M6×85 screws(P/N420440347)
4× tubes70mm(2.75in)
SEAL PUSHER(P/N529 035 766)



ROTARY SEAL PUSHER PLATE (P/N529 036 130)



SEAL PUSHER (P/N529 035 766)



#### ROTARY SEAL PUSHER PLATE ASSEMBLY

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

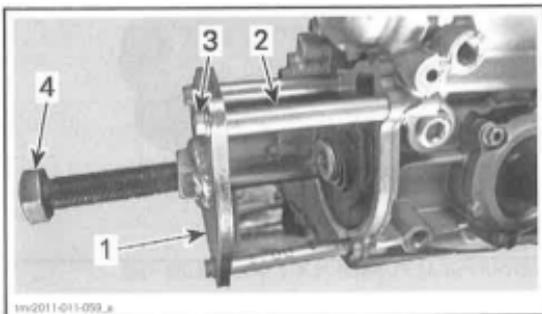
NOTE: Make sure pusher bolt has a plane surface.

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.

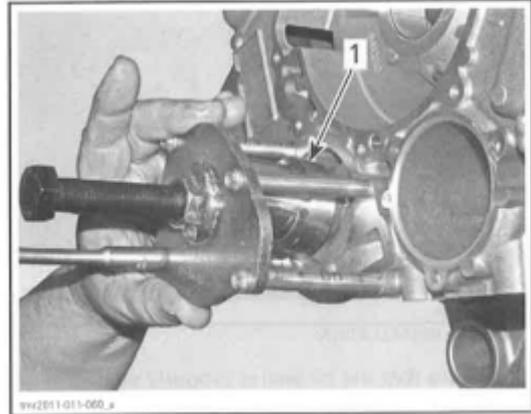
**NOTICE** Do not use pneumatic or electric tools for tightening screws.



#### ROTARY SEAL PUSHER PLATE INSTALLTION

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

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



#### SEAL PUSHER INSTALLTION

1. Seal puslleraill gneol with pusher bolt

12.5 lighten the pusher bolt by hand until it stops against the seal pusher.

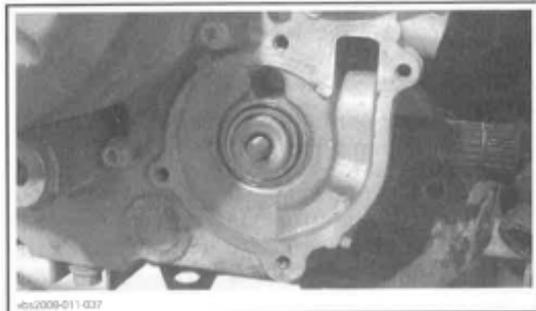
13. Carefully thread the pusher bolt 1-1/2 turns.

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.

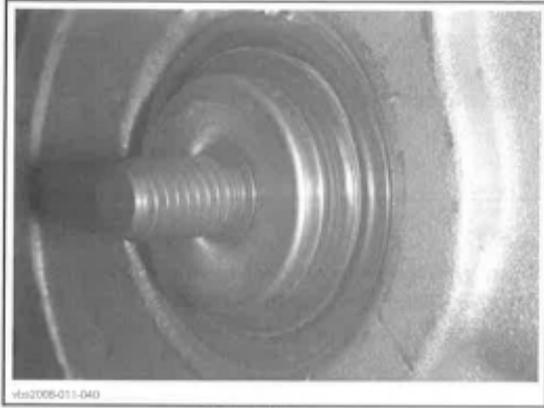


#### ROTARY SEAL PROPERLY SEATED ON CRANKCASE

17. Carry out the final adjustment of the water pump shaft as follows.

17.1 Install M8×1.25 nut (P/N233 281 414) onto water pump shaft.

17.2 Carefully thread M8 nut until the rotary seal is flush with the end of water pump shaft threads.



WATER PUMP SHAFT PROPERLY ADJUSTED WITH ROTARY SEAL

**NOTICE** The water pump shaft must be properly adjusted with rotary seal.

The water pump shaft must move freely while pushing it toward the crankcase.

18. Install the following parts, see procedure in this subsection

- WATER PUMP IMPELLER
- WATER PUMP HOUSING

19. Refill and bleed cooling system. Refer to PERIODIC MAINTENANCE PROCEDURES subsection.

20. Check cooling system for leaks

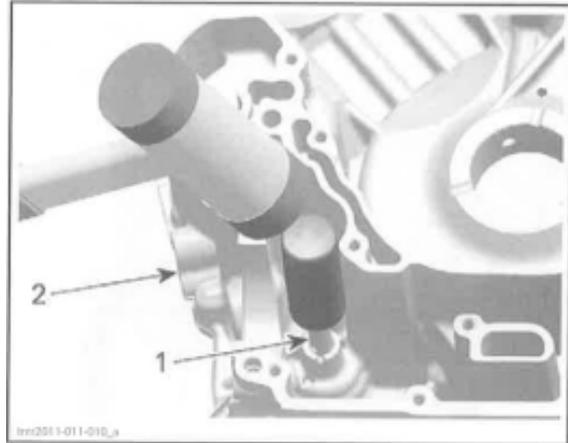
**Water Pump Shaft and Seals Replacement (Disassembled Engine)  
Water Pump Shaft and Seals Removal**

1. Remove the following parts:

- WATER PUMP HOUSING
- WATER PUMP IMPELLER
- WATER PUMP GEARS

2. Push out water pump shaft with inner portion of rotary seal from inside of crankcase MAG side.

REQUIED TOOL
Soft hammer

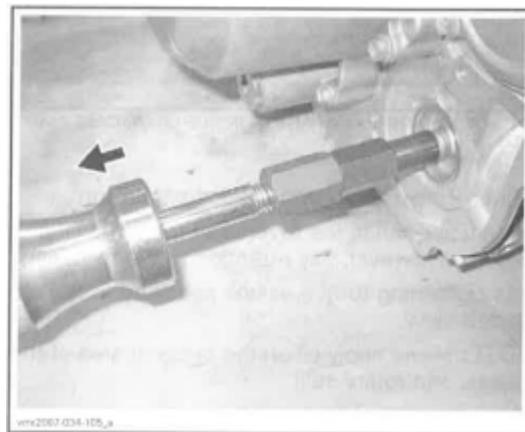


1. Water pump shaft
2. Crankcase MAG side

3. Remove outer part of rotary seal.

REQUIED TOOL	
BLAND HOLE PULLER KIT (P/N 529 036 056)	

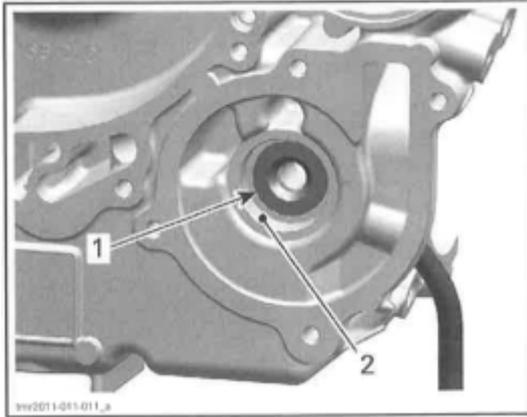
4. Install expander snugly against outer part of rotary seal and pull seal out.



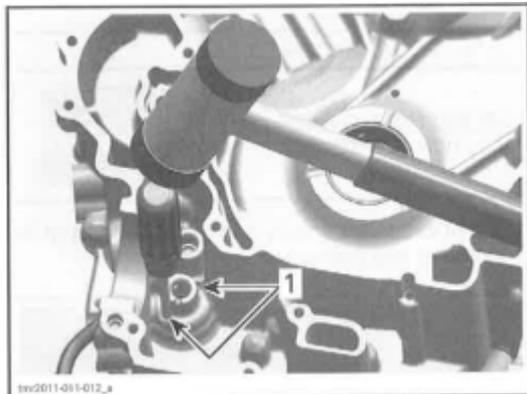
TYPICAL

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

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



1. Oil seal
2. Machined surface for rotary seal



**OIL SEAL REMOVAL-FROM INSIDE CRANKCASE MAG SIDE**

1. Orifices for oil seal removal

**Water Pump Shaft and Seals Installation**

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

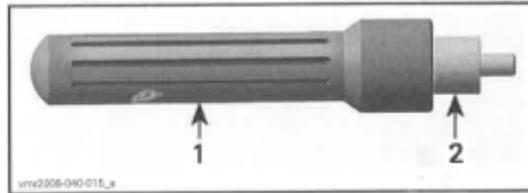
Use tightening torque values specified in the exploded view.

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.

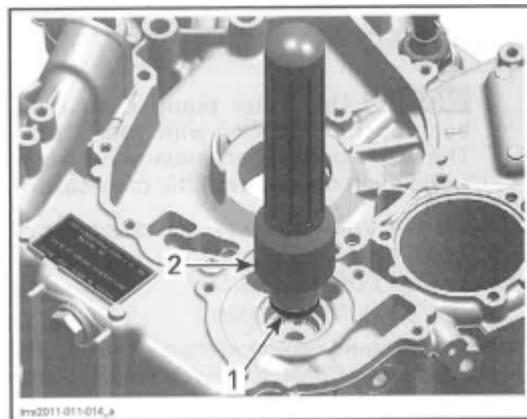
REQUIED TOOL
OIL SEAL PUSHER (P/N 529035757)
HANDLE (P/N 420877650)



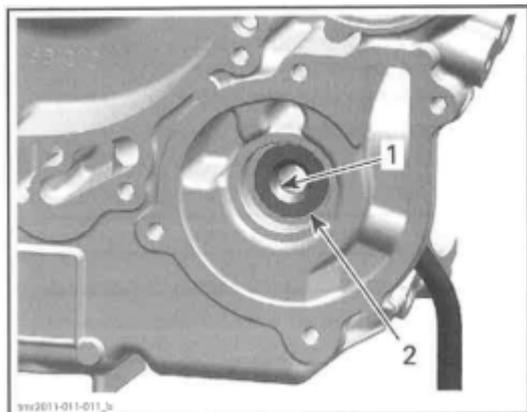
- 1.Handle
2. Pusher

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

Push NEW oil seal in place.

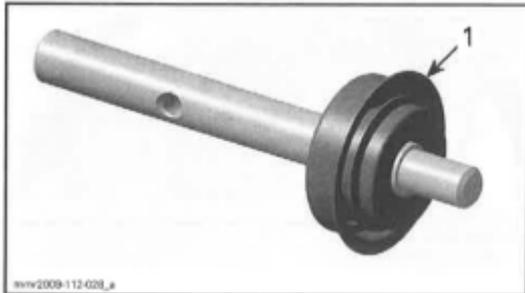


1. Oil seal
  2. Installer handle with oil seal pusher
- Apply DOW CORNING 111 (P/N413 707 000) on Sealing lip of the oil seal.



1. Sealing lip
  2. Oil seal properly installed
- Apply engine oil on the water pump shaft and intermediate shaft.  
Slide NEW water pump shaft assembly into crankcase.

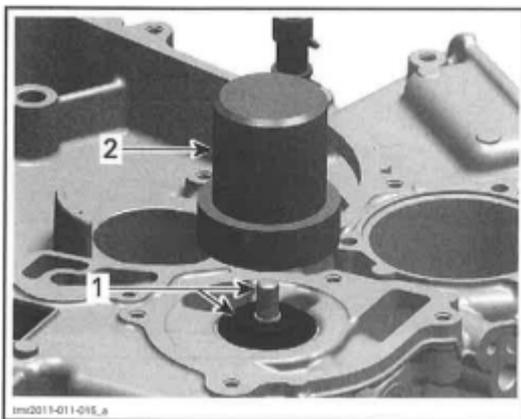
REQUIED TOOL	
SEAL PUSHER (P/N 529035766)	



7. Surface where rotary seal is pushed by tool

### Water Pump Shaft Assembly

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

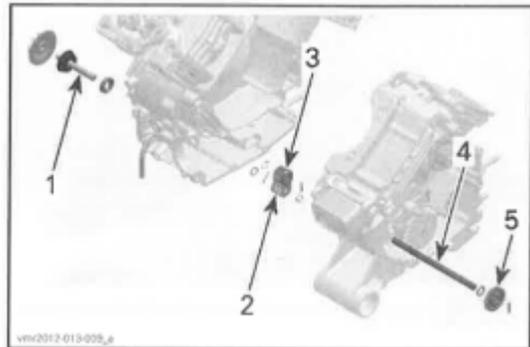


1. Water pump shaft with rotary seal
2. Water pump seal installer

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

## WATER PUMP GEARS

### Water Pump Gears Identification

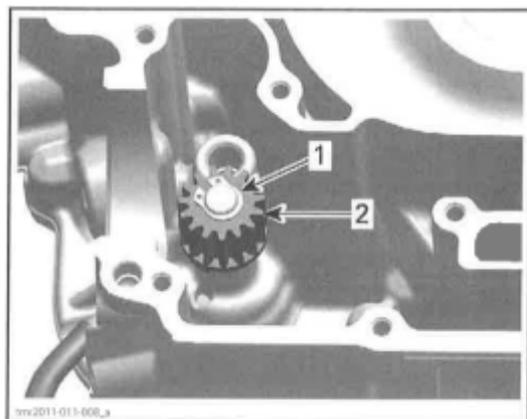


1. Water pump shaft
2. Water pump gear
3. Water pump intermediate drive gear
4. Water pump intermediate shaft
5. Water pump drive gear (see BOTTOM END subsection)

### Water Pump Gears Inspection

#### Water Pump Gear

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

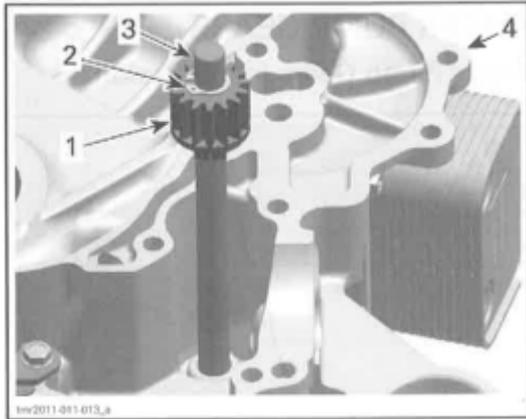


### CRANKCASE MAG SIDE

7. Circlip
2. Water pump gear

#### Water Pump Intermediate Drive Gear

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



#### CRANKCASE PTO SIDE

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

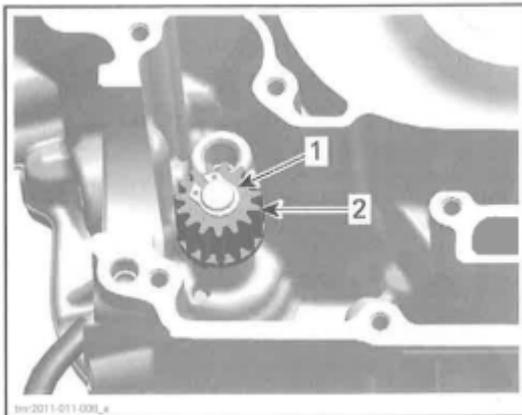
#### Water Pump Drive Gear

See BOTTOM subsection,

#### Water Pump Gears Removal

#### Water Pump Gear

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

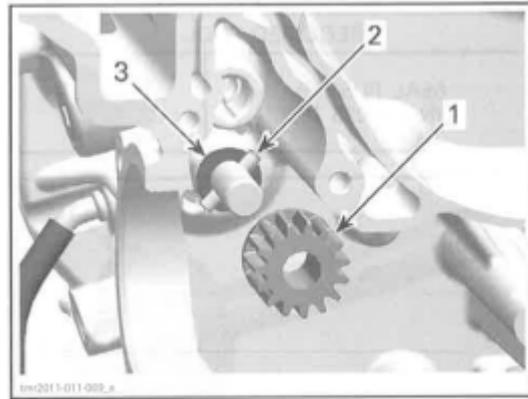


#### CRANKCASE MAG SIDE

1. Circlip
2. Water pump gear

#### 2. Remove the following parts:

- Water pump gear
- Needle pin
- Thrust washer.

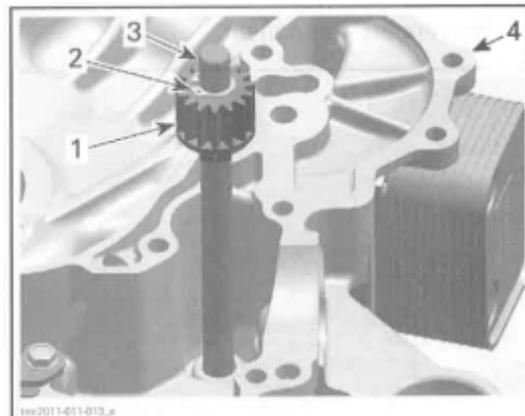


#### CRANKCASE MAG SIDE

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.

#### Water Pump Gears Installation

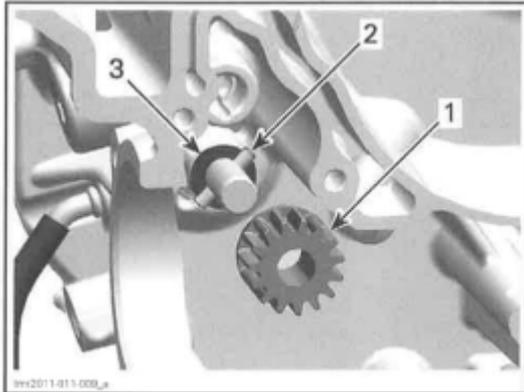
#### Water Pump Gear

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.



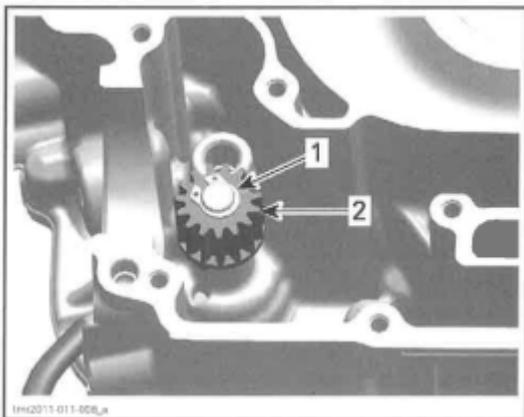
1. Water pump gear
2. Needle pin
3. Thrust washer

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.

**NOTICE** Never use the circlip a second time.

Always install a NEW one.

Water Pump Drive Gear

See BOTTOM END subsection.

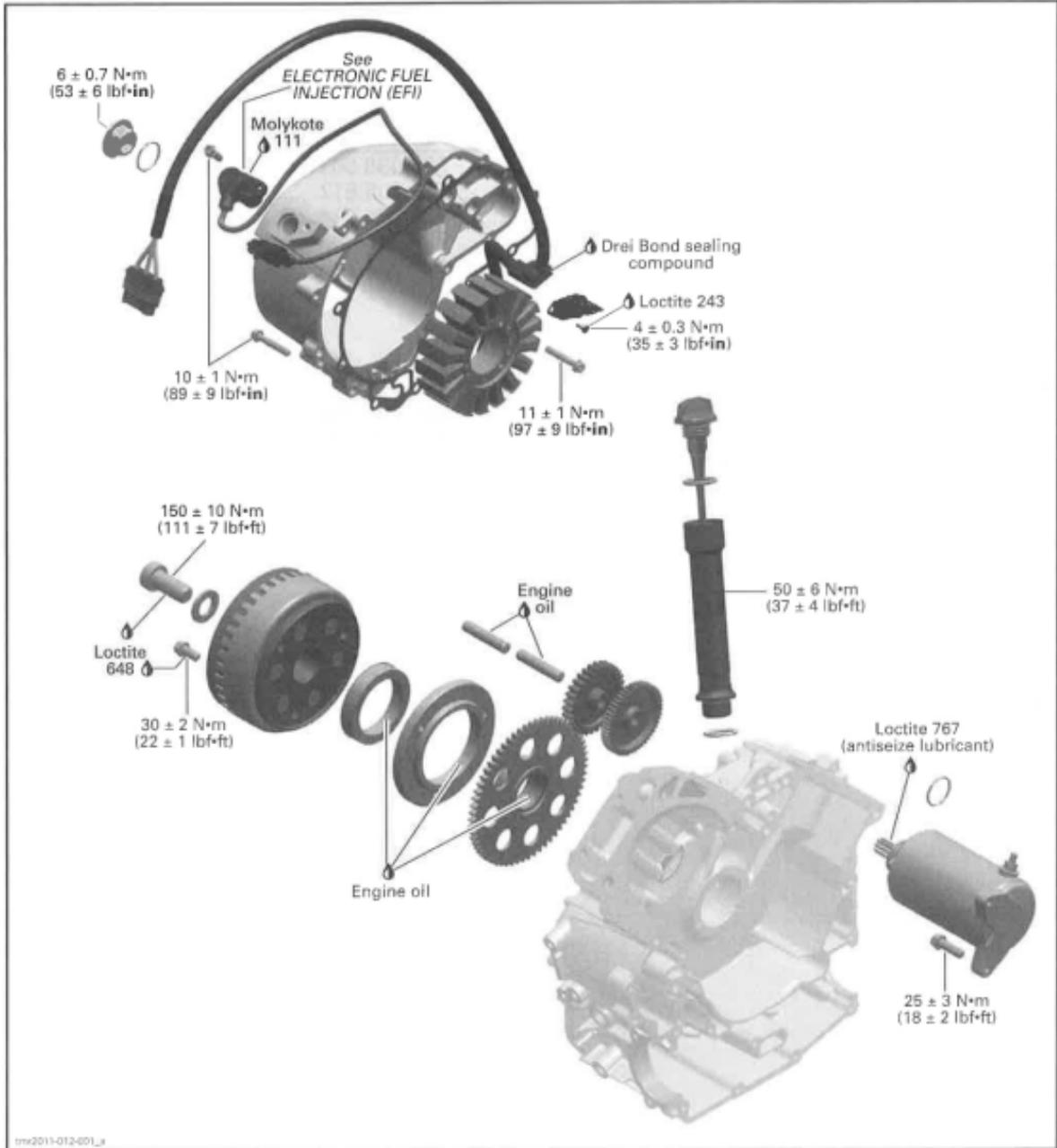
# MAGNETO SYSTEM

## SERVICE TOOLS

_Description	Part Number	Page
BACK PROBE TEST WIRES		
CRANKSHAFT LOCKING BOLT		
CRANKSHAFT PROTECTOR		
FLUKE115 MULITIMETER		
MAGNET0 PULLER		

## SERVICE PRODUCTS

Description	Part Number	Page
DREL BOND SEALING COMPOUND		
LOCTITE243 (BLUE)		
LOCTITE648 (GREEN)		
LOCTITE767 (ANTISEIZE LUBRICANT)		
LOCTITE CHISEL (GASKET REMOVER)		
PULLEY FLANGE CLEANER		



## PROCEDURES

### MAGNETO COVER

#### Magneto Cover Access

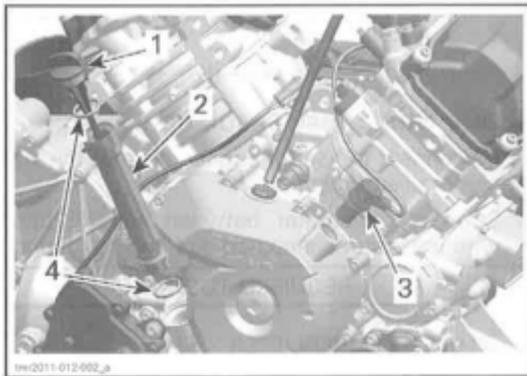
Remove fuel tank, refer to FUEL TANK AND FUEL PUMP

#### Magneto Cover Removal

Drain engine oil (refer to PERIODIC MAINTENANCE PROCUDURES subsection).

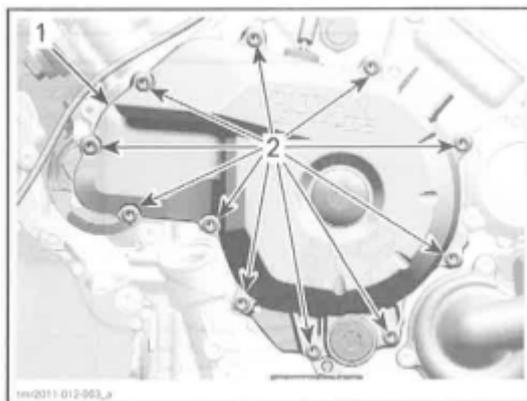
Remove crankshaft position sensor (CPS) and cut tie raps.

Remove dipstick and oil level tube with O-rings.



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

Remove magneto cover retaining screws



1. Magneto cover
2. Retaining crews

Pull out magneto cover.

NOTE: If required, remove stator and harness from magneto cover.

### Magneto Cover Inspection and

### Cleaning

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

NOTE: Clean all metal components in a nonferrous metal cleaner. Use LOCTITE CHISEL (GAS- KET REMOVER) (P/N413 708 500), or suitable equivalent.

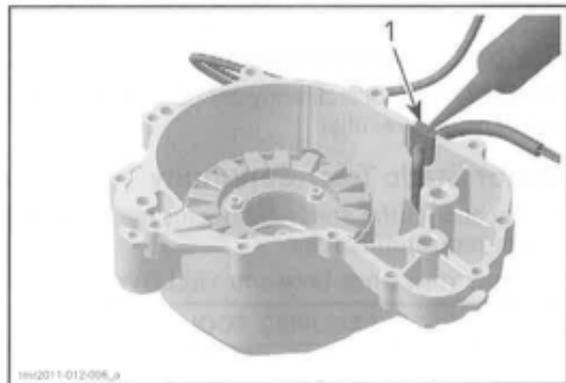
#### ▲WARNING

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

### Magneto Cover Installation

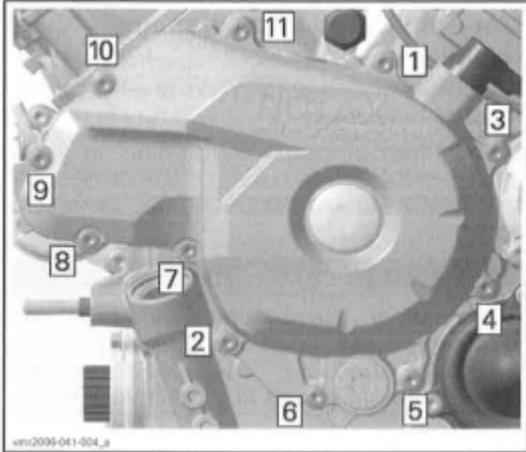
For installation, reverse the removal procedure. However, pay attention to the following.

NOTE: Install a NEW magneto cover gasket. Apply DREI BOND SEALING COMPOUND (P/N420 297 906) on stator cable grommet as shown in next illustration.



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

Tighten screws using the following sequence



**TIGHTENING SEQUENCE**

MANGENTO COVER SCREW	
Tightening torque	10N.m ± 1N.m ( 89lbf.in ± 9lbf.in )

Refill engine with recommended oi1.

**STATOR**

**Stator Connector Access**

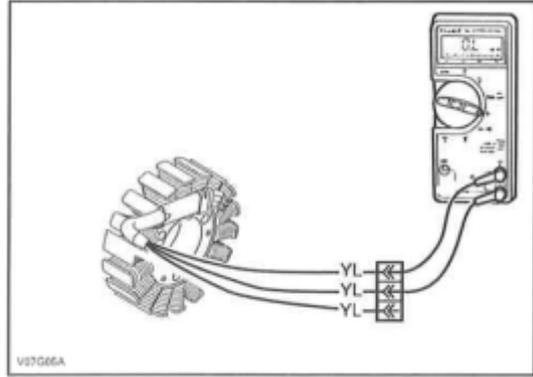
**NOTE:** The stator is directly connected to the voltage regulator/rectifier.

**Stator Static Test: Continuity**

1. Disconnect the stator connector from the voltage regulator/rectifier.
2. Check resistance between YELLOW wires.

REQUIED TOOL	
FLUKE115 MULTIMETER (P/N529 035 868)	

TERMINAL	RESISTANCE@ 20°C(68°F)
1 and2	0.15 - 0.30Ω
1 and3	
2 and3	



TYPICAL

3. If any reading is out of specification, replace stator.

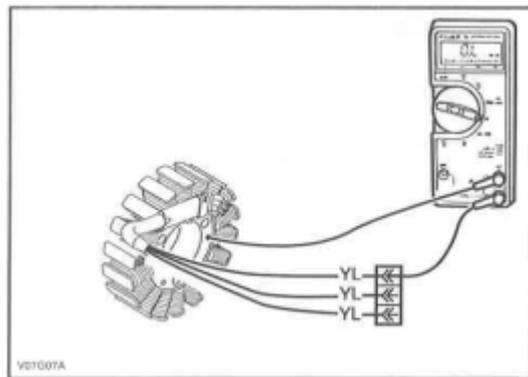
4. Re-plug connectors properly.

**Stator Static Test: Insulation**

1. Disconnect the stator connector from the voltage regulator/rectifier.
2. Connect multimeter between any YELLOW wire(on stator connector) and engine ground.

REQUIED TOOL	
FLUKE115 MULTIMETER (P/N529 035 868)	

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



3. If there is a resistance or continuity, the stator coils and/or the wiring is shorted to ground and needs to be repaired or replaced.

4. Re-plug connectors properly.

### Stator Dynamic Test: AC Voltage Output

1. Disconnect stator connector at voltage regulator/rectifier.
2. Start engine.
3. Check AC voltage output as follow:

REQUIRED TOOL	
BACK PROBE TEST WIRES (P/N529 036 063)	
FLUKE 115 MULTIMETER (P/N529 035 868)	

4. Read voltage as per following table.

TEST ENGINE SPEED	TERMINAL	VOLTAGE
4000 RPM	1 and 2	15 Vac MINIMUM
	1 and 3	
	2 and 3	

5. If voltage is lower than specification, replace stator.

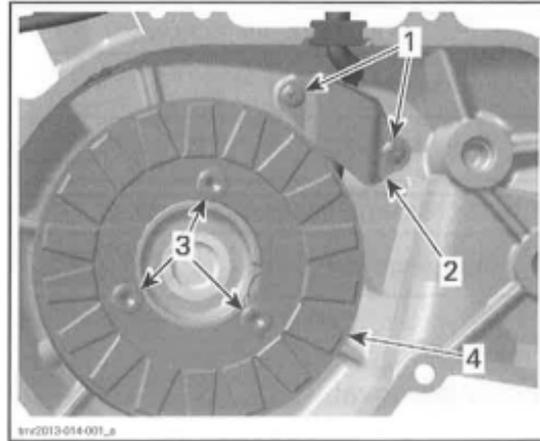
6. Re-plug connectors properly.

### Stator Removal

Remove MAGNETO COVER. See procedure in this subsection.

Remove screws securing the wire holding strip.

Remove stator retaining screws then the stator.



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

### Stator Inspection

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

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

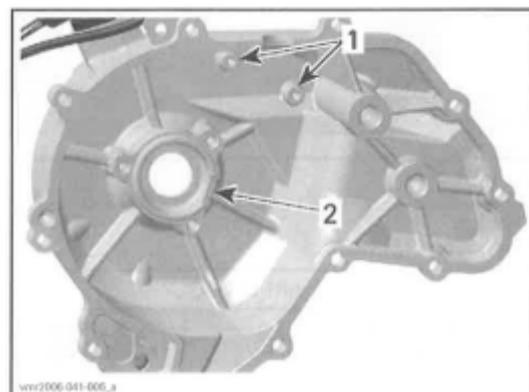
### Stator Installation

For installation, reverse the removal procedure.

However, pay attention to the following.

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

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



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

HOLDING STRIP SCREWS	
Service product	LOCTITE243 (BLUE) (P/N293 800 060)
Tightening torque	4N·m± 0.5N·m (35lbf·in±4lbf·in)

STATOR RETAINING SCREWS	
Tightening torque	11N·m± 1N·m (97lbf·in±9lbf·in)

### HOLDING STRIP SCREWS

Service product  
LOCTITE243 (BLUE)  
(P/N293 800 060)

Tightening torque  
4N·m± 0.5N·m  
(35lbf·in±4lbf·in)

## ROTOR

### Rotor Removal

Remove MAGNETO COVER. See procedure in this subsection.

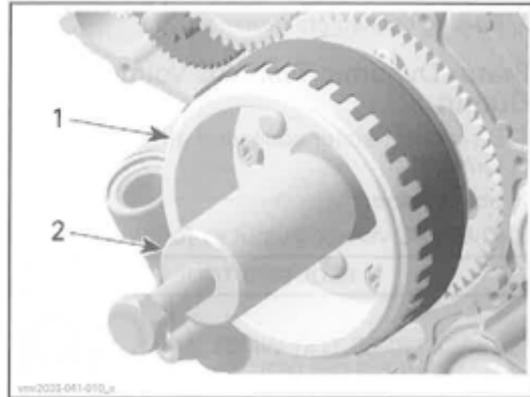
Lock crankshaft(refer to CRANKSHAFT LOCKING PROCEDURE in the BOTTOM END subsection).

REQUIRED TOOL	
CRANKSHAFT LOCKING BOLT (P/N 529035617)	

Heat screw in order to break the Loctite.  
Remove screw and washer securing rotor to crankshaft.  
Remove rotor.

REQUIRED TOOL	
MAGNETO PULLER (P/N529 035 748)	
CRANKSHAFT PROTECTOR (P/N529 036 034)	

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



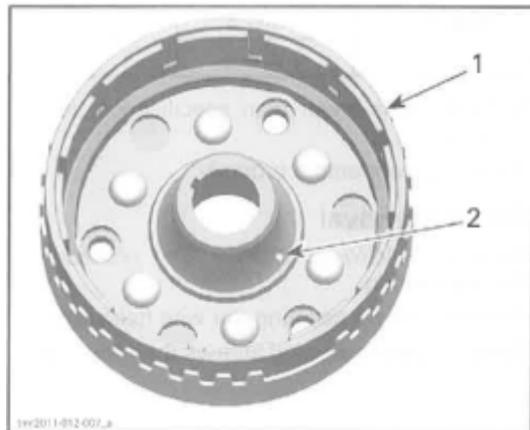
1. Rotor
2. Magneto puller

Screw magneto puller bolt to remove rotor.

### Rotor Inspection

Check inner side of rotor for scratches or other damage.

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



1. Rotor
2. Oil bore

Check keyway of the rotor for wear or damages.  
Check if trigger wheel teeth are bent or otherwise damaged.

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

Replace parts as necessary.

## Rotor Installation

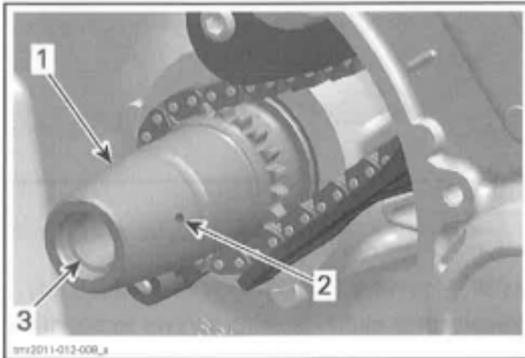
For installation, reverse the removal procedure.

However, pay attention to the following.

Use PULLEY FLANGE CLEANER (P/N413 711 809) to clean following:

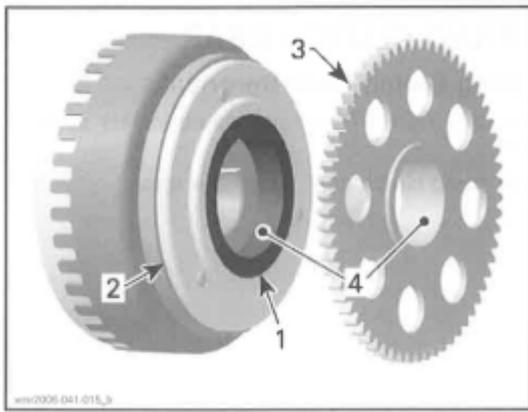
- Crank shaft taper
- Oil passage in crank shaft taper
- Thread in crankshaft
- Rotor taper
- Oil bore in rotor.

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



1. Crankshaft (MAG side)
2. Oil passage
3. Threads

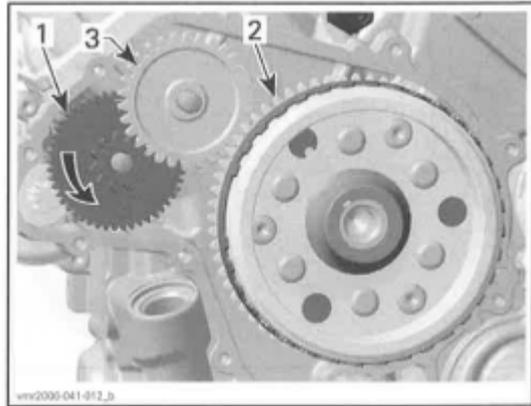
Oil sprag clutch and install sprag clutch gear.



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

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

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



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

ROTOR RETAINING SCREW	
Service product	LOCTITE648 (GREEN) (P/N413 711 400)
Tightening torque	150N·m±10N·m (111 lbf·ft±7lbf·ft)

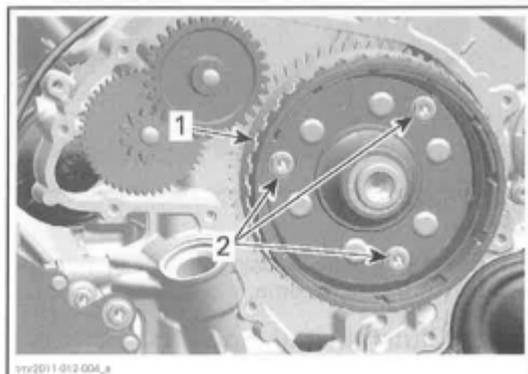
## SPRAG CLUTCH

### Sprag Clutch Removal

Remove MAGENTO CIVER. See procedure in this subsection.

Heat screws in order to break the Loctite.

Loosen sprag clutch housing screws located inside rotor.

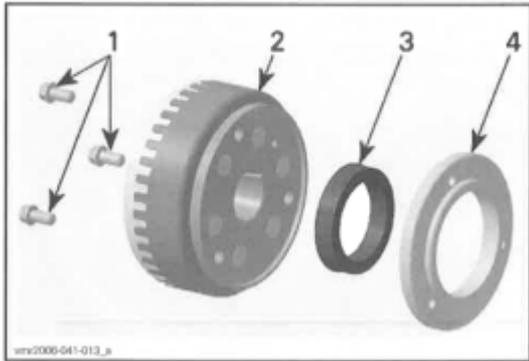


1. Rotor
2. Sprag clutch housing screws

Remove rotor(refer to/11'07-0/li'in this subsection).

Remove sprag clutch gear.

Remove sprag clutch housing screws and sprag clutch housing.



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

## Sprag Clutch Inspection

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

Also check the collar of the sprag clutch gear.

Rotate sprag clutch gear in sprag clutch.

NOTE: Sprag clutch must lock in counterclockwise direction.



## SPRAG CLUTCH FUNCTION TEST

1. Lock

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

## Sprag Clutch Installation

For installation, reverse the removal procedure.

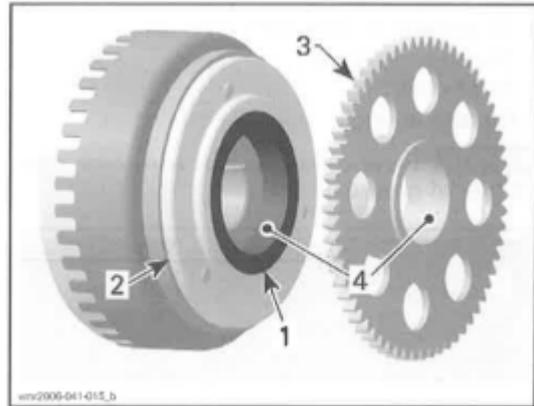
Pay attention to the following details.

Apply LOCTITE648 (GREEN) (P/N413 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.

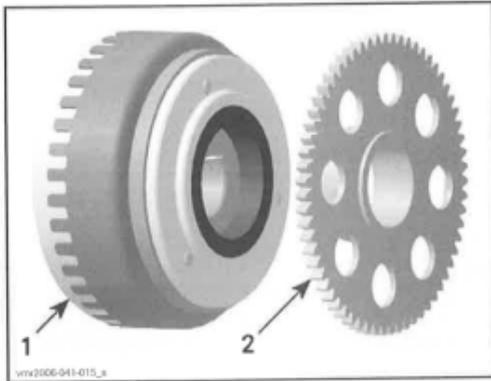
SPRAG CLUTCH HOUSING SCREW	
Tightening torque	30N·m±2N·m (22 lbf·ft±1lbf·ft)

## SPRAG CLUTCH GEAR

### Sprag Clutch Gear Removal

Remove ROTOR. See procedure in this subsection.

Pull sprag clutch gear out of the rotor.

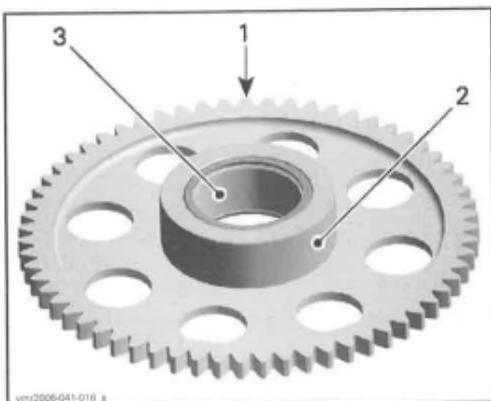


1. Rotor
2. Spfag clutch gear

### Sprag Clutch Gear Inspection

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

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



INSPECT

1. Teeth
2. Collar
3. Needle bearing

### Sprag Clutch Gear Installation

The installation is the reverse of the removal Procedure.

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

## STARTER DRIVE GEARS

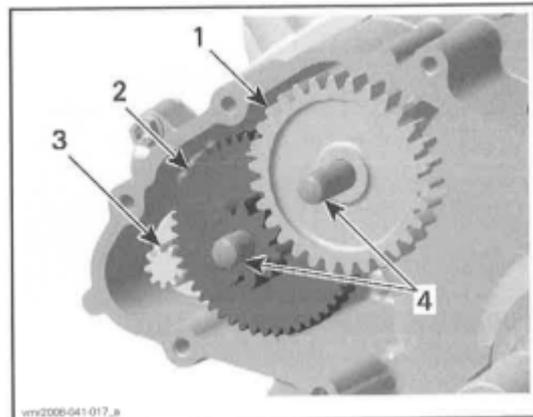
### Starter Drive Gear Location

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

### Starter Drive Gear Removal

Remove MAGENTO COVER. See procedure in this subsection.

Remove location pins, starter double gear and intermediate gear.



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

### Starter Drive Gear Inspection

Inspect gears and location pins for wear and damage.

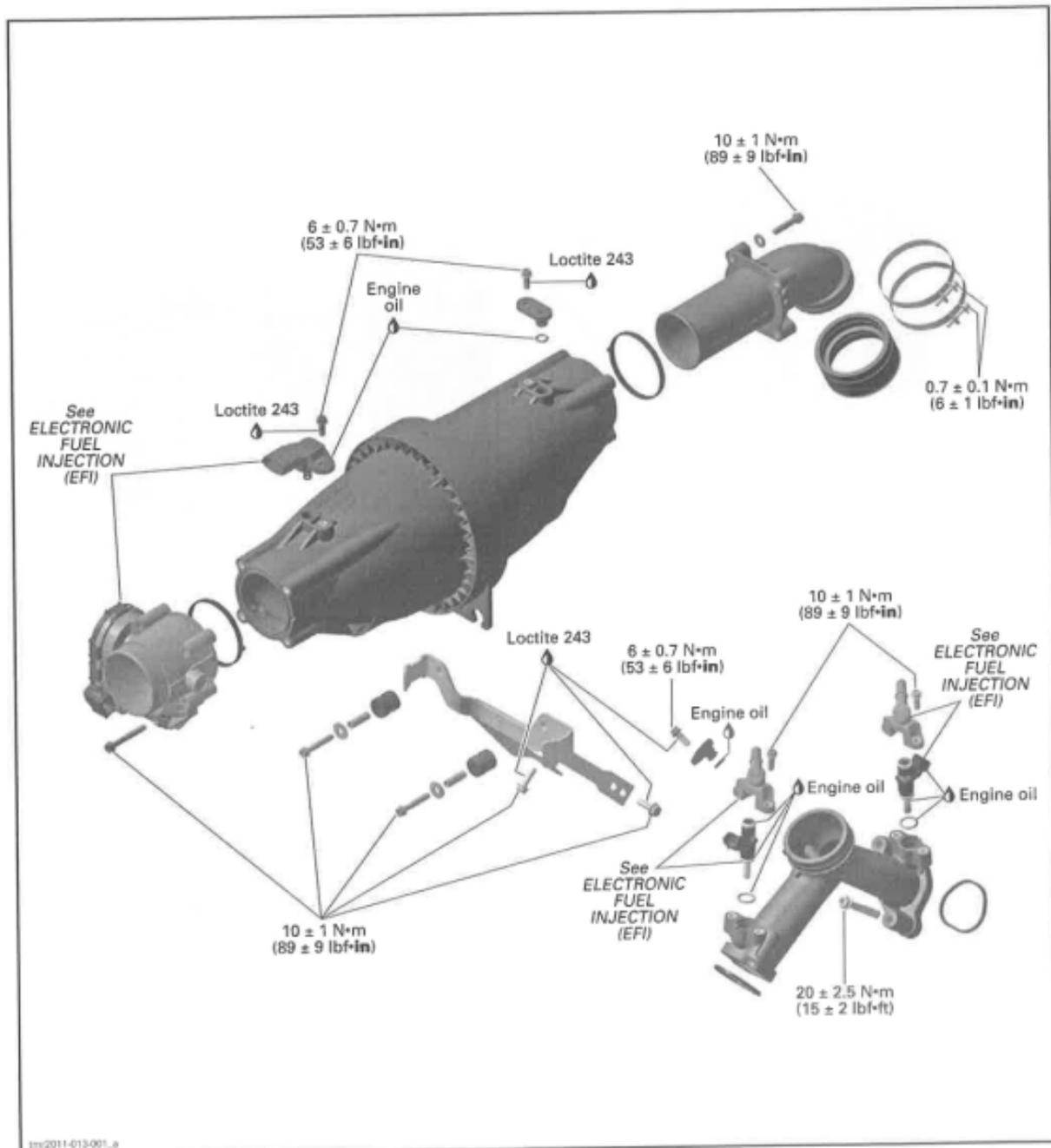
Replace parts as necessary.

### Starter Drive Gear Installation

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

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (p1N2g3 800 o7o) on starter gear before installing the starter double gear. Apply engine oil on location pins.

# INTAKE MANIFOLD



## PROCEDURES

### PLENUM BRACKET

#### Plenum Bracket Installation

On Cylinder1, install the plenum bracket using the appropriate mounting holes.



1. Mounting holes for the 1000 engine
  2. Mounting holes for the 800R engine
- Tighten plenum bracket retaining screws to specification

#### PLENUM BRACKET RETAINING SCREWS

Tightening torque	10N·m±1 N·m (89lbf·in±9lbf·in)
-------------------	-----------------------------------

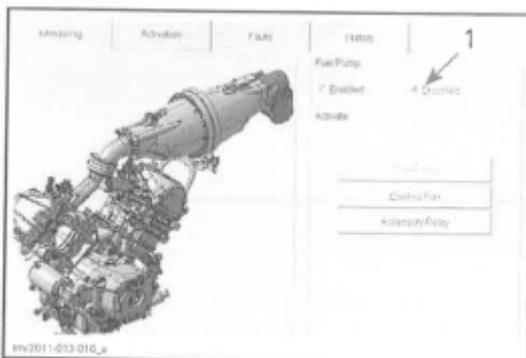
### INTAKE MANIFOLD

#### Intake Manifold Access

Refer to BODY and remove the lower console .

#### Intake Manifold Removal

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



1. Click "Dossible"

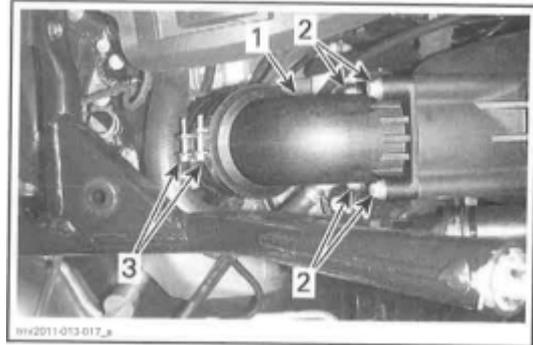
2. Release fuel pressure by running engine until it runs out of gas.

3. Disconnect the fuel hoses at the fuel injectors , refer to ELECTRON FUEL INJECTION (EFI).

△CAUTION The fuel hose may still be under pressure.

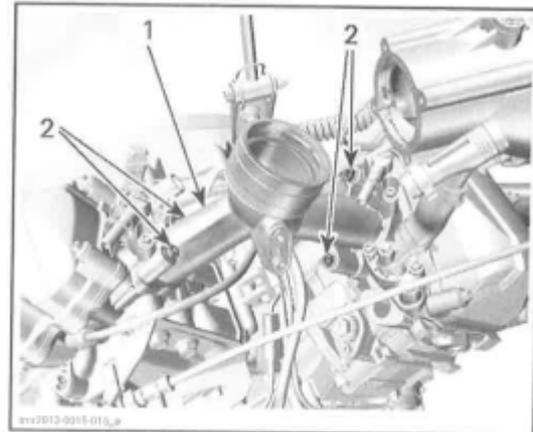
4. Disconnect fuel injectors electrical connectors .

5. Remove plenum adapter elbow.



1. Plenum adapter elbow
2. Remove retaining screws
3. Remove clamps

6. Remove intake manifold from engine



SOME PARTS REMOVED FOR CLARITY

- 1 Intake manifold
2. Remove retaining screws (×4)

#### Intake Manifold Inspection

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

### Intake Manifold Installation

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

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

INTAKE MANIFOLD RETAINING SCREWS	
Tightening torque	$20\text{N} \cdot \text{m} \pm 2.5\text{N} \cdot \text{m}$ ( $15\text{lb} \cdot \text{ft} \pm 2\text{lb} \cdot \text{ft}$ )

Tighten elbow retaining screws to specification.

INTAKE MANIFOLD RETAINING SCREWS	
Tightening torque	$10\text{N} \cdot \text{m} \pm 1\text{N} \cdot \text{m}$ ( $89\text{lb} \cdot \text{ft} \pm 9\text{lb} \cdot \text{ft}$ )

Tighten intake manifold clamps to specification.

INTAKE MANIFOLD RETAINING SCREWS	
Tightening torque	$0.7\text{N} \cdot \text{m} \pm 0.1\text{N} \cdot \text{m}$ ( $6\text{lb} \cdot \text{ft} \pm 1\text{lb} \cdot \text{ft}$ )

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

## TOP END

### SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT		
ENGINE LEAK DOWN TEST KIT		
PISTON CIRCLIP INSTALLER..		
PISTON CIRCLIP INSTALLER..		
PISTON RING COMPRESSOR		
TDC DIAL INDICATOR		
VALVE GUIDEINSTALLER		
VALVE GUIDE REMOVER5 MM		
VALVE SPRING COMPRESSOR CUP		
VALIVE SPRING COMPRESSOR		

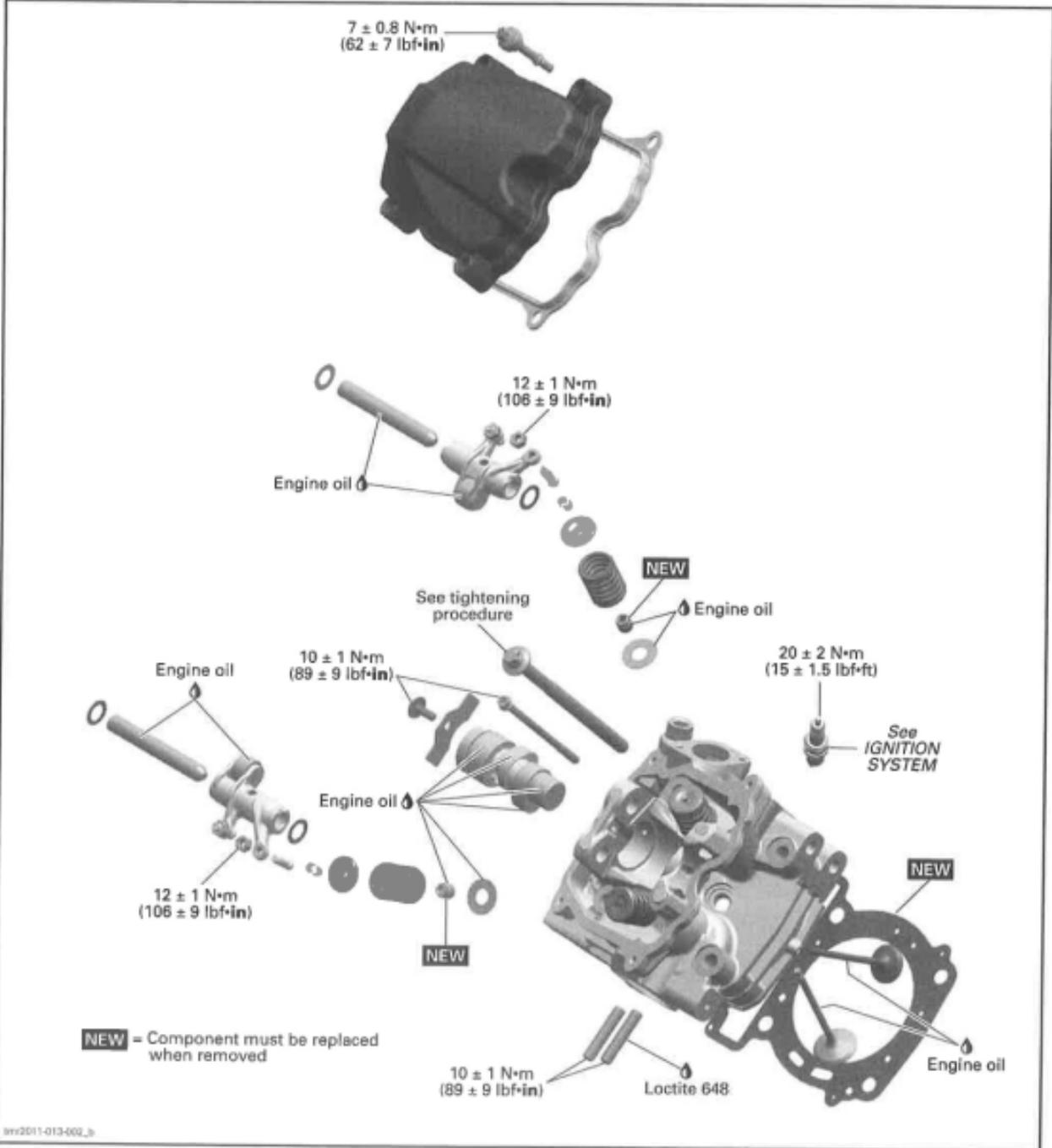
### SERVICE TOOLS- OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON PLIERS		

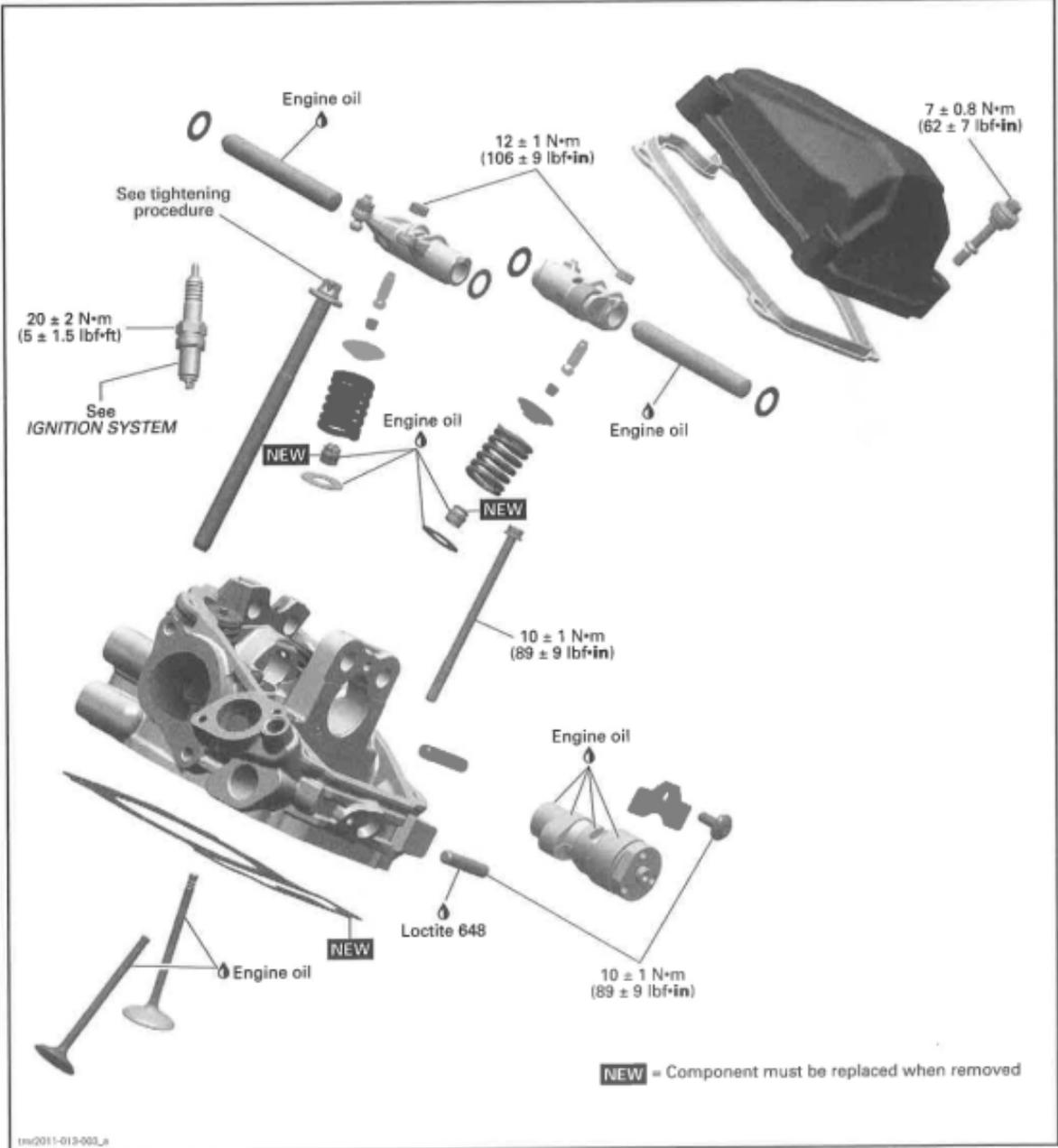
### SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE767 (ANTISEIZE LUBRICANT)		

# CYLINDER HEAD NO.1



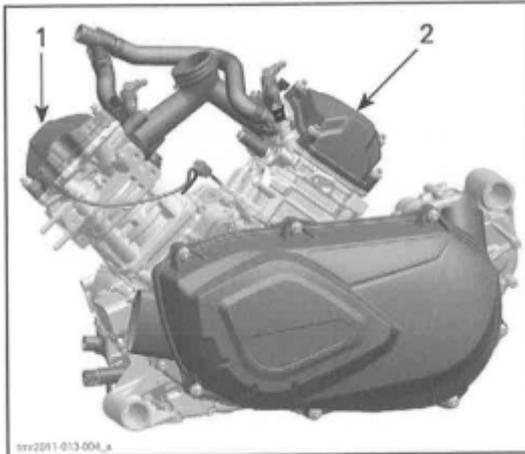
# CYLINDER HEAD NO.2





## GENERAL

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



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

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

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

IMPORTANT: Note position of parts on disassembly. This may help to find the root cause of a problem. A component that is not replaced should be reinstalled in the same position as originally mounted.

## INSPECTION

### LEAK TEST

Before performing the cylinder leak test, verify the following:

- Clamp(s) tightness
- Radiator and hoses.

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

### △WARNING

Prevent burning yourself on hot engine parts.

Preparation

Disconnect battery

### △WARNING

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

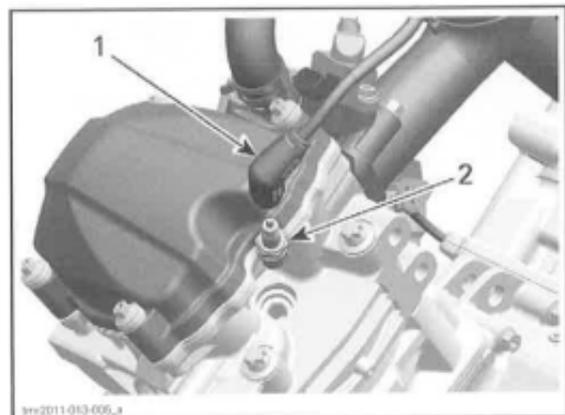
Remove radiator cap.

### △WARNING

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

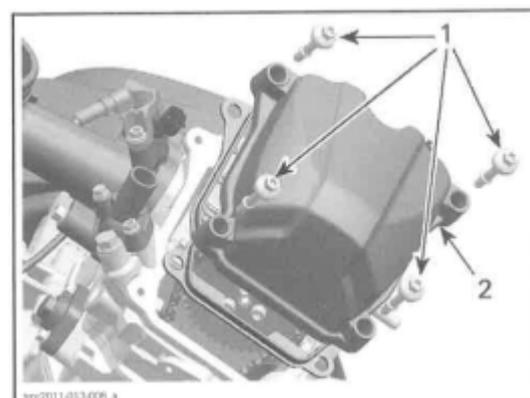
Unplug spark plug cable.

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



1. Spark plug cable
2. Spark plug

Remove valve cover.



1. Valve cover screws
2. Valve cover

Rotate crankshaft until piston is at ignition TDC.

To turn crankshaft, there are two possible procedures.

### First Procedure

Turn the drive pulley.

### Second Procedure

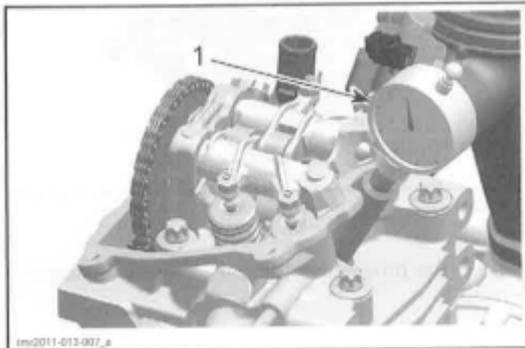
1. Remove plug screw with O-ring from magneto cover.

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	
TDCDIAL INFCATOR (P/N 414 104 700)	

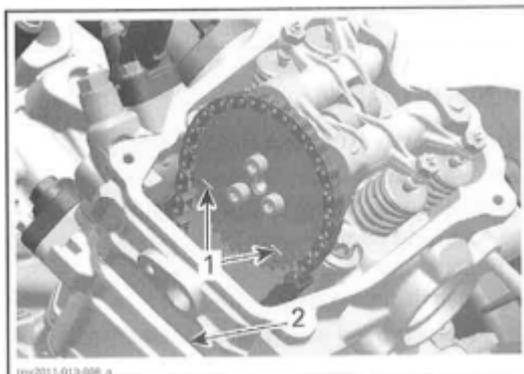


1. Dial gauge

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

**NOTICE** Do not scratch or damage piston/ cylinder surface.

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



1. Marks on camshaft timing gear
2. Cylinder head base

## Leak Test

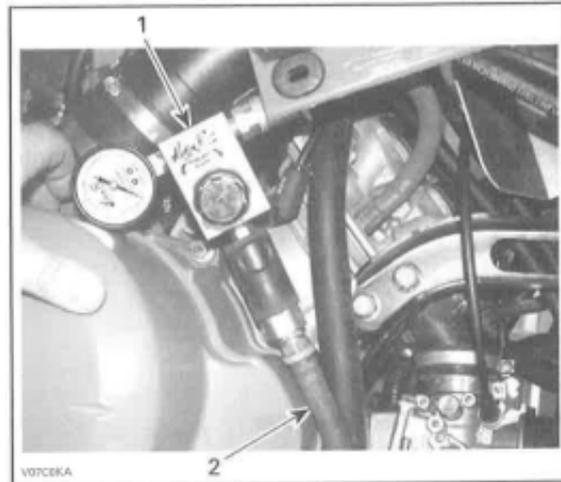
REQUIRED TOOL	
ENGINE LEAK DOWN TEST KIT (P/N 529 035 661)	

Connect leak tester to adequate air supply  
Set needle of measuring gauge to zero.

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

Install gauge adapter into previously cleaned spark plug hole.

Supply combustion chamber with air pressure.



## TYPICAL

1. Leak tester
2. Air supply hose

Note the amount or percentage of leakage (depending on tester).

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to15%	Excellent condition
16% to25%	Good condition
26% to40%	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

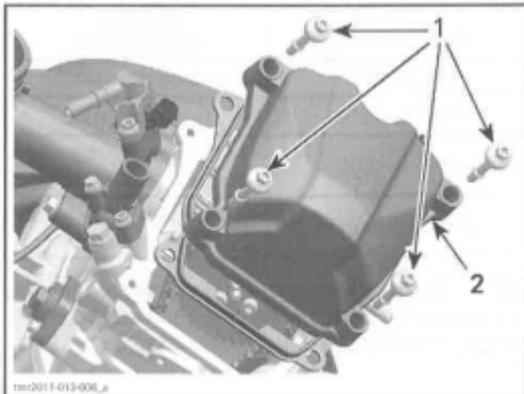
#### Valve Cover Access

Refer to BADC and remove:

- Upper console
- Lower console
- LH and RH lateral console panels.

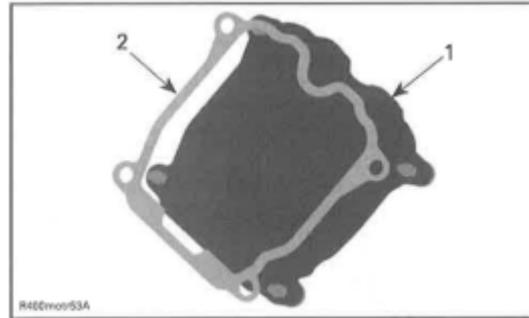
#### Valve Cover Removal

Remove valve cover screws of valve cover.



1. Valve cover screws
2. Valve cover

Remove valve cover and gasket



1. Valve cover
2. Gasket

Repeat the procedure for the other valve cover if required.

#### Valve Cover Inspection

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

#### Valve Cover Installation

For installation, reverse the removal procedure.

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

VALE COVER RETAINING SCREW	
Tightening torque	7N • m ± 0.8N • m (62lbf • ft ± 7 lbf • ft)

## ROCKER ARM

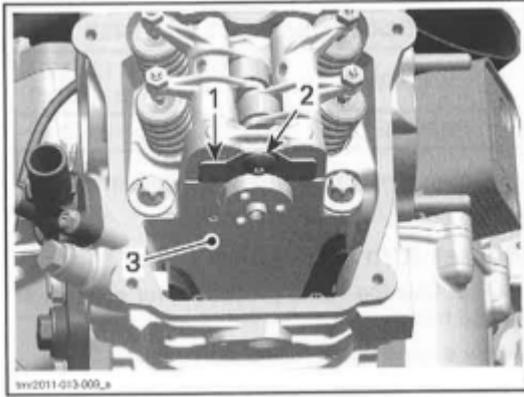
### Rocker Arm Removal

Remove valve cover.

Refer to TIMING CHAIN subsection and remove the following parts:

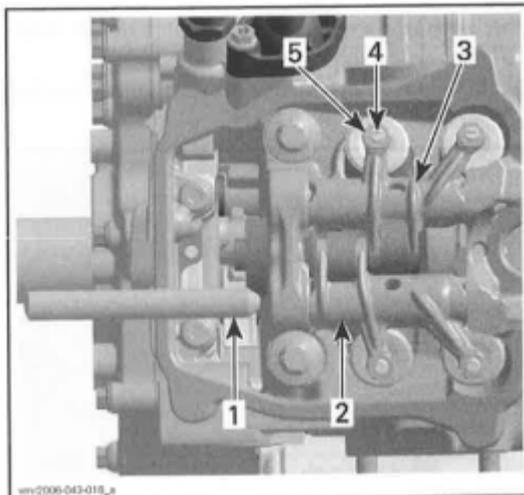
- Timing chain tensioner
- Camshaft timing gear.

Remove pan head screw and camshaft retaining plate.



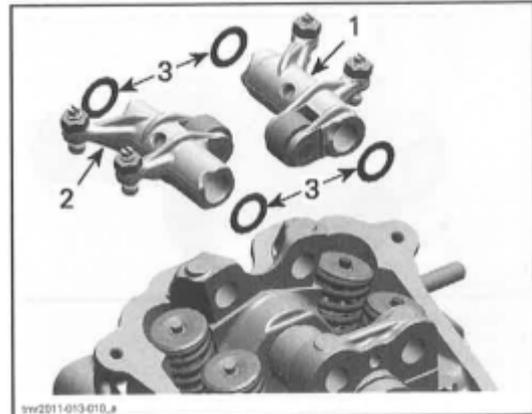
1. Camshaft retaining plate
2. Pan head screw
3. Cylinder head'

### Remove rocker arm shafts



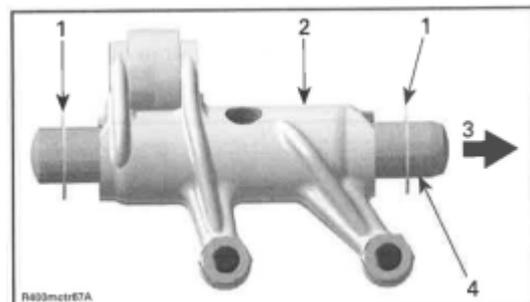
1. Rocker arm shaft
2. Rocker arm (exhaust side)
3. Rocker arm (intake side )
4. Adjustment screw
5. lock nut

Remove rocker arm assembly(exhaust side and intake side) with adjustment screws and lock nut  
Remove thrust washers.



1. Rocker arm (exhaust side)
2. Rocker arm (intake side )
3. Thrust washers

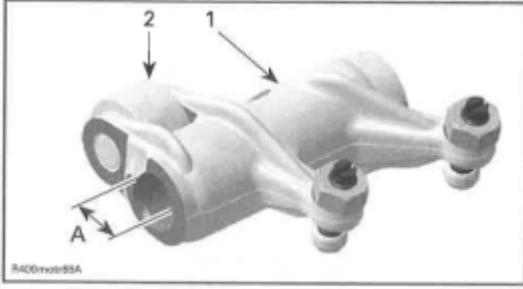
**NOTICE** Pay attention not to lose thrust washers or drop them into the timing chain compartment.



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

### Rocker Arm Inspection

Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly. Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly if necessary.

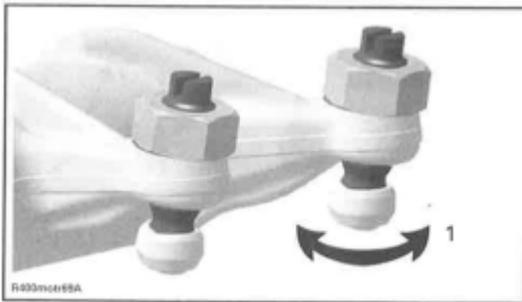


1. Rocker arm (exhaust side)
2. Roller
3. Bore for rocker arm shaft

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

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

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

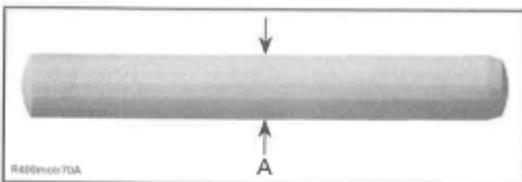


1. Free movement of adjustment screw top

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

Any area worn excessively will require parts replacement.

### Rocker Arm Installation

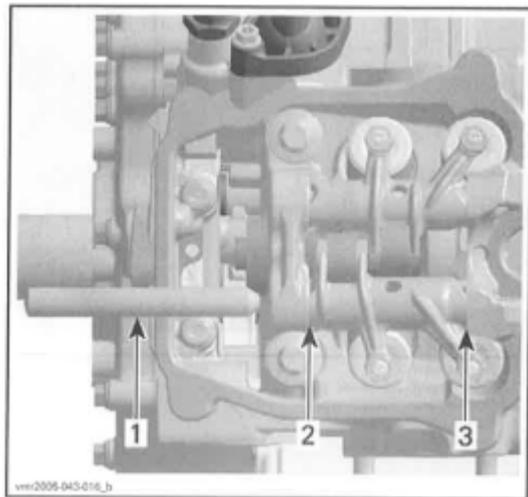
NOTE: Use the same procedure for exhaust and intake rocker arm.

Apply engine oil on rocker arm shaft.

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

Insert a rocker arm pin through rocker arm pin bore.

Install a thrust washer at timing chain side, then the proper rocker arm(exhaust side or intake side). Push in rocker arm shaft until its chamfer reaches the end of rocker arm bore.



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

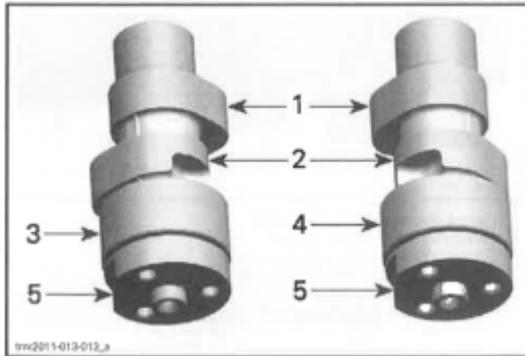
Place the other thrust washer and push rocker arm shaft to end position.

Install the camshaft retaining plate.

Adjust valve clearance, refer to PERIODIC MAINTENANCE PROCEDURE

## CAMSHAFT

NOTE: The engine is equipped with two different camshafts.



1. Intake cam
2. Exhaust cam
3. Camshaft of cylinder1
4. Camshaft of cylinder1
5. Flat spot

### Camshaft Removal

The removal procedure is the same for both camshafts.

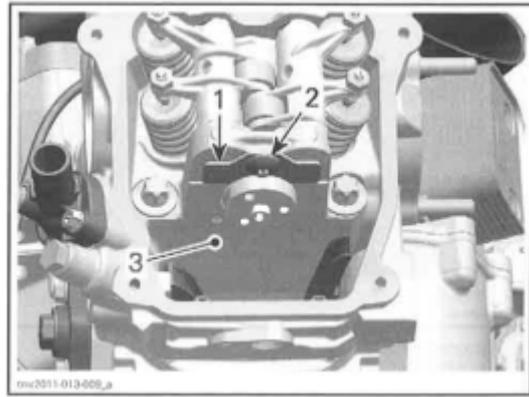
**NOTICE** Each camshaft is different in design. Thus, it is important not to mix up any parts of the camshaft assembly with that of the other cylinder. Keep parts as a group.

Remove valve cover(see VALVE COVER in this subsection).

Refer to TIMING CHAIN subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

Remove the camshaft retaining plate.

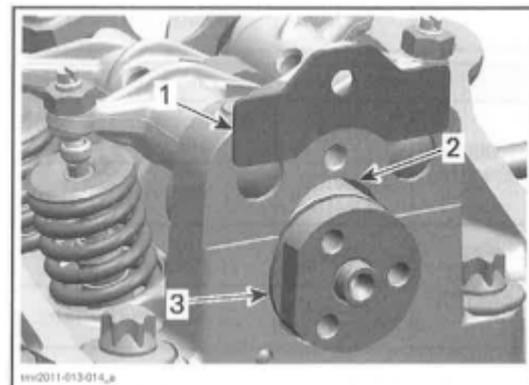


1. Camshaft retaining plate
2. Pan head screw
3. Cylinder head

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

Remove the camshaft.

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



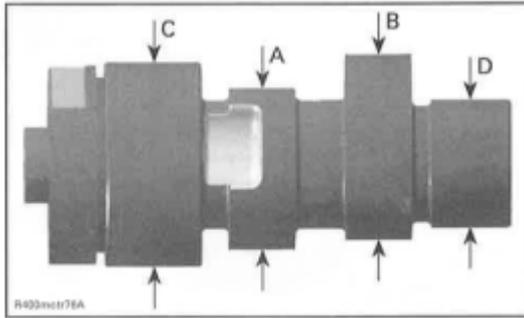
1. Camshaft retaining plate
2. Area for camshaft lobes
3. Camshaft

### Camshaft Inspection

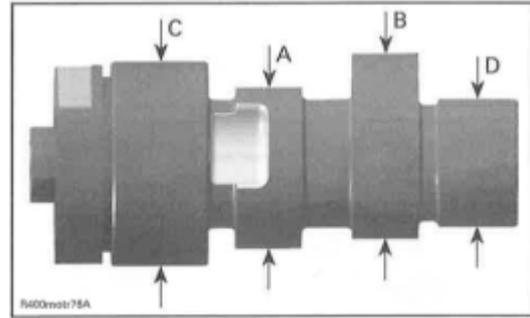
#### Camshaft Lobe Inspection

Check each lobe for scoring, scuffing, cracks or other signs of wear.

Measure camshaft lobe height using a micrometer



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



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

CAMSHAFT LOBE (EXHAUST)		
800R ENGINE	NEW	32.950mm to 33.150 mm (1.2972in to 1.3051 in)
	SERVICE LIMIT	32.930 mm (1.2965 in)
1000 ENGINE	NEW	32.860 mm to 33.060 mm (1.294in to 1.302in)
	SERVICE LIMIT	32.840 mm (1.293in)

CAMSHAFT JOURNAL (TIMING CHAIN SIDE)	
NEW	34.959mm to 34.975mm (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 (.8645in to .8654in)
SERVICE LIMIT	21.950 mm (.8642 in)

CAMSHAFT LOBE (INTAKE)		
800R ENGINE	NEW	32.890mm to 33.090 mm (1.2949in to 1.3028 in)
	SERVICE LIMIT	32.870 mm (1.2941 in)
1000 ENGINE	NEW	32.960 mm to 33.160 mm (1.298in to 1.306in)
	SERVICE LIMIT	32.940 mm (1.297in)

#### Camshaft Installation

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

**NOTICE** The camshafts are not identical in design. Do not invert the camshafts during assembly. Any mix-up of the components will lead to engine damage.

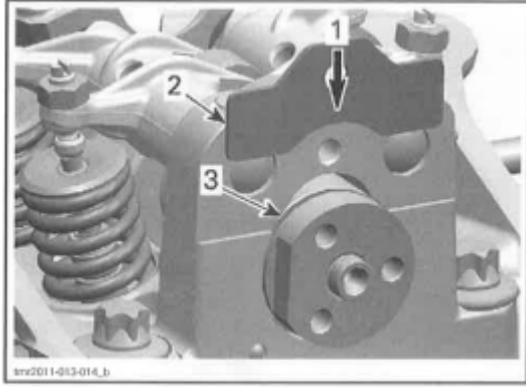
Place the camshaft retaining plate in the slot of the camshaft.

Measure camshaft bearing in cylinder head . Refer to **CYLINDER HEAD INSPECTION** in this subsection.

#### Camshaft Journal Inspection

Check each journal for scoring, scuffing, cracks or other signs of wear.

Measure camshaft journal using a micrometer .



1. Direction of movement
2. Camshaft retaining plate
3. Slot retaining camshaft

For other parts, refer to proper installation procedure.

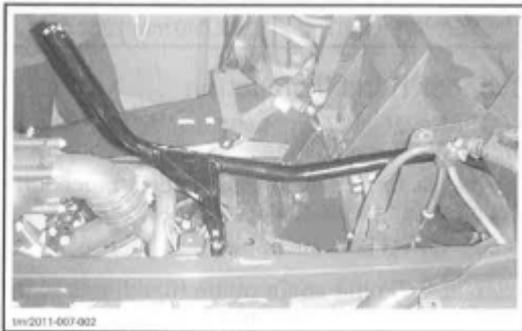
#### CYLINDER HEAD

##### Cylinder Head Access

Refer to BODY and remove:

- Lower console
- LH and RH lateral console panels.

Remove LH passenger handhold bar.



LH PASSENGER HANDHOLD BAR

On cylinder2, remove the shift cable bracket.

Refer to INTAKE MANIFOLD subsection to remove following parts:

- Plenum, for cylinder 1
- Intake manifold.

##### Cylinder Head Removal

The removal procedure is the same for both cylinder heads.

Drain coolant. Refer to ENGINE COOLANT REPLACEMENT in the PERIODIC MAINTENANCE PRODURES 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.

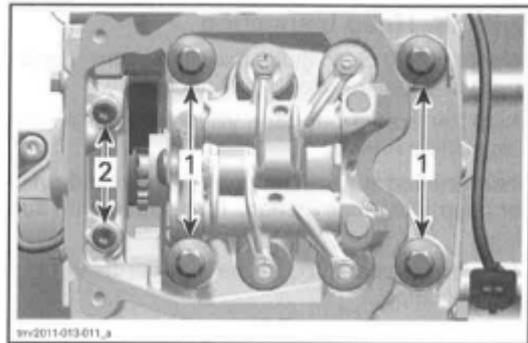
Disconnect temperature sensor connector, located at rear cylinder head.

Remove the valve cover and its gasket (see VALVECOVER 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.

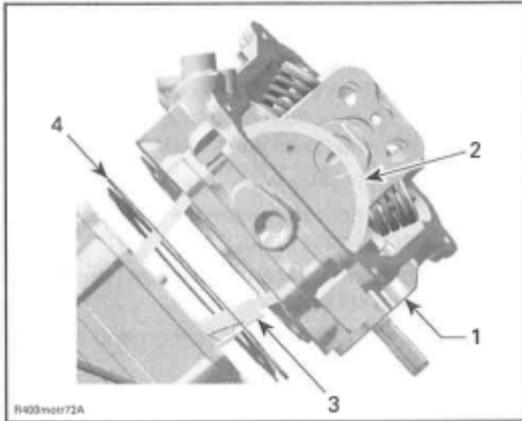


1. Cylinder head screws M 10
2. Cylinder head screws M 6

Pull up cylinder head.

Remove timing chain guide (fixed).

Remove and discard the cylinder head gasket,



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

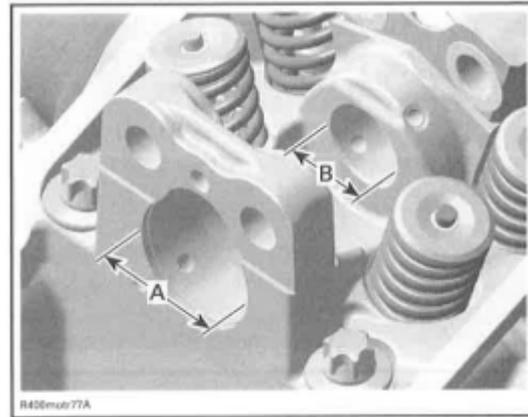
### Cylinder Head Inspection

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

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

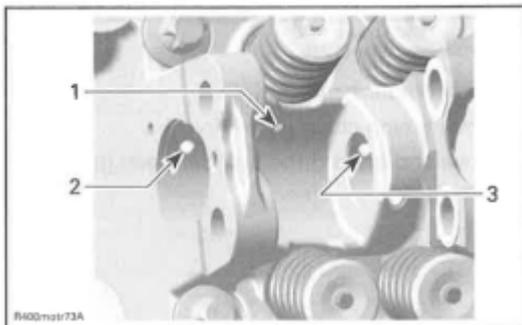
Check mating surface between cylinder and cylinder head for contamination. If so, clean both surfaces.

Clean oil support through the cylinder head from contamination.



- A. Cam shaft bearing (timing chain side)  
 B. Cam shaft 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)



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

### Cylinder Head Camshaft Bearing Inspection

Measure camshaft bearing in cylinder head.

### Cylinder Head Installation

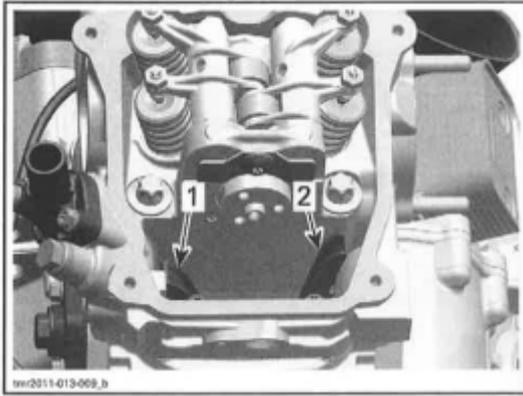
NOTE: Never invert front and rear cylinder heads. On the 800R, cylinder heads are not identical.

For installation, reverse the removal procedure.

Pay attention to the following details.

Ensure dowel pins are in place.

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

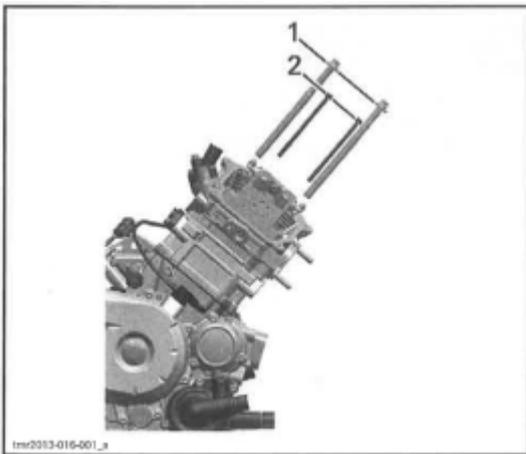


**TYPICAL**

1. Timing chain guide (tensioner side) mounted in crankcase
2. Timing chain guide (fixed) between cylinder ,and cylinder head

Install a NEW cylinder head gasket.  
Install cylinder head screws in correct position.

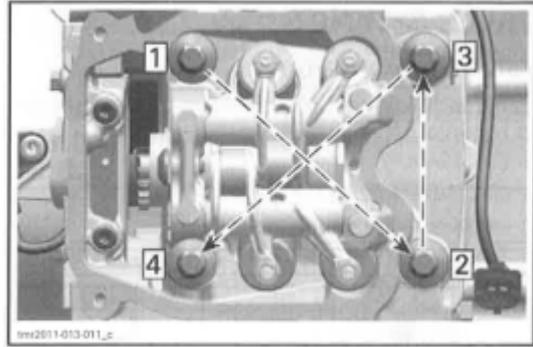
**NOTICE** Cylinder head screws have different sizes and lengths.



1. Location no. 1
2. Location no. 2

CYLINDER HEAD SCREW IDENTIFICATION		
800R engine	Location no. 1	M10×140
	Location no. 2	M6×85
1000 engine	Location no. 1	M10×159
	Location no. 2	M6×105

Tighten M10 cylinder head screws FIRST as per following specifications.

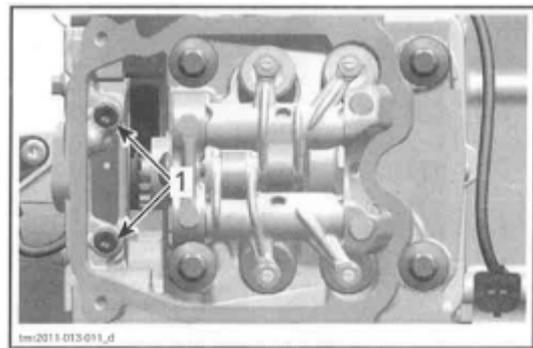


TIGHTENCE SEQUENCE-M10 CYLINDER HEAD SCREWS

M10 CYLINDER HEAD SCREWS	
Tightening torque (step1)	20N·m±1N·m (15lb·ft±1 lb·ft)

M10 CYLINDER HEAD SCREWS	
Tightening torque (step2)	180° +/-5°

Tighten M6 cylinder head screws as per following specification.



1. M6 Screws

Check timing chain guide (tensioner side) for movement.

On cylinder1, install the plenum bracket, refer to INTAKE MANIFOLD subsection.

## VALVE SPRINGS

### Valve Spring Removal

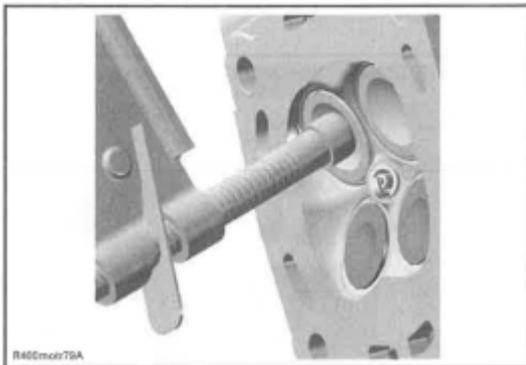
Refer to following procedures in this subsection to remove:

- CAMSHAFT
- CYLINDER

Compress valve spring.

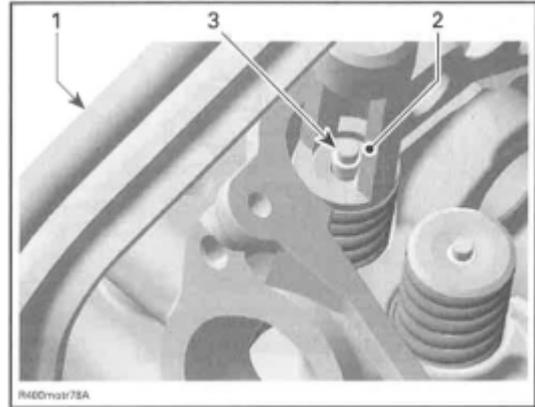
REQUIRED TOOL	
VALVE SPRING COMPRESSOR (P/N529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N529 035 764)	

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



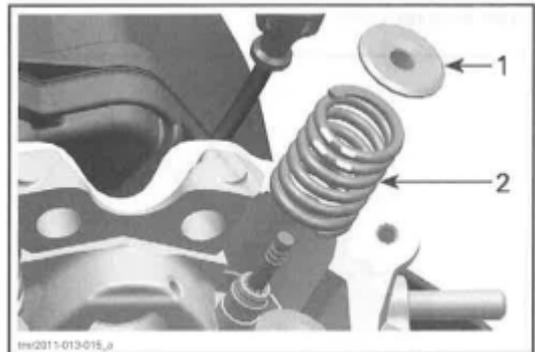
LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

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.

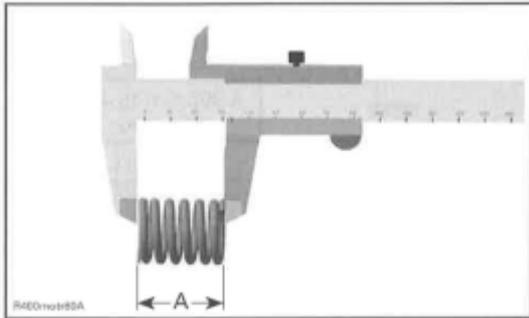


1. Valve spring retainer
2. Valve spring

### Valve Spring Inspection

Check valve spring for visible damage. If so, replace valve spring.

Check valve spring for free length and straightness.



A. Valve spring length

VALVE SPRING FREE LENGTH	
NEW	40.81 mm(1.607in)
SERVICE LIMIT	39.00 mm(1.535in)

Replace valve springs if not within specifications.

#### Valve Spring Installation

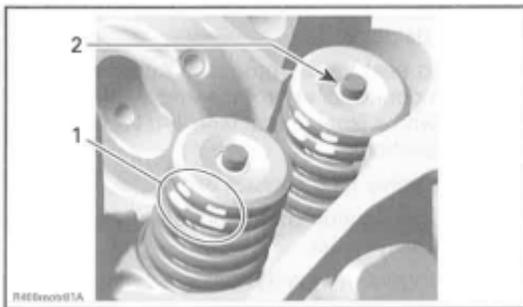
For installation, reverse the removal procedure.

Pay attention to the following details.

Colored area of the valve spring must be placed on top.

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

NOTE: Valve cotter must be properly engaged in valve stem grooves.



1. Position of the valve spring
2. Valve cotter

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

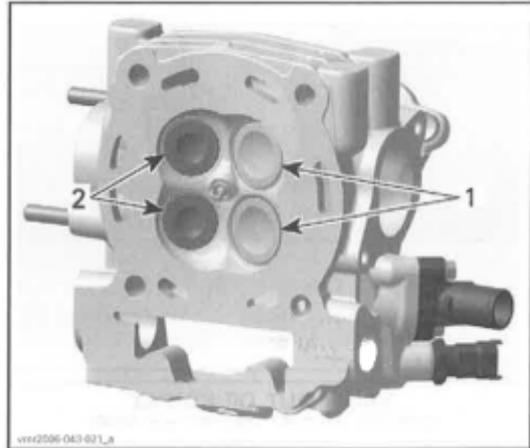
**NOTICE** An improperly locked valve spring will cause engine damage.

## VALVES

### Valve Removal

Remove valve spring, see VALVE SPRING in this subsection.

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



1. Intake valve 31mm
2. Exhaust valve 27 mm

Remove valve stem seal and discard it

REQUIRED TOOL	
SNAP-ON PLIERS(P/N YA 8230)	



### Valve Inspection

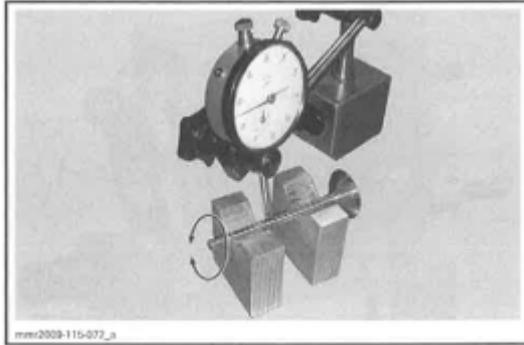
Whenever valves are removed always inspect valve guides. Refer to VALVE GUIDES in this subsection.

## 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.

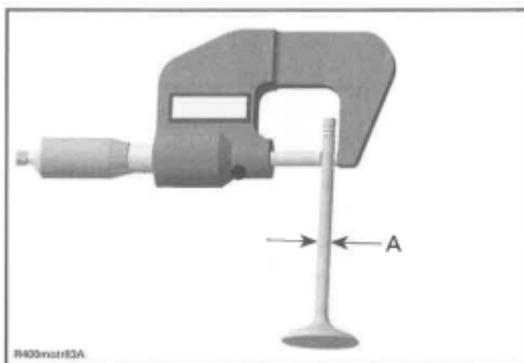


VALVE OUT OF ROUND (INTAKE AND EXHAUST VALVES)	
NEW	0.005mm(.0002 in)
SERVICE LIMIT	0.06 mm(.0024in)

### Valve Stem

Measure valve stem in three places using a micrometer .

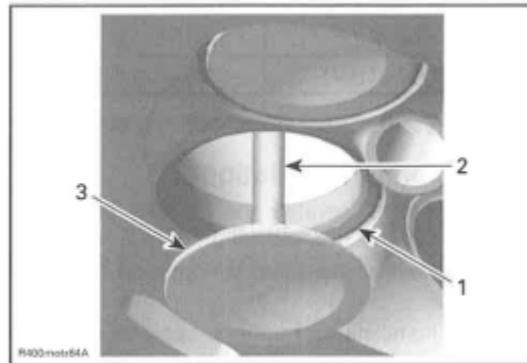
Replace valve if valve stem is out of specification or has other damages such as wear or friction surface.



A. Valve stem diameter

VALVE STEM DIAMETER	
EXHAUST VALVE	
NEW	4.956mm to 4.970 mm (.1951 in to .1957 in)
SERVICE LIMIT	4.930mm(.1941 in)
INTAKE VALVE	
NEW	4.966mm to 4.980 mm (.1955 in to .1961 in)
SERVICE LIMIT	4.930mm(.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 GUIDEA in this subsection).

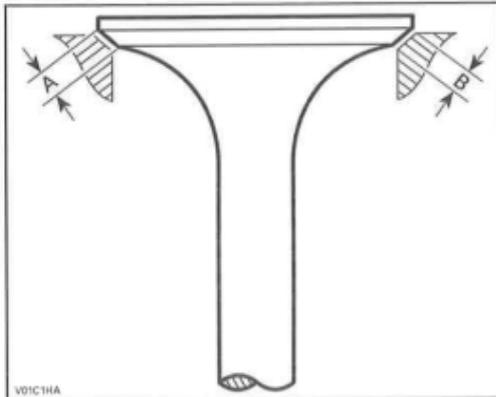
Measure valve face contact width.

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	1.25mm to 1.55mm (.049 in to .061 in)
SERVICE LIMIT	2.00 mm(.079 in)
INTAKE VALVE	
NEW	1.05mm to 1.35mm (.041 in to .053 in)
SERVICE LIMIT	1.80mm(.071 in)

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



- A. Valve face contact width
- B. Valve seat contact width

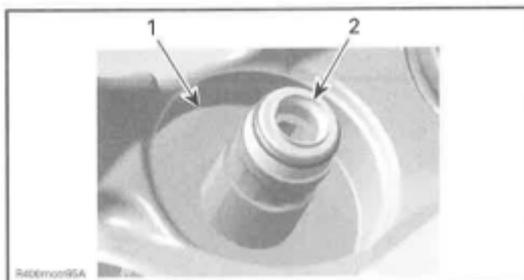
### Valve Installation

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

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

Apply engine oil on valve stem and install it.

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



- 1. Thrust washer
- 2. Sealing lips of valve stem seal

To ease installation of cotteners, apply oil or grease on them so that they remain in place while releasing the spring.

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

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

### VALVE GUIDES

#### Valve Guide Inspection

Always replace valve stem seals whenever valve guides are removed.

Measure valve guide in three places using a small bore gauge.

NOTE: Clean valve guide to remove carbon deposits before measuring.

Replace valve guide if it is out of specification or has other damages such as wear or friction surface.

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

#### Valve Guide Removal

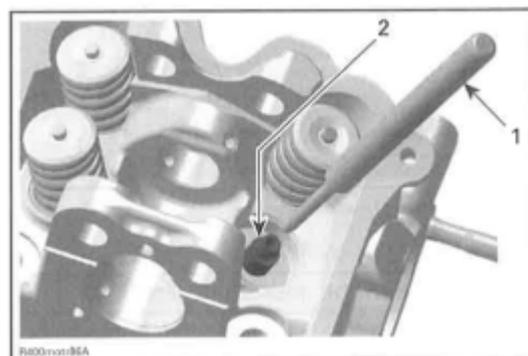
Refer to following procedures in this subsection to remove:

- Cylinder head
- Valves.

NOTE: Clean valve guide area from contamination before removal.

Drive the valve guide out of cylinder head.

REQUIRED TOOL	
Hammer	
VALVE GUIDE REMOVER 5 MM	



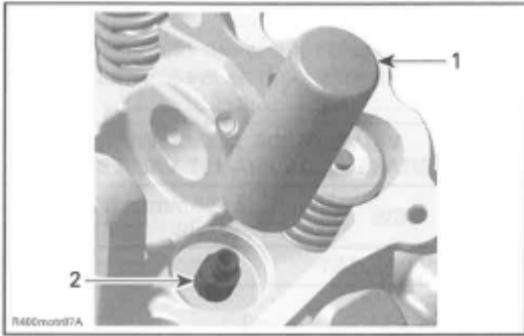
- 1. Valve guide remover
- 2. Valve guide

#### Valve Guide Installation

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.

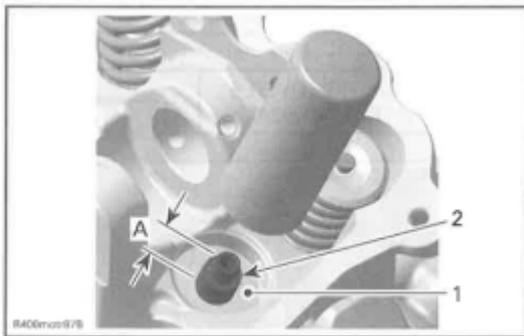
REQUIED TOOL	
VALVE GUIDE INSTALLER	



1. Valve guide installer
2. Valve guide

NOTE: Apply LOCTITE767 (ANTISEIZE LUBRICANT) (P/N293 800 070) on valve guide prior to install it into the cylinder head.

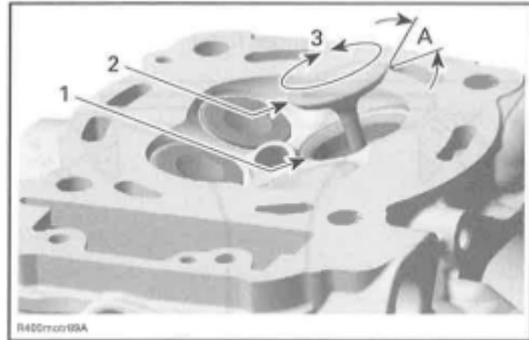
**NOTICE** Push valve guide in the cold cylinder head as per following illustration.



1. Thrust surface of cylinder head
2. Valve guide
- A. Measurement from thrust surface to valve guide top

VALVE GUIDE(MEASUREMENT "A" )	
NEW	14.00mm to14.40mm (.5512 in to .5669 in)

Apply some lapping compound to valve face and work valve on its seat with a lapping tool.



1. Valve seat
2. Valve face (contact surface to valve seat)
3. Turn valve while pushing against cylinder head
- A. Valve seat angle 45°

NOTE: Ensure to seat valves properly. Apply marking paste to ease checking contact pattern. Repeat procedure until valve seat/valve face fits together.

#### CYLINDER

##### Cylinder Removal

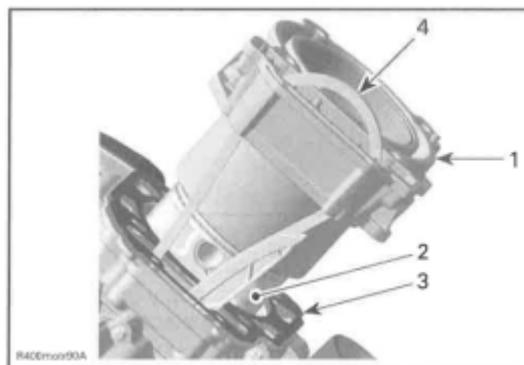
Refer to TUMING CHAIN subsection and remove the following parts:

- Timing chain tensioner
- Camshaft timing gear.

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

Pull cylinder.

Discard cylinder base gaskets.



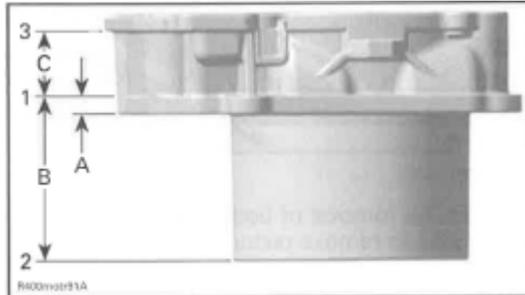
1. Cylinder
2. Piston assembly
3. Cylinder base gasket
4. Camshaft timing chain

## Cylinder Inspection

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

### Cylinder Taper

Measure cylinder bore at 3 recommended positions.



- A. First measurement (from cylinder bottom)
- B. Second measurement
- C. Third measurement

CYLINDER TAPER MEASUREMENTS		
ENGINE	MEASUREMENT	SPECIFICATION
800R engine	A	5mm(.197in)
	B	63mm(2.48in)
	C	32 mm(1.26in)
1000 engine	A	5mm(.197 in)
	B	58 mm(2.283 in)
	C	52 mm(2.047 in)

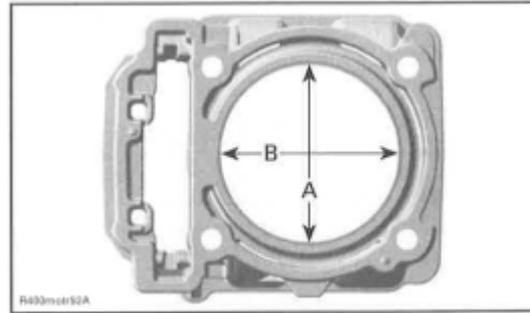
CYLINDER TAPER SPECIFICATION	
NEW (MAXIMUM)	0.038mm(.0015in)
SERVICE LIMIT	0.090 mm(.0035in)

Distance between measurements should not exceed the service limit mentioned above. Otherwise, replace cylinder and piston rings.

### Cylinder Out of Round

Measure cylinder diameter in piston axis direction from top of cylinder. Take another measurement 90° from first one and compare.

NOTE: Take the same measuring points like described in CYLINDER TAPER above.



- A. Perpendicular to crankshaft axis
- B. Parallel to crankshaft axis

CYLINDER OUT OF ROUND	
NEW (MAXIMUM)	0.015mm(.0006in)
SERVICE LIMIT	0.020 mm(.0008 in)

## Cylinder Installation

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

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

NOTE: Make sure piston rings are properly spaced, refer to PISTON 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	

First mount cylinder 2.

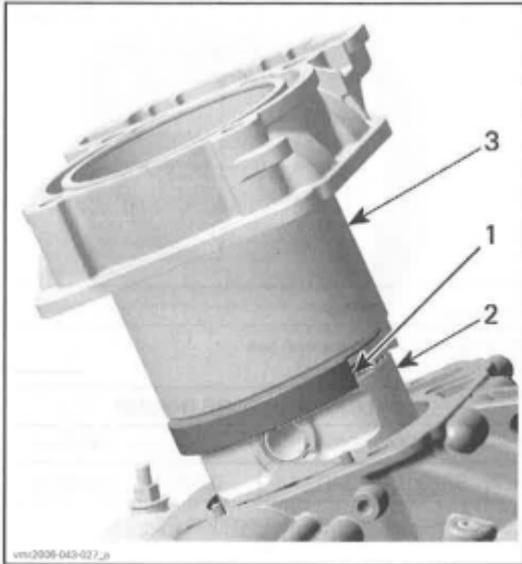
NOTE: The cylinder can not be pushed fully over the piston unless the piston is located at TDC.

Then remove the CRANKSHAFT LOCKING BOLT (P/N529 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 cylinder2 is at TDC and lock crankshaft. Refer to CRANKSHAFT BOTTOM END subsection.

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

## PISTON

### Piston Removal

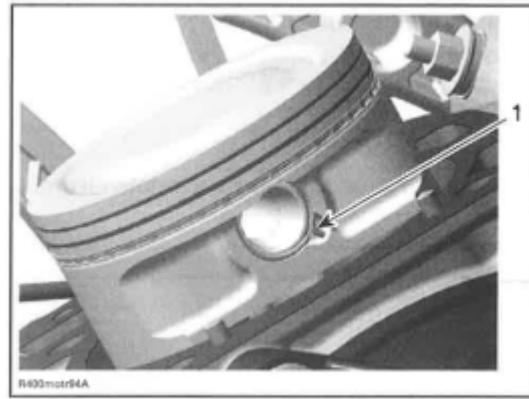
Refer to following procedures in this subsection to remove:

- Cylinder head
- Cylinder.

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

△ WARNING
Piston circlips are spring loaded

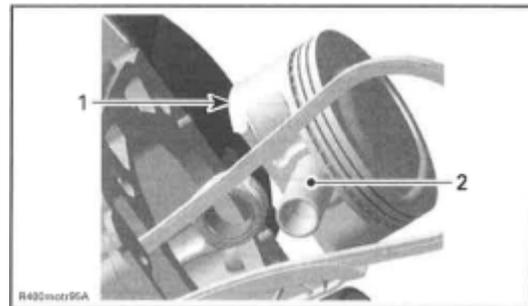
Remove one piston circlip and discard it.



1. Piston circlip

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

Push piston pin out of piston.



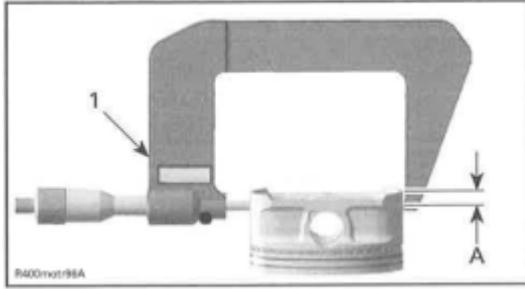
1. Piston
2. Piston pin

Detach piston from connecting rod.

### Piston Inspection

Inspect piston for scoring, cracking or other damages. Replace piston and piston rings if necessary.

Using a micrometer, measure piston at 8mm (.315in) perpendicularly (90°) to piston pin.



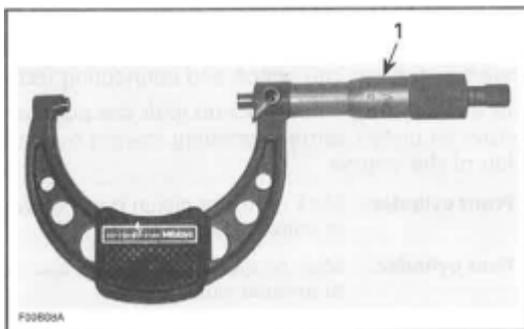
1. Measuring perpendicularly (90°) to piston pin  
A. 8mm (.315in)

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

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

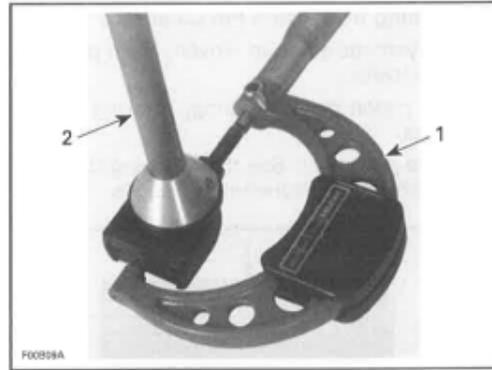
### Piston/Cylinder Clearance

Adjust and lock a micrometer to the piston dimension.

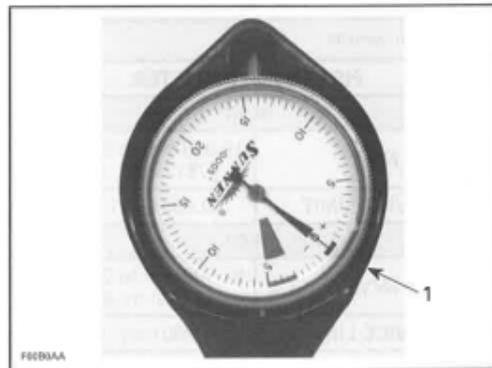


1. Micrometer set to the piston dimension

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	0.027mm to 0.057 mm (.0011 in to .0022in)
SERVICE LIMIT	0.100 mm (.0039 in)

NOTE: Make sure used piston is not worn.

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

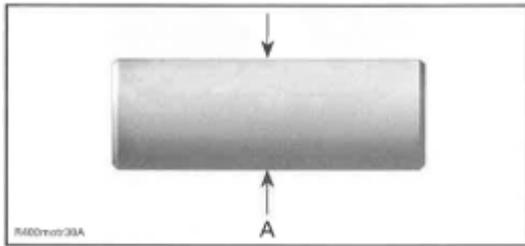
NOTE: Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

### Connecting Rod/Piston Pin Clearance

Using synthetic abrasive woven, clean piston pin from deposits .

Inspect piston pin for scoring, cracking or other damages.

Measure piston pin . See the following illustration for the proper measurement positions.

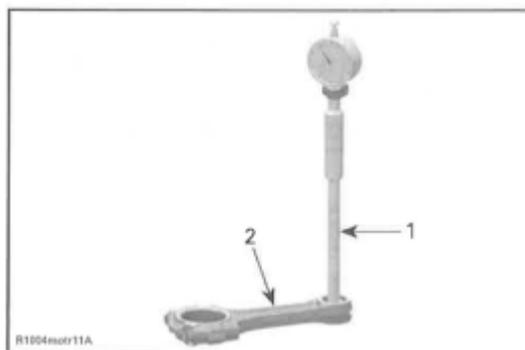


A. Piston pin diameter

PISTON PIN DIAMETER	
800R	
NEW	19.996mm to20.000 mm (.7872in to.7874in)
SERVICE LIMIT	19.980 mm(.7866 in)
1000	
NEW	21.996mm to22.000 mm (.866in to.8661 in)
SERVICE LIMIT	21 .980 mm(.8654in)

Replace piston pin if diameter is out of specifications.

Measure inside diameter of connecting rod small end bushing .



1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER	
800R	
NEW	20.010 mm to20.020 mm (.7878in to.7882in)
SERVICE LIMIT	20.060 mm(.7898 in)
1000	
NEW	20.010 mm to20.020 mm (.7878in to.7882in)
SERVICE LIMIT	20.050 mm(.7894in)

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	0.080mm(.0031 in)

### Piston Installation

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

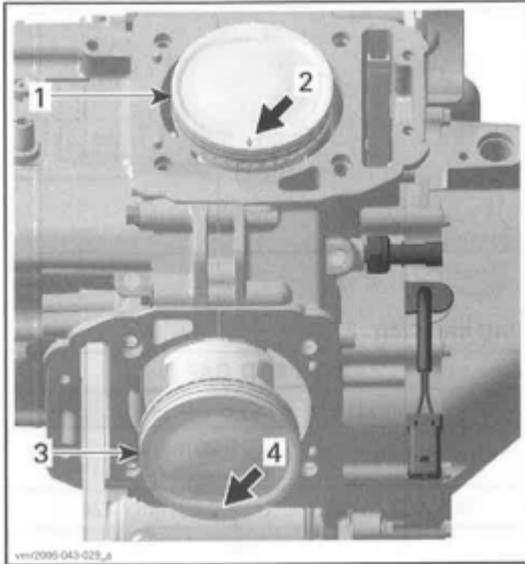
Apply engine oil on the piston pin.

Insert piston pin into piston and connecting rod.

For each cylinder, Install piston with the punched arrow on piston dome is pointing toward the rear side of the engine.

Front cylinder: Mark on top of piston must show to intake side.

Rear cylinder: Mark on top of piston must show to exhaust side.



1. Piston of cylinder 1
2. Mark on piston must show to intake side of cylinder 1
3. Piston of cylinder 2
4. Mark on piston must show to exhaust side of cylinder 2

Use the piston appropriate circlip installer to assemble the NEW piston circlip as per following procedure:

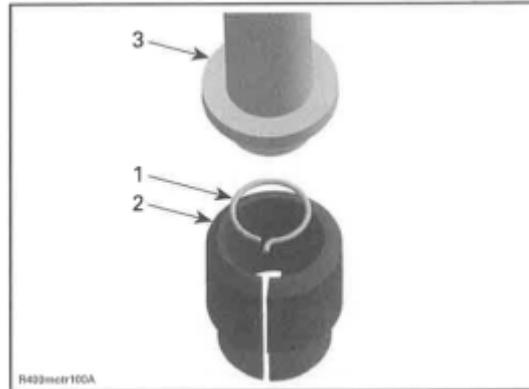
ENGINE TYPE	TOOL
800R	PISTON CIRCLIP INSTALLER
1000	PISTON CIRCLIP INSTALLER



TYPICAL

**NOTICE** Always replace disassembled piston circlip(s) by NEW ones. Place a rag on cylinder base to avoid dropping the circlip inside the engine.

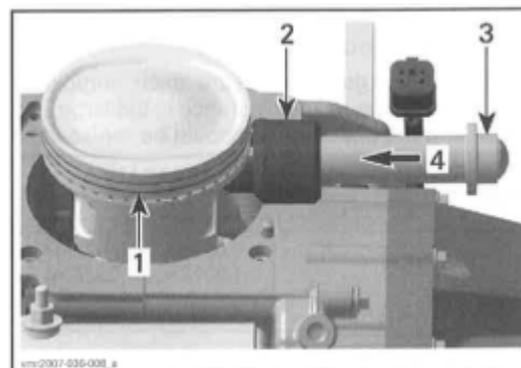
Place circlip in sleeve as per following illustration.



1. Circlip
2. Sleeve
3. Assembly jig from piston clip installer

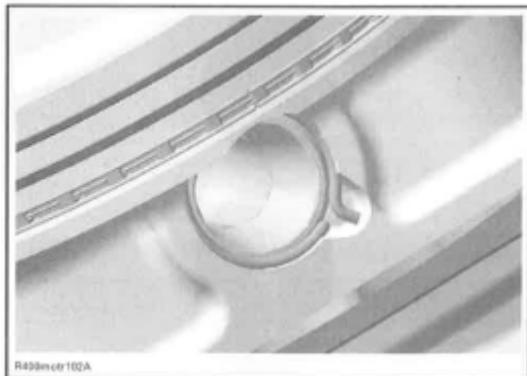
Push taper side of assembly jig until circlip reaches middle of sleeve.

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

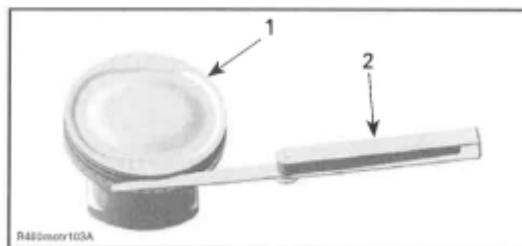


1. Hold piston while pushing circlip in place
2. Sleeve
3. Assembly jig
4. Direction to push circlip

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



CORRECT POSITION OF THE PISTON CIRCLIP



1. Piston
2. Feeler gauge

## PISTON RINGS

### Ring Removal

Remove the piston (see PISTON in this subsection).

### Ring Inspection

#### Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance. If the clearance is too large, the piston and the piston rings should be replaced.

RING END GAP	
UPPER COMPRESSION RING	
NEW	0.03mm to 0.07mm (.0012in to .0028in)
SERVICE LIMIT	0.150mm(.0059in)
LOWER COMPRESSION RING	
NEW	0.02 mm to 0.06mm (.0008in to .0024in)
SERVICE LIMIT	0.150mm(.0059in)
OIL SCRAPER RING	
NEW	0.01 mm to 0.18mm (.0004in to .0071 in)
SERVICE LIMIT	0.250mm(.0098in)

### Ring End Gap

RING/PISTON GROOVE CLEARANCE	
UPPER COMPRESSION RING	
NEW	0.20 mm to 0.40 mm (.008in to .016in)
SERVICE LIMIT	0.60 mm(.024in)
LOWER COMPRESSION RING	
NEW	0.20 mm to 0.40mm (.008in to .016in)
SERVICE LIMIT	0.70 mm(.028 in)
OIL SCRAPER RING	
NEW	0.20 mm to 0.70mm (.008in to .028in)
SERVICE LIMIT	1.00 mm(.039in)

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

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

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

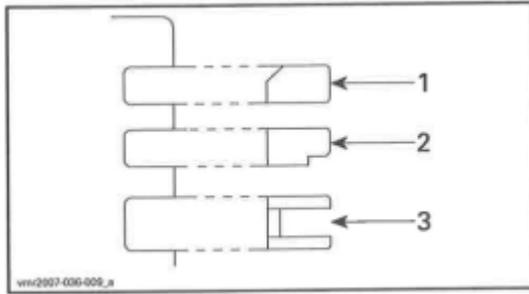
### Ring Installation

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

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

NOTE: First install spring and then rings of oil scraper ring.

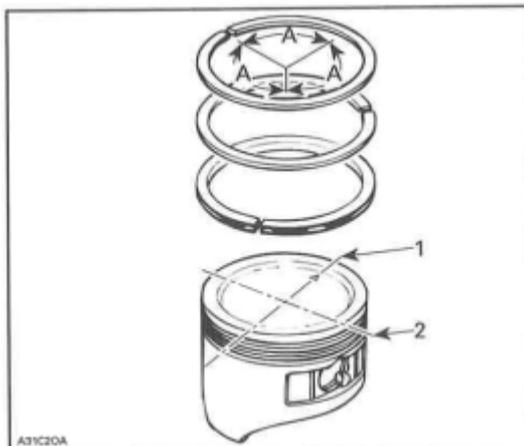
Install the oil scraper ring first, then the lower compression ring with the word "N" and "TOP" facing up, then the upper compression ring with the word "N" and "TOP" facing up.



1. Upper compression ring
2. Lower compression ring
3. Oil scraper ring

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

Check that rings rotate smoothly after installation.  
Space the piston ring end gaps  $120^\circ$  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.  $120^\circ$

## TIMING CHAIN

## SERVICE TOOLS

Description	Part Number	Page
-------------	-------------	------

CAMSHAFT TIMING TOOL

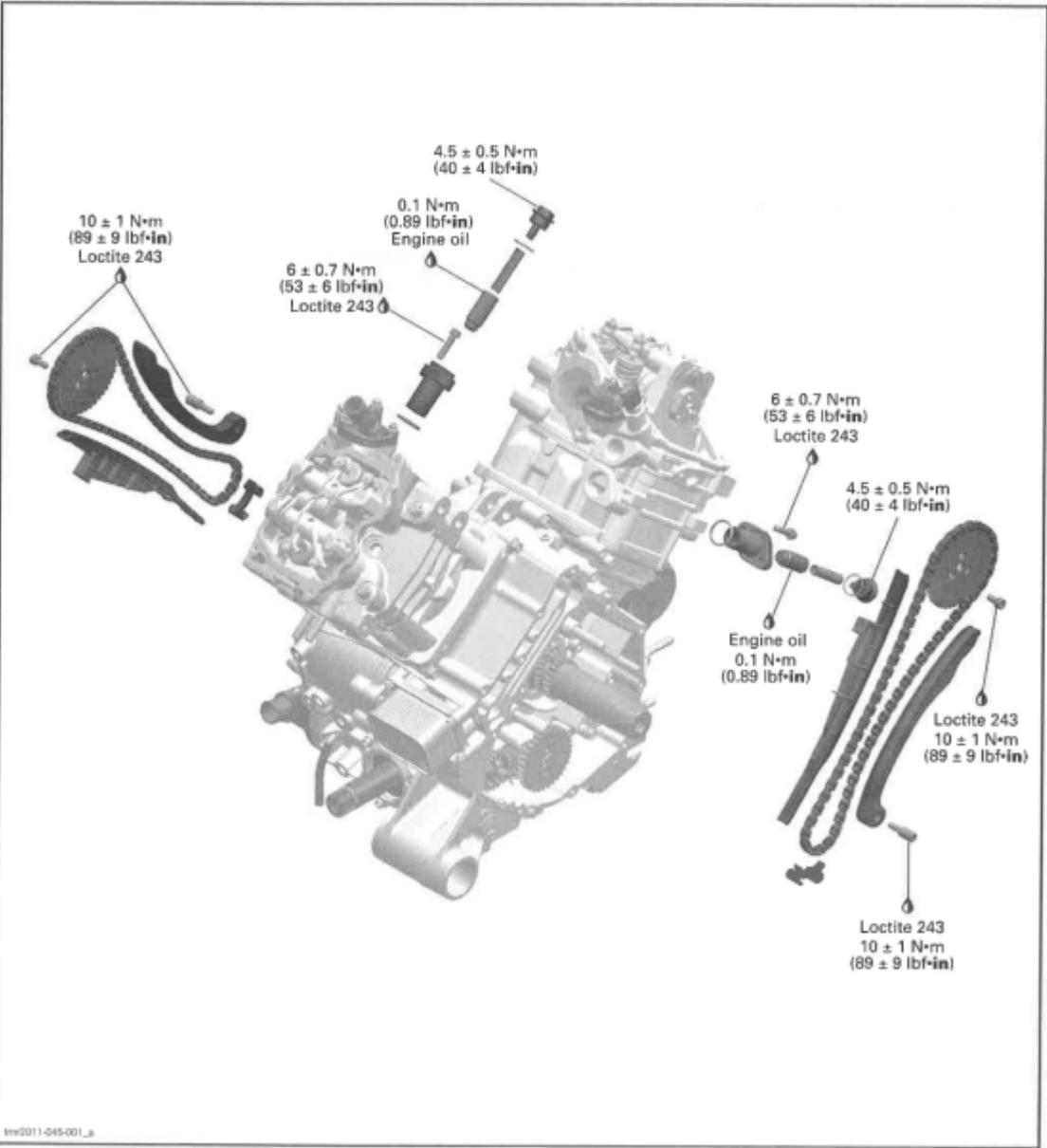
CRANKSHAFT TDC POSITION TOOL

## SERVICE PRODUCTS

Description	Part Number	Page
-------------	-------------	------

LOCTITE243 (BLUE)

# 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 chain guide(s)

#### 4. STRETCHED TIMING CHAIN OR WORN OUT TIMING GEARS

-Replace timing chain and timing gears.

#### 5. LOOSE TIMING GEAR RETAINING SCREWS

-Retighten screws to recommended torque.

#### 6. INCORRECT CAMSHAFT TIMING

-Replace damaged components and readjust camshaft timing.

### ENGINE LACKS ACCELERATION OR POWER

#### 1. INCORRECT CAMSHAFT TIMING

-Replace damaged components and readjust camshaft timing.

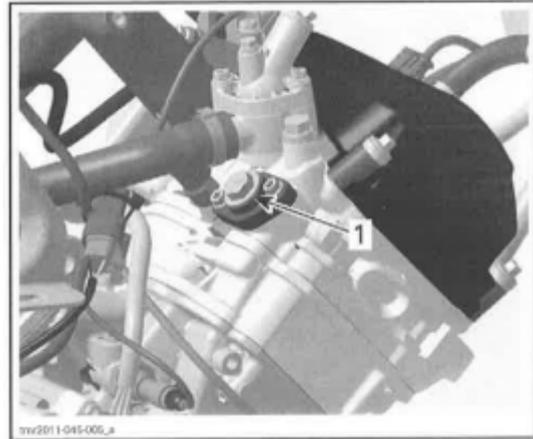
## PROCEDURES

### TIMING CHAIN TENSIONERS

#### Timing Chain Tensioner Location

##### 800R Engine

The timing chain tensioner is located in the cylinder head.



800R Engine-(FRONT CYLINDER SHOWN)

1. Timing chain tensioner

##### 1000 Engine

The timing chain tensioner is located in the cylinder.



800R Engine-(FRONT CYLINDER SHOWN)

1. Timing chain tensioner

### Timing Chain Tensioner Removal

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

2. Carefully unscrew chain tensioner plug and release spring tension.

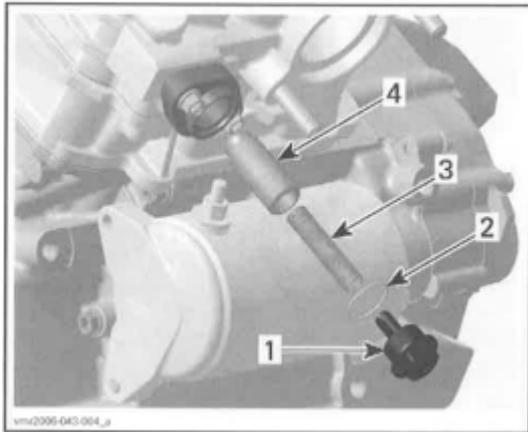
△CAUTION Tensioner is spring loaded.

3. Remove:

- O-ring

- Spring

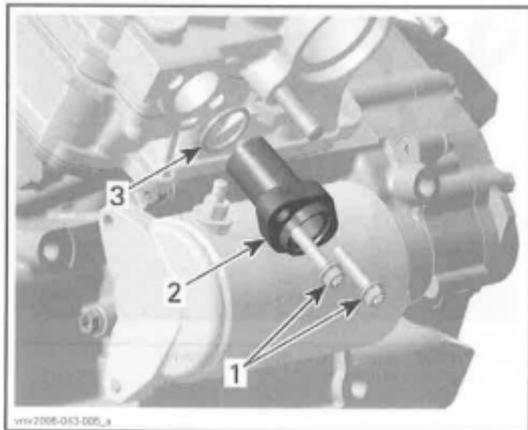
- Chain tensioner plunger



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

4. Remove:

- Chain tensioner housing retaining screws
- Chain tensioner housing
- O-ring.



1. Screws
2. Chain tensioner housing
3. O-ring,

### Timing Chain Tensioner Inspection

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

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

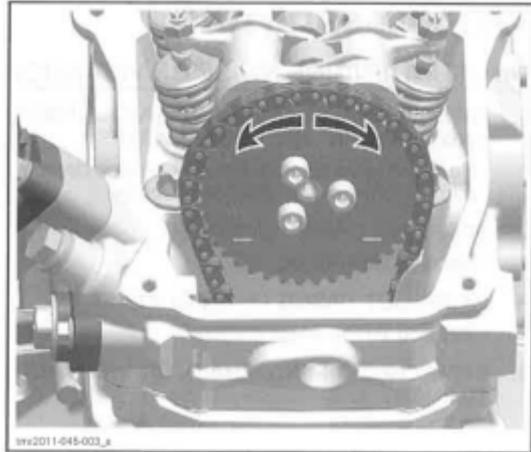
Check if O-rings are brittle, cracked or hard. Replace if necessary.

Check spring condition. Replace if bent, broken or worn.

### Timing Chain Tensioner Installation

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

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



MOVE GEAR BACK AND FORTH

2. Apply engine oil on the plunger before installation.

3. Slightly turn the camshaft timing gear in order to get the timing chain play on the tensioner side.

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

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

TIMING CHAIN TENSIONER ADJUSTMENT (TORQUE)
0.1 N·m(.9lbf-in)

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

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

NOTE: Turn spring only clockwise in order to fit the spring end into the notch of the plunger to avoid loosening the plunger during spring installation. Do not preload the spring.

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

7. Then compress the spring and screw the plug in.

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

8. Remove locking tool and install all other removed parts.

9. Finally, tighten the plug.

## CAMSHAFT TIMING GEARS

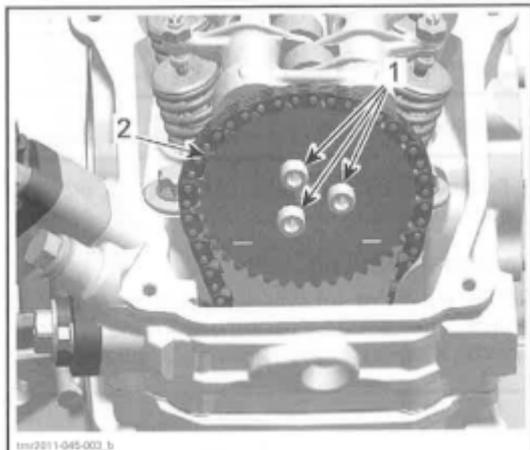
### Camshaft Timing Gear Removal

Remove the valve cover, refer to TOP END sub section.

Turn crankshaft to TDC ignition of the respective cylinder and lock magneto flywheel, see CAMSHAFT TIMING in this subsection.

Unscrew timing chain tensioner. Refer to TIMING CHAIN TENSIONERS in this subsection.

Remove camshaft timing gear retaining screws.



1. Camshaft timing gear retaining screws
2. Camshaft timing gear

Remove the camshaft timing gear.

NOTE: Secure timing chain with a piece of wire.

### Camshaft Timing Gear Inspection

Check camshaft timing gear for wear or deterioration.

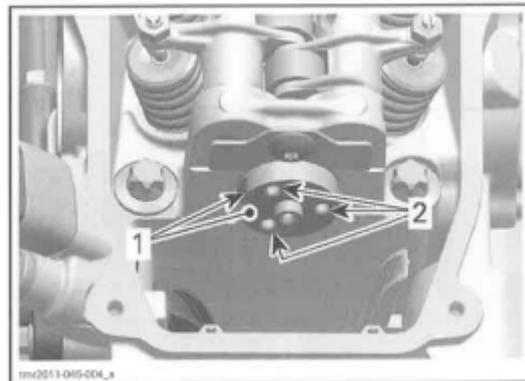
If gear is worn or damaged, replace it as a set with the timing chain.

For crankshaft gear, refer to BOTTOM END subsection, see CRANKSHAFT.

### Camshaft Timing Gear Installation

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

1. Clean mating surface and threads of camshaft prior installing camshaft timing gear.



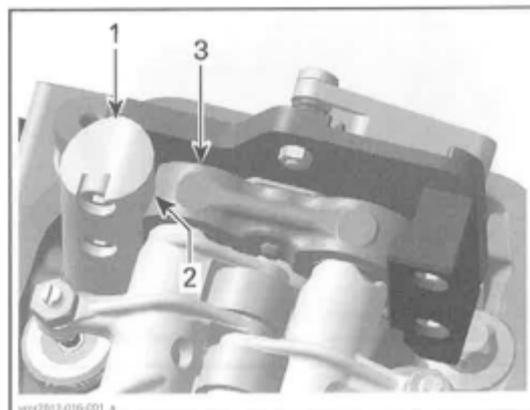
1. Mating surface on camshaft
2. Threads for camshaft screws

2. Crankshaft must be set to TDC ignition position before installing the timing chain, refer to CAMSHAFT TIMING in this subsection.

3. Install the camshaft timing tool on the cylinder head.

REQUIRED TOOL	
CAMSHAFT TIMING TOOL	

NOTE: Align tube of camshaft adjustment tool properly with machined radius on cylinder head.

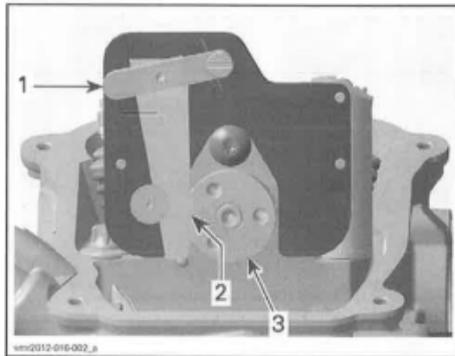


### CAMSHAFT TIMING TOOL INSTALLED

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.



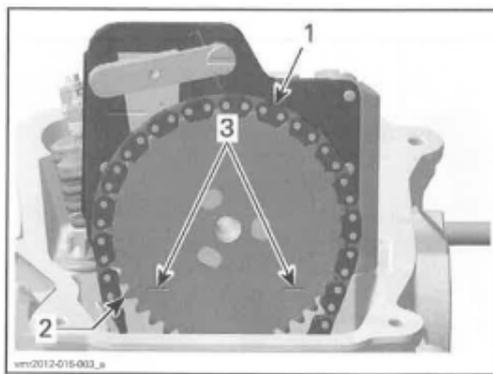
PRESS TOOL LEVER DOWN

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.

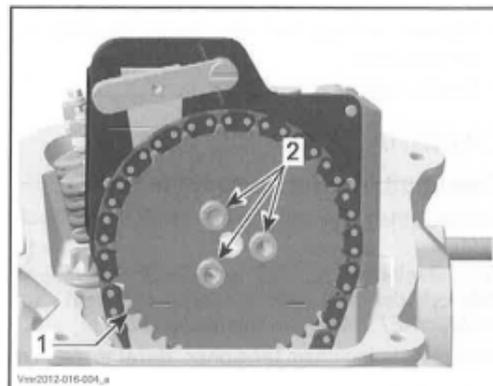
NOTE: The printed marks on the camshaft timing gear must be parallel to the cylinder head base.



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 TENSIONERS in this subsection.

7. Install and tighten camshaft timing gear retaining screws to specified torque.



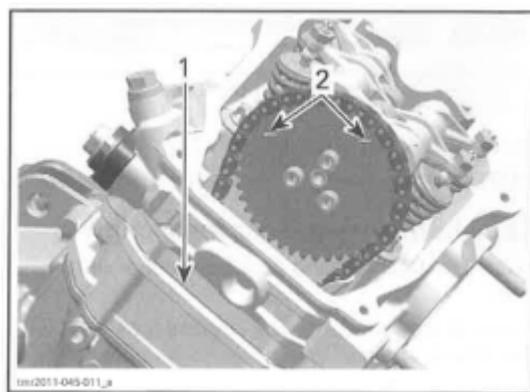
1. Camshaft timing gear
2. Timing gear retaining screws

#### CAMSHAFTTIMING GEAR RETAINING SCREWS

Service product	LOCTITE243 (BLUE)
Tightening torque	10N·m±1N·m (89lbf·in ± 9lbf·in)

8. Remove the CAMSHAFTTIMING TOOL  
Camshaft Timing

NOTE: If a piston (of cylinder1 or2) is set to TDC ignition, the camshaft timing gear of the opposite cylinder must be in the following position.



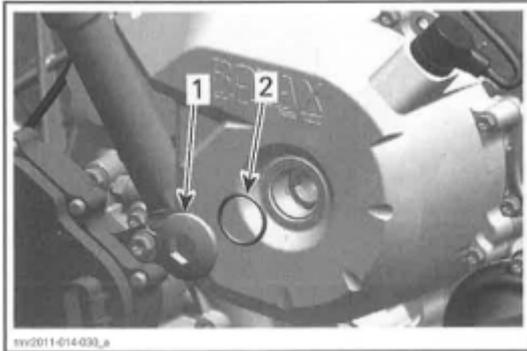
TYPICAL

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

Camshaft Timing Piston No. 2 (rear)

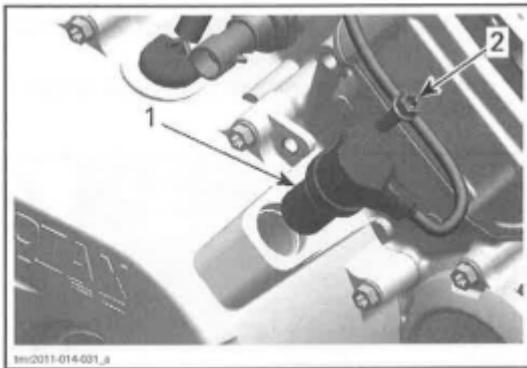
1. Remove spark plugs of both cylinders

2. Remove valve covers of both cylinders.
3. Remove the plug and O-ring of magneto cover.



1. Plug
2. O-ring

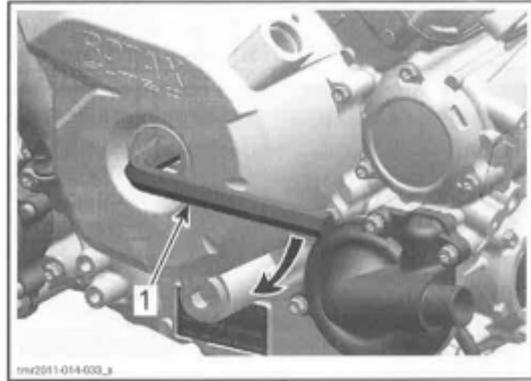
4. Remove the crankshaft position sensor (CPS),



1. CPS
2. Screw

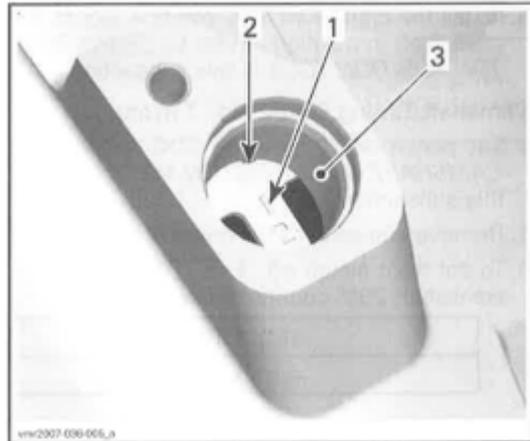
5. Set piston no. 2 to TDC ignition by turning the crankshaft.

REQUIED TOOL
Allen key 14mm



1. Allen key 74mm

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.



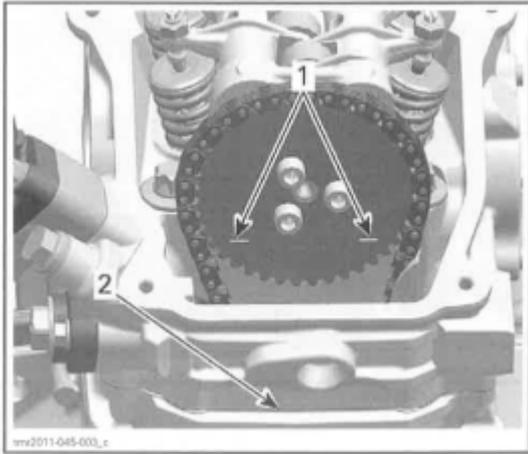
PISTON NO. 2 AT TDC

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.



TYPICAL – PISTON AT TDC IGNITION

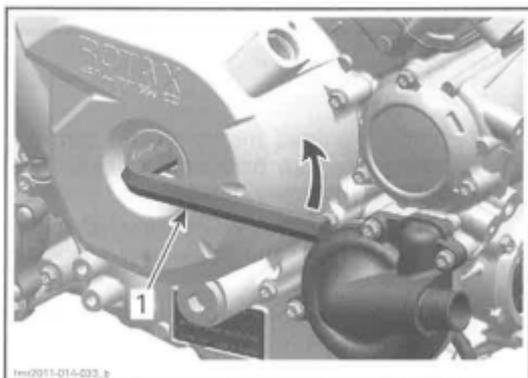
1. Printed marks on camshaft timing gear
2. Cylinder head base

6. Install the crankshaft TDC position tool to lock crankshaft in position. Refer to CRANKSHAFT TDC POSITION TOOL in this subsection.

**Camshaft Timing Piston No. 1 (front)**

1. Set piston no. 2 (rear) to TDC ignition, see CRANKSHAFT TIMING PISTON NO. 2(READ) in this subsection.
2. Remove crankshaft TDC position tool.
3. To set front piston no. 1 to TDC ignition turn crankshaft 280° counterclockwise.

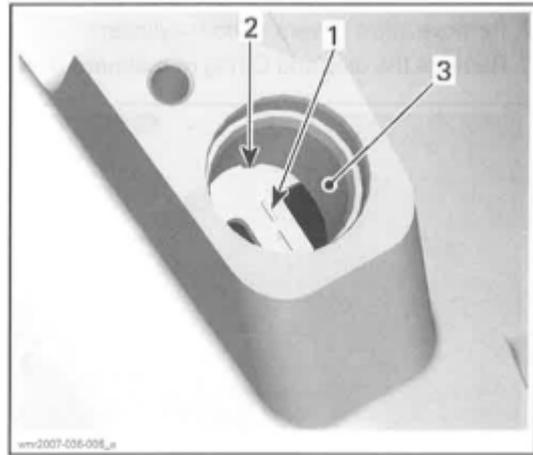
<b>REQUIED TOOL</b>
Allen key 14mm



TURN CRANKSHAFT 280° COIUNTERCLOCKWISE

1. Allen key14 mm

3.1 The front piston is at TDC when it's index mark on the magneto flywheel is aligned with the notch in the magneto cover.

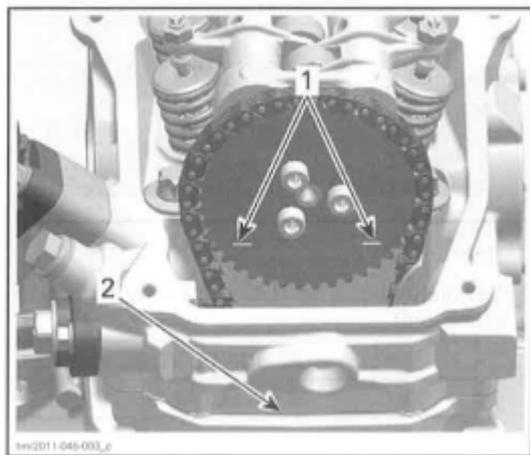


CYLINDER 1 AT TDC IGNITION

1. Mark “1” on magneto flywheel
2. Notch on magneto cover
3. Location of crankshaft position sensor

3.2 Confirm printed marks on the camshaft timing gear are parallel with cylinder head base, in the lowest position.

NOTE: In this position the piston is set to TDC ignition.



TYPICAL – PISTON AT TDC IGNITION

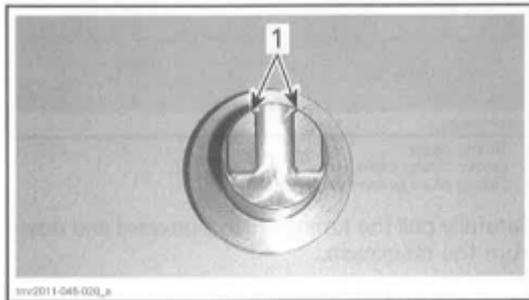
1. Printed marks on camshaft timing gear
2. Cylinder head base

**Crankshaft TDC Position Tool Installation**

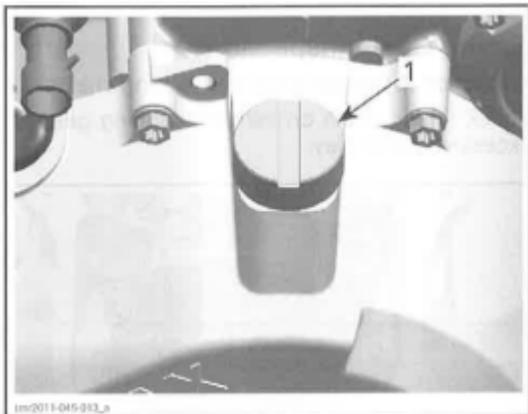
Install tool in magneto cover CPS bore.

REQUIED TOOL	
CRANKSHAFT TDC POSITION TOOL	

NOTE: Make sure to match the teeth on the crankshaft TDC position tool with the magneto rotor.



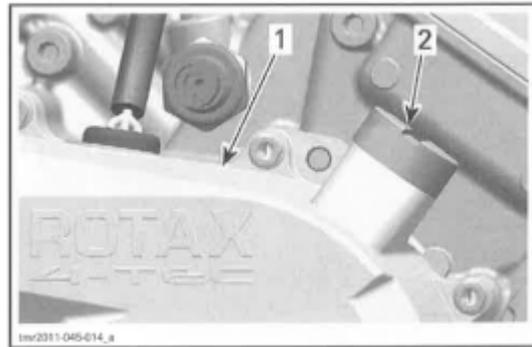
1. Crankshaft TDC position tool teeth (end view)



#### MAGNETO COVER

1. Crankshaft TDC position tool installed in CPS bore

**NOTICE** Tool must be fully inserted



1. Magneto cover  
2. TDC position tool

#### TIMING CHAIN

The engine is equipped with two timing chains.

- MAG side timing chain is located behind the magneto cover.
- PT0 side timing chain is located behind the PT0 cover.

#### Timing Chain Removal (MAG Side)

Refer to MAGNETO SYSTEM subsection and remove following parts:

- Magneto cover
- Rotor
- Sprag clutch gear.

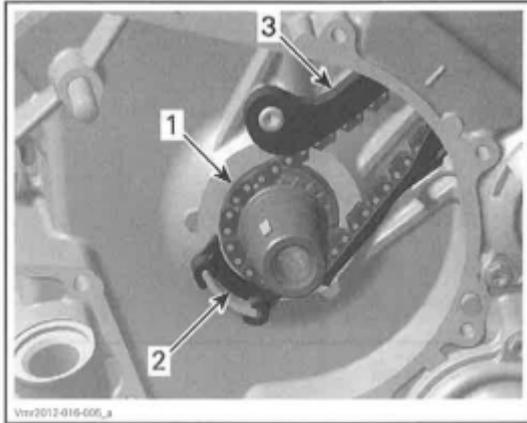
Refer to TOP END subsection and remove following parts:

- Valve cover.

Refer to following procedures in this subsection and remove following parts:

- Chain tensioner
- Camshaft timing gear.

Remove timing chain guide (tensioner side) and lower timing chain guide.



1. Timing chain
2. Lower timing chain guide
3. Timing chain guide (tensioner side)

NOTE: Mark the operating direction of the timing chain and check for excessive radial play before removal. Refer to TIMING CHAIN INSPECTION.

Carefully pull the timing chain downwards and sideways, then out of the crankcase.

#### Timing Chain Removal (PTO Side)

Refer to BOTTOM END subsection and remove following parts:

- PTO cover
- Breather gear
- Intermediate gear.

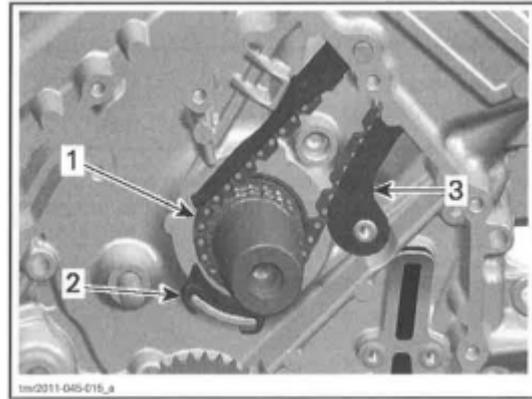
Refer to PTO END subsection and remove following parts:

- Valve cover.

Refer to following procedures in this subsection and remove following parts:

- Chain tensioner
- Camshaft timing gear.

Remove timing chain guide (tensioner side) and lower timing chain guide.



1. Timing chain
2. Lower timing chain guide
3. Timing chain guide (tensioner side)

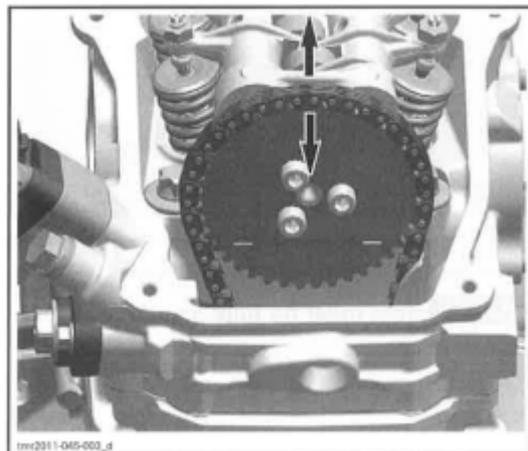
Carefully pull the timing chain sideward and down from the crankcase.

NOTE: Mark the operating direction of the timing chain and check for excessive radial play before removal. Refer to TIMING CHAIN INSPECTION.

#### Timing Chain Inspection

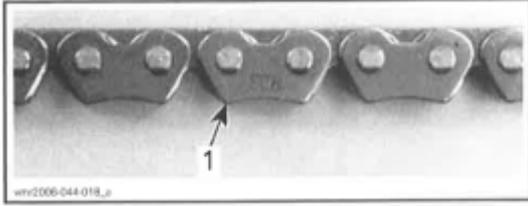
Inspection is the same for both timing chains.

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



#### CHECK TIMING CHAIN RADIAL PLAY

Check chain condition for wear and teeth condition.



### 1. Timing chain

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

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

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

### Timing Chain Installation

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

**NOTE:** Installation is the same for both timing chains.

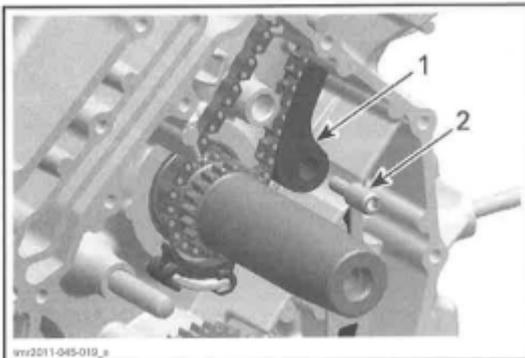
Install timing chain with camshaft timing gear.

**NOTE:** Ensure to carry out proper valve timing, refer to CAMSHAFT TIMING GEARS in this subsection.

**NOTICE** Improper valve timing will damage engine components.

## TIMING CHAIN GUIDE

### (TENSIONER SIDE)



1. Timing chain guide (tensioner side)

2. Bearing screw

### Timing Chain Guide Removal

#### (Tensioner Side)

Refer to TIMING CHAIN in this subsection

### Timing Chain Guide Inspection

#### (Tensioner Side)

Check timing chain guide for wear, cracks or deforming. Replace if necessary.

### Timing Chain Guide Inspection

#### (Tensioner Side)

The installation is the reverse of the removal procedure.

TIMING CHAIN GUIDE BEARING SCREW	
Service product	LOCTITE243 (BLUE)
Tightening torque	10N · m ± 1 N · m (89lbf·in±9lbf·in)

## BOTTOM END

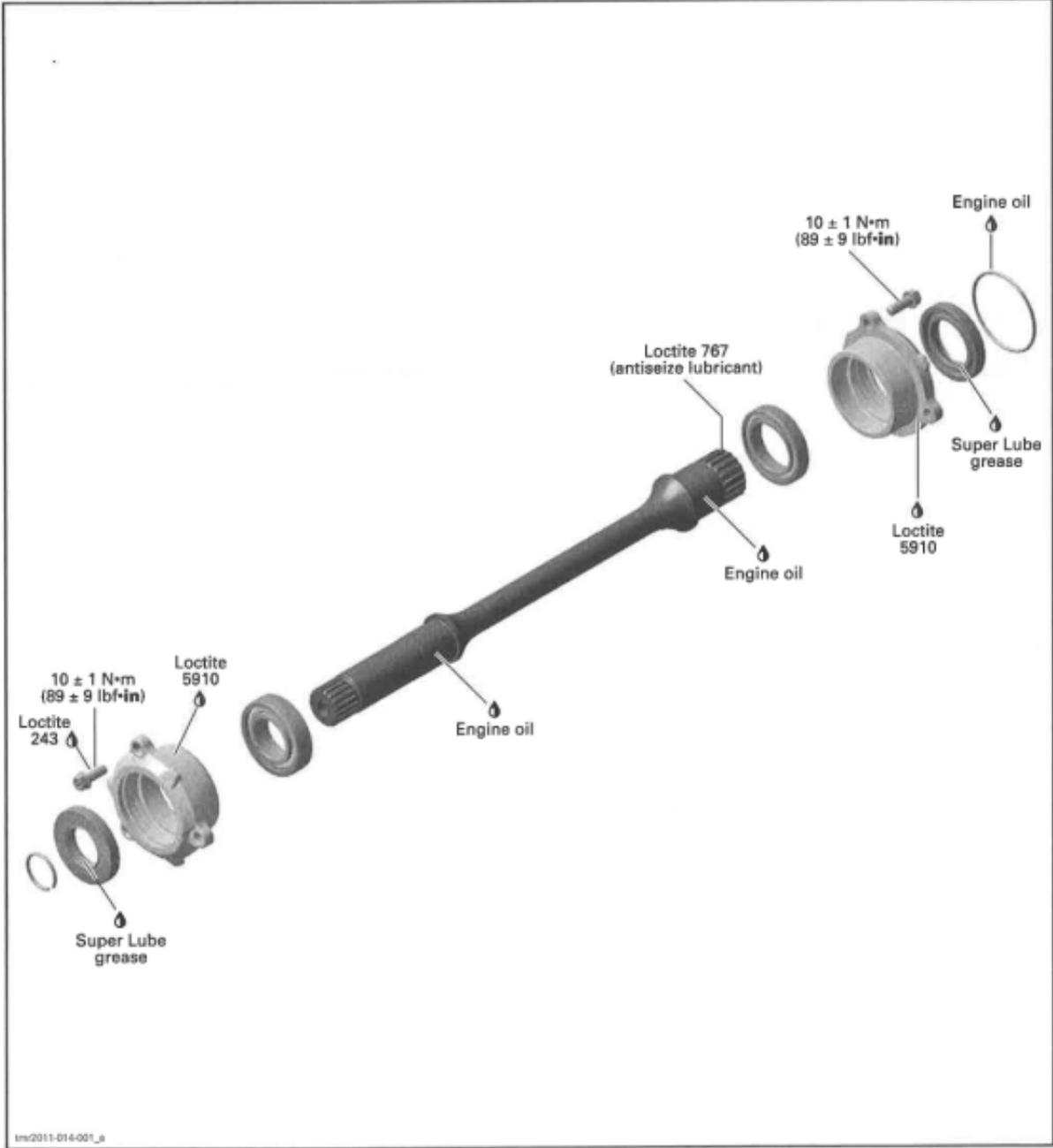
### SERVICE TOOLS

Description	Part Number	Page
CRANKCASE SUPPORT MAG/PT0		
CRANKSHAFT LOCKING BOLT		
DRIVE SHAFT OIL SEALINSTALLER		
DRIVE SHAFT OIL SEAL PROTECTOR_ PLAIN BEARING REMOVER/INSTALLER PLAIN BEARING REMOVER/INSTALLER		
PT0 COVER OIL SEAL INSTALLER		

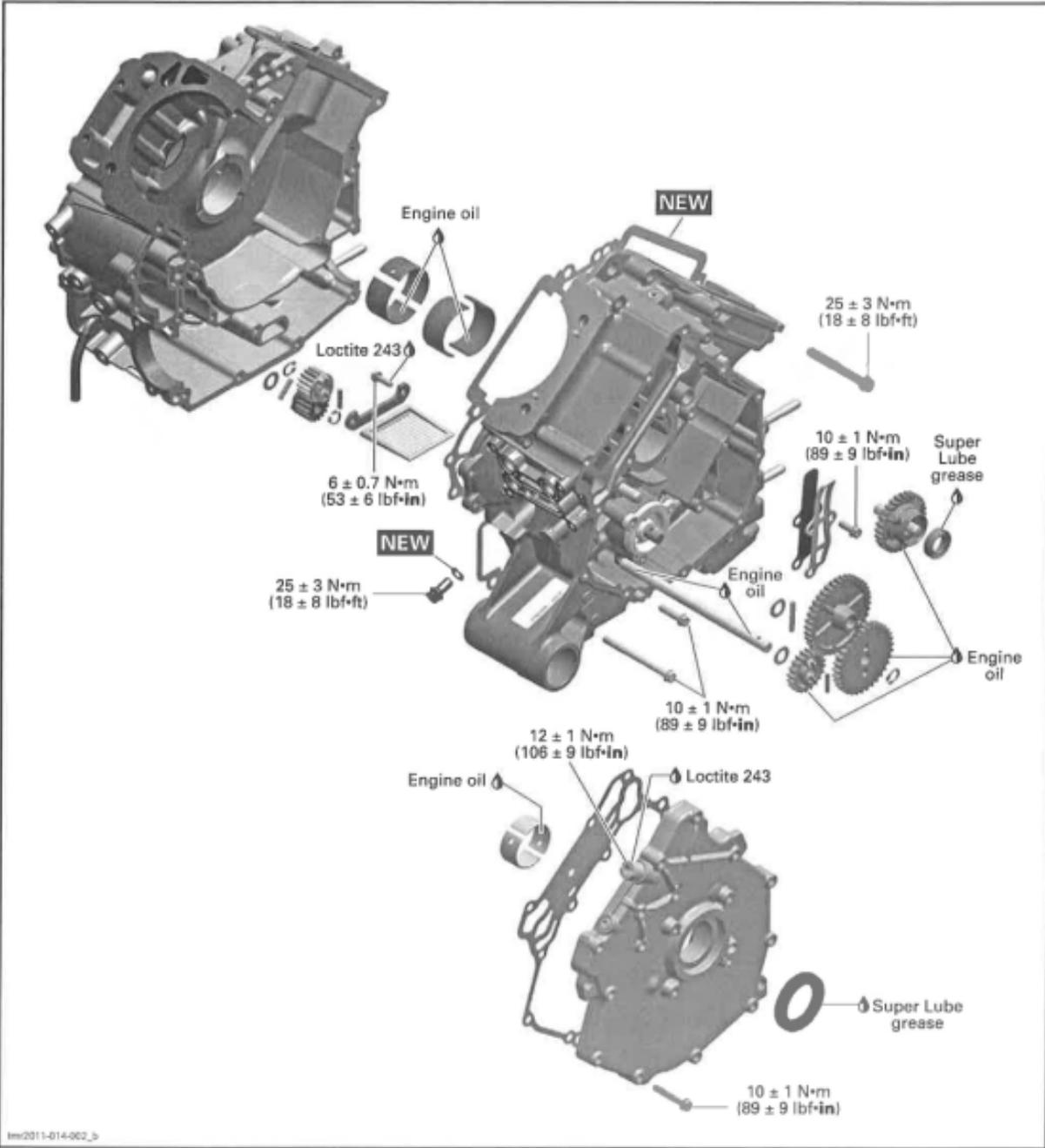
### SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE243 (BLUE)		
LOCTITE5910		
LOCTITE CHISEL (GASKET REMOVER)		

# ENGINE DRIVE SHAFT



# CRANKCASE AND PTO COVER





## GENERAL

**IMPORTANT:** Note position of parts on disassembly. This may help to find the root cause of a problem. A component that is not replaced should be reinstalled in the same position as originally mounted.

## PROCEDURES

### ENGINE DRIVE SHAFT

**NOTE:** The engine drive shaft transmits the power from the gearbox to the front differential and is located inside the crankcase.

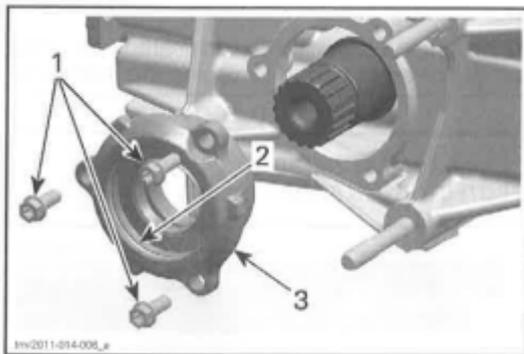
#### Engine Drive Shaft Removal

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

#### Rear Bearing Cover Removal

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

At rear of engine, remove the bearing cover and its O-ring.

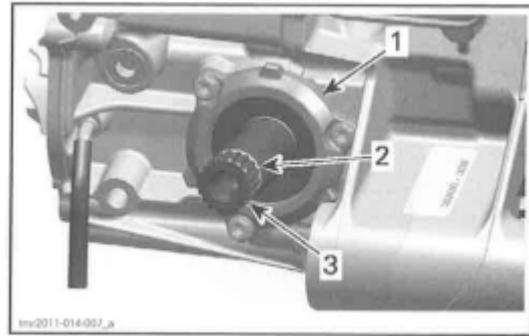


1. Bearing cover screws
2. O-ring
3. Bearing cover gearbox

#### Front Bearing Cover Removal

Remove the bearing cover at the front of the engine.

**NOTICE** Check ends of the circlip for sharp edges or burr before removing the drive shaft, to avoid damaging the oil seal.

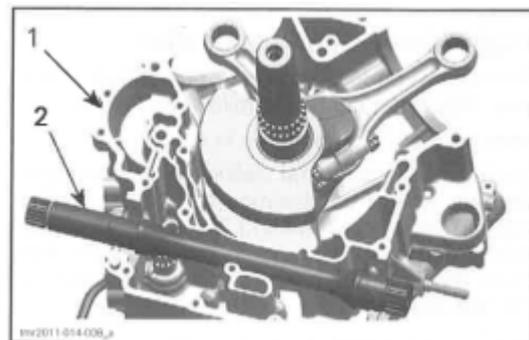


1. Bearing cover front drive side
2. Circlip
3. Drive shaft

#### Engine Drive Shaft Removal

Split crankcase, refer to CRANKCASE in this subsection.

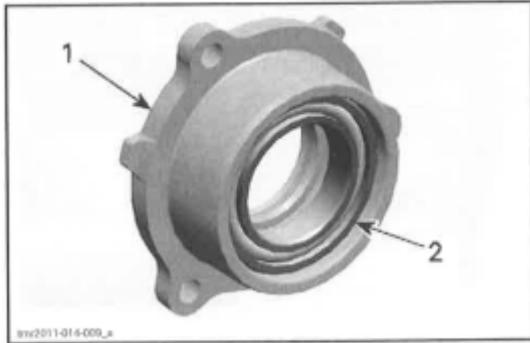
Remove engine drive shaft from the crankcase.



1. Crankcase MAG side
2. Engine drive shaft

#### Engine Drive Shaft Inspection

Replace oil seals and/or O-ring (bearing cover gearbox side) if they are brittle, hard or damaged. Check drive shaft bearings for contamination and/or metal shavings. Check if bearings turn freely and smoothly. Replace if necessary.



1. Bearing cover
2. Drive shaft bearing

Check drive shaft for cracks, bend, pitting or other visible damages.

Check drive shaft splines for wear or damages.

Check oil seal running surface of the drive shaft for scratches. Replace if necessary.

### Engine Drive Shaft Installation

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

Clean all metal components in solvent.

Crankcase surfaces and bearing covers are best cleaned using a combination of LOCTITE CHISEL (GASKET REMOVER) (P/N413 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.

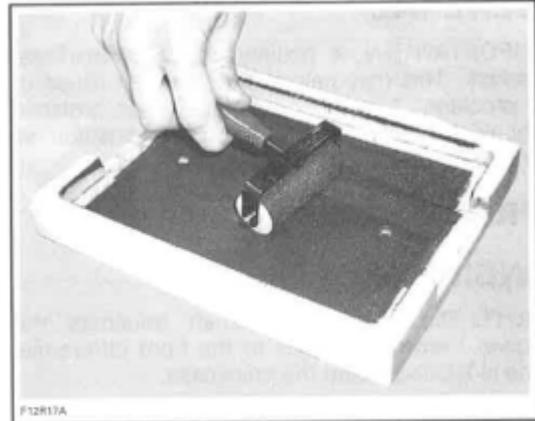
Use a suitable installer for installing bearings.

Use LOCTITE5910 (P/N293800 081) on mating Su faces.

**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 50mm-75mm (2in\_ 3in), available in arts products suppliers for printing, and roll the sealant to get a thin uniform coat on the plate (spread as necessary). When ready, apply the sealant on bearing cover surfaces.



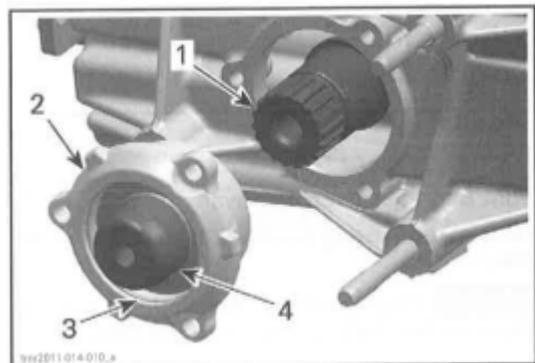
Do not apply in excess as it will spread out inside crankcase.

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

### Rear Bearing Cover Installation

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

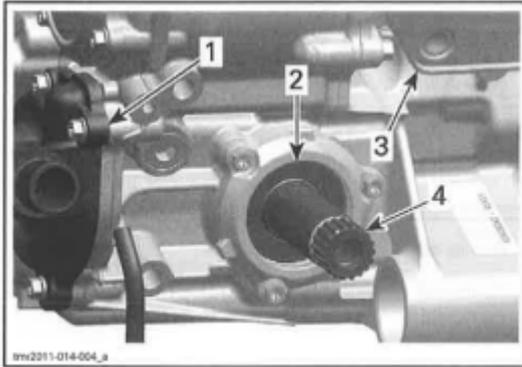
REQUIRED	
DRIVE SHAFT OIL SEAL	



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

REQUIRED	
Tightening torque	10N • m ± 1 N • m (89lbf • in ± 9lbf • in)

### Front Bearing Cover Installation



#### FRONT OF ENGINE

1. Water pump cover
2. Oil seal front side
3. Oil cover
4. Drive shaft

FRONT BEARING COVER SCREWS	
Service product	LOCTITE243 (BLUE) (P/N293 800 060)
Tightening torque	10N • m ± 1 N • m (89lbf • in ± 9lbf • in)

### Engine Drive Shaft Installation

Finally check for axial play of the drive shaft

#### FRONT OIL SEAL

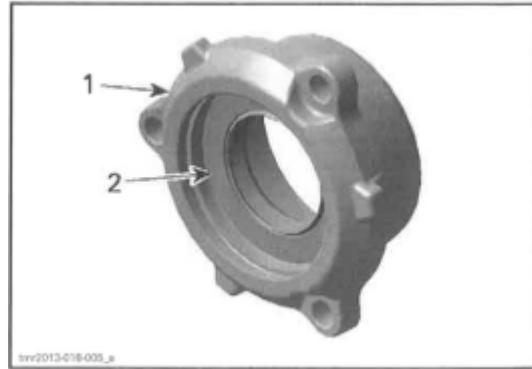
#### (ENGINE DRIVE SHAFT)

#### Front Oil Seal Replacement

#### (Engine Drive Shaft)

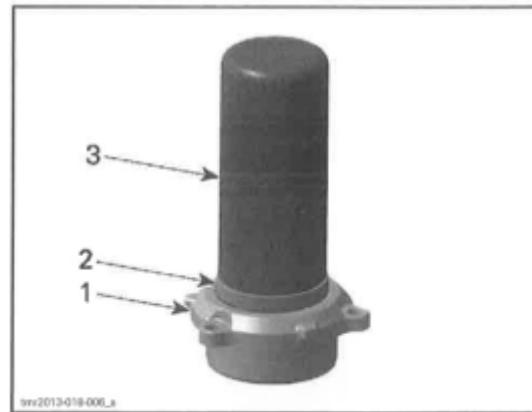
NOTE: The front oil seal can be replaced with the engine installed.

1. Remove front propeller shaft.
2. Remove adapter sleeve between propeller shaft and front engine drive shaft.
3. Remove the front bearing cover, refer to ENGINE DRIVE SHAFT REMOVAL / INSTALLATION in this subsection.
4. Remove drive shaft seal from bearing cover.



1. Bearing cover
2. Oil seal

5. Install drive shaft oil seal using the following



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

REQUIRED	
ENGINE DRIVE SHAFT OIL SEAL	

6. Reinstall remaining parts in the reverse order of removal.

#### REAR OIL SEAL

#### (ENGINE DRIVE SHAFT)

#### Rear Oil Seal Replacement

#### (Engine Drive Shaft)

1. Remove rear bearing cover , refer to ENGINE DRIVE SHAFT REMOVAL / INSTALLATION in this subsection.

2. Remove drive shaft seal from bearing cover.
3. Remove O-ring from bearing cover.

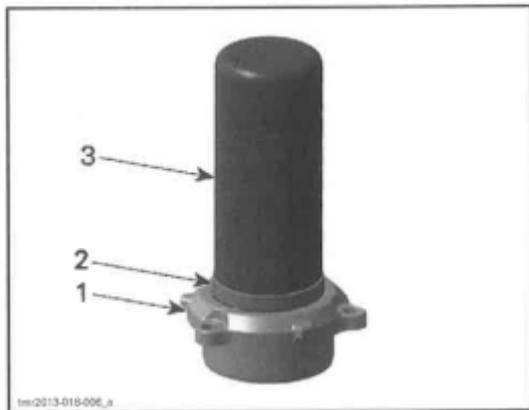


1. Bearing cover
2. O-ring



1. O-ring
2. Bearing cover

4. Install drive shaft oil seal using the following tool.



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

REQUIRED	
DRIVE SHAFT OIL SEAL	

5. Install O-ring in rear bearing cover.

6. Reinstall remaining parts in the reverse order of removal.

#### PTO COVER OIL SEAL

To replace oil seal it is not necessary to remove engine from vehicle.

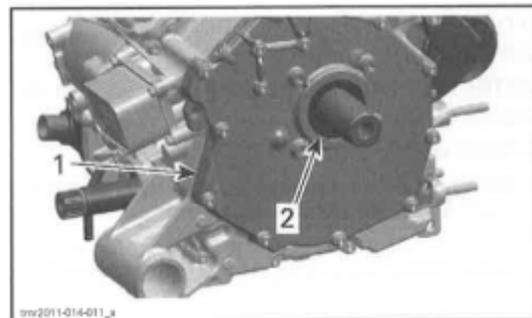
#### PTO Oil Seal Removal

Refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) subsection to remove the following parts:

- CVT cover
- Drive pulley
- Driven pulley
- CVT air guide.

Remove oil seal with a small flat screwdriver.

**NOTICE** Avoid scoring surfaces with tool.



1. PTO cover
2. Oil seal

#### PTO Oil Seal Inspection

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

## PTO Oil Seal Installation

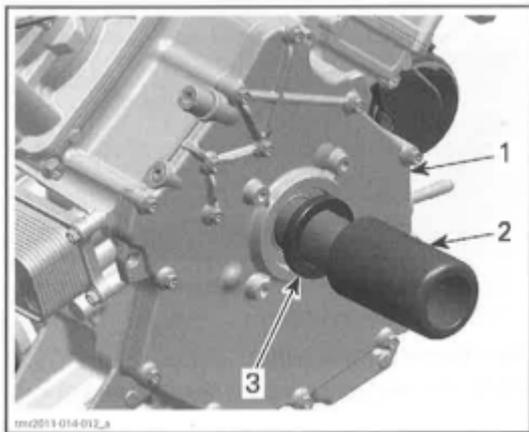
The installation is the reverse of the removal procedure.

Pay attention to the following details.

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

Push oil seal in place.

REQUIRED	
PTO COVER OIL SEAL	



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

## PTO COVER

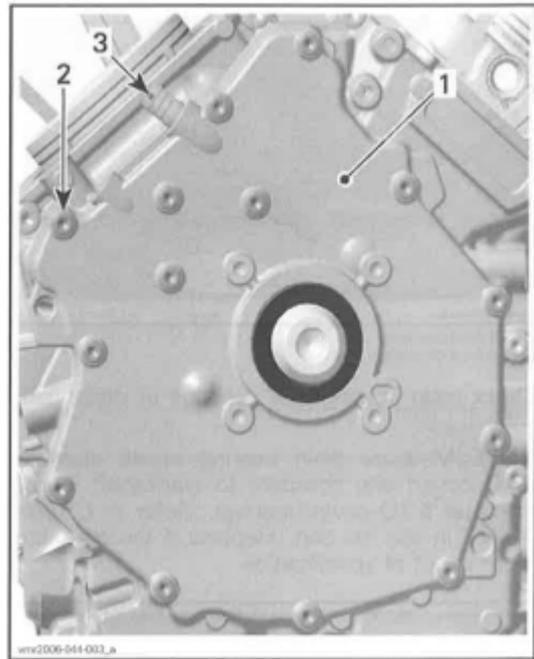
### PTO Cover Removal

Refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) subsection to remove the following parts:

- CVT cover
- Drive pulley
- Driven pulley
- CVT air guide.

Disconnect vent hose.

Remove PTO cover screws and pull PTO cover.



1. PTO cover
2. PTO cover screws
3. Vent hose nipple

### PTO Cover Inspection

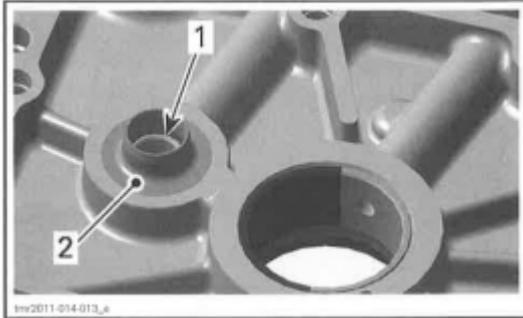
Check the PTO cover for cracks or other damage. Replace PTO cover if damaged.

Clean oil breather bore in PTO cover from contaminations with part cleaner then use pressurized air to dry it.

### ▲WARNING

Always wear skin and eye protection. Chemicals can cause skin rash, skin burns and severe eye injury.

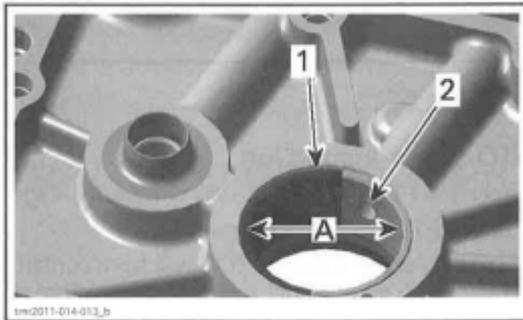
Check surface of sealing sleeve for wear or other damages. Replace PTO cover if damaged.



1. Oil breather bore
2. Surface of sealing sleeve

Check plain bearings for scorings or other damages.

NOTE: Measure plain bearing inside diameter (PTO cover) and compare to crankshaft journal Diameter (PTO cover bearing). Refer to CRANK SHAFT in this section. Replace if the measurement is out of specification.



1. Plain bearing
  2. Oil bore
- A. Measure plain bearing inside diameter

PLAIN BEARING INSIDE DIAMETER  
(PTO COVER)

SERVICE LIMIT	34.120 mm(1.3433 in)
---------------	----------------------

### Plain Bearing Replacement (PTO Cover)

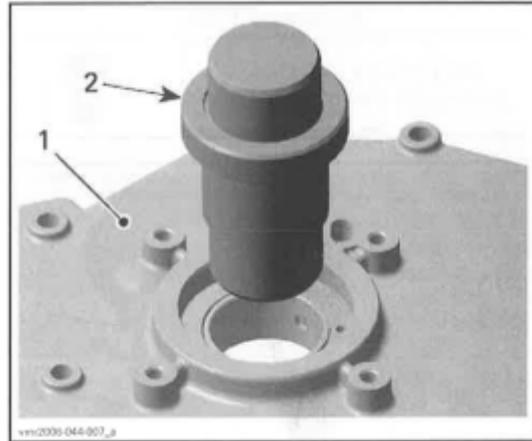
#### Plain Bearing Removal

**NOTICE** Unless otherwise instructed, never use a hammer to install plain bearings. Use a press only. Carefully remove the PTO oil seal with a screwdriver, without damaging the PTO cover.

Press out the plain bearings from the outside towards the inside.

PLAIN BEARING TOOL	
PLAIN BEARING REMOVER / UNSTALLER	

The PTO cover has to be supported from below with suitable support with straight surface, in order to prevent damage of the sealing surface.



1. PTO cover
2. Plain bearing remover /installer

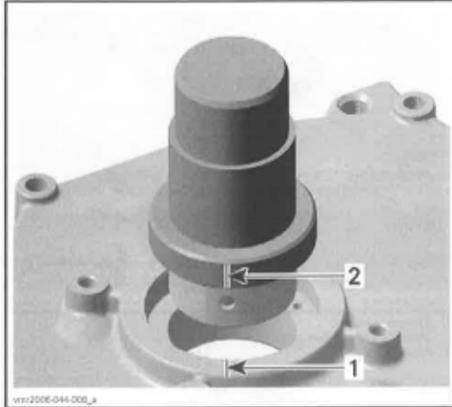
### Plain Bearing Installation

NOTE: Do not lubricate plain bearings and/or PTO cover for installation.

Install plain bearings in a cool PTO cover.

PLAIN BEARING TOOL	
PLAIN BEARING REMOVER / UNSTALLER	

**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.

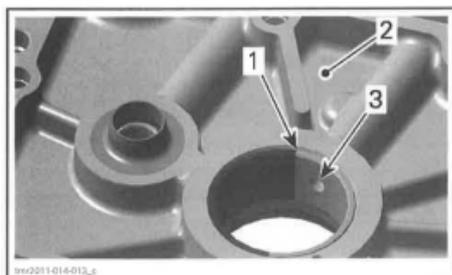


1. Mark position of oil bore on PTO cover
2. Mark position of oil bore on plain bearing remove/installer

Carefully press-in the plain bearings in the same direction as during disassembly, from the outside towards the inside. Support PTO cover with suitable support with straight surface, in order to prevent damage of the sealing surface.

NOTE: Wrong oil bore position will stop oil supply to plain bearings and will damage the engine.

**NOTICE** The partition of the plain bearings must be positioned near to oil bore in counterclockwise direction.



1. Partition
2. PTO cover (inside)
3. Oil bore

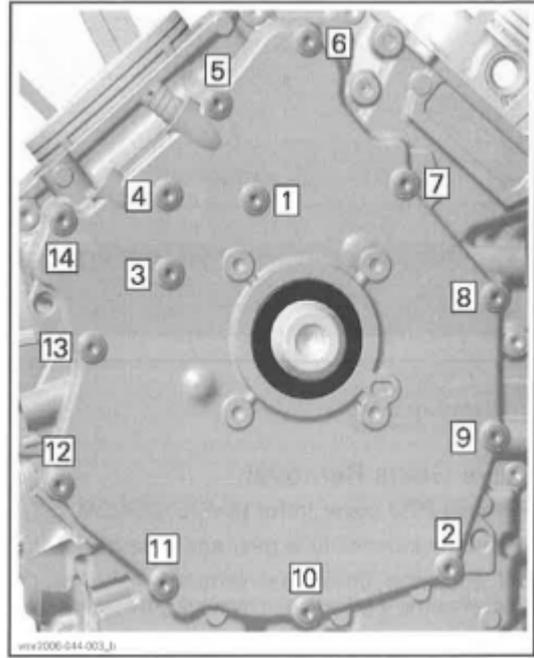
### PTO Cover Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

NOTE: At installation, replace PTO cover gasket and oil seal.

Tighten PTO cover screws following the illustrated sequence.



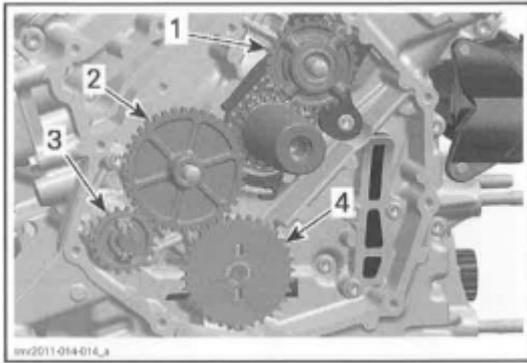
### TIGHTENING SEQUENCE

PTO COVER SCREW	
Tightening sequence	10N • m ± 1 N • m (89lbf • in ± 9lbf • in)

### DRIVEGEARS

#### 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

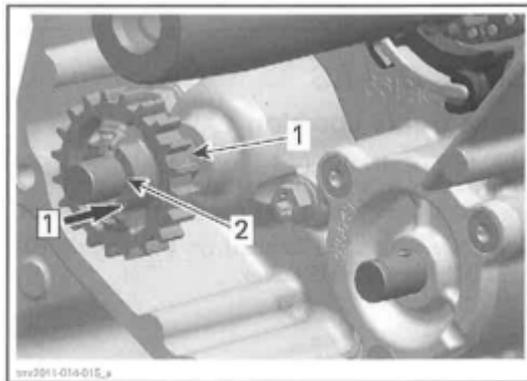
### Drive Gears Removal

Remove PT0 cover (refer to IC)70 C0 産用.  
Withdraw intermediate gear and breather gear.

For oil pump drive gear removal, refer to OIL PUMP in the LUERICATION 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.

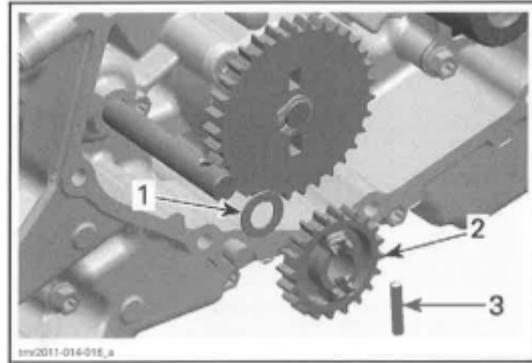


Step: Push gear in

1. Water pump drive gear
2. Intermediate shaft

Remove needle pin and pull water pump drive gear out.

Remove thrust washer from intermediate shaft.



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

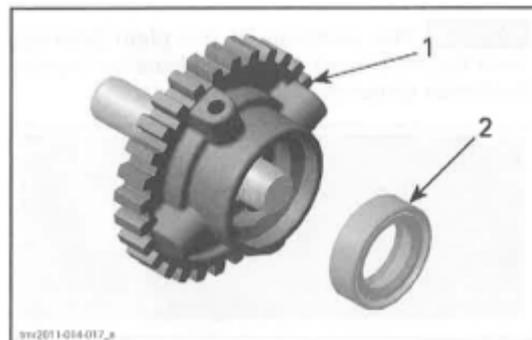
### Drive Gears Inspection

Intermediate Gear/Oil Pump Drive Gear/Water Pump Drive Gear

Inspect gears for wear or other damage. Replace if damaged.

### Breather Gear

Check if oil seal is brittle, hard or damaged. Replace if necessary.



1. Breather gear
2. Oil seal

Inspect gear for wear or other damage.

Check ball bearing for excessive play and smooth operation. Replace breather gear assembly if necessary.

### Drive Gears Installation

The installation is essentially the reverse of the removal procedure.

Adequately oil the ball bearing of the breather gear.

## CRANKCASE

### Crankcase Disassembly

1. Refer to PERIODIC MAINTENANCE PROCEDURES subsection and:

- 1.1 Drain cooling system.
- 1.2 Drain engine oil.
- 1.3 Drain gearbox oil.

2. Lock crankshaft. Refer to CRANKSHAFT LICKING PROCEDURES 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 4×4 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 M/~/0 al-11,4//V subsection to remove following parts:

- Chain tensioners
- Camshaft timing gears
- Timing chains
- Timing chain guides.

9. Refer to TIMING CHAIN subsection to remove following parts:

- Front cylinder head
- Rear cylinder head
- Cylinders.

10. Refer to C00i//VCSB 田 subsection to remove following parts:

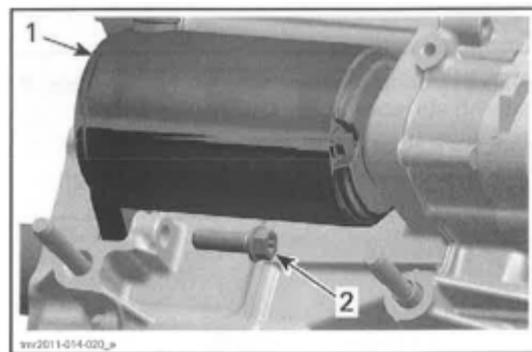
- Water pump housing.

11. Refer to LUBRICATION SYSTEM subsection to remove following parts:

- Oil filter
- Oil cooler
- Oil pump drive gear.

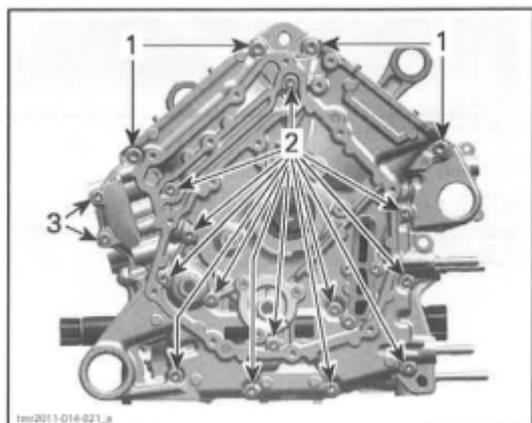
NOTE: Oil pump removal from crankcase is not necessary, but recommended to see condition of oil pump (refer to LUBRICATION SYSTEM subsection).

12. Remove electric starter.



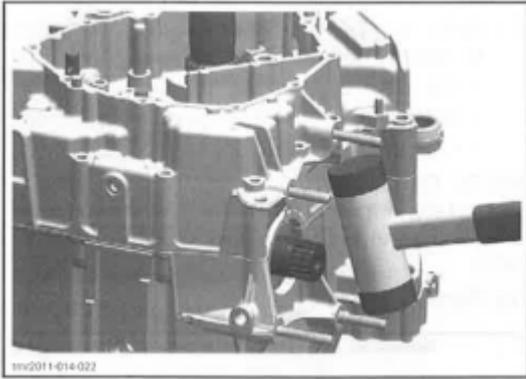
1. Electric starter
2. Screw

NOTE: Before splitting the crankcase, measure crankshaft axial play. Refer to CRANKSHAFT. Remove retaining screws of crankcase.

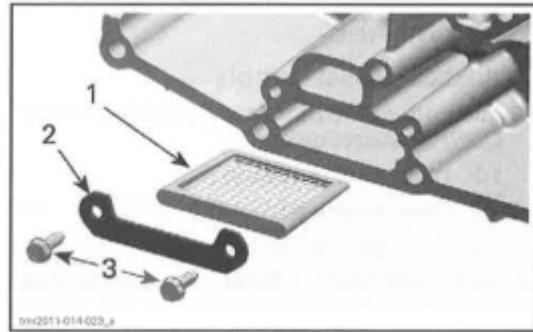


1. Four screws M8x65
2. 13 screws M16x75
3. Two screws M6x25

Carefully split crankcase halves by using a screwdriver and a soft hammer.



NOTE: During disassembly, do not damage the sealing surfaces of the crankcase halves.  
 Pull crankshaft out of crankcase.  
 Remove the water pump intermediate shaft.



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

### Crankcase Cleaning

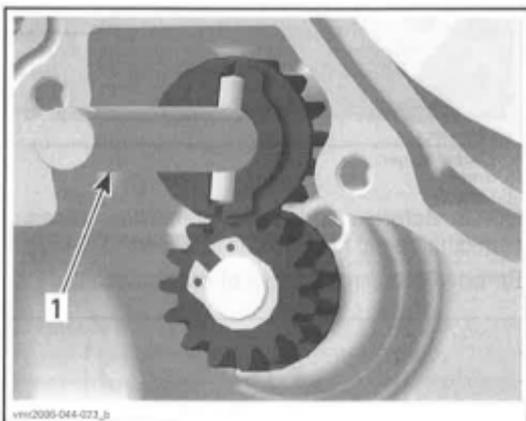
#### △WARNING

Use safety goggles to avoid eye injuries

Clean crankcase using a part cleaner.  
 Dry crankcase using compressed air .  
 Blow the oil supply lines.

### Crankcase Inspection

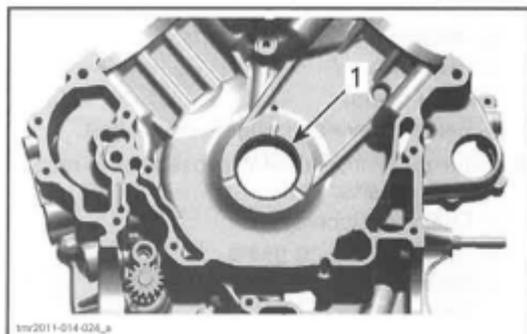
Check crankcase halves for cracks or other damage. Replace if damaged.  
 Check MAG and PTO plain bearings in for scoring or other damages.



1. Water pump intermediate shaft

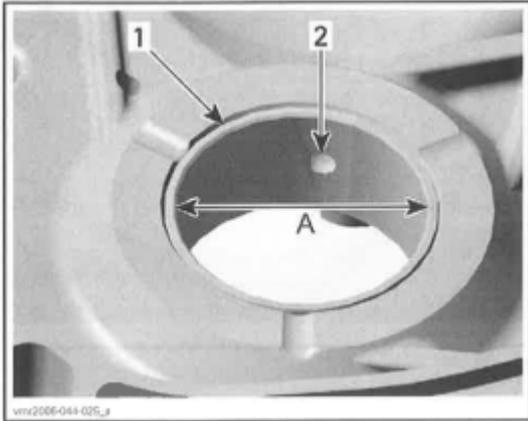
Remove engine oil strainer.

NOTE: Oil strainer removal for inspection and cleaning is recommended. Refer to LUBRICATION SYSTEM subsection.

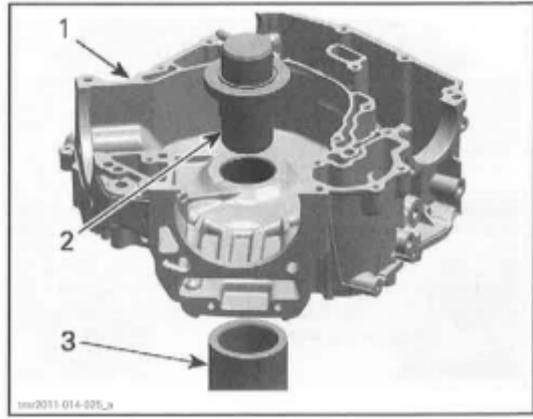


1. Plain bearing

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



**PUSH PLAIN BEARING OUTSIDE**

- 1. Crankcase half
- 2. plain bearing remover/installer
- 3. Crankcase support sleeve

MAIN BEARING INSIDE DIAMETER(PTO/MAG)	
SERVICE LIMIT	42.100 mm(1 6575in)

**Plain Bearing Replacement (Main)**

**Plain Bearing Removal**

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

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

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

REQUIED TOOLS	
CRANKCASE SUPPORT MAG/PTO	
PLAIN BEARING REMOVER/INSTALLER	

**NOTE:** During disassembly, make sure not to damage the sealing surfaces of the crankcase halves.

**Plain Bearing Installation (Main)**

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

**NOTE:** Place the proper crankcase support sleeve under crankcase halves before installing the plain bearings (refer to BEARING REMOVAL PROCEDURE)

Carefully press in the plain bearings in the same direction as during disassembly, from the crankcase inside towards the outside.

During reassembly, make sure not to damage the sealing surfaces of the crankcase halves.

Install plain bearings in a cold crankcase.

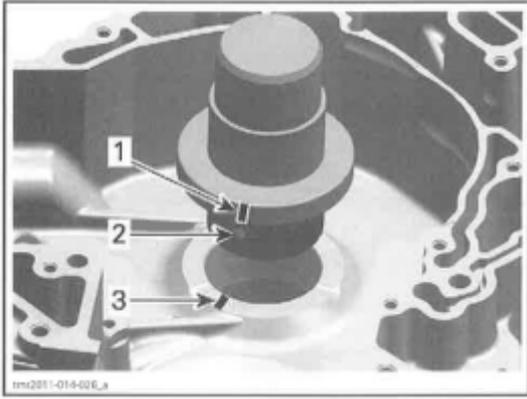
**NOTE:** Do not lubricate plain bearings and/or crankcase for installation.

Use an O-ring (  $\phi$  42x1mm to 1.5mm (.04 into .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.

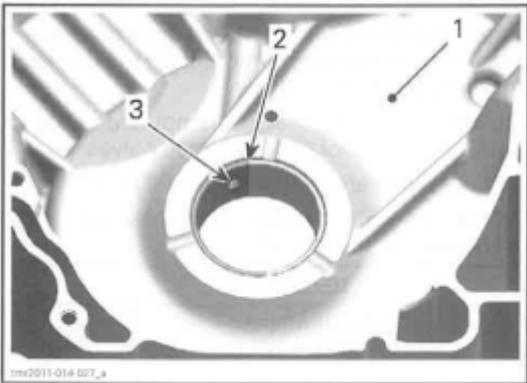


1. Oil bore position marked on plain bearing remover/installer
2. Plain bearing oil bore
3. Oil bore position marked on crankcase

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

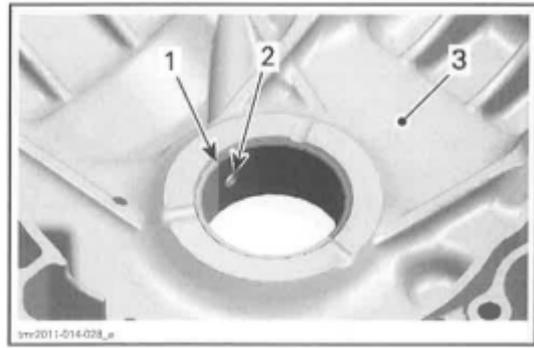
Carefully press in the plain bearings from inside the crankcase towards the outside.

**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)

### Crankcase Assembly

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

Install a NEW crankcase gasket.

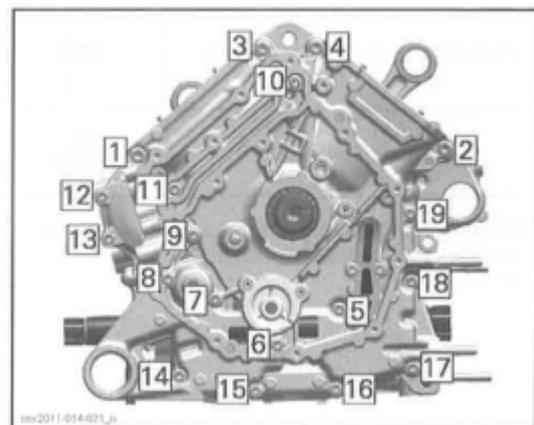
Oil the plain bearings before mounting the crankshaft.

**NOTICE** Correctly reinstall crankshaft (refer to CRANKSHAFT)

Properly reinstall engine oil strainer and screws. Refer to LIBRICATION SYSTEM subsection.

Reinstall water pump intermediate shaft and gears. Refer to WATER PUMP GEARS in the COOLING SYSTEM subsection.

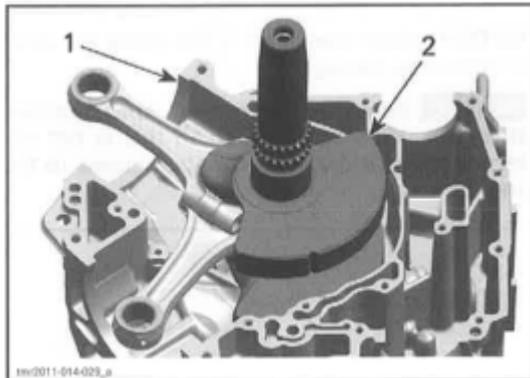
Tightening sequence for screws on crankcase is as per following illustration.



TIGHTENCE SEQUENCE

CRANKCASE SCREWS	
Tightening torque- M6	10N·m±1N·m (89lbf · in ± 9lbf · in)
-Tightening torque- M8	25N·m±3N·m (18lbf·ft ± 2 lbf · ft)

## CRANK SHAFT



1. Crankcase MAG
2. Crankshaft

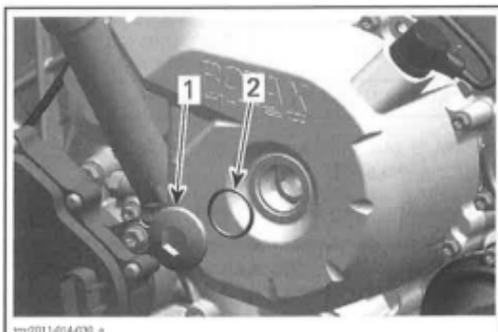
### Crankshaft Locking Procedure

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 CRANKSHAFT TIMING GEAR in the TIMING CHAIN subsection.

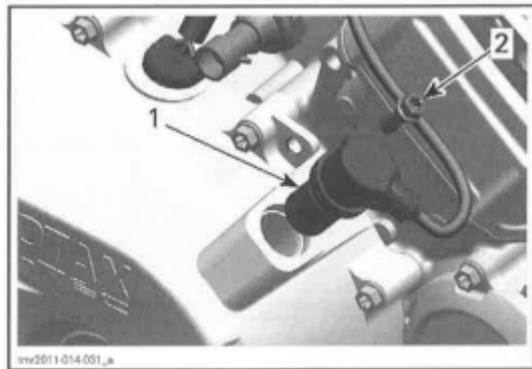
Remove:

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



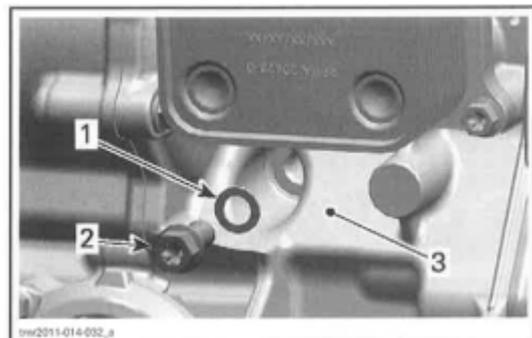
1. Plug screw
2. O-ring

3. Crankshaft position sensor.



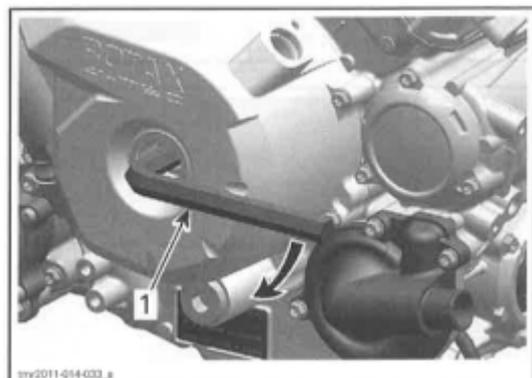
1. Crankshaft position sensor
2. Screw

4. Plug screw and discard sealing ring



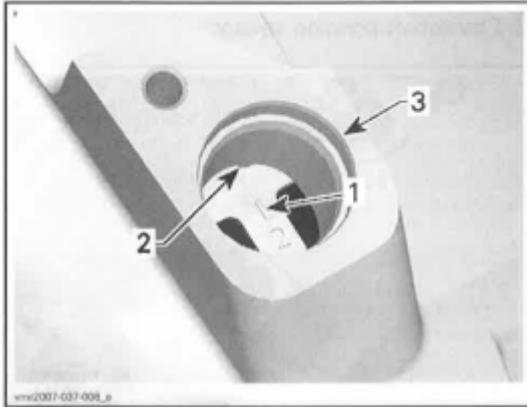
1. Sealing ring
2. Plug screw
3. Crankcase PTO side, front side

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



1. Allen key 14 mm

When rear piston is at TDC marks on magneto 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

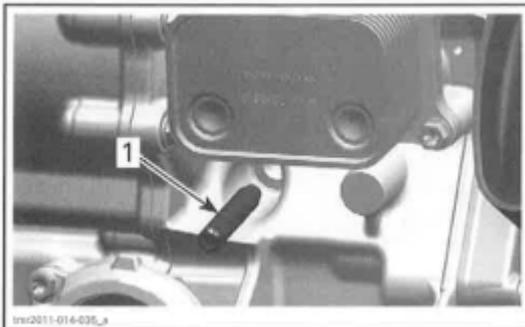
Use a screwdriver to check if the groove in the crankshaft is aligned with the hole.



1. Screw driver

Lock crankshaft

REQUIED TOOL	
CRANKSHAFT LOCKING	



1. Crankshaft locking bolt

Gradually insert the tool in the crankshaft groove. Make sure that the tool tip enters the groove and does not jam on the crankshaft balancer surface.

### Crankshaft Removal

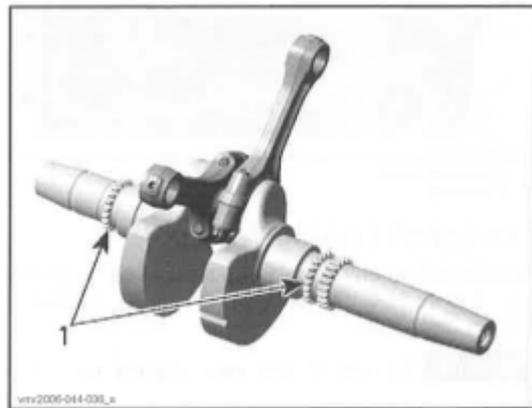
Refer to CRANKCASE

### Crankshaft Inspection

NOTE: Check each bearing journal of crankshaft for scoring, scuffing, cracks or other signs of wear.

NOTE: Replace crankshaft if the gears are worn or otherwise damaged.

**NOTICE** Components out of specifications always have to be replaced .If this is not observed, severe damage may be caused to the engine.



1. Crankshaft timing gears

### Crankshaft Axial Play

NOTE: Axial play needs to be measured before splitting the crankcase.

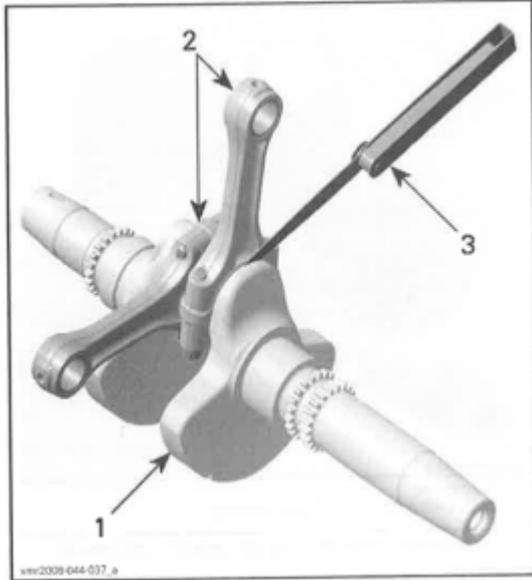
Measure play on PT0 end, using a dial indicator.

Crankshaft Axial Play	
NEW	0.200 mm to 0.500 mm (.008in to .02in)
SERVICE LIMIT	0.600 mm(.024in)

If play is out of specification, replace crankcase and/or crankshaft.

### Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between butting face of connecting rods and crankshaft counterweight . If the distance exceeds specified tolerance, replace the crankshaft.



1. Crank shaft
2. Connecting rods
3. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY		
800R ENGINE	NEW	0.200 mm to 0.500 mm (.008in to .02in)
	SERVICE LIMIT	0.600 mm(.024in)
1000 ENGINE	NEW	0.250 mm to 0.550 mm (.01 in to .022in)
	SERVICE LIMIT	0.600 mm(.024in)

### Connecting Rod/Piston Pin Clearance

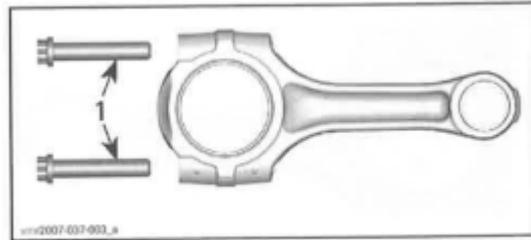
Refer to TOP END section.

### Connecting Rod Big End Radial Play

NOTE: prior to remove connecting rod from the crankshaft, mark big end halves together to ensure a correct reinstallation (cracked surface fits in only one position).

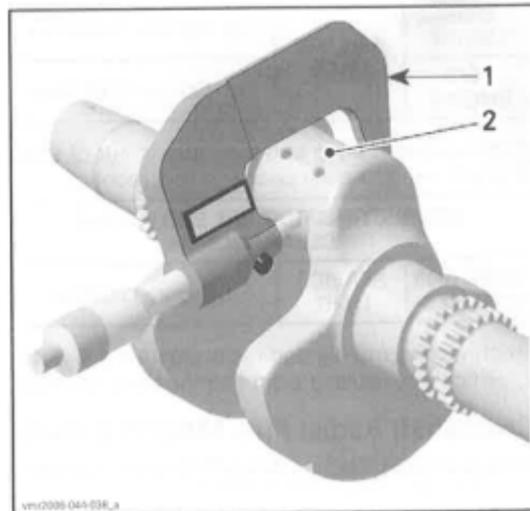
Remove connecting rods from crankshaft.

**NOTICE** Connecting rod screws are not reusable. Always discard screws and replace by NEW ones. It is recommended to install new plain bearings when reinstalling connecting rods.



1. Connecting rod screws

Measure crankpin . Compare to inside diameter of connecting rod big end.



1. Micrometer
2. Crankpin area for plain bearing

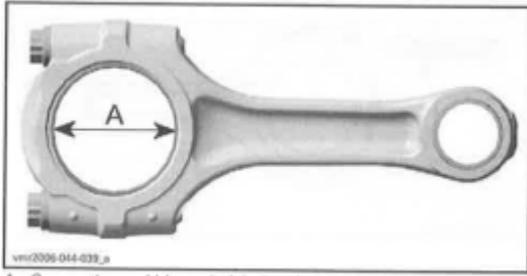
CRANK PIN DIAMETER		
800R ENGINE	NEW	40.009mm to 40.025mm (1.5752in to 1.5758in)
	SERVICE LIMIT	39.990 mm(1 .5744in)
1000 ENGINE	NEW	41 .986 mm to 42.010 mm (1 653in to 1.6539in)
	SERVICE LIMIT	41 967mm(1 6522 in)

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.



A. Connecting rod, big end plain bearing

CONNECTING ROD BIG END RADIAL		
800R ENGINES	SERVICE LIMIT	40.100mm(1.5787in)
1000 ENGINES		42.100mm(1.6575in)

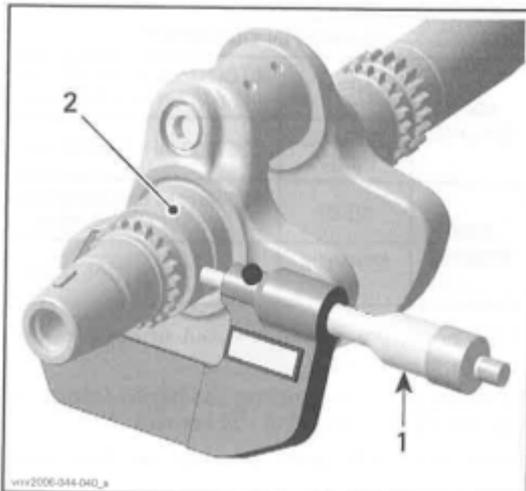
If connecting rod big end diameter is out of specification, replace plain bearings and recheck.

CONNECTING ROD BIG END RADIAL		
800R/1000 ENGINES	SERVICE LIMIT	0.09mm(.0035in)

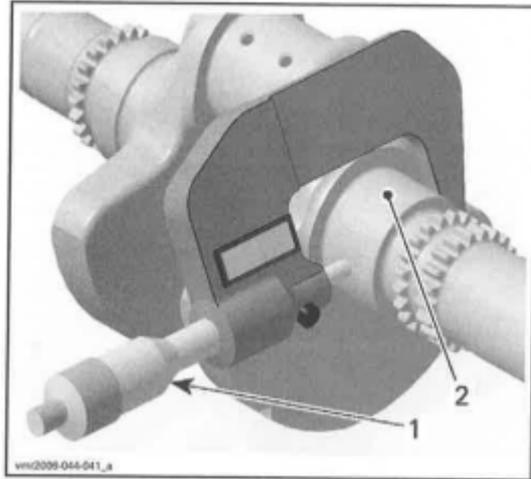
If connecting rod big end radial clearance is out of specification, replace plain bearings and recheck.

#### Crankshaft Radial Play MAG/PTO Side

Measure crankshaft on MAG/PTO side . Compare to inside diameter of MAG/PT0 plain bearing (refer to CRANKCASE).



1. Micrometer
2. Crankshaft area for MAG plain bearing



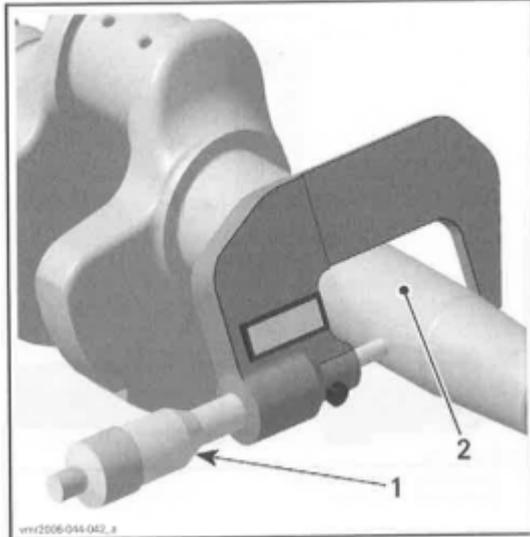
1. Micrometer
2. Crankshaft area for PTO plain bearing

CRANKSHAFT MAIN BEARING JOURNAL DIAMETER (MAG/PTO SIDE)	
NEW	42.016mm to 42.040mm (1.6542in to 1.6551 in)
SERVICE LIMIT	42.000mm(1.6535in)

CRANKSHAFT RADIAL PLAY (MAG/PTO SIDE)	
SERVICE LIMIT	0.07 mm(.0028in)

#### 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	34.004mm to 34.020 mm (1.3387in to 1.3394in)
SERVICE LIMIT	33.998 mm (1.3385in)

CRANKSHAFT RADIAL PLAY (PTO COVER BEARING)	
SERVICE LIMIT	0.10 mm (.0039 in)

If crankshaft journal diameter is out of specification, replace crankshaft.

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

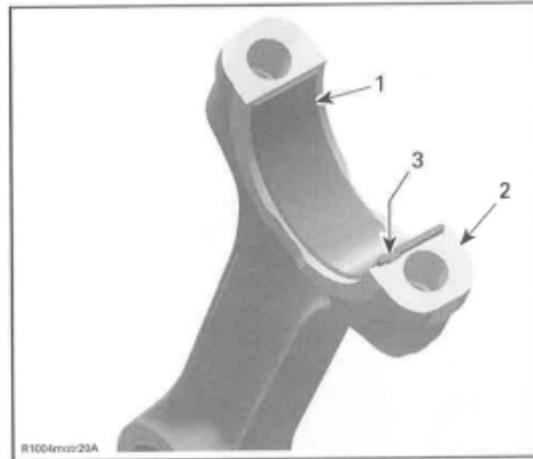
### Crankshaft Assembly

For assembly, reverse the disassembly procedure.

Pay attention to following details.

Clean the split surface on both sides (cracked area) carefully with compressed air.

Put plain bearings correctly in place.



1. Half plain bearing of connecting rod big end
2. Split surface of the connecting rod
3. Nose of plain bearing in line with connecting rod groove

Oil the plain bearing surface of the connecting rod and crank pin before installation.

**NOTICE** Lower cap and rod must match together since there is a cracked surface.

Oil NEW connecting rod screws

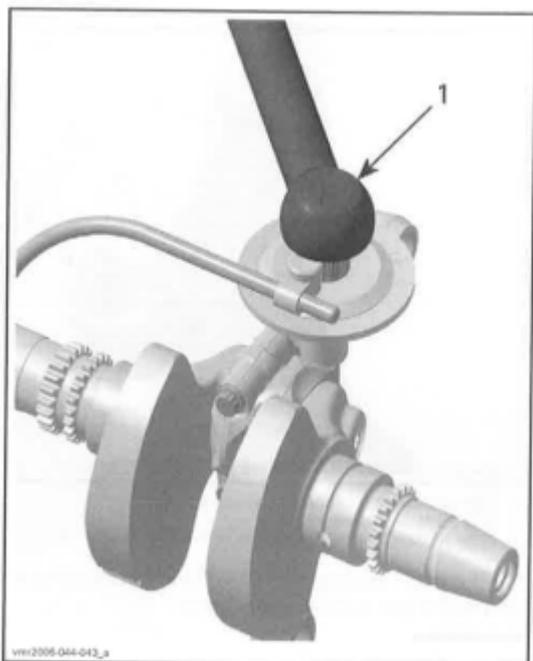
**NOTICE** Always use NEW connecting rod screws at final assembly. They are not reusable.

Thread screws in the connecting rods, then tighten as per following procedure.

**NOTICE** Strictly adhere following instructions:

- Do not apply any thread locker.
- The running direction of the big end bearings and of the piston pins must not change.
- Always perform each step on both connecting rod
- Failure to strictly follow procedure may cause connecting rod screws to loosen and lead to Severe engine damage.

REQUODE TOOLS
Torque wrench
Angle torque wrench



1. Angle torque wrench

800R Engine:

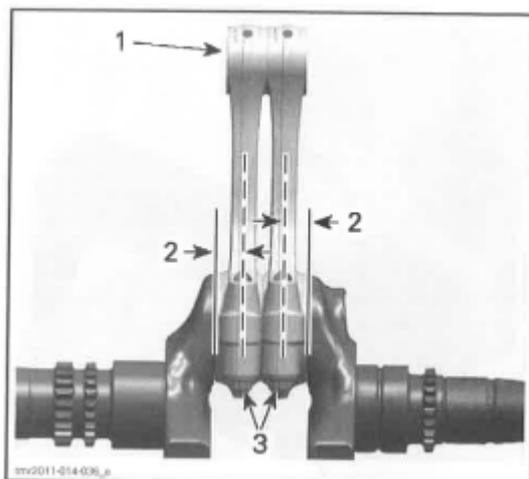
NOTE: NEW connecting rods can be installed either way.

CONNECTING RODS SCREWS TIGHTENING SEQUENCE	
1	Tighten to 1/2 of specified torque
2	Tighten to $20\text{N}\cdot\text{m} \pm 2\text{N}\cdot\text{m}$ ( $15\text{lb}\cdot\text{ft} \pm 1\text{lb}\cdot\text{ft}$ )
3	Torque by an additional $60 \pm 5^\circ$ turn using an angle torque wrench

1000 Engine:

**NOTICE** Connecting rods are asymmetric.

There must be no gap between the small ends when they face each other.



1. Connecting rod small ends
2. Connecting rod offset
3. Connecting rod screws

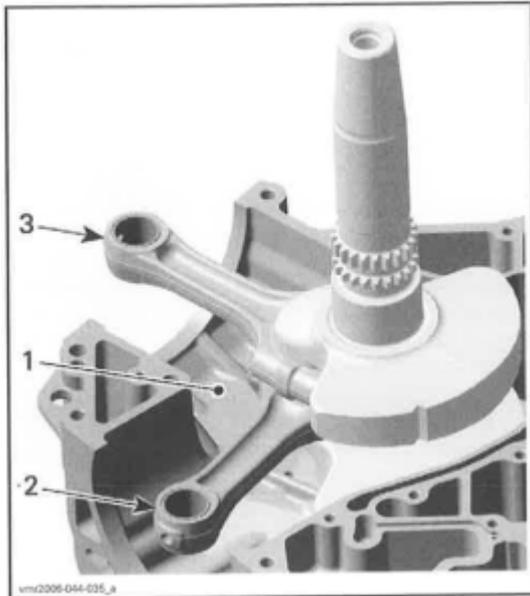
CONNECTING RODS SCREWS TIGHTENING SEQUENCE	
1	Tighten to 1/2 of specified torque
2	Tighten to $30\text{N}\cdot\text{m} \pm 2\text{N}\cdot\text{m}$ ( $22\text{lb}\cdot\text{ft} \pm 1\text{lb}\cdot\text{ft}$ )
3	Torque by an additional $90 \pm 5^\circ$ turn using an angle torque wrench

### Crankshaft Installation

For installation of crankshaft in crankcase reverse the removal procedure. Pay attention to the following details.

Do not mix up the connecting rods of cylinders 1 and 2 during installation.

**NOTICE** Observe the correct installation position when fitting the crankshaft with the connecting rods. The connecting rod MAG side has to face cylinder no. 1.



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

## CONTINUOUSLY VARIABLE

### TRANSMISSION (CVT)

#### SERVICE TOOLS

Description	Part Number	Page
-------------	-------------	------

CLUTCH HOLDER

CLUTCH PULLER.

PULLER/LOCKING TOOL

#### SERVICE PRODUCTS

Description	Part Number	Page
-------------	-------------	------

ISOFLEX GREASE TOPAS NB52

PULLEY FLANGE CLEANER

## TRANSMISSION

Never touch CVT while engine is running.

**never drive vehicle when *variator* cover is removed.**

Subcomponent installation and assembly tolerances require strict adherence to procedures detailed.

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

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

These pulleys have metric threads. Do not SAE threads puller. Always tighten puller by hand to ensure that the drive pulley has the same type of threads prior to fully tightening.

### DRIVE BELT

#### Removal

Remove:

- Distance screws
- remove *variator* cover and gasket.

1. *Variator* cover
2. Distance screw
3. Gasket

#### NOTE:

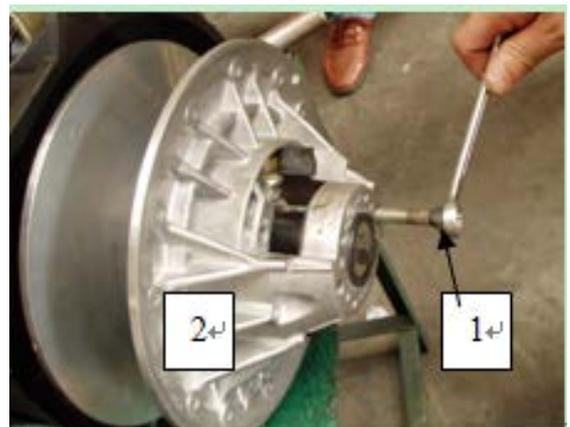
Remove the center top screw last. This screw allows to support the cover during removal.

Open driven pulley with the driven pulley expander.

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

1. *Driven pulley expander*
2. *Fixed sheave of driven pulley*

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



**INSPECTION**

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

Drive belt width	
Service limit	30.00mm(1.181 in)

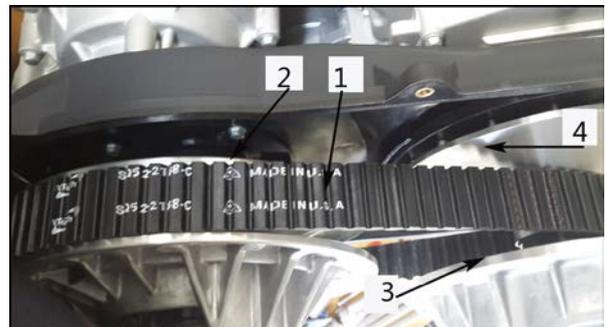


**Installation**

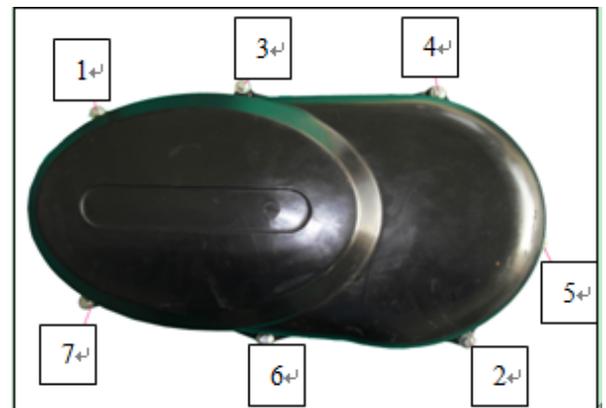
For installation, reverse the removal procedure. Pay attention to following details.

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

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.



Install variator cover gasket.  
Install the center top screw in first.  
Tighten the distance screw as per following sequence.



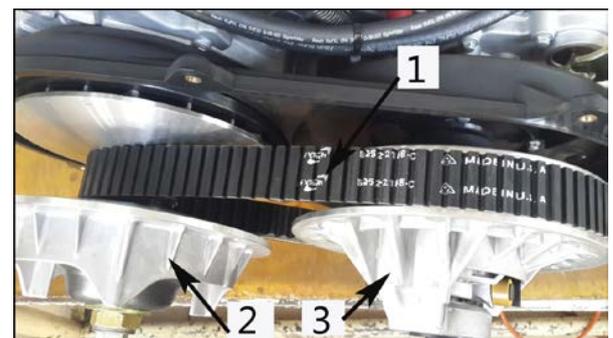
**DRIVE PULLEY**

1. Belt
2. Drive pulley
3. Driven pulley

**Removal**

- remove *variator* cover and gasket.
- Remove belt

Block the drive pulley as followed.

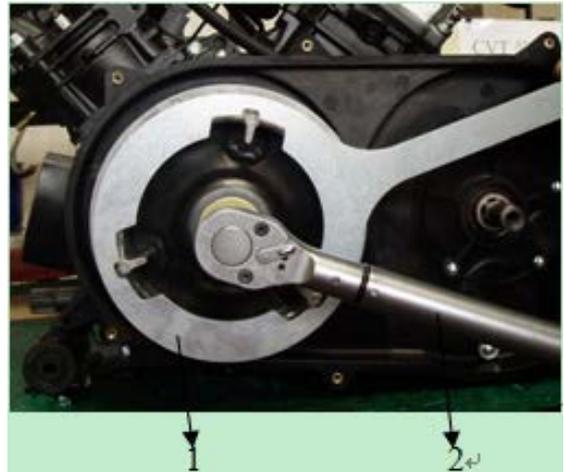


Block drive pulley with the pulley holding tool.

1. Pulley holding tool
2. Torque wrench

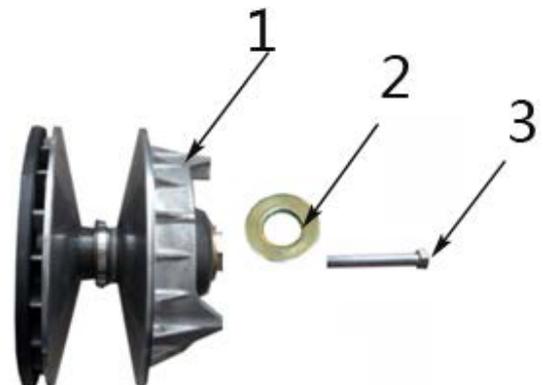


When the drive pulley is blocked, mark sliding sheave and governor cup to ensure correct reinstallation.



Unscrew the drive pulley screw (right hand thread), then remove it as well as the conical spring washer and thrust washer.

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



### Inspection

Drive pulley should be inspected annually for wear or damages.

Check drive pulley for cracks and sliding contact surface for excessive wear. Replace it if necessary.

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

### Installation

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

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

Clean pulley faces and shaft with dry cloth.

Install drive pulley on crankshaft extension.

Do not forget to place thrust washer

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

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

To torque the drive pulley screw, block the drive pulley. Refer at the beginning of this section.

When the drive pulley is blocked, torque screw to 100N.m.

## DRIVEN PULLEY

Removal

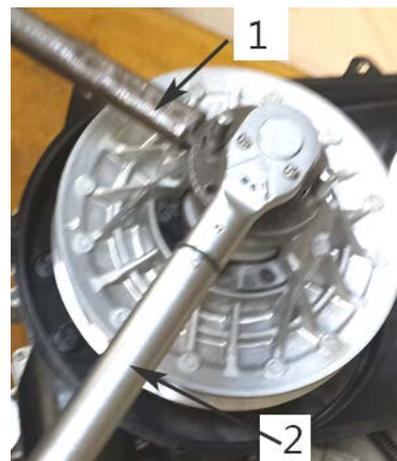
- remove *variator* cover and gasket.
- Remove belt



Using the pulley holding tool, hold the driven pulley during the removal of the driven pulley screw, do not remove screw completely.

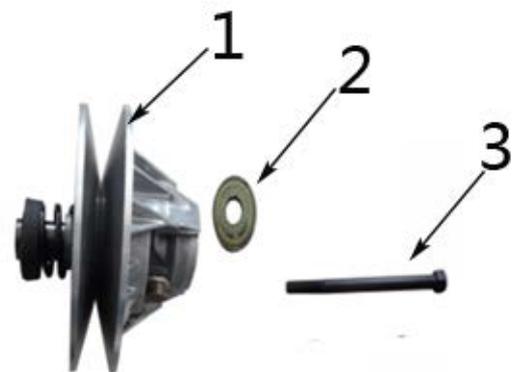


Put in tow STUD to Driven Pulley



1. Driven Pulley holding tool
2. Torque wrench

When the driven pulley is blocked, unscrew the driven pulley screw.



1. *Driven pulley*
2. *Thrust washer*

### 3. Driven pulley screw

#### Inspection

Driven pulley should be inspected annually for wear or damages.

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

Check sliding sheave bushings for cracks, scratch and for free movement when assembled to sliding sheave.

Check ball bearing for free play and smooth operation. Replace if necessary.

#### Installation

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

Chamfer on inside diameter of the spacer must face engine side.

Clean pulley faces and shaft with dry cloth.

Driven pulley is a spring loaded system.

Always place washer at the time of driven pulley installation.

When the driven pulley is blocked, torque screw to 60N.m.

## CVT AIR GUIDE

#### Removal

Remove:

- Variator cover
- Drive belt
- Drive pulley
- Driven pulley

Unscrew the clamps retaining the CVT air hoses

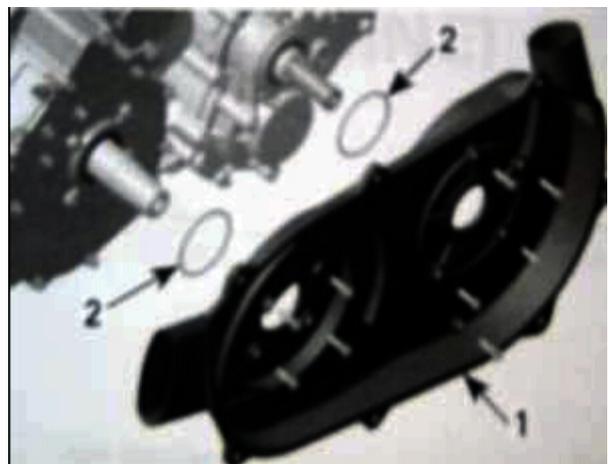
Remove CVT air guide.

#### Inspection

Clean CVT air guide from contamination.

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

1. CVT air guide
2. O-rings



#### Installation

For installation, reverse the removal procedure.

## GEARBOX AND 4X4 COUPLING UNIT

### SERVICE TOOLS

Description	Part Number	Page
BLIND HOLE BEARING PULLER SET		
COUNTERSHAFT OIL SEAL PUSHER		
ECM ADAPTER TOOL		
FLUKE 115 MULTIMETER		
OIL SEAL INSTALLER (GEARBOX)		
OIL SEAL INSTALLER		

### SERVICE TOOLS- OTHER SUPPLIER

Description	Part Number	Page
BACK PROBE TEST WIRES		

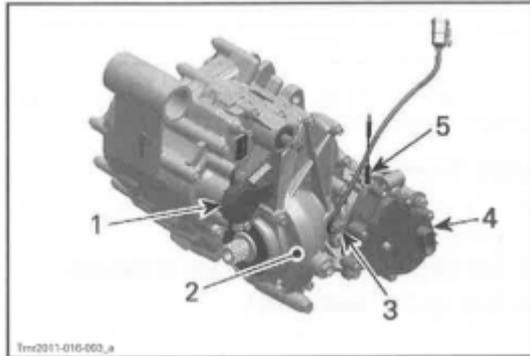
### SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910		
LOCTITE CHISEL (GASKET REMOVER)		
SUPER LUBE GREASE		

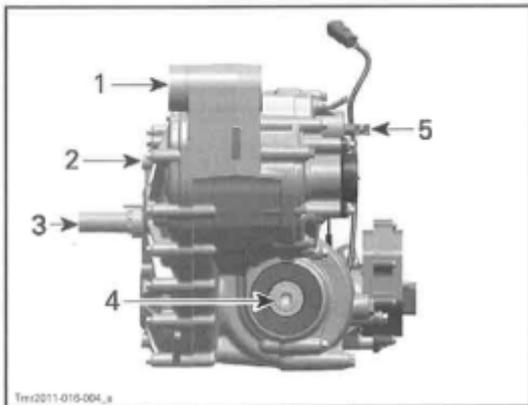


## GENEAL

### GEARBOX OVERVIEW



1. Gearbox position sensor (GBPS)
2. Right cover
3. Vehicle speed sensor (VSS)
4. Actuator
5. 4WD indicator switch



1. Center housing
2. Left cover
3. Countershaft
4. Output shaft
5. Shift shaft

## TROUBLESHOOTING

### UNUSUAL GEARBOX NOISE AND/OR VIBRATIONS

1. Low oil level in gearbox.
  - Oil leakage from gearbox .Replace damaged(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.

### GEARINDICATION 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 DRIVEINDICATION FAILS

1. 4WD indicator switch failure .

-Test 4WD indicator switch. Replace as required

-Bad contact. Check for corrosion or loose connector.

-Damaged wires. Repair as required

### 4 WHEEL DRIVE DOES NOT ENGAGE OR DISENGAGE

1. Defective 4WD switch.

-Check 4WD switch operation.

2. Defective actuator.

-Test actuator.

3. Damaged or worn shifting fork or sleeve.

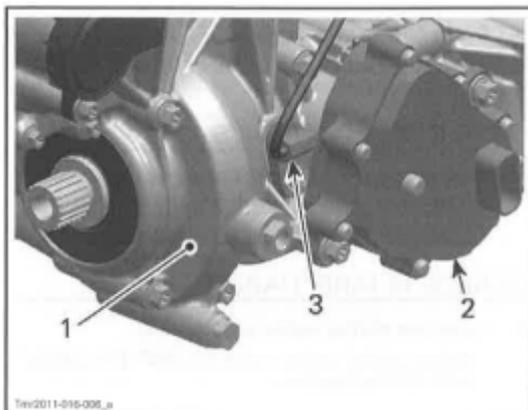
Remove actuator and inspect shifting fork and sleeve.

### PROCEDURES

#### VSS (VEHICLE SPEED SENSOR)

##### VSS Location

The vehicle speed sensor is located on the right housing of the gearbox behind the actuator.



1. Tight housing of gearbox
2. Actuator
3. VSS (Vehicle Speed Sensor)

### VSS Access

To reach the VSS, remove the following parts

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

### VSS Wire Identification

FUNCTION	PIN	COLOR
12-volt input from fuse F5	A	RED
Speed signal (to ECM-A E1)	B	WHITE
Ground(to ECM-A D4)	C	BLACK/GREEN

### VSS Circuit Protection

CONDITION	CIRCUIT PROTECTION
Supplied with main relay activated	Fuse5 of fuse block1 (from main relay R2)

### VSS Input Voltage Test

1. Turn ignition switch ON.
2. Back-probe the VSS connector and measure voltage.

REQUIRED TOOLS	
BACK PROBE TEST WIRES (P/N529 036 063)	
FLUKE115 MULTIMETER (P/N529 035 868)	

VSS INPUT VOLTAGE TEST		
TEST PROBES		RESULT (KEY ON)
PIN A (RED wire)	PIN C (BLACK/GREEN wire)	Battery voltage

If voltage is not as specified, test positive and ground separately.

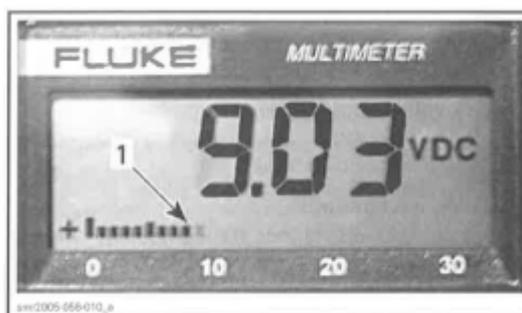
### VSS Signal Test

1. Lift rear of vehicle so that rear wheels are off the ground.
2. Set transmission to 2WD and to Neutral.
3. Turn ignition switch ON.
4. Back-probe the VSS connector and measure voltage while slowly rotating rear wheels by hand.

REQUIRED TOOLS	
BACK PROBE TEST WIRES (P/N529 036 063)	
FLUKE115 MULTIMETER (P/N529 035 868)	

VSS INPUT VOLTAGE TEST		
TEST PROBES		RESULT (KEY ON)
PIN B (WHITE wire)	PIN C (BLACK/GREEN wire)	Alternate reading between battery voltage and 0 Vdc

NOTE: Since we measure pulsating voltage, the numeric display will continuously change. The analog display may be easier to follow.



1. Analog display

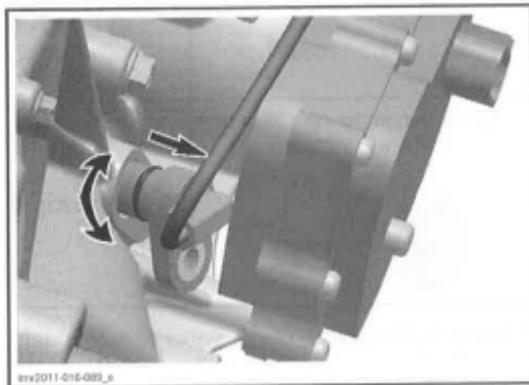
## VSS Removal

Remove screw retaining the VSS



1. Screw
2. VSS

Turn sensor and weave it out of the gearbox right cover.



## VSS Installation

For installation, reverse the removal procedure.

Pay attention to the following.

Apply SUPER LUBE GREASE (P/N293 550 030) on VSS O-ring.

## GBPS (GEARBOX POSITION

### SENSOR)

#### GBPS Reset

When replacing the gearbox position sensor (GBPS), it is required to reset (re-zero) its values for proper operation.

A reset must be carried out each time any of the following parts has been replaced:

- Gearbox assembly

- Shift drum
- GBPS
- ECM.

1. Connect vehicle to the latest applicable version Of B.U.D.S. software, refer to COMMUNICATION TOOL AND B.U.D.S. subsection.

NOTE: Ignition key must stay ON during the reset procedure. If the key is turned off, the procedure must be carried out again.

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

- Read Data button
- Setting page tab
- ECM tab.



1. Read data button
2. Setting page tab
3. ECM tab

3. Make sure that gearbox is set to NEUTRAL position.

4. In the Gear Position Sensor Initialization field, click on the Reset button.



#### GEAR POSITION SENSOR INITIALIZATION

1. Reset button

A message will be displayed if the operation is successful.

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  $2500 \pm 200$  RPM.

8.3 Let engine returns to idle.

8.4 Select an other position (P, R, H or L). Repeat substeps 8.2 and 8.3 until all position are verified.

NOTE: The vehicle must be in movement to complete the procedure on R, H and L position.

### GBPS Access

To reach the GBPS sensor, remove the following parts:

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

### GBPS Input Voltage Test

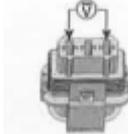
NOTE: Prior to conduct testing, check fault codes in B.U.D.S.

Set shift lever in NEUTRAL position.

Back-probe the GBPS connector .

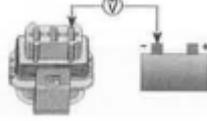
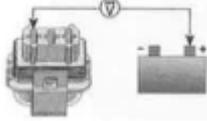
REQUOED TOOL	
BACK PROBE TEST WIRES	

Test as follow

MULITIMETER PROBE POSITIONS	VOLITAGE
PIN1 and PIN3 of the GBPS connector 	5 volts

If voltage is adequate, check GBPS communication link (CAN).

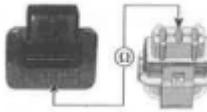
If there is no voltage, check each GBPS input as follows.

MULITIMETER PROBE POSITIONS	VOLITAGE
PIN1 connector(pin1) and battery ground 	5 volts
GBPS connector (pin3) and battery + terminal 	Battery voltage

If there is no voltage, check wires and connector pins. Replace or repair defective parts and reset fault codes.

### GBPS Communication Link Continuity Test

Unplug connector "A" from ECM and connect it to the ECM ADAPTER TOOL (P/N529 036 166).

MULITIMETER PROBE POSITIONS	RESISTANCE @ 20°C(68°F)
GBPS connector(pin2) and ECM adapter tool (pin F4) 	1 Below 1Ω

If resistance is out of specification, check wires and connectors. Repair and reset fault codes.

If resistance is good and the other tests succeeded, replace the GBPS and reset fault codes.

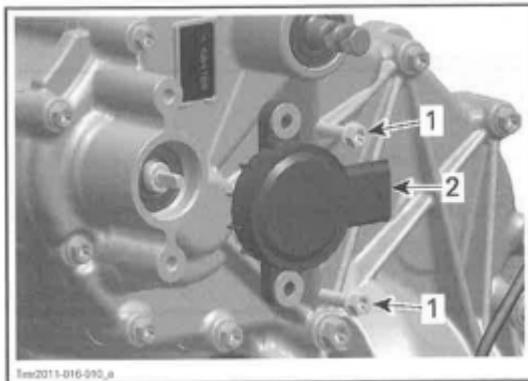
NOTE: The GBPS must be reset.

### GBPS Removal

Set shift lever in NEUTRAL position.

Unplug GBPS connector.

Remove screws and withdraw GBPS.



1. Screws
2. Gearbox Position Sensor (GBPS)

### GBPS Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

Shift lever must be in the NEUTRAL position.

Align GBPS with the flat on the shift drum shaft.



1. flat on shift drum shaft

Reset the GBPS. Refer to GBPS RESET in this subsection.

## 4WDINDICATOR SWITCH

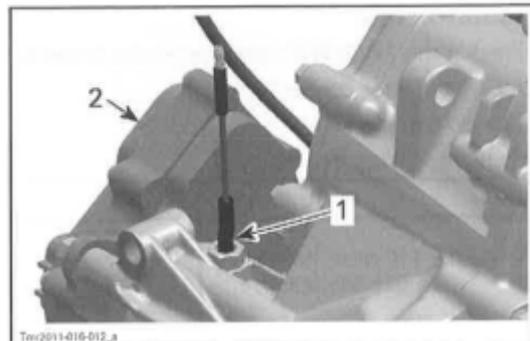
### 4WDIndicator Switch Access

To reach the 4WD indicator switch, remove the following parts:

- \_ Passenger seat
- RH lateral console panel
- Fuel tank cowl.

### 4WDIndicator Switch Removal

Disconnect 4WD indicator switch connector.



1. 4 WD indicator switch
2. Actuator

### 4WDIndicator Switch Test

Measure switch resistance as follows

SWITCH POSITION	SWITCH WIRE	RESISTANCE
2WD	BLACK/ BEIGE Engine ground	Infinite (OL)

If the resistance is out of specification, replace the 4WD indicator switch.

### 4WDIndicator Switch Installation

For installation, reverse the removal procedure.

Pay attention to the following details.

Take care do not damage indicator switch threads during installation.

Apply carefully some LOCTITE 5910(P/N293 800 081) on threads of indicator switch.

**NOTICE** Do not apply Loctite5910 on switch plunger, as it will lead to switch malfunction.

# ACTUATOR

## Actuator Access

To access the actuator, remove the following parts:

- Passenger seat
- RH lateral console panel
- Fuel tank cowl.

Remove screws securing fuel tank and move tank on passenger's floor without disconnecting hoses and connector from fuel pump.

## Actuator Test

Check if the 2WD/4WD selector works properly.

Unplug actuator connector.

Turn ignition key ON.

Measure voltage as follows .

REQUIRED TOOL	
FLUKE 115 MULTIMETER	

SWITCH POSITION	SWITCH WIRE	VOLTAGE
2WD	WHITE/BLUE	Battery voltage
4WD	WHITE/BLACK	

If the selector is out of specifications, check wires, connectors and replace the selector if necessary.

If the selector is good, check the vehicle harness.

If the vehicle harness is good, replace the actuator.

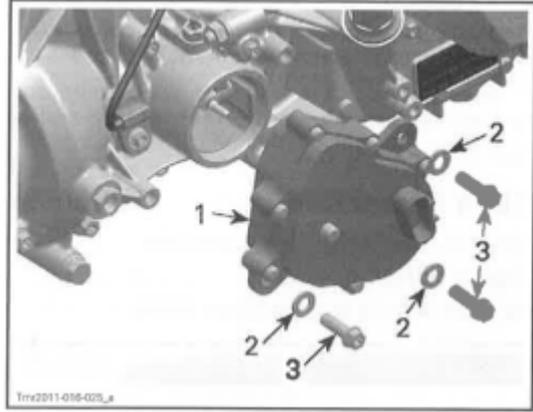
## Actuator Removal

NOTE: Before beginning any servicing on the actuator, make sure the vehicle is in 4WD position.

No need to remove engine from vehicle.

Place a drain pan under actuator.

Remove actuator screws.

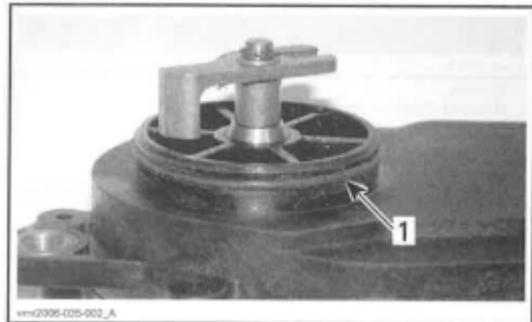


1. Actuator
2. Washer
3. Screw

Pull the actuator out of housing.

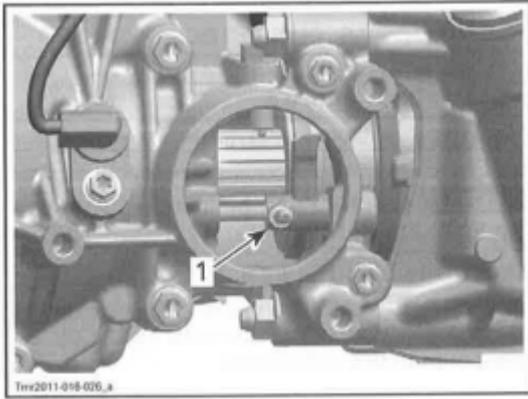
## Actuator Installation

Apply a small amount of SUPER LUBE GREASE (P/N293 550 030) on actuator O-ring.



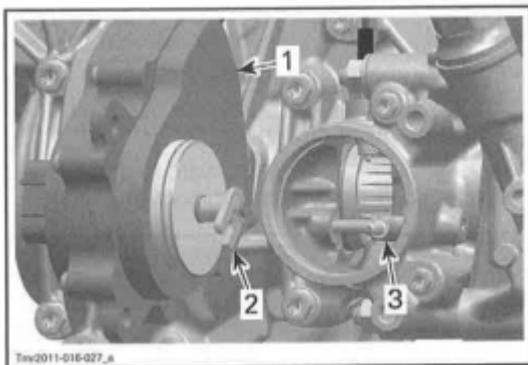
1. Actuator O-ring

Ensure coupling fork is in 4WD position (toward the front of vehicle).



1. Coupling fork in 4WD position

Align the actuator fork with the pin on coupling fork then push the actuator in the housing. See the following illustration to position the actuator correctly.



1. Actuator
2. Actuator for 111
3. Coupling fork

Rotate the actuator counterclockwise until it orients itself to mounting position.

**NOTICE** Do not cut or break the actuator O-ring.

Install all actuator screws and tighten them.

ACTUATOR SCREWS	
Tightening torque	25N.m ± 3N.m (18 lbf.ft ± 2 lbf.ft)

Connect actuator.

Lift the front of vehicle.

Turn front wheels. The front propeller shaft should not turn (the PARK position must be selected).

If the front propeller shaft turns, the actuator is not installed correctly. Remove actuator and reinstall it.

Place ignition switch to ON position and select the 2WD position.

Turn front wheel again. The front propeller shaft should turn easily.

If the front propeller shaft does not turn, the actuator is not installed correctly. Remove actuator and reinstall it.

**NOTICE** Refill missing gearbox oil, refer to GEARBOX OIL REPLACEMENT in PERIODIC MAINTENANCE PROCEDURES subsection.

Install all other removed parts. GEARBOX OIL SEALS

Gearbox Oil Seal Replacement

Replace oil seals if they are brittle, hard or damaged.

A small flat screwdriver can be used to remove most of these oil seals.

**NOTICE** Avoid scoring parts during oil seal removal.

When replacing an oil seal, take this opportunity to inspect the following:

-Check bearings behind each oil seal for contamination and/or metal shavings.

-Check oil seal running surfaces for scratches.

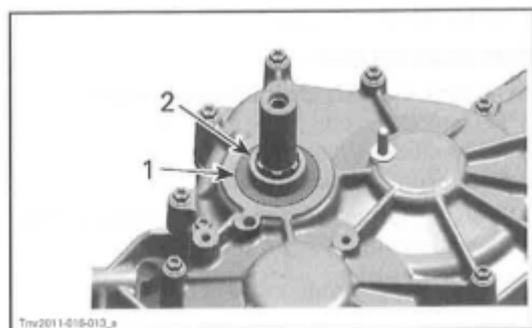
Countershaft Oil Seal

To replace the countershaft oil seal, remove:

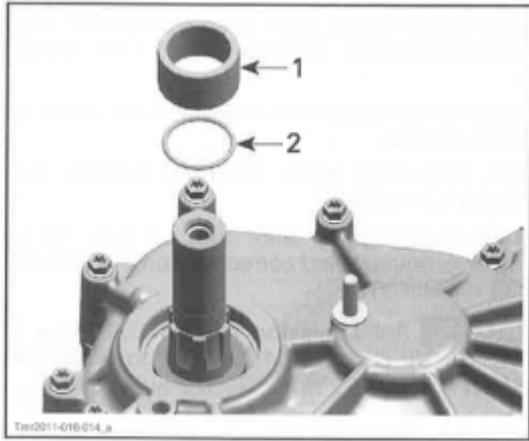
-Drive and driven pulleys

-CVT air guide.

NOTE: When oil seal is removed also inspect O-ring behind distance sleeve.



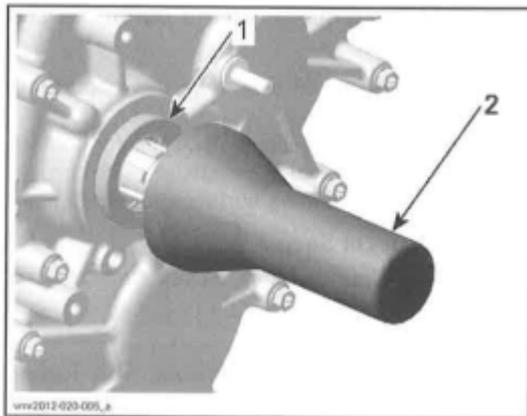
1. Countershaft oil seal
2. Distance sleeve



1. Distance sleeve
2. O-ring

Install countershaft oil seal

REQUIRED TOOL	
COUNTERSHAFT OIL SEAL PISHER	



1. Countershaft oil seal
2. Oil seal installer

### Shift Shaft Oil Seal

To replace the shift shaft oil seal, remove:

-RH lateral console panel and fuel tank cowl, refer to BODY subsection.

-Shift plate from shift shaft.

The shift shaft oil seal can be removed without removing the gearbox from the vehicle.

Use a suitable tube with the proper diameter to install the oil seal.

If gearbox housing is apart, use following tools for shift shaft oil seal installation.

REQUIRED TOOL	
OIL SEAL INSTALLER (GEARBOX) (P/N529 035 758)	
HANDLE (P/N420877 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 SENSIR). See procedure in this subsection.

Use a suitable tube with the proper diameter to install the oil seal.

**NOTICE** Oil seal must be installed with sealing lip toward gearbox.

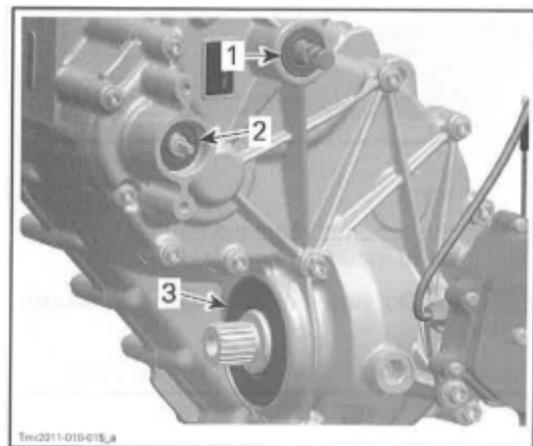
### Output Shaft Oil Seal

To replace the output shaft oil seal, proceed as follows

Remove propeller shaft screw from gearbox output shaft.

Remove rear final drive bolts.

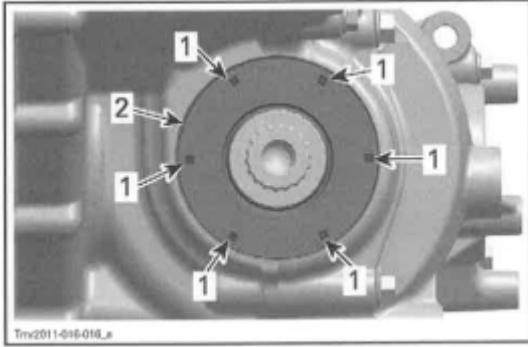
Move the rear final drive rearward to dislodge the propeller shaft from the gearbox output shaft.



1. Shift shaft oil seal
2. Shift drum shaft oil seal
3. Output shaft oil seal

Punch a sharp screwdriver through oil seal for removal.

NOTE: Position screwdriver only in marked areas to avoid damaging the ball bearing underneath oil seal during removal.



1. Marked areas for removal
2. Output shaft oil seal

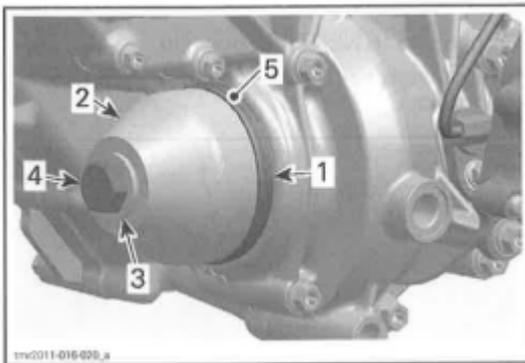
Before beginning the installation ensure gearbox is set to PARK position.

Apply SUPER LUBE GREASE P/N293 550 030) on sealing lips.

Apply engine oil on outer diameter of oil seal to avoid damaging it during installation.

Place oil seal on output shaft and install it using the following tools.

REQUIRED TOOL	
OIL SEAL INSTALLER (P/N529 036 204)	
Flat washer (P/N250 200 102)	
M12 × 1.25 × 35 hexagonal screw	



1. Output shaft oil seal
2. Oil seal installer
3. Flat washer (P/N250 200 102)
4. M12 × 1.25 × 35 hexagonal screw
5. Apply engine oil on outer diameter of oil seal

## GEAR BOX

### Gearbox Removal

Remove engine from vehicle. Refer to ENGINE REMOVAL AND INSTALLATION for the procedure.

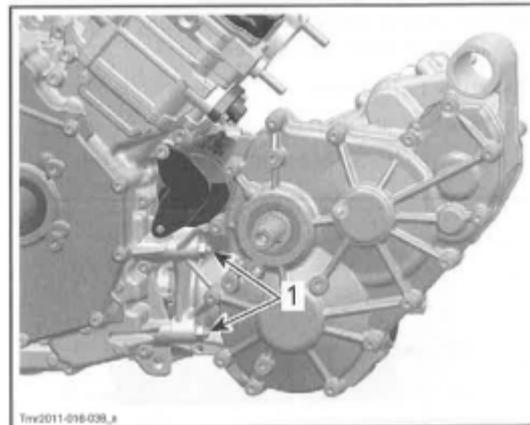
Refer to CONTINUOUSLY VARIABLE TRANSMISSION (CVT) subsection to remove following parts:

- CVT cover
- Drive and driven pulleys
- CVT air guide.

Drain gearbox. Refer to GEARBOX OIL REPLACEMENT in PERIODIC MAINTENANCE PROCEDURES subsection.

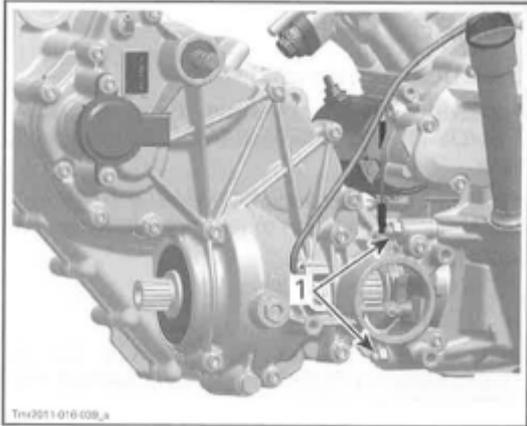
Remove ACTIATOR see procedure in this subsection.

Unscrew the four (4) nuts that attach the gearbox to the engine.



### LH SIDE OF ENGINE

1. Nut M8



RH SIDE OF ENGINE

1. Nut M8

Pull gearbox to separate it from engine.

### Gearbox Disassembly

NOTE: During gearbox disassembly, inspect the condition of each part closely.

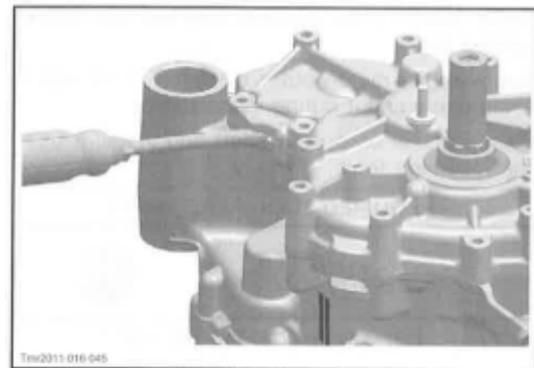
### Gearbox Left Cover

Set gearbox to NEUTRAL position.

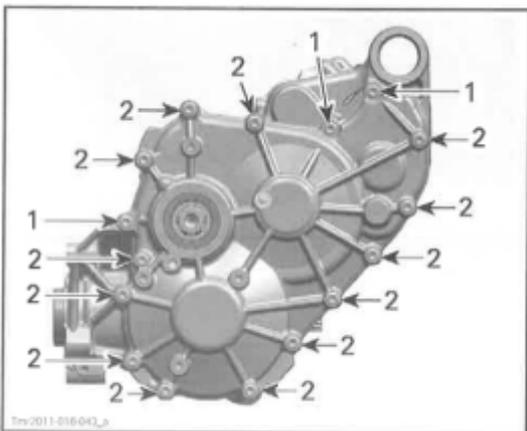
Unscrew all bolts retaining the gearbox left cover.



POSITION FOR SOFT HAMMER



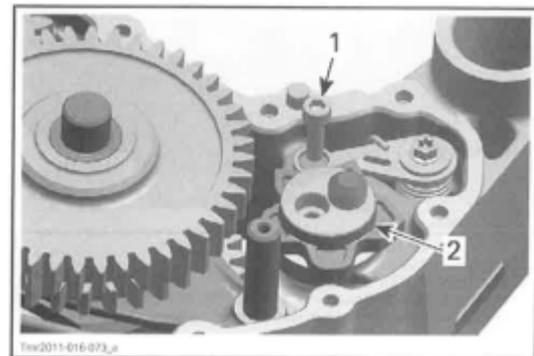
POSITION FOR BIG FLAT SCREWDRIVER



1. 3 screws M6x35
2. 13 screws M6x55

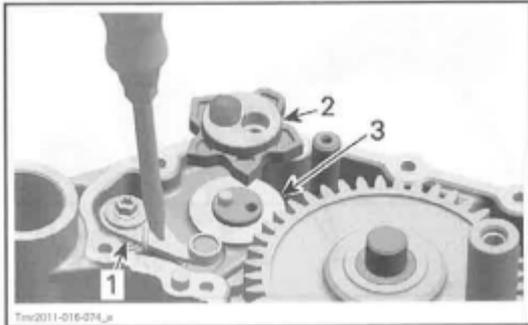
Place the center housing on a wood stand, left cover pointing upwards.

Using a big flat screwdriver and a soft hammer to lift the left cover .



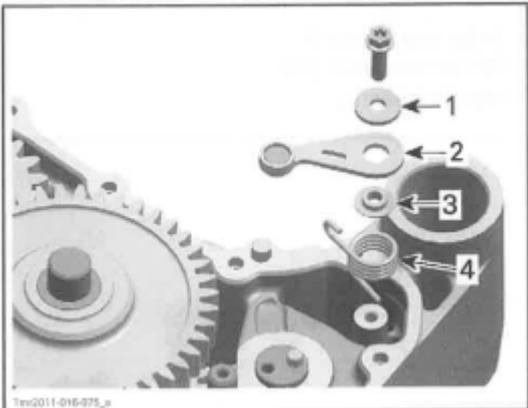
1. Screw
2. Index washer

Insert a flat screwdriver in the slot of index lever.  
Turn screwdriver clockwise and remove index washer.



1. Index lever
2. Index washer
3. Shaft drum

Remove the index lever with washer, step ring and spring.

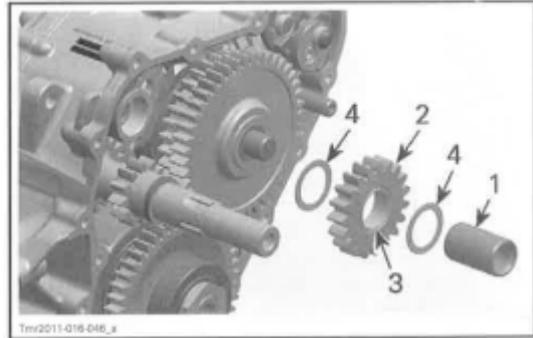


1. Washer
2. Index lever
3. Step ring
4. Index spring

### Main Shaft and Shift Forks

Remove bearing pin, reverse intermediate gear and thrust washers.

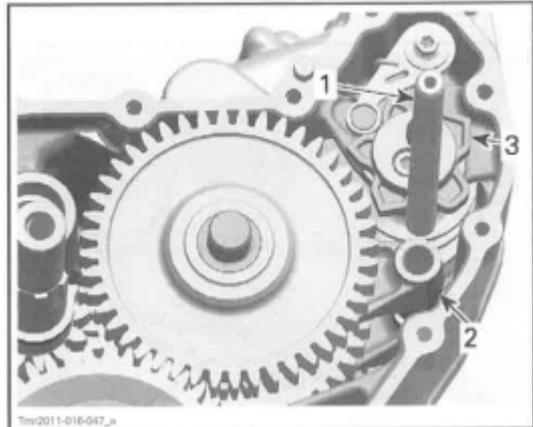
NOTE: Take care not to lose lower thrust washer during removal.



1. Bearing pin
2. Reverse intermediate gear
3. Needle bearing
4. Thrust washers

Remove shift fork shaft.

Disengage shift forks from shift drum



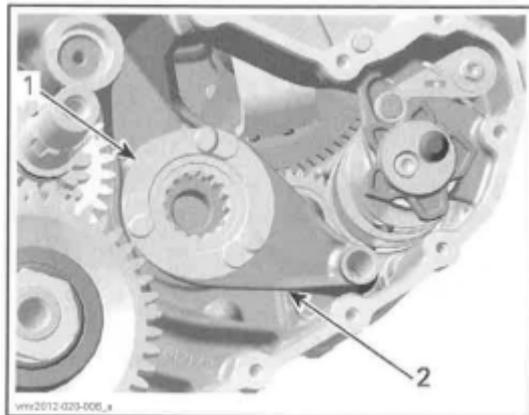
1. Shaft fork shaft
2. Shaft fork
3. Shaft drum

Remove main shaft assembly with shift fork.



1. Main shaft assembly
2. Shift fork

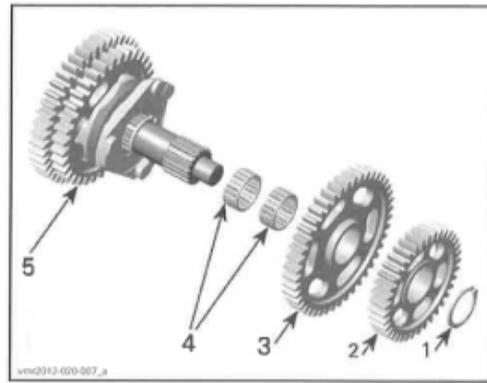
Remove shifting sleeve (HIGH range gear) and shift fork.



1. Shifting sleeve (HIGH range gear)
2. Shift fork

When required, remove from main shaft assembly:

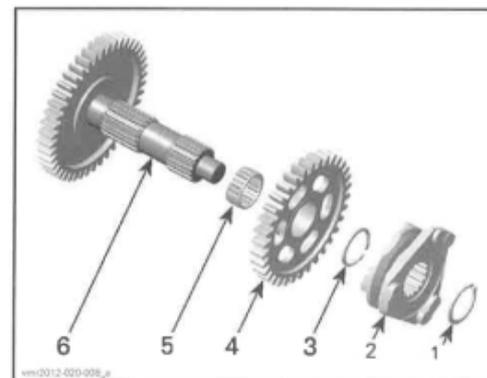
- Snap ring (discard)
- HIGH range gear
- LOW range gear
- Needle bearings.



1. Snap ring
2. Free pinion (HIGH range gear)
3. Free pinion (LOW range gear)
4. Needle bearings
5. Main shaft assembly

Remove from main shaft assembly:

- Snap ring (discard)
- Shifting sleeve (LOW/REVERSE range gear) - Snap ring (discard)
- REVERSE range gear
- Needle bearing.

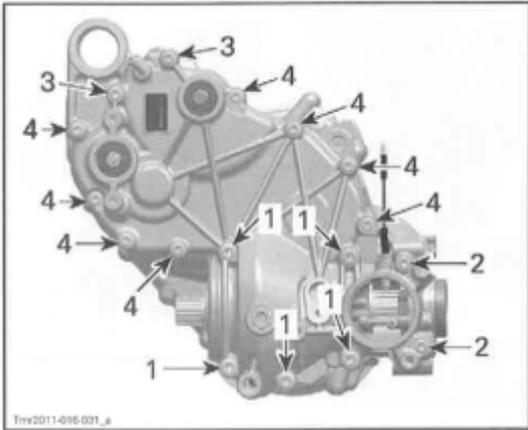


1. Snap ring
2. Shifting sleeve (LOW/REVERSE range gear)
3. Snap ring
4. Free pinion (REVERSE range gear)
5. Needle bearing
6. Main shaft assembly

### Gearbox Right Cover

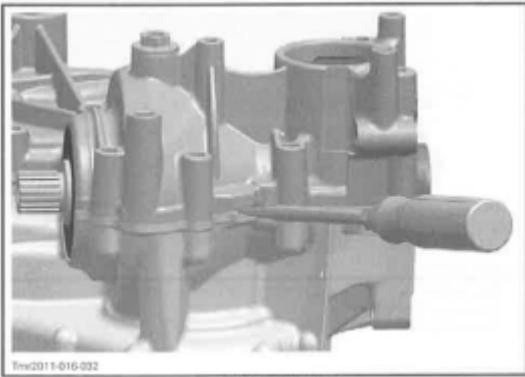
Remove ACTUATOR and GBPS (GEARBOX POSITION SENSOR) see procedures in this subsection.

Unscrew all bolts retaining the gearbox right cover.



- 1. 5 Screws M8x55
- 2. 2 Screws M6x85
- 3. 2 Screws M6x55
- 4. 8 Screws M6x35

To remove cover, use 2 big screwdrivers



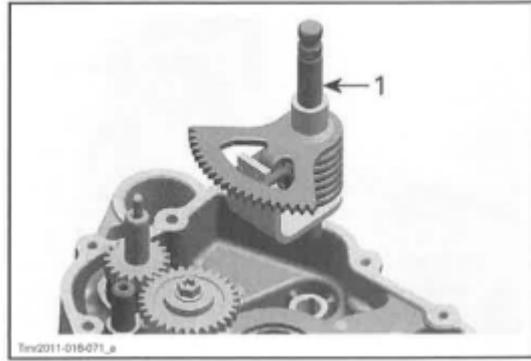
POSITION FOR BIG FLAT SCREWDRIVER



POSITION FOR BIG FLAT SCREWDRIVER

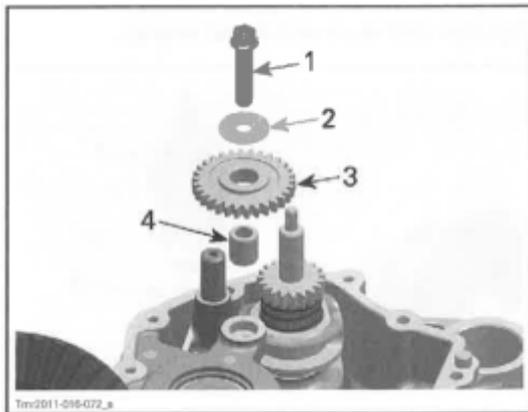
### Shift Shaft and Shift Drum

Withdraw shift shaft assembly.



1. Shift shaft assembly

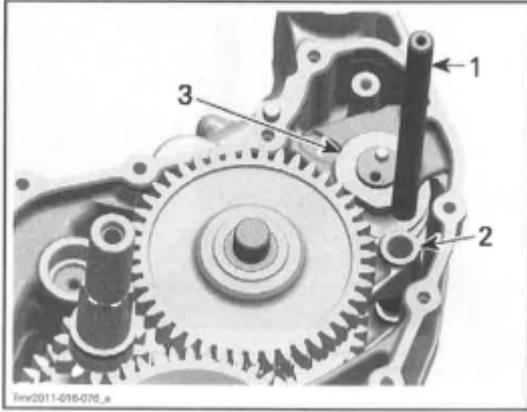
Remove screw retaining the shifting intermediate gear.



- 1. Screw
- 2. Washer
- 3. Intermediate gear
- 4. Dowel pin

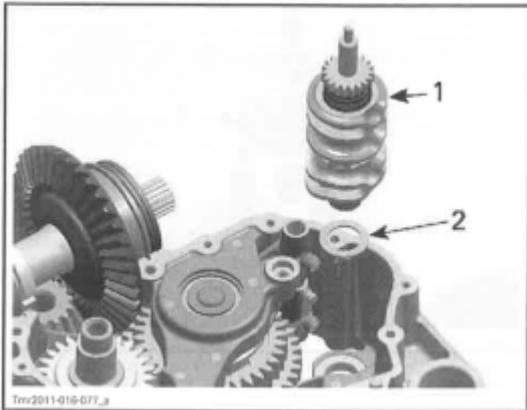
Remove shift fork shaft.

Disengage shift forks from shift drum.



1. Shift fork shaft
2. Shift fork
3. Shift drum

Remove shift drum and thrust washer.

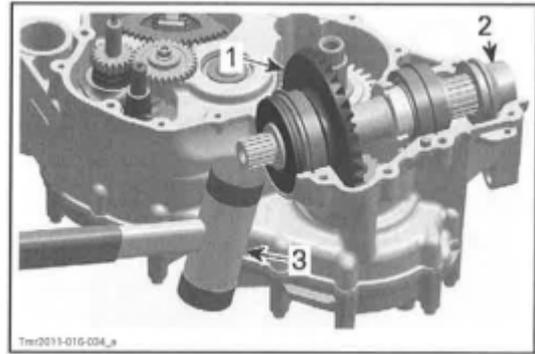


1. Shift drum
2. Thrust washer

### Output Shaft and 4×4 Coupling Mechanism

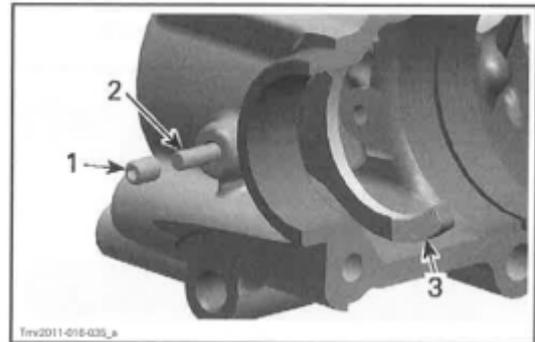
Remove output shaft from center housing and withdraw 4×4 coupling sleeve.

**NOTICE** Use a soft hammer to remove output shaft.



1. Output shaft
2. 4×4 coupling sleeve
3. Soft hammer

Remove set screw, coupling fork shaft and coupling fork from right cover.

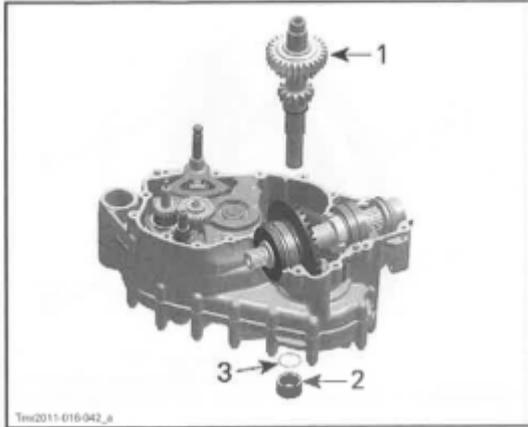


1. Set screw
2. Coupling fork shaft
3. Coupling fork

### Countershaft

Use a soft hammer to push out countershaft from gearbox CVT side.

Remove distance sleeve and O-ring.



1. Counter shaft
2. Distance sleeve
3. O-ring

### Gearbox Bearings

If necessary heat housing up to 100°C (212°F) before removing ball bearings.

△ WARNING
Clean oil, outside and inside, from housing before heating.

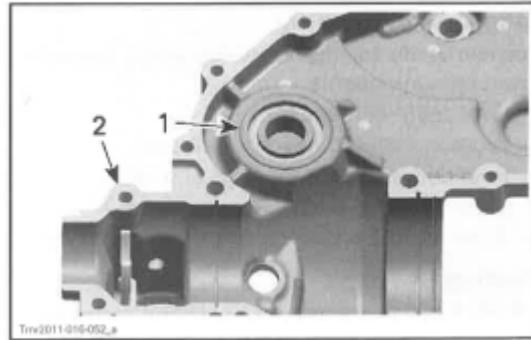
**NOTICE** Always support gearbox housings properly when ball bearings are removed.

Housing damages may occur if this procedure is not performed correctly.

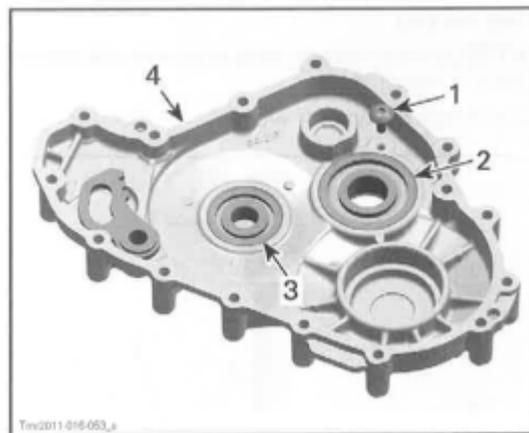
To remove ball bearings of countershaft (right cover) and main shaft (left cover) use following tool .

REQUIED TOOL	
BLIND HILE BEARING	

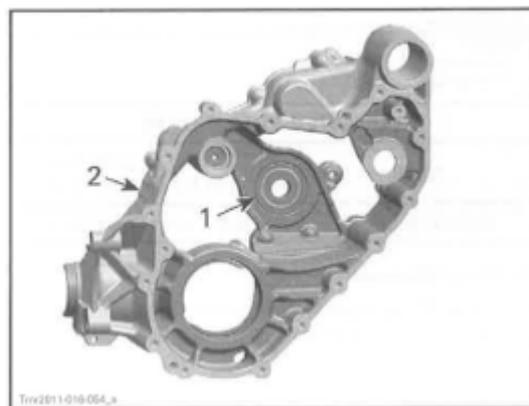
For ball bearings of countershaft (left cover) and main shaft (center housing) push with a suitable puller from outside in .



1. Ball bearing countershaft
2. Right cover



1. Screw
2. Ball bearing countershaft
3. Ball bearing main shaft
4. Left cover



1. Ball bearing main shaft
2. Center housing

## Gearbox Inspection

Always verify for the following when inspecting gearbox components:

- Gear teeth damage
- Worn or scoured bearing surfaces
- Rounded engagement dogs and slots
- Worn shift fork engagement groove
- Worn splines on shafts and shifting sleeves.

## Bearings

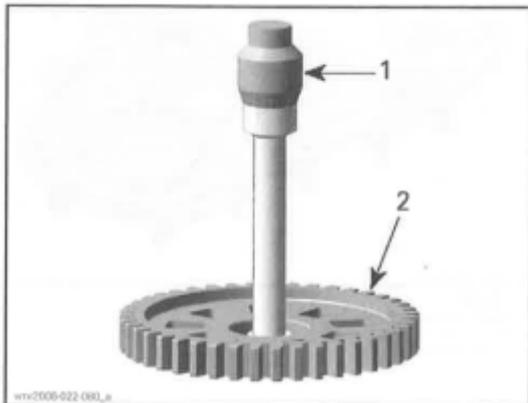
Check if ball bearings turn freely and smoothly.

Check all bearings, bearing points, tooth flanks and taper grooves.

## Free Pinions

NOTE: Always replace snap rings and use special pliers to install them.

Check free pinions for wear.



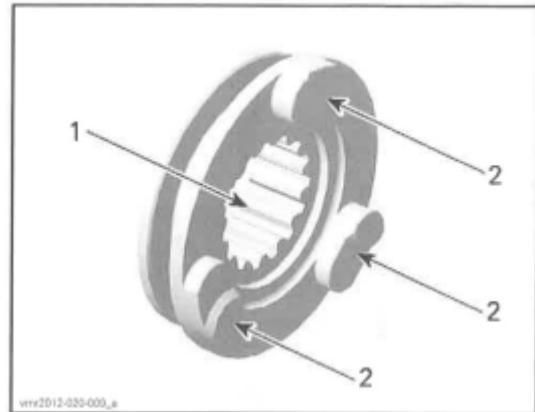
TYPICAL

1. Micrometer
2. Free pinion

DIAMETER FREE PINION	
NEW	29.000 mm to 29.013 mm (1.1417 in to 1.1422 in)
SERVICE LIMIT	29.015 mm (1.1423 in)

## Shifting Sleeves

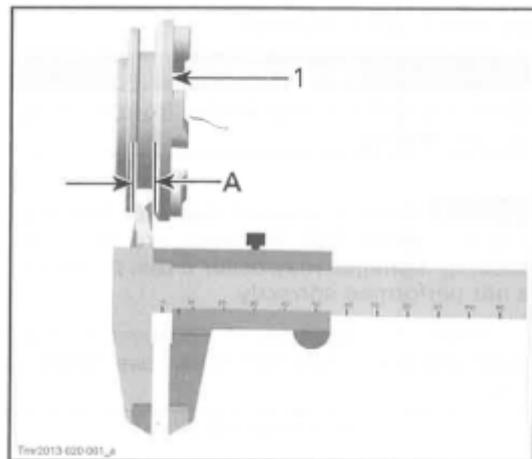
Check shifting sleeves for worn inner splines and rounded or damaged engagement dogs.



TYPICAL

1. Inner splines
2. Engagement dogs

Measure the width of shift fork engagement groove.



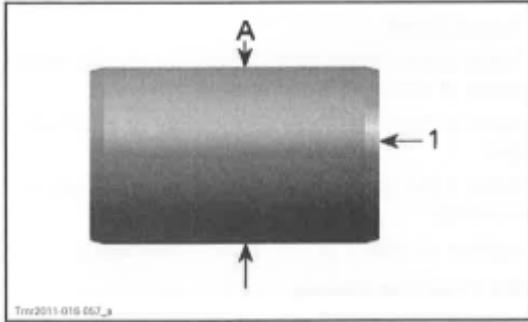
TYPICAL

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

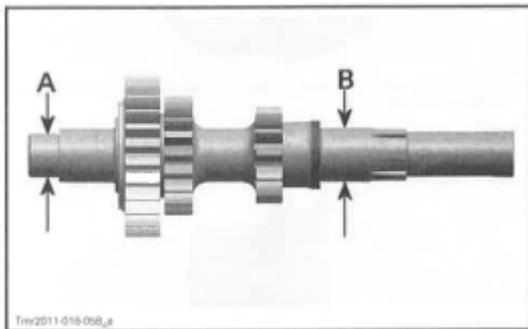
Check bearing pin of reverse intermediate gear for wear.



1. Bearing pin  
A. Outer diameter

BEARING PIN OUTER DIAMETER	
NEW	24.987mm to 25.000mm (.984in to .984in)
SERVICE LIMIT	24.977 mm (.9833 in)

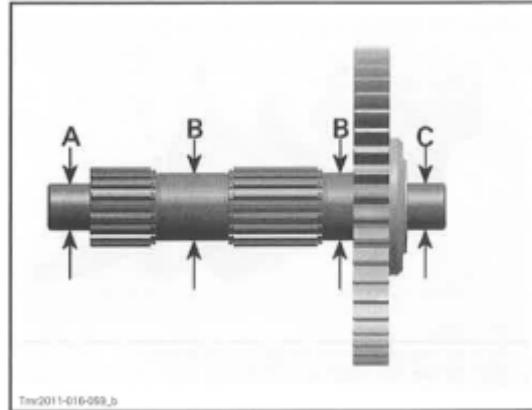
Check countershaft bearing journals for wear.



A. MAG side  
B. Bearing journal CVT side

COUNTERSHAFT BEARING JOURNALS	
MAG SIDE	
NEW	19.977 mm to 19.990 mm (.786in to .787in)
SERVICE LIMIT	19.973 mm (.786in)
CVT SIDE	
NEW	24.977mm to 24.990mm (.983in to .984in)
SERVICE LIMIT	24.970 mm (.983 in)

Check main shaft for wear



A. Bearing journal MAG side  
B. Free pinion bearing  
C. Bearing journal CVT side

MAIN SHAFT	
FREE PINION BEARING	
NEW	24.987mm to 25.000 mm (.984in to .984in)
SERVICE LIMIT	24.984 mm (.984 in)
BEARING JOURNAL CVT/MAG SIDE	
NEW	16.980mm to 16.991 mm (.669in to .669in)
SERVICE LIMIT	16.976mm (.668in)

#### Shift Shaft

Check shift shaft for worn splines and gears.

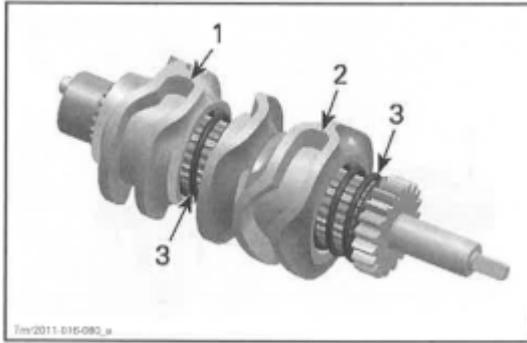
Check shift shaft spring for damages.

#### Shift Drum

**NOTICE** Do not disassemble shift drum.

Check if shifting gates move easily on shift drum splines and check condition of springs.

Check shift drum tracks for scouring or heavy wear, like rounded engagement slots.



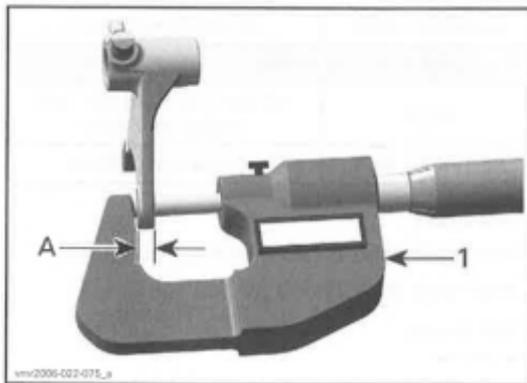
1. Track for the low/reverse range gear shift fork
2. Track for the high range gear shift fork
3. Springs

### Shift Forks

Check both shift forks for visible damage, wear or bent shift fork claws.

Check engagement rollers for wear and smooth movement.

Measure the shift fork claw thickness.



1. Micrometer
- A. Shift fork claw thickness

SHIFT FORK CLAW THICKNESS	
NEW	5.10 mm to 5.20 mm (.201 in to .205 in)
SERVICE LIMIT	5.00 mm (.197 in)

### Shift Fork Shaft

Check shift fork shaft for visible damage or wear.

Check if shift fork shaft is straight.

### Index Lever and Parking Lever

Index lever with roller must move freely.

Check parking lever for cracks or other damages.

### Output Shaft

Check output shaft and its gear for cracks, bend, pitting or other visible damages.

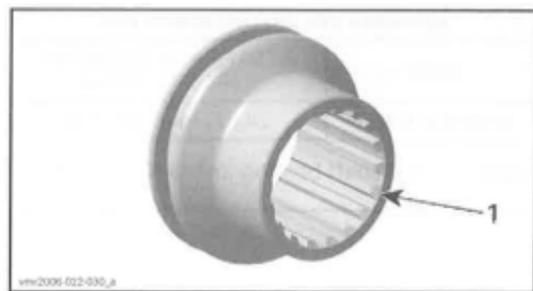
Check output shaft splines for wear or other damages.

Check if the output shaft bearings turn freely and smoothly.

Replace oil seal if brittle, hard or damaged.

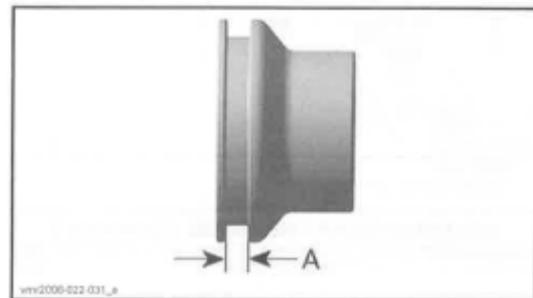
### 4×4 Coupling Sleeve

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	5.25mm to 5.35mm (.207 in to .211 in)
SERVICE LIMIT	5.50mm (.217 in)

### Coupling Fork

Check coupling fork for visible damage, wear or bent coupling fork claws.

Check coupling fork claw thickness.

